

SIXTH FRAMEWORK PROGRAMME

Structuring the European Research Area Specific Programme

RESEARCH INFRASTRUCTURES ACTION

Contract for an:

INTEGRATING ACTIVITY

implemented as

INTEGRATED INFRASTRUCTURES INITIATIVE

Annex I - Description of Work

Project acronym:

ILIAS

Project full title:

**Integrated Large Infrastructures for
Astroparticle Science**

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1. Project summary

ILIAS is an Integrated Infrastructure Initiative that has pulled together all of Europe's leading infrastructures in Astroparticle Physics to produce a focused, coherent and integrated project to improve the existing infrastructures and their operation as well as to organise and structure the scientific community to prepare the best infrastructures for the future.

ILIAS results from an extensive consultation of the community and an internal review process through the **Astroparticle Physics European Co-ordination (ApPEC)**.

ILIAS has 20 participants. In addition, there are numerous institutions that will contribute to the activities of ILIAS (but are not signatories to the contract).

ILIAS will strengthen the new coordination by focusing on the following three scientific poles:

i) Physics in deep underground laboratories

A large portion of the ILIAS activities will take place in at least one of the four European deep underground laboratories: the “Laboratorio Nazionale del Gran Sasso” (LNGS, Italy), the “Laboratoire Souterrain de Modane” (LSM, France), the “Laboratorio Subteraneo de Canfranc” (LSC, Spain) and the “Boulby Mine Underground Laboratory” (IUS, Great-Britain). Within ILIAS, a rapid increase of users is foreseen: users will benefit from dedicated experimental underground areas, ultra-low background instrumentation, cryogenic installations, computing networks and many other technical facilities. To that end, ILIAS coordinates the operations via one transnational access activity, three networks (improvement of performance, direct dark matter detection, and double β decay) and two joint research activities (low background and double β decay new techniques).

ii) Gravitational wave detection

For the technological challenges of this rapidly growing field, a network is designed to structure the activities using the two large European interferometers and the three resonant cryogenic detectors, complemented by a joint research activity to investigate new materials, new cryogenic techniques, and fundamental thermal noise mechanisms.

iii) Theoretical astroparticle physics

This network underpins the experiments and infrastructures of the field. It is designed to encourage cooperative theoretical projects, improve links with experiments, promote better understanding of existing data and help define future projects.

ILIAS coordinates and enhances all infrastructures of the Astroparticle Physics community in Europe, with a management going far beyond the frame of the present EU contract. The new structuring will favour exchanges on the numerous questions common to the relevant communities, greatly enhancing its organisation and efficiency, and helping to guarantee its long term sustainability and competitiveness.

2. Overall description and fundamental objectives of the I3

The basic objective of ILIAS is to bring together all the researchers who can contribute to the optimal operation of the different infrastructures in astroparticle physics and to gain maximum benefit from the many common features in the technical problems to be overcome and in the ultimate scientific goals.

2.1 Description

The various types of the ILIAS activities are organised along three scientific poles as described below.

a) *Physics in deep underground laboratories*

The long-term purpose is to reach a situation where the four European deep underground laboratories, the “Laboratorio Nazionale del Gran Sasso” (LNGS, Italy), the “Laboratoire Souterrain de Modane” (LSM, France), the “Laboratorio Subteraneo de Canfranc” (LSC, Spain) and the “Boulby Mine Underground Laboratory” (IUS, Great-Britain), will be dealt with as a single entity. The use of such facilities is vital for exploring rare processes, which need a protection from the cosmic muon background and a low level of natural radioactivity (e.g. double-beta decay, dark matter search, solar neutrino detection, proton decay, other fields than physics).

Activities related to this scientific pole are:

One Transnational access activity:

- Deep Underground Science Laboratories (TA1-DUSL)

Transnational Access to the four underground laboratories reflects the co-ordinated European approach of ILIAS. A rapid increase of transnational users is foreseen: users will benefit from dedicated experimental underground areas, ultra-low background instrumentation, cryogenic installations, computing networks and many other technical facilities.

Three networking activities contribute to coordinate the research programs in the underground laboratories:

- Deep Underground Science Laboratories (N2/DUSL)

This network aims at providing a mechanism for the joint structuring and co-ordination of the four facilities, to ensure a better service for users with more efficient use of resources.

- Direct dark matter detection (N3/DMD)

The network is designed to catalyse the co-ordination between European laboratories involved in direct dark matter detection in order to generate the critical mass of combined expertise to co-ordinate the future strategy of large-scale instrumentations for direct dark matter detection in Europe.

- Search on Double β Decay (N4/DBD)

This network aims at the co-ordination of the double beta decay community, thus enhancing the ability to produce proposals for the next generation experiments.

Two joint research activities are aiming at improving the technical quality of the environment or of the equipments in underground laboratories:

- Low Background Techniques for Deep Underground Science (R1, JRA1/LBT-DUSL)

This JRA tackles the worrisome sources of residual background intrinsic to the detectors themselves (radiopurity) or characteristic of the environment (e.g. radon, neutron or gamma flux).

- Integrated double-beta-decay European activities (R2, JRA2/IDEA)

The purpose of this JRA is to develop and integrate the most promising techniques in the field of DBD, in order to study this elusive process with different isotopes and complementary technical approaches.

b) Gravitational Wave Detection

The activities in this field are coordinated around one network and one joint research project:

- “Gravitational Wave Antenna” (N5/GWA)

The objective of this network is to increase the level of coordination in the field of gravitational wave research. It aims at linking the theoreticians and the groups working on the experimental detection using the two large European interferometers and the three resonant cryogenic detectors.

- “Study of Thermal Noise Reduction in Gravitational Wave Detectors”(JRA3/STREGA)

The aim is a ten-fold reduction of thermal noise using new materials, new cryogenic techniques and studying fundamental noise mechanisms.

c) Theoretical astroparticle physics

- “Theoretical astroparticle physics” (N6/ENTApP)

This network promotes cooperation between theoreticians on different phenomenological and theoretical aspects of the field: neutrinos, dark matter, and gravitational waves. It helps to understand the existing data and to define the future projects.

Interdependency of the ILIAS activities

	N2	N3	N4	N5	N6	TA1	JRA1	JRA2	JRA3
N2		*	*		*	*	*	*	
N3	*		*		*	*	*	*	
N4	*	*			*	*	*	*	
N5					*				*
N6	*	*	*	*			*	*	*
TA1	*	*	*				*	*	
JRA1	*	*	*		*	*		*	
JRA2	*	*	*		*	*	*		
JRA3				*	*				

2.2 Integrated provision of infrastructure related services to the scientific community

Based also on the co-ordination activities of ApPEC, ILIAS is expected to contribute to an advanced integration of the use of infrastructures in astroparticle physics. Through ILIAS, scientists are encouraged to cooperate in the planned networking activities and to speed up the JRAs whose results condition the quality of the future infrastructures. For underground laboratories, examples of the integrated services which will be offered to the users are common application and evaluation procedures for users selection, co-ordinated design and development of specific materials or equipment, non-redundancy of some costly specific equipments. For the other infrastructures, the new networks and JRAs will help to develop new generic common tools and to avoid redundant activities in this field. The exchange of ideas and the better contact between individuals within the different networks and technical projects will lead to common approaches for the future equipments, and will enhance cooperation at the European level.

2.3 Long term sustainability and structuring effect

As ILIAS co-ordinates a large part of the activities of the astroparticle physics community in Europe, its impact is expected to go well beyond the frame of the expected EU contract. In particular, regarding the competition between Europe, United States and Japan, the impact provided by ILIAS is expected to

contribute to ensuring in the future that the most up-to-date research in this field be carried out by European teams. The structuring effect of the ILIAS is considerable, as this support enhances the strong-willed policy of the different national funding agencies to cooperate and to concentrate their efforts towards a restricted number of more ambitious projects.

3. List of participants

The following legal entities are participants to the contract:

#	Participant			Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium
	Name	Short name	Country			
1	Commissariat à l’Energie Atomique, Paris	CEA	France	<i>start of project</i>	<i>end of project</i>	<p><u>Laboratories/Facilities:</u> Laboratoire Souterrain de Modane (LSM) , DAPNIA, DRECAM, SPhT</p> <p><u>Fields of excellence:</u> Dark matter, neutrino and axion physics, under water astroparticle experiments, electronics, micromegas, TPCs, photodetectors, bolometers.</p> <p>Co-operator of the Modane underground Lab (LSM).</p> <p><u>LSM Fields of excellence:</u> Development and test of low background detectors, test of ultra-low background materials, applications of low background techniques to environmental physics and radiation, R&D in cryogenic materials and their applications.</p> <p><u>Specific role:</u> Participation in N1, N2, N3, N6, TA1, JRA1</p>
2	Centre National de la Recherche Scientifique, Paris	CNRS	France	<i>start of project</i>	<i>end of project</i>	<p><u>Laboratories/Facilities:</u> Laboratoire Souterrain de Modane (LSM), LAPP_Anecy, LAPTH_Anecy, CENBG_Bordeaux, LPC_Caen, CRTBT_Grenoble, IPN_Lyon, LMA_Lyon, LPM-GAM_Montpellier, OCA_Nice, IAS_Orsay, LAL_Orsay, CSNSM_Orsay, LPT_Orsay, IAP_Paris, LPHE_Paris, LPNHE_Paris, APC_Paris, ESPCI_Paris, LKB_Paris, LPTENS_Paris, LUTH_Paris-Meudon, IReS_Strasbourg</p> <p><u>Fields of excellence:</u> High-quality photo-detectors and readout, analogue microelectronics, high pressure TPCs, low radioactivity, enriched isotopes, metrology tools for optical measurements, advanced interferometric detectors.</p> <p>Co-operator of the Modane underground Lab (LSM).</p> <p><u>LSM Fields of excellence:</u> <i>see above</i></p> <p><u>Specific role:</u> Participation in N2, N3, N4, N5, N6, TA1, JRA1, JRA2, JRA3</p>
3	Istituto Nazionale di Fisica Nucleare, Frascati	INFN	Italy	<i>start of project</i>	<i>end of project</i>	<p><u>Laboratories/Facilities:</u> Laboratori Nazionale del Gran Sasso (LNGS), L’Aquila, Bari, Cagliari-Ferrara, Firenze, Frascati, LNF_Frascati, Genova, Lecce, Legnaro, Laboratori Nazionali INFN di Legnaro, Milano, Milano-Bicocca, Milano-Como, Napoli, Padova, Perugia, Pisa, Roma 1, Roma 2, Roma 3, Salerno, SISSA, Torino, Trento, Trieste, ICTP_Trieste, Urbino</p> <p><u>Fields of excellence:</u> Neutrino physics, dark matter, double beta decay, Gamma spectroscopy, neutron background, radon detection, very low background Ge detectors, study and implementation of MC background simulation codes, R&D on radipurity, scintillators and gas detectors, low background studies, ultra-low level radioactivity measurements, low temperature physics, cryogenics, bolometry, gravitational wave detectors operating with resonant mass and interferometric techniques.</p> <p>Operates also the largest underground lab. in Europe: Gran Sasso (LNGS).</p> <p><u>LNGS Fields of excellence:</u> Development and test of low background detectors, test of ultra-low background materials, applications of low background techniques to environmental physics and radiation, R&D in cryogenic materials and their application, simulations for underground physics experiments and theoretical astrophysics, study of nuclear reactions at very low energies (LUNA facility).</p> <p><u>Specific role:</u> Participation in N2, N3, N4, N5, N6, TA1, JRA1, JRA2, JRA3</p>

#	Participant			Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium
	Name	Short name	Country			
4	Universidad de Zaragoza	UNIZAR	Spain	<i>start of project</i>	<i>end of project</i>	<p><u>Fields of excellence:</u> DBD, dark matter, neutrino physics (e.g. IGEX, ROSEBUD, CUORICI), low back, Ge facilities, material selection, DBD set-ups, micromegas and gas tests, cosmogenic activation, scale-up design, simulations</p> <p>LSC is an underground facility of the Universidad de Zaragoza.</p> <p><u>LSC Fields of excellence:</u> Development and test of low background detectors, test of ultra-low background materials, applications of low background techniques to environmental physics and radiation, R&D in cryogenic materials and their application, construction of shielding and parts of detectors for rare event physics.</p> <p><u>Specific role:</u> Participation in N2, N3, N4, N6, TA1, JRA1, JRA2</p>
5	The University of Sheffield	USFD	United Kingdom	<i>start of project</i>	<i>end of project</i>	<p><u>Fields of excellence:</u> Dark Matter detectors (DRIFT, ZEPLIN), liquid noble gases, TPCs, Micromegas, GEMs, LP GEM, m-gas tests, 2d readout, large area design, charge tests < 5 keV in liquid Xe, scale-up designs, 1 ton detector. Provision of underground infrastructure, low background Ge tests, radon assessments. Operation of 2 kg Ge detector, activity and radon tests, LB simulations.</p> <p>Boulby mine underground laboratory of the Institute of Underground Science (IUS), formed by the consortium of Universities, is responsible for the new infrastructure and based at the University of Sheffield.</p> <p><u>IUS Fields of excellence:</u> Development and test of low background detectors, test of ultra-low background materials, applications of low background techniques to environmental physics and radiation, R&D in cryogenic materials and their applications.</p> <p><u>Specific role:</u> Participation in N2, N3, N6, TA1, JRA1</p>
6	Czech Technical University in Prague (CeskeVysoke Uceni Technike v Praze)	CTU	Czech Republic	<i>start of project</i>	<i>end of project</i>	<p><u>Fields of excellence:</u> Nuclear physics experiments</p> <p><u>Specific role:</u> Participation in N4, JRA2</p>
7	University Of Southern Denmark, Odense (Syddansk Universitet)	SDU	Denmark	<i>start of project</i>	<i>end of project</i>	<p><u>Fields of excellence:</u> Theoretical contributions to phenomenology of astroparticle physics, neutrino physics, CMB and Cosmology.</p> <p><u>Specific role:</u> Participation in N6</p>
8	University of Jyväskylä (Jyvaeskylaen Yliopisto)	JYU	Finland	<i>start of project</i>	<i>end of project</i>	<p><u>Fields of excellence:</u> Calculation of nuclear matrix elements for DBD.</p> <p><u>Specific role:</u> Participation in N4, N6, JRA2</p>
9	Max-Planck Society for the advancement of Science, represented by Max-Planck-Institute for Nuclear Physics, Heidelberg (Max-Planck Gesellschaft zur Förderung der Wissenschaften e.V.)	MPIK	Germany	<i>start of project</i>	<i>end of project</i>	<p><u>Laboratories/Facilities:</u> Bonn, Garching, Golm, Hannover, Heidelberg, Munich</p> <p><u>Fields of excellence:</u> Low energy nuclear physics, low radioactivity, ultra-low background Ge diodes, ultra-low background gas proportional counters; contribution to R&D and construction of ULBF facilities at LNGS, radipurity and purification using facilities at LNGS and MPIK, Low energy nuclear physics, low radioactivity, conventional and liquid nitrogen dipped Ge-diodes.</p> <p>Photo-detectors., mirrors, electronics, low-pressure TPCs, simulations and software, theory support for low pressure applications, axions, x-rays, 2-gamma events. Theoretical support.</p> <p><u>Specific role:</u> Participation in N3, N4, N5, N6, JRA1, JRA2</p>
10	Technische Universität München	TUM	Germany	<i>start of project</i>	<i>end of project</i>	<p><u>Fields of excellence:</u> Neutrinos physics, Monte Carlo simulation, low background measurements, rare event search, contr. to R&D and construction of ULBF facilities at LNGS; R&D on radipurity and</p>

#	Participant			Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium
	Name	Short name	Country			
						purification using facilities at LNGS and TUM. <u>Specific role:</u> Participation in N3, N6, JRA1
11	Eberhard Karls Universität Tübingen	EKUT	Germany	start of project	end of project	<u>Fields of excellence:</u> Cryogenic detectors, Monte-Carlo simulations, low background measurements, calculation of nuclear matrix elements for DBD. <u>Specific role:</u> Participation in N3, N4, JRA2
12	Aristotle University of Thessaloniki (Aristoteleio Panepistimio Thessalonikis)	AUTH	Greece	start of project	end of project	<u>Fields of excellence:</u> KK and solar axions (CAST), micromegas, track reconstruction, simulations, theory support, axion application, evaluation of e^- track reconstruction. <u>Specific role:</u> Participation in N3, N6
13	Istituto di Fotonica e Nanotecnologie-CNR-Sezione di Trento (Consiglio Nazionale delle Ricerche)	IFN	Italy	start of project	end of project	<u>Laboratories/Facilities:</u> CNR Roma, IFN-CNR and IT Trento <u>Fields of excellence:</u> Development of cryogenic suspensions for advanced resonant detectors, selective readout simulation, FEM, low loss matching networks for SQUID amplifiers. <u>Specific role:</u> Participation in N5, JRA3
14	European Gravitational Observatory, Cascina	EGO	Italy	start of project	end of project	<u>Fields of excellence:</u> Construction and operation of the VIRGO detector, data analysis, R&D for next generation interferometer detectors. <u>Specific role:</u> Participation in N5
15	Leiden University – LION Institute of Physics (Universiteit Leiden)	MiniGRAIL	Netherlands	start of project	end of project	<u>Fields of excellence:</u> Low temperature physics, low mechanical noise set-ups, design and construction of the spherical cryogenic detector MiniGRAIL and R&D on advanced resonant detectors. <u>Specific role:</u> Participation in N4, N5, N6, JRA2, JRA3
16	Faculty of Mathematics, Physics & Informatics, Comenius University, Bratislava (Comenius University)	FMFI-UK	Slovakia	start of project	end of project	<u>Fields of excellence:</u> Calculation of nuclear matrix elements for DBD, study of different mechanisms of the neutrinoless DBD. <u>Specific role:</u> Participation in N4, JRA2
17	European Organisation for Nuclear Research, Geneva	CERN	International European Interest organisation	start of project	end of project	<u>Fields of excellence:</u> The leading laboratory in Europe in experimental and theoretical particle physics. <u>Specific role:</u> Participation in N2, N6
18	Bogazici University, Istanbul	BU	Turkey	start of project	end of project	<u>Fields of excellence:</u> Solar axions (CAST), TPCs, simulations and theory, axion application and simulations. LP application in CAST, simulations of two-prong gamma sensitivity. <u>Specific role:</u> Participation in N3
19	University of Glasgow	U.Glasgow	United Kingdom	start of project	end of project	<u>Fields of excellence:</u> Design and construction of the interferometric detector GEO600 and R&D on advanced detectors. <u>Specific role:</u> Participation in N5, JRA3
20	University College London	UCL	United Kingdom	start of project	end of project	<u>Fields of excellence:</u> Scintillators, calorimeters, data analysis. <u>Specific role:</u> Participation in N4, JRA2

The following institutions are expected to contribute to the activities of ILIAS, but are not signatories to the Contract:

Table 1b – Other entities foreseen to contribute to the project (but are not signatories to the Contract)			
Name of institution	City	Country	Role: contribution to
Yerevan Physical Institute	Yerevan	Armenia	N4
Universität Wien	Vienna	Austria	N6
Aarhus University	Aarhus	Denmark	N6
Nordic Institute of Theoretical Physics	Copenhagen	Denmark	N6
Helsinki University	Helsinki	Finland	N6
Bonn University	Bonn	Germany	N6
Technical University Darmstadt	Darmstadt	Germany	N3
University of Dortmund	Dortmund	Germany	JRA1
University Frankfurt	Frankfurt	Germany	N3
Deutsche Elektronen-Synchrotron (DESY)	Hamburg	Germany	N2, N5, N6
Laser Zentrum Hannover	Hannover	Germany	N5
Heidelberg University	Heidelberg	Germany	N6
Friedrich-Schiller University	Jena	Germany	N5
Institut für Physik, Hochttechnologie	Jena	Germany	N3
Forschungszentrum (KFK)	Jülich	Germany	N2
Forschungszentrum Karlsruhe (FZK)	Karlsruhe	Germany	N3, JRA1
University Karlsruhe	Karlsruhe	Germany	N3
Astrophysikalisches Institut	Potsdam	Germany	N6
Wuppertal University	Wuppertal	Germany	N6
Inst. Theor. Physik und Astrophysik, Würzburg	Würzburg	Germany	N6
Athens University	Athens	Greece	N6
Ioannina University	Ioannina	Greece	N6
Democritos University	Komotini	Greece	N2
Politecnico di Milano	Milano	Italy	JRA1
Saga University	Saga	Japan	JRA2
Free University of Amsterdam	Amsterdam	Netherlands	N6
University of Amsterdam	Amsterdam	Netherlands	N6
University of Utrecht	Utrecht	Netherlands	N6
National Institute for Nuclear Physics and High Energy Physics	Amsterdam	Netherlands	N6
Bergen University	Bergen	Norway	N6
Oslo University,	Oslo	Norway	N6
University of Silesia	Katowice	Poland	JRA1
Henryk Niewodniczanski Institute of Nuclear Physics	Krakow	Poland	J1
Jagiellonian University	Krakow	Poland	N6
Cracow University	Krakow	Poland	N6
Institute of Mathematics, Polish Academy of Sciences	Warsaw	Poland	N5
Warsaw University	Warsaw	Poland	N6
Instituto Superior Técnico	Lisboa	Portugal	N6
Institute for Nuclear Research, Baksan Neutrino Observatory	Baksan	Russia	N4
Joint Institute for Nuclear Research	Dubna	Russia	N4, JRA2
Institute for Theoretical and Experimental Physics	Moscow	Russia	N4
University of Novi Sad	Novi Sad	Serbia	N3
University of Barcelona	Barcelona	Spain	N5, N6
Universidad de les Illes Balears	Mallorca	Spain	N5
Universidad de Santiago de Compostela	Santiago de Compostela	Spain	N5
Universidad de Valencia	Valencia	Spain	N6
Universidad de Madrid	Madrid	Spain	N6
Stockholm University	Stockholm	Sweden	N6
University Bern	Bern	Switzerland	N3
Geneva University	Geneva	Switzerland	N6
Lausanne University,	Lausanne	Switzerland	N6

Table 1b – Other entities foreseen to contribute to the project (but are not signatories to the Contract)			
Name of institution	City	Country	Role: contribution to
University of Sussex	Brighton	United Kingdom	N6
University of Birmingham	Birmingham	United Kingdom	N5
University of Cambridge	Cambridge	United Kingdom	N6
Cardiff University	Cardiff	United Kingdom	N5
Rutherford-Appleton Laboratory	Chilton	United Kingdom	N2, N3, JRA1
University of Durham	Durham	United Kingdom	N6
Imperial College	London	United Kingdom	N5, N6
Oxford University	Oxford	United Kingdom	N3, N6
University of Southampton	Southampton	United Kingdom	N6
University of California	Berkeley, Ca	USA	N4, JRA2
University of South Carolina	Columbia, SC	USA	N4, JRA2
Idaho National Engineering and Environmental Laboratory	Idaho Falls, Id	USA	N4, J2
Mount Holyoke College	South Hadley, Ma	USA	N4, JRA2
Fermi National Laboratory	Chicago, Il	USA	N2
Stanford Linear Accelerator Centre	Stanford, Ca	USA	N2
Brookhaven National Laboratory	Upton, NY	USA	N2
Princeton University	Princeton, NJ	USA	N2

4 List of activities

The participants to the contract will perform the activities summarised in this table:

Activity Number / Short title	Descriptive Title	Short description and specific objectives of the ILIAS activities
<i>Networking Activities</i>		
N1	Management of ILIAS	Co-ordination, financial and administrative management of ILIAS. The objective is to run ILIAS in an efficient and transparent manner.
N2 (DUSL)	Deep Underground Science Laboratories	<p>The DUSL networking activity is designed to implement a mechanism for the joint structuring and co-ordination of the four underground laboratories, with the overall objective being to provide a better service to users with more efficient use of resources.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Provision of higher quality environments and operational support to users, via coordination of site assignment and cooperation on basic equipment, technical and logistic support, access and communication, - Improved health and safety, via exchange of best practice experience and progress to a common approach on safety procedures specific to underground sites, and - Improve scientific coordination and communications to the public, through cooperation on communication initiatives. <p>The new structures envisaged to handle the above objectives will need to cross-link with other networking activities and JRAs in particular N3, N4, N6, JRA1 and JRA2.</p>
N3 (DMD)	Direct Dark Matter Detection	<p>This network promotes common activities among experimental groups actually involved in direct dark matter search projects, in order to reach a common strategy for dark matter direct detection. It gathers essential expertise from several of the world leading laboratories in this highly competitive field.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To reach convergence in the assessment of different detector concepts. - To provide a platform for the discussion on problems common to all detector concepts. - To reach convergence on the strategy for future large scale European dark matter experiments. - To investigate how data from direct dark matter detection can provide information for other projects. - To study the relevance of the present and future direct and indirect dark matter searches.
N4 (DBD)	Search on Double Beta Decay	<p>Objectives:</p> <ul style="list-style-type: none"> - To coordinate the Double Beta Decay community towards a common approach in preparation for the next generation of experiments. - To coordinate the choice of experimental techniques, the choice of isotopes and some related topics. Both theoretical and experimental aspects will be addressed. - To provide the community with an extensive database on isotopically enriched isotopes and the nuclear matrix elements which will guide future experimental choices in this field. - To facilitate the knowledge sharing resulting from discussion on the next generation of experiments and to beneficially position the European laboratories to be able to propose internationally competitive experiments.

Activity Number / Short title	Descriptive Title	Short description and specific objectives of the ILIAS activities
N5 (GWA)	Gravitational Wave Antennas	<p>This networking activity links all the experimental groups involved in this field and is expected to be an essential asset for the development and structuring of a European research community for gravitational waves.</p> <p>Objective:</p> <ul style="list-style-type: none"> - To increase the level of European coordination in this field in order to enhance the performance of the existing antennas and to prepare the future of this discipline in Europe. - To improve the exchange of information on subjects of common interest such as commissioning and operation of existing detectors, methodologies for joint data analysis. - To support the elaboration of a common strategy for future detectors in Europe.
N6 (ENTApP)	Theoretical Astroparticle Physics	<p>ENTApP is focussed on theoretical astroparticle physics and it is designed to play a key role in enhancing the scientific potential of existing infrastructure as well as in defining the potential of future facilities. ENTApP encompasses three major topics: 1) Neutrinoless double beta decay and related studies; 2) Dark matter and related studies; 3) Gravitational waves and related studies.</p> <p>Within ENTAaP, the strong inter-dependence of the various topics is expected to lead to a synergy of efforts among different units, which will be enhanced both by encouraging exchange of visits and by organizing regular inter-disciplinary meetings. Outside the network, the recognized expertise and the engagement of the various ENTApP working groups will encourage a wide dissemination of the results.</p> <p>Objective:</p> <ul style="list-style-type: none"> - To coordinate the theoretical research in Europe related to the ILIAS topics, e.g. double β decay, dark matter, and gravitational waves. - To facilitate exchange of information with experimentalists involved in the ILIAS activities.
Transnational Access Activities		
TA1 (TA-DUSL)	Deep Underground Science Laboratories	<p>Underground sites located in pre-existing mines or in especially built laboratories, are characterized by a cosmic ray flux that is extremely reduced compared with the flux on the Earth surface. This results in a very low level of total radiation noise. An underground site is the ideal place for delicate experiments that investigate on fundamental physics in the sectors of rare-event astroparticle, particle and nuclear physics. Participants to the Transnational Access activity are the four major Deep Underground Laboratories in the EU:</p> <ul style="list-style-type: none"> - Laboratorio Nazionale del Gran Sasso (LNGS, Italy) - Laboratoire Souterrain de Modane (LSM, France) - Laboratorio Subterráneo de Canfranc (LSC, Spain) - Boulby Mine Underground Laboratory Science (IUS, UK) <p>Objective:</p> <ul style="list-style-type: none"> - To coordinate the access to the four European deep underground laboratories, which should be perceived as a single infrastructure with four different installations. <p>The minimum quantity of access to be provided is 2500 user-days.</p>
Research Activities		
JRA1 (LBT-DUSL)	Low Background Techniques for Deep Underground Science	<p>The JRA carried on jointly by the four European underground laboratories (LNGS, LSM, LSC, and IUS) aims at structuring the activity of the Deep Underground Science Laboratories in their common scientific and technical objectives. It undertakes the improvement and implementation of innovative ultra-low background techniques in the four European Underground Laboratories. Several external teams, expert in the field of ultra-low background techniques which are operating experiments in the underground labs, will contribute to the JRA, enlarging its structural character.</p> <p>The expected impact of the JRA is an improvement of the quality of the services offered by Underground Laboratories to the scientific</p>

Activity Number / Short title	Descriptive Title	Short description and specific objectives of the ILIAS activities
		<p>community in Astroparticle Physics and Rare-Event Physics, as well as the efficiency of the research carried on in the laboratories.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To identify and measure the different backgrounds (intrinsic, induced and environmental) contributing to a given experiment. - To develop a standard library of background simulation codes. - To design methods and techniques (shieldings, vetos, identification and discrimination mechanisms) to suppress them. - To perform dedicated R&D for ultra-low background techniques and facilities in the EU underground laboratories. - To perform on highly radio-pure materials and purification techniques based on all the new data and information from the coordinated R&D program developed in the JRA. - To provide an improved and coordinated system of European facilities for ultra-low background measurement applications in rare event physics and in other fields (e.g. environmental physics, archeometry and radio-datations, geophysics) of world-wide value.
JRA2 (IDEA)	Integrated Double-Beta-Decay	<p>Recent results from experiments measuring atmospheric and solar neutrinos indicate that neutrino flavour oscillations are taking place. This implies that neutrinos have a finite mass. Neutrinoless Double Beta Decay (DBD) is presently the only process which can shed light on the neutrino nature: Majorana particle (equal to its antimatter partner) or Dirac particle (different from its antimatter partner). In the event that neutrinos are Majorana particles, the DBD experiments stand to measure the absolute neutrino mass. DBD is a rare nuclear process, in principle occurring in several nuclides but never observed. From the lifetime of the process, it is possible to extract the neutrino mass scale. Presently it is known that Majorana neutrino masses are lower than 0.5 eV. Several European groups currently lead the world in the field of DBD experiment and have developed innovative techniques, which can extend the neutrino mass sensitivity down to about 0.01 eV in the next generation of experiments.</p> <p>This JRA will further develop R&D and integrate the most promising techniques in the field, capable of studying this elusive nuclear process with different isotopes and complementary technical approaches, and to crosscheck stringent limits.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To favour exchange of researchers, materials and competences among groups using different techniques and operating in different laboratories, so as to promote integration among the diverse approaches. - To push the most promising techniques for DBD to their maximum potential, solving crucial open problems. - To develop sophisticated technology for DBD searches, having in mind its application to other sectors, like radiation spectroscopy and space science. <p>Innovative techniques in particle detection are expected to improve significantly the energy resolution of nuclear detectors with important social and political spin-offs, like the development of devices able to identify fissile materials and to control effectively nuclear proliferation.</p>

Activity Number / Short title	Descriptive Title	Short description and specific objectives of the ILIAS activities
JRA3 (STREGA)	Study on Thermal Noise Reduction in Gravitational Wave Detectors	<p>The observation of gravitational waves will open a new window to the Universe. Current detectors are designed to achieve the first direct detections and their proposed upgrades will allow detection of typical sources at distances of up to 100Mpc. For effective Gravitational Wave Astronomy the sensitivity of future advanced detectors must increase ten-fold. The main noise limitation to the current and upgraded detectors is internal thermal noise of the test masses. The joint challenge presented by this ten-fold reduction of thermal noise requires increased focusing of research effort from the European collaborators drawing on all of the expertise acquired to date. In the future, the research structure developed by this JRA will continue with the objective of designing and building an array of European advanced detectors. The main objective of this JRA is to produce a ten-fold reduction of the internal thermal noise level in future detectors, and requires in particular:</p> <ul style="list-style-type: none"> - To design, construct and test the final stage prototypes for advanced interferometers and test masses for resonant detectors. - To develop advanced electromechanical, optical and super conductive transducers. - To provide facility for the investigation of the mechanical effects of cosmic ray absorption in test masses. - To develop cryogenic suspensions for interferometers and resonant spheres. - To provide facilities for direct thermal noise measurements.

5. Financial information for the whole duration of the I3

Financial information – whole duration of the project															
Particip- pant n°	Organi- sation short name	Cost model used		Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities								Total (8)= (1)+(2)+(3) +(4)+(5)+(6) +(7)	Total receipts	
		For transnat ional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities							
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)				
1	CEA	FC	FC	Eligible costs	<i>Direct costs (a)</i>	287500		1134639	138450	20724		37437	1618750		
					<i>of which subcontracting</i>	0		0	0		0	0	0		0
					<i>Indirect costs (b)</i>	57500		845694	0	4145		0	0		907339
					<i>Total eligible costs (a)+(b)</i>	345000		1980333	138450	24869		37437	2526089		
				Requested EC contribution	172500		417994	138450	24869		37437	791250			
2	CNRS/IN 2P3	FCF	FCF	Eligible costs	<i>Direct costs (a)</i>	1192000			193083	37815		16102	1439000		
					<i>of which subcontracting</i>	0			0	0		0	0		
					<i>Indirect costs (b)</i>	238400			38617	7563		3220	287800		
					<i>Total eligible costs (a)+(b)</i>	1430400			231700	45378		19322	1726800		
				Requested EC contribution	715200			231700	45378		19322	1011600			
3	INFN	AC	AC	Eligible costs	<i>Direct costs (a)</i>	1544667			269163	89000		233500	2136330		
					<i>of which subcontracting</i>	0			0	0		0	0		
					<i>Indirect costs (b)</i>	308933			53837	17800		46700	427270		
					<i>Total eligible costs (a)+(b)</i>	1853600			323000	106800		280200	2563600		
				Requested EC contribution	1853600			323 000	106800		280200	2563600			
4	UNIZAR	AC	AC	Eligible costs	<i>Direct costs (a)</i>	447500			194083	43000		31167	715750		
					<i>of which subcontracting</i>	0			0	0		0	0		
					<i>Indirect costs (b)</i>	89500			38817	8600		6233	143150		
					<i>Total eligible costs (a)+(b)</i>	537000			232900	51600		37400	858900		
				Requested EC contribution	537000			232900	51600		37400	858900			
TOTAL				Eligible costs											
				Requested EC contribution											

Financial information – whole duration of the project														
Participa- nt n°	Organi- sation short name	Cost model used		Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3) +(4)+(5)+(6))+(7)	Total receipts	
		For transnat- ional Access	For any other activities		RTD activities (1)	Demonstr- ation activities (2)	Consortiu- m Managem- ent activities (3)	Other specific activities						
								Coordinati- on/Networ- king (4)	Transnatio- nal access (5)	Connectivi- ty (6)	Other including Specific Service Activities for CND (7)			
5	USFD	AC	AC	Eligible costs	Direct costs (a)	207500			184333	43000		31167	466000	0
					of which subcontracting	0		0	0	0	0	0		
					Indirect costs (b)	41500			36867	8600		6233	93200	
					Total eligible costs (a)+(b)	249000			221200	51600		37400	559200	
				Requested EC contribution	249000			221200	51600		37400	559200		
6	CTU		AC	Eligible costs	Direct costs (a)	8333			10500				18833	
					of which subcontracting	0		0						
					Indirect costs (b)	1667			2100				3767	
					Total eligible costs (a)+(b)	10000			12600				22600	
				Requested EC contribution	10000			12600				22600		
7	SDU		AC	Eligible costs	Direct costs (a)				59583				59583	
					of which subcontracting			0				0		
					Indirect costs (b)				11917				11917	
					Total eligible costs (a)+(b)				71500				71500	
				Requested EC contribution				71500				71500		
8	JYU		AC	Eligible costs	Direct costs (a)	8333			10500				18833	
					of which subcontracting	0		0						
					Indirect costs (b)	1667			2100				3767	
					Total eligible costs (a)+(b)	10000			12600				22600	
				Requested EC contribution	10000			12600				22600		
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – whole duration of the project															
Participan n°	Organisation short name	Cost model used		Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts		
		For transnational Access	For any other activities		RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Other specific activities							
								Coordination/Networking (4)	Transnational access (5)	Connectivity (6)	Other including Specific Service Activities for CND (7)				
9	MPIK		AC	Eligible costs	Direct costs (a)	115000				70083				185083	
					of which subcontracting	0				0			0		
					Indirect costs (b)	23000				14017			37017		
					Total eligible costs (a)+(b)	138000				84100			222100		
				Requested EC contribution	138000				84100			222100			
10	TUM		FC	Eligible costs	Direct costs (a)					19200				19200	
					of which subcontracting					0			0		
					Indirect costs (b)					0			0		
					Total eligible costs (a)+(b)					19200			19200		
				Requested EC contribution					19200			19200			
11	EKUT		FC	Eligible costs	Direct costs (a)	16667				243150				259817	
					of which subcontracting	0				0			0		
					Indirect costs (b)	3333				0			3333		
					Total eligible costs (a)+(b)	20000				243150			263150		
				Requested EC contribution	10000				243150			253150			
TOTAL				Eligible costs											
				Requested EC contribution											

Financial information – whole duration of the project														
Participa nt n°	Organi sation short name	Cost model used		Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities								Total (8)= (1)+(2)+(3) +(4)+(5)+(6))+(7)	Total receipts
		For transna tional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities						
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)			
12	AUTH		FC	Eligible costs	Direct costs (a)					9600				9600
					of which subcontracting					0				0
					Indirect costs (b)					0				
					Total eligible costs (a)+(b)					9600				9600
				Requested EC contribution					9600				9600	
13	IFN		FC	Eligible costs	Direct costs (a)	69500								69500
					of which subcontracting	0								0
					Indirect costs (b)	13900								13900
					Total eligible costs (a)+(b)	83400								83400
				Requested EC contribution	41700								41700	
14	EGO		FC	Eligible costs	Direct costs (a)					540000				540000
					of which subcontracting					0				0
					Indirect costs (b)					10000				10000
					Total eligible costs (a)+(b)					550000				550000
				Requested EC contribution					550000				550000	
15	MiniGRA IL		AC	Eligible costs	Direct costs (a)	146250				3500				149750
					of which subcontracting	0				0				0
					Indirect costs (b)	29250				700				29950
					Total eligible costs (a)+(b)	175500				4200				179700
				Requested EC contribution	175500				4200				179700	
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – whole duration of the project															
Participa nt n°	Organi sation short name	Cost model used		Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities								Total (8)= (1)+(2)+(3) +(4)+(5)+(6))+(7)	Total receipts	
		For transnat ional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities							
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)				
16	FMFI-UK		AC	Eligible costs	Direct costs (a)	8333				10500				18833	
					of which subcontracting	0				0					
					Indirect costs (b)	1667				2100				3767	
					Total eligible costs (a)+(b)	10000				12600				22600	
				Requested EC contribution	10000				12600				22600		
17	CERN		AC	Eligible costs	Direct costs (a)					59167				59167	
					of which subcontracting					0				0	
					Indirect costs (b)					11833				11833	
					Total eligible costs (a)+(b)					71000				71000	
				Requested EC contribution					71000				71000		
18	BU		AC	Eligible costs	Direct costs (a)					6670				6670	
					of which subcontracting					0				0	
					Indirect costs (b)					1330				1330	
					Total eligible costs (a)+(b)					8000				8000	
				Requested EC contribution					8000				8000		
19	UG		AC	Eligible costs	Direct costs (a)	152083								152083	
					of which subcontracting	0								0	
					Indirect costs (b)	30417								30417	
					Total eligible costs (a)+(b)	182500								182500	
				Requested EC contribution	182500								182500		
TOTAL				Eligible costs											
				Requested EC contribution											

Financial information – whole duration of the project														
Participa nt n°	Organi sation short name	Cost model used		Estimated eligible costs and requested EC contribution (whole duration of the project)	Costs and EC contribution per type of activities								Total (8)= (1)+(2)+(3) +(4)+(5)+(6))+(7)	Total receipts
		For transnat ional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities						
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)			
20	UCL		AC	Eligible costs	Direct costs (a)	12500			3500				16000	
					of which subcontracting	0			0			0		
					Indirect costs (b)	2500			700			3200		
					Total eligible costs (a)+(b)	15000			4200			19200		
				Requested EC contribution	15000			4200			19200			
				Eligible costs	Direct costs (a)									
					of which subcontracting									
					Indirect costs (b)									
				Total eligible costs (a)+(b)										
Requested EC contribution														
				Eligible costs	Direct costs (a)									
					of which subcontracting									
					Indirect costs (b)									
				Total eligible costs (a)+(b)										
Requested EC contribution														
				Eligible costs	Direct costs (a)									
					of which subcontracting									
					Indirect costs (b)									
				Total eligible costs (a)+(b)										
Requested EC contribution														
TOTAL				Eligible costs	5059400		1980333	2250000	280247		411759	9981739		
				Requested EC contribution	4120000		417994	2250000	280247		411759	7480000		

6. Estimated breakdown of the EC contribution per reporting period

Estimated breakdown of the EC contribution per reporting period			
Reporting Periods	Month x – Month y	Estimated Grant to the Budget	
		Total	In which first six months
Reporting Period 1	M1-M12	1 812 000	
Reporting Period 2	M13-M24	1 980 000	865 760
Reporting Period 3	M25-M36	1 769 000	890 000
Reporting Period 4	M37-M48	1 402 000	710 000
Reporting Period 5	M49-M60	517 000	300 000
Reporting Period 6			
Reporting Period 7			

7. Management of the I3

7.1 Description of the activity

Overall structure: The following committees are involved in the overall management of the ILIAS Integrated Infrastructure Initiative:

- **Executive Board (EB) and Management Team (MT)**
- **Governing Council (GC)**
- **Steering Committee (SC)**
- **Deep Underground Labs Co-ordination and Management Committee (DUL-CoMag)**
- **Peer Review Committee (PRC)**

The management structure of ILIAS contains three levels, the “Legislation” level with the **Governing Council (GC)** as the ultimate decision making body, advised by the **Steering Committee (SC)** and the **Peer Review Committee (PRC)**; the “Consortium-wide Executive Level” with the **Co-ordinator**, the **Executive Board (EB)** and the **Management Team (MT)**; and the “Activities Executive Level” with the **Deep Underground Labs Co-ordination and Management Committee (DUL-CoMag)** and also boards and working groups monitoring the various JRA and Access activities.

