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THE GRAVITATIONAL VOICE
News from EGO and VIRGO

Special edition

VIRGO

Proposal for the construction

of a large interferometric

detector of Gravitational Waves

Submitted : May 1989

VIRGO 20TH ANNIVERSARY

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The content of this newsletter does not necessarily represent the opinion of the management.

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SPECIAL ANNIVERSARY EDITION

EDITORIAL

When Alain Brillet proposed to celebrate the 20th anniversary of the Virgo Proposal (May 1989) in the next issue of *h* I accepted immediately; I then relayed the idea to my editor colleagues, which then finally became this special "Anniversary Edition". It has to be read, hence, as a story of recollection, not as an information document. It may be more touching for a few of us, who were already here in the very early times, but it is implicitly also a grateful thanking to the many who joined along the road; only the strength acquired through the number and competences of the people involved made the approval and the funding of Virgo and, later, of EGO possible.

This Anniversary Issue contains a few articles written by Alain Brillet and Adalberto Giazotto, the reproduction of some relevant pages from official documents and a few "historical" pictures.

The next regular issue, *h*12, will follow on the 1st of July.

In this Anniversary Edition it is due to mention another very important "gravitational" anniversary happening this month: the 90th anniversary of the first experimental verification of General Relativity, during the solar eclipse of May 29, 1919 (http://en.wikipedia.org/wiki/Tests_of_general_relativity, http://arxiv.org/PS_cache/astro-ph/pdf/0102/0102462v1.pdf). At that occasion Sir Arthur Eddington organized an expedition to the Principe African Island to observe, successfully, the deviation of light by the mass of the Sun. This date will be celebrated by a dedicated ceremony promoted by the International Year of Astronomy 2009, together with the local authorities of Principe Island (http://www.astronomy2009.org/globalprojects/specialprojects/1919/, http://www.1919eclipse.org/1919eclipse.php). On the last page of this *h* issue we publish an illustration taken from the 22 November 1919 edition of the Illustrated London News.

C. BRADASCHIA

Anniversaries by Alain Brillet

We are celebrating a double anniversary: 20 years ago (May 1989) since the publication of the Virgo proposal, and 15 years (June 1994) since the signature of the agreement, between the directors of INFN and CNRS, to build Virgo in Cascina.

The proposal had 47 authors, many of them theoreticians and astrophysicists, and a few experimentalists, mainly from Pisa, Orsay, and Napoli/Salerno.
From the initial authors, a dozen are still present in the Virgo collaboration.
The proposal ended an R&D phase, which had started independently in Pisa and Orsay, about ten years earlier.

Before Virgo, early studies in Orsay: 1979-1985

In Orsay, the project to get involved in GW detection goes back to the second Marcel Grossman meeting (Trieste 1979), when Alain Brillet (AB), who was presenting the results of an advanced Michelson-Morley experiment, met Ron Drever and members of the Garching group (A.Rüdiger, R.Schilling), reporting on their small prototypes. They all had been developing Weber bars for many years, and were beginning to work with small prototype interferometers: while other teams in Italy, Australia and in the USA were beginning to fight thermal noise by cooling their bars, they were beginning to play with interferometers.

Their first results were encouraging, Ron had lots of new ideas (recycling, among them), the Germans too, (they reported on their first mode-cleaner), but they were not yet experts in optics and lasers (the first mode cleaner was a degenerate confocal Fabry-Perot cavity!). Their research was important, challenging, well in line with our previous activity in laser frequency metrology. Jean Yves Vinet (JYV), after a thesis dedicated to the comparative study of various resonant GW detectors, became interested in interferometers and managed to work at it half time, and Nary Man (CNM), in the middle of her PhD work, was willing to join, so we started evaluating the fundamental limitations of interferometers, and trying to understand the technical difficulties. Rai Weiss played a very important role in that decision. In 1973, he had produced a detailed study of the noise sources in a GW interferometer. His team was operating a small prototype, but NSF was not yet providing strong support to that activity, and he had become strongly involved in space projects (IRAS, COBE). Yet, when AB visited him for the first time, in 1981, Rai was very friendly, encouraging, and helpful: he spent two full days explaining his views about large interferometers, and provided copies of many documents, including unpublished noise calculations (as he had probably done before with the Garching team). He was clearly pushing for a wide international collaboration in the field, and always continued in that direction: he hired David Shoemaker after his PhD in Orsay, sent us remarkable post-docs (Dan Dewey, and later Peter Fritschel), shared other activities with JY Vinet (scattered light noise and mitigation), and still tries to maintain an active and friendly international collaboration, rather than competition. With the support of a few well known colleagues, like Thibault Damour, Philippe Tourrenc, Christian Bordé, Claude Cohen-Tannoudji, we were able to start working on the laser and optics for a GW detector from the beginning of the 80s, using some funding from each of the physics departments of CNRS and from the French military; they were initially interested in understanding whether GWs could be used to communicate with submarines, and then interested by the development of new, high power, lasers.

