THE GRAVITATIONAL VOICE

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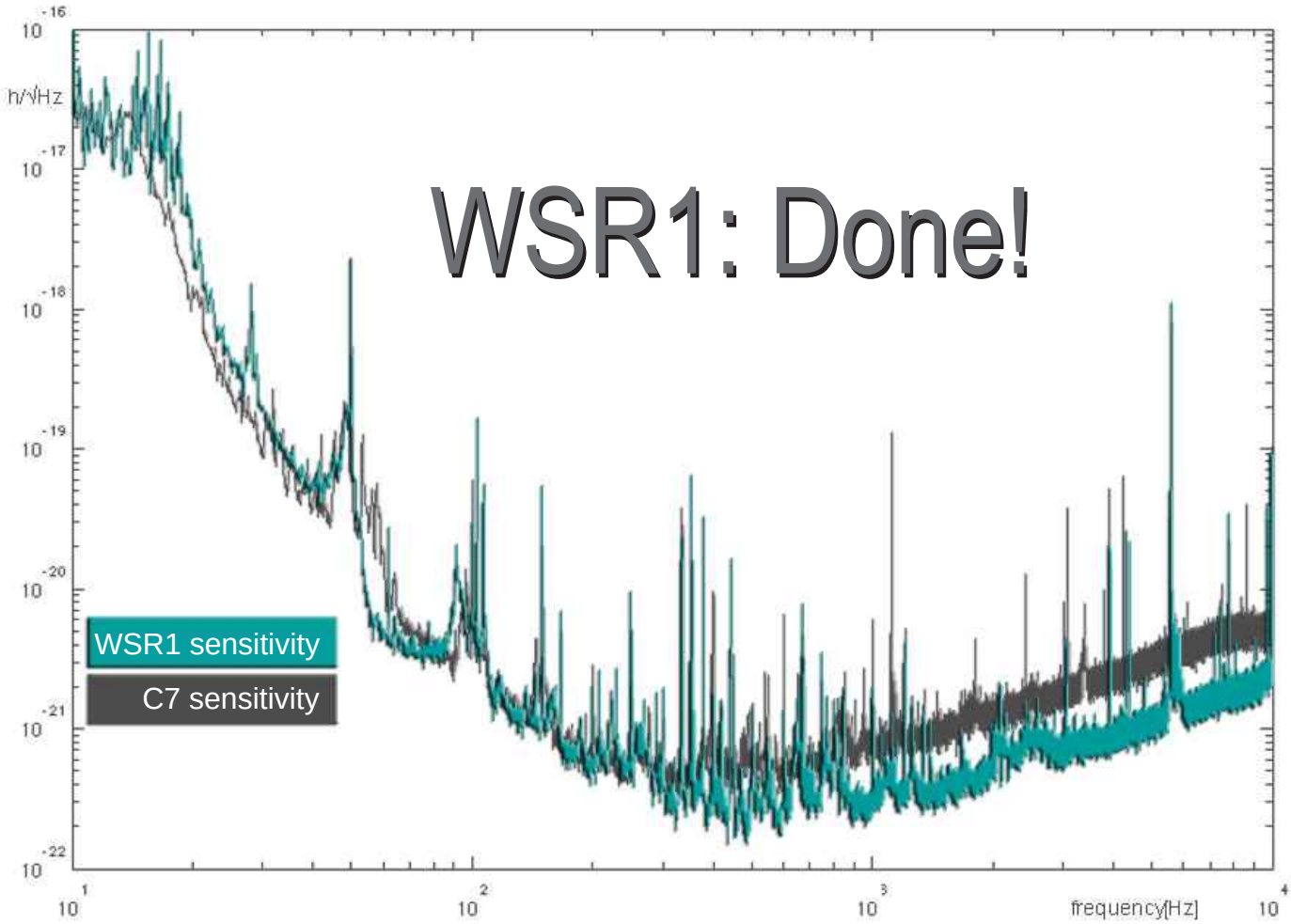
WSR1: Done!



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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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WSR1: Done!

The first Weekly Science Run performed last September 8-11 has been successful

We are glad to report on advancements at the site, reproducing the letter recently addressed to the EGO Council by the Virgo spokesman, Benoit Mours:

"Virgo is proud to announce that today we successfully completed our first Weekly Science Run (WSR1). This is the beginning of the transition phase we announced during the last council where we are mixing commissioning activities during the week and science data taking during the week-end.

The start of this new period has been made possible by the progress of the commissioning of Virgo, which is now able to operate with a good duty cycle (90% of science mode during WSR1) and sensitivity similar to the LIGO detectors at high frequency. This turns Virgo to a competitive instrument for sources emitting into this frequency band.

(…) We expect additional progresses for the sensitivity in the whole frequency band during the up coming months. The ramping up of the analysis of these and the future science data is also taking place with the wish of starting soon our joint activities with LIGO.

This success is the achievement of a very long process of design, construction and commissioning of Virgo made possible by the steady effort of all the Virgo groups and EGO.

We look forward to presenting these and future progresses during the next STAC and EGO council meetings."

This announcement triggered a shower of congratulation messages from all over the world. Let us consider that as an omen for long lasting scientific runs to start soon.

C. BRADASCHIA

FRONTCOVER: VIRGO SENSITIVITY CURVE AS FROM WWW.VIRGO.INFN.IT, PREPARED BY G. HEMMING

EGO Council and STAC Meetings Outcome

Outcome of the June 2006 meetings of
EGO Council and of its Scientific and Technical Advisory Committee (STAC)

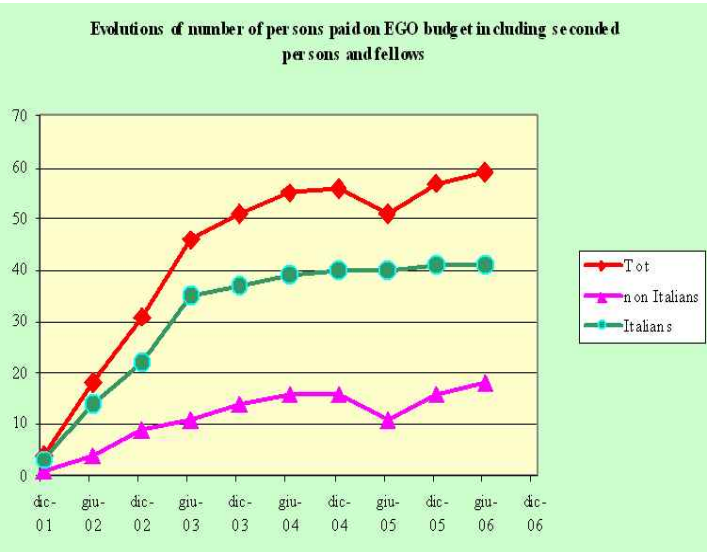
The Council meeting was subdivided into two sections, one for formal matters of the Consortium and the second part devoted to the consideration of the developments both for EGO and for the Virgo collaboration.

In the formal part the 2005 accounts were closed and approved and the mandate of the present EGO director was extended till the end of September 2007.

In the second part the Council considered several reports, the launch of the new R&D program was examined and a first discussion on the preparation of the 2007 budget proposal was also held.

EGO director's report

The EGO director reported on the developments achieved in the various departments since the preceding Council meeting, noting in particular on the personnel side that six new staff members have joined EGO in the months since the previous Council meeting. Moreover, three conventions have been drawn up (respectively, at Nice OCA, at Annecy LAPP, at Florence-Urbino) to support commissioning fellowships c/o Virgo laboratories. The resulting staff evolution at EGO is depicted in the graph below.