The management scheme of ILIAS is presented in Figs. 1 and 2. The detailed management structure for each activity is presented in section 8.

The organisation of the committees and boards, the scope of power, responsibilities and working procedures are described in detail in the Consortium Agreement. In the following, a brief outline of the composition and the role is presented:

Project Co-ordination

The ILIAS Co-ordinator is from Commissariat à l’Energie Atomique (CEA), working in the DSM/DAPNIA.

Role:

- is responsible for the overall management of the ILIAS Project and for the day-to-day operation;
- ensures administrative, financial and legal management of ILIAS;
- is the intermediary between the Consortium and the Commission and fulfils his duties in accordance with the EC Contract.

The Co-ordinator chairs the Management Team, acts as Deputy-Chair of the Executive Board, and is a non-voting member of all other Committees described below.

The scientific co-ordination is ensured by one Project Scientist (presently from CNRS) and two Project Deputy-Scientists (presently one from the Sheffield University and one from INFN). All scientific and technical issues of ILIAS are supervised by the Executive Board.

Executive Board (EB)

Composition:

Project Scientist (Chair); ILIAS Coordinator (Deputy-Chair); two Project Deputy-Scientists, Co-ordinators of the Networking, Joint Research, and Transnational Access Activities; Communication and dissemination officer; Chair of the ApPEC Steering Committee.

Role:

- checks the right progress of all scientific and technical activities according to the Implementation Plan;
- controls implementation of the decisions of the Governing Council (GC) and recommendations of the Steering Committee and the Peer Review Committee (PRC);
- commissions and receives plans for the next stage of ILIAS programme from all activities, passes to the Governing Council (GC), the Steering Committee (SC), and Peer Review Committee (PRC) for review;
- co-ordinates the preparation of the technical and financial reports;
- assembles reports, passes to the Governing Council for approval by the Board;
- submits approved reports to the Co-ordinator for submission to the EU;
- distributes funds to ILIAS participants/activities;
- makes sure that all financial aspects of the project are dealt with correctly and in due time;
- manages the exchange of information inside and outside the consortium;
- promotes ILIAS at international level.

In emergency situations, the Executive Committee is authorised to take any decision required by the circumstances, which must then be validated by the GC.

Management Team (MT)

Composition:

The Co-ordinator, the Project Scientist, administrative staff, and financial staff.

Role:

Ensures the day-to-day management of the ILIAS project:

- manages the administrative, legal, financial and other non-technical aspects;
- commissions and receives progress and financial reports from all ILIAS activities;
- manages the ILIAS budget, including reconciliation of annually audited accounts;
- maintains all financial, administrative and statistical records;
- provides secretariat support for the ILIAS Executive Board and the Governing Council;
- assists the Executive Board regarding all related matters (e.g. follow-up of planning schedule, issue reminders for task initiation or completion);
- assists the Co-ordinator in preparing of the Annual Report document.
- assists the Executive Board in implementing the competitive selection procedure for new contractors.

Governing Council (GC)

Composition:

Each contractor appoints one authorised representative to the GC.

Role:

- monitors the issues related to the overall framework of the ILIAS project, as established in the management plan approved by the GC;
- discusses on political and strategic orientation of the Project;
- decides on the general policy of the project for each year;
- approves the annual working plan proposed by the Executive Board (EB), taking into account respective recommendations from the Steering Committee (SC);
- approves overall budget-relevant matters proposed by the EB, taking into account respective recommendations from the SC;
- approves and endorses changes proposed by the EB and regarding the structure of the project, taking into account respective recommendations from the SC;
- approves and endorses changes proposed by the EB regarding the Consortium Agreement, taking into account respective recommendations from the SC;
- endorses the establishment of the broad lines of budgetary appropriations proposed by the EB;

- endorses all reports required in the frame of the Contract;
- endorses the ILIAS project's "Implementation Plan" and "Plan for using and disseminating the Knowledge";
- endorses the realised expenditure in accordance to the budget presented by the Co-ordinator;
- endorses the Consortium's budget and the financial allocation of the EU's contribution between the various activities on the one hand, and between the various contractors on the other hand;
- upon proposal of the SC, may vote the inclusion of a new participant on a basis of the qualified majority;
- upon proposal of the SC, decides on the exclusion or the withdrawal, on a basis of the qualified majority (minus the vote of the contractor concerned), of a contractor pursuant to the terms set forth by EC;
- makes sure that the commitments proposed by the EB are consistent with the EC Contract;
- proposes to the EB feedback to the scientific community at large;
- endorses changes in the ILIAS Consortium Agreement.

Steering Committee (SC)

Composition:

The 8 members are nominated by the Chairpersons of the Governing Council and the ApPEC Steering Committee.

Role:

- monitors the overall progress of ILIAS;
- is attentive to the progress of all ILIAS activities;
- advises on the different steps of the implementation of the project, upon report and/or request of the EB;
- examines the budgetary requests proposed by the EB and provides recommendations to the GC;
- submits to the GC chairperson items to be discussed during the forthcoming GC meetings;
- upon proposal of the EB, provides recommendations regarding technical and financial adjustments to the activities in progress;
- advises on the handling of potential conflicts;
- makes sure that a publication policy has been defined within each activity and if necessary, may propose a policy with the advise of the PRC;
- advises on the annual working plan proposed by the EB;
- advises on overall budget relevant matters proposed by the EB;
- advises on any changes proposed by the EB regarding the structure of the project;
- advises on any changes proposed by the EB regarding the consortium agreement.

Peer Review Committee (PRC)

Composition:

The Peer Review Committee is composed of 15 to 18 scientific experts in astroparticle physics and chosen in consideration of their individual competence, independently of nationality or place of work. They do not necessarily belong to participant institutions of ILIAS, and can be nationals of third countries.

Role:

- reviews periodically the scientific and technical work produced in the joint research and the transnational access activities;
- monitors the co-ordination achievements of the networks;
- via their assessments, may help the EB to produce the progress and final reports required by the European Commission;
- evaluates the ILIAS Implementation Plan as well as the results obtained;
- may be consulted by the other ILIAS Committees on any scientific issues;

- may make any proposal or transmit any information it deems useful to the relevant ILIAS committees.

Deep Underground Labs Co-ordination and Management Committee (DUL-CoMag)

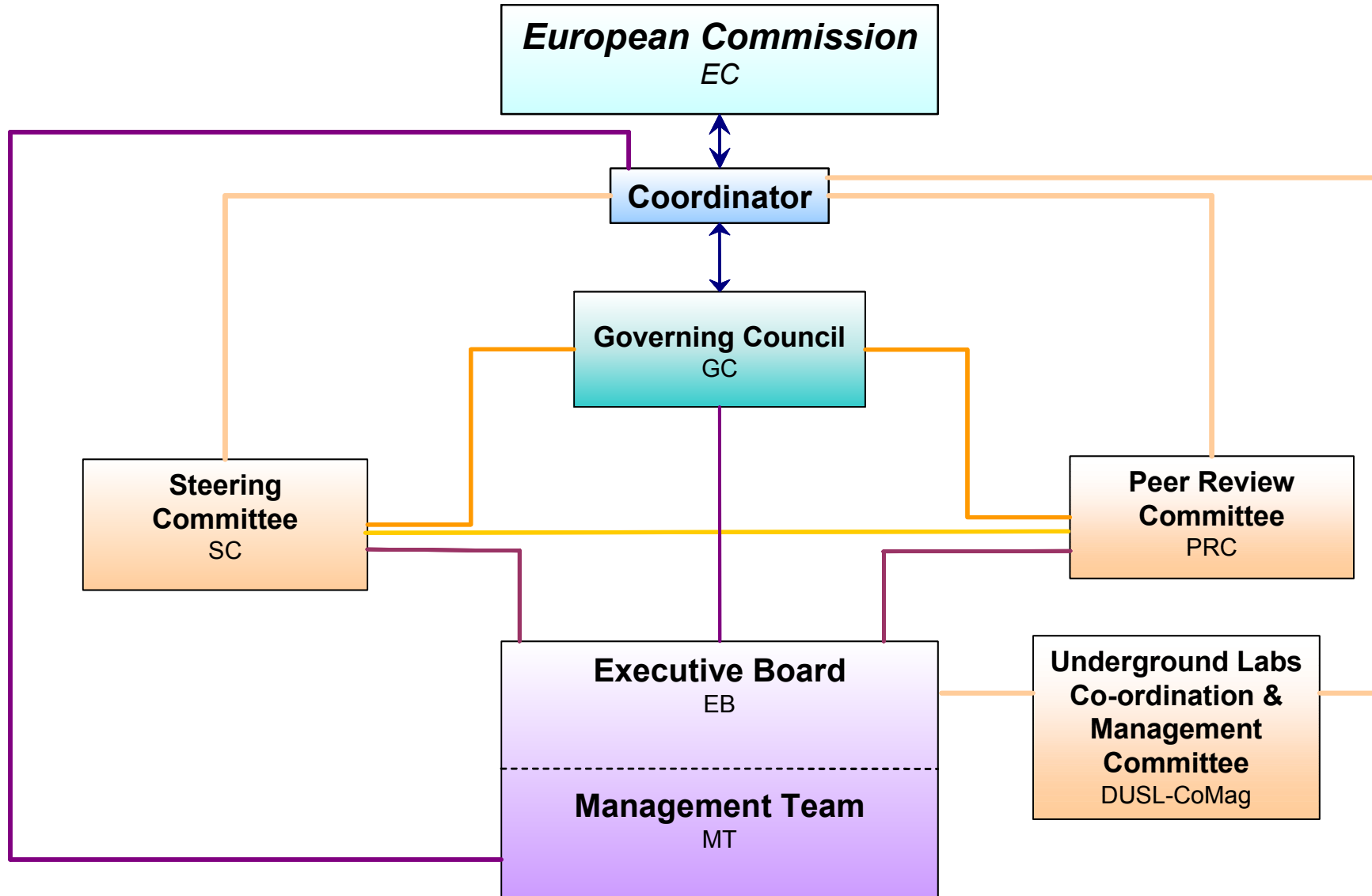
Composition:

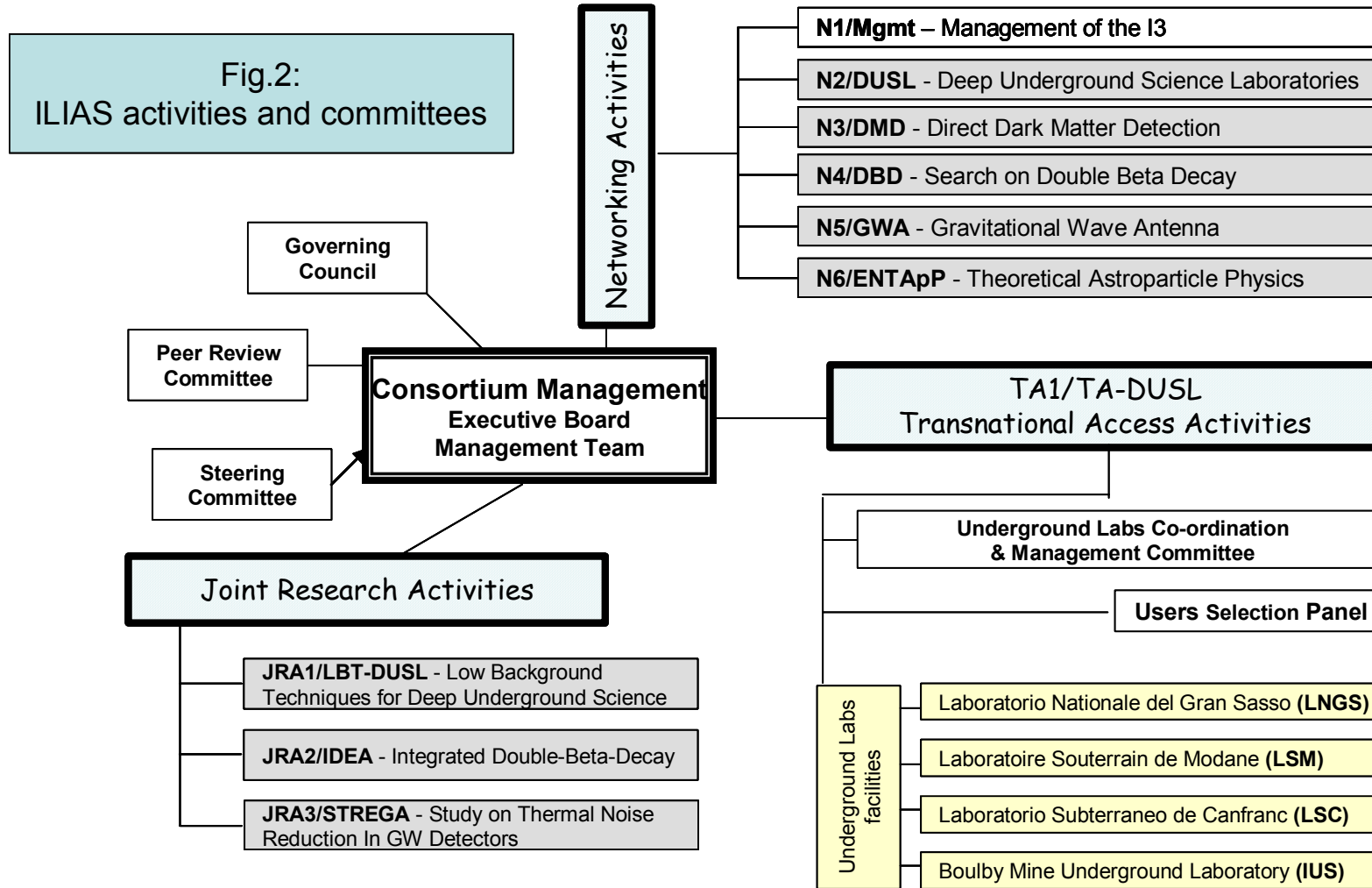
The Deep Underground Labs Co-ordination and Management Committee is composed of the directors of the four deep underground laboratories. This committee has its own management structure.

Role:

- reinforces cooperation and co-ordination on common subjects;
- shares information;
- makes sure there is no duplication of research effort;
- sets up the User Group Selection Panel;
- co-ordinates their security measures.

Fig. 1– ILIAS Management Scheme





7.2 Plan for using and dissemination knowledge

ILIAS activities will result in the generation of new knowledge. One of the intrinsic objectives of ILIAS is to disseminate such knowledge as widely as possible. One of the members of the Executive Board (EB) is explicitly appointed to supervise all questions of communication and publication of results.

ILIAS website

A website for ILIAS has already been created (<http://appec.in2p3.fr/>). This website will concentrate on three axes.

1. Information on ILIAS:

The organisational structure and the role of all participants and related information will be displayed. The website will contain information on all of ILIAS' activities, including meetings, as well as documents presented in the meetings, the public minutes of ILIAS meetings, any electronic proceedings of workshops arising from the networking activities as well as lists of, and links to, preprints and publications arising from ILIAS activities.

2. Links to relevant websites:

On the ILIAS website, links will be provided to numerous already existing websites, e.g. regarding underground laboratories and gravitational wave observatories in Europe and elsewhere, as well as links to facilitate the access to preprints and papers recorded in widely consulted libraries (e.g. High Energy Physics Web Library of CERN and of SLAC).

3. Outreach:

The main objective in this context is to attract more students to the scientific fields, especially in Physics. Based on relevant experience of a number of the ILIAS participants, ILIAS address, e.g. via appropriate documents and conferences, high school students and teachers, undergraduate students in science, and also the media.

Meetings and Conferences

ILIAS will use all its meetings for the dissemination of the results achieved. A general meeting of all the scientists involved in ILIAS will be organized twice during the period of the contract, with plenary and parallel meetings. The results obtained in the different activities will be presented in details by the participants and discussed. All documents will be made available to the world community.

All ILIAS participants will be actively encouraged to participate in relevant international conferences and workshops, to give papers and posters at such meetings and thus, to disseminate results to the world community.

Publications

Researchers benefiting from Transnational Access will be encouraged to publish their scientific results in refereed journals. Results arising from JRAs will also be published in appropriate scientific journals.

It will be a requirement that ILIAS and the EU-funding be acknowledged in all publications. All reasonable attempts will be made to ensure that a significant level of public outreach is maintained. This might also be through public lectures at ILIAS facilities and interaction with respective scientific associations.

The tight contacts between ILIAS and ApPEC is expected to ensure the effective communication of the activities results to the members of the European Astroparticle Physics community who are not directly involved in the activity of ILIAS.

8. Description of each activity of the I3 (including its outline implementation plan)

8.N1 Management of the ILIAS

8.N1.1 Description and objectives

This activity comprises the overall co-ordination and financial and administrative management of ILIAS. The overall objective is to run ILIAS in an efficient and transparent manner.

The main objectives are to:

1. Ensure the administrative and financial management of ILIAS.
2. Receive the entire financial contribution from the Commission. The Co-ordinator shall manage this contribution by allocating it to the contractors pursuant to the implementation plan and the decisions taken by the appropriate bodies.
3. Prepare annual accounts as requested by the Commission and prepare, within the requested time, an actual statement upon request of the Commission or the GC or the SC.
4. Inform the Commission of the distribution of the funds among the contractors, specifically the amounts allocated and the dates of payment to each contractor.
5. Communicate to the Commission all information in connection with the project.
6. Create the relevant structures for the evaluation of all ILIAS activities and definition of structuring roadmaps in various fields of the European astroparticle physics.
7. Take care of legal aspects of the projects.
8. Ensure the dissemination of the knowledge on a worldwide scale.
9. Create the relevant structures for strengthening the communication towards a large public.

8.N1.2 Participants

The French Commissariat à l'Énergie Atomique (CEA) is the Co-ordinator of ILIAS. As explained in Section 7, the Executive Board and the Management Team will assist the Co-ordinator in the relevant tasks.

At the present time, the Executive Board is composed of collaborators from 6 Participants (# 1, 2, 3, 4, 5, and 10). This configuration may be subject to changes during the lifetime of the ILIAS.

The Management Team is entirely provided by CEA and includes administrative and financial assistants.

8.N1.3 Outline implementation plan for the full duration of the activity (including milestones and deliverables)

8.N1 – Table 1 – Implementation plan for the full duration of the ILIAS project							
Activity	PARTICIPANT		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Management of ILIAS	Commissariat à l'Énergie Atomique (CEA)	Tasks	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of ILIAS - Organisation of different Committees Meetings (e.g. GC, SC, PRC) - Dissemination activities, e.g. ILIAS website 	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of IIAS - Participation to the ganisation of different Committees Meetings - Dissemination activities, e.g. ILIAS website 	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of ILIAS - Participation to the organisation of different Committees Meetings - Dissemination activities, e.g. ILIAS website 	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of ILIAS - Participation to the organisation of different Committees Meetings - Dissemination activities, e.g. ILIAS website 	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of ILIAS - Participation to the organisation of different Committees Meetings - Dissemination activities, e.g. ILIAS website
		Milestones and Deliverables	<ul style="list-style-type: none"> - Annual report on ILIAS activities - Update of ILIAS website 	<ul style="list-style-type: none"> - Annual report on ILIAS activities - Update of ILIAS website - First general meeting foreseen 	<ul style="list-style-type: none"> - Annual report on ILIAS activities - Update of ILIAS website 	<ul style="list-style-type: none"> - Annual report on ILIAS activities - Update of ILIAS website - Second general meeting foreseen 	<ul style="list-style-type: none"> - Annual report on ILIAS activities - Update of ILIAS website

8.N1.4 Expected outcome

The main expected result here is an efficient, transparent, and smooth management of ILIAS, in order to facilitate the structuring character of the Consortium and the realisation of the R&D projects. This process is also expected to facilitate the preparation and submission of new proposals, such as design studies.

Note:

In the following Sections, the Activities are organised as follows:

- Each Activity is performed by **Working Groups (WG)**.
- Each Working Group (WG) is in charge of one **Work Package (WP)**.
- Each WG / WP is either **mono-Task** or **multi-Task**.
- Whenever suitable, a **Task** is divided into **Sub-Tasks**.

8.N2 Deep Underground Science Laboratories (DUSL)

8.N2.1 Description and objectives of the activity

The DUSL networking activity is designed to implement a mechanism for the joint structuring and co-ordination of the four deep underground science laboratories (LNGS, Italy; LSM, France; LSC, Spain; IUS, United Kingdom), in order to ensure a better service to users with more efficient use of resources. To achieve this improved and optimised performance, the network has three key objectives:

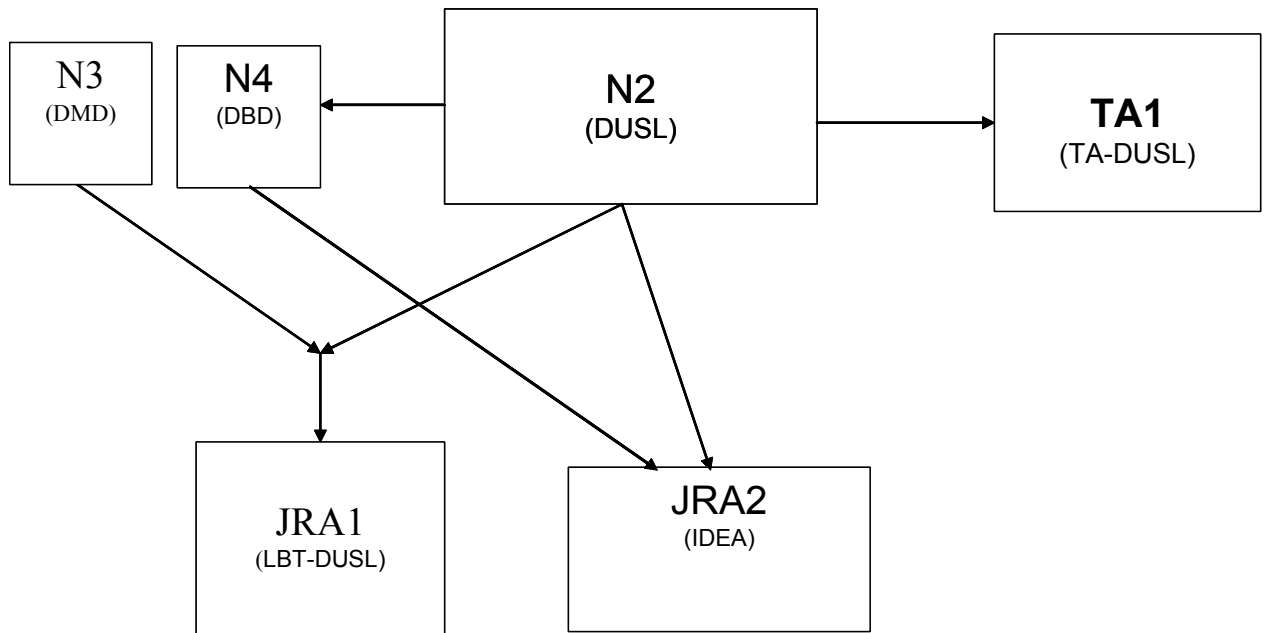
- (1) Provision of higher quality environments and operational support to users, via coordination of site assignment and improvements on basic equipment, technical and logistic support, access and communication.
- (2) Improved health and safety issues, via exchange of best practice experience, progressing to a common approach on safety procedures specific to underground sites.
- (3) Improved scientific coordination and communications to the public, through cooperation on communication initiatives.

Activity DUSL will have a key structuring effect. Not only will it accelerate integration of the existing separate management structures of the Underground laboratories at a European level but the new structures, handling the objectives above, will establish cross-links (Fig. 1) with many of the other networks and JRAs within ILIAS, in particular with N3, N4, TA1, JRA1 and JRA2. Thus N2 underpins coordination of a large part of the ILIAS activities.

8.N2 - Table 1 –DUSL Activities

WP	Descriptive Title	Short description and specific objectives
1	Performance improvement and possible extensions of the deep underground laboratories	A cross-site planning is needed in order to ensure maximum operational efficiency, best use of space, and better matching of experiment environment. Objectives : - Improve the quality of service provided to the users of the different experiments by existing underground space at the sites (e.g. environment, equipment, technical support, logistics and operation). - Design strategies for co-ordination of possible new extensions of the present infrastructures and gain maximum benefit from the complementary characteristics of the different sites.
2	Safety problems and accident prevention in underground sites	Optimal safety conditions are of primary importance in underground sites hosting a great variety of experimental installations. Consistent and clear procedures for health and safety across the sites and improved solutions to safety problems are crucial issues in the Underground Labs. Objectives : - To share experience acquired in health and safety issues in each laboratory and improve the relevant procedures.
3	Scientific Coordination and Public Communication	Various aspects of “inreach” and “outreach” need special effort in order to share with the scientific community the findings in the Deep Underground Labs and to improve the awareness of the general public. Objectives : - Stimulate co-ordination and promotion of Underground Science within the field across all the sites. - Improve the quality of public communication of Underground Science activities to citizens by exploiting together best practices in the field.

8.N2 - Fig. 1
Interdependency of the N2 Networking Activity with other activities



8.N2.2 Participants

8.N2 -Table 2a – Participants			
#	Name	Short name	Role: Participation in
1	Commissariat à l’Energie Atomique	CEA	WP 1, WP 2, WP 3
2	Centre National de la Recherche Scientifique	CNRS	WP 1, WP 2, WP 3
3	Istituto Nazionale di Fisica Nucleare	INFN	WP 1, WP 2, WP 3
4	Universidad de Zaragoza	UNIZAR	WP 1, WP 2, WP 3
5	The University of Sheffield	USFD	WP 1, WP 2, WP 3

8.N2 - Table 2b –Other entities foreseen to contribute to this activity (but not signatories to the contract)	
Name	Role: Contribution to
Deutsche Elektronen-Synchrotron (DESY)	WP 1, WP 2, WP 3
Forschungszentrum (KFK)	WP 3
Rutherford-Appleton Laboratory	WP 1, WP 2
Democritos University	WP 3
Fermi National Laboratory	WP 1, WP 2, WP 3
Stanford Linear Accelerator Centre	WP 1, WP 2, WP 3
Brookhaven National Laboratory	WP 3
Princeton University	WP 3

8.N2.3 Outline implementation plan for the full duration of the activity

8.N2 - Table 3 – 5 Years Execution Plan							
WP #	Descriptive Title		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1	Performance improvement and possible extensions of the Deep Underground Laboratories	Tasks	- Inventory of the equipment performance - Extension projects in the 4 labs - Working Group formation	- Definition of specific points (e.g. access, ventilation, electrical install.) for a cooperation among the 4 labs	- Common studies and recommendations on the selected points of interest*	- Common studies and recommendations on the selected points of interest*	- Common studies and recommendations on the selected points of interest*
		Milestones and Deliverables	- Report on the labs equipment and on the labs projects. - Specific plans for year 2	- Report on a detailed program of cooperation - Specific plans for year 3	- Report on common studies and recommendations* - Specific plans for year 4	- Report on common studies and recommendations* - Specific plans for year 5	- Report on common studies and recommendations*
2	Safety problems and accident prevention in underground sites	Tasks	- Exchange information and compare strategies in the 4 labs - Working Group formation	- Search for an optimized strategy	- Follow-up of the operation of the defined strategy, especially considering the prevention aspects for each situation*	- Follow-up of the operation of the defined strategy, especially considering the prevention aspects for each situation*	- Follow-up of the operation of the defined strategy, especially considering the prevention aspects for each situation*
		Milestones and Deliverables	- Status Report on the safety strategies and realisations	- Report on a common strategy	- Report analyzing the strong and weak points of the defined strategy. Suggestions for improvements in the solutions to safety problems*	- Report analyzing the strong and weak points of the defined strategy. Suggestions for improvements in the solutions to safety problems*	- Report analyzing the strong and weak points of the defined strategy. Suggestions for improvements in the solutions to safety problems*

8.N2 - Table 3 – 5 Years Execution Plan							
WP #	Descriptive Title		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
3	Scientific Coordination and Public Communication	Tasks	<ul style="list-style-type: none"> - Inventory of the Communication facilities in the 4 Labs - Definition of a common project and formation of a Work Group. - Inventory of the present scientific policy in each lab 	<ul style="list-style-type: none"> - Preparation of a Booklet of the Underground Labs and guide to users. 	<ul style="list-style-type: none"> - Investigation on a possible scientific coordination among the 4 labs 	<ul style="list-style-type: none"> - Video-conference connection among the 4 Laboratories, and crossed virtual visits of them by using Web-cameras. 	<ul style="list-style-type: none"> - Investigate the possibility of common future programs of Underground Science
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on these inventories - Agreement on a common project on Communication 	<ul style="list-style-type: none"> - Booklet /user-guide finalised 	<ul style="list-style-type: none"> - Report on practical possibilities for scientific coordination among the 4 labs 	<ul style="list-style-type: none"> - Virtual connection among the 4 labs. 	<ul style="list-style-type: none"> - Report on strategies to stimulate the coordination and future prospects of Underground Science

* In these cases, detailed **Milestones and Deliverables** will be defined for **each year** on the basis of the knowledge acquired during the **previous year(s)**.

8.N2 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1: Performances improvement and possible extensions of the Deep Underground Laboratories																				
Tasks: - Inventory of the equipment performance - Extension projects in the 4 labs - Working Group Formation																				
Deliverables: - Report on the labs equipment and on the labs projects - Specific plans for year 2																				
Tasks: - Definition of specific points (e.g. access, ventilation, electrical install.) for a cooperation among the 4 labs																				
Deliverables: - Report on a detailed program of cooperation (R) - Specific plans for year 3 (P3)																				
Tasks: - Common studies and recommendations on the selected points of interest*																				
Deliverables: - Reports on common studies and recommendations* - Specific plans for year 4 (P4) and year 5																				
WP 2: Safety problems and accident prevention in underground sites																				
Tasks: - Exchange information & compare strategies in the 4 labs - Working Group formation																				
Deliverables: - Status Report on the safety strategies and Realisations																				
Tasks: - Search for an optimized strategy																				
Deliverables: - Report on a common strategy																				
Tasks: - Follow up of the operation of the defined strategy, especially considering the prevention aspects for each situation* - Suggestions for improvements in the solutions to safety problems*																				
Deliverables: - Reports analyzing the strong and weak points of the defined strategy																				

WP 3: Scientific Coordination and Public Communication																			
Tasks: - Inventory of the Communication facilities in the 4 Laboratories - Definition of a common project and formation of a Work Group - Inventory of the present scientific policy in each lab																			
Deliverables: - Report on these Inventories - Agreement on a common project on Communication																			
Tasks: - Preparation of a Booklet of the Underground Labs and guide to users																			
Deliverables: - Booklet /user-guide finalised																			
Tasks: - Investigation on a possible scientific coordination among the 4 labs																			
Deliverables: - Report on practical possibilities for scientific coordination among the 4 labs																			
Tasks: - Video-conference connection among the 4 Laboratories, and crossed virtual visits of them by using Web-cameras																			
Deliverables: - Virtual connection among the 4 labs																			
Tasks: - Investigate the possibility of common future programs of Underground Science																			
Deliverables: - Report on strategies to stimulate the coordination and future prospects of Underground Science																			

* In these cases, detailed **Milestones and Deliverables** will be defined for **each year** on the basis of the knowledge acquired during the **previous year(s)**.

8.N2.4 Expected outcome

The DUSL Activity will create, by combining the knowledge and existing managerial structures of the labs, an important change in the performance of all the sites, in particular via improved technical and logistic support through greater coordination, enhanced provision of safety procedures, improved interaction between researchers at the sites and better communication with the public.

Each Working Group (see the management structure in Table 5) will monitor progress on its tasks with success measured by completion of listed milestones and associated deliverables (see Table 3). Publications of open reports after each of the Working Group meetings, detailing success with the deliverables, will be submitted for approval to the relevant ILIAS Committees. The monitoring will be performed, e.g., via questionnaires or website hits. The results of the monitoring will be made available on the ILIAS website.

Subsequent impact will also be evaluated by assessing the use and implementation of, e.g.:

- joint technical notes,
- recommendations made by the WGs,
- new safety initiatives,
- communication documents.

8.N2.5 Management

The Management structure for the DUSL Activity is characterised by the following elements (the composition of the boards and groups is provided in Table 5):

- The DUSL Co-ordination and Management Committee
- An overall DUSL Executive Board (DUSL EB)
- One Executive Board for each of the three Work Packages
- One Working Group for each of the 3 Work Packages: These working groups will include experts of each laboratory, possibly together with experts from external institutions or industries.

The corresponding activities will be structured along the organization of periodic working meetings (corresponding to milestones) where the status and perspectives of the network activities will be co-ordinated and reported.

The Director of the LNGS will supervise the three activities on DUSL: N2, JRA1, and TA1.

8.N2 - Table 5 –Management Structure of Activity DUSL		
DUSL Co-ordination and Management Committee		
(1 meeting per year)		
Supervisor : Director of the LNGS		
DUSL EB: DUSL Co-ordinator: CEA, Deputy Co-ordinator: USFD, Directors and/or Representatives of the 4 Deep Underground Labs		
↓	↓	↓
DUSL WP1 EB	DUSL WP2 EB	DUSL WP3 EB
Composition of each WP EB: 3 Members: 1 Work Package Leader and 2 Members from the corresponding Working Group (WG)		
↓	↓	↓
DUSL WG1	DUSL WG2	DUSL WG3
Composition of each WG: About 5 to 10 Members		

8.N3 Direct Dark Matter Detection (DMD)

8.N3.1 Description and objectives of the activity

The network will promote the European coordination among experimental groups presently involved in direct Dark Matter search projects, in order to reach a common strategy for Dark Matter direct detection. The Network gathers essential expertise from several of the world leading laboratories in this highly competitive field. It will catalyse the co-ordination between European laboratories involved in direct Dark Matter detection. It will generate the critical mass of combined expertise to co-ordinate the future strategy of large-scale instrumentation for direct Dark Matter detection in Europe.

Objectives:

- Convergence in the assessment of different detector concepts.
- Convergence on the strategy for future large scale European dark matter experiments.

Deliverables:

- Report on the sensitivity of the present and future direct and indirect dark matter searches
- Creation of a virtual centre on direct Dark Matter detection in Europe

The network activity will be based on eight working groups dedicated to the 8 following Work Packages:

- **WP1: CDC:** Cryogenic Detectors and Cryostat
- **WP2: LX:** Non cryogenic detectors and liquid xenon
- **WP3: GENAI:** Germanium- and NaI-Detectors
- **WP4: AD:** Advanced detectors including directional concepts
- **WP5: BSNS:** Background Simulation, Neutron-Shield and Muon-Vetos
- **WP6: HPMP:** High Radiopurity Materials and Materials Purification
- **WP7: AXION:** Axion Search
- **WP8: COMMON:** Common Issues and link to Theory

The DMD-network includes different detector concepts (Work Packages CDC, LX, GENAI, AD) but also issues common to all detectors (Work Packages BSNS, HPMP, COMMON). One working group will study the application of the dark matter detection data and data from X-ray astrophysics to other projects (Work Package AXION). COMMON will serve as link between CDC, LX, GENAI and AD and between the DMD network and the ENTApP network (N6). BSNS will be a common activity with the JRA1 (LBT-DUSL), and the HPMP will be common with the N4 network (DBD).

The activities and their specific objectives are outlined in Table 1 for each Working Package.

8.N3 - Table 1 – DMD Activities		
WP	WP Title	Short description and specific objectives
1	CDC	<p>Different cryogenic detection concepts (e.g. calorimetry, charge-heat, light-heat, grains) are being prepared towards one or two large scale dark matter projects. Any of these solutions needs to realise a cryogenic system taking into account issues of low radioactivity and shielding from external background.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Reach convergence in the assessment of cryogenic detector concepts. - Combine the expertise in Europe to discuss the problems for the cryogenic facility.
2	LX	<p>The group shall discuss the results from the realisation of several liquid xenon modules and assess the potential of different solutions to reach a mass of the order of 100 kg. The data on photon collection and of backgrounds, notably regarding the uranium content of the materials used, and the purification of the recirculated xenon shall be compared.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Discuss the different solutions, identify the demands on the set-up and define the optimum strategy for a large-scale liquid xenon detector
3	GENAI	<p>The group shall compare and discuss the results from the realisation of several projects using Germanium and/or NaI-detectors with potential to reach a mass of the order of 1000 kg.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Assessment of (non-cryogenic) detector concepts for a large scale project, discuss different solutions, identify the demands on the set up and define the optimum strategy for a large scale detector
4	AD	<p>The group shall concentrate on the area of advanced detectors, such as gas TPCs and novel photon and charge readout development.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Identify promising new detector concepts. - Exchange data from the different projects of the involved groups and discuss and compare the potential of these detectors. - Make an assessment on the possibilities for large scale dark matter project based on one or more of these concepts.
5	BSNS	<p>The group shall compare results from different Monte Carlo simulation packages, discuss and compare results on simulations of higher energy neutrons and muons.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Identify the most appropriate Monte Carlo simulation code. - Identify the needs on the shielding and assess different proposals for solutions. - Discuss data on purity of different materials and its influence on the set up. <p>This work will be done in close collaboration with the JRA1 (LBT-DUSL).</p>
6	HPMP	<p>The working group on high-purity materials will be transversal to the network N4 (DBD).</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Collect existing data and know-how acquired independently by the various groups, and organise the information in a <i>European Database</i> on radioactive contamination of commonly used materials for detectors construction, accessible to all researchers interested in highly radio-pure materials. - Co-ordinate with the EU underground laboratories (see JRA1), which manages the low activity detector set-ups, to plan new campaign of measurements on new or poorly documented materials and insert the results in the <i>Database</i>. - Co-ordinate present and future efforts on purification techniques in order to optimise manpower and resources.

