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THE GRAVITATIONAL VOICE

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Photo: M. D'Andrea (EGO)

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"h - The Gravitational Voice" is an internal publication of the European Gravitational Observatory (EGO) and the Virgo Collaboration.

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

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EDITORIAL

The old year is over and a new one has just started, but our life is never flat: we have news, good and worrying, we exclude the adjective "bad".

We have a new EGO director. Federico Ferrini has been with us for a few weeks, and we already feel very easy with him, as if we had been working together for much longer. We wish him a long and very satisfactory mandate, as was that of Jacques Colas. We are happy to publish an article by each of them.

Worries, we have a few: not having yet boosted the sensitivity as we were expecting with the new monolithic suspensions; not having yet confirmed the 2011 budget (although, happily, this worry has already passed); not having yet fully agreed the Advanced Virgo optical scheme. To list the major ones.

Hopes: we have many, at least we are confident of soon overcoming all of the problems and rapidly progressing forward.

As for surprises, well, we had a big snow-fall on December 17th, as shown in the cover page picture and, at the other extreme, a fire near the site, as covered in Fred's safety article, but let us hope that the best surprises are still to come…

C. BRADASCHIA

Safety Corner

Photo: H. Heitmann

The equipment present at the EGO site and the remoteness of the site from the Public Fire brigade makes fire hazards a topic of a paramount importance. Although the site is protected by fume detectors and auto-extinguishing systems events in the vicinity of the site, like those shown below, require attention and should be promptly reported to the Fire brigade to insure a quick intervention. In case of fire inside or in the vicinity of the site please call:

During normal working hours (09:00-18:00): EGO fire brigade at 2222 from any EGO phone.

Outside normal working hours (18:00-09:00): Fire Brigade 115.

F. RICHARD / C. FABOZZI

Optical cooling of solids

by Mauro Tonelli

As announced in *h* 16, in this issue we publish another article on "radiative cooling", this time describing a completely different physical process. In the *h* 16 article, by Roberto Passaquieti, the cooling effect was obtained by capturing the heat naturally radiated by a mirror while preventing the absorption of heat coming from the environment. In the following article, by Mauro Tonelli, the cooling effect is obtained if a material contains atoms with two different sets of energy levels, such that, absorbing a photon from a light source, the atom jumps to a level of the upper set. Then the atom acquires further energy (heat) from the surrounding matter; now, decaying to a level of the lower set it can lose more energy than that previously absorbed. The net energy balance is negative and the material cools down. This process may be useful to cool down the crystal fibres supporting a mirror, in order to reduce thermal noise.

Further articles will follow in the next issues of *h*, describing the opposite phenomenon: radiative heating and its application in Virgo, to correct the shape of the mirrors, as it comes from the fabrication process (curvature radius correction), or as it is changed by laser beam absorption (thermal compensation).

The optical cooling (that is obtained by shining light) of solids was first proposed in 1930, but the first real demonstration was only realized more than sixty years later [1], when powerful, tuneable laser sources were available.

In the last decade, several research groups have focused their activity on developing a fully solid-state cryocooler, based on optical cooling, because the achievable temperature range is functional for many applications, like high-Tc superconductors, infrared detectors, cooled electronic devices and would be well-suited also for space-based applications.

The basic idea of optical cooling takes advantage of the anti-Stokes luminescence. In this process a centre (like an active atom or ion) – after the absorption of a photon from an appropriate light source – thermally interacts with the surrounding matter and eventually spontaneously emits another photon at a different wavelength. The difference in energy between the absorbed and emitted photon produces an overall heating or cooling of the matrix surrounding the atom or ion.

If we define ν_f as the mean fluorescence frequency, when the "pumping" frequency ν of the light from the source is lower than ν_f, the average emitted energy is larger than the absorbed energy and the cooling efficiency of the sample is given by:

$$\eta_{cool} = \frac{P_{cool}}{P_{abs}} = \frac{h\nu_f - h\nu}{h\nu} \approx \frac{kT}{h\nu}$$

where kT represents the thermal energy absorbed from surrounding matter.

Figure 1 (below) shows the energy diagram of the ground and first excited manifolds (sets of energy levels) of the Yb^{3+} ions and energy path of one ion, as described before.

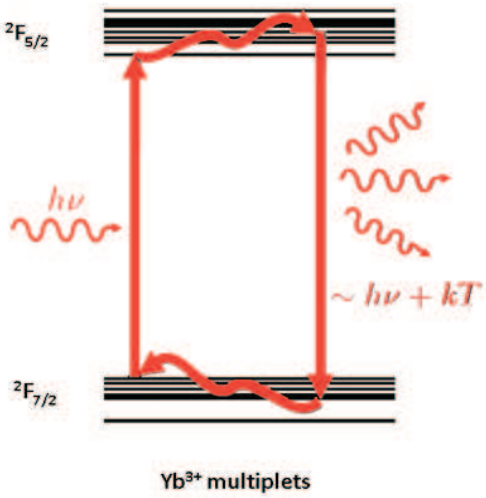


Figure 1

Figure 2 (next page) shows the absorption and emission spectra corresponding to these levels, recorded at room temperature, and plotted as a function of the wavelength, according to usual spectroscopic notation. The vertical line at ~1002 nm corresponds to λ_f, the mean fluorescence wavelength, defined as a function of the fluorescence emission intensity $I(\lambda_f)$ by:

$$\lambda_f = \frac{\int I(\lambda)\lambda d\lambda}{\int I(\lambda) d\lambda}$$

The mean fluorescence wavelength is related to the mean fluorescence frequency by $\lambda_f = c/\nu_f$.

The shaded tail of the absorption curve indicates the region corresponding to wavelengths larger than λ_f (that is frequencies smaller than ν_f) that can produce a net cooling.

It is obvious that this mechanism can produce a net cooling only when other detrimental processes are avoided: in particular, the presence of impurities and dislocations inside the material could produce different mechanisms of energy transfer, inhibiting the photon emission and producing a net heating of the material even when the pump and the absorption spectra are favourably arranged as in figure 2.