It was also noted that EGO in the last three years has supported 34 fellowships in different laboratories for a total of 70 man-years with a total cost of 2.1 M€ to support the Gravitational Waves community. They have been given under different headings: 12 fellowships in the R&D program, 4 fellowships in non-R&D support to individual laboratories, 11 fellowships in VESF program, 7 Virgo commissioning fellowships.

The Director provided, for the Council, a summary of the highlights of his written report. He underlined the developments for Virgo upgrades and Virgo+, the smooth advancement in the works for the new building, the completion of the Virgo+ and R&D laboratories in the West intermediate building, the completion of the works for the new computer room, the realization of the injection bench from project to construction, the participation to most of the commissioning activities, for which EGO also provides the full team of operators. He also noted the advancements made by the electronics, SW, suspension and vacuum groups. For computing he underlined the completion of the storage farm, now with 120 TB capacity.

He also presented an update of the deployment, within EGO, of projects, which are temporary inter-departmental structures crossing horizontally through the vertical departmental structure of EGO to fulfil specific activities, as, for example, the Project on Commissioning and the Energy Saving Project, which has been established with the view to contain or possibly reduce the cost of energy at EGO.

Reports from the Virgo collaboration

The Virgo spokesman presented the highlights of his report. Reports were then given by: the commissioning coordinator, Matteo Barsuglia, on commissioning status and plans; the coordinator for data analysis, Andrea Viceré, on data analysis status; the coordinator for outreach, Carlo Bradaschia, on outreach; the detector coordinator, Michele Punturo on Virgo upgrades. These reports are available on the Virgo collaboration web site.

The Council quite appreciated the advancements in Virgo commissioning and the developments of the data analysis, in particular positively evaluating the increasing level of collaboration with LIGO.

The Council also could appreciate the positive developments in the area of upgrading Virgo and preparing for Virgo+.

Carlo Bradaschia presented to Council the development of the outreach activities, including the quarterly on-line news bulletin, "h-the gravitational voice", of EGO and Virgo.

Report from the STAC chairman

The first day of the STAC meeting was dedicated to discussion of the reports from the laboratories that have participated to the first R&D program launched by EGO and carried out over the period 2003-2006. Results obtained in the 18 projects that were part of the R&D program were reported. From the report to Council of the STAC chairman, David Shoemaker, several considerations may be underlined. Among them was that the R&D funds of the first EGO programme have been very productively used.

The prospects of launching a new EGO R&D programme were then considered and it was noted that the new R&D program is crucial to setting the scope, and then detailing, the Advanced Virgo upgrade; the STAC recommends giving highest funding priority to those R&D programs that have immediate relevance to the planned Virgo upgrades.

Regarding the reports by EGO, it was noted that the scope of activities of EGO is impressive: helping to grow the VESF, strategically funding R&D, managing fellowships, and building up the infrastructure, in addition to scientific and technical contributions, while the continued strength of the commissioning contribution was notable.

Regarding the reports by the Virgo collaboration, it was considered that, among several things, the very recent achievement of locking was the crucial point of inflection post-intervention, allowing study of a linear system and incremental improvements. Also it was considered that the studies to date with the higher circulating power were very encouraging and the STAC was impressed with the focus, organization, and progress of the commissioning.

Considering that the commissioning plan proposes to focus for the near term on the high-frequency regime, followed by a Science Run I of 3-6 months at a sensitivity of 15 Mpc for NSNS binaries, optimized for direction and polarization, while the following commissioning stage is designed to address low-frequency issues, followed by a Science Run II of 3-6 months at a sensitivity of 30 Mpc for NSNS binaries, optimized for direction and polarization, the STAC supported this approach to defining the scope for Science Run I and II.

Hearing about progress for Virgo+, the STAC considered that this upgrade is well defined, has few technical challenges, and gives a remarkable improvement in performance for a moderate amount of effort.

Then, considering that EGO and Virgo wish to start intervention in 2011 for Advanced Virgo, the STAC noted that for this it is important to be timely, in order to keep pace with other developments in the field (Advanced LIGO, LCGT, GEO-HF), while it appeared that EGO/Virgo infrastructure are very well poised to be upgraded at minimal cost, although the project organization, and the engineering design must be brought forward now to allow cost estimates, funding decisions, and scope adjustment to be made.

Report on VESF (Virgo-EGO Scientific Forum)

The report was presented by the VESF coordinator, Francesco Fidecaro. It contained a résumé of the activities carried out since last November, the most relevant ones having been: the conclusion of 11 conventions between EGO and proponents of VESF fellowships; the 1st VESF School for GW at EGO last May which was attended by 38 students coming from 9 countries; the joint GWADW (Gravitational Waves Advanced Detectors Workshop)-VESF meeting at Elba island last May. There were 114 participants from all over the world, with all main GW actors represented.

Three new groups have applied for, and been accepted to, VESF membership: the MTA-KFKI-RMKI Group, from Budapest, Hungary, the Geneva University Group, Switzerland and the Institute of Cosmology and Gravitation group, from Portsmouth (UK). There are now 43 VESF groups from the 10 European countries: France, Germany, Greece, Hungary, Italy, Poland, Russia, Spain, Switzerland, UK.

The 2007 draft budget proposal

The director presented the first draft of the 2007 budget, the main scope of which is, on one side, the functioning and maintenance of the interferometer and of the whole site with its infrastructures and its computing centre, and, on the investment side, the completion of the new main building and its outfitting, the completion of the acquisitions for the approved program of the present Virgo upgrades and of the upgrades for Virgo+.

The Council considered the overall budget proposal as acceptable for the time being. The final financial envelope of the 2007 budget will be defined in consultation with the member Institutions in view of the final budget proposal to be discussed and approved by Council in its autumn meeting.

F. MENZINGER

The Summer Collaboration Meetings

Amsterdam in July

This summer, for the first time, the Virgo collaboration meeting was held in the NIKHEF University Centre in Amsterdam, which made a welcome change to the monthly Virgo week routine. The meeting took place between the third and fifth of July, and was quite well attended, with more than 50 registered people.

The Commissioning status outcome was quite satisfactory with respect to previous meetings. In the last month much progress had been made: problems in the injection bench had been fixed (in particular the contact between filter 7 and the marionetta), the locking acquisition was becoming fast and repeatable, longer locking stretches were available, the higher frequency sensitivity was better than C7, thermal effects were in the process of being better understood, and several monitor devices, such as the scanning Fabry-Perot on the dark fringe, were giving more information and confirmation of heating of the input mirrors (the simulation of which is the object of several people, some of them from the NIKHEF group). In addition, automatic alignment was being closed on more degrees of freedom (five degrees of freedom on automatic alignment, six on drift control, only BS on local controls).

Even if C7 sensitivity curve was not yet reached, it was clear that the interferometer was going to work soon in the same conditions as C7, in terms of both sensitivity and reliability, which was quite nice news. It was proposed to start weekly science runs during weekends as soon as the C7 sensitivity curve was attained.

Some discussion went on in both the plenary session and in the data analysis meeting about the starting of data exchange with LIGO. In the Detector meeting a lot of discussion was within the framework of thermal effects in the interferometer. The discussions on the phase camera, scanning Fabry-Perot, sidebands thermal drifts, and thermal compensation, were all triggered by the evidence of the thermal effects in the mirrors, which were being confirmed by the measurements and the simulations. Even if there was general agreement on the utility of the scanning Fabry-Perot, so that an additional one on B2 (interferometer reflection) was decided, no final decision was taken on the shape that the phase camera should have, even if its utility is recognised.

Other particular events of note included: the presentation of the Roma II group, having recently joined the collaboration; well wishes to Romain Gouaty, who has left for a post doc in LIGO; and the appointment of Giovanni Losurdo as Advanced Virgo coordinator, which is both deserved recognition for Giovanni and a milestone in the starting of the organization of activity towards Advanced Virgo.