8.N3 - Table 1 – DMD Activities		
WP	WP Title	Short description and specific objectives
7	AXION	<p>Objectives:</p> <ul style="list-style-type: none"> - Define a procedure allowing to using the relevant monocrystal data for axion search. - Identify possibilities to optimise the detection of dark matter related events with new data evaluation algorithms.
8	COMMON	<p>Objectives :</p> <ul style="list-style-type: none"> - Reach convergence in the assessment of different detector concepts (e.g. cryogenic, non-cryogenic, liquid xenon, germanium, NaI) for a large scale dark matter experiment. - Provide a platform for the discussion on problems common to all detector concepts, such as background studies, shielding and material selection purification and evaluation algorithms. - Combine the data from direct detection experiments, axions searches and X-ray astrophysics for the search for dark matter particles. - Reach convergence on the strategy for a future large scale dark matter experiment, based on a comparison on possible detector concepts. <p>Common objectives together with the network on Theoretical Astroparticle Physics (N6-ENTApP):</p> <ul style="list-style-type: none"> - Relevance of the present and future direct dark matter searches for supersymmetry. - Comparison to indirect searches. - Relevance of the data from direct searches for supersymmetry. - Relevance of the data from axions searches for theory.

8.N3.2 Participants

8.N3 -Table 2a – Participants			
#	Name	Short name	Role
1	Commissariat à l’Energie Atomique	CEA	Innovative cryogenic systems and detectors, low temperature physics, muon and neutron physics, data analysis, link to JRA1, N2 Working labs.: DAPNIA, DRECAM Participation to WP: CDC, HPMP, BSNS, COMMON
2	Centre National de la Recherche Scientifique	CNRS	Innovative cryogenic systems and detectors, low temperature physics, high purity materials, electronics, Monte Carlo simulations, data analysis, link to JRA1, N2, N6 Working labs.: CRTBT_Grenoble, IPN_Lyon, CSNSM_Orsay, IAS_Orsay, IAP_Paris, LSM_Modane Participation to WP: CDC, BSNS, HPMP, COMMON
3	Istituto Nazionale di Fisica Nucleare	INFN	Low background gamma-spectroscopy, cryogenic detectors, link to N2, JRA1, N4, Working labs.: Laboratory Nazionali del Gran Sasso, Università di Milano, link to JRA2 Participation to WP: CDC, HPMP, BSNS, GENAI, COMMON
4	Universidad de Zaragoza	UNIZAR	Cryogenic detectors, low background, link to N2, JRA1, N4, JRA2 Participation to WP: CDC, HPMP, BSNS, COMMON
5	The University of Sheffield	USFD	Directional detectors, liquid xenon detectors, low background techniques, Participation to WP: LX, AD, GENAI, COMMON
9	Max-Planck Society for the advancement of Science, represented by Max-Planck-Institute for Nuclear Physics, Heidelberg	MPIK	Non cryogenic detectors, germanium and liquid Xenon detectors, cryogenic detectors, axion search, link to N4, N6, JRA2 Working lab. MPK, MPE_Garching, Participation to WP: CDC, GENAI, BSNS, HPMP, LX, COMMON
10	Technische Universität München	TUM	Cryogenic detectors, low-background, link to N6, JRA1. Participation to WP: CDC, BSNS, HPMP, COMMON
11	Eberhard Karls Universität Tübingen	EKUT	Low background experiments, double beta decay theory, link to N4, JRA1, JRA2 Participation to WP: CDC, BSNS, HPMP, COMMON
12	Aristotle University of Thessaloniki	AUTH	Background simulation, directional detectors, data evaluation, link to N6 Participation to WP: AXION, COMMON
18	Bogazici University, Istanbul	BU	Axion search, background simulation, directional detectors, link to N6, Participation to WP: AXION

8.N3 - Table 2b –Other entities foreseen to contribute to this activity (but not signatories to the contract)	
Name	Role: Contribution to
Forschungszentrum Karlsruhe (FZK)	WP: BSNS, COMMON
University Karlsruhe	WP: BSNS, COMMON
Institut für Physik. Hochtechnologie	WP: CDC
Technical University Darmstadt	WP: AXION, AD
University Frankfurt	WP: AXION, AD
Imperial College	WP: LX, AD
Oxford University	WP: CDC
Rutherford-Appleton Laboratory	WP: LX, AD
University Bern	WP: CDC, BSNS
University of Novi Sad	WP: BSNS, HPMP

8.N3.3 Outline implementation plan for the full duration of the activity

WP		8.N3 -Table 3 – 5 Years Execution Plan				
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1 CDC	Tasks	- Working group setup - Setup WG WEB page - Working group implementation plan, based on considered technologies	- Identification of most promising detector concepts	- Identification of required read out techniques - Identification of requirements on cooling	- Identify combined needs (purity, shielding and detector technology) with other working groups (within COMMON) - Strategy on integration of the cryogenic system into external shield	- Integration of detector, read out and cooling techniques - Assessment on comparison with other techniques (within COMMON)
	Milestones and Deliverables	- Annual report: description of the considered cryogenic detector techniques - WG WEB page	- Annual report: techniques, identification of needs for optimization, comparison of different detector types	- Annual report: read out techniques and their impact on the integrated system, possible cooling scenarios	- Annual report: assessment on how demands on purity can be considered with cryogenic set up	- Final report: possible strategy on a large scale European cryogenic Dark Matter Search project
2 LX	Tasks	- Working group setup - Setup WG WEB page - working group implementation plan, based on considered technologies	- Identification of most promising detector concepts and possibility for discrimination	- Identification of required read out techniques - Identification of requirements on detector operation	- Identify combined needs (purity, shielding and detector technology) with other working groups (within COMMON) - Strategy on integration of the liquid xenon system into external shield	- Integration of detector, read out and operation techniques - Assessment on comparison with other techniques (within COMMON)
	Milestones and Deliverables	- Annual report description of considered detector concepts - WG WEB page	- Annual report comparison of different concepts	- Annual report read out techniques and their impact on the integrated system, possible scenarios for operation of a large detector	- Annual report assessment on how demands on purity can be considered with liquid xenon possibilities of purification	- Final report possible strategy on a large scale European liquid xenon Dark Matter Search project

WP		8.N3 -Table 3 – 5 Years Execution Plan				
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
3 GENAI	Tasks	<ul style="list-style-type: none"> - Working group setup - Setup WG WEB page - Identification of concepts large scale experiments based on Ge and NaI - Identification of shielding strategies - Identification of read out schemes 	<ul style="list-style-type: none"> -Identification of concepts large scale experiments based on Ge and NaI - Identification of read out schemes (phase I) - Continue identification of shielding strategies 	<ul style="list-style-type: none"> - Identification of shielding strategies - Identification of read out schemes (phase II) 	<ul style="list-style-type: none"> - Identify combined needs (purity, shielding and detector technology) with other working groups (within COMMON) 	<ul style="list-style-type: none"> - Integration of detector, read out and operation techniques - Assessment on comparison with other techniques (within COMMON)
	Milestones and Deliverables	<ul style="list-style-type: none"> - WG WEB page - Report First conclusions on large scale experiments, shielding strategies, and read out schemes 	<ul style="list-style-type: none"> - Annual report description of considered detector concepts and read out schemes (phase I) 	<ul style="list-style-type: none"> - Annual report description of shielding strategies and read out techniques 	<ul style="list-style-type: none"> - Annual report assessment on how demands on purity can be considered with Ge and NaI detectors 	<ul style="list-style-type: none"> - Final report possible strategy on a large scale European Dark Matter Search project based on Ge and/or NaI detectors
4 AD	Tasks	<ul style="list-style-type: none"> - Working group setup - Setup WG WEB page - Working group schedule and strategy - Identification of promising new concepts for direct Dark Matter search - Start selection on considered concepts 	<ul style="list-style-type: none"> - Identification of promising new concepts for direct Dark Matter search - End selection on considered concepts 	<ul style="list-style-type: none"> - Comparison of new concepts - Identify advantages compared to 'standard' detectors 	<ul style="list-style-type: none"> - Identify combined needs (purity, shielding and detector technology) with other working groups (within COMMON) 	<ul style="list-style-type: none"> - Integration of detector, read out and operation techniques - Assessment on comparison with other techniques (within COMMON)
	Milestones and Deliverables	<ul style="list-style-type: none"> - WG WEB page - Report First conclusions on new concepts for direct Dark Matter search 	<ul style="list-style-type: none"> - Annual report description of considered detector concepts 	<ul style="list-style-type: none"> - Annual report comparison of concepts and description of advantages 	<ul style="list-style-type: none"> - Annual report assessment on how demands on purity can be considered with new concepts 	<ul style="list-style-type: none"> - Final report possible strategy on a large scale European Dark Matter Search project based on new advanced detectors
5 BSNS	Tasks	<ul style="list-style-type: none"> - Working group setup - Setup WG WEB page - Identify considered Monte Carlo codes 	<ul style="list-style-type: none"> - Implementation of Monte Carlo codes for Gamma and Neutron tracking - Comparison of different Monte Carlo codes - decision on codes used 	<ul style="list-style-type: none"> - Results from simulations of different shielding strategies 	<ul style="list-style-type: none"> - Implement Monte Carlo systems for detector concepts of working groups: CDC, LX, GeNaI and AD 	<ul style="list-style-type: none"> - Results from simulations for detector set ups based on different detector concepts

WP		8.N3 -Table 3 – 5 Years Execution Plan				
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
	Milestones and Deliverables	- WG WEB page - Annual report Monte Carlo codes Availability	- Annual report Comparison of Monte Carlo codes	- Annual report Report on results from shielding and impact on detector set up	- Annual report report on possibilities for simulations for different detector concepts	- Final report report on estimated background for different detector concepts
6 HPMP	Tasks	- Working group setup - Setup WG WEB page - Working group strategy	- Collection of existing data on material purity - Organization knowledge base	- Identification of demands on purity measurements - Identification of demands on material purification	- Identification of demands on pure material production - Organization of measurement campaign - Identify purity demands of different detector concepts	- Include results on purity into Monte Carlo Codes (working group BSNS) of different detector concepts
	Milestones and Deliverables	- WG WEB page - Annual report Strategy of data collection	- Annual report Data Collection Strategy on Knowledge base	- Annual report planned purity measurements planned purification strategies Status of knowledge base	- Annual report demands on pure material production purity demands on different detector concepts	- Final report description of purity issues of different detector concepts status of knowledge base
7 AXION	Tasks	- Working group setup - Setup WG WEB page - Relevance of CAST data for Dark Matter	- Relevance of CAST data for Dark Matter - Possibility to use data from EDELWEISS / CRESST for AXION search	- Identify possible modifications to EDELWEISS / CRESST to optimize Axion search possibilities - Review of other experiments for their relevance for Axion search	- Impact of data from CAST experiment on Dark Matter Searches - Optimization of planned large scale Dark matter Search projects to Axion searches	- Comparison of different detector concepts on their potential for axion search
	Milestones and Deliverables	- WG WEB page - Annual report: Define conditions under which CAST data could be exploited in the dark matter studies	- Annual report Interplay between data from CAST and data from EDELWEISS / CRESST	- Annual report Suggest modifications to EDELWEISS / CRESST Interplay between data from CAST and data from other experiments	- Annual report Impact of CAST to Dark Matter Search Optimization of large scale experiment to Axion search	- Final report Assessment on different detector concepts on their potential for axion search

WP		8.N3 -Table 3 – 5 Years Execution Plan				
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
8 COMMON	Tasks	<ul style="list-style-type: none"> - Working group setup - Setup WG WEB page - Link to Network on Theoretical Astroparticle physics 	<ul style="list-style-type: none"> - Define goals for large scale dark matter search project form theoretical considerations - Define desired scale of future dark matter search projects 	<ul style="list-style-type: none"> - Combine efforts of working groups on detector technologies (CDC, LX, GeNaI, AD) with working groups on general aspects (HPMP, BSNS, COMMON) - Define demands on different detector technologies on integration in the large scale facility 	<ul style="list-style-type: none"> - Combine efforts on shielding and purity with detector technologies - Studies on sensitivity of different concepts 	<ul style="list-style-type: none"> - Combine efforts on shielding. Monte Carlo studies, shielding strategy and detector concepts into a coherent strategy for large scale dark matter search facility - Asses sensitivity reach from theoretical point of view
	Milestones and Deliverables	<ul style="list-style-type: none"> - WG WEB page - Annual report qualitative goals of a large scale dark matter search facility work plan together with network on theoretical astroparticle physics 	<ul style="list-style-type: none"> - Annual report quantitative goals for large scale dark matter search facility assessment on WIMP dark matter and Axion dark matter 	<ul style="list-style-type: none"> - Annual report demands on shielding and purity identification of optimization needs for the implementation of different detector technologies into a large scale set up 	<ul style="list-style-type: none"> - Annual report shielding strategy how can different detector concepts be combined with shielding strategy 	<ul style="list-style-type: none"> - Final report: Strategy for large scale European Dark Matter Search projects - Comparison of the different possible solution - Assessment on the advantages of different realisations - Impact of large scale European dark matter search project on particle physics and astrophysics

8.N3 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1 - CDC: Cryogenic Detectors and Cryostat																				
Tasks:																				
Working group set up and website																				
Identification of most promising detector concepts																				
Identification of required read out techniques																				
Identification of requirements on cooling																				
Identify combined needs (e.g. purity, shielding.) with other working groups																				
Strategy on integration of the cryogenic system into external shield																				
Integration of detector, read out and cooling techniques																				
Assessment on comparison with other techniques																				
Deliverables:																				
Annual report																				
WG WEB page																				
WP 2- LX: Non cryogenic detectors and liquid xenon																				
Tasks:																				
Working group set up and WEB site																				
Identification of most promising detector concepts and possibility for discrimination																				
Identification of required read out techniques																				
Identification of requirements on detector operation																				
Identify combined needs (e.g. purity, shielding.) with other working groups																				
Strategy on integration of the liquid xenon system into external shield																				
Integration of detector, read out and cooling techniques																				
Assessment on comparison with other techniques																				

8.N3 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Deliverables:																				
Annual report																				
WG WEB page																				
WP 3 - GENAI: Germanium- and NaI-Detectors																				
Tasks:																				
Working group set up and WEB site																				
Identification of concepts large scale experiments based on Ge and NaI																				
Identification of shielding strategies																				
Identification of read out schemes																				
Identify combined needs (e.g. purity, shielding) with other working groups																				
Integration of detector, read out and operation techniques																				
Assessment on comparison with other techniques																				
Deliverables:																				
Annual report																				
WG WEB page																				
WP 4 - AD: Advanced detectors including directional concepts																				
Tasks:																				
Working group set up and WEB site																				
Identification of promising new concepts for direct Dark Matter search																				
Selection on considered concepts																				
Comparison of new concepts																				
Identify advantages compared to 'standard' detectors																				
Identify combined needs (purity, shielding etc) with other working groups																				
Integration of detector, read out and operation techniques																				
Assessment on comparison with other techniques																				

8.N3 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Deliverables:																				
Annual report																				
WG WEB page																				
WP 5 - BSNS: Background Simulation, Neutron-Shield and Muon-Vetos																				
Tasks:																				
Working group set up and WEB site																				
Identify considered Monte Carlo codes																				
Implementation of Monte Carlo Codes for Gamma and Neutron tracking																				
Comparison of different Monte Carlo Codes																				
Decision of codes used																				
Results from simulations of different shielding strategies																				
Implement Monte Carlo systems for working groups: CDC, LX, GeNaI and AD																				
Results from simulations for detector set ups based on different detector concepts																				
Deliverables:																				
Annual report																				
WG WEB page																				
WP 6 - HPMP: High Radiopurity Materials and Materials Purification																				
Tasks:																				
Working group set up and WEB site																				
Collection of existing data on material purity																				
Organization knowledge base																				
Identification of demands on purity measurements																				
Identification of demands on material purification																				
Identification of demands on pure material production																				
Organization of measurement campaign																				
Identify purity demands of different detector concepts																				

8.N3 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Include results on purity into Monte Carlo Codes of different detector concepts																				
Deliverables:																				
Annual report																				
WG WEB page																				
WP 7 - AXION: Axion Search																				
Tasks:																				
Working group set up and WEB site																				
Relevance of CAST data for Dark Matter																				
Possibility to use data from EDELWEISS / CRESST for AXION search																				
Identify modifications to EDELWEISS / CRESST to optimize Axion search																				
Review of other experiments for their relevance for Axion search																				
Impact of data from CAST experiment on Dark Matter searches																				
Optimization of planned large scale Dark matter Search projects to Axion searches																				
Comparison of different detector concepts on their potential for axion search																				
Deliverables:																				
Annual report																				
WG WEB page																				

8.N3 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 8 - COMMON: Common Issues and link to Theory																				
Tasks:																				
Working group set up and WEB site																				
Define goals for large scale dark matter search project form theoretical considerations																				
Define desired scale of future dark matter search projects																				
Combine efforts of working groups on detector technologies (CDC, LX, GeNaI, AD) with working groups on general aspects (HPMP, BSNS, COMMON)																				
Define demands on different detector technologies on integration in the large scale facility																				
Combine efforts on shielding and purity with detector technologies																				
Studies on sensitivity of different concepts																				
Combine efforts on shielding. Monte Carlo studies, shielding strategy and detector concepts into a coherent strategy for large scale dark matter search facility																				
Asses sensitivity reach from theoretical point of view																				
Deliverables:																				
Annual report																				
WG WEB page																				

8.N3.4 Expected outcome

The network will bring together laboratories whose efforts are not yet co-ordinated. The working groups should serve as seed for future collaborations. Finally these new collaborations are expected to be combined in a virtual centre for Dark Matter detection in Europe.

The success and the impact of the Dark Matter Network activity are expected to be reflected by the number of coordinated new research projects among the participants.

8.N3.5 Management

The Network Co-ordinator will chair the DMD Executive Board made of about 10 members representing the main active areas in Dark Matter search (see **Table 5**). This board is meant to initiate a representative structure of the European Dark Matter search community.

Each working group (WG) will be composed of at least 10 experts representing the main research areas involved in the activity. Each WG will elect a leader and a deputy acting as WG Chairpersons. They will ensure the free circulation of information among the various groups involved, follow up actions decided during meetings and establish activity reports. They will also participate to the executive board meetings. The Executive Board will meet twice a year whereas working groups will meet at least 4 times a year.

8.N3 - Table 5 –Management Structure of Activity DMD							
DMD EB (2 meetings per year) 16 Permanent Members: 8 WG leaders Invited Members: Representatives from JRA1 (LBT-DUSL), from N4 (DBD) and N6 (ENTApP)							
↓	↓	↓	↓	↓	↓	↓	↓
DMD WG CDC	DMD WG LX	DMD WG GeNaI	DMD WG AD	DMD WG BSNS	DMD WG HPMP	DMD WG AXION	DMD WG COMMON
Composition of each WG: About 10 to 15 members							

8.N4 Search on Double β Decay (DBD)

8.N4.1 Description and objectives of the activity

The overall objective is to co-ordinate the double beta decay community, enhancing thus the ability of the proponents to produce proposals for the next generation experiments.

The network activities are based on three work packages dedicated to the following topics:

- **WP1:** Coordination of DBD searches
- **WP2:** Bank of pure isotopes
- **WP3:** Collection and investigation of experimental inputs, needed for the calculation of nuclear matrix elements

Short description and specific objectives for each of the working groups are given in **Table 1**.

8.N4 -Table 1 – DBD Activities		
WP	Descriptive Title	Short description and specific objectives of the activity
1	Coordination of DBD searches	- Explore the possibility of using the same isotope with different techniques - Investigate the ultimate background of each technique Objective: Produce guidelines for improvements of current techniques
2	Bank of pure isotopes	- Produce data base of existing isotopes for DBD purposes - Contact and negotiations with Russian institutions on isotopes Objective: Creation of a bank of isotopes
3	Collection and investigation of experimental inputs, needed for the calculation of nuclear matrix elements	- Collection of experimental information related to DBD matrix elements - Coordination of theoretical calculations of DBD matrix elements - Determination of the sensitivity of different theoretical approaches to the inputs extracted from measurements - Provision of orientation for the experimental efforts Objective: Produce guidelines for dedicated experiments

8.N4.2 Participants

8.N4 - Table 2a - Participants			
#	Name	Short name	Role
2	Centre National de la Recherche Scientifique	CNRS	Low radioactivity, low temperature physics, cryogenics, low energy nuclear physics, enriched isotopes, calculation of nuclear matrix elements for DBD Working labs.: CENBG_Bordeaux, LPC_Caen, LAL_Orsay, IReS_Strasbourg. Participation in: WP1, WP2, WP3
3	Istituto Nazionale di Fisica Nucleare	INFN	Low temperature physics, cryogenics bolometry, purification of materials, electronics, set-ups for DBD experiments Working labs.: INFN_Firenze, INFN_Milano/Como, INFN_Legnaro, INFN_Gran Sasso. Participation in: WP1, WP2, WP3
4	Universidad de Zaragoza	UNIZAR	Low radioactivity, cosmogenic activation, underground experiments, DBD set-ups Participation in: WP1, WP2, WP3
6	Czech Technical University in Prague	CTU	Nuclear physics experiments. Participation in: WP2, WP3
8	University of Jyväskylä	JYU	Calculation of nuclear matrix elements for DBD. Participation in: WP3
9	Max-Planck Society for the advancement of Science, represented by Max-Planck-Institute for Nuclear Physics, Heidelberg	MPIK	Low energy nuclear physics, low radioactivity, conventional and liquid nitrogen dipped Ge-diodes. Participation in: WP1, WP2
11	Eberhard Karls Universität Tübingen	EKUT	Calculation of nuclear matrix elements for DBD. Participation in: WP3
15	Leiden University – LION Institute of Physics	MiniGRAIL	Low temperature physics, cryogenics, low mechanical noise set-ups. Participation in: WP1
16	Faculty of Mathematics, Physics & Informatics, Comenius University, Bratislava	FMFI-UK	Calculation of nuclear matrix elements for DBD, study of different mechanisms of the neutrinoless DBD. Participation in: WP3
20	University College London	UCL	Scintillators, calorimeters, data analysis. Participation in: WP1, WP2

8.N4 -Table 2b –Other entities foreseen to contribute to this activity (but not signatories to the contract)

Name	Role: Contribution to
Institute for Nuclear Research, Baksan Neutrino Observatory	WP2
University of California	WP1
University of South Carolina	WP1
Joint Institute for Nuclear Research	WP1, WP2
Idaho National Engineering and Environmental Laboratory	WP2
Institute for Theoretical and Experimental Physics	WP2
Mount Holyoke College	WP2
Yerevan Physical Institute	WP2

8.N4.3 Outline implementation plan for the full duration of the activity

8.N4 - Table 3 – 5 Years Execution Plan							
WP #	Descriptive Title		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1	Coordination of DBD searches	Tasks	- Discussions on the potentials of different techniques with the same isotope - Sensitivity of each technique to its ultimate background	- Database on different isotopes, as well as different techniques and related background issues	- Comparisons among different techniques and recommendations on the most promising ones	- Common working group with JRA2 on the R&D projects in relation with the N4 recommendations and follow-up of those R&D	- Common working groups with the other two work packages and with representatives of JRA2 to put forward recommendations for the next generation of experiments
		Milestones and Deliverables	- Preliminary report on techniques and background issues	- Database on isotopes - Final report on background issues	- Report on recommendations on the most appropriate techniques	- Report on interplay between N4 recommendations and JRA2	- White-book on DBD common to all work packages
2	Bank of pure isotopes	Tasks	- Formation of the Isotope Working Group - Contact Russian labs - Definition of a program for utilization of available isotopes - Selection of new interesting isotopes and discussion of enrichment and purification techniques	- Negotiations with Russian labs - Selection of new interesting isotopes and discussion of enrichment and purification techniques - Definition of isotopes for mass production	- Constitution of a data base of a Bank of Isotopes	- Comparisons of radiopurity results obtained by different methods and/or in different labs	- Common working groups with the other two work packages and with representatives of JRA2 to put forward recommendations for the next generation of experiments
		Milestones and Deliverables	- Report on the recommended program, first conclusions on isotope selection and contact with Russian labs	- Database on new isotopes - Results of negotiations with Russian labs	- Database on isotopes	- Report on radiopurity issues	- White-book on DBD common to all work packages

8.N4 - Table 3 – 5 Years Execution Plan							
WP #	Descriptive Title		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
3	Collection and investigation of experimental inputs, nuclear matrix elements	Tasks	<ul style="list-style-type: none"> - Establishment of the status of theoretical approaches - Definition of the calculations relevant to the next-generation experimental developments - Definition of an appropriate computational scheme to optimize the existing codes and/or identify more powerful computers 	<ul style="list-style-type: none"> - Collection of experimental information - Database of theoretical matrix elements 	<ul style="list-style-type: none"> - Common conclusions of the Year 2 working groups and isotope selection for new generation of experiments 	<ul style="list-style-type: none"> - Common working group with JRA2 on the R&D projects in relation with the N4 recommendations and follow-up of those R&D 	<ul style="list-style-type: none"> - Common working groups with the other two work packages and with representatives of JRA2 to put forward recommendations for the next generation of experiments
		Milestones and Deliverables	<ul style="list-style-type: none"> - First conclusions on theoretical and computational issues 	<ul style="list-style-type: none"> - Report on experimental and matrix element status 	<ul style="list-style-type: none"> - Report on conclusions on matrix element computation and selected isotopes 	<ul style="list-style-type: none"> - Report on interplay between N4 recommendations and JRA2 	<ul style="list-style-type: none"> - White-book on DBD common to all work packages

8.N4 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1: Coordination of DBD searches																				
Tasks: - Discussions on the potentials of different techniques with the same isotope - Sensitivity of each technique to its ultimate background																				
Deliverables: - Preliminary report on techniques and background issues																				
Tasks: - Database on different isotopes, as well as different techniques and related background issues																				
Deliverables: - Database on isotopes - Final report on background issues																				
Tasks: - Comparisons among different techniques and recommendations on the most promising ones																				
Deliverables: - Report on recommendations on the most appropriate techniques																				
Tasks: - Common working group with JRA2 on the R&D projects in relation with the N4 recommendations and follow up of those R&D																				
Deliverables: - Report on interplay between N4 recommendations and JRA2																				
Tasks: - Common working groups with the other two work packages and with representatives of JRA2 to put forward recommendations for next the generation of experiments																				

8.N4 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Deliverables: - White-book on DBD common to all work packages																				
WP 2 : Bank of pure isotopes																				
Tasks: - Formation of the Isotope Working Group - Contact Russian labs - Definition of a program for utilization of available isotopes - Start: Selection of new interesting isotopes and discussion of enrichment and Purification techniques																				
Deliverables: - Report on the recommended program, first conclusions on isotope selection and contact with Russian labs																				
Tasks: - Negotiations with Russian labs - End: Selection of new interesting isotopes and discussion of enrichment and Purification techniques - Definition of isotopes for mass production																				
Deliverables: - Database on new isotopes - Report on results of negotiations with Russian labs																				
Tasks: - Constitution of a data base of a Bank of Isotopes																				
Deliverables: - Database on isotopes																				
Tasks: - Comparisons of radiopurity results obtained by different methods and/or in different labs																				
Deliverables: - Report on radio purity issues																				

8.N4 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<p>Tasks:</p> <ul style="list-style-type: none"> - Common working groups with the other two work packages and with representatives of JRA2 to put forward recommendations for the next generation of experiments 																				
<p>Deliverables:</p> <ul style="list-style-type: none"> - White-book on DBD common to all work packages 																				
WP 3: Collection and investigation of experimental inputs, nuclear matrix elements																				
<p>Tasks:</p> <ul style="list-style-type: none"> - Establishment of the status of theoretical approaches - Definition of the calculations relevant to the next-generation experimental developments - Definition of an appropriate computational scheme to optimize the existing codes and/or identify more powerful computers 																				
<p>Deliverables:</p> <ul style="list-style-type: none"> - Report on first conclusions on theoretical and computational issues 																				
<p>Tasks:</p> <ul style="list-style-type: none"> - Collection of experimental information - Database of theoretical matrix elements 																				
<p>Deliverables:</p> <ul style="list-style-type: none"> - Report on experimental and matrix element status 																				
<p>Tasks:</p> <ul style="list-style-type: none"> - Common conclusions of the Year 2 working groups and isotope selection for new generation of experiments 																				
<p>Deliverables:</p> <ul style="list-style-type: none"> - Report on conclusions on matrix element computation and selected isotopes 																				
<p>Tasks:</p> <ul style="list-style-type: none"> - Common working group with JRA2 on the R&D projects in relation with the N4 recommendations and follow up of those R&D 																				

8.N4 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Deliverables: - Report on interplay between N4 recommendations and JRA2																				
Tasks: - Common working groups with the other two work packages and with representatives of JRA2 to put forward recommendations for the next generation of experiments																				
Deliverables: - White-book on DBD common to all work packages																				

8.N4.4 Expected outcome

A co-ordination among the existing European projects will be the first outcome of this networking activity. The second will be to prepare the choice for the next generation experiments within a European Observatory for DBD Project.

8.N4.5 Management

The structure of the management is outlined below in tabular form (**Table 5**). The Network Executive Board will have eight permanent members: The Network Leader, The Network Deputy Leader, the three Working Group leaders, and one representative from each of the main underground laboratories: Canfranc, Gran Sasso and LSM. The board will meet 3 times per year to discuss and orient the scientific policy of the Network and the distribution of funds.

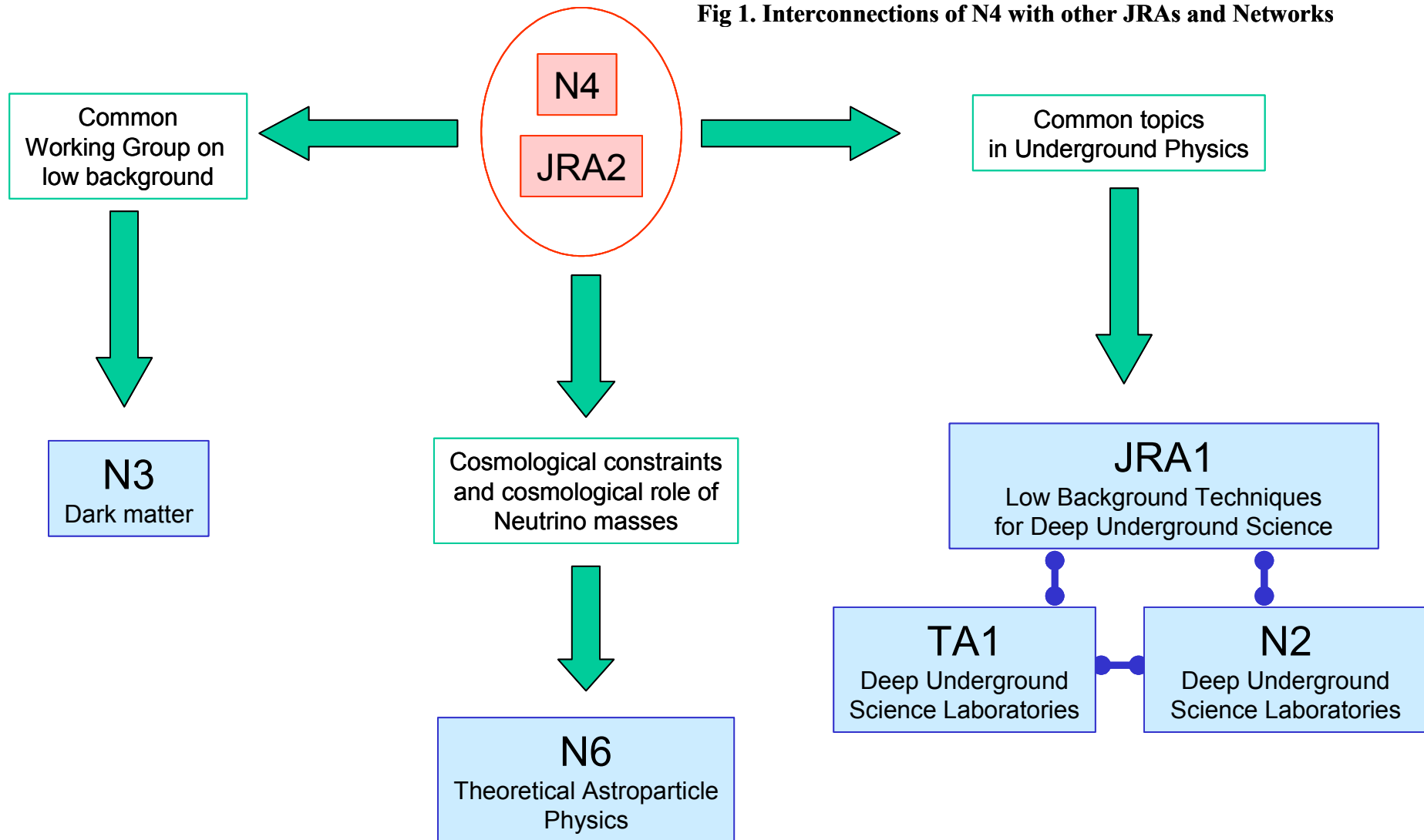
Each Working Group will have a chairperson whose functions include that of scientific leader and manager. The composition of the Working Group may vary during the execution of the project, but will be managed by the Working Group chairperson.

The main communication medium across the network will be the Web. A network Web-manager will support the general website from which it will be possible to access the web pages of each Working Group, allowing everyone to remain informed in as up-to-date a form as possible. There will be a plenary meeting of the network once a year where each Working Group will participate. The plenary meetings of the JRA2 and the DBD network will be merged. The minutes of all meetings will be available on the Web.

The interconnections with other JRAs and Networks are depicted in Fig.1.

8 - N4 - Table 5: Management Structure of Activity DBD		
DBD EB (2 meetings per year) 8 Members: Network Leader, Network Deputy Leader, 3 Work Packages Leaders and 1 representative per underground labs LNGS, LSM, LSC		
↓	↓	↓
DBD WP1 EB Leader: CNRS	DBD WP2 EB Leader: INFN-Milano	DBD WP3 EB Co-Leader: Univ Zaragoza Co-Leader: Univ Jyväskylä
Composition of each Executive Board: 3 Members: 1 Working Group leader; 2 Members from the corresponding working group		
↓	↓	↓
DBD WG1	DBD WG2	DBD WG3.
Composition of each Working Group: From 4 to 12 Members.		

Fig 1. Interconnections of N4 with other JRAs and Networks



8.N5 Gravitational Wave Antenna (GWA)

8.N5.1 Description and objectives of the activity

The objective of this network is to increase the level of European coordination in the field of gravitational wave research in order to maximise the return on the large investment already made, to enhance the performance of the existing detectors, and to prepare the future of this discipline in Europe. The network is expected to improve the exchange of information on subjects of common interest such as commissioning and operation of existing detectors, to foster the development of common methodologies for joint observations, and to support the elaboration of a common strategy for future gravitational wave detectors in Europe.

The network activities are based on three working groups dedicated to the following topics:

- **WP1:** Antenna commissioning and characterization
- **WP2:** Joint operation of antennas and network data analysis
- **WP3:** A European strategy for future antennas

A short description and specific objectives for each of the working groups are given in **Table 1**.

An annual general meeting of the N5 will be organised and the participation of young researchers will be encouraged and partly supported. A website will be set up to ensure the dissemination of expected results among the community.

8.N5 – Table 1 – GWA Activities		
WP	Descriptive Title	Short description and specific objectives of the activity
1	Antennas Commissioning and Characterization	<p>Coordination of GEO and Virgo detectors during commissioning and characterization of detectors, as well as their operation.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To speed-up the commissioning and the characterization of the GEO and Virgo detectors by means of a deeper collaboration between the two teams. - To develop common methods for the characterization of laser interferometer gravitational wave detectors to be applied to the GEO and Virgo detectors - To provide inputs for establishing priorities in the short term improvement of existing interferometer type detectors on the base of the characterization of the Virgo and GEO detectors.
2	Joint Operation of Antennas and Network Data Analysis	<p>Promote the required coordination among the European operating detectors for specific classes of gravitational wave signals.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To ensure the coordination among the European gravitational wave detectors to perform joint observation of specific classes of astrophysical sources. - To define the technical set-ups of data analysis pipelines for the network of detectors. - To define programs of joint observation with gamma, neutrino and optical telescopes. - To support the dissemination of the results of the gravitational wave searches (either detections or upper limits). - To provide the comparison among results obtained by different observation for the same signal class.
3	A European Strategy for Future Antennas	<p>Plan the enhancement of the performances of the European gravitational wave detectors and to organise their collective operation.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To determine scientific objectives that could be attained through short term improvements, optimisation and association of detectors now available in Europe. - To establish the bases for integrating existing and future gravitational wave detectors in a coherent network. - To draft a plan for a European network of gravitational wave detectors at the 2010 horizon.

8.N5.2 Participants

8.N5 – Table 2a – Participants			
#	Name	Short name	Role
2	Centre National de la Recherche Scientifique	CNRS	Construction and operation of the VIRGO detector, data analysis, R&D for next generation interferometer detectors. Participation in WP1: LAPP_Annecy, IPN_Lyon, OCA_Nice, LAL_Orsay, ESPCI_Paris WP2: LAPP_Annecy, OCA_Nice, LAL_Orsay WP3: LAPP_Annecy, IPN_Lyon, OCA_Nice, LAL_Orsay, ESPCI_Paris, LKB_Paris
3	Istituto Nazionale di Fisica Nucleare	INFN	Construction and operation of the VIRGO, AURIGA, EXPLORER and NAUTILUS detectors, data analysis, R&D for next generation interferometer and resonant detectors. Participation in WP1: Firenze, Frascati, Napoli, Salerno, Pisa, Roma1 WP2: INFN_Ferrara, INFN_Firenze, INFN_Frascati, INFN_Legnaro, INFN_Napoli, INFN_Salerno, INFN_Padova, INFN_Perugia, INFN_Pisa, INFN_Roma1, INFN_Roma2, INFN_Trento WP3: Ferrara, Firenze, Frascati, Genova, Legnaro, Napoli, Salerno, Padova, Perugia, Pisa, Roma1, Roma2, Trento
9	Max-Planck Society for the Advancement of Science, represented by Max-Planck-Institute for Nuclear Physics, Heidelberg	MPIK	Construction and operation of the GEO detector, R&D for next generation interferometer detectors Theoretical research in gravitational wave emission process Participation in WP1: MPI-Golm WP2: MPI-Golm, MPI-Hanover WP3: MPI-Golm, MPI-Hanover, MPI-Garching
13	Istituto di Fotonica e Nanotecnologie-CNR-Sezione di Trento	IFN	Construction and operation of the AURIGA detector, data analysis, R&D for next generation resonant detectors. Participation in WP2: Roma, Trento WP3: Roma, Trento
14	European Gravitational Observatory, Cascina	EGO	Construction and operation of the VIRGO detector, data analysis, R&D for next generation gravitational wave detectors. Participation in WP1, WP2 and WP3.
15	Leiden University – LION Institute of Physics	MiniGRAIL	Construction and operation of the MiniGRAIL detector, data analysis, R&D for next generation resonant and interferometer detectors. Participation in WP2 and WP3.
19	University of Glasgow	U-Glasgow	Construction and operation of the GEO detector, data analysis, R&D for next generation interferometer detectors. Participation in WP1, WP2 and WP3.