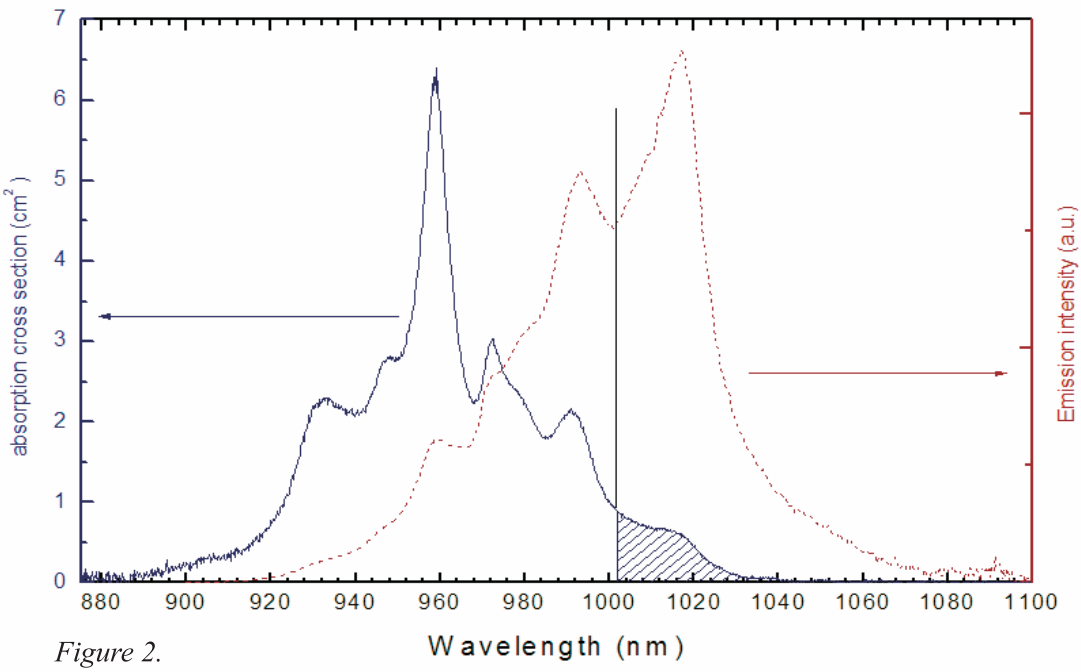


Figure 2.

According to these facts, in order to obtain cooling it is necessary to use a suitable material, doped with centres having absorption and fluorescence spectra overlapped, free of impurities and defects so that the anti-Stokes may be very efficient.

All these arguments suggest some trivalent rare earths ions like Yb^{3+}, Er^{3+}, Tm^{3+}, Ho^{3+}, and Dy^{3+}, as good centres. Among these, a particparticular place is reserved to $Yb^{3+}$and Tm^{3+}, because their absorption spectra match with the emission curve of powerful and tune-able lasers.

For this reason, the first material used in the demonstration of optical cooling of solids was a glass doped with Yb^{3+}, the ZBLAN [1]. Other materials - always doped with Yb^{3+} – have been tested over the years, both glasses and crystals. Actually, the main problem with glasses is their poor mechanical characteristics (ZBLAN is hygroscopic), so an optical cryocooler based on a crystal is more reliable.

Up to now, the cooling has been obtained in both oxides and fluorides crystals, but the former show poorer results. The reason can be attributed both to the higher phonon energy and to the higher refractive index of oxides.

The first results obtained in the past with Yb^{3+} doped glasses (ZBLAN) and disordered oxide crystals ($KGd(WO_4)_2$) are reported in 1995 [1] and in 2000. The record of the maximum cooling obtained in a glass was obtained in 2005, when the temperature of 208 K was reached by starting from room temperature.

In the last decade, new materials have been studied and developed for optical cooling, with these particular characteristics:

- Low energy phonon (to obtain minimum quenching of the optical transition).
- Low refraction index to reduce the radiation trapping inside the cooling sample.
- Good thermo-mechanical characteristics.
- No hygroscopic characteristics.
- Very low background absorption.

At the Physics Department of Pisa University we have developed fluoride crystals doped with rare earths, satisfying these particular characteristics: in particular fluorides have a typical refraction index of ~1.5 (in comparison oxide materials show a refraction index of about 2).

These materials have been grown in special high vacuum Czochralski furnaces, to avoid the contamination of OH radicals: a few parts per million of OH is sufficient to reduce their efficiency. Moreover, it is necessary to grow the samples with particular care to avoid microbubbles inside the crystals, because these can turn on scattering centres and induce heating when the samples are optically pumped.

To obtain these results, a temperature stability below 0.1 K during the growth process is necessary. In this condition we obtain crystals with a background absorption lower than 10-4 cm-1 corresponding to high quality samples and to a material with a good cooling potentiality.

We studied three different crystals doped with Yb^{3+} and Tm^{3+} in particular $LiYF_4$:5% Yb^{3+}, BaY_2F_8:2.5% Yb^{3+} and BaY_2F_8: 1.2%Tm^{3+} in a simple cooling apparatus, where the sample is pumped in a single pass, and we have obtained a temperature drop of 6, 4 and 3 K respectively. The typical growth temperature of these crystals ranges between 800 and 1000 C.

To increase the cooling effect we have developed a multipass system. In this case the sample is placed inside a resonator: to improve the pumping energy the resonator is an

active Fabry-Perot, locked in order to maintain the resonance condition. The pump source is a YAG:Yb disc laser, tuned in the tail at 1022 nm. Figure 3 shows the sample, a $LiYF_4$:5% Yb^{3+} crystal, and figure 4 shows the multipass structure, with the resonant control system and the differential luminescence thermometry (DLT), the system to measure the temperature of the sample.

Figure 3

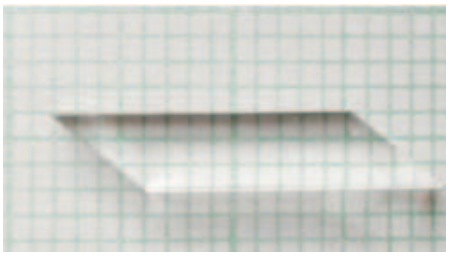
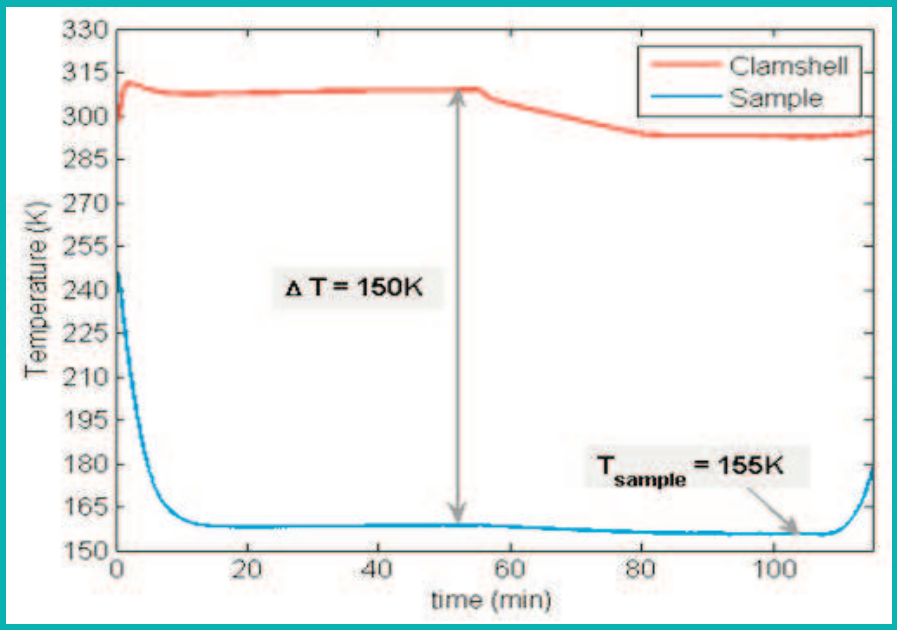