Globally, in particular after the May-June fears of insuperable problems caused by thermal effects, the general impression was of confidence in near-future progress. Overall, the collaboration meeting of Amsterdam should (and will) be surely remembered for the warm reception and organization of the NIKHEF group.

The NIKHEF (Nationaal Institut voor Kernifysica en Hoge-Energiefysica) is located in the Amsterdam Science Park, in the eastern outskirts of Amsterdam, and is very well connected to the centre of town by bus and underground.

The Science Park and its buildings are quite new, and graciously surrounded by green, which makes a very nice impression to the visitor (at least in summer, and when it doesn't rain). The seminar hall, where we met for the first two days, is wide and receptive, maybe with just the small remark that there is no electrical power connection directly to each seat: but this is surely meant intentionally, so that people cannot switch on their laptops instead of listening to the speaker (even if everybody succeeded in bypassing the problem). Of particular interest are the scientific apparatus on show in the hall of the NIKHEF institute.

The reception by the Dutch group was very warm. The lunches were essential and quick, allowing us to get back to work soon, so that it was possible to finish the meeting earlier, and have some free time to wander around Amsterdam, which is such a lovely town, especially with the surprisingly hot weather we encountered.

Besides, if the lunch was moderate, the dinner offered us by the NIKHEF group on the first day was really surprising: we met at the "Lovers" dock, where a long boat was waiting to escort us along the channels of the city while we were dining. That was really an unusual experience for those who had the chance to be there.

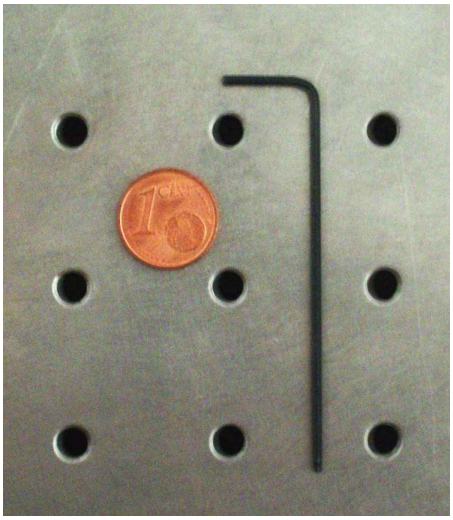
So, we think we should again thank NIKHEF for the way in which this meeting was organised and managed, and, as a personal thank you, one of us would like to take the opportunity to express his gratitude to all the secretaries of NIKHEF (Mrs. Dekkar, Mrs. Schram-Post, Mr. Bulten), for the help they gave in solving an unfortunate accident that occurred, clear evidence of their problem-solving capacity.

Last but not least, how could it be forgotten that on the Tuesday night the Italy-Germany World Cup match took place, and Italy won, among great happiness, at least from the Italian side of the collaboration?

Cascina in September

The hints for coming commissioning progress, contained in the seeds of detector comprehension announced and discussed at the NIKHEF Virgo Week, sprouted vigorously in the following weeks. The results were announced and discussed in the next Collaboration meeting, held in early September and on-site, when a new sensitivity curve was shown - much improved with respect to C7.

We are convinced that this was also a long-term beneficent effect of the healing Amsterdam atmosphere on several Virgo members. Not surprisingly, since we saw several distinguished commissioning scientists attending those pharmacies (curiously called "Coffee Shops") selling herbal inhalation medication, so helpful for mind welfare and sharpness.



The positive slope continued in the following weeks, allowing the performance of a very satisfactory first Weekly Science Run (WSR1), mentioned also in another part of this h issue.

Several hardware interventions have been decided and scheduled in the September Virgo week: studying and possibly overcoming the apparently poor Faraday isolator performance, installing the acoustic isolation box in the Laser Lab, building the "phase camera", studying wider Brewster windows that do not cut the beam tails.

We can announce that the first goal has already been successfully achieved. After a few days of work inside the injection tower, it was discovered that, as suspected, the Faraday isolator malfunctioning was actually due to magnetic field deformation. What was not expected is that the origin of the deformation was a small steel "Allen" key (see photo above), that had been sucked inside the magnet surrounding the Faraday crystal. This time, the door to success was opened by extracting the key, instead of plugging it into the right lock.

Other highlights of the September Virgo Week were: the kick-off meeting forAdvanced Virgo activities, the proposal by Michele Punturo of a "Virgo+ White Book" and the decision and plan for the Weekly Science Runs.

Finally, Francesco Fidecaro proposed to produce a "Yellow Book" (the name borrowed from the good old Yellow Book on LEP physics) on the physics of phenomena accessible with Virgo and on methods to analyse them. In order to profit from all of the knowledge and experience existing in VESF, LSC and the whole scientific community, it will be a "WikiBook", that is a sort of "open content textbook", where everybody will have the possibility to contribute.

P. LA PENNA, C. BRADASCHIA
PHOTO: C. BRADASCHIA

More Room and Cooling for the Computing System

Computing and storage capacity has increased constantly since the construction of the Virgo buildings in 1998. Now it includes 23 racks

with more than 120 TB of on-disk storage and the so-called "300 GFlops" computing farm (1 TB - (Terabyte) corresponds to 1000 Gigabytes. 1 GFlops corresponds to the computing power of a processor able to perform 1 billion operations per second, with floating point numbers).

The farm will be completed in the next few months, when other 128 AMD CPU will take the computing power to more than 400 KSpecInt2000 (see figure). To have an idea of what this means, think to 400 PC at 2.8 GHz networked to exchange data at a speed of 1 Gigabit per second.

The large disk storage area is necessary to enable the on site processing of several months of rough data. The computing farm is necessary in the search for coalescing binary events "in time", that is keeping pace with the data acquisition.

Computing Infrastructure facilities have hardly kept pace with the growing needs of Virgo. The floor occupancy changed from the initial 20 m^2 to 45 m^2 by eating nearby rooms and the cooling system was extended in 2003; but there was no hope of cooling the new farm and everything else (including the offices): existing cold water pipes from the refrigerator building cannot sustain a flow of more than 40 kW, the false floor is also too low for the needed airflow. Think of a rack of 80 CPU and it will eat up more than 10 kW, and the whole farm alone will amount to 30 kW.

Therefore the computer room was re-thought according to the cooling needs. This was one of the main reasons to move the Control Room to the ground floor. The displacement left an additional 45 m^2 space alongside the current computer room to install the new cooling system and racks without impacting upon Virgo activity.

The refrigerating fluid chosen is a gas mixture (no danger of water dripping on the Virgo operators downstairs...). The heat exchangers have been mounted on the Control Building roof, which has been transformed for the purpose. Inside the room two systems work together: the first cools globally, with 4 refrigerator and venting units forcing the air through the floor in the cold corridors removing 50 kW of heat (for all the Virgo servers, the EGO servers and the storage farm); the second is made of 3 units hanging from the ceiling over the corridor where 10 kW of heat per rack must be extracted, for a net cooling power of another 30 kW.

Of course the possible failure of 1 unit must be overcome, therefore the units are oversized with a nominal total power of 120 kW.

The system was put to work on July 5th with all the needed network and power, but still in hard conditions: in order to minimize the down time of the interferometer.