We started an effort on lasers and optical metrology. At that time, the search for GWs was focussed on supenovae emitting at 1 kHz and more: then seismic isolation looked like a relatively simple problem and the main challenge was to convince the community that it could be possible to split the dark fringe into more than ten billion, which required an incredibly stable and powerful laser. In that frequency range, the main noise sources to be considered were shot noise and laser noise, and the difficult problem was apparently to build a stable high power laser, in addition to using the "recycling" techniques proposed by Ron Drever, but not yet proven by an experiment or even by a calculation.

At the beginning of the 80s, we jumped on Ron Drever's idea and began to look also at the optical problems, including mirror quality, mode cleaners, radiation pressure, laser noises, …The only high power single frequency lasers available at that time were Argon lasers (expensive monsters requiring many tens of kW of electric power to generate a few Watts of green light). Nary Man used it for a few years, to demonstrate injection locking as a path towards high power, to demonstrate the shot noise limited sensitivity of a Michelson-Fabry-Perot interferometer (up to 2 Watts), and to experimentally prove, for the first time, the efficiency of power recycling.

Argon lasers were noisy and unreliable, and we quickly began to study diode pumped Nd-YAG lasers, when we learned that they could emit a few hundred mW, but that multiwatt systems would soon be available, pushed by military applications (Star Wars). The first PhD student we took to start that work was David Shoemaker, who moved back to MIT after he got his diploma. By 1989, our prototype injection locked Nd-YAG laser was reaching a world record of 18W. Meanwhile, among other modelling activities, JYV was developing our first FFT light propagation code (ancestor of DarkF and of LIGO and GEO propagation programs), with his student Patrice Hello. This work led us to the definition and the specifications of the optical components and made us understand the benefit of working with infrared wavelength, rather than green light; at the same power level, the shot noise power is proportional to the wavelength, but scattering losses are inversely proportional to the inverse square of the wavelength, so that, for the same input power, the sensitivity increases with the wavelength.

Another consequence of the optical modelling studies was the evidence that the contrast defect would be dominated by the generation of high order modes, so that the (shot) noise level and the ability to control the interferometer would be improved by the addition of an output mode-cleaner.

It also revealed a big problem: the specifications of the mirrors were too stringent: by lack of adequate metrology, and because we would be the only customers, none of the European manufacturer were interested in solving it. The solution came later, in 1991-1992, when the teams of Jean Marie Mackowski and Claude Boccara joined the project.

Before Virgo, early studies in Pisa: 1980-1987

In the year 1980 Adalberto Giazotto (AG) started to think of the possibility of building a GW detector with a high sensitivity also at low frequency; the triggers for this idea were the data of several radio-telescopes detecting an enormous number of Pulsars at very low frequency. The number spectrum of Pulsars was extremely peaked toward low frequency, less than 1 Hz, mainly due to rotation slowing down acting since their very creation time; the striking thing was the existence of some tens of Pulsars with a rotation frequency above 5Hz, and hence, able to emit GW with a frequency larger than 10 Hz. Today this number has increased consistently due to extensive radio-telescope observations; at that time this evidence was already a scientific case strong enough to propose to INFN R&D-experiments the construction of a GW detector sensitive enough from 10 Hz onward. At such low frequencies the first enemy to beat was seismic noise and the aim of defeating this noise gave birth to the IRAS (Interfe-rometer for the Active Reduction of Seism) project.

