THE GRAVITATIONAL VOICE

number 7

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News from EGO and VIRGO

Happy 2008!

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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

HOW MANY READ *h?*

To answer this question and to measure our effectiveness as journalists, we asked Antonella to install a contact counter on the ***h*** web page. The counter started counting in the late summer and just before the appearance of the 6th issue of ***h***, last October, it reached about 350 contacts. Today we have a score of over 1000: is this a success? Is it a failure? Hard to say. Let us wait for ***h*** 7.

Meanwhile, in order to try to increase our readership, we introduce from this issue of ***h*** a couple of new columns:
- a guest article contributed by the LSC (LIGO Scientific Collaboration) world
- the help service "Say it in English, not in Virglish".

The first LSC article has been written by Dave Reitze, the LSC spokesperson (that's a good start!) and tells us about the satisfaction of the successful completion of S5 and the effort for the upgrade to Enhanced LIGO. The column "Say it in English, not in Virglish" is a help service that the ***h*** editors offer to the readers. It has been conceived in order to help all of us to improve our often poor English pronunciation. We would be delighted to know if you like these novelties, in particular, and how to improve the newsletter, in general. To this aim, we have the potential column "Letter to the Editor", with the e-mail link at the bottom of the ***h*** web page. Please write, let us know your thoughts!

There is another point where we need help: if you read here at the top left of this page you will see that the ***h*** team is composed by three persons from Italy, one from France, two from the United Kingdom and one from the Republic of Ireland. That is fine from the point of view of internationality, but does not at all reflect the composition of our community. We are missing at least one French and one Dutch editor. So we put forward another request to our readers: please volunteer as ***h*** editors, join us to make this newsletter more interesting and more pleasant.

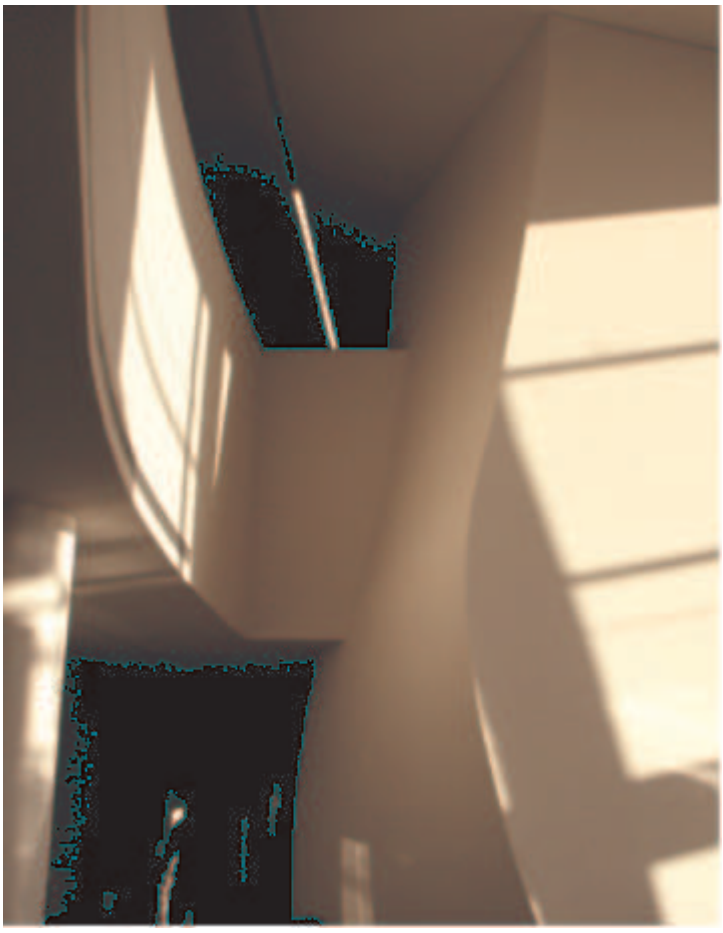
Finally we are happy to have the opportunity to wish to all of you the best possible and fruitful new year. It will be a tough year, devoted first to the implementation of the upgrades for Virgo+, then to the commissioning of the improved detector. It is a difficult task and we shall not only need a strong effort but also a lot of luck.

C. BRADASCHIA

FRONT COVER: New building by night
Photo taken by M.PERCIBALLI

Highlights of the November Virgo week

The last Virgo Week, which took place from Nov. 26th till Nov 28th, has been one of many similar meetings over the past years. Yet, as any event, there were some unique aspects to it: it was the First Virgo Week after the First Virgo Science Run, it was the first meeting housed in the new office building, and it was the occasion to discuss Virgo+ for which a specific review meeting had taken place in October 2007. Let's start with the new office building. I think all Virgo and EGO can be proud of it, and especially Filippo Menzinger, who as director of EGO had an important part in its realisation. It is a surprising office building: yes, there are straight lines, but no, definitely not all lines are straight. Rather, it shows in the entrance hall beautiful forms of what Euclidian space could look like if a strong gravitational wave passes by. Well, this might be more an "Artist's impression" of the effects of GWs, but I cannot help having this association of thought.



The 1st Virgo Science Run was finished after about 4 months of data taking. For the first time, the Virgo Interferometer took data simultaneously with its American counterpart LIGO. The run was characterized by a very good duty cycle of more than 80 %, and by the fact that the sensitivity slowly increased, such that the horizon for neutron star mergers (BNS) at the end was above 4 Mpc. This is quite a good achievement, although still below the design value, and the probability to find in these data signals from a coalescence is unfortunately small. In contrast to those among us who are analyzing these data – and who are looking backward, in some sense – most of the activities in the next months and in fact years will be directed to the future, namely the timely installation and commissioning of Virgo+, and this subject was the common theme in most of the working meetings.