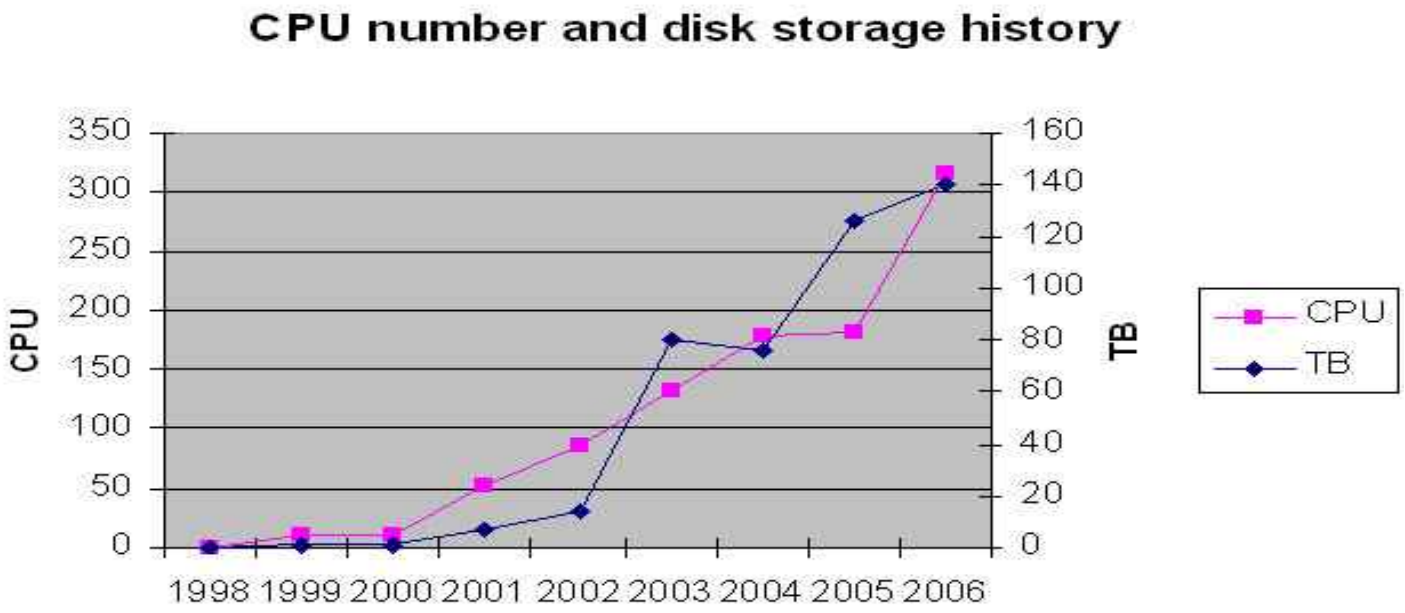
Only the computing farm was moved into the new room, all the other servers were kept in the old one and cooled with the new system by eliminating the separating wall.

This is not the final setup, but at least people in the Control Building could enjoy the return of air conditioning in the offices, which had to be dropped during summer heat peaks!

The next step will be saved for the next interferometer shutdown, foreseen in 2007: the old room will be cleared, the network cabling will be untangled and the servers moved into the final places.

And then? If needed, besides squeezing in other computing nodes and storage, using part of the redundancy, higher densities will call for more powerful cooling solutions able to extract 20 kW per rack.

S. CORTESE, EGO
PHOTO: C. FABOZZI/B. LOPEZ



11th Marcel Grossmann Meeting

The 11th Marcel Grossmann meeting took place in Berlin, last July, from the 24th to the 29th. It is one of the largest meetings inside the General Relativity Community: more than 900 physicists were there, astrophysicists, mathematicians, string theorists and "alternative theorists"!

The current status of Gravitational Wave antennae were reported with plenary talks on the 26th and, each day, a parallel section was dedicated to GW research: Operating GW Detectors, Advanced GW Detectors, Space and Third Generation GW Detectors, GW Data Analysis. It is nice to see that there is so much room for our field inside the GR community. I was there, but of course to summarize a meeting of this complexity is very difficult; all information about it can be found on the web at: http://www.icra.it/MG; video live streams of the plenary sessions are also available by choosing "Conference Lifestream" in the main page menu. Proceedings will come out quite a bit later, in 2007.

At MG11 no striking news was announced: unfortunately the dark matter discovery claim by Chandra X-ray Observatory was diffused two weeks later, on August 14.

A. DI VIRGILIO
PHOTO: WWW.ICRA.IT/MG

EDITORIAL STAFF

*We would like to thank **Giovanni Losurdo** for his important, even if short, collaboration to h.*

*At the same time we also welcome **Gary Hemming** as a new member of the h-staff.*

EPS Meeting in Kiev

Last June I was in Kiev for a meeting of the European Physical Society, it was my first time there and my first time inside an EPS meeting - in April I was appointed to be one of the eleven members of the EPS Executive Committee. The organization, headed by Professor Litovchenko, was simple, but extremely efficient and rich in humanity.

At the airport a young student was waiting for me, very patient since my airplane had been delayed by several hours, and then with a taxi we went to the hotel. The highway around Kiev is very large and well constructed, the traffic is heavy, and the cars, quite old I must say, run rather fast. The church S. Sofia, very old and beautiful, is the only monument left. The metro is very convenient, and runs very fast, much faster than the ones we are used to. Old ladies sell flowers on the corners of the streets.

The meeting was devoted to discussing the situation of physics in Ukraine, and to the annual "Journée de reflection" of the Executive Committee. The main point of reflection of the EPS restricted meeting was based upon the European Institute of Technology. It is a European Union project aiming to create, inside Europe, a flagship project for excellence in higher education, research and innovation. The EPS president Ove Pulsen pointed out the importance of carefully following the progress of this project - anyone interested on this point can read the editorial in the last issue of Europhysics News.

The current status of the EPS journal Europhysics Letters was reviewed: the Society is very proud to see that it is going very well and will do its best in order to provide a European alternative to Physical Review Letters.

The hospitality of the Ukrainian physicists was extremely warm and kind. A large effort was made and all representatives of the Ukrainian University were there, as well as representatives of neighbouring countries. The vice minister of education, a physicist, was present as well. From the talks it was evident that physics is alive and well in Ukraine. Unfortunately they have very little income, the structures are old, but they are very talented in physics, and they use this talent to publish a lot of papers - the average is six papers per year per physicist. Young people are attracted by science and each university has several thousand students in physics. However, they cannot afford PhD level courses; and on this issue help from Western countries would be very welcome.

We were very impressed by the story on how the Ukrainian Physical Society was born and later kept alive, during the break down of the Soviet Union. Students are constantly motivated with Olympiads and competitions, which clearly show that most of the old Soviet Union tradition has not been lost; we should remember how important that school of physics has been. My impression was that they are smart people, with a lot of good sense, really willing to emerge, and do their best in everything, with very little. It was also clear to me that they look at Europe, aiming to be better integrated into it as soon as possible.

A. DI VIRGILIO

Wind, Sun and Hydrogen around EGO

The interest in alternative energy sources sprouted recently in and around the Cascina site. It may be a coincidence or, more likely, it is due to the increasing importance of the energy issue in today's world. This is testified by a "web focus", on the web site of Nature, were you can find a long list of articles published on Nature about all the problems and the advancements on energy saving and production (http://www.nature.com/nature/focus/energy/index.html).

The events, in roughly chronological order: two companies proposed to install aeolian generators in the vicinity of EGO, to produce clean electricity; EGO and Virgo started considering the possibility of installing photovoltaic generators on tunnel roofs; ENI (the Italian state oil company) inaugurated, on the highway station of Grecciano, the first Italian hydrogen pump.

First commercial Hydrogen pump in Grecciano

Let us start from the last event, even if it is close to us only from a geographical point of view. It involves, in the same place, many unusual power sources. What makes the Grecciano station unique in Europe, and in the world, is the fact that the sold hydrogen is locally produced through water electrolysis, by renewable power sources.