The first competition was with Ron Drever: at Glasgow, he was realizing an active pendulum the length of which was increased by feedback to a piezo, displacing the pendulum suspension point; the correction signal was obtained by measuring the pendulum mass displacement. They obtained a pendulum virtual length increase to 5m. With IRAS, in which mass displacement was measured interferometrically, we started to obtain a much larger pendulum virtual length increase. AG presented first results of this experiment at MG4 in June 1985. (*Performance of an active pendulum with interferometric sensing* - A. Giazotto, E. Campani, D. Passuello, A. Stefanini - Proceedings of the 4th Marcel Grossman Meeting on general relativity, Rome, June 1985).

This presentation at MG4 was certainly programmed by fate because it is there that AG met AB for the first time, and there, walking together around Minerva Fountain at La Sapienza in Rome, they decided to start working on the realisation of a "3 km arm Fabry-Perot interferometer, with high sensitivity at low frequency"; at that time the name "Virgo" was still unknown.

Back to Pisa, tests on an interferometric pendulum continued and, finally, a virtual increase to one mile was obtained. This was a very relevant result for two reasons, the first being that we acquired a good reputation in a completely new field of research, i.e. GW, completely new for Pisa INFN section (the realm of High Energy particle physics, from which AG was also coming); second, was the evidence that, due to the high complexity of this kind of apparatus, it would have been impossible to reach the required seismic noise attenuation at 10 Hz: IRAS attenuation was 10^{-3} while the attenuation required for our future ITF was 10^{-10}-10^{-12}. This evidence almost stopped our activity; but one point was clearly emerging: whatever chain of filters is used for seismic isolation, every filter should attenuate in all 6 degrees of freedom of a rigid body, i.e. 3 translations and 3 rotations. With this clear concept in mind the IRAS group started to design mechanical filters isolating in 6 DOFs. The purpose was to create a chain of several filters able to support a 400 kg payload and with the required attenuation at 10 Hz. It was named by Hans Kautzky "Superattenuator" (SA) and the complete system was a real monster: it was composed of two chains of seven 100 kg gas spring filters, 8 m tall and under vacuum, the payload being two 400 kg brass cylinders appended to the chains. The idea was to measure the remnant noise interferometrically, but a very sensitive accelerometer, home built, was also attached to one of the two masses. We still remember the noise in the accelerometer before the vacuum was turned on, it was relatively high with a lot of structures; when we turned on the pumping system, since no signal with some structure emerged anymore from the accelerometer, we thought that something was broken. Suddenly we realized that probably we had the most silenced object on Earth, and the emotion was overwhelming. But the big problem was how to measure the real attenuation at several frequencies; we tried hitting the vacuum tank at the Superattenuator suspension point with heavy hammers, but no visible signal was present in the accelerometer. The strongest excitation was obtained connecting a motor with an eccentric mass, through a metal bellow, to the wire from the top filter to the second one; large motor vibrations, measured with an accelerometer, excited the SA top wire. Still no remnant signal was visible in the suspended accelerometer in the range 10-60 Hz (*First results from the Pisa seismic noise super-attenuator for low frequency gravitational wave detection* - R. Del Fabbro, A. Di Virgilio, A. Giazotto, H. Kautzky, V. Montelatici, D. Passuello - **Phys. Lett. A** 132, 237 (1988)).

This was a big result, the SA picture was also printed in a famous J. Weeler book on gravity; but the biggest result was that INFN Scientific National Commission 2, financing IRAS, was starting to seriously consider our idea of building a 3 km interferometer with mirrors suspended to SAs.

In the final version of SA (the present one) gas springs were abandoned and metal blades were adopted as elastic elements together with magnetic anti-springs for reducing metal blade stiffness.