8.N5 – Table 2b – Other entities foreseen to contribute to this activity (but not signatories to the contract)	
Name	Role: Contribution to
Laser Zentrum Hannover	WP1, WP3
Friedrich-Schiller University	WP3
University of Birmingham	WP1, WP2, WP3
Cardiff University	WP1, WP2, WP3
Imperial college	WP3
University of Barcelona	WP2, WP3
Universitat de les Illes Balears	WP1, WP2
Institute of Mathematics, Polish Academy of Sciences	WP2

8.N5.3 Outline implementation plan for the full duration of the activity

WP #	Descriptive Title		8.N5 – Table 3 – 5 Years Execution Plan				
			YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1	Antennas commissioning and characterization	Tasks	- Working group setup - GEO/VIRGO noise sources comparison	- GEO/VIRGO joint noise characterization - Development of common characterization algorithms	- GEO/VIRGO joint noise characterization - Implementation of common characterization algorithms	- GEO/VIRGO joint noise characterization	- Writing of final report
		Milestones and Deliverables	- Annual report	- Recommendation report for short term improvements - Annual report	- Annual report	- Recommendation report for long term improvements - Annual report	- Final report
2	Joint operation of antennas and network data analysis	Tasks	- Working group set-up - Comparative study on the compatibility and expected significance of the operating European detectors for joint observations - Definition of the general aspects of technical set-ups for data formats and software development	- Proposal for joint observations for all classes of target signals (definition of the compatibility and expected significance of available detectors; definition of the data analysis strategy; proposed plan of the first joint observation) - Definition of the technical set-ups for joint observation for all classes of target signals (data exchange, data analysis procedures)	- Comparison of the results of the first joint observations performed with previous ones and other independent searches - Comparative study on alternative data analysis strategies	- Revision of proposals for joint observations for all classes of target signals - Revisions of the technical set-ups for joint observation for all classes of target signals - Comparison of the results of the joint observations performed with previous ones and other independent searches	- Comparison of the results of the joint observations performed with previous ones and other independent searches - Writing of final report

WP #	Descriptive Title		8.N5 – Table 3 – 5 Years Execution Plan				
			YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
	Joint operation of antennas and network data analysis	Milestones and Deliverables	- Annual report on the activity	- Annual report on the activity - Recommendation report on the planning of joint observations for all signal classes, including the technical proposals for the related data exchange and analysis	- Annual report on the activity, including status, results and comparative analysis of the first joint observations	- Annual report on the activity, including status, results and comparative analysis of the joint observations - Revision of recommendation report on the planning of joint observations for all signal classes, including the technical proposals for the related data exchange and analysis	- Report on the status, results and comparative analysis of the joint observations performed - Final report
3	A European strategy for future antennas	Tasks	- Working group setup - Definition of a list of possible short-term improvements	- Evaluation of proposed short term improvements - Preparation of a document describing a proposition for short term improvements.	- Presentation of short term plan to the funding agencies - Definition of realistic objectives for new generation antennas - Definition of requirements and needs for possible next generation antennas	- Evaluation of compatibility among proposed long-term scenarios - Draft of a credible plan for a European network of gravitational waves detectors at the 2012 horizon	- Finalization of the ‘White book’ - Discussion of ‘White book’ with funding agencies - Writing of final report
		Milestones and Deliverables	- Preliminary report describing possible scenarios for short term improvements	- Report on short term plan setting priorities and guidelines for the operation and improvement of existing detectors in the next few years	- Preliminary report describing possible scenarios for the European gravitational wave community over a 10-year period	- Draft of the ‘White book’ defining the gravitational wave community’s strategic objectives over a 10-year period	- ‘White book’ - Final report

8.N5 – Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1: Antennas commissioning and characterization																				
Tasks:																				
Working group and WEB site set-up																				
Analysis and comparison of GEO and VIRGO noise performances																				
Annual VIRGO/GEO joint characterization report																				
Preparation of recommendations report for short term improvements																				
Preparation of recommendations for long-term improvements																				
Writing of final report																				
Deliverables:																				
Annual Report																				
WP 2: Joint operation of antennas and network data analysis																				
Tasks:																				
Working group and WEB site set-up																				
Feasibility study of joint operation of detectors for the different classes of target signals																				
Elaboration of the data exchange and analysis strategies for the different classes of signals																				
Support to the implementation of the joint data analysis for the different classes of target signals																				
Comparative study of the results of the joint observations																				
Reports on the activity, on the recommended planning and technical set-ups of joint observations and on the results obtained																				
Writing of final report																				
Deliverables:																				
Annual Report																				

WP 3: A European strategy for future antennas																			
Tasks:																			
Working group and WEB site set-up																			
Elaboration of short term improvement plan																			
Presentation of short term plan to institutions																			
Elaboration of 'White book'																			
Presentation of 'White book' to institutions																			
Writing of final report																			
Deliverables:																			
Annual Report																			

8.N5.4 Expected outcome

The results of Working Group 1 are expected to allow establishing a coordinated collaboration among the Anglo-German team working at the commissioning of GEO and the French-Italian team working at the commissioning of the Virgo detector. This collaboration will speed up the commissioning of the detectors and will allow testing similar characterization algorithms on the two detectors. Apart from the annual reports, the two teams will provide recommendations for short and long term improvements based on the detector commissioning results.

The prospects of setting relevant astrophysical results (based on signal detection or upper limits) rely on the achieved degree of coordination of the community, given that the operation of many detectors as a network is required. Working Group 2 is expected to establish the necessary coordination among the groups involved in the operating detectors in order to perform joint observations and the related data analysis. Recommendations for the planning of joint observations and the technical aspects involved in the data exchange and analysis will be provided. In addition, the Working Group 2 will provide comparative studies on the achieved results on the observation and on the relevance of the participating detectors.

Working Group 3 is focused on producing a plan setting up priorities and objectives for the existing and future detectors and defining a coherent global strategy around which the European gravitational waves community could unite and on pulling together their efforts, expertise and capabilities towards a common objective.

The development of a European research community for gravitational waves is also expected to contribute to establishing more balanced and productive collaborations with non European communities (USA, Japan).

8.N5.5 Management

The GWA Executive Board will meet once or twice a year.

Each working group (WG) will be composed of at least 10 experts representing the main research areas involved in the activity. Each WG will elect a leader and a deputy acting as WG Chairpersons. Working Groups Leaders and deputies will ensure the free circulation of information among the various groups involved, follow up actions decided during meetings and establish activity reports. They will also participate in the executive board meetings. The Working Groups will meet at least 4 times a year.

8.N5 – Table 5 –Management Structure of Activity GWA		
GWA EB (2 meetings per year) 10 Permanent Members: 2 representatives of the Virgo collaboration, 2 representatives of the GEO collaboration, 2 representatives of the resonant antennas, 1 representative of the LISA project Leaders of the 3 working groups Invited Members: EGO Director, Representatives from JRA3 and N6		
↓	↓	↓
GWA WG1	GWA WG2	GWA WG3
Composition of each Working Group: From 8 to 15 Members		

8.N6 Theoretical Astroparticle Physics (ENTApP)

8.N6.1 Description and objectives of the activity

The objective of this network is to increase the level of European coordination and integration theoretical astroparticle physics, with a special focus on areas of experimental programs with high priority within ILIAS. These include neutrinoless double beta decay, dark matter, and gravitational wave research and related activities.

ENTApP is designed to increase the coherence in the field, to improve the exchange of information and expertise among theorists, and to foster links with relevant experimental groups in Europe on subjects of common interest such as enhancing experimental capabilities potential, planning future programs and developing joint strategies for analyzing experimental data in terms of underlying theoretical models.

In order to pave the way for the future of theoretical astroparticle physics in Europe, the network will outline strategic goals for the field and set up a better structured co-ordination of the research activity in this field. In addition, activities designed to attracting and training new generations of young researchers and students are included.

The network activity is based on three work packages dedicated to the following topics:

- **WP1:** Neutrinoless double beta decay and related studies (DBD)
- **WP2:** Dark matter and related studies (DM)
- **WP3:** Gravitational waves and related studies (GW)

A short description of the activities and objectives for each of the working groups are given in **Table N6-1**.

Two following additional activities will be common to all work packages:

i) Visitors programme: As one means to implement the goals and objectives of the Work Packages, and in particular to start new collaborations in connection with related activities within ILIAS, small-scale collaborative visits (one to three weeks) of individual researchers or small teams are foreseen. The Visitors Programme will be organised through related calls that will be issued periodically. The members of the relevant Selection Panels will be nominated by the **Board of Representatives** (see section 8.N6.5 ‘Management structure’). Visitors will be selected on a competitive basis.

ii) Training sessions: They are meant to provide an organized way of sharing expertise, as well as attracting and training new generations of young researchers and students involved in ILIAS. These sessions will address basically new potential users of the deep underground laboratories and the gravitational waves infrastructures. It is envisaged that these sessions could involve teams of around 10-20 participants and last two to three days. It is foreseen to hold these sessions in conjunction with specialised workshops in order to improve the interaction of the trainees with the experts.

The Training sessions will be organized in parallel to other relevant international events (e.g. conferences, workshops), in order to reduce the financial cost and to benefit from the presence of the world experts in various topics of interest.

8.N6 - Table 1 –ENTApP Activities		
WP	Descriptive Title	Short description and specific
1	DBD	<p>Neutrinoless double beta decay strongly relates to many other aspects, such as neutrino masses and mixings and absolute neutrino masses from cosmology.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To coordinate the theoretical research on double beta decay currently carried out by many European groups, so as to generate new collaborations, and to improve mobility of people and exchange of ideas within this Working Group. - To promote research on those topics which are likely to have a high discovery potential in the next decade and a strong impact in neutrino physics, such as neutrinoless double beta decay, and absolute neutrino masses from cosmology. - To facilitate exchange of information and possible collaborations with other working groups in this network, as well as with experimental networks involved in the same topics.
2	DM	<p>WP DM addresses one of the most challenging issues in astroparticle physics</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To develop coordination among European theory groups working in the area of dark matter and related areas of cosmology and particle physics. - To establish focus groups whose role will be to work out consensus on benchmark particle physics and astrophysics scenarios as a basis for further investigation. - To develop a coherent underlying framework for dark matter physics. - To support the development of joint theory-experimental activities whose purpose will be to perform detailed studies of experimental signatures for the set of benchmark models in the context of currently operating and planned detectors. - To foster the flow of information from related areas where progress may have a strong impact on the area of dark matter studies.
3	GW	<p>Gravitational waves are predicted to exist in all well-established theoretical frameworks. Current experimental sensitivity is approaching the level at which a signal from known astrophysical source can be expected.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - To coordinate current and new programs of analytical and numerical studies of potential sources of gravitational radiation, particularly those involving neutron stars and black holes. - To work out theoretical prediction templates, to be used by experimental teams for a better signal/noise separation in upcoming detectors of gravitational waves. - To develop links with the teams involved in the related activity N5. - To support further integration of the theory groups involved in gravitational wave research with other European centres of excellence.

8.N6.2 Participants

8.N6 - Table 2a – Participants			
#	Name	Short name	Role
1	Commissariat à l’Energie Atomique	CEA	Neutrino Physics, Dark Matter, Early Universe & Dark Energy, Cosmic Microwave Background & Cosmological Structure, Astrophysical High Energy Sources Working lab.: Service de Physique Theorique Participation in WP1, WP2
2	Centre National de la Recherche Scientifique	CNRS	Neutrino Physics, Dark Matter, Early Universe & Dark Energy, Cosmic Microwave Background & Cosmological Structure, Astrophysical High Energy Sources Working labs.: APC_Paris, IAP_Paris, IPN_Lyon, LAPTH_Annecy, LPM-GAM_Montpellier, LPNHE_Paris, LPT_Orsay, LPTENS_Paris, LPTHE_Paris, LUTH_Paris-Meudon, OCA_Nice Participation in WP1, WP2 and WP3
3	Istituto Nazionale di Fisica Nucleare	INFN	Neutrino Physics, Dark Matter, Early Universe & Dark Energy, Cosmic Microwave Background & Cosmological Structure, Astrophysical High Energy Sources Working labs.: INFN_Bari, INFN_Cagliari-Ferrara, ICTP_Trieste, INFN_Lab. Nazionali Gran Sasso, INFN_L’Aquila, INFN_Lecce, INFN-Milano, INFN_Milano-Bicocca, INFN-Napoli, INFN_Padova, INFN_Pavia, INFN_Pisa, INFN-Roma 1, INFN_Roma 2, INFN_Salerno, INFN_Torino, Trieste, SISSA, INFN and Astron. Dept. Participation in WP1, WP2 and WP3
4	Universidad de Zaragoza	UNIZAR	Neutrino Physics, Early Universe & Dark Energy, Cosmic Microwave Background & Cosmological Structure, Astrophysical High Energy Sources Participation in WP1, WP2 and WP3
5	University of Sheffield	USFD	Neutrino Physics, Dark Matter, Early Universe & Dark Energy, Cosmic Microwave Background & Cosmological Structure, Astrophysical High Energy Sources Participation in WP1, WP2
7	Univ. of Southern Denmark, Odense	SDU	Neutrino Physics, Cosmic Microwave Background & Cosmological Structure Participation in WP1 and WP2
8	University of Jyväskylä	JYU	Neutrino Physics, Early Universe & Dark Energy Participation in WP1 and WP2
9	Max-Planck Society for the Advancement of Science, represented by Max-Planck-Institute for Nuclear Physics, Heidelberg	MPIK	Neutrino Physics, Early Universe and Dark Energy, Dark Matter, Cosmic Microwave Background & Cosmological Structure, Astrophysical High Energy Sources Working labs.: MPI-Munich, MPI-Garching, MPI-Bonn Participation in: WP1 and WP2
10	Technische Universität München	TUM	Neutrino Physics, Dark Matter, Astrophysical High Energy Sources Participation in WP1, WP2
12	Aristotle University of Thessaloniki	AUTH	Neutrino Physics, Early Universe & Dark Energy, Astrophysical High Energy Sources Participation in WP1, WP2, WP3
15	Leiden University – LION Institute of Physics	MiniGRAIL	Dark Matter, Early Universe & Dark Energy Participation in WP2
17	European Organisation for Nuclear Research	CERN	Neutrino Physics, Dark Matter, Early Universe & Dark Energy, Cosmic Microwave Background & Cosmological Structure, Astrophysical High Energy Sources Participation in WP1, WP2 and WP3

8.N6 - Table 2b – Other entities foreseen to contribute to this activity (but not signatories to the contract)	
Name	Role: Contribution to
Universität Wien	WP1, WP2
Aharus University	WP1, WP2
Nordic Institute of Theoretical Physics	WP1, WP2
Helsinki University	WP1, WP2, WP3
Astrophysikalisches Institut	WP3
Deutsche Elektronen-Synchrotron (DESY)	WP1, WP2, WP3
Heidelberg University	WP2
Inst. Theor. Physik & Astrophysik	WP1, WP2
Bonn University	WP2
Wuppertal University	WP2
University of Cambridge	WP1, WP2
University of Durham	WP1, WP2
Imperial College	WP1, WP2
Lancaster University	WP2, WP3
University of Oxford	WP1, WP2, WP3
University of Southampton	WP1, WP2
University of Sussex	WP1, WP2, WP3
Athens University	WP1, WP2
Ioannina University	WP1, WP2
National Institute for Nuclear Physics and High Energy Physics	WP1, WP2, WP3
University of Amsterdam	WP1, WP2, WP3
Free University of Amsterdam	WP1
University of Groningen	WP2
University of Utrecht	WP1, WP2
Instituto Superior Técnico	WP1, WP2
University of Barcelona	WP1, WP2
Universidad de Madrid	WP1, WP2
Universidad de Santiago de Compostela	WP1, WP2
Universidad de Valencia	WP1, WP2
Stockholm University	WP1, WP2
Bergen University	WP1, WP2
Oslo University	WP1, WP2
University Cracow	WP1, WP2
Jagiellonian University	WP1, WP2
Warsaw University	WP1, WP2
Geneva University	WP2 and WP3
Lausanne University	WP1, WP2, WP3

8.N6.3 Outline implementation plan for the full duration of the activity

8.N6 - Table 3 – 5 Years Execution Plan						
WP		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1 DBD	Tasks	<ul style="list-style-type: none"> - Setup DBD website - Initial meeting of the work package. - Setting up of working group. - Call for applications for visitor's program. - Training session (see Joint activities below). 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Final meeting of the work package. - Visitor's program.
	Milestones and Deliverables	<ul style="list-style-type: none"> - DBD Website - Contribution to Annual Report 	<ul style="list-style-type: none"> - Minutes of meetings - Report on visitors program. 	<ul style="list-style-type: none"> - Minutes of meetings - Report on visitors program 	<ul style="list-style-type: none"> - Minutes of meetings - Report on visitors program 	<ul style="list-style-type: none"> - Minutes of meetings - Report on visitors program - Final Report
2 DM	Tasks	<ul style="list-style-type: none"> - Setup DM website - Initial meeting of the Work package. - Setting up of working group. - Call for applications for visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Final meeting of the work package. - Visitor's program.
	Milestones and Deliverables	<ul style="list-style-type: none"> - DM Website. - Contribution to Annual Report 	<ul style="list-style-type: none"> - Minutes of meetings. - Report on visitors program 	<ul style="list-style-type: none"> - Minutes of meetings. - Report on visitors program 	<ul style="list-style-type: none"> - Minutes of meeting. - Report on visitors program 	<ul style="list-style-type: none"> - Minutes of meetings. - Report on visitors program
3 GW	Tasks	<ul style="list-style-type: none"> - Setup GW website - Initial meeting of the work package. - Setting up of working group. - Call for applications for visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Annual meeting of the work package. - Visitor's program. 	<ul style="list-style-type: none"> - Two small-scale meetings of the working group. - Final meeting of the work package. - Visitor's program.

8.N6 - Table 3 – 5 Years Execution Plan						
WP		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
	Milestones and Deliverables	- GW Website - Contribution to Annual Report	- Minutes of meetings. - Report on visitors program.	- Minutes of meetings. - Report on visitors program	- Minutes of meetings. - Report on visitors program	- Minutes of meetings. - Report on visitors program
Common to all WPs	Tasks	Annual meeting of the Network - Training session	- Annual meeting of the Network - Training session	- Annual meeting of the Network	- Annual meeting of the Network - Training session	- Annual meeting of the Network
	Milestones and Deliverables	- Minutes of the Annual meeting - Proceedings of the Training session	- Minutes of the Annual meeting - Proceedings of the Training session	- Minutes of the Annual meeting	- Minutes of the Annual meeting - Proceedings of the Training session	- Minutes of the Annual meeting

8.N6 - Table 4 – Outline Implementation Plan

Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1: Neutrinoless Double Beta Decay and Related Studies																				
Tasks:																				
Setup DBD website	■	■	■	■					■	■	■	■					■	■	■	■
Initial meeting of the work package	■	■	■	■					■	■	■	■					■	■	■	■
Setting up of working group	■	■	■	■					■	■	■	■					■	■	■	■
Call for applications for visitor's program	■	■	■	■					■	■	■	■					■	■	■	■
Two small-scale meetings of the working group	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Annual meeting of the work package	■	■	■	■					■	■	■	■					■	■	■	■
Visitor's program	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Deliverables:																				
DBD Website	■	■	■	■					■	■	■	■					■	■	■	■
Minutes of meetings	■	■	■	■					■	■	■	■					■	■	■	■
Report on visitors program	■	■	■	■					■	■	■	■					■	■	■	■
WP 2: Dark Matter and Related Studies																				
Tasks:																				
Setup DM website	■	■	■	■					■	■	■	■					■	■	■	■
Initial meeting of the work package	■	■	■	■					■	■	■	■					■	■	■	■

8.N6 - Table 4 – Outline Implementation Plan

Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Setting up of working group																				
Call for applications for visitor's program																				
Two small-scale meetings of the working group																				
Annual meeting of the work package																				
Visitor's program																				
<u>Deliverables:</u>																				
DM Website																				
Minutes of meetings																				
Report on visitors program																				
WP 3: Gravitational Waves and Related Studies																				
<u>Tasks:</u>																				
Setup GW website																				
Initial meeting of the work package																				
Setting up of working group																				
Call for applications for visitor's program																				
Two small-scale meetings of the working group																				
Annual meeting of the work package																				
Visitor's program																				

8.N6 - Table 4 – Outline Implementation Plan

	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Tasks and Deliverables	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Deliverables:																				
DM Website																				
Minutes of meetings																				
Report on visitors program																				
Common to all WGs																				
Tasks:																				
Annual meeting of the Network																				
Training session																				
Deliverables:																				
Annual Report																				
Proceedings of Training session																				

8.N6.4 Expected outcome

In addition to the anticipated outcome of the working packages as described above, ENTApP is expected to have further impact, as outlined below:

- An underlying framework for relating the objectives of Work Packages 1-3 among themselves and with other strictly connected research activities, such as: Early universe and dark energy, CMB and cosmological structures, astrophysical high-energy sources.
- Links established with other groups not involved in ILIAS *via* “Working Groups” bringing together European experts on each “Work Package” topic.
- Draft of a strategic plan for European astroparticle theory for the next decade, embedding not only the three main activities of WP1-WP3, but also the above mentioned connected activities, due to the creation of a think tank of experts of different backgrounds.
- A short-term plan setting priorities and guidelines for the European astroparticle theory over the next few years.
- A strategic plan outlining long-term goal of the community for the next decade.

8.N6.5 Management

In order to accomplish the objectives defined above, the network has a well-defined structure of management. ENTApP will be led by a **Board of Representatives** from seven largest communities in theoretical astroparticle physics and chaired by a network co-ordinator and a deputy co-ordinator. These will be elected from among the members of the Board of Representatives every two years.

Each WG will elect a leader and a deputy acting as WG chairpersons. The leaders and deputies will monitor the execution of assumed plans of action, ensure the free circulation of information among the various groups involved, follow up actions decided during meetings and establish activity reports. WG leaders will participate in the meetings of the Board of Representatives. The Board will meet twice a year whereas working groups will meet at least two times a year.

8.N6 - Table 5 – Management Structure of Activity ENTApP		
ENTApP Board of Representatives (2 meetings per year) 7 Permanent Members Invited Members: Representatives from N3, N4 and N5, JRA1, JRA2, JRA3 Leaders of the 3 Working Groups		
↓	↓	↓
ENTApP WG1	ENTApP WG2	ENTApP WG3
Composition of each Working Group: From 10 to 20 members		

8.TA1 Transnational Access – Deep Underground Science Laboratories (TA-DUSL)

Under this *contract*, access for *user groups* will be provided to the *infrastructures* indicated in the table below. This table gives the minimum quantity of access to be provided by each infrastructure and the corresponding estimated number of users and user groups:

Implementation Plan for specific activities aiming to provide transnational access											
Participant n°	Organisation short name	Short name of the Infrastructure	Installation (s)		Country code of operator or “INO” for International Organisations	Cost model used for Access (UF / AC)	Unit cost (in €) (only for UF contractors)	Unit of access	For the whole duration of the project		
			Number (s)	Short name(s)					Minimum quantity of access to be provided	Estimated number of users	Estimated number of user groups
1	CEA	EU-DUSL/CEA	1	LSM	FR	UF	99	user-day	250	10	5
2	CNRS	EU-DUSL/CNRS	1	LSM	FR	UF	182	user-day	250	5	3
3	INFN	EU-DUSL/INFN	1	LNGS	IT	AC	-	user-day	1500	50	25
4	UNIZAR	EU-DUSL/UNIZAR	1	LSC	ES	AC	-	user-day	250	10	5
5	USFD	EU-DUSL/USFD	1	IUS	GB	AC	-	user-day	250	10	5

The unit(s) of access shown in the above table is(are) defined as follows:

One **User-Day** = one day spent by a user (single person) at one of the four infrastructures (“Deep Underground Laboratories”) to carry out a given project.

The time of each **User-Day** will be spent by the user for:

- Test/installation/operation of detectors or apparatus provided by the user's group inside the underground infrastructure in order to carry on a given project. In this case, the facility used is the underground space itself with all the needed supports. The users bring in all appropriate detectors, and the relevant Underground Lab provides an ensemble of adequate pre-exciting facilities, such as shielding, cryogenic equipment, chemistry lab, electronics, and computer.
- Activity or data taking at one pre-existing facility of one of the labs, used to carry on the work defined in the project.

On the average, a user-day is expected to mean at least about 7 hours of work.

Experiments to be conducted under the Transnational Access activity may take longer than 3 months due to the nature of the measurements and the complexity of the set-up. Therefore access required by a user group may exceed 3 months. With reference to Article 6.7 of Annex III, each particular user within a given user group may be allowed access for a total period of up to 90 user-days, if necessary and justified, without prior written approval of the Commission.

8.R1 Low Background Techniques for Deep Underground Science (LBT-DUSL)

8.R1.1 Description and objectives of the activity

The sensitivity of experiments searching for rare event physics is dictated to a large extent by the background level achieved. Thus, it is imperative to carefully study the background, determining its nature and location, in order to develop strategies leading to its rejection. That goes in parallel with the development of state-of-the-art ultra-low background techniques for producing and measuring radio-pure materials, and is a common issue in all searches in Neutrino Physics and Astroparticle Physics.

The underground laboratories have, as their main objective, to provide the conditions needed for such low background experiments, i.e. a deep underground site to avoid cosmic radiation and the provision of the most advanced technologies to deal with all sources of background and drive them to their lowest level.

The main **objective** of activity LBT-DUSL is to identify and measure the different backgrounds (intrinsic, induced and environmental) contributing to a given experiment, and to design methods and techniques (shielding, vetoes, and identification and discrimination mechanisms) to suppress them. For that purpose a comprehensive R&D program on the improvement and implementation of ultra-low background techniques will be carried out cooperatively in the four European Underground Laboratories: Laboratori Nazionali del Gran Sasso (LNGS-Italy), Laboratorio Subterráneo de Canfranc (LSC-Spain), Laboratoire Souterrain de Modane (LSM-France) and Boulby Underground Lab (IUS-UK). This research will also benefit from the collaboration established with the teams of the experiments being performed in the various Underground Laboratories and, in particular with the researchers of the Networks N3 (DMD), N4 (DBD) and that the Joint Research Activity JRA2 (IDEA).

Projects for new Ultra-Low Background Facilities (ULBF) in the Deep Underground Laboratories

LNGS - New ULBF, which will be installed in LNGS, include:

- A new multipurpose Ultra-low Background Facility based on HP-Ge and scintillation detectors. The new counting facility aims at increasing the potential of the existing Germanium detector laboratory at LNGS by adding well-type detectors and new Ge-detectors built according to the most up-to-date technology. Moreover, in the past few years the need for multidisciplinary research has become evident, and this will be implemented with this upgrade. The new facility includes plans for doing radio dating in ultra-low-background conditions, developing at the same time well-known standard techniques towards innovative methods of measurement. In addition, ¹⁴C- and ³H-dating will be addressed with this new facility, including also XRF techniques, which will be of great interest to geologists, archaeologists and environmental scientists. Moreover, collaborations with space science are possible, giving the opportunity to measure very small samples with dedicated detectors. The new low background counting facility will be located underground in a prefabricated building. The preparation of dating samples will be done outside in the chemical labs of the LNGS.
- An ultra-low background facility for the measurement of extremely low radioactivity samples with gas counters. Existing equipment and techniques presently used by the solar neutrino experiments in LNGS will be enlarged and upgraded to become a facility of the Lab. The new facility will be a unique resource available for measuring ultra-low radioactivity samples (at the level of a few atoms) with gas counters (e.g., it is possible to measure concentrations of Rn of the order of $\mu\text{Bq}/\text{m}^3$) eventually coupled with scintillator detectors. A new laboratory specially equipped for radiochemical manipulation of ultra-low radioactivity samples will be installed to support the facility.
- An (active+passive) shielded ultra-low background facility for the test of liquid scintillator samples and other materials and detectors in an extremely low background environment. A facility in LNGS presently used by the LENS experiment for its pilot phase (LLBF) will be upgraded to become a multi-purpose facility. LLBF consists presently of a massive high purity shielding of Polyethylene /Pb/Steel/Cooper including a shielded volume of several m^3 in controlled atmosphere. This will be a unique facility for testing ultra-low materials (in particular liquid scintillators, detectors, or parts of detectors).

LSC - New ULBF, which will be installed in LSC, include:

- An underground facility for electroforming copper and production of pure lead bricks will be available at LSC in 2005. The objective is to produce underground the purest copper free from cosmogenic activated radioimpurities (copper is an essential material ingredient in most component detectors both cryo and non-cryogenic), needed for ultra low radiopurity background experiments. In the new Canfranc (enlarged) facility, a set of clean rooms of class 100 to 1000 (totalling ~80-100 m²) will be installed. In these and in an adjacent zone, an electroplating facility to fabricate high-purity copper detector components will be used. A mechanical workshop to machine the electroformed pieces will be established nearby. The copper components of low background detectors will be electroformed from an ultrapure CuSO₄ solution onto polished stainless-steel mandrels.
- A small room in the mechanical workshop sector of the new Canfranc will be dedicated to the making of lead shielding. Archaeological lead (and other old lead) will be melted (two-three times for cleaning up of impurities) in a pure inert gas atmosphere in a special tungstate crucible. The resulting pure lead will be melted again into bricks (or other forms as required) and machined according, following the technique followed successfully by the Zaragoza group along more than ten years.
- A prototype underground facility for growth of detector crystals will be established, this being the ultimate strategy for avoiding the worrisome cosmogenic activation of material components.

LSM - New ULBF, which will be installed in LSM, include:

- **New generation Radon facilities:** a specific R&D program at LSM will be carried out on the testing and installation of new equipment for Radon measuring and removal from the air, which could later become a standard for all the underground labs. The new prototypes will include first of all a Radon Precision Measuring Facility (RPMF), comprising two very sensitive Silicon radon detectors optimised to measure Radon contaminations down to few mBq per cubic meter. A second prototype (Radon from Air Removing Equipment, RARE) will be designed with the aim of developing an air purification system capable of reducing its Radon contamination from several Bqs/m³ to few mBqs/m³, and maintaining this purity level in large experimental volumes. Cooperation with industry will be actively pursued.
- A Radiochemical installation for Uranium contamination Measurements in materials (RUM). A number of experiments are sensitive to neutrons emitted by Uranium (spontaneous fission) present as a contamination in various materials and in particular in lead, usually employed as a shielding against gammas from radioactivity. A radiochemical technique allowing a Uranium activity determination much better than with gamma spectroscopy (better than a mBq/kg sensitivity level) will be developed. This requires chemical equipment and reagents of extra-pure quality.
- A large upgraded Ge detector ULBF, including:
 - (1) Cryo-generators for Ge detectors, at LN₂ temperature: the project is to replace LN₂ as cooling system for the Ge detectors. The reasons for that are related to safety (risk for persons in case of LN₂ rapid evaporation), but also to transportation through the tunnel (rather complicated and time-consuming), and to efficiency in the distribution of Nitrogen in the 14 Germanium installations (time-consuming and dirty job).
 - (2) New very low background Ge detectors: R&D will be carried out to decrease the background of the present Ge detectors by a factor 10, by means of a more rigorous selection of all the installation components. This R&D is mandatory for most of the future use of these Ge detectors as test benches or for dating measurements and environment study and monitoring.
 - (3) New Ge detector for low-energy gammas: R&D will be carried out with the aim of reaching a good sensitivity for γ 's below 30 keV. The reason for that is the possibility to improve the sample selection for experiments sensitive on these low energy regions (e.g. Dark Matter searches). A planar Ge detector with a window made of organic material will be developed to achieve this objective.

R&D will be carried out in cooperation with participants of the other Underground Labs, in view of the fact that the new techniques and equipment could be later exported to the other Labs.

IUS Boulby - New ULBF will be installed in Boulby in a new Underground Low Background Laboratory (ULBL). This will be a dedicated room of 30 x 10 x 5 m³ equipped with environmental control of radon, gases, air flow, humidity, temperature and radioactive sources. Services will include a liquid nitrogen plant for LB Ge detectors and low radon flush, and a portable DD neutron beam. New facilities include:

- An upgraded HP-Ge and NaI detector facility: An existing 2 kg LB Ge and new 20 kg NaI array will be transferred to the ULBL and upgraded with latest automated analysis/control software, higher purity

Pb/Cu shielding and radon control. Prime use will be for assessment of next generation dark matter and double beta decay detector parts including: photomultipliers, dynodes, electronics, ceramics, meshes, glues and other structures needing sub-ppb U/Th. R&D will be on sensitivity improvement and analysis techniques, focussing on high value components of unusual geometry. Work will be in tandem with chemical analysis in cooperation with the other laboratories. Production of specialist vessels will allow use by life science, environmental science and geologist groups.

- Neutron and muon background monitoring and veto shielding facility: A new facility in the ULBL will be dedicated to neutron background suppression techniques vital for next generation dark matter and neutrino physics facilities (linked also to N3). A new gas-based multi-wire detector with changeable gas fills will be installed for assessment of fluxes $< 10^{-6} \text{ cm}^{-2}\text{s}^{-1}$ with R&D to push lower. New gas purification/control will be installed. Neutron rejection requires new low threshold scintillators including Gd doping. A new neutron-veto array of 4 m^2 will be installed for optimisation with prototype modules, complementing gamma shield work at other sites.
- Radon measurement and control: The naturally low radon at Boulby provides a good basis for developing next generation automated radon monitoring and removal for ultra-low activity applications. A new array based on RAD7 radon/thoron alpha/gamma capture devices at sub pCi/l levels will be installed. This will allow measurement of radon outgas from specialist materials (e.g. Lucite and glues). Development will focus on applications where monitoring small volumes inside detectors is vital.

The R&D of JRA1 is organised in four Work Packages, with the specific objectives described in **Table 1**.

- **WP 1:** Measurement of the backgrounds in the EU underground sites
- **WP 2:** Development of a standard library of background simulation codes
- **WP 3:** R&D for ultra-low background techniques and facilities in the EU underground labs
- **WP 4:** R&D on radiopurity of materials and purification techniques

A graphical representation of the Work Packages discussed above and their interdependency is shown in **Figure 1**. WP 1 and WP 2 are strictly interconnected: the new measurements from WP 1 will be a crucial test for the Monte Carlo codes developed in WP 2; on the other hand, reliable Monte Carlo simulations will help in understanding the origin of backgrounds and the planning for further measurements. A strong link is also present between WP 3 and WP 4: the development of Ultra Low Background techniques and facilities will boost R&D possibilities carried out in WP 4, whereas new purification techniques and low background materials studied in WP 4 could improve the performance of new facilities.

The R&D carried out in JRA1 will benefit from cross-links established with other Networks and JRAs of ILIAS. These links are shown schematically in the **cross-link table** below.

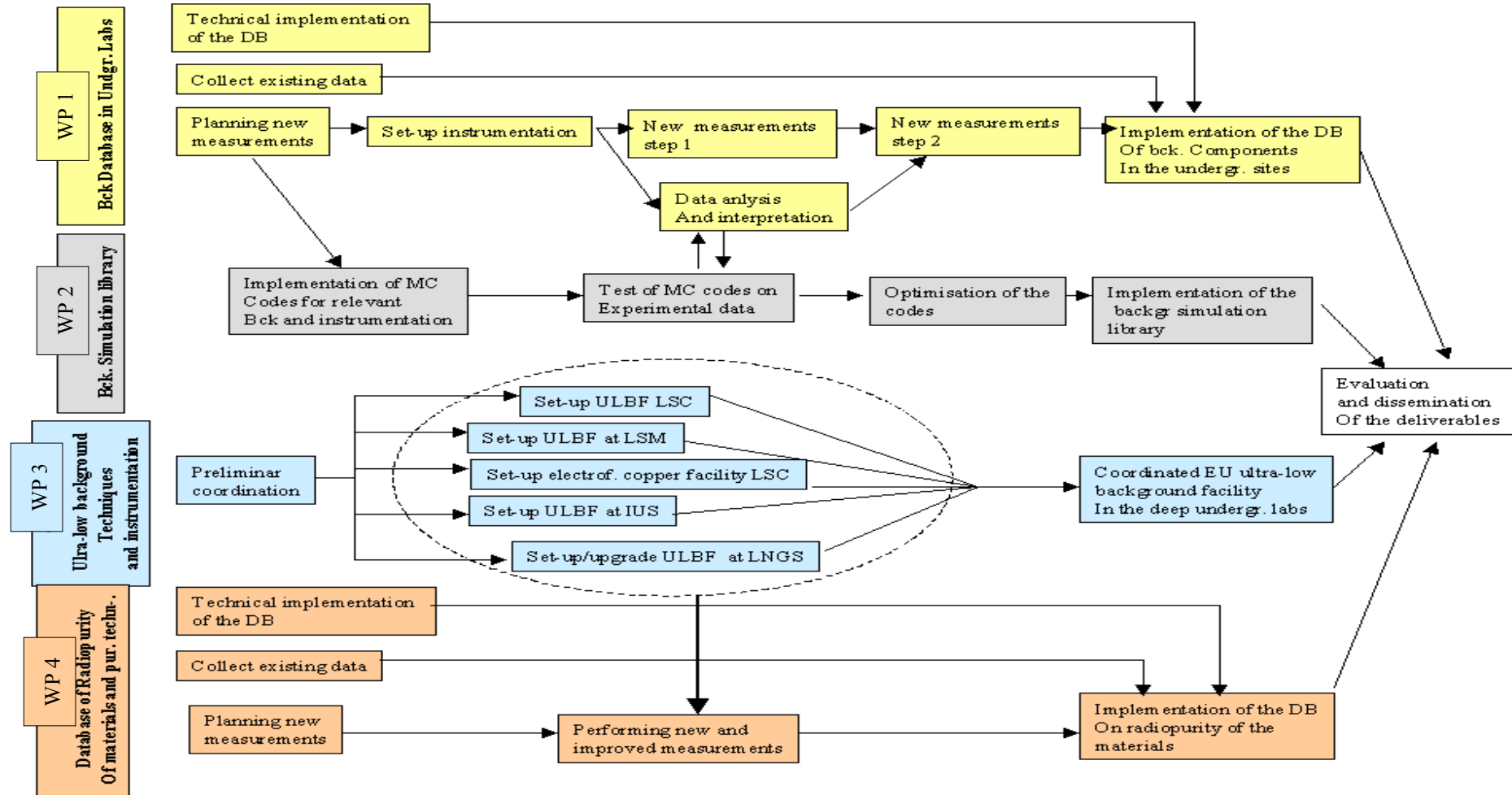
Particularly important are the links with the other activities directly involving the Underground Laboratories, namely TA1 (TA-DUSL) and N2 (DUSL). N2 will support the R&D of JRA1 through close co-ordination of the Laboratories at a technical and management level. Results obtained by the R&D carried out in JRA1 will reinforce the possibilities for Transnational Access offered within TA1.