This explains the purpose of the three small windmills (20 kW each) that have been raising our curiosity for a while when going for lunch at the restaurant "Le Colline". But this is not all: more clean energy comes from silicon photovoltaic panels, covering the roof of the station. In Grecciano the only fuel not sold is alcohol (wine is available at the bar); all the others are there: besides hydrogen, there are gasoline, diesel oil (containing some vegetal oil), methane and LPG.

The H_2 production capacity will be sufficient to cover a total of 40,000 km per year, by a fleet of two Multipla and two Doblo', modified by ILT Technology (Ponsacco), to burn either gasoline or hydrogen. The double fuel cars have 20% reduced performances, using hydrogen, and an autonomy of 380 + 120 km (gasoline + H_2).

Jules Verne anticipation (L'ile mysterieuse, 1874: "Je crois qu'un jour l'eau servira de carburant, que l'hydrogène et l'oxygène qui la constituent, ...") is becoming reality?

Windmills: friends to the environment, are they enemies to Virgo?

Pushing for high sensitivity, we realized that the Cascina plain is a relatively windy place: according to the anemometer on top of the Central Building, 45% of the time there are winds blowing faster than 10 km/h, reaching peak values of 70 km/h.

Other qualities, such as being distant from urban areas, close to Pontedera industrial site and to be of residual negligible naturalistic value, make the Cascina site a candidate location for wind energy production plants ("windmills").

To comply with the requests of the Kyoto Protocol for the reduction of polluting emissions, the Tuscany regional energy plan (PER: Piano Energetico Regionale) set the target to produce 300 MW of wind power by the year 2010.

As part of PER, two wind parks have been proposed for installation in the EGO neighborhood. The first one to start operations (next spring) is managed by the Italian ASA (Azienda Servizi Ambientali, Livorno). It consists of four 2.3 MW wind turbines placed East of EGO, between 5.5 and 6 km from the Central Building.

The second one, managed by the German Windwaerts, is still in the design phase. According to the last agreed layout, it will consist of four 2.0 MW turbines located between 5.1 and 6.1 km South West from the Virgo West Building (Vicarello).

The two chosen locations are the result of long diplomatic and scientific work performed to protect Virgo from the not good vibrations produced by windmills.

Latest generation windmills are huge: the steel tower is about 100 m high and supports a nacelle and a 3-blade rotor with a diameter of 90 m, that is about 100 tons of total weight and tall as a 40-storey skyscraper. A close view reveals that the nacelle is as large as a big truck!

The chosen models are optimized for a moderate wind speed, between 2.5 and 25 m/s (9 - 90 km/h). They are endowed with a feedback control system of the rotor speed (typical value of the rotor revolution period is T = 5-6 s) acting on the blades pitch angle; the nacelle rotates in the horizontal plane to follow the wind direction.

Although modern turbines have been optimized to be acoustically quiet (less than 50 dB at 100 m distance), not much work has been dedicated to make them "seismically quiet". In fact we expect them to produce not negligible ground vibrations. The low frequency seismic emission (below 10 Hz) from the two wind parks is obviously a concern for Virgo: both because they could cause a significant increase of the noise background at the site, and particularly because the production of low frequency monochromatic seismic waves can excite critical resonances of interferometer components, for example, mechanical modes of mirror suspensions.

However, we are not alone: the GEO600 site has an 8-turbine wind park at about 1.5 km from its North arm, and LIGO (Hanford) had to deal with two proposals for the installation of large wind parks in its close neighborhood. R. Schofield from LIGO first performed a study of the seismic emission from a wind park, with the aim of predicting its spectral composition and intensity at the LIGO site. The wind park next to GEO600 gave the optimum chance to study the properties of the seismic wave field in a soft soil, made of lime and sand, which is similar to that of the EGO site; and at the same time to investigate possible effects on the interferometer.

Sponsored by ILIAS, we paid a visit to our German colleagues and performed a study of the seismic emission of the wind park next to GEO600. We (Lara Giordano, Federico Paoletti and Irene Fiori on the EGO/Virgo side; Gillian Mayer and Stefan Hild on the GEO side; and Emanuele Marchetti from the Geophysics Dept. of Firenze University) performed a mapping of the seismic wave field around

GEO600 using a pair of low frequency portable seismic stations operated in coincidence (with GPS antennae): one station deployed at a fixed location close to one windmill, and the second one moved to many locations at increasing distances (5m to 5km). One microphone was used to look for the presence of a component of seismic low frequency vibration propagating through the air. One anemometer measured wind speed and direction. Measurements were performed over four days, thus covering different conditions: low and intense wind, periods with windmills stopped, day and night time.

The spectral analysis revealed that the windmills seismic signal contains intense low frequency (0.1 to 10 Hz) components whose intensity increases with wind speed. Peak frequencies correspond to the rotor frequency and to its third harmonic, and to resonant modes of the tower. We measured a relatively fast attenuation of the seismic wave field with distance. Precisely, as expected in presence of soil dispersion effects, RMS noise decays exponentially with distance, such that a few km away the signal is of the same amplitude as the seismic environmental background.

The final purpose was to elaborate a model of windmill seismic signal and derive the "safety distance" from the Virgo buildings, such that windmill spectral noise does not exceed the environmental background. This constraint has been discussed with ASA and Windwaerts who could produce modified layout solutions, complying with Virgo needs, in addition to those imposed by urban and environmental constraints (i.e. distance from roads, houses, urban sites).

We now anxiously wait for the first of the two wind parks to start operations (this should happen right in the middle of our first science run) hoping to see our predictions confirmed!

Will sun power help EGO?

The idea to use the huge amount of energy shined by the sun on our tunnel roofs has been turning in our minds for a long time; but we started to consider it seriously, as a silent alternative more compatible with gravitational wave detection, with respect to the proposed windmills. It must be said immediately that today photovoltaic electricity production is not intrinsically economic, due to the high cost of silicon panels. The business becomes somewhat convenient thanks to the fact that ENEL (the Italian electrical company) is forced by law to buy the excess produced clean energy at about four times the market price.

We are convinced, anyway, that this operation would be strongly positive for the image of EGO and Virgo, on a local scale, and of CNRS and INFN, at national and international level. It would show how we are in favor of renewable energy sources and that we have pushed the windmills a little away from the site uniquely for scientific reasons.

Let us give a few orders of magnitude (http://en.wikipedia.org/wiki/Photovoltaic_array):

1 kW/m² is the specific solar power reaching the earth surface at the Equator, at noon

170 W/m² is the specific solar power at our latitude, averaged on the whole year, clouds included

0.6 kWh/m²/day is the energy output of a 1 m² panel with a good conversion efficiency of 15%

The simple practical solution being considered is to cover only the best-oriented part of the West tunnel roof, that is the lap looking South. In this way we could reach the nominal 1MW peak power, the maximum permitted by law to access the promotional price. A computation performed by a professional designer, on a proposed surface of 2750x2.7=7425 m², gives an average production of 1,276,000 kWh per year, for at least 20 years, taking into account all the possible inefficiencies due to temporary failures and maintenance.

Even if at present the total yearly consumption of EGO is of the order of 3 Millions kWh, that is three times the possible solar production, at least during the day, in summer, there would be an excess of power. In fact the average power used by EGO is about 400 kW, with peaks of up to 700 kW - below the photovoltaic peak power of 1 MW. In practice, the compensation would not be done locally; EGO will continue to get power through the usual power lines, while the produced power would be fed into the power network through an independent connection. The compensation would be computed a posteriori, with an appropriate algorithm, taking into account the energy flow in both directions.

The real issue is the cost of the system. The overall estimated budget, including silicon panels, support structure, assembly on site, DC/AC converters and cabling is about 5.5 MEuros. According to the designer computation, the operation is anyway economically positive. In case the needed budget is made available by the EGO Council (which is unlikely), the first several years of operation would be necessary to recover the spent money, then there should be real profit. In case the budget is given on loan by a financing company the profit is expected start a few years later.