VIRGO

Proposal for the construction of a large interferometric detector of Gravitational waves

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Revised version January 1990

Interferometric detection of gravitational waves

monomode optical fiber OF. The injection is performed by means of the microscope objective M; the λ/2 plate and the polarizer P restore the plane polarization.

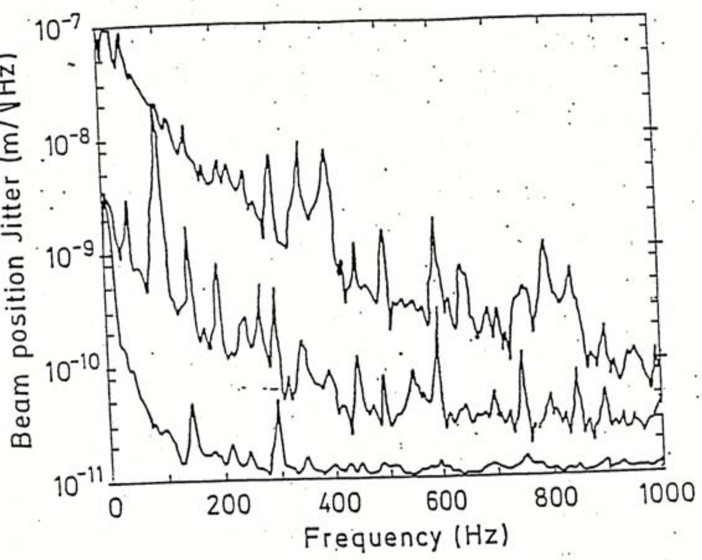

Fig.2.8.2
The lateral beam jitter (from Shoemaker et al.[1985]) as measured with a position sensitive diode; the upper curve is the unfiltered laser beam, the middle one represents the beam jitter after a mode cleaner and the lower represents the jitter after a monomode optical fiber.

Virgo proposal: 1985-1989

As already mentioned before, Pisa and Orsay met accidentally at the 4th Marcel Grossman meeting in Rome (1985). AB and AG immediately realised the complementarity of the two teams, and decided to join together for the (Italian-French) project of a wideband interferometric detector. In spite of a few European meetings, and a good collaboration with German and British colleagues through 2 European grants, we were actually pushed in the direction of a bi-national project, rather than a joint two-detector European project, by the fact that the German team at Garching and the British team (mainly at Glasgow) were pushing their own national projects, and feared that the settlement of a European collaboration would delay their acceptation.

In Italy, INFN and its president, Nicola Cabibbo, were initially rather enthusiastic about our collaboration. Commission II was able to support in parallel the cryogenic resonant bar effort and the Pisa IRAS experiment, and was even willing to consider the possibility of developing a large Italian interferometer. The collaboration for Virgo construction started around 1986-87; the Pisa group, joined by groups from Naples University, led by Leopoldo Milano, from Frascati INFN Laboratory, led by Gianni Matone, and from Perugia University led by Fabio Marchesoni, were forming the hard kernel of Virgo on the Italian side. The scientific and financial control body was INFN Scientific National Commission 2, and twice per year AG and AB had to present status reports both for IRAS and Virgo. In France, the situation was different: each of the four physics departments of CNRS had supported our small scale initial efforts, but none of them was willing to fund a large project (although the first cost estimate we made in 1984, for a 1 km interferometer, was underestimated by a large factor). The president of IN2P3, Pierre Lehmann, was very interested, but could not decide to support a project as long as no particle or nuclear physicist was involved, so that, between 1985 and 1989, it looked clear that the interferometer, if any, would be built in Italy, by INFN. This is when the site of Cascina was selected. Between 1985 and 1988, the Pisa team were able to finish the construction of, and start testing, two complete superattenuators in a new dedicated building, in San Piero, the Orsay team was performing optical and modelling studies, while Napoli/Salerno were beginning to study alignment procedures.

Simultaneously, we were writing the "Proposal", that we would finally submit to CNRS and INFN in May 1989.