Figure 5 shows the cooling process as a function of time.



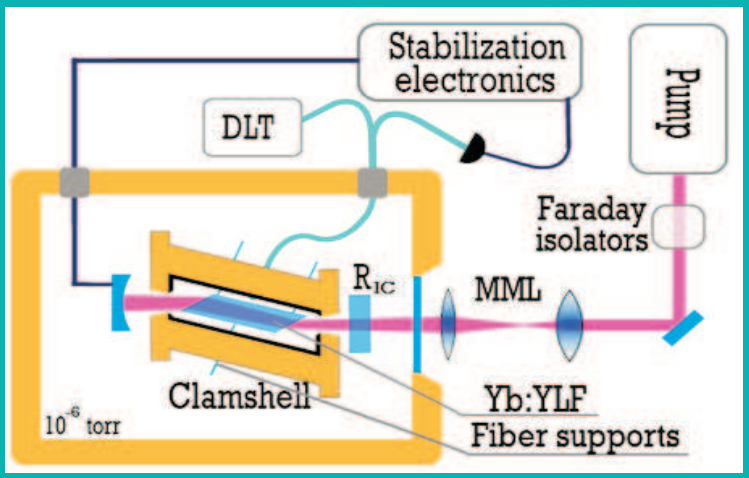


Figure 4

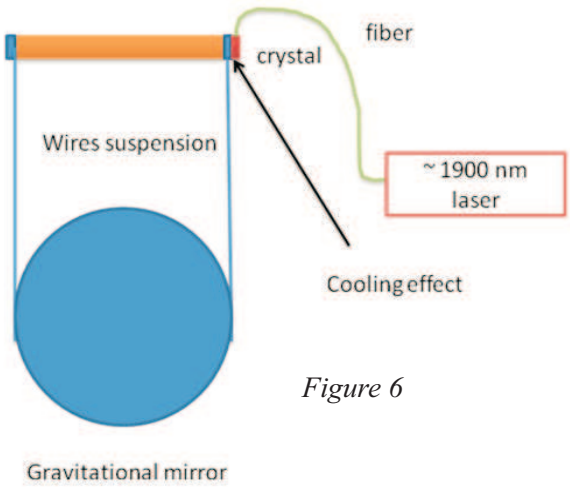


Figure 6

With this experimental apparatus, in 2009, we have cooled the sample down to the absolute temperature of 155 K , by starting from room temperature [2].
This result was the first demonstration that optical cooling can reach temperature below the minimum obtainable with a thermo-electric cooler, so breaking the "Peltier barrier".

The power removed from the sample was about 90 mW, and this allows to obtain an optical cooler with a true payload: in a successive work, we obtained the cooling to 165 K of a semiconductor device thermally connected to the cooled crystals. The last (preliminary) results show a limiting temperature of ~110 K, near the value predicted by the theory.

This result can be applied, for example, to cool the bending point of the wire supporting a mirror of a gravitational interferometer and so to reduce the thermal noise at low frequency. In the arrangement sketched in figure 6, a crystal of YLF or BYF doped with $Tm^{3+}$is connected with the clamping structure of the wire and cools this part. The crystal can be pumped by laser light around 1900 nm, transported through an optical fibre.

In this way we can cool that part of the apparatus at a particular temperature, changing the input power and wavelength. The optimum performance would be reached supporting the mirror with doped crystal fibers that could be directly cooled.

I would like to conclude by acknowledging the invaluable work of Stefano Bigotta, Alberto Di Lieto, Daniela Parisi, the Mansoor Sheik-Bahae research group operating in New Mexico University and Richard I. Epstein from Los Alamos National Laboratory.

References

[1] R. I. Epstein, M. I. Buchbald, B. C. Edwards, T. R. Gosnell, C. E. Mungan 'Observation of laser

-induced fluorescent cooling of a solid' Nature 377 (1995) 500-503 [2] D.V. Seletskiy, S.D. Melgaard, S. Bigotta, A. Di Lieto, M. Tonelli, M. Sheik-Bahae, Nature Photonics, 4 161-164 (2010).

A new Virgo group: POLGRAW

As of April 24th, 2009, POLGRAW has become a full member group of the VIRGO project. POLGRAW consists of 9 members, based in Polish institutions located in various cities: Bialystok, Torun, Warsaw, and Zielona Gora. Our group consists of people with various backgrounds: applied mathematics, astronomy, astrophysics, general relativity. None of us has a degree in electronic engineering or computer science but we have been learning a lot about data analysis and signal processing. The leader of the group is Andrzej Krolak who has been working on gravitational wave data analysis since 1986, when he was hired as a post-doc in Cardiff. Some members of our group gained experience in searching for gravitational waves by analysing data from the Italian bar detectors EXPLORER and NAUTILUS.
POLGRAW group was formed when a number of astrophysicists, lead by Tomek Bulik, became involved and consequently our group gained sufficient expertise to analyse and interpret gravitational wave data. We search VIRGO and also LIGO data for gravitational waves from rotating neutron stars, coalescing binaries and we take part in searches for coincidences with wide field optical telescopes. In September this year we organised the LSC - Virgo collaborative meeting in Krakow.
In the near future we also hope to involve an experimentalist in our group.

So, let the members speak for themselves!