Schematic view of the cross-links of JRA1 with the other ILIAS activities

	JRA1 – WP 1	JRA1 – WP 2	JRA1 – WP 3	JRA1- WP 4
N1				
N2	x	x	x	x
N3	x	x		x
N4		x		x
JRA2			x	x
TA1	x	x	x	x

8.R1 - Table 1 – LBT-DUSL Activities		
WP #	Descriptive Title	Short description and specific objectives of the activity
1	Measurement of the backgrounds in the EU underground sites	<p>Objectives:</p> <ul style="list-style-type: none"> • To measure the environmental background components (in particular neutrons, gammas, muons, and Rn contamination in the air and in the water) in the four underground sites LNGS, LSM, LSC, and Boulby. Special effort will be devoted in order to collect data in the different sites in a coherent, co-ordinated, and compatible way. • The data collected in the measurements will be organised in a database of the background components which characterize the European underground labs; the database will be made available to users of the Labs.
2	Development of a standard library of background simulation codes	<p>Objective</p> <ul style="list-style-type: none"> • To produce a reliable and well tested Monte Carlo library of simulation codes to identify and quantify the components of the various environmental backgrounds in underground sites as well as in a variety of experiments and conditions, with a view to interpreting current data and designing new underground experiments. The joint research effort should optimise the know-how of the different participants; experimental results from WP 1 will be essential to validate the library of codes. A coherent and tested library of codes will be made available for the users of the Labs; the codes will be interfaced with the database from WP 1.
3	R&D for ultra-low background techniques and facilities in the EU underground labs	<p>Objectives</p> <ul style="list-style-type: none"> • Construction and upgrading of innovative Ultra Low Background Facilities (ULBF) in the four underground labs They should all together form a new EU-coordinated system of facilities for ultra-low background measurement applications in rare event physics and other fields (e.g. environmental physics, archeometry and radioactive dating, geophysics) of world-wide value. • Implementation of new and innovative techniques to deal with the radioactive background: active and passive shielding, veto systems, particle discrimination techniques, fragmentation of calorimeter detectors, control and suppression of radon levels. • Study of the feasibility of fabrication of detectors and materials underground.
4	R&D on radiopurity of materials and purification techniques	<p>Objectives:</p> <ul style="list-style-type: none"> • Collect new data on radioactive contamination and cosmogenic activation of materials typically used for the construction of detectors employed in rare-event physics and ultra-low background instrumentation The measurements of radiopurity of materials and its optimisation will be carried out using the new capabilities offered by the R&D and facilities of WP 3. • Development and test of purification techniques to improve the radio-purity of different materials. • Development and test of Monte Carlo codes to analyse the cosmogenic activation of different materials. • Implementation of an up-to-date database containing all the information from the R&D of this task. The database will be accessible to all researchers interested in the use of highly radio-pure materials, and will be extremely helpful for the selection of the materials to be used in a new experiment.

JRA1 - Figure 1. Graphical representation of the interdependencies of the Work Package



8.R1.2 Participants

8.R1 - Table 2a – Participants			
#	Organisation	Short name	Role
1	Commissariat à l’Energie Atomique	CEA	Underground Lab.: Laboratoire Souterrain de Modane (LSM) γ spectroscopy, neutron background, radon detection, pulse-shape discrimination, veto systems, very low background Ge detectors, earth sciences, radiodations, environmental studies, MC calculations, material selection and purification.
2	Centre National de la Recherche Scientifique	CNRS	WP 1: background measurements at LSM (all components) WP 2: study and implementation of MC background simulation codes WP 3: R&D and construction of ULBF at LSM WP 4: R&D on radiopurity and purification using facilities at LSM; Coordination of WP 4
3	Istituto Nazionale di Fisica Nucleare	INFN	Underground Lab.: Laboratori Nazionali del Gran Sasso (LNGS) Low-background instrumentation and techniques (HP Ge detectors, scintillator detectors), purification techniques, MC simulation of background for rare event physic; experiments in rare event physics and neutrino physics, low energy nuclear physics, bolometry, liquid argon TPCs; archeometry, radon monitoring, radiodations WP 1: background measurements at LNGS (all components); Coordination of WP 1 WP 2: study and implementation of MC background simulation codes WP 3: R&D and construction of ULBF at LNGS; Coordination WP 3 WP 4: R&D on radiopurity and purification using facilities at LNGS.
4	Universidad de Zaragoza	UNIZAR	Underground Lab.: Laboratorio Subterraneo de Canfranc, Universidad de Zaragoza (LSC) Low background techniques (instrumentation HpGe, shielding, Rn monitoring, electroforming copper, MC simulation for gamma and neutrons); experiments in rare event physics (Axion search, DM, DBD) WP 1: background measurements at LSC (all components) WP 2: study and implementation of MC background simulation codes; Coordination of WP 2 WP 3: R&D and construction of ULBF at LSC. WP 4: R&D on radiopurity and purification using facilities at LSC
5	University of Sheffield	USFD	Underground Lab.: Boulby Lab. Of the Institute for Underground Sciences (IUS) Dark matter searches, scintillators and gas detectors, low background studies, HP Ge detectors, radon and gamma assay, neutrino physics, low background fabrication; low background data bases, neutron activation and mass spectrometry, veto design WP 1: background measurements at Boulby (all components) WP 2: study and implementation of MC background simulation codes especially for simulating the Boulby lab conditions; deputy coordination WP 3: R&D and construction of ULBF at Boulby WP 4: R&D on radiopurity and purification using facilities at Boulby
9	Max-Planck Society for the advancement of Science, represented by Max-Planck-Institute for Nuclear Physics, Heidelberg	MPIK	Low energy nuclear physics, low radioactivity, ultra-low background Ge diodes, ultra-low background gas proportional counters WP 3: contribution to R&D and construction of ULBF at LNGS WP 4: R&D on radiopurity and purification using facilities at LNGS and MPIK
10	Technische Universität München	TUM	Monte Carlo Simulation, low background measurements, rare event search WP 2: MC simulation codes for neutron background WP 4: R&D on radiopurity and purification using facilities at LNGS and TUM

8.R1 - Table 2b –Other entities foreseen to contribute to this activity (but not signatories to the contract)	
Name	Role: Contribution to
Rutherford Appleton Laboratory	WP 1: background measurements at Boulby WP 2: study and test of MC background simulation codes WP 3: contribution to R&D and construction of ULBF at Boulby WP 4: R&D on radiopurity and purification using facilities at Boulby and RAL
Forschungszentrum Karlsruhe (FZK)	WP 2: study and test of MC background simulation codes (neutrons)
University of Dortmund	WP 1: Neutron and gamma background measurements at LNGS with CdTe crystals WP 2: Study and test of MC background simulation codes (neutrons and gammas)
University of Silesia	WP 1: Neutron background measurements at LNGS WP 2: MC simulation codes for neutron and muon backgrounds
Henryk Niewodniczanski Institute of Nuclear Physics	WP 4: R&D on radiopurity and low radioactivity measurements using facilities at LNGS and INP-Krakow
Politecnico di Milano	WP 1: neutron background measurements WP 2: neutron background simulations

8.R1.3 Implementation plan for the full duration of the activity

WP #	Descriptive Title		8.R1 - Table 3 – 4 Years Execution Plan			
			YEAR 1	YEAR 2	YEAR 3	YEAR 4
1	Background measurements inside the Underground Labs	Tasks	<ul style="list-style-type: none"> - Existing information collected - Plan and coordination of new measurements completed - First full survey of background components started 	<ul style="list-style-type: none"> - Data of the first survey analysed and understood - Plan for second survey completed - Second survey of background measurements started 	<ul style="list-style-type: none"> - Second survey of background measurements completed 	<ul style="list-style-type: none"> - Data of all background components understood and organised in the database
		Milestones and Deliverables	<ul style="list-style-type: none"> - First version of database on background components in the underground Labs, containing existing information and first new data on gamma-ray and neutron backgrounds 	<ul style="list-style-type: none"> - First version of database open to UG lab users, and containing all available data on gamma, neutron and radon backgrounds in the labs. - Rn monitoring systems in operation in all Labs 	<ul style="list-style-type: none"> - Scientific papers on gamma, neutron, and Rn background published - Database documentation ready 	<ul style="list-style-type: none"> - Complete database with all data collected available for UG lab users
2	Background simulation codes	Tasks	<ul style="list-style-type: none"> - Existing codes compared and discussed - Platform, language and structure of the library fixed - First set of MC codes for relevant background components and instrumentation ready 	<ul style="list-style-type: none"> - MC codes tested on second survey of background measurements from Task 1 - Program of refinement of the codes and documentation defined 	<ul style="list-style-type: none"> - MC codes tested on second survey of background measurements from Task 1 	<ul style="list-style-type: none"> - Open the MC library to the UG lab users - Complete and make available to the users the relevant documentation
		Milestones and Deliverables	<ul style="list-style-type: none"> - First “test” version of Monte-Carlo libraries implemented. Technical report prepared. 	<ul style="list-style-type: none"> - Second “test” version of standard Monte-Carlo libraries implemented (completely tested on data from Task 1). Technical report prepared. 	<ul style="list-style-type: none"> - Final version of standard Monte-Carlo codes implemented on computing infrastructures of each lab 	<ul style="list-style-type: none"> - MC library opened to the UG lab users - Complete documentation available

WP #	Descriptive Title		8.R1 - Table 3 – 4 Years Execution Plan			
			YEAR 1	YEAR 2	YEAR 3	YEAR 4
3	R&D on ultra-low-background techniques and facilities	Tasks	<p>LNGS:</p> <ul style="list-style-type: none"> - Building hosting new ULBF installed; - New HP-Ge / liq. scintillator facility and chemical lab for sample preparation installed; <p>LSC:</p> <ul style="list-style-type: none"> - Installation of electroforming copper facility and lead melting facility started. - R&D on feasibility of crystal growth underground started <p>LSM:</p> <ul style="list-style-type: none"> - Materials for low threshold Ge detectors selected; - air filtering prototype for Radon removal designed <p>IUS:</p> <ul style="list-style-type: none"> - ULBF clean room and environment control installed - upgrade of Ge/NaI complete, new shield in place, first tests - Neutron-muon veto test array assembled, first rock neutron tests 	<p>LNGS:</p> <ul style="list-style-type: none"> - HP-Ge / liq. scintillator facility and chemical lab for sample preparation started up - Installation of ULBF for gas detectors started <p>LSC:</p> <ul style="list-style-type: none"> Electroforming copper and lead melting facility installed <p>LSM:</p> <ul style="list-style-type: none"> - some units of optimised cryogenerators installed; - prototype for Radon removal from the air installed; - radiochemical measurements and optimisation of this techniques started <p>IUS:</p> <ul style="list-style-type: none"> - R&D on Ge sensitivity, vessel/material selection underway - neutron facility operational, veto optimisation R&D underway - Rn component outgas facility operational, first plastics tests 	<p>LNGS:</p> <ul style="list-style-type: none"> - ULBF facility for gas detectors in operation - Upgrade of shielded ULBF facility started <p>LSC:</p> <ul style="list-style-type: none"> - Electroforming copper and lead melting facility started up - R&D on feasibility of crystal growth underground completed <p>LSM:</p> <ul style="list-style-type: none"> - Very low background and low threshold Ge detectors optimised ; units of optimised cryogenerators operational - System for radon removal from the air tested and optimised - Radiochemical measurements and optimisation of this techniques started. <p>IUS:</p> <ul style="list-style-type: none"> - Ge/NaI optimised for specialist parts, shield upgrade - R&D on neutron veto complete, analysis upgraded 	<p>LNGS:</p> <ul style="list-style-type: none"> - shielded ULBF facility in operation <p>IUS:</p> <ul style="list-style-type: none"> - ULBF fully operational and automated

WP #	Descriptive Title		8.R1 - Table 3 – 4 Years Execution Plan			
			YEAR 1	YEAR 2	YEAR 3	YEAR 4
		Milestones and Deliverables	<ul style="list-style-type: none"> - Technical report discussing the status of the new low background facilities in the different labs and a coordination among them 	LNGS: <ul style="list-style-type: none"> - HP-Ge / liq. scintillator facility and chemical lab for sample preparation operative LSM: <ul style="list-style-type: none"> - Bench of very low background Ge detectors operative; - Radiochemical technique for Uranium measurements implemented IUS: <ul style="list-style-type: none"> - First DM/$\beta\beta$ component tests and Rn from plastics completed - First neutron veto tests completed with materials selected 	LNGS: <ul style="list-style-type: none"> - ULBF facility for gas detectors operative LSC: <ul style="list-style-type: none"> - Electroforming copper and lead melting facility operative - Technical report on the feasibility of the crystal growth underground LSM: <ul style="list-style-type: none"> - optimised cryogenerators operative; - system for Radon removal from the air operative IUS: <ul style="list-style-type: none"> - Technical report on component U/Th and Rn - neutron-muon veto facility operating - design optimised 	<ul style="list-style-type: none"> - Final Technical report discussing the new low background facilities installed in the different labs and their impact on the support of the research activities.
4	R&D for radiopurity of materials and purification techniques	Tasks	<ul style="list-style-type: none"> - Existing information collected - R&D program for purification techniques defined - New measurements on radiopurity of materials started 	<ul style="list-style-type: none"> - Measurements of cosmogenic activations started - R&D on purification techniques started 	<ul style="list-style-type: none"> - Measurements on cosmogenic activations completed - Measurements on radiopurity of materials completed 	<ul style="list-style-type: none"> - R&D program on purification techniques completed - Evaluation of Results and Prospects
		Milestones and Deliverables	<ul style="list-style-type: none"> - First “test” version of database, containing existing information and first new data on radiopurity of materials 	<ul style="list-style-type: none"> - Database open to UG lab users, containing up-to-date collected data 	<ul style="list-style-type: none"> - Technical report and scientific publications on the results of the R&D on radiopurity of materials - Technical report on and scientific publications on the results of the R&D on cosmogenic activations 	<ul style="list-style-type: none"> - Complete database with all data collected available for UG lab users

8.R1 - Table 4 - Outline Implementation Plan																
Tasks and Deliverables	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1: Measurement of the backgrounds in the EU deep underground Labs																
Tasks:																
Collecting existing data																
Planning new measurements																
Gamma rays: set-up instrumentation																
Neutrons: set-up instrumentation																
Gamma rays: survey in underground labs																
Neutrons: survey in underground labs																
Set-up of upgraded Radon monitoring systems																
Radon monitoring																
Data analysis and interpretation																
Implementation of results in database																
Opening and optimising database for UG lab users																
Deliverables:																
First version of database on background components in Underground Labs																
First version of database open to Underground Labs users																
Rn monitoring system in operation in Underground Labs																
Scientific papers on background																
Database documentation																
Complete database with all collected data for Underground Labs users																
WP 2: Development of the library of background simulation codes																
Tasks:																
Implementation of MC codes for the relevant backgrounds/instrumentation																
Analysis of data collected in the background monitoring campaign with the MC codes																
Optimisation of the codes																
Design and implementation of the library																

8.R1 - Table 4 - Outline Implementation Plan																
Tasks and Deliverables	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Opening and Optimising library for UG lab users																
Deliverables:																
First “test” version of Monte-Carlo libraries																
Technical Report																
Second “test” version of standard Monte-Carlo libraries tested and implemented																
Final version of standard Monte-Carlo codes implemented in UG Labs.																
Monte-Carlo library opened to the UG Labs																
Complete documentation																
WP 3: R&D on Ultra-Low-Background Techniques and facilities																
Tasks:																
Preparation of the underground areas and services																
LNGS: Installation and startup of new HP-Ge / liq. scintillator facility + chemical lab for sample preparation																
LNGS: Installation and startup of ULBF for gas detectors																
LNGS: Installation and startup of a shielded multi-purpose low background facility																
LSC: Study of feasibility of crystal growth underground																
LSC: Installation and startup of Electroforming copper and lead melting facility																
LSM: Installation and startup of Bench of very low background detectors																
LSM: Installation and startup of radiochemical facility for Uranium measurements																
LSM: Installation of optimised cryogenerators																
LSM: Installation of Rn reduction facilities																
IUS: Installation of new ULBF, environment control, clean areas and DD source																
IUS: Upgrade/start-up of Ge/NaI facility, production and test of DM/BB samples																
IUS: Installation of neutron/muon facility, veto tests and assessment, rock measurements																

8.R1 - Table 4 - Outline Implementation Plan																
Tasks and Deliverables	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
IUS: Establish Rn outgas facility, material tests																
Coordination and information exchange (indicative)																
Deliverables:																
Technical Report																
LNGS: - Liquid scintillator - Chemical lab operative																
LSM: - Bench of Ge detectors - Radiochemical technique for U measurements																
IUS: - Results of first DM/ $\beta\beta$ component test and Rn from plastics - Results of first neutron veto tests and selected materials																
LNGS: - ULBF for gas detectors operative																
LSC: - <u>Electroforming Cu and Pb melting facilities operative</u> - <u>Technical report on crystal growth underground</u>																
LSM: - Optimised cryogenerators operative - System for Radon removal from the air operative																
IUS: - Technical report on component U/Th and Rn - Neutron-muon veto facility operative																
Final technical report																
WP 4: R&D on radiopurity of materials and purification techniques																
Tasks:																
Collecting existing data into the DB																
Defining new measurements (in collaboration with N3, N4, N5)																
Measurements of radiopurity of new materials																
R&D on purification techniques																
Opening and optimising database for UG lab users																

8.R1 - Table 4 - Outline Implementation Plan																
Tasks and Deliverables	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<u>Deliverables:</u>																
First version of database																
Database open to UG lab users																
Technical report and scientific publications on the results of the R&D on radiopurity of materials and on cosmogenic activations																
Complete database with all collected available for UG lab users																
Activities common to all tasks																
<u>Tasks:</u>																
Design and. implementation of the DB platforms																
Preparation of the JRA activities (supported by N2)																
Evaluation and dissemination of results (also supported by N2)																
<u>Deliverables:</u>																
DBD platforms																
Report on the evaluation and dissemination of results																

8.R1.4 Expected outcome

The results from JRA1 will provide a significant step towards a more efficient and co-ordinated performance of the EU Underground Infrastructures.

The impact of JRA1 will improve the quality of the services offered by Underground Labs to the scientific community in the sectors of Astroparticle Physics and Rare-Event Physics, as well as improve the efficiency of the research carried on in the Labs.

The results are going to have an important impact in terms of improved instruments, facilities and technology: In particular, new techniques for material selection and purification (essential for planning and building new experiments in astroparticle and rare event physics) will be available. Several of the new techniques in this JRA1 are original and innovative, e.g. the participants plan to fabricate detectors and components in the underground site itself (never done before) to avoid cosmogenic activation.

JRA1 will also provide improved access capabilities to the underground infrastructures in terms of scientific and technical support to the researchers: New ultra-low background facilities for test and design of new experiments will be available, together with complete set of data relative to the environmental background in the Underground sites.

Agreements for patents and intellectual property, exploitation and publication will be realised through the JRA1 Executive Board.

Main parameters to monitor the success of the present activity are:

- Improvement in the scientific results from the low background facilities in the deep underground labs (e.g., in terms of number of scientific projects carried out at the facilities, number of researchers involved, and relevant publications.)
- Number of Scientific publications from the R&D activity.
- Quality, efficiency, and usefulness of the databases and code libraries containing the results of the R&D carried out in Work packages 1, 2, and 4. This can be quantified for instance by counting the number of users of the databases and libraries.

Risk assessment

The installation of the low background facilities as planned in Work Package 3 is reasonably safe, and is strongly supported by the institutions operating the laboratories. The outcome of Work Packages 1, 2 and 4 to be successful, implies that new and complete information resulting from the R&D (on backgrounds, radiopurity and purification techniques) be made available to scientific community through a well designed and efficient interface of databases and libraries. Participants in JRA1 are world leaders in ultra-low background technology. This should guarantee that the objectives of the R&D program can be met.

8.R1.5 Management

The general management of JRA1 will be carried out by an executive board (EB) consisting of 10 permanent members (see below).

The JRA1 Co-ordinator will represent the JRA1 collaboration and will take care of reporting the progress of the R&D to the ILIAS management and external bodies.

Each Working Package has a co-ordinator, who ensures that the progress of the relevant Tasks follow the Execution and Implementation Plans.

8.R1 – Table 5 - Management Structure of Activity LBT-DUSL			
<p>LBT-DUSL EB</p> <p>2 meetings per year</p> <p>LBT-DUSL Co-ordinator (LSC Director), LBT-DUSL Deputy Co-ordinator (LNGS) N2/TA1/JRA1 Supervisor (LNGS)</p> <p>LNGS Director, LSM Director, IUS Director Co-ordinators of the 4 Work Packages</p>			
LBT-DUSL WG1	LBT-DUSL WG2	LBT-DUSL WG3	LBT-DUSL WG4
<p>Co-ordinator: LNGS Deputy Co-ordinator: LSC</p> <p>1 Representative for each institution contributing to the WP</p>	<p>Co-ordinator: LSC Deputy Co-ordinator: IUS</p> <p>1 Representative for each institution contributing to the WP</p> <p>1 Representative from N4</p>	<p>Co-ordinator: LNGS Deputy Co-ordinator: LSM</p> <p>1 Representative for each institution contributing to the WP</p> <p>1 Representative from JRA2</p>	<p>Co-ordinator: LSM Deputy Co-ordinator: LNGS</p> <p>1 Representative for each institution contributing to the WP</p> <p>1 Representative from each of N3, N4, JRA2</p>

8.R2 Integrated Double β Decay (IDEA)

8.R2.1 Description and objectives of IDEA

This JRA will contribute to the development of the most promising techniques in the field and to the creation of a *European Observatory for DBD (EODBD)*, a distributed research infrastructure which has the ambition of being a world reference for the study of the neutrino nature and mass scale.

There are **three areas of study** which require substantial R&D activity:

- 1) DBD Isotope Enrichment, to extend DBD investigation to new isotopes. R&D is needed to produce isotopes which cannot be enriched with the traditional centrifuge technique and to improve the purity level of the enriched materials.
- 2) Study of Promising Nuclides, such as ^{82}Se and ^{150}Nd . The main R&D objectives concern the purification of ^{82}Se and the Realisation of Nd-based bolometric detectors.
- 3) New methods for the Control of the Background Radioactivity. R&D is required for the reduction of surface radioactivity (with active and passive methods), of the cosmogenic activity (with simulation and experimental techniques) and for the implementation of radically new shielding techniques (*Ge* diodes in purified liquid nitrogen).

The work in these three areas has been divided in 3 Work Packages and 7 corresponding Tasks (see Table 1):

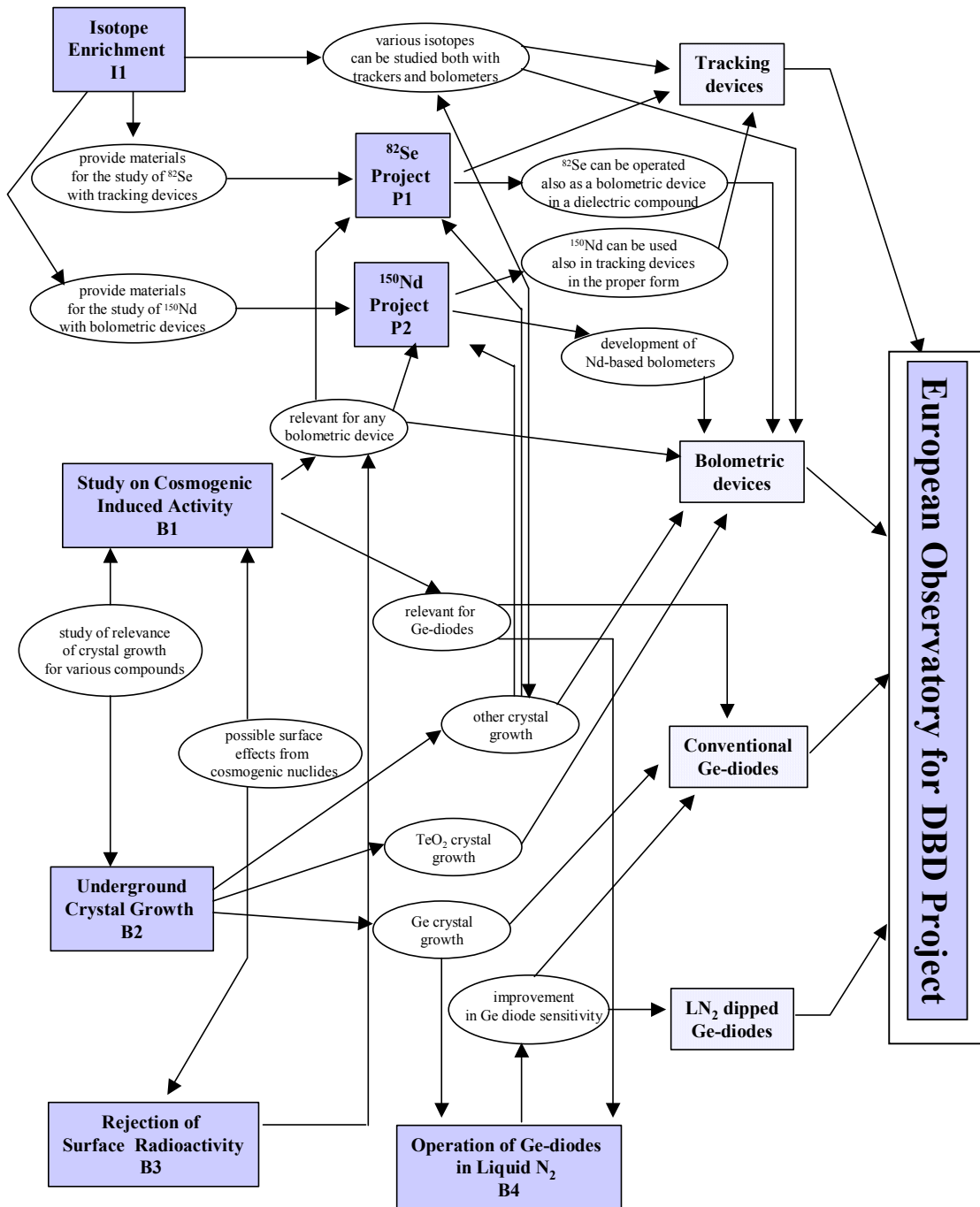
- **WP 1:** Isotope Enrichment; **Task I1**
- **WP 2:** Promising Nuclide Study; **Tasks P1 and P2**
- **WP 3:** Background Control; **Tasks B1 to B4**

The interrelations among the tasks, the four basic technologies and the final infrastructure are shown in **Figure 1**.

8.R2 - Table 1 – IDEA Activities			
WP #	Task	Descriptive Title	Short description and specific objectives of the activity
1	I1	Isotope Enrichment	<p>The reach in sensitivity of DBD experiments has two components: the sensitivity of the experimental technique and the quantity and quality of the DBD isotopes. Isotopes which undergo DBD normally have a low natural isotopic abundance (with the significant exception of ^{130}Te). Therefore isotopic enrichment is extremely important for future neutrinoless DBD searches and will be performed and studied in this task. Significant R&D work is required for the enrichment of some nuclides.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Production of ^{82}Se • Production of ^{150}Nd with the novel Ion Cyclotron Resonance enrichment method (it requires substantial R&D work and success is not guaranteed) • Feasibility study on the enrichment of Ca in ^{48}Ca with novel techniques • Enrichment of Cd in ^{116}Cd • Enrichment of Te in ^{130}Te • Production of ^{82}Se (subject to revisions of the enrichment plan) • Supply of the European <i>Bank of Isotopes</i> with the nuclides produced, in common with N4
2	P1	^{82}Se Project	<p>General purpose of this task is to perform a zero-background experiment with the tracking technique using the isotope ^{82}Se</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Chemical purification of the ^{82}Se produced in Task I1. R&D activity is required for the implementation of the purification procedure • Realisation of the ^{82}Se source for tracking experiments • Feasibility study of a bolometric experiment based on ^{82}Se. Significant R&D work is required for the identification of the optimum bolometric material • In case of positive outcome of the previous item, development of Se-based bolometers
2	P2	^{150}Nd Project	<p>This task is devoted to the investigation, realisation, and test of bolometers.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Realisation of a NdF_3 bolometer (requires substantial R&D work) • Contribution to the Realisation of a bolometer based on NdGaO_4 or on compounds with a similar magnetic ordering • Development and test of small scale Nd-based bolometers • Study of the background in Nd-based bolometers, in case of success in the previous items
3	B1	Study on Cosmogenic Induced Activity	<p>In the source as detector approach, an important part of the intrinsic background is due to cosmogenic activation of the detector, the main component being produced during fabrication at surface level and transportation to the underground site. This task aims at the control of this background source.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Development and upgrade of the cosmogenic activation codes • Study of particular Ge detectors with a well known « cosmogenic history » • New experiments based on irradiation of Ge and TeO_2 samples with high energy protons at accelerators • Analysis of the irradiation results to check/upgrade activation codes <p>The numerical part of this task will be developed in common with JRA1</p>

8.R2 - Table 1 – IDEA Activities			
WP #	Task	Descriptive Title	Short description and specific objectives of the activity
3	B2	Underground Crystal Growth	<p>The most direct way to eliminate Cosmogenic Induced Activity is to grow crystals underground, where the proton and neutron fluxes are suppressed by the rock shielding, and in general in well controlled conditions in terms of radiopurity. This task is relevant for Ge, TeO₂ and whenever source and detector coincide.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Crystallization of TeO₂ in radio-clean conditions, by eliminating radioactivity coming from crucibles and other elements • Feasibility study of underground Ge crystallization (LSC) • Feasibility study of underground TeO₂ crystallization (LNGS) • Realisation of underground test crystallization plants (in the event of positive outcomes of the previous studies and of positive issues of cost negotiations with the mentioned companies)
3	B3	Rejection of Surface Radioactivity	<p>In bolometric detectors, the radioactivity of the materials facing the crystals is presently the most dangerous contribution to the background, due to energy-degraded alpha and beta particles reaching the detector surfaces. This task is devoted to the analysis of this phenomenon, which can be controlled either by a proper surface treatment or by the development of bolometers able to localize surface events.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Implementation of various surface analysis method • Implementation of various surface cleaning procedures • Realisation of surface sensitive prototype bolometers • Development of CUORE-like modules with foreseen reduction of surface radioactivity by a factor between 10 and 100 with respect to present CUORICINO modules
3	B4	Operation of Ge-diodes in Liquid N ₂	<p>Residual background components in Ge-diode-based experiments may potentially be overcome by operating the Ge crystal directly in liquid nitrogen, an ideal shielding material to protect against external gamma radiation. R&D is needed however to achieve high purity in the N₂ liquid phase.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Study of adsorption materials, especially for Kr and other potential contaminants like cosmogenic ⁷Be. • Upgrade of the potential of the existing nitrogen (gas) purification plant (which is housed in LNGS) in order to serve a large self-shielding liquid nitrogen tank (inner diameter above 12 m) • Test operation of Ge diodes in purified nitrogen <p>Cooperation foreseen with JRA1.</p>

JRA2 - Fig. 1 – Graphical representation of the interrelations among tasks of IDEA



8.R2.2 Participants

8.R2 - Table 2a – Participants			
#	Name	Short name	Role (including involvement in Tasks)
2	Centre National de la Recherche Scientifique	CNRS	Nuclear physics experiments; low radioactivity; tracking detectors for DBD, enriched isotopes Task - I1 Production of enriched ^{82}Se Study of ^{150}Nd enrichment Experimental selection of nuclides to be enriched (tracking option) Task - P1 Purification of ^{82}Se and radioactivity measurements Source making with ^{82}Se Tracking experiment with ^{82}Se Task - P2 Up-grade of ^{150}Nd tracking experiment
3	Istituto Nazionale di Fisica Nucleare	INFN	Low energy nuclear physics, low temperature physics, cryogenics, bolometry, low radioactivity, set-ups for DBD experiments, purification of materials (in particular copper), data analysis, electronics Task - I1 Experimental selection of nuclides to be enriched (bolometric option) Task - P1 Test on Se-based bolometers Task - P2 Study of proper Nd compounds for bolometers Characterization of NTD Ge thermistors for Nd-based bolometers Design and run of a ^{150}Nd bolometric experiment Task - B1 Development and test of codes to simulate cosmic activation Experiment on activation of TeO_2 with proton test beams Task - B2 Design of TeO_2 crystal growth plant Development of a test facility for TeO_2 crystal growth (logistics) Task - B3 Installation of facility for surface impurity analysis Cleaning of copper and teflon surfaces Realisation and test of surface sensitive bolometers Characterization of NTD Ge thermistors for surface sensitive bolometers Run DBD experiments with low surface background bolometers Task - B4 Installation of LN_2 purification plant
4	Universidad de Zaragoza	UNIZAR	Low radioactivity, cosmogenic activation, underground experiments, DBD set-ups Task - B1 Codes to simulate cosmic activation Experiment on activation of Ge with test beams Task - B2 Design and development of a test facility for Ge crystal growth Task - B4 Test of Ge-diodes in liquid nitrogen
6	Czech Technical University in Prague	CTU	Nuclear physics experiments, isotope enrichment Task - I1 Production of ^{82}Se Task - P1 Source making with ^{82}Se
8	University of Jyväskylä	JYU	Calculation of nuclear matrix elements for DBD Task - I1 Theoretical selection of nuclides to be enriched Task - P1 Extraction of neutrino Majorana mass limit from ^{82}Se experiment Task - P2 Evaluation of the sensitivity of a ^{150}Nd experiment
9	Max-Planck Society for the advancement of Science, represented by Max-Planck-Institute for Nuclear Physics, Heidelberg	MPIK	Low energy nuclear physics, low radioactivity, conventional and LN_2 dipped Ge-diodes; Task - B3 Selection of pure materials for bolometric holders Task - B4 Design, Realisation and test of LN_2 purification plant
11	Eberhard Karls Universität	EKUT	Calculation of nuclear matrix elements for DBD Task - I1 Theoretical selection of nuclides to be enriched Task - B1 Extraction of neutrino Majorana mass limit from ^{82}Se experiment Task - B2 Evaluation of the sensitivity of a ^{150}Nd experiment
15	Leiden University – LION Institute of Physics	MiniGRAIL	Low temperature physics, cryogenics, low vibrational noise set-ups Task - P2 Study of thermal properties for the development of Nd-based bolometer Task - B3 Study of thermal properties for the development of bolometers active shields

8.R2 - Table 2a – Participants			
#	Name	Short name	Role (including involvement in Tasks)
16	Faculty of Mathematics, Physics & Informatics, Comenius University, Bratislava	FMFI-UK	Calculation of nuclear matrix elements for DBD, determining their theoretical uncertainty, study of different mechanisms of the neutrinoless DBD within GUT's and their SUSY extensions Task -I1 Theoretical selection of nuclides to be enriched Task - P1 Extraction of different Lepton Number Violating (LNV) parameters including the effective Majorana neutrino mass from ⁸² Se DBD experiment Task - P2 Evaluation of the sensitivity of a ¹⁵⁰ Nd experiment to a signal of LNV
20	University College London	UCL	Scintillators, calorimeters, data analysis Task - P1 Tracking experiment with ⁸² Se

8.R2 - Table 2b –Other entities foreseen to contribute to this activity (but not signatories to the contract)	
Name	Role: Contribution to
University of California	Task -P2 Development of NTD Ge thermistors for Nd-based bolometers Task - B3 Development of NTD Ge thermistors for surface sensitive bolometers
University of South Carolina	Task - B1 Simulation of cosmic activation Task - B4 Test of Ge-diodes in liquid nitrogen
Joint Institute for Nuclear Research	Task - I1 Production of ⁸² Se Production of other enriched isotopes
Idaho National Engineering and Environmental Laboratory	Task - P1 Purification of ⁸² Se
Institute for Theoretical and Experimental Physics	Task - I1 Production of ⁸² Se
Mount Holyoke College	Task - P1 Purification of ⁸² Se
Saga University	Task - P1 Tracking experiment with ⁸² Se

8.R2.3 Implementation plan for the full duration of IDEA

WP #	TASK		8.R2 - Table 3 – 5 Years Execution Plan				
			YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1	I1	Task	- Implementation of ⁸² Se enrichment procedure	- Selection of isotopes to be produced	- Implementation of an enrichment procedure for ¹⁵⁰ Nd	- Establishment of a procedure to purify ¹⁵⁰ Nd	- Production of selected isotopes continues
		Milestones and Deliverables	- 2 kg of ⁸² Se	- Table of isotopes (¹³⁰ Te, ¹⁵⁰ Nd, ¹¹⁶ Cd, ⁴⁸ Ca, ⁹⁶ Zr) to be produced, with indication of the methods and of the costs	- Technical report describing the ICR technique applied to Nd isotopic enrichment	- Substantial amounts (~ 100 g) of pure Nd enriched in ¹⁵⁰ Nd, in case of successful completion of the ICR technique study	- Significant amount of isotopes to feed the “Bank of Isotopes”
2	P1	Task	- Establishment of a procedure to purify ⁸² Se	- Production of Se source starting from pure material	- NEMO operational with Se source	- High statistics experiment with ⁸² Se source to fix the background level - Study of Se compounds to be operated as bolometers	- Operation of bolometric prototypes based on Se compounds
		Milestones and Deliverables	- 2 kg of purified ⁸² Se	- ⁸² Se source	- Technical report and scientific paper on the NEMO3 set-up operated with the ⁸² Se source	- Report and scientific paper on the background level and structure in ⁸² Se experiment	- Technical characteristics of Se-based bolometers - Scientific papers on new stringent limit on neutrino Majorana mass from ⁸² Se experiment - Scientific paper introducing a bolometric experiment on ⁸² Se
2	P2	Tasks	- Study on LT specific heat of Nd compounds - Study of bolometric behaviour of NdF ₃ bolometers - Production of bolometric thermistors (NTD Ge) (in collaboration with B3)	- Crystallization tests on promising Nd compounds, such as NdGaO ₄ - Characterization of bolometric thermistors (NTD Ge) started (in collaboration with B3)	- Design of a high statistics measurement on a Nd-based DBD experiment	- Adaptation of the CUORE structure to house Nd-based bolometers - Performance of long runs with Nd-based bolometers	- Evaluation of the background level in Nd-based bolometric experiment and of the corresponding sensitivity in terms of neutrino mass
		Milestones and Deliverables	- NdF ₃ bolometric prototype – preliminary tested (and related technical reports)	- NdF ₃ bolometers – finally tested (and related scientific papers)	- Other Nd-based bolometers (such as NdGaO ₄ devices) and related technical reports	- Technical drawings of CUORE detector including a section based on Nd-bolometers	- Upgrade of CUORE proposal to include a Nd-based section
3	B1	Task	- Analysis of existing codes for n/p activation	- Upgrading of existing codes for n/p activation - Design of n/p activation tests on Ge and TeO ₂	- Preparation and execution of n/p activation experiments	- Analysis of n/p activation experiments	- Development of experimentally checked n/p activation codes
		Milestones and Deliverables	- Table summarizing the features of the existing codes for n/p activations	- New upgraded code for n/p activation and related technical report	- Technical report describing the activation experiments	- Scientific paper and technical report on the activation experiments, including analysis	- Technical report on the activation codes with experimental cross-check