Chapter 3.1

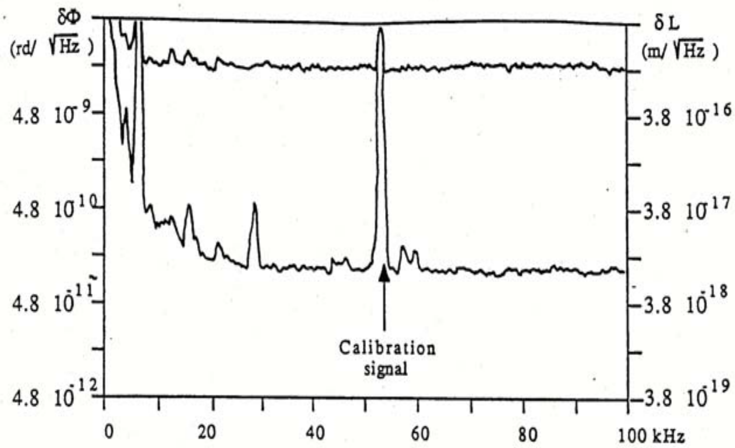

Fig.3.1.15 : Spectral density of length fluctuations of a Michelson interferometer

top curve : simple MITF

bottom curve : with Fabry-Perot cavity in both arms

(the left scale is valid only for the top curve)

Fig 3.1.14 shows the block diagram of this experiment, and Fig 3.1.15 shows the spectral density of the path-length difference of the MITF, in the frequency range 0 to 100 kHz, both for the simple MITF and for the MITF with the Fabry-Perot cavities in each arm. The improvement by two orders of magnitude of the mirror displacement sensitivity is exactly the expected result

Recycling experiments have been done in Orsay, (Man et al.[1987]) and in Garching (Schnupp et al [1987]); with a typical overall loss of 1% and a recycling mirror $T_r = 2\%$, we have achieved a recycling factor of 40.

External modulations using one and two photodiodes have been tested in Orsay in a recycling MITF. The optical configuration used in those experiments corresponds to the scheme of Fig.3.1.12 : the external light is derived from an extra reflection of the beamsplitter, so it has travelled the same way as that of the MITF arms. We effectively checked out that there were no extra sensitivity to the laser frequency fluctuations (Man et al.[1988]).

In this experiment, we encountered a power limitation above which we observed optical damage on the beamsplitter This limitation appeared for an incident power of 0.3W, corresponding to a stored power of 12W. This is quite encouraging, because, although we did not use "supercoatings", this corresponds to an intensity of 6kW/cm²

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3.4 SEISMIC ISOLATION AND THERMAL NOISE

3.4.1 SEISMIC ATTENUATION, SOME RESULTS

A full scale suspension system for the VIRGO project has been built and tested at the INFN PISA Laboratory. This system is called a Super Attenuator (SA).

The SA system consists in a cascade of 7 vertical gas springs, each weighing 100 Kg, connected to vertical wires ≅ .7 m long each as shown in Fig.3.4.1.

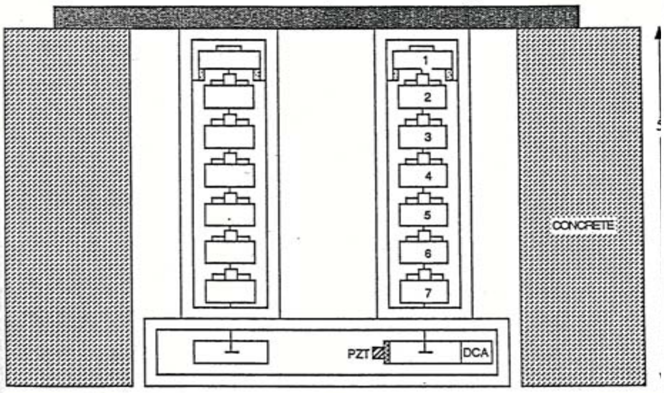

Fig. 3.4.1 Schematic diagrams of the experimental apparatus. The two SA chains are suspended in the two vertical vacuum chambers. The two 400 Kg brass test masses, contained in the horizontal vacuum chamber, are also shown. The deep coil accelerometer (DCA) and a calibrating piezo (PZT) are shown attached to the right test mass.

The SA can levitate heavy 400 Kg mirrors which can be useful for reducing the thermal noise.