Luckily all around Italy there are public agencies devoted to promoting renewable power sources. The EGO Director has recently signed an agreement with the Agenzia Energetica di Pisa, that will prepare the preliminary project to be submitted and eventually accepted by ENEL. The Agency help will be very important also in finding financial and industrial partners to set up joint ventures to build the system. More flexibility may be obtained by a staged program to equip 1 km of tunnel roof every 2-3 years.

As in the case of windmills, a word of caution about noise is also necessary. Photovoltaic generators have no moving parts; on the other hand the converters from DC current, produced by solar cells, to AC current fed into the network may produce electromagnetic noise, being based on oscillators. Moreover, the best converters work at higher frequency, which may imply higher noise pick-up. As soon as a preliminary design is available, noise measurements will be performed on the chosen devices.

The previous pictures show windmills at the GEO site and Federico Paoletti installing a seismometer at the base of a windmill tower.

I. FIORI, C. BRADASCHIA

Solar Cells: How do they Work?

The principle, the photovoltaic effect, comes from the properties of semiconductors; we will try to explain the matter in a simple, intuitive way, not to be taken as a rigorous treatise (1).

A semiconductor is a material, usually crystalline, containing electrons weekly bound to their atomic nuclei, hence relatively free to move inside the crystal lattice. Semiconductors allow the passage of electric current, but not as easily as metals (conductors), where there are electrons completely free to move around, inside the material.

In a semiconductor, a moving electron leaves behind a "hole", that is a missing electron. It is amazing to see from the equations that a hole moves exactly as if it was a real positive charged particle (the run away electron has a negative charge).

To increase the conductivity we dope semiconductors; there are no sport laws prohibiting this practice! Typical semiconductors are silicon and germanium, elements with 4 valence electrons in the outer shell; every atom is bound to the four surrounding ones, saturating all the possible bonds. If we replace here and there in a silicon crystal one atom with one of arsenic, a "donor" atom, having a valence of 5, we will

have an extra electron free to go around (the overall electric charge is zero, since the extra electron negative charge is compensated by an extra positive proton in the arsenic nucleus). More available electrons give higher conductivity. A semiconductor doped with donor impurities is called of "n-type", having a majority of negative carriers. In semiconductors the same effect can be obtained increasing the density of holes, with positive charge. Very simple: instead of doping with arsenic, we can use an "acceptor" atom, like aluminum. Having a valence of 3, aluminum is not able to bind itself to all the 4 surrounding silicons and leaves out a free place: a positive hole, free to move as we said. This will be a "p-type" semiconductor.

Imagine a slice of silicon (a "wafer"), doped for ½ of its thickness with donor atoms and for the other half with acceptor atoms. In the two half slices, respectively electrons and holes are more abundant and move freely around. Electrons and holes diffuse also in the other type of material, were their charge is not more equilibrated by the charge of the original atomic nuclei. The excess of electrons diffused in p-type material and of holes diffused in n-type material produces a small voltage difference between the two layers of the wafer. This recalls what happens at the contact surface between zinc and copper in a classical battery: the Volta "pile". The carrier diffusion continues until when the extra + and - charge accumulated on the n-side and on the p-side, respectively, of the separation surface ("junction") create an electric field stopping the charge migration. With a copper wire (or with semiconductor slabs) we can put in electrical contact the two faces of the wafer, in the hope to get a usable current. Unfortunately at the additional contact interfaces introduced in the circuit, similar carrier diffusion mechanisms create voltage differences exactly balancing the one at the junction.

Let us now shine a strong light on one wafer face. Photons, hitting atoms, will kick off electrons and generate many more + and - carrier pairs. If the wafer is thin enough, electron/hole pairs are generated close to the junction (in the so called depletion zone) and can sustain charge carrier diffusion across it. The current flowing in our copper wire is now there and can be used.

Solar cells have been used initially to power satellites, emergency phones along the highways and pocket calculators. Nowadays they have hundreds of applications.

Commercial photovoltaic panels appear as 1 m^2 aluminum frames; but, under the glass, instead of a picture, the surface is covered by silicon wafers, very similar in width and thickness to blackish, squared CDs. Cutting edge developments are leading to the creation of panels of amorphous (non crystalline) silicon, deposited on plastic film, to be attached as wallpaper, or photovoltaic tiles to be integrated on houses from the start.

Notes

(1) We encourage the interested reader to consult Wikipedia to discover more on this subject:

http://en.wikipedia.org/wiki/Semiconductor

http://en.wikipedia.org/wiki/Solar_cells

We suggest also The Feynman Lectures on Physics, Vol. 3 - Quantum Mechanics. In spite of the frightful title, we are convinced that also the non-physicist reader will profit of the incredible telltale capability of Richard Feynman. Chapter 14, on semiconductors, contains only fourteen simple equations over 20 pages! Feynman's chair at Caltech is today held by Kip Thorne.

C. BRADASCHIA

PERSONNEL MOVEMENTS
01 June - 31 August 2006

ARRIVALS

Staff

Fabio Gherardini
Technical assistant for the operation of the interferometer, Interferometer Operation (Operations)

Michele Nassi
Technical assistant for the operation of the interferometer, Interferometer Operation (Operations)

FabioTerenzi
Computer technician, Computing

Collaborators

Daniel Sentenac
Commissioning Project

Matthew Evans
Commissioning Project

DEPARTURES

Staff

Mehdi Gacem
Technical assistant for the operation of the interferometer, Interferometer Operation (Operations)

Roberto Spagnoli
Technical assistant for the operation of the interferometer, Interferometer Operation (Operations)

Christophe Moins
Software Engineer, Interferometer Operation

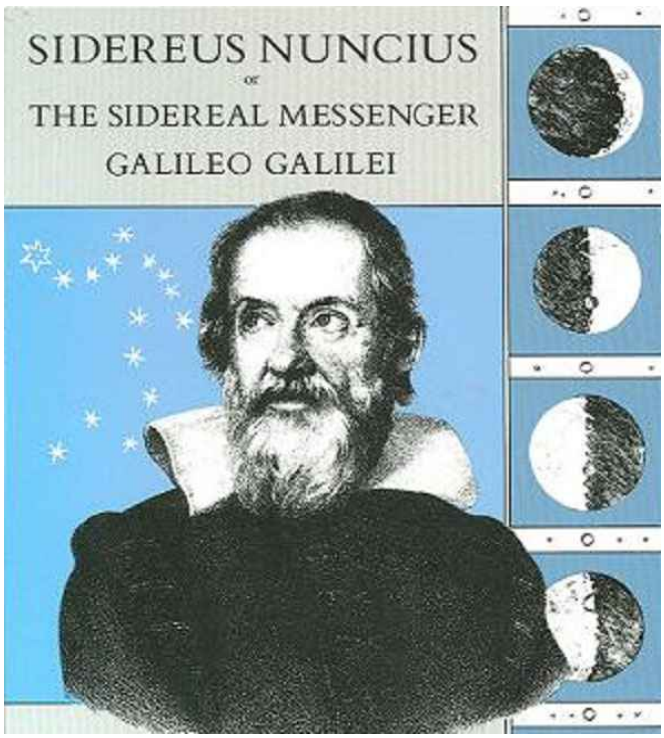
Sidereus Nuncius

Not everybody knows that during the past months, besides the usual scientific collaborations all around the word, EGO also participated to the creation of a European artistic project: Sidereus Nuncius - Narrazioni tra arte, fede e Scienza (Sidereus Nuncius, narrations between art, faith and Science), a European project in honour of Galileo Galilei, with the aim of promoting dialogue between rational and religious thinking (1).