Andrzej Królak (right) is a relativist. For some time he worked on black holes and space-time singularities. After being awarded a postdoc by Bernie Schutz in Cardiff he started working on gravitational wave data analysis. He continues this activity until now and he is determined not to retire until the gravitational waves are detected.
He is a very frequent visitor at the Max Planck Institute for Gravitational Physics in Golm and Hannover where fellow gravitational wave seekers abound.
To keep all the options open he works on LISA data analysis where the Mock LISA Data Challenge serves a complete menu of gravitational wave signals to taste.
He is the leader of the POLGRAW group that joined the VIRGO project in April 2008.
Recently with another member of VIRGO-POLGRAW group Piotr Jaranowski he has published a book entitled "Analysis of Gravitational-Wave Data": http://www.cambridge.org/catalogue/catalogue.asp?isbn=9780521864596.
He takes every opportunity during a winter conference to ski and tries to go every summer to Mediterranean Sea. His (not so up to date) web page can be found at http://www.impan.pl/User/krolak/.

Piotr Jaranowski (below), age 49, is an associate professor in the Faculty of Physics at the University of Bialystok, Poland.
He currently works in the field of gravitational-wave data analysis and general-relativistic problem of motion. His data analysis work began from the PhD thesis written under the supervision of Andrzej

Krolak, in the thesis he solved the so called inverse problem for chirp signals.
In collaboration with Gerhard Schäfer from Friedrich-Schiller-University of Jena, Germany, and Thibault Damour from IHES, France, he computed for the first time the 3rd post-Newtonian dynamics of compact binary systems.
He has a son and a daughter (both are students), likes reading books and hiking.

Kaz Borkowski, now 62, is a radio astronomer and has 'always' been with the Torun Centre for Astronomy Astronomy, Nicolaus Copernicus University, Torun, Poland. His scientific interests focused on practical astronomy and radio astronomical methods and instrumentation. Presently he holds the post of so called Friend of VLBI with duties including supervision of VLBI and e-VLBI observations at the Torun station of the European VLBI Network. He joined this group about 10 year ago when he was entrusted with the task of preparing a software for precise computation of the detector position in an inertial reference frame. Privately, he is a father of three children (now grown-up) and is a devotee of an Indian saint by name of Sathya Sai Baba. His web page is at www.astro.uni.torun.pl/~kb/personal.html.

Tomasz Bulik is now a professor at the Astronomical Observatory of the University of Warsaw. He had graduated from the department of Physics at the University of Warsaw, then obtained PhD at Penn State University. After a post doctoral

stage at the University of Chicago he moved back to Poland where he worked at the Copernicus Center for 10 years, and recently moved back to the University to finish the full circle.
He had enjoyed working in a multiple area of astrophysics, from cosmology through binary evolution, from gamma-ray bursts to pulsars, as well as on gamma-ray emission and of course on sources of gravitational wave radiation. He enjoys seeing similarities in apparently distant fields, and get a kick from moving into new and new fields.
On a personal level he is a father of a 10 year old daughter - Alicja. He enjoys sports, but especially he does care for social life in sports. So he likes biking, hiking and all other activities one can do in a group. He enjoys challenges like long hikes in the wilderness. His recent success in this field was to hike the 90 km Fish River Canyon Trail in Namibia. “Lying down at night in the wilderness I looked at the sky and thought that somewhere out in space there are the binary black hole systems which are about to merge and send the gravitational waves straight into VIRGO!”

Dorota Rosinska is an associate professor at the Institute of Astronomy at the University of Zielona Gora in Poland where she established a new research group working on astrophysical sources of gravitational radiation. Her adventure with gravitational waves began in 2002 when she was working at the Paris Observatory as a post-doc in a European Training and Research Network "Theoretical Foundations of Sources for Gravitational Wave Astronomy of the Next Century". She was working on modeling of neutron star binaries and rotating neutron stars as sources of gravitational waves. She joined the POLGRAW group two years ago. Recently thanks to a grant of the Foundation of Polish Science she built a gravitational waves computing cluster devoted to data analysis.
She has a lot of passions and interests - she loves reading books, traveling by hitch-hiking, dancing, diving, skating and skiing. She is a mother of tree children: Joanna, Jan, and Wiktoria (12, 4 and 2 years old).

Michal Bejger is a post-doc in N. Copernicus Astronomical Center in Warsaw, and a Marie Curie Fellow. In addition to working for LVC in the CW group, his scientific interests are related to the properties of dense matter equation of state, phase transitions and numerical simulations of rotating neutron stars and relativistic binary systems. After work he enjoys the proximity of books, espresso and cats.

Adam Zadrozny, 25, is a PhD student at The Andrzej Soltan Institute for Nuclear Studies. Graduated from College of Interdisciplinary Studies Warsaw University with MSc degree in theoretical physics, quantum optics. He has joined Virgo Collaboration in 2009. He is mostly involved in the Look-Up project and an astronomical group "Pi of the Sky". He works also on data analysis methods for gravitational wave data, like the matching pursuit. His scientific interests are focused on data analysis methods, information technology, and astrophysics. In his work he likes to combine methods from different fields and sciences, which makes sometimes a lot of fun. Privately he likes hiking, historical dances, and reading.

Izabela Kowalska is a PhD student in Astronomical Observatory University of Warsaw. Her Advisor is Tomasz Bulik - that is the direct reason she is interested in gravitational astronomy. She is a member of CBC data analysis group in LVC. Recently she was working on the distribution of eccentricity of compact binary objects. Apart from that she is collaborating with Dorota Rosinska on a differential rotating neutron stars project.
She has an opportunity to teach students of astronomy. It is a big challenge, but also gives a lot of

satisfaction and it's so much fun. She likes to read books (usually during her way to work by public transport) and watching night sky. In her free time she is learning how to design dynamic websites.

ET in Budapest

The "3rd Einstein Telescope annual workshop", which was organized by the ET collaboration, was held in the beautiful Hungarian capital Budapest on the 23rd and 24th of November, 2010. The event was a great success for the project and as ET Scientific Coordinator, I would like to thank Veronica Colautti, Virginie Bornes and Marta Budroni of the EGO European Projects Services for the very efficient organization. The beautiful building housing the Hungarian Academy of Sciences (Magyar Tudományos Akadémia, MTA) played host to 92 registered participants, thanks to the local support of the Virgo colleagues (István Rácz, …) of the Hungarian Research Institute for Particle and Nuclear Physics (RMKI). All details on the workshop, including the program of the different sessions and the shown slides, can be accessed via the ET web site. Figure 1 illustrates the geographical distribution of the participants and a photo of the participants, taken on the entrance stairs of the MTA building, is shown above right.