The necessity to create a seismic isolation scheme allowing the suspension of mirrors weighing up to 400 Kg and giving 3 dimensional attenuation of 10^{-9} at 10 Hz

Fig. 3.4.12 shows a section of a vacuum chamber with inside an SA chain.

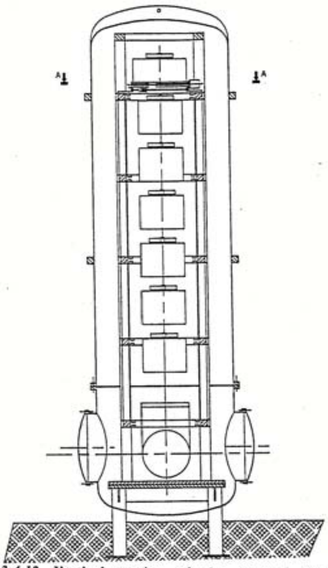

Fig. 3.4.12 Vertical section of the vacuum chamber with the SA chain inside.
The vessel of the top gas spring is solidal to the chamber; it is mounted on xy table having ±10 cm displacement on the horizontal plane. The horizontal section to defferentiate the vacuum of the mirror is also visible.

As it is shown in Fig. 3.4.12 the top gas spring of the chain is solidal to the vacuum chamber; it is mounted on a xy table having ±10 cm displacement range on the horizontal plate in order to compensate the horizontal displacements of the suspension point larger than those corrected by the steering system. The chamber is divided in two sections having differentiated vacuum, as it will be explained in section 3.6.

September 1991

ANNEX

The French and Italian teams, led by A. BRILLET and A. GIAZOTTO have obtained advanced results concerning :

- the neodymium power lasers and their frequency stabilisation;
- the light recycling scheme (first demonstrated by the collaboration);
- the achievement of the "super-attenuators" of seismic noises demonstrating for the first time that the antenna can be operated in a frequency range with a lower edge as low as 10 Hz.

The teams propose the following main characteristics for VIRGO:

- two arms, each one 3 km long;
- each arm equipped with a Fabry-Perot of finesse 40;
- a special Nd:YAG laser operating at the fundamental 1μm wavelength and with a frequency spectral amplitude brought to 10^{-7} $Hz^{-1/2}$;
- very low frequency seismic noise "super-attenuators";
- bandwith spanning from 10 Hz to 3 kHz;
- sensitibity goals of

  $h < 3x10^{-23}$ $Hz^{-1/2}$ at 1 kHz.
  $h < 5x10^{-25}$ at 10 Hz (1 year integration time),

  this corresponds to an expectation of a few supernovae and/or binary collapses per year.

VIRGO PROJECT

September 1991

Expression of common interest

by

"CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE" (CNRS)

and

"ISTITUTO NAZIONALE DI FISICA NUCLEARE" (INFN)

Considering that the detection of gravitational waves would provide :

- in the field of fundamental physics :

  - a direct proof of the existence of gravitational radiation;
  - a proof of the tensor character of the gravitational field;

- in the field of astronomy and astrophysics :

  - new means of observing distant objects, the third means besides electromagnetic waves and neutrinos; this new means of observation will be unique for highly energetic phenomena such as collapses of supernovae and close binaries;

Considering that a collaboration exists since several years between French and Italian teams, with complementary expertise, and that advanced results have been obtained - cf. Annex

CNRS and INFN

express their common interest in continuing the studies in view of building and operating together the VIRGO antenna;

express their common interest in acquiring new partnerships (terms and conditions to be agreed upon);

agree that the collaboration will make all efforts in view of setting-up proper connections with other antenna projects;

agree to promote the setting up of an European ad-hoc Committee to organise an effective coordination between the representatives of the funded gravitational antenna projects in Europe;

agree to promote in the appropriate time the same coordination with the US project;

understand that a major step toward the complete definition of the project will be the "Final Design" of VIRGO;

agree that any further decision can be taken only after the analysis and discussion of the Final Design.