WP #	TASK		8.R2 - Table 3 – 5 Years Execution Plan				
			YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
3	B2	Task s	<ul style="list-style-type: none"> - Contact and agreement with a company specialized in Ge crystal growth for Ge diodes - Definition of new materials for crucible construction in TeO₂ crystal growth 	<ul style="list-style-type: none"> - Design of a test small scale underground set-up for Ge crystal growth - Contact and agreement with a company specialized in TeO₂ crystal growth - Crystallization tests with new crucible materials 	<ul style="list-style-type: none"> - Design of a test small scale underground set-up for TeO₂ crystal growth - Bolometric operation of crystals realized with new material crucible 	<ul style="list-style-type: none"> - Test facility for underground Ge crystal growth (if economically feasible, depending on negotiation issues with involved company, otherwise detailed design of an underground Ge crystal growth plant) 	<ul style="list-style-type: none"> - Test facility for underground TeO₂ crystal growth (if economically feasible, depending on negotiation issues with involved company, otherwise detailed design of an underground TeO₂ crystal growth plant)
		Milestones and Deliverables	<ul style="list-style-type: none"> - Technical table reporting alternative materials for crucible construction in TeO₂ crystal growth 	<ul style="list-style-type: none"> - Technical report describing the features of a test underground Ge crystal growth plant 	<ul style="list-style-type: none"> - Technical report describing the features of a test underground TeO₂ crystal growth plant 	<ul style="list-style-type: none"> - Technical report on the background study in TeO₂ bolometers realized with crystals grown in new material crucible 	<ul style="list-style-type: none"> - Final technical report on underground crystal growth, enlightening similarities and differences between the TeO₂ and the Ge cases
3	B3	Tasks	<ul style="list-style-type: none"> - Study of methods to measure surface impurities - Completion of design of surface sensitive bolometers - Production of NTD Ge thermistors for surface sensitive bolometers (in collaboration with WG3) 	<ul style="list-style-type: none"> - Characterization of NTD Ge thermistors for surface sensitive bolometers (in collaboration with P2) - Implementation of surface cleaning methods 	<ul style="list-style-type: none"> - Optimization of surface sensitive bolometers - Purification procedure for surfaces 	<ul style="list-style-type: none"> - Adaptation to CUORE of the experience collected on surface radioactivity rejection 	<ul style="list-style-type: none"> - Realisation and test of CUORE modules with negligible surface contribution to the background
		Milestones and Deliverables	<ul style="list-style-type: none"> - Technical report describing the operation mechanism and the performance simulation of surface sensitive bolometers 	<ul style="list-style-type: none"> - Installation and calibration of a laser ablation facility for the measurement of surface impurities, and related technical report 	<ul style="list-style-type: none"> - Prototype surface sensitive bolometers and related scientific paper 	<ul style="list-style-type: none"> - Technical drawing of CUORE including surface sensitive modules 	<ul style="list-style-type: none"> - Scientific paper on the background level achieved with CUORE modules with negligible contribution to background from surface
3	B4	Task	<ul style="list-style-type: none"> - Definition of absorbers for nitrogen purification 	<ul style="list-style-type: none"> - Tests of nitrogen purification capability completed 	<ul style="list-style-type: none"> - Upgrade of the existing nitrogen (gas) purification plant to a nitrogen (liquid phase) purification plant 	<ul style="list-style-type: none"> - Completion of a nitrogen purification facility 	<ul style="list-style-type: none"> - Operation of Ge diodes in (purified) liquid nitrogen
		Milestones and Deliverables	<ul style="list-style-type: none"> - Technical table with absorber materials for nitrogen purification 	<ul style="list-style-type: none"> - Design of a liquid nitrogen purification plant 	<ul style="list-style-type: none"> - Report on the technical aspects of the upgrade operation of the existing nitrogen purification plant 	<ul style="list-style-type: none"> - Technical report on the purification capability of the realized facility 	<ul style="list-style-type: none"> - Scientific papers and reports on Ge diodes operating in liquid nitrogen

8.R2 - Table 4 – Outline Implementation Plan																					
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
WP 1-TASK I1: Isotope Enrichment																					
Tasks:																					
Production of at least 2 kg of ⁸² Se																					
Enrichment study for ¹⁵⁰ Nd																					
Production of ¹⁵⁰ Nd																					
Selection of elements to be enriched																					
Production of selected isotopes																					
Deliverables:																					
2 kg of ⁸² Se (in collaboration with WP2-P1)																					
Table of isotopes to be produced, with indication of the methods and of the costs																					
Technical report describing the ICR technique applied to Nd isotopic enrichment																					
About 100 g of pure Nd enriched in ¹⁵⁰ Nd, (in case of successful completion of the ICR technique study)																					
Significant amount of isotopes to feed the “Bank of Pure Isotopes” (see N4)																					
WP 2-TASK P1: ⁸²Se Project																					
Tasks:																					
Purification of ⁸² Se																					
⁸² Se source making																					
Tracking experiment on ⁸² Se																					
Bolometric experiment on ⁸² Se																					
Deliverables:																					
2 kg of ⁸² Se (in collaboration with WP1-I1)																					
⁸² Se source																					
Technical report and scientific paper on the NEMO3 set-up operated with the ⁸² Se source																					

8.R2 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Report and scientific paper on the background level and structure in ⁸² Se experiment																				
Report on technical characteristics of Se-based bolometers																				
Scientific papers																				
WP 2-TASK P2: ¹⁵⁰Nd Project																				
Tasks:																				
Selection of Nd-based crystals																				
Nd-based bolometer Realisation																				
DBD bolometric experiment with ¹⁵⁰ Nd																				
Up-grade of ¹⁵⁰ Nd tracking experiment																				
Deliverables:																				
NdF ₃ bolometric prototype and technical report																				
Report on the NdF ₃ bolometers tests and related scientific papers																				
Report on the other Nd-based bolometers (e.g. NdGaO ₄ devices)																				
Technical drawings of CUORE detector including a section based on Nd-bolometers																				
Upgrade of CUORE proposal to include a Nd-based section																				
WP 3-TASK B1: Study on Cosmogenic Induced Activity																				
Tasks:																				
Development of Monte-Carlo codes																				
Tests on neutron/proton activation																				
Measurements of induced activities																				
Feedback on codes from exp. inputs																				
Deliverables:																				
Table summarizing the features of the existing codes for n/p activations																				
Report on the new upgraded code for n/p activation																				

8.R2 - Table 4 – Outline Implementation Plan																					
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Technical report describing the activation experiments																					
Scientific paper and technical report on the activation experiments, including analysis																					
Technical report on the activation codes with experimental cross-check																					
WP 3-TASK B2: Underground Crystal Growth																					
Tasks:																					
Design of facility for Ge crystal growth																					
Test facility Realisation for Ge crystals																					
Plan with SICCAS for TeO ₂ crystals																					
Design of facility for TeO ₂ cr. growth																					
Test facility Realisation for TeO ₂ cryst.																					
Deliverables:																					
Technical on alternative materials for crucible construction in TeO ₂ crystal growth																					
Technical report on the features of a test underground Ge crystal growth plant																					
Technical report on the features of a test underground TeO ₂ crystal growth plant																					
Technical report on the background study in TeO ₂ bolometers realised with crystals grown in new material crucible																					
Final technical report on underground crystal growth, enlightening similarities and differences between the TeO ₂ and the Ge cases																					
WP 3-TASK B3: Rejection of Surface Radioactivity																					
Tasks:																					
Analysis of surface radio-impurities																					
Study of surface cleaning methods																					
Surface-sensitive bolometers																					
Bolometers with low surface BKG																					
Deliverables:																					

8.R2 - Table 4 – Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Technical report on the operation mechanism and the performance simulation of surface sensitive bolometers																				
Technical reports on systematic measurements of surface impurities																				
Prototype surface sensitive bolometers and related scientific paper																				
Technical drawing of CUORE including surface sensitive modules																				
Scientific paper on the background level achieved with CUORE modules																				
WP 3-TASK B4: Operation of Ge-diodes in Liquid N2																				
Tasks:																				
Study of special absorbers for LN ₂ purification																				
Design of a LN ₂ purification plant																				
Realisation of a LN ₂ purification plant																				
Tests of Ge-diodes in purified LN ₂																				
Deliverables:																				
Technical table with absorber materials for nitrogen purification																				
Design of a liquid nitrogen purification plant																				
Report on the technical aspects of the upgrade operation of the existing nitrogen purification plant																				
Technical report on the purification capability of the realised facility																				
Scientific papers and reports on Ge diodes operating in liquid nitrogen																				

During the execution of the plan it may happen that task programmes are revised as a result of the advances in that particular field. The possible revisions of the plan will be discussed in the annual IDEA general meetings.

8.R2.4 Expected outcome

IDEA will provide significant progresses in the following areas thanks to an intense R&D activity:

- 1) Isotope enrichment and purification
- 2) Specific searches on promising nuclides
- 3) Development of new methods for background control and analysis

Thanks to these progresses and to integration of competences, resources and experiences, the participants will contribute to the realisation of EODBD, an infrastructure unique in the world capable to design and perform DBD experiments.

The immediate exploitation of results will concern fundamental science, in particular neutrino physics, for which EODBD aims at being a permanent key-infrastructure. Furthermore, devices based on IDEA technologies can find applications in X and gamma ray astrophysics, direct neutrino mass investigation, measurement of subtle solid state effects (chemical shifts, BEFS). Beyond fundamental science, possible outcomes are:

- new gamma and alpha detectors with unprecedented energy resolution;
- determination of properties of materials at very low temperatures (plastic, epoxies, metal alloys), useful for *space technology*;
- *many-body approaches*, developed for the calculation of DBD matrix element but applicable to various branches of physics such as solid state, plasma physics and atomic clusters, having a high relevance for technological applications.

Possible parameters to monitor the success of the JRA2 are the improvement in the limits and/or sensitivity on the neutrino Majorana mass from specific nuclides, obtained thanks to the results achieved in this project. A limit/sensitivity better than 0.5 eV for a specific nuclide can be defined as « good performance »; an « excellent performance » would consist of a limit/sensitivity of the order of 0.05 eV. IDEA could be considered highly successful as a whole if an excellent performance can be demonstrated for at least three different nuclides and moderately successful if a good performance can be demonstrated for at least three different as yet poorly studied nuclides.

8.R2.5 Management

The Management structure is outlined in Table 5. Each WP will have a leader combining The board composition will have as large an overlap as possible with that of N4 and corresponding meetings will be partially merged, in order to save time and travel funds.

Each WG will have a leader combining the functions of scientific co-ordinator and manager.

8.R2 – Table 5 - Management Structure of Activity IDEA						
<p>IDEA EB</p> <p>4 meetings per year</p> <p>Members: Co-ordinator of IDEA, Deputy co-ordinator of IDEA Leaders and co-leaders of the 7 tasks, 1 theory representative</p> <p>Invited Members: Representatives of the main Underground Laboratories</p>						
↓	↓	↓	↓	↓	↓	↓
IDEA WG2/I1	IDEA WG2/P1	IDEA WG2/P2	IDEA WG3/B1	IDEA WG3/B2	IDEA WG3/B3	IDEA WG3/B4
Composition of each Working Group: From 14 to 36 Members						

8.R3 Study on Thermal Noise Reduction in GW Detectors (STREGA)

8.R3.1 Description and objectives of the activity

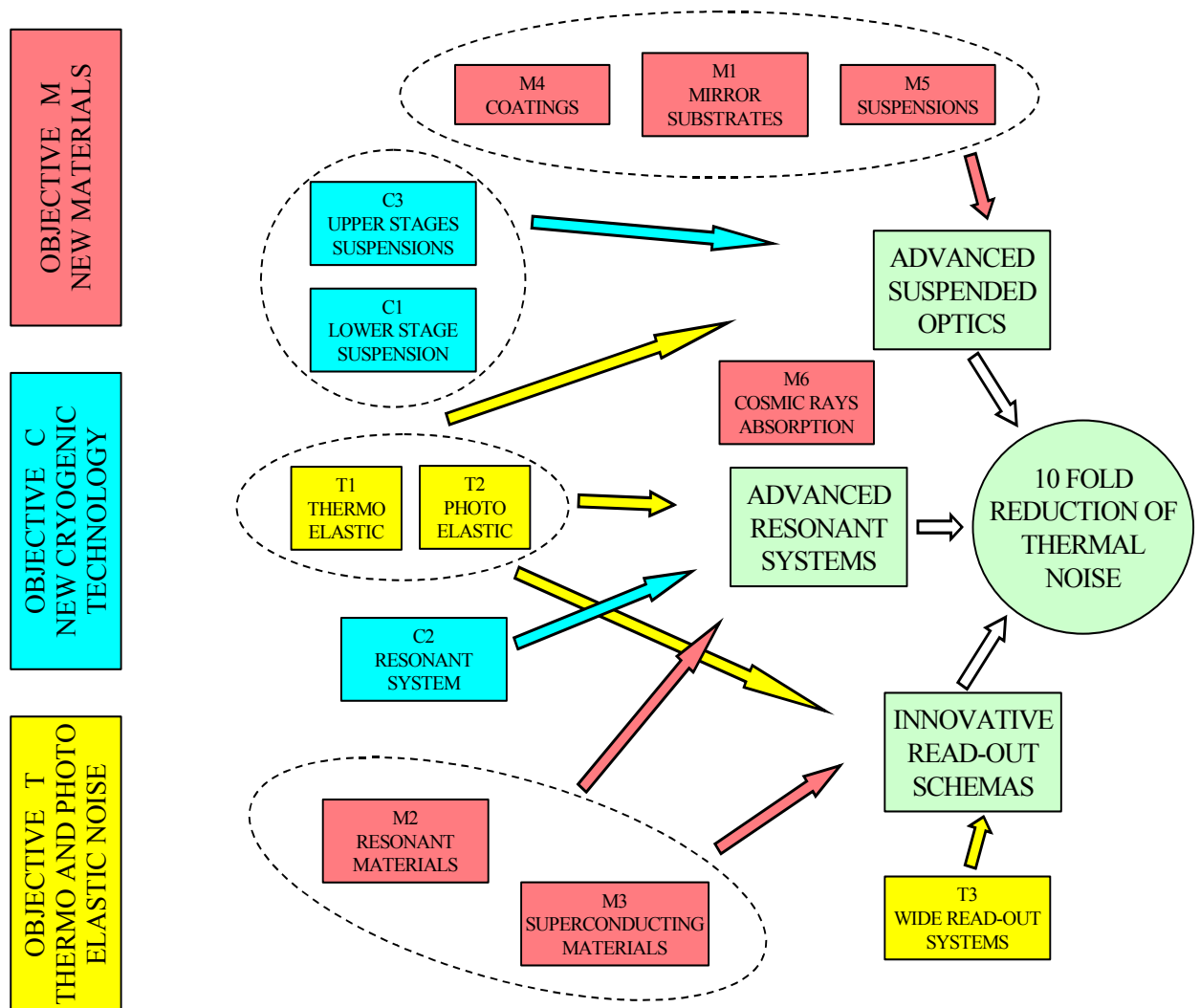
JRA3 will exploit the potential of the complementary expertise in the gravitational wave acquired separately over the years in a number of laboratories. Development of new technologies will allow the future gravitational wave detectors to increase their capabilities significantly over the frequency range between few Hz and few GHz.

The present JRA STREGA has three main **objectives**, each corresponding to a Work Package:

- **WP 1:** Investigation of Materials for Future Detectors;
- **WP 2:** Design of Advanced Cryogenic Suspensions;
- **WP 3:** Study of Thermo and Photo Elastic Effect.

Each of the three Work Packages has been divided in tasks, 12 in total, as described in Table 1. The interdependencies of the tasks are depicted in Fig. 1. Each task is identified by a code: M1 to M6 for the tasks regarding the investigation of advanced materials (WP 1); C1 to C3 for the cryogenic suspension development (WP 2); T1 to T3 for the ones regarding the thermo and photo elastic noise study (WP 3).

JRA3 - Fig. 1 – Graphical representation of the interdependencies of the tasks



8.R3 - Table 1 – STREGA Activities			
WP	Task	Descriptive Title	Short description and specific objectives of the activity
1	M1	Advanced materials for mirrors substrates	Thermal expansion, thermal conduction and mechanical losses of Silicon (Si) and Calcium Fluoride (CaF ₂) will be measured, varying the temperature from 300K down to 4K. Objectives: - Measurement of the thermal expansion, thermal conduction and mechanical losses of those two materials, varying the temperature from 300K down to 4K. - Investigation of the alteration of thermo-mechanical properties of silicon as a function of quantity and nature of dopants. - Realisation and test of prototypes in connection with the tasks M4 and M5.
1	M2	Advanced materials and techniques for resonant detectors	High-performance materials can increase the sensitivity and bandwidth of resonant detectors to achieve the intended 10-fold increase in the detection capabilities. This task aims to develop knowledge of the material properties and innovative technology for the production of test masses and transducers made of these new materials. The selected materials are Molybdenum, Silicon-Carbide (SiC), Beryllium, Copper Aluminium (CuAl), Niobium. Objectives: - Measurement of the thermal expansion, thermal conduction and mechanical losses by varying the temperature from 300K down to 0.1K. - Investigation of the fabrication processes of silicate bonding for SiC, and electron beam welding, explosion welding and cold welding for metals. - Investigation of the various metal production processes as well as low temperature calorimetric studies to choose metals with the smallest Hydrogen contamination.
1	M3	Investigation on superconducting materials	Superconducting resonant cavities will be built using the technique of niobium sputtering on a substrate having high thermal conductivity and low intrinsic mechanical dissipations. Objective: - Build cavities using the technique of niobium sputtering on a substrate having high thermal conductivity and low intrinsic mechanical dissipations.
1	M4	Development of low loss dielectric coatings for advanced detectors	An innovative technology for low loss dielectric coatings will be developed, starting from an investigation of the specific loss reduction of SiO_2/Ta_2O_5 . and SiO_2/Al_2O_3 . Another possibility is to decrease the number of layers and investigation on SiO_2/XX , where XX is a high index of refraction material like Zinc Selenide (ZnSe), will also be considered. Objectives: - Measurement of mechanical losses, optical losses and index of refraction performed at room and low temperatures. - Realisation and test of prototypes in connection with the tasks M1 and M5.
1	M5	Innovative materials for advanced detectors suspension	An investigation of low temperature properties of and fabrication processes for fibres made of Silicon, Calcium Fluoride, Molybdenum and Ruthenium is planned. These materials have excellent low temperature properties and they are compatible with the mirror and test mass materials developed in WP-M1 and WP-M2. A very innovative technology that has to be fully investigated is based on a localized cooling process through the inverse fluorescence mechanism. Objectives: - Investigation and development of a novel technology for the fabrication and doping of fibres made of YAG, CNGG [Ca ₃ Nb ₂ Ga ₃ O ₁₂] and NLW [NaLa(WO ₄) ₂]. Prototypes will be realized and tested in connection with the tasks M1 and M4.
1	M6	Study of thermo elastic effects caused by absorption of cosmic	In a low temperature detector the energy released by cosmic rays represents a significant contribution to the thermal energy of the test masses. In addition to the increase in the average energy in the test masses, the absorption of cosmic rays produces bursts of acoustic emission through a thermoelastic process that could be confused with gravitational wave bursts by the detector.

8.R3 - Table 1 – STREGA Activities			
WP	Task	Descriptive Title	Short description and specific objectives of the activity
		rays	<p>Objectives:</p> <ul style="list-style-type: none"> - Theoretical investigation of the thermoelastic mechanism that generates the acoustic emission and a series of tests on different materials are proposed. - Tests at low temperature and the acoustic emission, induced by particles accelerated by a machine and detected by mechanical or optical transducers.
2	C1	Cryogenic Last Stage Suspension	<p>This part of the suspension system close to the optics is called final stage. A full prototype of cryogenic final stage will be assembled and tested.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Design of new suspension elements (such as cantilever blades or flexural joints) to be located on the final stage. - Achieve a low noise remote control of the mirror position, using sensors and actuators compatible with the cryogenic environment. - Assembling and test of a full prototype of cryogenic final stage.
2	C2	Cryogenic suspension system for advanced resonant detectors	<p>The double task of removing the heat from the antenna resonator while keeping it mechanically isolated from the environment is similar to the one that will be encountered in the cooling of the interferometer mirrors. Although the ultra cryogenic detectors have been successfully operated, further advances in cooling and/or isolating the antenna can be achieved via finite element modelling and experimental tests.</p> <p>Objective:</p> <ul style="list-style-type: none"> - Two 1.2 ton spheres with their cryogenic suspension assembled and measurements of mechanical quality factor and thermal noise at low temperatures performed.
2	C3	Cryogenic suspension system for interferometers	<p>This task consists in demonstrating the capacity to remove a sufficient amount of heat from the cryogenic payload while preserving the suspension seismic isolation performance, namely its “softness” in all degrees of freedom. This result can be achieved by connecting suspension attenuation stages with high compliance and high thermal conductivity elements, exhibiting, at the same time, low stiffness.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - The entire apparatus be located in a cryogenic environment; the extra noise coming from the cryogenic system be studied and reduced to negligible values. - A full cryogenic suspension be assembled and tested.
3	T1	Set-up of a facility for the measurement of thermo-elastic noise	<p>Using a very high sensitivity interferometer with a small spot size on the optical elements, it should be possible to observe the thermo-elastic noise in sapphire, YAG, Silicon and CaF₂ masses.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Existing facilities, such as the interferometers in Glasgow and in Perugia, to be converted and upgraded. - Possibility of the direct measurement of thermo-elastic noise to be investigated.
3	T2	Direct measurement of the photo-elastic noise	<p>Theories on thermal conduction inside mirrors and coatings can be experimentally verified using the photo-elastic effect induced by a low frequency intensity modulation of the light entering a Fabry-Perot cavity.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Measurements with the temperature ranging between tenths of Kelvin up to room temperature. - Test of low optical loss coatings.
3	T3	Development of selective read-out schemes	<p>The effect of thermal noise depends on the size of the read-out area that in case of the interferometers is determined by the laser spot on the mirrors whereas in case of the resonant masses is determined by the displacement transducer used.</p> <p>Objectives:</p> <ul style="list-style-type: none"> - Study of read-out configurations, in which only the contributions coming from modes strongly coupled to the signal of interest are selected. - Implementation of the Fabry-Perot cavities, RF superconducting cavities and capacitive transducers.

8.R3.2 Participants

#	Organisation	Short name	Role (including involvement in Tasks)
2	Centre National de la Recherche Scientifique	CNRS	<p>Metrology tools for optical measurements. Theoretical and experimental studies of thermal noise. Development and characterization of large dielectric coatings. Development of optical configuration and locking schemas for advanced interferometric detectors. Task - M1: investigation of the optical properties of CaF₂, YAG and Silicon; Task - M4: production of dielectric coatings with low mechanical losses and development of new tool for optical measurements; Task - T1: theoretical investigation of the thermo-elastic noise at low temperature and direct measurement; Task - T2: production of dielectric coatings with low optical losses and optical absorption measurements; theoretical investigation of light absorption effects of coatings at low temperature; Task - T3: development of selective read-out for resonant detectors.</p> <p>Working labs: ESPCI_Paris, LKB_Paris, LAL_Orsay, LMA_Lyon</p>
3	Istituto Nazionale di Fisica Nucleare	INFN	<p>Design, construction and operation of the resonant cryogenic detectors AURIGA EXPLORER and NAUTILUS and development of advanced resonant detectors and transducers. Design and construction of detectors based on superconductive RF cavities. Design, construction and operation of the detector VIRGO and development of advanced interferometric detectors. Task - M1: investigation of advanced materials for mirror substrates; Task - M2: investigation of advanced materials for resonant detector test masses; Task - M3: full investigation of Niobium superconductive state; Task - M4: investigation of mechanical losses of dielectric coatings for optical transducers; Task - M5: characterization of suspension materials for resonant detectors; Task - M6: full investigation and facility modification for cosmic ray induced acoustic emission; Task - C1: design and construction of a final stage suspensions for interferometers; Task - C2: development of cooling technology for advanced resonant detectors; Task - C3: development and construction of advanced cryogenic system for interferometers; Task - T1: investigation of thermo-elastic noise at low temperature; Task - T2: direct measurement of the photo-elastic noise at low temperature; Task - T3: development of selective read-out for resonant detectors.</p> <p>Working labs: INFN_Ferrara, INFN_Firenze, INFN_Genova, INFN_Frascati, INFN_Legnaro, INFN_Napoli, INFN_Padova, INFN_Perugia, INFN_Pisa, INFN_Roma 1, INFN_Roma 2, INFN_Trento, INFN_Urbino</p>
13	Istituto di Fotonica e Nanotecnologie-CNR-Sezione di Trento	IFN	<p>Selective readout simulation, FEM, low loss matching networks for SQUID amplifiers. Task - M2: investigation of some advanced materials for resonant detector test masses; Task - T3: development of selective read-out for resonant detectors.</p>

#	Organisation	Short name	Role (including involvement in Tasks)
15	Leiden University – LION Institute of Physics	MiniGRAIL	Design and construction of the spherical cryogenic detector MiniGRAIL and R&D on advanced resonant detectors. Task - M1: low temperature characterization of mirror substrates; Task - M2: investigation of some advanced materials for resonant detector test masses; Task - M4: cryogenic system for dielectric loss measurement facility; Task - M5: cryogenic system for suspension loss measurement facility; Task - C1: thermal conduction investigation of final stage suspension; Task - C2: development and construction of advanced cryogenic system for resonant detectors; Task - T1: investigation of the thermo-elastic noise at low temperature;
19	University of Glasgow	U-Glasgow	Design and construction of the interferometric detector GEO600 and R&D on advanced detectors. Task - M1: low temperature Q measurements of some advanced materials for mirror substrates; Task - M2: investigation of some advanced materials for resonant detectors test masses; Task - M4: investigation of mechanical losses of dielectric coatings; Task - M5: low temperature Q measurements of some advanced materials for mirror suspensions; Task - T1: modification of a test facility for the direct measurement of thermal noise; Task - T2: investigation of the photo-elastic noise at low temperature

8.R3.3 Implementation plan for the full duration of the activity

8.R3 - Table 3 – 5 Years Execution Plan							
WP #	Task		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1	M1	Tasks	- Room temperature measurements (optical and mechanical) on Si and CaF2	- Low temperature measurements (optical thermal and mechanical) on Si and CaF2 - Thermal expansion measurements on Si and CaF2 at 4K	- Determination of the optimal doping parameters for Si substrates - Definition of the Silicate bonding optimal parameters and procedure	- Definition of the technological limits on the production of large substrates - Selection of companies and research labs for an R&D projects on technological upgrading	- Execution plan and cost description of the production of full size prototypes - Production of the prototypes
		Milestones and Deliverables	- Cryogenic facilities for mechanical and optical measurements fully operational	- Silicate bonding samples ready for testing - Execution plan in a form of a report for the investigation of the effect of doping in Si - Technical report	- Report on the results of the effect of doping on thermal and mechanical properties of Si relevant for the thermal noise reduction - Report on the results of the investigation on the optimal procedure for the silicate bonding	- Report on the investigation of technological possibilities available at that time on the production of the mirror substrates	- Final report
1	M2	Tasks	- Increasing of the electric field in capacitive transducer to 50 MVm - Test of elastic coupling of dissimilar materials - Implementation of a double SQUID amplifier on a capacitive transducer	- First cryogenic Q measurements - Installation and test of a metallic transducer on a sphere - Measurement of coating Q effect in optical transducer at low temperature	- Investigation of mechanical losses vs. heat treatment - Investigation of limiting E field in electrostatic transducers - Increase the sensitivity of the capacitive transducer read by double SQUID amplifier	- Alignment and power control of the optical component in ultra-cryogenic environments	- Prototypes test
		Milestones and Deliverables	- Construction of CuAl, SiC and Be resonator prototypes - Construction of optical and superconductive capacitive transducer prototypes	- Report on Q measurements at low temperature for Mo, SiC and Be - Report on the test of a metallic transducer on a sphere	- Protocol for resonator fabrication - Definition of the optimum parameters and procedures of chemical, thermal and coating treatments for high Q factor and bias electric field	- Construction of superconducting transducers	- Final report
1	M3	Tasks	- Trial Cavity mock-up built - Test Set-up for RF cavity measurement	- Cryogenic set -up, for Superconducting materials, installed - Complete design of a prototype cavity	- First Niobium on Copper cavity fully characterized	- Identification of a company suitable for the Technology Transfer and prototype construction	- Full scale cavity prototype construction
		Milestones and Deliverables	- Report on the first tests on the mock-up Cavity	- Construction Drawings for a prototype cavity ready	- Niobium on copper cavity built. - Report on DC characterization of Superconducting Sputtered samples	- Report on the cryogenic tests and full characterization (mechanical and electrical) of a RF Superconducting Detector-Transducer	- Report on first results on the final cavity prototype.

8.R3 - Table 3 – 5 Years Execution Plan							
WP #	Task		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
1	M4	Tasks	<ul style="list-style-type: none"> - Room temperature firsts measurements - Calibration of the experimental set-ups 	<ul style="list-style-type: none"> - Coating losses measurements at low temperature on SiO₂/Ta₂O₅ and SiO₂/Al₂O₃ samples - Identification of diffraction coating production processes 	<ul style="list-style-type: none"> - Improvement of the coating performances at low temperature - Optimisation of the diffraction coating fabrication 	<ul style="list-style-type: none"> - Identification of companies or labs interested on the fabrication of the prototypes 	<ul style="list-style-type: none"> - Prototypes test
		Milestones and Deliverables	<ul style="list-style-type: none"> - First production of samples SiO₂/Ta₂O₅ and SiO₂/Al₂O₃ - Report on the results of measurements and calibration 	<ul style="list-style-type: none"> - First production of samples SiO₂/high n - Report on the results of the coating losses measurements 	<ul style="list-style-type: none"> - Report on optimal fabrication process and parameters for SiO₂/Ta₂O₅ and SiO₂/Al₂O₃ coatings 	<ul style="list-style-type: none"> - Report on optimal process and parameters for SiO₂/high n - Report on optimal process and parameters for diffraction coatings 	<ul style="list-style-type: none"> - Production of transmissive optics prototypes - Production of reflective optics prototypes - Final report
1	M5	Tasks	<ul style="list-style-type: none"> - Facilities for the measurement of mechanical properties fully operational - Loss angle measurement facilities fully operational - Mono-crystalline fibres production facility operational 	<ul style="list-style-type: none"> - Local cooling (anti-Stokes fluorescence) facility(ies) implementation - Development of a facility for direct thermal noise measurements on fibres, at resonance 	<ul style="list-style-type: none"> - Design of geometry and production of suitable fibres for advanced detector 	<ul style="list-style-type: none"> - Identification of the companies or labs interested on the production of fibres 	<ul style="list-style-type: none"> - Prototypes test
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on room temperature measurement of loss angle and mechanical properties of commercial fibres and samples (e.g. Si, YAG) - Production of the first fibre by the collaboration 	<ul style="list-style-type: none"> - Report on room temperature measurements of thermal and mechanical properties of fibres produced by the collaboration - Report on the effect estimation of local cooling of a fibre on its level of thermal noise 	<ul style="list-style-type: none"> - Report on low temperature measurements of thermal and mechanical properties of fibres produced by the collaboration - Report on the optimal dopants for maximum cooling rate in crystalline fibres 	<ul style="list-style-type: none"> - Report on optimal geometry and chemical composition of suspension fibres - Report on mounting procedure of suspension fibres 	<ul style="list-style-type: none"> - Production of fibre prototypes - Final report
1	M6	Tasks	<ul style="list-style-type: none"> - Linac electron beam with bunches of > 10⁴ electrons - Completion of the experimental set-up for room temperature measurements - Design and implementation of the detector of acoustic emission 	<ul style="list-style-type: none"> - Completion of the experimental set-up for low temperature measurements on Al 	<ul style="list-style-type: none"> - Development of the general theory on the acoustic emission generated by particle absorption 	<ul style="list-style-type: none"> - Assessment of the cosmic rays effect on advanced detectors 	<ul style="list-style-type: none"> - Conclude on all performed measurements
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on room temperature measurements on Al using an electron particle beam 	<ul style="list-style-type: none"> - Report on low temperature measurements on Al using an electron particle beam 	<ul style="list-style-type: none"> - Report on low temperature measurements on Cu using an electron particle beam 	<ul style="list-style-type: none"> - Report on low temperature measurements on Si using an electron particle beam 	<ul style="list-style-type: none"> - Final report
2	C1	Tasks	<ul style="list-style-type: none"> - Modification of existing cryogenic facility - Design of the first payload prototype 	<ul style="list-style-type: none"> - PT refrigerator integrated in the cryogenic facility 	<ul style="list-style-type: none"> - Payload prototype integrated in the cryogenic facility - Improved design of the second payload prototype 	<ul style="list-style-type: none"> - Second prototype of payload integrated with the suspension system 	<ul style="list-style-type: none"> - Test of the second payload performance

8.R3 - Table 3 – 5 Years Execution Plan							
WP #	Task		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		Milestones and Deliverables	- Production of low temperature accelerometers - Report on the results of Software Simulation on the heat transmission trough payload	- Drawings of the first payload prototype - Report on heat and vibration transmission measurements done in the Rome cryogenic facility	- Production of the first payload - Report on the Thermal Gradient measurements - Report on noise measurement on the cryogenic mirror	- Production of the second payload - Report on the full characterization of the first payload prototype	- Final report
2	C2	Tasks	- Cool down of MiniGRAIL to 50 mK - Investigation of heat transfer from the mixing chamber to the sphere	- Choice of most suitable superconductive amplifier for MiniGRAIL readout - Noise tests with a capacitive transducer	- Completion of the development of 3 modes readout system for MiniGRAIL - Optimisation of transducer system for a spherical antenna	- MiniGRAIL Operational with 6 complete transducers - Improvement of the detector sensitivity	- Data analysis - Data exchange with other GW detectors
		Milestones and Deliverables	- Report on mechanical transfer function measurements of cryogenic suspension	- Report on thermal noise measurement at T<0.1 K	- Report on the test done on the transducer optimised to the sphere	- Report on the 3 modes readout and double SQUID performance	- Final report - Data of the cryogenic detector
2	C3	Tasks	- Design of a anti-seismic suspension prototype - Design of the cryogenic facility for the suspension system	- Completion of the design of the suspension system - Selection of the companies interested in the production of the cryogenic facility	- Completion of the design of the cryogenic facility	- Assembly of the cryogenic facility in Cascina - The suspension chain is installed in the cryostat	- Installation of the prototype in the cryogenic facility for testing
		Milestones and Deliverables	- Completion of a small cryogenic facility - Report on a finite element analysis on conduction property of a suspension prototype	- Drawings of all the elements of the suspension chain	- Production and assembly of the suspension prototype - Report on mechanical and thermal characteristic of the suspension system at room temperature	- Report on seismic isolation and thermal conductivity of the suspension system at low temperature	- Final report
3	T1	Tasks	- Continuous locking of the laser to the 10m cavity - Design of the short measuring cavity	- First locking of the measuring cavity to the laser - Perugia facility in continuous operation - New seismic noise isolation in the IGR facility	- Design of the cryogenic upgrade of the IGR facility - Performance optimisation of the IGR facility - Broadening of the detection band in the Perugia facility	- First measurement of thermal noise at low temperature	- Thermal noise measurements on mirror prototypes
		Milestones and Deliverables	- Report on the new frequency stabilization system for the IGR interferometer	- Report on measurements at the resonance on Si membranes - Report on the performances of the IGR interferometer	- Report on the first measurements on crystalline optics with the IGR facility - Report on the upgrade of the Perugia facility	- Assembly of the IGR cryogenic facility	- Final report
3	T2	Tasks	- Experimental test of photo thermal effect at room temperature	- Measurement of photo thermal effect at room temperature on different substrates and spot size	- Measurement of photo thermal effect at low temperature on different substrates and spot size	- Measurement of photo thermal effect at low temperature on coatings - Design of the optical readout system for advanced resonant detectors	- Realisation of an optimal readout system and implementation on an existing detector

8.R3 - Table 3 – 5 Years Execution Plan

WP #	Task		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		Milestones and Deliverables	- Assembly of a high finesse cavity at low temperature - Report on noise performance of the low temperature cavity	- Report on the measurements described in the Milestones	- Assembly of the cryogenic reference cavities with high frequency stabilization - Report on the measurements described in the Milestones	- Report on the measurements of photo thermal effect	- Final report
3	T3	Tasks	- Estimation of noise reduction of folded Fabry-Perot cavity and concave-convex cavity with respect to conventional cavities	- Design of a wide area and selective read-out either capacitive and optical	- Optimisation of wide area read-out to dual detector either capacitive and optical	- Mechanical transfer function of the prototype at low temperatures	- Final design of the DUAL detector
		Milestones and Deliverables	- Report on the activity described in the Milestones	- Conceptual design of dual detector	- Construction of a wide area readout prototypes	- Report on the mechanical transfer function	- Final report

8.R3 - Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1 – Task M1: Advanced materials for mirrors substrates																				
Tasks:																				
Meas. at room temp. on Si and CaF2	■	■	■	■																
Meas. at low temp. on Si and CaF2																				
Investigation on the doping effect on Si																				
Investigation on silicate bonding at low temp.																				
Optical measurements on Si and CaF2	■	■	■	■	■	■	■	■	■	■	■	■								
Prototypes Design and Build													■	■	■	■	■	■	■	■
Writing up of the final report																	■	■	■	■
Deliverables:																				
- Operational cryogenic facilities for mechanical and optical measurements, and Report				■																
- Silicate bonding samples ready for testing - Report on the investigation of the effect of doping in Si								■												
- Report on the results of the effect of doping on thermal and mechanical properties of Si - Report on the results of the optimal procedure for the silicate bonding												■								
- Report on technological possibilities available on the production of the mirror substrates - Final Report																■				■
WP 1 – Task M2: Advanced materials and techniques for resonant detectors																				
Tasks:																				
alpha, k and Q meas. at low temperature	■	■	■	■	■	■	■	■												
Construction and test of resonators in CuAl, SiC and Be	■	■	■	■	■	■	■	■												
Improving fabrication processes																				
Investigation of Q at lowest achievable frequencies	■	■	■	■	■	■	■	■												
Test of a metallic trans. on a resonant sphere																				
Upgrade of suspension performance of test facilities																				
Test on CuAl and SiC trans. at room and low temp.													■	■	■	■	■	■	■	■
Investigation of mech. losses after chemical treatments																				
Construction and test of optical and superconducting transducers	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Limiting bias electric fields in the capacitive transducer																				

8.R3 - Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Effect of the dielectric coating on the thermal noise																				
Design, build and test prototypes																				
Writing up of the final report																				
Deliverables:																				
- CuAl, SiC and Be resonator prototypes																				
- Optical and superconductive capacitive transducer prototypes																				
- Report on Q measurements at low temperature for Mo, SiC and Be																				
- Report on the test of a metallic transducer on a sphere																				
- Protocol for resonator fabrication																				
- Report on the procedures of treatments for high Q factor and bias electric field																				
- Superconducting transducers																				
- Final Report																				
WP 1 – Task M3: Investigation on superconducting materials																				
Tasks:																				
Cavity Design and mock-up measurements																				
Production of seamless copper cavities																				
Niobium Sputtering Optimisation																				
Mechanical qualification of substrata																				
Prototype Build and Measurement																				
Writing up of the final report																				
Deliverables:																				
- Report on the First Tests on the mock-up Cavity																				
- Construction drawings for a prototype cavity																				
- Niobium on copper cavity																				
- Report on DC characterization of Superconducting Sputtered samples																				
- Report on the cryogenic tests and characterization of a RF Superconducting Detector-Transducer																				
- The final cavity prototype																				
- Report on results																				
WP 1 – Task M4: Development of low loss dielectric coatings for advanced detectors																				
Tasks:																				
Production of substrates and coatings																				
Development of diffractive coatings																				