A summary of the progress in the design of the ET observatory was provided during the one and a half days. Four sessions were devoted to the activities of the corresponding technical work-packages composing the ET organization. We learned the status of the ET science case, the ET site selection process and infrastructures design, the cryogenic apparatuses and seismic filtering issues and the ET optical design concepts. If you wonder why the ET meeting was organized in Budapest, although Hungary is not in the ET design study beneficiary

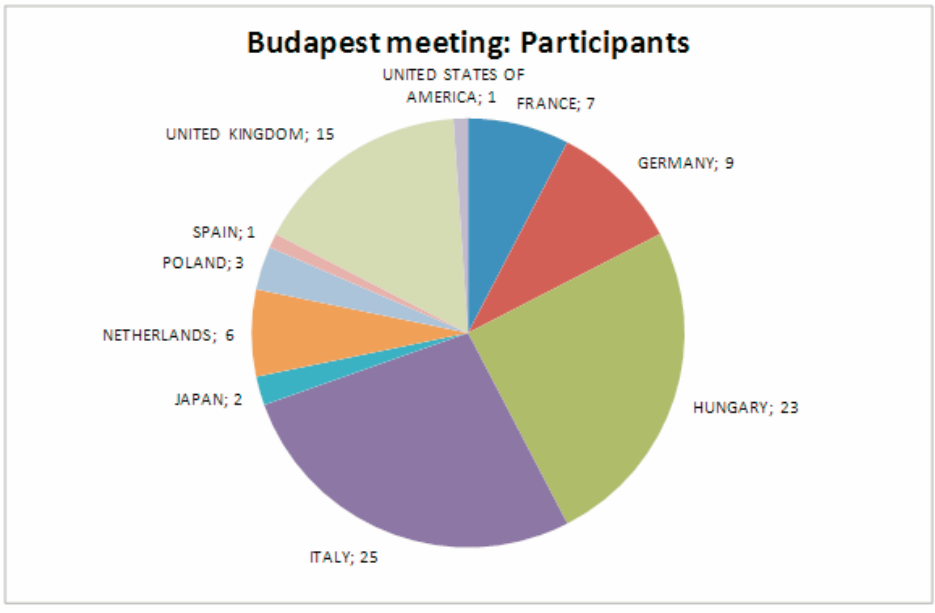
Photo of the participants to the 3rd Einstein Telescope annual workshop.

list, I invite you to have a look of the slide #36 of the Mark Beker talk presented at the meeting in the WP1 session. The seismic noise level in the Gyöngyösoroszi mine (Mátra Mountain, not too far from Budapest) is, currently, one of the most appealing for the ET site!

The opening session of the meeting consisted of a short status report on the ET project, an overview of the most innovative gravitational wave projects in the ET-timescale (LISA and LCGT) and interesting suggestions by local scientific organisations.

The Budapest workshop was the last general meeting of the ET collaboration to be organized in the design study period. The European Commission support, within the seventh Framework Program (FP7), will end at the beginning of July 2011, and that date is also the

Fig. 1 - Country distribution of the participants to the 3rd Einstein Telescope annual workshop



A picture of the Transversal Writing Team (TWT) meeting in a beautiful room of the MTA building.

deadline for delivering the ET design study document. This important target has affected the overall activity of the ET collaboration in the last months. A small team named the Transversal Writing Team (TWT) was created by selecting young scientists who were particularly productive in the working packages activities [1]. This team, chaired by Harald Lück and coordinated by the ET executive board, has the duty of collecting the results of the working package activities and harmonizing them into the ET design study document. The first operative face-to-face meeting of the TWT (see the picture above) occupied the full day before the ET general meeting and it was a very productive and intense working day. On that occasion we released the first (and still incomplete) draft version of the ET design study document [2].

The 3rd ET annual workshop was also a good occasion for an interesting outreach activity. A press conference was organized with the participation of several Hungarian journalists, the president of the Hungarian Academy of Sciences, József Pálinkás, the former EGO director, Jacques Colas, the ET deputy scientific coordinator, Harald Lück, the local organizer of the meeting, István Rácz, and myself. You can find a nice article on the MTA web server [3]. I should admit that my understanding of the Hungarian language is zero (thanks István for the translation!).

And now, what next? In the next months the main objective for the ET collaboration is the completion of the ET design study document. The TWT activity has been restarted with regular weekly teleconferences, a new face-to-face TWT meeting is expected for the end of February in Amsterdam and then a final event is under preparation … but this will be the subject for a new article in *h*.

M. PUNTURO
ET Scientific Coordinator

Internet links:

[1] http://www.et-gw.eu/twt
[2] https://tds.ego-gw.it/ql/?c=7954
[3]http://mta.hu/tudomany_hirei/magyarorszagon-epulhet-meg-az-elso-gravitacioshullam-obszervatorium-126146/

LATEST NEWS

Virginie Bornes (Admin Assistant for the ET project) entered her 5-month maternity leave on January 21st. Marta Budroni substitutes her during those months.

On the 17th of October, La Repubblica, one of the most widely-diffused daily newspapers in Italy, published, with much emphasis, an article on the apparent recognition of Ettore Majorana in a photograph alongside the Nazi war-criminal, Adolf Eichmann, and two other passengers, on a ship destined for Argentina, in 1950. Majorana was a brilliant physicist, who mysteriously disappeared in 1938, on the eve of the Second World War. Many investigations and much conjecture have been made in relation to this episode and many books have been written, such as 'La scomparsa di Majorana' (The disappearance of Majorana) by Leonardo Sciasca.

In light of the article, we asked our colleague, Ettore Majorana, nephew of the disappeared physicist, if he would kindly tell us a little about his uncle and discuss the reliability of the recognition.

The mystery of Majorana

Relevant physics centenaries have occurred frequently over the past ten years:

- *2000, anniversary of the hypothesis of energy quanta (Max Plank) and Fermi's and Pauli's birth*
- *2005, celebration of Einstein's golden year*
- *2006, anniversary of Majorana's birth.*

On July 6th 1929, the theoretical physicist Ettore Majorana took his degree in physics at "La Sapienza" university in Rome. On the same day another eminent physicist, Edoardo Amaldi, obtained his degree at La Sapienza. Everybody at the EGO site knows both of these names. The first one at least because of me, a homonymous researcher who can be met around the vacuum chambers of the interferometer test masses, the latter because of the EGO consortium address.