For CNRS
Dr F. KOURILSKY
(Director General)

Paris, 27 Sept 1991

For INFN
Prof. N. CABIBBO
(President)

Rome, 27/9/91

The approval: June 27, 1994

By autumn 1989 CNRS had created a small committee to evaluate the Virgo proposal. The chairman of the evaluation committee was Patrick Fleury, a high energy physicist: he started a very detailed study to understand all aspects of the project. Initially very critical, he sought advice from all kinds of physicists, visited (with AB) all the main GW projects and their institutions, and, from spring 1990, ended strongly supporting the project, only asking for a wider collaboration. Although the decision-making process was much more advanced for LIGO, he had understood that Virgo was ahead on some points (suspensions, lasers, optical design), and that it would anyway be important to operate a few detectors in coincidence. Meanwhile, with the support of P. Lehmann, French high energy physicists had moved in the direction of Virgo: at LAPP, a small team led by Michel Yvert, which had previously started imagining an original detector based on capacitance measurements, had understood that this would not compete with interferometry, and had decided to join Virgo. It was quickly followed by a LAL team, led by Michel Davier, and the original Orsay team joined LAL at the end of 1990. The situation was a bit confusing over the next few years, for two main reasons: We had to justify the fact that we would not build a prototype, like the Germans, the British, the Americans and the Japanese did: our argument was that it was much more useful and faster to test full size elements, like a superattenuator, a high power laser, a large mirror, etc, rather than to operate a mid-size interferometer with mid-size components, solve their specific problems, and then start again with a different, full-size, system. This was initially considered as crazy, then risky, and finally as reasonable.


Seminario di fisici italiani e francesi

Un'antenna scoprirà le origini del cosmo

Although the Virgo proposal was clearly bi-national, and although INFN had quickly included the Virgo project in its next quinquennial plan, CNRS and INFN kept progressing rather independently, so that the INFN management was a bit surprised when the French minister, Hubert Curien, announced his approval of the project, by June 1992. The first Italian-French structure, the "Provisional Virgo Council", was created in April 1993, and final approval from INFN arrived in September. CNRS itself was not yet ready to start the project: most of the manpower involved in the project, except the original team, belonged to IN2P3, but it was not clear which CNRS department or institute was supposed to support the project.

A few more months were needed to write and approve the final agreement between INFN and CNRS, which was signed by the directors Luciano Maiani and François Kourilsky on June 27th, 1994, fifteen years ago.

Then the construction could start. But that is another story…

Signatures of the Virgo approval

La firma dell'accordo tra Luciano Maiani e Francois Kourlisky

ACCORD
concernant la Réalisation de
l'Antenne de Détection
des Ondes Gravitationnelles
VIRGO

Le Centre national de la Recherche scientifique, Etablissement Public à caractère Scientifique et Technologique - ci-après désigné par les initiales CNRS et dont le siège social est sis 3, rue Michel-Ange, F75794 Paris Cedex 16, représenté par son Directeur Général, M. François Kourilsky,

et

l'Istituto Nazionale di Fisica Nucleare, institut publique pour la recherche scientifique - ci-après désigné par les initiales INFN et dont le siège social est sis via Enrico Fermi 40, I 00044 Frascati, représenté par son Président, M. Luciano Maiani,

ci-après désignés les Parties ;

CONSIDÉRANT que la détection des ondes gravitationnelles offrira

dans le domaine de la physique fondamentale

- une preuve directe de l'existence des ondes gravitationnelles ;
- un mode d'investigation des caractéristiques tensorielles du champ gravitationnel ;

dans le domaine de l'astronomie et de l'astrophysique

- un nouveau moyen d'observation des objets lointains, en sus des ondes électromagnétiques et des neutrinos ; il s'agira d'un instrument unique pour la détection des phénomènes très énergétiques tels que l'effondrement des supernovae et des binaires serrées ;

CONSIDÉRANT qu'une collaboration dans ce domaine existe déjà depuis de nombreuses années entre scientifiques français et italiens ;

- 1 -

conseguenza il presente Accordo sarà modificato tramite una clausola aggiuntiva.