Virgo participated actively to the realisation of the project. The artists involved, namely Paolo Pierazzini, Isabel Preuilh, Eraldo Bernocchi (http://www.myspace.com/eraldobernocchi), Alain Wergifosse, Alvaro Una Resa, Juan Coll Soler and others, came to the Virgo site, speaking with scientists, making videos and photos of the interferometer, and mainly listening to real and simulated Virgo signals. When they left, they had their USB keys full of digitalized cracks, pops, hisses and chirps of various origin.

The material collected was used first to teach electronic composition in a workshop attended by students from various European countries and, ultimately, as a basis for the creation of an interactive event, Virgo Ma 49-100/04 (http://www.fabbricaeuropa.com/index.php?id=736). The premiere took place on May 20th in Florence, during the Fabbrica Europa Festival, which takes place every year at the Leopolda Station.

Carlo Bradaschia, Paolo La Penna (with daughters) and myself had the pleasure of attending: we were taken, together with the rest of the audience, inside a large room completely filled with sound, where, from time to time, you could recognize some of the Virgo signals; screens were hanging from all the walls, showing the images captured from video cameras placed all around. Mime artists in white suits (2) mixed with the audience, acting so as to focus our attention to one place or another in the room, and invited us to mimic faces and gestures in front of the cameras, thus becoming part of the show: later, people were encouraged to make music themselves, plucking steel ropes stretched from the ceiling to the floor, or even knocking hard on the head of one of the artists (luckily protected by a motorcyclist helmet).



The performance went on in a crescendo of noise, sounds and images, until it ceased abruptly, leaving us almost relieved. A final long cheerful applause greeted the artists.

The performance of Virgo Ma 49-100/04 was preceded by the projection of Gravitational Psalms, an audio visual work by the physicist Andrea Ferrara, a researcher active in the field of general relativity (SISSA, Trieste), and composer of the group Tempo Reale, founded by Luciano Berio (http://www.centrotemporeale.it/index.php?lang=en&sez=home&sub=0). A video of the work has been kindly given to us by Andrea (3).

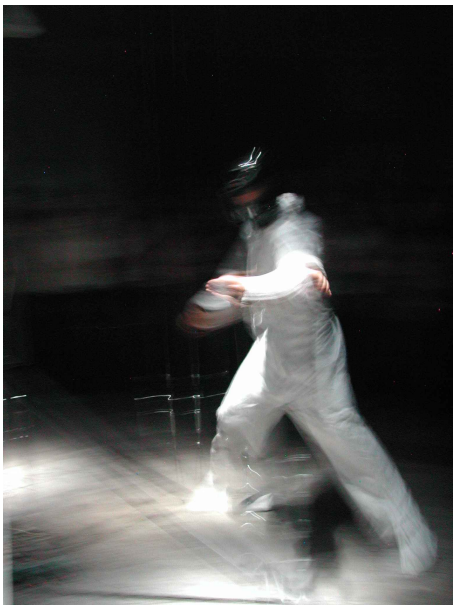
The Florentine performance was repeated during Ipse dixit, the multimedial event which closed Sidereus Nuncius, and which was held in Pisa on September 24 and 25 (http://www.sidereusnuncius.net/sidereus/index.html).

Ipse Dixit was a two day event, organised as a hypertext, which took place in various places of the town, at different times. Both days opened with Co-stellazioni, a true treasure-hunt, which led people from place to place following the steps of Galilei. Wireless antennae had been installed to allow the use of notebooks, while walking around.

After that, at sunset, inside the Botanical Garden (4) actresses, playing nymphs of the waters, were reading the most poetic passages from Galileo's fairy tale works. They were accompanied by musicians, hidden in the shadow of the ancient trees, playing primitive and ethnical instruments (cithara, didjeridoo, xylophone, drum). The fabulous atmosphere was perfectly evocative.

Then in Piazza Dei Miracoli, inside the Battistero, people could listen to SiderisVox, a work by Leonello Tarabella, composer and information technology researcher at CNR in Pisa, which fully exploited the extraordinary acoustic capabilities of this monument (think only that the reverberation time exceeds 15 s!). In the meantime, the people inside the Camposanto monument could follow the life of Suor Maria Celeste,

Galileo's daughter, through the letters she exchanged with her illustrious father (to see the whole play, go to http://www-serra.unipi.it/webtv/galileo.html).



In the same hours, the "Vecchi Macelli" (the old Pisa slaughterhouse), hosted two other events: in the old cowshed, the company “I Sacchi di Sabbia” performed a play entitled “Le leggi di gravità (Gravity laws)”; after that, the former pigsty, which now hosts the "Museo degli strumenti di Calcolo" offered a new stage to a reduced, still impressive, version of Virgo Ma 49-100/04.

The two days were completed by exhibitions and installations scattered all around the town.

Notes

(1) Sidereus Nuncius (Sidereal Messenger), published in 1610 by Galileo Galilei. Written in Latin, it is the first scientific book based on observations made through a telescope. It describes the Moon, the stars, and claims the existence of moons orbiting around Jupiter.

(2) Used clean room overalls and overshoes supplied by EGO.

(3)Andrea Ferrara (ongaku.aw@alice.it) Gravitational Psalms - Video/audio track of the performance, premiered at the festival “Fabbrica Europa”, Firenze, May 19, 2006.

2006#009 PRODUCTION@ Ongaku Studios, Creative Commons, Sample clip: http://www.ego-gw.it/public/hletter/clip_issue2.avi

Full performance, compressed: http://www.ego-gw.it/public/hletter/video_issue2.avi

(4) Founded in 1544, it is the oldest university botanical garden in the world - http://www.horti.unimore.it/CD/Pisa/Pisahome.html.

I. FERRANTE
UNIVERSITA DEGLI STUDI DI PISA

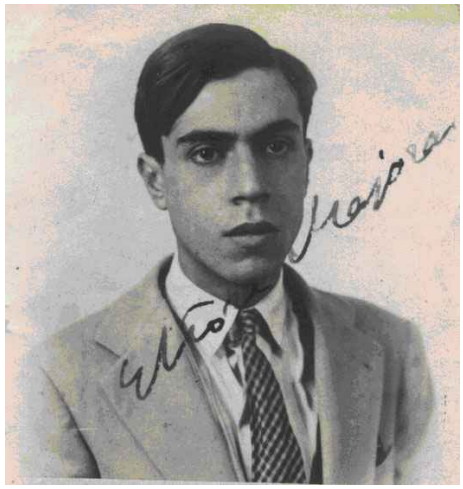
Dates to Keep an Eye on

August 5, 1906

One century ago Ettore Majorana was born, one of the most brilliant physicists of the past century. He was a member of the Fermi team in Roma, known as "i ragazzi di via Panisperna", from the street were the Physics Institute was located at that time.

Majorana, in his very short scientific life, performed several precursory investigations on relevant issues of that nascent branch of science that we now call elementary particle physics. In particular, Majorana undertook fundamental theoretical work on particle symmetry, which turned out to be the cornerstone of neutrino mass studies, currently a very active subject of research.

Giuseppe Cocconi reported the following sentence, pronounced by Fermi in 1938: "Because, you see, in the world there are various categories of scientists: people of a secondary or tertiary standing, who do their best but do not go very far. There are also those of high standing, who come to discoveries of great importance, fundamental for the development of science (and here I had the impression that he placed himself in that category). But then there are geniuses like Galileo and Newton. Well, Ettore was one of them. Majorana had what no one else in the world had (...)"



Our colleague, Ettore Majorana, the nephew of this homonymous uncle, provided the photograph for the exclusive use of "h".