I never met the brother of my father, as he announced his departure in 1938 (March) and disappeared a few days later; many years before my birth. Sometimes people comment about the fortune of having such an uncle. I answer that on the contrary my situation is quite usual since every genius has normal relatives. I extracted the following paragraph from a book owned by Majorana:

"... les savants croient qu'il y a une hiérarchie des faits et qu'on peut faire entre eux un choix judicieux; ils ont raison, puisque sans cela il n'y aurait pas de science et que la science existe. Il suffit d'ouvrir les yeux pour voir que les conquêtes de l'industrie qui ont enrichi tant d'hommes pratiques n'auraient jamais eu le jour si ces hommes pratiques avaient seuls existé, et s'ils n'avaient été devancés par des fous désintéréssés qui sont morts pauvres, qui ne pensaient jamais à l'utile, et qui pourtant avaient un autre guide que leur caprice. C'est que, comme l'a dit Mach, ces fous ont économisé à leurs successeurs la peine de penser".
(Henri Poincaré, Science et Méthode, 1927).

In Italy Majorana was probably the first actual "theoretical physicist" in the modern sense. Careful attention paid to experimental results and priority to symmetry mathematical rules driving the intuition towards the description of physics phenomena. Fascinated by the mathematician H. Weyl, he brought, with his close friend G. Gentile Jr. – initiated in Pisa by the mathematician L. Bianchi -, the Theory of Groups (TG) into Fermi's research team. In the 19th century strong contributions had been provided to mechanics by mathematicians through TG. While A. Einstein was probably the ancestor of a modern approach to modern physics, from a quite different path, by letting a symmetry principle – the equivalence between inertial and gravitational masses - play a structural role in a fundamental theory (General Relativity, 1916).

Majorana was more a physicist than a mathematician, capable of realising the limits of mathematical representation, leading to modelling trade-offs; from the point of view of physics assets he was closer to E. P. Wigner than to the scientists of the Fermi group. Standing at their side, he collaborated primarily with Fermi, but also the others were able to interact fruitfully with him in modelling difficult problems. He also worked in Leipzig with W. K. Heisenberg on models of nuclear forces, during eight months in 1933.

Recently, Majorana has been studied in comparison with Enrico Fermi [1]. This parallel initially appears structurally challenging due to net differences: long versus short life and linear, effective and pragmatic personality versus withdrawn, severe and sarcastic character. In reality, the result turns out to be quite impressive and interesting, and sometimes even moving, for both. Moreover, the picture enlightens the frantic developments of atomic and nuclear physics through the human and scientific experience of these great men. This is the latest (and probably best) reference about Majorana, a scientist always seeking beyond the appearance and even beyond his own striking intuitions.

Recently, Majorana's figure has somehow become "infected" by the hypothesis of his survival after his disappearance, with an article appearing in La Repubblica, last October 17th, by L. Fraioli and

Fig. 1a

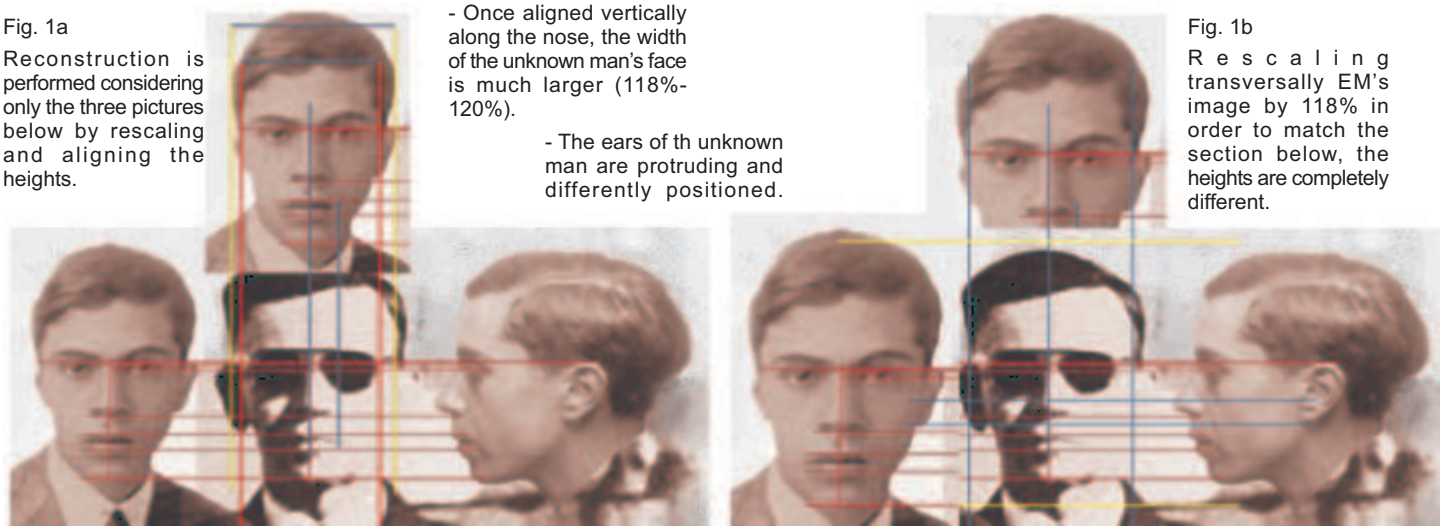
Reconstruction is performed considering only the three pictures below by rescaling and aligning the heights.

- Once aligned vertically along the nose, the width of the unknown man's face is much larger (118%-120%).

- The ears of th unknown man are protruding and differently positioned.

Fig. 1b

Rescaling transversally EM's image by 118% in order to match the section below, the heights are completely different.



M. Mafai. The author of the scoop, G. Dragoni, proudly announced his claims in spite of small contextual details: the great scientist is pictured, in 1950, together with Nazi criminal Adolf Eichmann, escaping from Europe to Argentina [2]. The only positive side of this crazy hypothesis could be that, in this case, Majorana did not commit the tremendous sin of suicide.

The attack on the memory of Majorana came from several individuals, belonging to the academy, journalism and intellectual lobbies, each well focused on there area of interest. The targets were blind voyeur-readers.

The main support to the hypothesis is based on the comparison of Majorana's head in an original picture with the newly discovered photography. The conclusion is disarmingly false. In the universe 16 dimensions can be defined, we experience three, some of us four. In a picture we have two dimensions, let's use both! (Fig. 1a, 1b).

What is striking is that any common user of a Microsoft Office package can check what is evident at a glance: if you compare the width of the two heads, the heights do not coincide and vice versa. In fact, the heads shown have quite different aspect ratios (oval versus trapezoidal), well beyond any possible clinical skull deformation occurring at adult age.