ARTICOLO 14 - CONTROVERSIE

Le Parti risolveranno amichevolmente ogni controversia che potrebbe risultare dalla interpretazione o dalla applicazione del presente Accordo.

ARTICOLO 15 - SCALA DEI TEMPI

La data di acquisizione del sito costituisce il tempo zero della scala dei tempi previsti per la realizzazione del progetto (Allegato B). Nel frattempo la progettazione e la realizzazione di prototipi di sottosistemi nonché altre attività definite dal Consiglio VIRGO, sono o potranno essere condotte senza relazione temporale con l'acquisizione del sito.

ARTICOLO 16 - ENTRATA IN VIGORE

Il presente Accordo entrerà in vigore dopo essere stato approvato dalle Autorità competenti delle Parti.

ARTICOLO 17 - DURATA

A meno che decidano di comune accordo di mettere fine alla loro collaborazione, le Parti si impegnano a partarla avanti, oltre alla fase di costruzione, per una durata minima di gestione di cinque anni, conformemente a quanto previsto dall'articolo 1. del presente Accordo.

ARTICOLO 18 - DISPOSIZIONI FINALI

Il presente Accordo é redatto in quattro esemplari originali, due in versione francese e due in versione italiana, entrambe facenti ugualmente fede.

Pisa li, 27 Juin 1994

Per il CNRS	Per l'INFN
François KOURILSKY	Prof. Luciano MAIANI
Direttore Generale	Presidente

Ministero dei Lavori Pubblici

DIREZIONE GENERALE DEL COORDINAMENTO TERRITORIALE

Prot. U.T. 647/727

VISTI gli articoli 12 e 13 della legge 25 giugno 1865, n.2359, sulla espropriazione per causa di pubblica utilità;

VISTO l'art.39 del R.D. 8 febbraio 1923, n.422;

VISTA la legge 17 agosto 1942, n.1150;

VISTO l'art.14 della legge 28 gennaio 1977, n.10;

VISTI gli artt.80 e 81 del D.P.R. 24 luglio 1977, n.616;

VISTO l'art.4 del D.P.R. 24 luglio 1977, n.617;

VISTA la deliberazione in data 3 agosto 1993 pubblicata sulla Gazzetta Ufficiale - Serie Speciale n.248 del 21 ottobre 1993, con la quale il Comitato Interministeriale per la Programmazione Economica ha approvato gli indirizzi generali e le linee operative del piano quinquennale dell'Istituto Nazionale di Fisica Nucleare per gli anni 1994 - 1998;

VISTA la risoluzione del 24 settembre 1993 con la quale il Consiglio Direttivo dell'I.N.F.N. ha approvato il progetto di costruzione di un interferometro per lo studio delle onde gravitazionali denominato "progetto Virgo", inserito nel citato piano quinquennale;

VISTA la nota 265/C/12 in data 11 aprile 1994 con la quale il Ministero della Ricerca Scientifica e Tecnologica - Servizio Vigilanza Enti, ha ritenuto il progetto "di alto interesse sotto il profilo scientifico e quindi di potere esprimere - ai fini del riconoscimento della pubblica utilità, indifferibilità ed urgenza delle relative opere - una valutazione senz'altro positiva sotto il profilo della congruità scientifica", prospettando altresì a questa amministrazione la necessità di avviare il procedimento

D E C R E T A:

Art.1 - Ai sensi e per gli effetti delle vigenti disposizioni di legge, le opere previste dal progetto "Virgo" citato nelle premesse, sono dichiarate di pubblica utilità, urgenti e indifferibili. I lavori e le relative espropriazioni avranno inizio entro otto mesi dalla data del presente decreto ed ultimati entro cinque anni dal loro inizio. Le occupazioni temporanee avranno durata limitata al quinquennio a far tempo dal giorno in cui hanno avuto luogo.

Art.2 - Il presente decreto viene pubblicato nella Gazzetta Ufficiale della Repubblica italiana.

Roma, 25 SET. 1995

IL MINISTRO

F.to Baratta

The observation of the 1919 eclipse as reported on the 22 November 1919 edition of the illustrated London News.