8.R3 - Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Meas. at room temp. on different coatings																				
Losses investigation at low temp on: SiO2/Ta2O5																				
Losses investigation at low temp on: SiO2/Al2O3																				
Losses investigation at low temp on: SiO2/high n																				
Losses investigation at low temp on: diffractive coatings																				
Optical measurement at room and low temp																				
Prototypes Design and Build																				
Writing up of the final report																				
Deliverables:																				
- First production of samples SiO2/Ta2O5 and SiO2/Al2O3 - Technical Report																				
- First production of samples SiO2/high n - Technical Report																				
- Report on optimal fabrication process and parameters for SiO2/Ta2O5 and SiO2/Al2O3 coatings																				
- Report on optimal process and parameters for SiO2/high n - Report on optimal process and parameters for diffraction coatings																				
- Transmissive optics prototypes - Reflective optics prototypes - Final Report																				
WP 1 – Task M5: Innovative materials for advanced detectors suspension																				
Tasks:																				
Mechanical and Q measurements on Si, YAG, Mo, Ru fibres																				
Production of monocrystalline fibres																				
Mechanical and Q measurements on monocrystalline fibres																				
Local cooling on monocrystal fibres																				
Design and realisation of full scale prototypes																				
Writing up of the final report																				
Deliverables:																				
- Report on room temperature measurement of loss angle and mechanical properties of commercial fibres and samples (e.g. Si, YAG)																				

8.R3 - Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
- First fibre by the collaboration																				
- Report on room temperature measurements of thermal and mechanical properties of fibres produced by the collaboration - Report on the effect estimation of local cooling of a fibre on its level of thermal noise																				
- Report on low temperature measurements of thermal and mechanical properties of fibres produced by the collaboration - Report on the optimal dopants for maximum cooling rate in crystalline fibres																				
- Report on optimal geometry and chemical composition of suspension fibres - Report on mounting procedure of suspension fibres																				
- Fibre prototypes - Final report																				
WP 1 – Task M6: Study of thermo-elastic effects caused by absorption of cosmic rays																				
Tasks:																				
Room temp. acoustic measurements on Al																				
Low temp. acoustic measurements on Al and Si																				
Low temp. acoustic meas. on Cu and other materials																				
Studying of acoustic emission induced by particle absorption																				
Writing up of the final report																				
Deliverables:																				
- Report on room temperature measurements on Al using an electron particle beam																				
- Report on low temperature measurements on Al using an electron particle beam																				
- Report on low temperature measurements on Cu using an electron particle beam																				
- Report on low temperature measurements on Si using an electron particle beam																				
- Final report																				
WP 2 – TaskC1: Cryogenic Last Stage Suspension																				
Tasks:																				
Low temperature accelerometer design and build																				
Installation and performance test of Pulse Tube Refr.																				
Modification of Rome cryogenic facility hosting PTR																				
Measurements of noise performance of PTR																				

8.R3 - Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Installation and testing of the prototype																				
Writing up of the final report																				
Deliverables:																				
- Low temperature accelerometers - Report on the results of Software Simulation on the heat transmission trough payload																				
- Drawings of the first payload prototype - Report on heat and vibration transmission measurements done in the Rome cryogenic facility																				
- First payload - Report on the thermal gradient measurements - Report on noise measurement on the cryogenic mirror																				
- Second payload - Report on the full characterization of the first payload prototype																				
- Final report																				
WP 2 – TaskC2: Cryogenic suspension system for advanced resonant detectors																				
Tasks:																				
Cooling of a spherical detector to 50 mK																				
Inst. and test of a PTR on the spherical det. MiniGRAIL																				
Noise measurement and tuning of suspensions																				
Test of a sphere with a resonant transducer																				
Optimisation of the read-out and double SQUID																				
Brownian noise measurement																				
Detector operation and data taking																				
Writing up of the final report																				
Deliverables:																				
- Report on mechanical transfer function measurements of cryogenic suspension																				
- Report on thermal noise measurement at T<0.1 K																				
- Report on the test done on the transducer optimised to the sphere																				
- Report on the 3 modes readout and double SQUID performance																				
- Data of the cryogenic detector - Final Report																				
WP 2 – TaskC3: Cryogenic suspension system for interferometers																				
Tasks:																				

8.R3 - Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Development of payload finite element model																				
Design of the cryogenic facility																				
Cryo payload Prototype: Design and Build																				
Design and Build of new super-attenuator																				
Installation and test of cryo facility in Cascina																				
Writing up of the final report																				
Deliverables:																				
- Completion of a small cryogenic facility - Report on a finite element analysis on conduction property of a suspension prototype																				
- Drawings of all the elements of the suspension chain																				
- Suspension prototype - Report on mechanical and thermal characteristic of the suspension system at room temperature																				
- Report on seismic isolation and thermal conductivity of the suspension system at low temperature																				
- Final report																				
WP 3 – TaskT1: Set-up of a facility for the measurement of thermo-elastic noise																				
Tasks:																				
Direct thermal noise meas. facility modification																				
Direct thermal noise meas. on Si membranes																				
Improvement of the ref. cavities noise performance																				
Direct thermal elastic noise meas. on suspended crystals																				
Writing up of the final report																				
Deliverables:																				
- Report on the new frequency stabilization system for the IGR interferometer																				
- Report on measurements at the resonance on Si membranes - Report on the performances of the IGR interferometer																				
- Report on the first measurements on crystalline optics with the IGR facility - Report on the upgrade of the Perugia facility																				
- IGR cryogenic facility																				
- Final report																				
WP 3 – TaskT2: Direct measurement of the photo-elastic noise																				
Tasks:																				

8.R3 - Table 4 - Outline Implementation Plan																				
Tasks and Deliverables	YEAR 1				YEAR 2				YEAR3				YEAR 4				YEAR 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Room temp. meas. on waist dependence of th-el noise																				
Different mirror substrates and coatings																				
Test and set-up of high finesse cavities at low temp.																				
Dynamic photo-therm. effect meas. at low temp.																				
Writing up of the final report																				
Deliverables:																				
- High finesse cavity at low temperature																				
- Report on noise performance of the low temperature cavity																				
- Technical Report																				
- Cryogenic reference cavities with high frequency stabilization																				
- Technical Report																				
- Technical Report																				
- Final Report																				
WP 3 – TaskT3: Development of selective read-out schemes																				
Tasks:																				
Development of the folded Fabry-Perot cavity																				
Development of concave-convex cavities at room temp.																				
Test of concave-convex cavities at low temp.																				
Noise evaluation of "Dual" det. with selective and wide area detection																				
Development of a selective read-out scheme to a wide area cap. trans.																				
Wide area read-out using r.f. superconducting cavities																				
Writing up of the final report																				
Deliverables:																				
- Technical Report																				
- Conceptual design of dual detector																				
- Wide area readout prototypes																				
- Technical Report																				
- Final report																				

During the execution of the plan it may happen that the items are revised as a result of advances in that particular field. The revision of the plan is one of the main points of discussion at each annual general meeting of STREGA.

8.R3.4 Expected outcome

The main aim of this Joint Research Activity is to reduce the thermal noise in Gravitational Wave Detectors 10 times with respect to the best achievable today with the current technology.

The actual level of thermal noise is the result of the sum of several noise sources located in critical parts of the detectors and each of them need to have a major improvement of their performance. Cryogenic has been indicated as a possible technical solution for lowering thermal noise in interferometers.

Following the R&D activity as planned in STREGA major breakthroughs are expected. In particular:

- Selection and production of advanced materials for: suspensions; mirror substrates; mirror coatings; test masses; superconducting cavities.
- Development of novel cryogenic techniques compatible with low mechanical noise requirements.
- Study of the fundamental processes of thermo-elasticity and photo-elasticity.

These outcomes will constitute the basis for the development of the third generation of Gravitational Wave Detectors since thermal noise is the fundamental limit of such detectors.

The results obtained by STREGA will be made available to all contractors in ILIAS according to European law and the internal rules of the JRAs. Whenever possible they will be published in the international peer-reviewed journals.

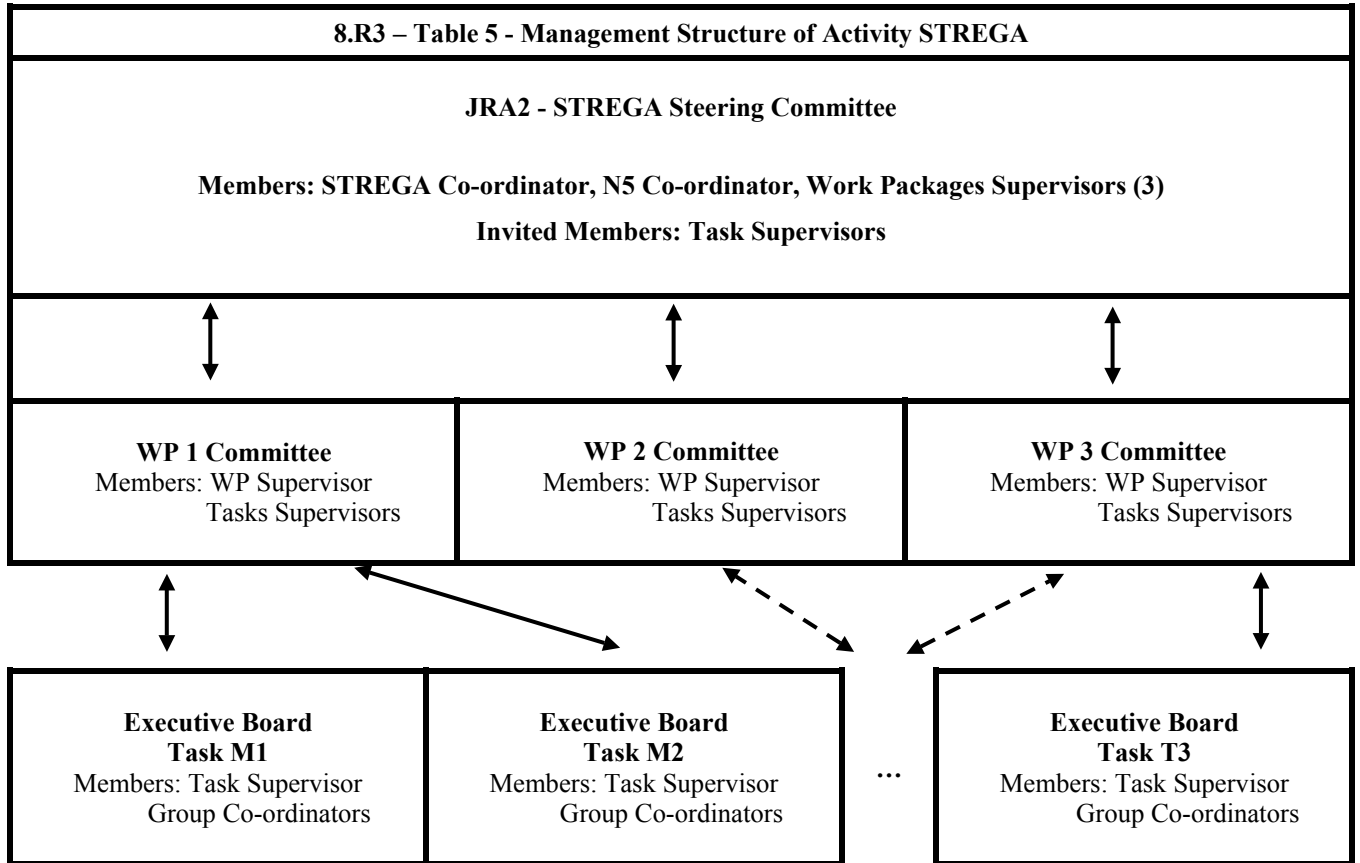
Risk assessment

The accomplishment of the scientific results declared in this JRA is supported by the many different projects submitted by all the participants and already approved by several funding agencies in Europe. The particular risk of this JRA is a failure to create an effective European Research Community of GW Detection. The common interest expressed for this project and the size of the challenge given by the design and construction of the future detectors should give a solid basis on which to build an efficient European Research Environment in this field.

8.R3.5 Management

The 3-level STREGA Management Structure is represented below.

The JRA3 Steering Committee, the uppermost level, has to assess the overall advancement of the activity and meets twice a year. At the second level, the managing of the STREGA is done by the Working Packages Supervisors. Their role is to keep the work of their group in line with the milestones. The third level of management is provided by the Task Supervisors. They will organize regular meetings with the WPs Supervisors in order to assess the state of the activities with respect to the Execution and Implementation Plans.



9. Detailed implementation plan for the first 18 months period

9.N1 Management of the I3

Activity		1 st to 6 th month	7 th to 12 th month	13 th to 18 th month
Scientific, technical, and financial Management	Tasks	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of ILIAS - Organisation of different Committees Meetings (EB, GC, SC, PRC) - ILIAS website 	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of ILIAS - Organisation of different Committees Meetings (EB, GC, SC, PRC) - ILIAS website 	<ul style="list-style-type: none"> - Liaison between ILIAS and EC - Co-ordination and management of ILIAS - Financial management of ILIAS - Participation to the organization of different Committees Meetings (EB, GC, SC, PRC) - ILIAS website
	Milestones and Deliverables	<ul style="list-style-type: none"> - Annual report on ILIAS activities - Audit certificates 		<ul style="list-style-type: none"> - Website updated

9. N1 - Table 2 - First 18 months Implementation Plan						
Tasks and Deliverables	1st To 6th Month		7th To 12th Month		13th To 18th Month	
<u>Tasks:</u>						
1 - ILIAS website						
2 - Organisation of different Committees meetings (e.g. EB, GC, SC, PRC)						
3 - Co-ordination and management of ILIAS						
4 - Organisation of the Executive Board meetings						
5 - Liaison between ILIAS and EC						
6 - Preparation of the Annual Report and plans for the next 18 months						
<u>Deliverables:</u>						
- ILIAS website						
- Minutes of different Committees meetings (e.g. EB, GC, SC, PRC)						
- Annual Report and plans for the next 18 months						

9.N2 Deep Underground Science Laboratories (DUSL)

9.N2 - Table 1 – DUSL - First 18 months Execution Plan					
WP #	WP Title		1st to 6th month	7th to 12th month	13th to 18th month
1	Performance improvement and possible extensions of the Deep Underground Laboratories	Tasks	<ul style="list-style-type: none"> - Formation of a working-group - 1st Working meeting - Inventory of the equipment performance and extension projects in the four labs 		<ul style="list-style-type: none"> - 2nd Working meeting - Definition of specific points (e.g. access, ventilation, fluids, electrical installations) for a cooperation among the 4 labs
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on the labs equipment and on the labs projects inventory 		<ul style="list-style-type: none"> - 1st draft of a Report on a detailed program of cooperation
2	Safety problems and accident prevention in underground sites	Tasks	<ul style="list-style-type: none"> - Formation of a working-group to exchange information on strategies and realisations in the four labs - 1st Working meeting 		<ul style="list-style-type: none"> - 2nd Working meeting - Search for an optimized strategy and prevention
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on the comparison of these different strategies and realisations 		<ul style="list-style-type: none"> - Definition of a strategy common to the 4 labs - Preliminary Status Report
3	Scientific Co-ordination and Public Communication	Tasks	<ul style="list-style-type: none"> - Formation of a working-group - 1st Working meeting - Inventory of the Communication facilities in the 4 Laboratories. - Inventory of the present scientific policy in each of the 4 labs 	<ul style="list-style-type: none"> - Definition of a common project for better communication and pedagogical initiatives (e.g. Booklet of the Underground Labs, better secondary school student access to the Labs) 	<ul style="list-style-type: none"> - 2nd Working meeting - Preparation of the Booklet of the Underground Labs and guide to users - Open discussion on possible strategies for a Scientific program coordination
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on inventories on Communication facilities and scientific policy 	<ul style="list-style-type: none"> - Agreement on a common project on Communication (Report) 	<ul style="list-style-type: none"> - 1st Draft of the Underground Labs Booklet and tentative definition of practical possibilities for scientific coordination among the 4 labs

9.N2 - Table 2 – DUSL - First 18 months Implementation Plan						
Tasks and Deliverables	1 ST TO 6 TH MONTH	7 TH TO 12 TH MONTH	13 TH TO 18 TH MONTH			
WP 1: Performance improvement and possible extensions of the DUL						
Tasks:						
1.1 - Formation of a working group - 1 st working meeting - Inventory of the equipment performance and extension projects in the 4 labs						
1.2 - 2 nd working meeting: definition of specific points (access, ventilation, fluids, electrical installations, etc) for a cooperation among the 4 labs						
Deliverables:						
- Reports on the labs equipment and on the labs projects - Specific plans for year 2						
WP 2: Safety problems and accident prevention in underground sites						
Tasks:						
2.1 - Formation of a working-group to exchange information on strategies and realisations in the 4 labs (1 st working meeting)						
2.2 - 2 nd working meeting: search for an optimized strategy and prevention						
Deliverables:						
- Status Report on the safety strategies and realisations						
WP 3 : Scientific coordination and public communication						
Tasks:						
3.1 - Formation of a working group - First working meeting: inventory of the communication facilities in the 4 labs, inventory of the present scientific policy in each of the 4 labs						
3.2 - Definition of a common project for better communication and pedagogical initiatives (e.g. Booklet of the Underground Labs; better secondary school student access to the Labs)						
3.3 - 2 nd working meeting - Preparation of the Booklet of the Underground Labs and guide to users - Open discussion on possible strategies for a scientific program coordination.						
Deliverables:						
- Report on the above inventories - Report on a common project on Communication						

9.N3 Direct Dark Matter Detection (DMD)

9.N3 - Table 1 – DMD - First 18 months Execution Plan							
WP		1 st to 6 th month		7 th to 12 th month		13 th to 18 th month	
1 CDC	Tasks	Plenary Meeting	<ul style="list-style-type: none"> - Set-up working group - Elect Task Co-ordinator - Set-up website 	WG meeting	<ul style="list-style-type: none"> - Identification of most promising cryogenic detector technologies 	WG meeting	<ul style="list-style-type: none"> - Identification of most promising detector concepts - Set up subgroups on different cryogenic detector technologies - Identification of requirements on cooling - Identify combined needs (e.g. purity, shielding) with other working groups
	Milestones and Deliverables	<ul style="list-style-type: none"> - Website - Report on the description of the considered cryogenic detector techniques - Work plan for year 2 and 3 				- Progress Report	
2 LX	Tasks	Plenary Meeting	<ul style="list-style-type: none"> - Set-up working group - Elect Task Co-ordinator - Set-up website 	WG meeting	<ul style="list-style-type: none"> - Working group implementation plan based on considered technologies 	WG meeting	<ul style="list-style-type: none"> - Identification of most promising detector concepts and possibility for discrimination - Identification of required read out techniques - Identification of requirements on detector operation
	Milestones and Deliverables	<ul style="list-style-type: none"> - Website - Report on the description of considered detector concepts 				- Progress Report	
3 GENAI	Tasks	Plenary Meeting	<ul style="list-style-type: none"> - Set-up working group - Elect Task Co-ordinator - Set-up website 	WG meeting	<ul style="list-style-type: none"> - Start identification of concepts for large scale experiments based on Ge and NaI - Start identification of shielding strategies - Start identification of read out schemes 	WG meeting	<ul style="list-style-type: none"> - Set up subgroups on Ge and NaI - Work on concepts - Identification of shielding strategies - Identification of read out schemes
	Milestones and Deliverables	<ul style="list-style-type: none"> - Website - Report on the first conclusions on large scale experiments, shielding strategies, and read out schemes - Work plan for year 2 and 3 				- Progress Report	
4 AD	Tasks	Plenary Meeting	<ul style="list-style-type: none"> - Set-up working group - Elect Task Co-ordinator - Set-up WEB site 	WG meeting	<ul style="list-style-type: none"> - Start identification of promising new concepts for direct dark matter search - Start selection on considered concepts 	WG meeting	<ul style="list-style-type: none"> - Identification of promising new concepts for direct dark matter search - Selection of considered concepts - Start comparison of new concepts - Identify advantages compared to 'standard' detectors - Set up subgroups
	Milestones and Deliverables	<ul style="list-style-type: none"> - Website - Report on the first conclusions on new concepts for direct dark matter search 				- Progress Report	

9.N3 - Table 1 – DMD - First 18 months Execution Plan					
WP	1 st to 6 th month		7 th to 12 th month		13 th to 18 th month
5 BSNS	Tasks	Plenary Meeting - Set-up working group Elect Task Co-ordinator - Set-up website	WG meeting	- Identify considered Monte Carlo codes	WG meeting - Sub-groups on different Monte Carlo codes - Start implementation of Monte Carlo codes for Gamma and neutron tracking
	Milestones and Deliverables	- Website - Report on Monte Carlo codes - Work plan for year 2 and 3			- Progress Report
6 HPMP	Tasks	Plenary Meeting - Set-up working group - Elect Task Co-ordinator - Set-up WEB site	WG meeting	- Link to LBT-DUSL - Start knowledge base	WG meeting - Collection of existing data on material purity - Continue working on knowledge base
	Milestones and Deliverables	- Website - Report on: * Collection of existing data on material purity * Organization knowledge base			- Progress Report
7 AXION	Tasks	Plenary Meeting - Set-up working group - Elect Task Co-ordinator - Set-up WEB site	WG meeting	- Relevance of CAST data for dark matter	WG meeting - Start work on relevance of CAST data for Dark Matter - Start work on possibility to use data from EDELWEISS / CRESST for AXION search
	Milestones and Deliverables	- Website - Report on the conditions under which CAST data could be exploited in the dark matter studies			- Progress Report
8 COMMON	Tasks	Plenary Meeting - Set-up working group - Elect Task Coordinator - Set-up WEB site	WG meeting	- Determine qualitative goals on large scale dark matter search experiment - Assessment on Axion searches	WG meeting - Define goals for large scale dark matter search project from theoretical considerations - Link to theoretical astroparticle physics - Define desired scale of future dark matter search projects - Start work on quantitative goals of large scale experiment
	Milestones and Deliverables	- Website - Report on: * Qualitative goals of a large scale dark matter search facility * Work plan together with network on theoretical astroparticle physics			- Progress Report

9.N3 - Table 2 – DMD - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month		7 th To 12 th Month		13 th To 18 th Month	
WP 1 – CDC: Cryogenic Detectors and Cryostat						
Tasks:						
1.1 - set up working group - Elect Task Co-ordinator - set up web page						
1.2 - Working group meeting - determination of most promising cryogenic detector technologies - work plan for Years 2 and 3						
1.3 - Working group meeting - identification of most promising detector concepts - set up subgroups on different cryogenic detector technologies - identification of requirement on cooling - identify combined needs (e.g . purity, shielding) with other working groups						
Deliverables:						
- Contribution to the WG website						
- Report on cryogenic detector technologies						
- Work plan for Years 2 and 3						
WP 2 – LX: Non-cryogenic Detectors and Liquid Xenon						
Tasks:						
2.1 - set up working group - Elect Task Co-ordinator - set up web page						
2.2 - Working group meeting - working group implementation plan based on considered technologies						
2.3 - Working group meeting - identification of most promising detector concepts and possibility for discrimination - identification of required read out techniques - identification of requirements on detector operation						
Deliverables:						
- Contribution to the WG website						
- Report on non-cryogenic detectors technologies						
WP 3 – GENAI: Germanium- and NaI- Detectors						
Tasks:						
3.1 - set up working group - Elect Task Co-ordinator - set up web page						
3.2 - Working group meeting: - start identification of concepts for large scale experiments based on Ge and NaI - start identification of shielding strategies - start identification of read out schemes - work plan for Years 2 & 3						
3.3 - Working group meeting - set up subgroups on Ge and NaI - work on concepts - identification of shielding strategies - identification of read out schemes						
Deliverables:						
- Contribution to the WG website						
- Report on first conclusions on large scale experiments, shielding strategies, and read out schemes						
- work plan for Years 2 & 3						
WP 4 – AD: Advanced Detectors including directional concepts						
Tasks:						

9.N3 - Table 2 – DMD - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month		7 th To 12 th Month		13 th To 18 th Month	
4.1 - set up working group - Elect Task Co-ordinator - set up web page						
4.2 - Working group meeting - start identification of promising new concepts for direct dark matter search - start selection on considered concepts						
4.3 - Working group meeting - identification of promising new concepts for direct dark matter search - selection of considered concepts - start comparison of new concepts - identify advantages compared to 'standard' detectors - set up sub-groups						
Deliverables:						
- Contribution to the WG website						
- Report on first conclusions on new concepts for direct dark matter search						
WP 5 – BSNS: Background Simulation, Neutron Shield and Muon Veto						
Tasks:						
5.1 - set up working group - Elect Task Co-ordinator - set up web page						
5.2 - Working group meeting - identify considered Monte Carlo codes - work plan for Years 2 and 3						
5.3 - Working group meeting - sub-groups on different Monte Carlo codes - start implementation of Monte Carlo codes for Gamma and neutron tracking						
Deliverables:						
- Contribution to the WG website						
- Report on Monte Carlo codes						
- work plan for Years 2 and 3						
WP 6 – HPMP: High Radiopurity Materials and Materials Purification						
Tasks:						
6.1 - set up working group; - Elect Task Coordinato - set up web page						
6.2 - Working group meeting - link to LBT-DUSL - start knowledge base						
6.3 - Working group meeting - continue collection of existing data on material purity - continue working on knowledge base						
Deliverables:						
- Contribution to the WG website						
- Report on collection of existing data on material purity						
- Report on organization knowledge base						
WP 7 – AXION: Axion search						
Tasks:						
7.1 - set up working group - Elect Task Co-ordinator - set up web page						
7.2 - Working group meeting - Relevance of CAST data for dark matter						

9.N3 - Table 2 – DMD - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month		7 th To 12 th Month		13 th To 18 th Month	
7.3 - Working group meeting - start work on relevance of CAST data for Dark Matter - start work on possibility to use data from EDELWEISS / CRESST for Axion search						
Deliverables:						
- Contribution to the WG website						
- Report on conditions under which CAST data could be exploited in the dark matter studies						
WP 8 – COMMON: Common issues and link to Theory						
Tasks:						
8.1 - set up working group; - Elect Task Co-ordinator - set up web page						
8.2 - Working group meeting - determine qualitative goals on large scale dark matter search experiment - assessment on Axion searches						
8.3 - Working group meeting - define goals for large scale dark matter search project form theoretical considerations - link to theoretical astroparticle physics - define desired scale of future dark matter search projects - start work on quantitative goals of large scale experiment.						
Deliverables:						
- Contribution to the WG website						
- report on qualitative goals of a large scale dark matter search facility						
- report on work plan together with network on theoretical astroparticle physics						

9.N4 Search on Double β Decay (DBD)

9.N4 - Table 1 – DBD - First 18 months Execution Plan				
WP		1st to 6th month	7th to 12th month	13th to 18th month
1 Coordination of DBD searches	Tasks	<ul style="list-style-type: none"> - Formation of the Working Group - Definition of a program for utilisation of available isotopes 	<ul style="list-style-type: none"> - Comparison of the potential techniques for each isotope - Sensitivity of each technique to its ultimate background 	<ul style="list-style-type: none"> - Database on isotopes and techniques
	Milestones and Deliverables	<ul style="list-style-type: none"> - Preliminary report on techniques and background 		<ul style="list-style-type: none"> - Database on isotopes and background issues
2 Bank of pure isotopes	Tasks	<ul style="list-style-type: none"> - Formation of the isotope working group - Contacts with Russian labs 	<ul style="list-style-type: none"> - Definition of a program for utilisation of available isotopes - Selection of new interesting isotopes and discussion of enrichment and purification techniques 	<ul style="list-style-type: none"> - Negotiations for production of the selected isotopes - Contact with Russian and US labs for purification techniques
	Milestones and Deliverables	<ul style="list-style-type: none"> - Report on possibilities of Russian labs - Report on a recommended program - First conclusions on isotope selection and purification 		<ul style="list-style-type: none"> - Report on new isotopes possibly produced in Russia - Report on purification issues
3 Collection and investigation of experimental inputs, nuclear matrix elements	Tasks	<ul style="list-style-type: none"> - Establishment of the status of theoretical approaches - Definition of the calculations relevant to the next generation experimental developments 	<ul style="list-style-type: none"> - Definition of an appropriate scheme to optimise the existing codes and/or identify more powerful computers 	<ul style="list-style-type: none"> - Collection of experimental information - Database of theoretical matrix elements
	Milestones and Deliverables	<ul style="list-style-type: none"> - Report on theoretical and computational issues - First conclusions on theoretical and computational issues 		<ul style="list-style-type: none"> - Report on experimental inputs to matrix elements calculations

9.N4 - Table 2 – DBD - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month		7 th To 12 th Month		13 th To 18 th Month	
WP 1: COORDINATION OF DBD SEARCHES						
Tasks:						
1.1 - Formation of the Working Group - Definition of a program for utilization of available isotopes						
1.2 - Comparison of the potential techniques for each isotope - Sensitivity of each technique to its ultimate background						
1.3 - Database on isotopes and techniques						
Deliverables:						
- Preliminary report on techniques and background						
- Database on isotopes and background issues						
WP 2: BANK OF PURE ISOTOPES						
Tasks:						
2.1 - Formation of the isotope working group - Contacts with Russian labs						
2.2 - Definition of a program for utilization of available isotopes - Selection of new interesting isotopes and discussion of enrichment and purification techniques						
2.3 - Negotiations for production of the selected isotopes - Contact with Russian and US labs for purification techniques						
Deliverables:						
- Report on possibilities of Russian labs						
- Report on a recommended program						
- First conclusions on isotope selection and purification						
- Report on new isotopes possibly produced in Russia						
- Report on purification issues						
WP 3: COLLECTION AND INVESTIGATION OF EXPERIMENTAL INPUTS, NUCLEAR MATRIX ELEMENTS						
Tasks:						
3.1 - Establishment of the status of theoretical approaches - Definition of the calculations relevant to the next generation experimental developments						
3.2 - Definition of an appropriate scheme to optimize the existing codes and/or identify more powerful computers						
3.3 - Collection of experimental information - Database of theoretical matrix elements						
Deliverables:						
- First conclusions on theoretical and computational issues						
- Report on theoretical and computational issues						
- Report on experimental inputs to matrix elements calculations						

9.N5 Gravitational Wave Antenna (GWA)

9.N5 - Table 1 – GWA - First 18 months Execution Plan				
WP		1st to 6th month	7th to 12th month	13th to 18th month
1 Antennas commissioning and characterization	Tasks	- Set-up working group - Set-up WEB site - Analysis and comparison of main sources limiting the Virgo and GEO sensitivities	- Analysis and comparison of main sources limiting the Virgo and GEO sensitivities	- Analysis and comparison of main sources limiting the Virgo and GEO sensitivities - Comparison of characterization methodologies - Preparation of recommendation for short term improvement
	Milestones and Deliverables	- Annual Report		- Progress Report
2 Joint operation of antennas and network data analysis	Tasks	- Set-up working group - Set-up WEB site - Setting general standards on software development and data formats - Comparison of detectors as for their compatibility and significance to joint observations for each target signal	- Setting general standards on software development and data formats - Comparison of detectors as for their compatibility and significance to joint observations for each target signal - Definition of data exchange protocols and data analysis pipelines for each target search	- Comparison of detectors as for their compatibility and significance to joint observations for each target signal - Definition of data exchange protocols and data analysis pipelines for each target search - Preparation of proposals for joint observations - Support to the implementation of the joint data analysis for the different classes of target signals
	Milestones and Deliverables	- Annual Report		- Progress Report
3 European strategy for future antennas	Tasks	- Set-up working group - Set-up WEB site - Definition of a list of possible short-term improvements	- Definition of a list of possible short-term improvements	- Evaluation of proposed short term improvements
	Milestones and Deliverables	- Annual Report		- Progress Report

9.N5 - Table 2 – GWA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month	7 th To 12 th Month	13 th To 18 th Month			
WP 1: Antennas commissioning and characterization						
Tasks:						
1.1 - Set-up working group						
1.2 - Set-up WEB site						
1.3 - Analysis and comparison of main sources limiting the Virgo and GEO sensitivities						
1.4 - Writing of annual report						
1.5 - Comparison of characterization methodologies						
1.6 - Preparation of recommendation for short term improvement						
Deliverables:						
- Annual Report						
WP 2: Joint operation of antennas and network data analysis						
Tasks:						
2.1 - Set-up working group						
2.2 - Set-up WEB site						
2.3 - Setting general standards on software development and data formats						
2.4 - Comparison of detectors as for their compatibility and significance to joint observations for each target signal						
2.5 - Comparison of actual performances of data analysis methodologies for each target signal						
2.6 - Definition of data exchange protocols and data analysis pipelines for each target search						
2.7 - Preparation of proposals for joint observations						
2.8 - Support to the implementation of the joint data analysis for the different classes of target signals						
Deliverables:						
- Annual Report						
WP 3 : European strategy for future antennas						
Tasks:						
3.1 - Set-up working group						
3.2 - Set-up WEB site						
3.3 - Definition of a list of possible short-term improvements						
3.4 - Writing of annual report						
3.5 - Evaluation of proposed short term improvements						
Deliverables:						
- Annual Report						

9.N6 Theoretical Astroparticle Physics (ENTApP)

9.N6 - Table 1 – ENTApP - First 18 months Execution Plan				
WP		1st to 6th month	7th to 12th month	13th to 18th month
1 Neutrinoless Double Beta Decay and Related Studies	Tasks	<ul style="list-style-type: none"> - Set up website - Initial meeting of the Task Participants - Working groups form - Call for applications to the visitor's program for year 2 - Training session (see Joint activities below) 	<ul style="list-style-type: none"> - Annual meeting of the Task with N4 - Working groups start their activities - Decisions on the visitor's program for year 2 - Working groups to report on progress 	<ul style="list-style-type: none"> - Annual meeting of the Task Participants - Small-scale meetings of the working groups - Visitor's program begins - Plans for the first Training session on neutrino physics
	Milestones and Deliverable	<ul style="list-style-type: none"> - Minutes of the meetings: - Report on <ul style="list-style-type: none"> * Specific work tasks * Detailed plan of action for the first 2 years * Visitors program 		<ul style="list-style-type: none"> - Progress Report
2 Dark Matter and Related Studies	Tasks	<ul style="list-style-type: none"> - Set up website - Initial meeting of the Task Participants (ILIAS DM) - Working groups form - Call for applications to the visitor's program for year 2. - Plans for the first Training session on dark matter 	<ul style="list-style-type: none"> - Annual meeting of the Task with N3 - Working groups start their activities - Decisions on the visitor's program for year 2 - Working groups to report on progress - First Training session on dark matter: <i>The session will be organized jointly with IDM-04 (Identification of Dark Matter) to be held in Edinburgh 6-11 Sept 04, organized by Univ. of Sheffield and Univ. of Edinburgh. Around 15 ILIAS young experimentalists and theoreticians will attend the Training session.</i> 	<ul style="list-style-type: none"> - Annual meeting of the Task Participants - Small-scale meetings of the working groups - Visitor's program begins.
	Milestones and Deliverables	<ul style="list-style-type: none"> - Minutes of the meetings: - Report on <ul style="list-style-type: none"> * Specific work tasks * Detailed plan of action for the first 2 years * Visitors program - Proceedings of the Training session 		<ul style="list-style-type: none"> - Progress Report
3 Gravitational Waves and Related Studies	Tasks	<ul style="list-style-type: none"> - Set up website - Initial meeting of the Task Participants. - Working groups form - Call for applications to the visitor's program for year 2 	<ul style="list-style-type: none"> - Working groups start their activities - Decisions on the visitor's program for year 2 - Working groups to report on progress 	<ul style="list-style-type: none"> - Annual meeting of the Task with N5 - Small-scale meetings of the working groups. - Visitor's program begins. - Plans for the first Training session on gravitational waves
	Milestones and Deliverables	<ul style="list-style-type: none"> - Minutes of the meetings: - Report on <ul style="list-style-type: none"> * Specific work tasks * Detailed plan of action for the first 2 years. * Visitors program 		<ul style="list-style-type: none"> - Progress Report

9.N6 - Table 1 – ENTApP - First 18 months Execution Plan				
WP		1st to 6th month	7th to 12th month	13th to 18th month
4 Joint activity	Tasks	<ul style="list-style-type: none"> - Annual meeting of the network - Training session on neutrino physics and gravitational waves: <i>The session will be organized jointly with ISAPP 2004 edition of the “International School on Astroparticle Physics” for European Doctorates, to be held in the Gran Sasso Lab., June 27 – July 10, 2004</i> 		- Conclusions after the Annual meeting
	milestones and deliverable	<ul style="list-style-type: none"> - Website - Minutes of the Annual meeting - Proceedings of the Training Session 		- Progress Report

9.N6 - Table 2 – ENTApP - First 18 months Implementation Plan												
Tasks and Deliverables	1 st TO 6 th Month			7 th TO 12 th Month				13 th TO 18 th Month				
WP 1 - Neutrinoless Double Beta Decay and Related Studies												
Tasks:												
1.1 - Set up website - Initial meeting of the Task Participants - Working groups form - Plans for the Training session (see Joint activities below)												
1.2 - Working groups start their activities - Call for applications to the visitor's program for Year 2 - Decisions on the visitor's program for year 2 - Training session (see Joint activities below)												
1.3 - Website in use - Small-scale meetings of the working groups												
1.4 - Working groups to report on progress												
1.5 - Annual meeting of the Task (with N4)												
1.6 - Visitor's program begins												
Deliverables:												
- Minutes of the meetings - Report on: * Specific work tasks * Detailed plan of action for the first 2 years * Content of visitors program												
WP 2 - Dark Matter and Related Studies												
Tasks:												
2.1 - Set up website - Initial meeting of the Task Participants - Working groups form - Plans for the Training session on dark matter												
2.2 - Working groups start their activities - Call for applications to the visitor's program for Year 2 - Decisions on the visitor's program for year 2 - First Training session on dark matter (*)												
2.3 - Website in use - Small-scale meetings of the working groups												
2.4 - Working groups to report on progress												
2.5 - Annual meeting of the Task (with N3)												
2.6 - Visitor's program begins												
Deliverables:												
- Minutes of the meetings - Report on: * Specific work tasks * Detailed plan of action for the first 2 years * Content of visitors program												
WP 3 - Gravitational Waves and Related Studies												
Tasks:												

9.N6 - Table 2 – ENTApP - First 18 months Implementation Plan												
Tasks and Deliverables	1 st To 6 th Month				7 th To 12 th Month				13 th To 18 th Month			
3.1 - Set up website - Initial meeting of the Task Participants - Working groups form - Plans for the Training session (see Joint activities below)												
3.2 - Working groups start their activities - Call for applications to the visitor's program for Year 2 - Decisions on the visitor's program for year 2; - Training session (see Joint activities below)												
3.3 - Website in use - Small-scale meetings of the working groups												
3.4 - Working groups to report on progress												
3.5 - Annual meeting of the Task (with N4)												
3.6 - Visitor's program begins												
Deliverables:												
- Minutes of the meetings - Report on: * Specific work tasks * Detailed plan of action for the first 2 years * Content of visitors program												
WP 4 - Joint activity												
Tasks:												
4.1 - Annual meeting of the network - Training session on neutrino physics and gravitational waves (**)												
Deliverables:												
- Website - Minutes of the Annual meeting - Proceedings of the Training Session.												

(*): The session will be organized jointly with IDM-04 (Identification of Dark Matter) to be held in Edinburgh 6-11 Sept 04, organized by Univ. of Sheffield and Univ. of Edinburgh. Around 15 ILIAS young experimentalists and theoreticians will attend the Training session.