Hence the myth of Majorana in the literature, as the shy genius criticising Fermi and mysteriously disappearing in the darkness of the Fascist era, while refusing to engage in nuclear weapon development, now seems enriched by a new perspective: a dark resurrection. No thought for the millions of people that really suffered during the worst period of our history. No thought for those who loved and appreciated Majorana in his life and in his work. No thought as to whether his life was entirely devoted to study. And, finally, no respect is given to Wiesenthal's work, from which the picture was simply grabbed.

The incredible mystification was supported by the use of some sarcastic sentences, extracted from Majorana's private correspondence. In the same context Werner K. Heisenberg was presented as a scientist that was well known for his engagement in the German nuclear weapon project. During a radio program, just after the publication of the scoop, I explained the amazing "misunderstanding" – in the most optimistic hypothesis - about Majorana and that Heisenberg's relevance is due to his contribution to modern physics, mentioned in all textbooks. Indeed, in Italy, Science is somehow perceived as an "area of uncertain activity". The podcasts of the transmissions of the 19th and 27th of October can be listened to on the web page of "Radio3scienza". Finally, the theoretical physicist and fine analyst, F. Guerra [3], unveiled the testimony framework supporting the scoop as a wrong fantasy reconstruction, worked out a posteriori by means of a document that is mentioned as the trigger of the search along the German path. That letter turned out to be unknown by the author of the scoop at the time of his "long" researches! Moreover, the content of that letter, addressed to G. Gentile by G. Bernardini, seems to me to have been completely misunderstood, as it just reveals the pain felt by two scientists in accepting the tremendous choice of an admired colleague. The myth surrounding Majorana after his actual life is based upon our weakness and started reasonably at that time. Hence, I can easily conclude by citing the last sentence that closes a famous movie "Life is a mental state". ("Being there", H. Ashby 1979).

[1] G. Maltese, "Il papa e l'inquisitore, Enrico Fermi, Ettore Majorana, via Panisperna", Saggi, Zanichelli, 2010.
[2] S . Wiesenthal, "Giustizia, non vendetta", Mondadori, 1999.
[3] F. Guerra, N. Robotti, "Ettore Majorana sul piroscafo" – Nov. 15, 2010.
http://www.sif.it/SIF/resources/public/files/opinioni/op_1011_guerra_robotti.pdf

The Sherbro adventure:

Atlantis search project on the island of Sherbro continues

An analysis of the data collected in the mission of March 2010 pointed to an imprecision in the location of the area of the excavation, caused by tolerances introduced by the GPS system; close analysis, compared with new satellite images, specifically taken for the purpose, enabled us to precisely re-locate the points of demarcation of the zone of interest. At this point, it became necessary to obtain a direct confirmation 'in the field', before embarking upon the campaign of excavation foreseen for the period from March to May 2011 and which foresees the presence of diverse working groups.

Therefore, some of the members of the Marcello Cosci Association travelled to Sierra Leone with the objective of obtaining new samples in the newly identified location, within which it should be possible to find traces of the walls of the constructions revealed in the photo-interpretation of the satellite images undertaken by Prof. Cosci.

The team, composed of five people and taking advantage of the collaboration of ten local workers, undertook, even if with some difficulty given the prolonged rainy period, the foreseen excavations, producing some interesting results; the presence of the ground-water level at around one metre from the surface prevented us from digging deeper, but, with the use of an iron probe, it was possible to determine the presence of stony materials in direct correspondence with the analysed data. This was also repeated in other areas of interest to the excavation.

The decision to establish base-camp in a village near to the excavation site enabled us to optimise the time available to us, which allowed us to undertake further excavations in other areas of interest.

The excavations enabled us to return to the light (from depths ranging from 100 to 130cm) the remains of a fireplace and also to find ceramic pieces, the dating of which will be possible once their radio-carbon has been analysed.

In light of the results, the Spring 2011 excavation campaign is in a re-programming phase, in order to also prepare a stratigraphic excavation in the newly analysed area.

The website of the Association, www.marcellocosci.it, which is in the process of being constructed, will make updates on the 'Archaeological survey project on the island of Sherbro' (Sherbro Project) available in real-time. Over the next few days you will also be able to find the 'Application registration form' for the Association and the 'Excavation campaign participation form'.

R. COSCI

A well for the Yoni Village

Dear colleagues,
in the letter I wrote on the 15th of November, before departing for the third expedition in Sierra Leone, I talked of the necessity of building a drinkable-water well in the village of Yoni, on the island of Sherbro. There is an abundance of water on the island, but the sewage produced is dispersed in the earth, polluting the upper layers.
The weakest, as always, are the children and the mortality rate in those areas of Africa is among the highest.

Once arrived in Yoni, with a techinican from the area, we identified a location far from sources of pollution.
After a few days, he provided me with the calculation of the costs involved in the construction of the new well (deeper than the earlier one), which amount to approximately two thousand euros.
In March/April, we will return to Africa and I will personally follow the construction of the well.

In the meantime, I would like to send a heart-felt thanks to all of those that have contributed or still wish to do so.

Roberto Cosci

Below: the identified place where the well is thought to be built.

Arrivederci!

Une année s'en va,
sur le calendrier, une page est tournée.
Une année s'en vient,
sur le calendrier, une page est changée.
Nouvelle année, année nouvelle,
Dis-nous, qu'as-tu sous ton bonnet ?

Louisa Paulin (1888-1944)
Poet of the Langue D'Oc

When this issue of *h* appears not only will there be a new calendar page and 2010 will be finished but I will have completed my mandate as Director of EGO.
I remember when I first came to EGO a little over 3 years ago: "I was moving slowly forward on the straight road which disappeared into the horizon in the middle of fields. The car was moaning while lurching on the pot-holed road. Yet it was not a dream; the notice with the VIRGO EGO CNRS-INFN logo pointed in this direction. Then, on the left, I saw a blue building from which a long tunnel covered with a like-colored roof emerged. I was not wrong: EGO, my destination, was there."