September 11, 2006

It is the fifth anniversary of a sad event. But it is also the date of a European success: on this day a neutrino beam, produced by the accelerator complex of CERN, in Geneva, reached the Gran Sasso

GOOD NEWS!

*Congratulations to **Andrea** and **Germana Paoli** on the birth of their child **Alessandro**, who joined us on the evening of the 14th of September.*

*Best wishes to **Davide Soldani**, who married his **Daniela** on September 16th. From the Italian side: Auguri e figli maschi! and from the French side: Félicitations aux jeunes mariés!*

Laboratory of INFN, in Italy. The neutrino beam, originated at CERN, with a cross-section of less than 1 cm^2, reached the goal covering a 1 km^2 area, after traveling more than 700 km underground, in 2.5 milliseconds.

Neutrinos are continuously produced in nuclear reactions within the stars, and they are the most abundant particles in the Universe after photons. Our planet is constantly traversed by their flux: each second, 60 billion neutrinos go through a space the size of a fingertip. They interact so weakly with other particles that they can go through any form of matter without leaving a trace.

The new beam could shed light on the neutrino mass problem, very close to Majorana's studies (http://public.web.cern.ch/Public/Content/Chapters/Spotlight/SpotlightCNGS-en.html).

We wish the best of success to the Opera and Icarus detectors at Gran Sasso, built in order to detect and study the long travelling neutrino beam. Our wishes are even warmer, since the present director of the Gran Sasso Laboratory is Eugenio Coccia, gravitational wave hunter for decades and member of the Roma II group, recently joining the Virgo Collaboration.

November 30

On this day, every year since 2000, the Festa della Toscana is celebrated. We are proud to note that this date has been chosen to honour the same day of 220 years ago. On November 30, 1786 the grand duke of Tuscany (1765-1790) Peter Leopold of Lorraine published new laws for his state, including the definitive abolishment of the sentence to death, for the first time in Europe and in the world. In 1790, with the name Leopold II, he became Holy Roman Emperor till his death, in 1792.

C. BRADASCHIA

How to Get to EGO by Bicycle

With the intention of providing a few alternative means of getting to EGO and also exploring a little of the surrounding area, this is the first in a series on interesting diversions in and around Virgo. Titled 'How to get to EGO by bicycle' maybe it can provide a bit of encouragement to those considering alternatives to high fuel prices, traffic jams, expensive taxis etc.

Route 1: Pisa - EGO

Distance: 18km, Duration: 1 hour

(A map can be found on the following page)

We begin our journey from the south side of Ponte della Vittoria (1) and cycle the complete length of Lungarno Guadalongo. When the car park finishes, the road veers to the right. However, we go left (2) and join the cycle path, which runs parallel to the River Arno. We take this for approximately 4km, until the cycle path stops abruptly - mind the gap! - and descend to street-level on the right-hand side (3).

Having descended from the bicycle path, we take a right down a small street between two rows of houses (Via Enrico Malatesta) (4), then take the second left for Piazza Leone XIII and then an immediate right on to Via Piastroni. After roughly 150 metres, this becomes Via Vecchia Fiorentina, which will take us almost all of the way to the Via Tosco-Romagnola.

At half way along the Fiorentina the Badia di San Savino can be seen on the left-hand side. A small church and quiet courtyard are still to be found inside, while the ex-dormitory windows can be seen on the hillside as you pass by from the road.

After a couple of km on the Fiorentina we take a right onto Via di Quarto (5), which brings us briskly to the Via Tosco-Romagnola - normally very busy so keep your eyes peeled! Here we take a left so that we are on the main road for approximately 50 metres, before leaving it by taking a right onto Via Moggi. This takes us under the railway line and into a thankfully quieter area.

After passing beneath the railway line and overcoming the short subsequent climb, take a left onto Via di Pratale. We shortly encounter

a staggered crossroads; here, go straight on and take Via Ivan Rocchi.

At the T-junction (6), we go right onto Via Visignano and then take the left-hand turn that brings us to the first, and only, roundabout of our journey. We go straight over this and onto Via Oristano, which then merges onto Via Nugolaio, which passes in front of a couple of big Navacchio retail outlets (Desio e Robe etc.) and is the ugliest part of the journey.

After around 200 metres we take a left onto Via Fosso Vecchio (7) and into the pleasanter climes that the Arno plain has to offer.

The Fosso Vecchio is accompanied by the ditch (dry in summer), which gives it its name, and can be hard-going on windier days. It also makes up approximately 4km of our journey.

We leave it at the fourth available right-hand turning over the parallel main road (the FI-PI-LI) and cross the tallest bridge of the ride (8). We are now on Via Macerata, a couple of km in length and a nice change from the hard work of the Fosso Vecchio. Don't worry, we are now almost there and can see the North End of Virgo for the first time!

The Via Macerata brings us to Chiesanuova and the Via Arnaccio (9). Take care when crossing here as the traffic is often moving at high speed. Going straight over we continue on the Macerata for 3km before we taking the final left turn onto Via Amaldi (10) and one last fight against the wind before arriving at the gates of EGO.

Please feel free to contribute information, possibilities or suggestions on the various routes available in the surrounding area.

G. HEMMING
PHOTO: WWW.CERN.CH
MAP: WWW.GOOGLE.COM

SUMMER STUDENTS AT EGO

This year once again several summer students have been received at EGO. They have collaborated with different projects from software development to data analysis. Here is an extract of their impressions.

Jessica Democles from France, in collaboration with the Università degli Studi di Pisa: "The task of controlling the interferometer is really impressive since you have to make models to predict the expected behaviour, take data and then analyze it, and find what could be wrong when results do not fit. The purpose of this kind of internship is to get the head out of academic study, where you know what you should expect, and everything works because it has already been proven thousands of times. So I think that, by making my contribution to VIRGO on the analysis of the "Scanning Fabry-Perot", and by following some of the other activities of the interferometer, I have learned a lot of things."

Jaime Junell from USA, in collaboration with INFN Roma: "My short stay at the VIRGO site has brought me many wonderful experiences. The program itself was not very organized or prepared to receive me; however, everyone has been extremely kind and a few people have put forth great effort to help make this a valuable learning experience. (…) The variety of work that I have done has allowed me to see how several different fields overlap each other. Technicians, engineers, secretaries, computer technicians, physicists, and programmers all must work as a group. I have seen inventiveness, resourcefulness, hard work, and ingenuity working together towards one goal. I'm very happy with my experience here at VIRGO."

Edward Greve from USA, in collaboration with INFN Roma: "The work I have done here in Cascina was divided into two sections, first a small section on working with software programming for data collection devices to be used in VIRGO, and second on working with the Gravitational Wave Stochastic Background via mathematical modelling and computer simulation. (…) We were able to test the equations with simulated data, and then went on trying to determine how to maximize the performance of the detectors."

Geoffrey Guilbon from France, EGO internship: "Working at EGO was a very nice experience. I applied here for a four month training so as to work together with the Software Group. It was very interesting because it has been an occasion for me to learn a lot about software engineering inside a research centre and the way in which one has to work to make it possible for the whole structure to be successful over a long time period. (…) It was also the first time I worked and lived on my own in a foreign country, and I was really amazed to see how much people help each other, because at some point they have been in a similar situation. I'll leave EGO in a few days, at the end of September, and will have very good memories of my stay here in Italy among very nice people, and I'm pretty sure that I'll come back in the next years."

Encouraged by the positive comments, the Summer Student Program should be repeated also in the coming years; the "researcher apprentices" staying with us for a period, may become PhD students or collaborators in the future.

From their comments we also think to understand that a little more of preparation and organization of their work would make the program even more successful.

B. LOPEZ, C. BRADASCHIA
PHOTO: E. GREVE