(**): the session will be organized jointly with ISAPP 2004 edition of the "International School on Astroparticle Physics" for European Doctorates, to be held in the Gran Sasso Lab., June 27 – July 10, 2004.

9.TA1 Transnational Access – Deep Underground Science Laboratories (TA-DUSL)

Implementation Plan for specific activities aiming to provide transnational access											
Participant n°	Organisation short name	Short name of the Infrastructure	Installation (s)		Country code of operator or "INO" for International Organisations	Cost model used for Access (UF / AC)	Unit cost (in €) (only for UF contractors)	Unit of access	For the first 18 months period		
			Number (s)	Short name(s)					Minimum quantity of access to be provided	Estimated number of users	Estimated number of user groups
1	CEA	EU-DUSL/CEA	1	LSM	FR	UF	99	user-day	75	3	2
2	CNRS	EU-DUSL/CNRS	1	LSM	FR	UF	182	user-day	75	2	1
3	INFN	EU-DUSL/INFN	1	LNGS	IT	AC	-	user-day	450	15	7
4	UNIZAR	EU-DUSL/UNIZAR	1	LSC	ES	AC	-	user-day	75	3	2
5	USFD	EU-DUSL/USFD	1	IUS	GB	AC	-	user-day	75	3	2

9.R1 Low Background Techniques for Deep Underground Science (LBT-DUSL)

9.R1 - Table 1 – LBT-DUSL - First 18 months Execution Plan					
WP #	Descriptive Title		1st to 6th month	7th to 12th month	13th to 18th month
1	Measurement of the background in the EU Underground sites	Tasks	<ul style="list-style-type: none"> - Existing information collected - Plan and coordination of new measurements completed - Instrumentation for gamma ray background ready 	<ul style="list-style-type: none"> - First full survey of gamma background completed - Instrumentation for neutron background measurement ready; first data collected. 	<ul style="list-style-type: none"> - First full survey of neutron background underway - Plan for second survey completed - Upgraded Rn monitoring systems operative
		Milestones and Deliverables	- First version of database on background components in the underground Labs, containing existing information and first new data on gamma-ray and neutron backgrounds		
2	Development of a standard library of background simulation codes	Tasks	<ul style="list-style-type: none"> - Platform, language and structure of the library fixed - Existing codes compared and discussed 	- First set of MC codes for relevant background components and instrumentation ready	<ul style="list-style-type: none"> - Interpretation of results from Task 1 underway - Program of refinement of the codes and documentation defined
		Milestones and Deliverables	- First “test” version of Monte-Carlo libraries implemented. Technical report prepared		
3	R&D on ultra-low-background techniques and facilities	Tasks	<p>All labs</p> <ul style="list-style-type: none"> - Construction of buildings and preparation of areas hosting new ULBF - Coordination of the activities 	<p>LNGS:</p> <ul style="list-style-type: none"> - Building hosting new ULBF installed. - HP-Ge / liq. scintillator facility and chemical lab for sample preparation installed <p>LSC:</p> <ul style="list-style-type: none"> - Design for installation of electroforming copper facility and lead melting facility completed - R&D on feasibility of crystal growth underground started <p>LSM:</p> <ul style="list-style-type: none"> - Materials for low activity and low threshold Ge detectors selected - air filtering installation for Radon removal designed <p>IUS:</p> <ul style="list-style-type: none"> - Ge/NaI detector first upgrade complete with new shielding array - Neutron-muon array designed, construction started 	<p>LNGS:</p> <ul style="list-style-type: none"> - Installation of ULBF for gas detectors started - HP-Ge / liq. scintillator facility started up <p>LSM:</p> <ul style="list-style-type: none"> - Very low background and low threshold Ge detectors built and tested ; some units of optimised cryogenerators tested - Rn reduction facilities installed <p>IUS:</p> <ul style="list-style-type: none"> - First Ge/NaI tests on components completed, neutron facility operational - Rn outgas facility running, characterisation tests underway
		Milestones and Deliverables	- Technical report discussing the status of the new low background facilities in the different labs and the coordination among them		

9.R1 - Table 1 – LBT-DUSL - First 18 months Execution Plan					
WP #	Descriptive Title		1st to 6th month	7th to 12th month	13th to 18th month
4	R&D for radiopurity of materials and purification techniques	Tasks	- Existing information collected - Selection of materials to be investigated in terms of radiopurity defined	- New measurements on radiopurity of materials started - First data inserted in database	- Measurements of cosmogenic activations started - R&D on purification techniques started
		Milestones and Deliverables	- First “test” version of database, containing existing information and first new data on radiopurity of materials		- Progress Report

9.R1 - Table 2 – LBT-DUSL - First 18 months Implementation Plan						
Tasks and Deliverables	1 st to 6 th Month	7 th to 12 th Month	13 th to 18 th Month			
WP 1 – Measurement of the backgrounds in the EU deep underground labs						
Tasks:						
1.1 - Collect existing information						
1.2 - Plan and coordination of new background measurements						
1.3 - Set-up instrumentation for gamma background measurement						
1.4 - First full survey on gamma background						
1.5 - Set-up instrumentation for neutron background measurement						
1.6 - First full survey on gamma background						
1.7 - Set up of upgraded Rn-monitoring systems						
1.8 - Radon monitoring						
Deliverables:						
- First version of database on background components in Underground Labs						
WP 2 – Development of the library of background simulation codes						
Tasks:						
2.1 - Organising existing codes (collaboration with N3)						
2.2 - Planning new software developments needed, platforms and program languages						
2.3 - First “test” version of MC simulation codes						
2.4 - Interpretation of results from Task 1 and optimisation of the codes						
Deliverables:						
- First “test” version of Monte-Carlo libraries						
WP 3 – R&D on ultra-low background techniques and facilities						
Tasks:						
3.1 - Preparation of the underground areas and services						
3.2 - LNGS: Installation of buildings hosting new ULBF						
3.3 - LNGS: Installation of new HP-Ge/liq.scint. facility and chemical lab for sample preparation						
3.4 - LNGS: Startup of new HP-Ge/liq.scint. facility						
3.5 - LNGS: Installation of ULBF for gas detectors						
3.6 - LSC: Design of electroforming copper and lead melting facility						
3.7 - LSC: Installation of electroforming copper facility						

9.R1 - Table 2 – LBT-DUSL - First 18 months Implementation Plan						
Tasks and Deliverables	1 st to 6 th Month		7 th to 12 th Month		13 th to 18 th Month	
3.8 - LSC: Installation of lead melting facility						
3.9 - LSM: Design and selection of materials for low background Ge detectors						
3.10 - LSM: Installation of bench for low background Ge detectors						
3.11 - LSM: Design and installation of Rn removal device						
3.12 - LSM: R&D for the design of radiochemical installation for Uranium activity determination						
3.13 - IUS: Installation of NaI/Ge detector facility, initial background tests						
3.14 - IUS: Installation of Rn outgas measurements facility, first tests						
3.15 - IUS: Design and construction of neutron and muon background facility						
3.16 - IUS: First rock neutron and Rn measurements						
Deliverables:						
- Technical Report						
WP 4 – R&D for radiopurity of materials and purification techniques						
Tasks:						
4.1 - Collect existing information on radiopurity of materials and purification techniques						
4.2 - Plan and coordination of new measurements						
4.3 - Measurements on radiopurity of materials						
4.4 - Measurements on cosmogenic activation radioactivities						
4.5 - Definition of priorities for the R&D program for new purification techniques						
4.6 - R&D on purification techniques						
4.7 - Design and implementation of first version of database on radiopurity of materials and purification techniques						
Deliverables:						
- First version of database						
Activities common to all tasks						
Tasks:						
- Design and implementation of the DB platforms						
- Preparation of the JRA activities (supported by N2)						
Deliverables:						
- DBD platforms						

9.R2 Integrated Double β Decay (IDEA)

WP	Task	9.R2 - Table 1 – IDEA - First 18 months Execution Plan			
		1 st to 6 th month	7 th to 12 th month	13 th to 18 th month	
1	I1	Tasks	<ul style="list-style-type: none"> - Formation of Task I1 Group - Setup of calculus for matrix element computation - Overview of most promising nuclides (theoretically and experimentally) - Discussion and negotiation for enrichment of 2 kg of Se-82 with Russian experts - Overview of enrichment techniques for Nd-150 	<ul style="list-style-type: none"> - Meeting of Task I1 Group - Contacts with Russian experts for isotope selection - Production of 2 kg of Se-82 - Overview of enrichment techniques for Nd-150 - Organization of tests for sample production of Nd-150 	<ul style="list-style-type: none"> - Test for sample production of Nd-150 - Start of sample production of selected isotopes
		Milestones and Deliverables	<ul style="list-style-type: none"> - Plan of theory activity for matrix element calculation - 2 kg of enriched Se-82 - Annual Report- Table of isotopes to be produced 		<ul style="list-style-type: none"> - Table of isotopes to be produced - Progress Report
2	P1	Tasks	<ul style="list-style-type: none"> - Formation of Task P1 - Set-up of purification procedure with Russian and American experts 	<ul style="list-style-type: none"> - Meeting of Task P1 Group - Start of purification of 2 kg of Se-82 	<ul style="list-style-type: none"> - Purification of 2 kg of Se-82 - Start of ource making of purified Se-82
		Milestones and Deliverables	Report on the purification procedure		Purified Se-82
3	P2	Tasks	<ul style="list-style-type: none"> - Formation of Task P2 Group - Selection of compounds for Nd-based crystals - Start of production of crystals of (antiferromagnetic) Nd compounds (e.g. NdGaO₃) - Acquisition of sample crystals of NdF₃ - Acquisition of NTD Ge-thermistors for Nd bolometers 	<ul style="list-style-type: none"> - Meeting of Task P2 Group - Crystals of (antiferromagnetic) Nd compounds - Initial investment in new crystals (e.g. NdGaO₃) - Sample crystals of NdF₃ - Design and production of holder for ND-based bolometers - NTD Ge-thermistors for Nd bolometers - Set-up of acquisition and electronics for Nd bolometers - Preliminary bolometric tests on NdF₃ 	<ul style="list-style-type: none"> - Crystals of (antiferromagnetic) Nd compounds - Design and production of holder for ND-based bolometers - Characterization of NTD Ge-thermistors at low temperatures - Set-up of acquisition and electronics for Nd bolometers
		Milestones and Deliverables	<ul style="list-style-type: none"> - Table of promising compounds for Nd-based crystals - Sample crystals of Nd compounds - Annual Report 		<ul style="list-style-type: none"> - NTD Ge-thermistors for Nd bolometers - Test bolometers in NdF₃ - Progress Report
4	B1	Tasks	<ul style="list-style-type: none"> - Formation of Task B1 Group - Overview of existing codes and cross-section data - Planning of tests of n/p activations 	<ul style="list-style-type: none"> - Meeting of Task B1 Group - Up-grade and development of simulation codes - Planning of tests of n/p activations 	<ul style="list-style-type: none"> - Up-grade and development of simulation codes - Start-up of tests at CERN and other labs on Ge and TeO₂
		Milestones and Deliverables	<ul style="list-style-type: none"> - Table summarizing the features of existing activation codes - Annual Report 		<ul style="list-style-type: none"> - Progress Report

WP	Task		9.R2 - Table 1 – IDEA - First 18 months Execution Plan		
			1 st to 6 th month	7 th to 12 th month	13 th to 18 th month
5	B2	Tasks	<ul style="list-style-type: none"> - Formation of Task B2 Group) - Contact with a company specialist in Ge crystals - Definition of new materials for crucible construction in TeO₂ crystal growth 	<ul style="list-style-type: none"> - Meeting of Task B2 Group - Design of a facility for Ge crystal growth - Contact with a company specialist in TeO₂ crystal growth for use of new material crucibles - Definition of a radio-clean procedure for TeO₂ crystal growth 	<ul style="list-style-type: none"> - Design of a facility for Ge crystals growth - Contact with a company specialist in TeO₂ crystal growth for the design of a test facility- Report on crucible effects on crystal purity - Table with alternative materials for crucible for TeO₂ crystal growth
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on crucible effects on crystal purity - Table with alternative materials for crucible for TeO₂ crystal growth - Annual Report 		<ul style="list-style-type: none"> - Progress Report
6	B3	Tasks	<ul style="list-style-type: none"> - Formation of Task B3 Group - Discussion of surface analysis methods - Design of surface sensitive bolometers - Dilution refrigerator for surface sensitive bolometers: study of required characteristics 	<ul style="list-style-type: none"> - Meeting of Task B3 Group - Tests of surface analysis on copper samples - Dilution refrigerator for surface sensitive bolometers - Acquisition and electronics for surface sensitive bolometers - Acquisition of NTD Ge thermistors for surface sensitive bolometers (in collaboration with WG-P2) 	<ul style="list-style-type: none"> - Study of surface cleaning methods - Surface analysis on copper samples - Dilution refrigerator for surface sensitive bolometers - Acquisition and electronics for surface sensitive bolometers - Prototypes of surface sensitive bolometers
		Milestones and Deliverables	<ul style="list-style-type: none"> - Report on surface analysis methods - Report on surface sensitive bolometers (operation mechanism and simulations) - Annual Report 		<ul style="list-style-type: none"> - Progress Report
7	B4	Tasks	<ul style="list-style-type: none"> - Formation of Task B4 Group - Study adsorbers for nitrogen purification 	<ul style="list-style-type: none"> - Meeting of Task B4 Group - Study of a test trap system for nitrogen purification - Design of a liquid nitrogen purification plant 	<ul style="list-style-type: none"> - Completion of the design of the nitrogen purification plant - Start-up of the nitrogen purification plant construction - Design of the purification plant - Start-up of the plant construction
		Milestones and Deliverables	<ul style="list-style-type: none"> - Technical Report on adsorbers for nitrogen purification - Annual Report 		<ul style="list-style-type: none"> - Design of a liquid nitrogen purification plant - Progress Report

9.R2 - Table 2 – IDEA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st to 6 th Month		7 th to 12 th Month		13 th to 18 th Month	
WP 1-Task I1 – Isotope Enrichment						
Tasks:						
II – 1 - Setup of calculus for matrix element computation						
II – 2 - Overview of most promising nuclides (theoretically)						
II – 3 - Overview of most promising nuclides (experimentally)						
II – 4 - Contacts with Russian experts for isotope selection						
II – 5 - Start of sample production of selected isotopes						
II – 6 - Enrichment of 2 kg of Se-82 (discussion and negotiation)						
II – 7 - Enrichment of 2 kg of Se-82 (production)						
II – 8 - Overview of enrichment techniques for ¹⁵⁰ Nd						
II – 9 - Test for sample production of Nd 150						
Deliverables:						
- Plan of theory activity for matrix element calculation - 2 kg of ⁸² Se (in collaboration with WP2-P1) - Annual Report						
WP2 - Task P1 – ⁸²Se Project						
Tasks:						
P1 – 1 - Set-up of purification procedure with Russian and American experts						
P1 – 2 - Purification of 2 kg of Se-82						
P1 – 3 - Source making of purified Se-82						
Deliverables:						
- Report on the purification procedure						
WP2 - Task 3 P2 ¹⁵⁰Nd Project						
Tasks:						
P2 – 1 - Selection of compounds for Nd-based crystals						
P2 – 2 - Crystals of (antiferromagnetic) Nd compounds (e.g. NdGaO ₃)						
P2 – 3 - Acquisition of sample crystals of NdF ₃						
P2 – 4 - Design and production of holder for Nd-based bolometers						
P2 – 5 - Production of NTD Ge-thermistors for Nd bolometers						
P2 – 6 - Characterisation of NTD Ge-thermistors at LT						
P2 – 7 - Set-up of acquisition and electronics for Nd bolometers						

9.R2 - Table 2 – IDEA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st to 6 th Month		7 th to 12 th Month		13 th to 18 th Month	
Deliverables:						
- Sample crystals of Nd compounds - Nd-based preliminary bolometric prototype and Technical Report						
WP 3 - Task B1 – Study on cosmogenic induced activity						
Tasks:						
B1 – 1 - Overview of existing codes and cross-section data						
B1 – 2 - Up-grade and development of simulation codes						
B1 – 3 - Planning of tests of n/p activations						
B1 – 4 - Start-up of activation tests at CERN on Ge samples						
B1 – 5 - Start-up of tests at CERN on TeO ₂						
Deliverables:						
- Table summarizing the features of the existing codes for n/p activations - Annual Report						
Task B2 – Underground Crystal Growth						
Tasks:						
B2 – 1 - Contact with a company specialist in Ge crystals growth						
B2 – 2 - Design of a facility for Ge crystal growth						
B2 – 3 - Definition of a radio-clean procedure for TeO ₂ crystals growth						
B2 – 4 - Definition of new materials for TeO ₂ crucibles in crystal growth						
B2 – 5 - Design of a facility for TeO ₂ crystal growth (preliminary study)						
Deliverables:						
- Technical Report on alternative materials for crucible construction in TeO ₂ crystal growth - Annual Report						
WP 3 - Task B3 – Rejection of Surface Radioactivity						
Tasks:						
B3 – 1 - Discussion of surface analysis methods						
B3 – 2 - Tests on surface analysis of copper samples						
B3 – 3 - Study of surface cleaning methods						
B3 – 4 - Design of surface sensitive bolometers						
B3 – 5 - Dilution refrigerator for surface sensitive bolometers						
B3 – 6 - Acquisition and electronics for surface sensitive bolometers						

9.R2 - Table 2 – IDEA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st to 6 th Month		7 th to 12 th Month		13 th to 18 th Month	
B3 – 7 - Prototypes of surface sensitive bolometers						
Deliverables:						
- Technical report on surface analysis methods - Technical report on the design of surface sensitive bolometers - Annual Report						
WP 3 - Task B4 – Operation of Ge-diodes in Liquid N₂						
Tasks:						
B4 – 1 - Study of adsorbers for nitrogen purification						
B4 – 2 - Study of a test trap system for nitrogen purification plant						
B4 – 3 - Design of a liquid nitrogen purification plant						
B4 – 4 - Start-up of the plant construction						
Deliverables:						
- Technical report on adsorber materials for nitrogen purification - Annual Report						

9.R3 Study on Thermal Noise Reduction in GW Detectors (STREGA)

9.R3 - Table 1 – STREGA - First 18 months Execution Plan					
WP #	Task		1st to 6th month	7th to 12th month	13th to 18th month
1	M1	Tasks	- Room temperature measurements of Q for Si and CaF ₂ masses	- Thermal expansion and Q measurements at 4K of Si and CaF ₂ masses	- Q measurement of Si and CaF ₂ masses at variable temperature between 4K and 130K
		Milestones and Deliverables	- Results of optical and room temperature measurements of Q for Si and CaF ₂ masses		- Progress Report
1	M2	Tasks	- Construction of CuAl, SiC and Be resonators	- Test of CuAl and SiC transducers on an Aluminium antenna - Surface loss measurements after chemical treatment	
			- Construction of optical and superconductive capacitive transducers	- Coating losses measurements at low temperature - Niobium sputtering losses measurements at low temperature - Experiments on limiting bias electric fields in the capacitive transducer	
			- Q and α measurements on the materials CuAl, SiC and Be between 0.1K and 4K	- Loss property of silicate bonding on SiC at low temperature	
		Milestones and Deliverables	- CuAl, SiC and Be resonators - Optical and superconductive capacitive transducers		- Progress Report
1	M3	Tasks	- Realisation of an RF cavity with substrate of copper and internal coating of sputtered niobium		
		Milestones and Deliverables	- Cavity Design, realization and first tests		- Progress Report
1	M4	Tasks	- Production of the first SiO ₂ /Ta ₂ O ₅ and SiO ₂ /Al ₂ O ₃ coatings	- Loss measurements on SiO ₂ /Ta ₂ O ₅ at law and room T	- Loss measurements on SiO ₂ /Al ₂ O ₃ at room T
		Milestones and Deliverables	- SiO ₂ /Ta ₂ O ₅ and SiO ₂ /Al ₂ O ₃ coatings - Results of loss measurements on SiO ₂ /Ta ₂ O ₅		- Progress Report
1	M5	Tasks	- Design and construction of the connection element between the fibres and the test mass - Production of Si fibres, purchasing of CaF ₂ , Mo and Ru fibres	- Room temperature measurements of mechanical properties of fibres - Starting of the production of monocrystalline fibres	- Starting of the local cooling of monocrystalline fibres - Continuation of the production of monocrystalline fibres
		Milestones and Deliverables	- Results on Si, CaF ₂ , Mo and Ru fibres at room temperature		- Progress Report
1	M6	Tasks	- Modification of the cryogenic facility in Frascati		- Design and implementation of the electromechanical transducer for the detection of the acoustic emission
		Milestones and Deliverables	- Modified cryogenic facility in Frascati operative - Report on room temperature measurements on Al using an electron beam		- Progress Report

9.R3 - Table 1 – STREGA - First 18 months Execution Plan					
WP #	Task		1 st to 6 th month	7 th to 12 th month	13 th to 18 th month
2	C1	Tasks	<ul style="list-style-type: none"> - Modification of existing cryogenic facility in order to prepare the mirror cooling and reduce the mechanical noise - Development of low temperature accelerometer for vibration noise measurements 		<ul style="list-style-type: none"> - Noise vibration measurements at low temperature to qualify the refrigeration system
		Milestones and Deliverables	<ul style="list-style-type: none"> - Computer simulation study based on finite element software concerning transmission of refrigeration power, thermal gradient distribution and vibration transmission for the last stage suspension - Low temperature accelerometer for vibration noise measurements 		
2	C2	Tasks	<ul style="list-style-type: none"> - The MiniGRAIL spherical detector is cooled down to temperatures around 40-50 mK 	<ul style="list-style-type: none"> - Measure the thermal path conductance from the mixing chamber of the dilution refrigerator to the sphere - Measure the heat-treated copper links and silver links - Measure the transfer function of the attenuation masses with the new spring supports 	<ul style="list-style-type: none"> - Measure the Brownian noise of the antenna
		Milestones and Deliverables	<ul style="list-style-type: none"> - Test Quantum Design SQUIDs similar to those that the Legnaro group is using, on a capacitive three-mode transducer - Test the DC-SQUID coupled to a relaxation-oscillation SQUID made in Twente. Mount it on a capacitive double-mass transducer developed with the Roma group - Develop the 3-mode magnetically coupled transducer 		
2	C3	Tasks	<ul style="list-style-type: none"> - Design and test several high-compliance very high thermal conductivity suspensions for the interferometer mirrors - Design a cryogenic facility for testing a full-size model of a super-attenuator with a suspended mass to be cooled to ~5K - Modification of a small cryogenic facility 		<ul style="list-style-type: none"> - First tests of the high-compliance very high thermal conductivity elements for metal, glass and sapphire masses - Evaluation of the noise sources related to the cryogenic operations: liquid Helium and nitrogen boiloff - Study the possibility of using pulsed-tube refrigeration instead of liquid helium
		Milestones and Deliverables	<ul style="list-style-type: none"> - Finite element model of the payload 		

9.R3 - Table 1 – STREGA - First 18 months Execution Plan					
WP #	Task		1st to 6th month	7th to 12th month	13th to 18th month
3	T1	Tasks	- Optimization of the frequency stabilization of the master and slave lasers in the IGR interferometer		- Realigning the interferometer after the optics have been tested and suspended again
			- Installation of the reaction pendulums for the control of the measuring cavity in the IGR interferometer		
		Milestones and Deliverables	- Sensitivity upgrading of the interferometric system in Perugia	- Frequency stabilization of the master and slave lasers in the IGR interferometer optimized	- Progress Report
3	T2	Tasks	- Test and set-up of high finesse cavities at low temperatures		- Measurements of photo-thermal effects in fused silica substrates at low temperatures.
			- Investigation of the effect of the laser spot size and of the coatings at room temperature		
		Milestones and Deliverables	- Results from one substrate for waist dependence of thermal noise	- Progress Report	
3	T3	Tasks	- Evaluation of the expected noise for "dual" resonant detectors at the SQL when a selective and wide area detection strategy is applied		- Development of a selective read-out scheme for the captive transducer
			- Development of a concave-convex cavity at room temperature		
		Milestones and Deliverables	- Technical Report	- Progress Report	

9.R3 - Table 2 – STREGA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month	7 th To 12 th Month	13 th To 18 th Month			
WP 1 - Task M1: Advanced materials for mirrors substrates						
Tasks:						
1.1 - Room temperature measurements of Q on Si and CaF ₂ masses						
1.2 - Thermal expansion and Q measurements at 4K of Si and CaF ₂ masses						
1.3 - Q measurement of Si and CaF ₂ masses at variable temperature between 4K and 130K						
Deliverables:						
- Report on optical and room temperature Q measurements of Si and CaF ₂ samples						
WP 1 - TASK M2: Advanced materials and techniques for resonant detectors						
Tasks:						
2.1 - Construction of first CuAl, SiC and Be resonators						
2.2 - Construction of first optical and superconductive capacitive transducers						
2.3 - Low T and low frequency, Q measurements on CuAl, SiC and Be						
2.4 - Test of a metallic trans. on a resonant sphere						
2.5 - Test of Niobium sputtering losses at low temperature						
2.6 - Experiments on limiting bias electric fields in the capacitive transducer						
2.7 - Coating losses measurements at low temperature						
2.8 - Surface loss measurements at low temperature after chemical treatment						
2.9 - Q of silicate bonding on SiC at low T (as part of improving fabrication processes)						
Deliverables:						
- CuAl, SiC and Be resonator prototypes - Optical and superconductive capacitive transducer prototypes						
WP 1 - Task M3 : Investigation of superconductive materials						
Tasks:						
3.1 - Cavity Design and Mock-Up measurements						
3.2 - Production of seamless copper cavities						
3.3 - Mechanical qualification of substrata						
Deliverables:						
- Report on the first tests on the Mock-Up Cavity						
WP 1 – Task M4: Development of low loss dielectric coatings for advanced detectors						
Tasks:						
4.1 - Production of the first SiO ₂ /Ta ₂ O ₅ and SiO ₂ /Al ₂ O ₃ coatings						
4.2 - Loss measurements on SiO ₂ / Ta ₂ O ₅ at room T						
4.3 - Loss measurements on SiO ₂ /Al ₂ O ₃ at room T						
4.4 - Loss measurements on SiO ₂ /Ta ₂ O ₃ at low T						

9.R3 - Table 2 – STREGA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month	7 th To 12 th Month	13 th To 18 th Month			
4.5 - Optical measurements at room T						
4.6 - First design of diffractive coatings						
Deliverables:						
- First production of samples SiO ₂ /Ta ₂ O ₅ and SiO ₂ /Al ₂ O ₃ - Technical Report on the measurements results						
WP 1 - Task M 5: Innovative materials for advanced detectors suspension						
Tasks:						
5.1 - Measurements on Si, YAG, Mo, Ru fibres at room temperature						
5.2 - Starting of the production of monocrystalline fibres						
5.3 - Q measurements on monocrystalline fibres						
5.4 - Starting of the local cooling of monocrystalline fibres						
Deliverables:						
- Report on room temperature measurement of loss angle and mechanical properties of commercial fibres and samples (e.g. Si, YA) - First fibre produced by the collaboration						
WP 1 - Task M 6: Study of thermo-elastic effects caused by absorption of cosmic rays						
Tasks:						
6.1 - Modification of the cryogenic facility in Frascati						
6.2 - Design and implementation of the acoustic emission detector						
6.3 - Room temperature acoustic measurements on Al						
6.4 - Starting of low T measurements on Al and Si						
Deliverables:						
- Modified cryogenic facility in Frascati operative - Report on room temperature measurements on Al using an electron beam						
WP 2 - Task C1: Cryogenic Last Stage Suspension						
Tasks:						
7.1 - Low temperature accelerometer for vibration noise measurements						
7.2 - Modification of existing cryogenic facility in Rome						
7.3 - Installation of the Pulse Tube Refrigerator						
7.4 - Noise vibration meas. on the cryogenic facility at low temperature						
Deliverables:						
- Low temperature accelerometers						
WP 2 - Task C2: Cryogenic suspension system for advanced resonant detectors						
Tasks:						
8.1 - Cooling of MiniGRAIL down to 50mK						
8.2 - Meas. of the conductance from the mixing chamber to the sphere						
8.3 - Testing of the heat-treated copper links and silver links						

9.R3 - Table 2 – STREGA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month		7 th To 12 th Month		13 th To 18 th Month	
8.4 - Measurement of the transfer function with the new spring supports						
8.5 - Test SQUIDs (Legnaro's design) on a capacitive three-mode transducer						
8.6 - Test DC-SQUID coupled to a relaxation-oscillation SQUID						
8.7 - Measure the Brownian noise of the antenna						
Deliverables:						
- Report on the cooling of MiniGRAIL						
- Report on the different elements used for increasing the thermal conductance						
WP 2 - Task C3: Cryogenic suspension system for interferometers						
Tasks:						
9.1 - Finite element model of the payload						
9.2 - Design the cryogenic facility for the superattenuator						
9.3 - Production of high-compliance high-conductivity suspensions links						
9.4 - First tests of the high-compliance high-conductivity links						
Deliverables:						
- Report on a finite element analysis on conduction property of a suspension prototype						
WP 3 - Task T1: Set-up of a facility for the measurement of thermo-elastic noise						
Tasks:						
10.1 - Sensitivity upgrading of the interferometric system in Perugia						
10.2 - Noise measurements on Si membranes						
10.3 - Optimization of the freq stabilization in the IGR interferometer						
10.4 - Realigning the interferometer and testing of the measuring cavity in the IGR interferometer						
Deliverables:						
- Report on the new frequency stabilization system for the IGR interferometer						
WP 3 - Task T2: Direct measurement of photo-elastic noise						
Tasks:						
11.1 - Waist dependence of thermal elastic noise: results from one substrate						
11.2 - Investigation on different coatings						
11.3 - Set-up of high finesse cavities at low temperatures						
11.4 - Test of high finesse cavities at low temperatures						
11.5 - Measurements of photo-thermal effects SiO2 substrates at low T						
Deliverables:						
- Report on waist dependence of thermal elastic noise						
WP 3 - Task T3: Development of selective read out schemes						
Tasks:						

9.R3 - Table 2 – STREGA - First 18 months Implementation Plan						
Tasks and Deliverables	1 st To 6 th Month		7 th To 12 th Month		13 th To 18 th Month	
12.1 - Development of a Folded Fabry-Perot cavity at room temperature						
12.2 - Development of concave-convex cavity at room temperature						
12.3 - Evaluation of the expected noise for "dual" resonant detectors						
12.4 - Implementation of a selective read-out scheme to the cap. transducer						
Deliverables:						
- Technical Report						

10. Financial information for the duration of the detailed implementation plan

Financial information – “Reporting period 1 + first six months of Reporting period 2”														
Particip- ant n°	Organi- sation short name	Cost model used		Estimated eligible costs and requested EC contribution (first 18 months of the project)	Costs and EC contribution per type of activities								Total (8)= (1)+(2)+(3) +(4)+(5)+(6) +(7)	Total receipts
		For transnat ional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities						
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)			
1	CEA	FC	FC	Eligible costs	Direct costs (a)	137500		341392	39900	6217		9540	534549	
					of which subcontracting			0	0		0	0		
					Indirect costs (b)	27500		253708	0	1243		0	282451	
					Total eligible costs (a)+(b)	165000		595100	39900	7460		9540	817000	
			Requested EC contribution	82500		130000	39900	7460		9540	269400			
2	CNRS/IN 2P3	FCF	FCF	Eligible costs	Direct costs (a)	515833			54234	11344		4073	585484	
					of which subcontracting	0			0	0		0	0	
					Indirect costs (b)	103167			10846	2269		814	117096	
					Total eligible costs (a)+(b)	619000			65080	13613		4887	702580	
			Requested EC contribution	309500			65080	13613		4887	393080			
3	INFN	AC	AC	Eligible costs	Direct costs (a)	586167			79034	26667		70000	761868	
					of which subcontracting	0			0	0		0	0	
					Indirect costs (b)	117233			15806	5333		14000	152372	
					Total eligible costs (a)+(b)	703400			94840	32000		84000	914240	
			Requested EC contribution	703400			94840	32000		84000	914240			
4	UNIZAR	AC	AC	Eligible costs	Direct costs (a)	225000			54800	14250		8000	302050	
					of which subcontracting	0			0	0		0	0	
					Indirect costs (b)	45000			10960	2850		1600	60410	
					Total eligible costs (a)+(b)	270000			65760	17100		9600	362460	
			Requested EC contribution	270000			65760	17100		9600	362460			
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – “Reporting period 1 + first six months of Reporting period 2”													
Particip- ant n°	Organi- sation short name	Cost model used		Estimated eligible costs and requested EC contribution (first 18 months of the project)	Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3) +(4)+(5)+(6) +(7)	Total receipts
		For transnat ional Access	For any other activities		RTD activities (1)	Demon- stration activities (2)	Consortiu m Managem ent activities (3)	Other specific activities					
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)		
5	USFD	AC	AC	Eligible costs	Direct costs (a)	90833			51250	14250		8000	164333
					of which subcontracting	0			0	0		0	0
					Indirect costs (b)	18167			10250	2850		1600	32867
					Total eligible costs (a)+(b)	109000			61500	17100		9600	197200
				Requested EC contribution	109000			61500	17100		9600	197200	
6	CTU		AC	Eligible costs	Direct costs (a)	3333			3150				6483
					of which subcontracting	0			0				0
					Indirect costs (b)	667			630				1297
					Total eligible costs (a)+(b)	4000			3780				7780
				Requested EC contribution	4000			3780				7780	
7	SDU		AC	Eligible costs	Direct costs (a)				15000				15000
					of which subcontracting				0				0
					Indirect costs (b)				3000				3000
					Total eligible costs (a)+(b)				18000				18000
				Requested EC contribution				18000				18000	
8	JYU		AC	Eligible costs	Direct costs (a)	3333			3150				6483
					of which subcontracting	0			0				0
					Indirect costs (b)	667			630				1297
					Total eligible costs (a)+(b)	4000			3780				7780
				Requested EC contribution	4000			3780				7780	
TOTAL				Eligible costs									
				Requested EC contribution									

Financial information – “Reporting period 1 + first six months of Reporting period 2”															
Participant n°	Organisation short name	Cost model used		Estimated eligible costs and requested EC contribution (first 18 months of the project)	Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts		
		For transnational Access	For any other activities		RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Other specific activities							
								Coordination/Networking (4)	Transnational access (5)	Connectivity (6)	Other including Specific Service Activities for CND (7)				
9	MPI		AC	Eligible costs	Direct costs (a)	50000				18150				68150	
					of which subcontracting	0				0			0		
					Indirect costs (b)	10000				3630				13630	
					Total eligible costs (a)+(b)	60000				21780				81780	
				Requested EC contribution	60000				21780				81780		
10	TUM		FC	Eligible costs	Direct costs (a)					5600				5600	
					of which subcontracting					0				0	
					Indirect costs (b)					0				0	
					Total eligible costs (a)+(b)					5600				5600	
				Requested EC contribution					5600				5600		
11	EKUT		FC	Eligible costs	Direct costs (a)	6667				70080				76747	
					of which subcontracting	0				0				0	
					Indirect costs (b)	1333				0				1333	
					Total eligible costs (a)+(b)	8000				70080				78080	
				Requested EC contribution	4000				70080				74080		
TOTAL				Eligible costs											
				Requested EC contribution											

Financial information – “Reporting period 1 + first six months of Reporting period 2”																					
Particip- ant n°	Organi- sation short name	Cost model used		Estimated eligible costs and requested EC contribution (first 18 months of the project)	Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3) +(4)+(5)+(6) +(7)	Total receipts								
		For transnat ional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities													
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)										
12	AUTH		FC	Eligible costs	Direct costs (a)								2800						2800		
					of which subcontracting												0				0
					Indirect costs (b)												0				0
					Total eligible costs (a)+(b)												2800				2800
				Requested EC contribution												2800				2800	
13	INFN		FC	Eligible costs	Direct costs (a)	24330													24330		
					of which subcontracting	0														0	
					Indirect costs (b)	4870															4870
					Total eligible costs (a)+(b)	29200															29200
				Requested EC contribution	14600															14600	
14	EGO		FC	Eligible costs	Direct costs (a)								162000						162000		
					of which subcontracting																
					Indirect costs (b)												3000				3000
					Total eligible costs (a)+(b)												165000				165000
				Requested EC contribution												165000				165000	
15	MiniGRA IL		AC	Eligible costs	Direct costs (a)	54317							1050						55367		
					of which subcontracting	0											0			0	
					Indirect costs (b)	10863											210				11073
					Total eligible costs (a)+(b)	65180											1260				66440
				Requested EC contribution	65180											1260				66440	
TOTAL				Eligible costs																	
				Requested EC contribution																	

Financial information – “Reporting period 1 + first six months of Reporting period 2”														
Particip- ant n°	Organi- sation short name	Cost model used		Estimated eligible costs and requested EC contribution (first 18 months of the project)	Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3) +(4)+(5)+(6) +(7)	Total receipts	
		For transnat ional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities						
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)			
16	FMFI-UK		AC	Eligible costs	Direct costs (a)	3333				3150			6483	
					of which subcontracting	0				0		0		
					Indirect costs (b)	667				630		1297		
					Total eligible costs (a)+(b)	4000				3780		7780		
				Requested EC contribution	4000				3780		7780			
17	CERN		AC	Eligible costs	Direct costs (a)					15000			15000	
					of which subcontracting					0		0		
					Indirect costs (b)					3000		3000		
					Total eligible costs (a)+(b)					18000		18000		
				Requested EC contribution					18000		18000			
18	BU		AC	Eligible costs	Direct costs (a)					1917			1917	
					of which subcontracting					0		0		
					Indirect costs (b)					383		383		
					Total eligible costs (a)+(b)					2300		2300		
				Requested EC contribution					2300		2300			
19	UG		AC	Eligible costs	Direct costs (a)	52650							52650	
					of which subcontracting	0						0		
					Indirect costs (b)	10530						10530		
					Total eligible costs (a)+(b)	63180						63180		
				Requested EC contribution	63180						63180			
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – “Reporting period 1 + first six months of Reporting period 2”															
Particip- ant n°	Organi- sation short name	Cost model used		Estimated eligible costs and requested EC contribution (first 18 months of the project)	Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3) +(4)+(5)+(6) +(7)	Total receipts		
		For transnat ional Access	For any other activities		RTD activities (1)	Demonstr ation activities (2)	Consortiu m Managem ent activities (3)	Other specific activities							
								Coordinati on/Networ king (4)	Transnatio nal access (5)	Connectivi ty (6)	Other including Specific Service Activities for CND (7)				
20	UCL		AC	Eligible costs	<i>Direct costs (a)</i>	4167				1050				5220	
					<i>of which subcontracting</i>	0				0				0	
					<i>Indirect costs (b)</i>	833				210				1040	
					<i>Total eligible costs (a)+(b)</i>	5000				1260				6260	
					Requested EC contribution	5000				1260				6260	
				Eligible costs	<i>Direct costs (a)</i>										
					<i>of which subcontracting</i>										
					<i>Indirect costs (b)</i>										
					<i>Total eligible costs (a)+(b)</i>										
				Requested EC contribution											
				Eligible costs	<i>Direct costs (a)</i>										
					<i>of which subcontracting</i>										
					<i>Indirect costs (b)</i>										
					<i>Total eligible costs (a)+(b)</i>										
				Requested EC contribution											
TOTAL				Eligible costs		2 108 960		595 100	644 500	87 273		117 627	3 553 460		
				Requested EC contribution		1 698 360		130 000	644 500	87 273		117 627	2 677 760		