Since then, via dello Zannone has been partly repaired and, more importantly, the Virgo interferometer performance has improved significantly: on July 9th, as planned after a long stop to implement upgrades, Virgo restarted a 6 months long data taking period with essentially its design sensitivity, a duty cycle above 80% and an unprecedented quality in the data. This is a great result that many questioned at the time of Virgo approval. It was achieved by the Collaboration and the EGO personnel who have now acquired all the necessary expertise to run a complex and delicate instrument like a gravitational wave detector. Virgo is now the most sensitive detector in the frequencies below ~60Hz and this performance is currently being exploited by data analysis teams. This success helped us in getting the Advanced Virgo program approved by our funding institutions. In the first part of 2010 new mirrors suspended with very thin fused silica fibers were successfully installed and, in the coming months, this upgrade should help Virgo become the most sensitive detector ever built in the world. Even if many were disappointed by the relatively poor sensitivity reached by the interferometer during summer 2010, I am confident that the expertise present in EGO and in the collaboration will start approaching this important and ambitious goal. Indeed during the three years I have been at EGO I have come to appreciate how clever and motivated people are.

I would certainly have liked to see these achievements (together with the real start of the Advanced Virgo construction) but I am sure that Prof. Federico Ferrini's leadership will bring a new positive boost to the laboratory. It was a real pleasure and an honor for me to be the EGO director and I would like to warmly thank all EGO and Virgo people for the work we have done together. EGO is a nice laboratory, with many people who are committed to their work and dedicated to Virgo success. I know that Prof. Federico Ferrini will be able to rely on your efficient support and that together you will be up to the new challenges that 2011 has still in store:
Nouvelle année, année nouvelle,
Dis-nous, qu'as-tu sous ton bonnet?
I wish him and all of you all the best and a lot of success with Virgo and Advanced Virgo.
I am looking forward to coming back to Cascina to celebrate with you these achievements.

Jacques COLAS

Introducing myself

I am returning to Pisa, after an absence of eleven years, with the prestigious role of Director of EGO. I came to Pisa in November 1968 and studied at the Scuola Normale Superiore and Pisa University. After obtaining my "Laurea" in Physics in 1972 I did my PhD at the Scuola Normale from 1972 till 1975. I obtained a position at the Department of Physics in January 1976 and subsequently at Pisa University.

The study of the equation of state of neutron star matter together with statistics & gravitation were the first subjects of my research. I then moved to the formation and dynamics of planetary systems. My interests were attracted hence to the large-scale distribution of interstellar dust grains and the hydrodynamics within gas clouds in galaxies. An intermezzo on gravitational waves characterized my progress towards other themes.
As part of a project directed by Bruno Bertotti, I studied the effect of plasma scintillations on the transmission of signals from twin satellites orbiting the Earth, an early theoretical prototype of LISA. My studies on the non-linear nature of the star formation process was the basis of a series of papers on star formation and heavy element enrichment within the Milky Way, further extended to all galactic morphologies, including high red-shift evolution.

Starting from 1 January 2000 I spent two and half years in Bruxelles at INTAS, the EU DG Research agency devoted to financing research projects involving former Soviet Union scientists; I was in charge of Physics projects, naturally. From 9 December 2002 until now I was Scientific Attaché at the Permanent Mission of Italy to the International Organizations in Geneva, responsible for CERN, the World Meteorological Organization, the International Telecommunication Union and the environmental Organizations in Geneva. By participating in the life of these Organisations as Italian delegate, I lived on the front line during the LHC crisis, the successful construction, its impressive and

exciting start in 2009/2010, the global awareness of climate change in 2007 after IPCC Report and the subsequent negotiations, the exponential growth of communications, the related political problems and the debate on Internet Governance.

And now, on January 1st 2011, I am at Santo Stefano a Macerata, with the exciting and difficult task of directing EGO. Enthusiasm, a sense of responsibility and a wish to play a useful role in the community: these are my feelings. I am fully aware of the difficulties in front of us: scientific, technical, financial and temporal constraints will accompany us like vultures on the long and winding road that will lead us to the realization of Advanced VIRGO. My task is very clear indeed: to lead the EGO staff and to make the life of the VIRGO collaboration as easy as possible, enabling Advanced VIRGO to run, with the nominal sensitivity, in time and within the budget. It is crystal clear to me that the fundamental resource in order to reach this ambitious objective is the excellent human capital at EGO's disposal.
On December 9th, my first day at EGO, while sunset was fading on a clear sky; a strong wind was blowing from West, bringing with it the strong scent of the sea, I smelt it and, as I come from an island, I took it as a positive signal for our common future.

Federico FERRINI

A Researcher's Day

A very special visit took place on November 10th. As happened last year on November 3rd, 40 high school students came to the Cascina EGO site to spend a full day as researchers. This was part of "Pianeta Galileo", a one month program of activity launched every year by Regione Toscana to stimulate the interest in science by young people.

The students were divided into four groups of 10, each with a couple of tutors. After a site visit they took part in several practical activities:
• Seismic measurements
• Noise analysis (time domain and frequency domain)
• Comparison of a pendulum with an inverted pendulum
• Air refraction index versus pressure (counting fringes in a small interferometer).

The results of the various groups were discussed at the end. A quiz was then held and the winner was awarded a Galileoscope, a working reproduction of Galileo's instrument, developed in 2009 for the International Year of Astronomy. In truth, all groups were worthy of receiving the prize for their good work and good answers.
The tutors who were heavily involved from 9 in the morning until after 6 o'clock deserve a mention: Gabriele Balestri, Elena Cuoco, Irene Fiori, Franco Frasconi, Federico Paoletti, Gabriele Vajente and the author of this article.

C. BRADASCHIA

Support Cinema Arsenale

You may or may not be aware that, after 29 years of activity, Cinema Arsenale, found in Vicolo Scaramucci in Pisa, may have to close its doors in under two months time, owing to financial deadlines that fall at that time. The cinema is asking for support in order to be able to overcome these difficulties. More details can be found on their website, while a Facebook campaign has also been launched.

For anyone un-aware, Cinema Arsenale is a little jewel nestled in the back-streets of Pisa's historical centre. Providing non-mainstream, cultural and foreign language films, it has long been frequented by many EGO employees. Let us hope that it is able to continue entertaining its appreciative public for many years to come.

G. HEMMING

Links:
Arsenale website: www.arsenalecinema.it
Arsenale Facebook page: http://www.facebook.com/pages/Cinema-Arsenale/47168548604
Il Tirreno article of 08/01/11: http://iltirreno.gelocal.it/pisa/cronaca/2011/01/08/news/il-cineclub-arsenale-rischia-di-chiudere-3119267

GOOD NEWS!

Welcome to Inès, born on 05/12/2010 and felicitations to her parents Eric and Gratienne Genin!

Welcome to Edoardo, born on 25/12/2010 and felicitations to his parents Elena Catalano and her husband Giuseppe!

Welcome to Leonardo, born on 07/01/2011, and felicitations to his parents Livio and Julija Salconi!