Completely in line with this, Benoit's talk was entitled "Towards Virgo+". Already during the Virgo+ Review in October, it became clear that the technical difficulties for the monolithic suspension are such that it will not be available in time. This requires us to think again carefully about the configuration of the instrument when it is to be switched on simultaneously with LIGO for VSR2. The items which must be ready for the start of VSR2 must be the laser, the improved IMC, the electronics and the thermal compensation system; this baseline approach should bring the BNS horizon to about 15 Mpc. Installation of the new mirrors, including the monolithic suspension, could take place around 2 years from now when they will be available.

On a yet larger time scale, the EGO Council "supports the Advanced Virgo project" and states that the funding agencies must be involved in order to secure a timely funding, and to have Advanced Virgo operative at the same time as Advanced LIGO. But it also sees the need to find a more solid basis for funding, and urges to broaden the collaboration.
Funding is and remains an important issue, and with his remark that "the situation is severe, but not hopeless", Benoit positioned himself as a great future European Statesman by citing literally (and even translating into English) Konrad Adenauer's proverbial expression.

Stavros Katsanevas, the chairman of the EGO Council, explained in a Video-link presentation that the Council had decided, among others, to create the new position of a Scientific Director. Especially the Council's "expectation" that the Scientific Director is the same person as the spokesperson represents a change in the structure of Virgo and EGO and caused quite some discussion and could imply a modification of the rules of the Collaboration. On the technical level, the creation of a department for the future of Virgo headed by an engineer (or a person with equivalent capacities) will need discussion to

optimise the work.
The Virgo week also marked the departure of Filippo Menzinger. He addressed the Collaboration for a last time, and in the last minutes of his speech he gave a small overview of the development which took place during the years of his time as director of EGO. Indeed, it was a moment of visible emotion, in spite of the fact that everybody tried to hide it, including Filippo himself. I thought it was a pity that the "official" moment of his departure was at the end of the week, and not during the "Virgo-week" which – as everybody knows – is only half that what its name says… I think, since he is an extremely kind and friendly person, he used to understate his impact in making Virgo and EGO that what they are. Seen from the position of our group, from NIKHEFat Amsterdam, who joined only lately this project, I want to stress that Filippo helped us considerably to become a member of this collaboration and to feel "at home" here. I add a (non-professional) picture of Filippo during his speech.

T. BAUER, NIKHEF

The 19th EGO Council of 12-13 November

1. Re-organisation of the relationships between EGO and the Virgo collaboration
The Council decided in response to the recommendations made by the visiting committee, in particular its advice to "better integrate" EGO and Virgo, to implement the following:

Scientific director
The EGO Council decided to create the position of scientific director in order to assist the Director of EGO in scientific activities and, in particular, in the relationships with the Virgo collaboration. The Council expects that the Virgo spokesperson and the scientific director be the same person. The scientific director has a three-year contract with EGO, renewable.

Technical coordination
The Council proposes to the EGO director the creation of a new department for the future of Virgo (Virgo+, Advanced Virgo), headed by an engineer or a person with equivalent capacities, that would ensure the timely and cost effective realisation of the upgrades. The head of this department is appointed by the EGO director in agreement with the scientific director and the EGO Council.

EGO group participating in Virgo collaboration
Council asks the Virgo collaboration and the EGO laboratory, to clarify the motivations, format, implications and rules of the EGO group for formal participation in the Virgo collaboration and make a proposal to the EGO Council.

Relationship EGO-Virgo
The Council in view of the above changes further considers that an update of the MoA between EGO and the Virgo collaboration is required.

3. Prorogation of the EGO Consortium
The Council proposed the extension of the Consortium for 5 years from 29 November 2010 till 28 November 2015 and entrusted the Director to invite CNRS and INFN to formally approve the extension (Note added: this request has already been transmitted)

3. Budget 2008
The Council in July 2007 had given mandate to the Director to present a budget based on the assumption that the members would have been able to contribute 10 M€ in 2008. However at the end of October, the Director was informed that these contributions were instead to be considered up to a sum of only 9 M€ .
The director expressed concerns about such a reduction considering that the amount of recurrent expenditures would mean cutting heavily on possible investments in 2008, thus largely reducing the possibilities at a moment in which the maximum effort is dedicated to Virgo+ and to the preparation of Advanced Virgo. Indeed, the largest part of the budget of EGO is blocked by the need of supporting essential tasks and services.
The Council considering the more limited resources put at disposition of the CNRS and INFN delegations however approved the base line of the 2008 reduced budget set at 9 M€.
The currently approved R&D program will have to be reviewed through an evaluation of the first reports on the activities carried out so far, before the next June Council meeting to better assess the financial situation and needs.

4. Virgo, Virgo+, Advanced Virgo
The Council received extensive reports and had discussions on the following items presented by the Virgo collaboration:
- Virgo Progress Report (B.Mours)
- Commissioning status and plan (E.Tournefier)
- Virgo+ advancement status, result of the internal review. (M.Punturo)
- Advanced Virgo (G. Losurdo)
- Data Analysis status (A. Viceré)
- Outreach (C.Bradaschia)

The Council praised the Virgo

collaboration for all its achievements and in particular the successful comcompletion of VSR1, the efforts directed to reducing noise in the new phase of commissioning, the completion of the Virgo+ internal review and the completion of the conceptual design of Advanced Virgo, with its indication of possible costs and spending profile. The Council noted also the advancements obtained in Data Analysis organisation, and the growing collaboration with LSC on that subject.
The Council supports the Advanced Virgo project and took note of the proposed milestones. It expressed the consideration that adding new collaborating groups would certainly make the funding easier and this should be actively pursued.The Council also took note of the need to further involve the funding Institutions in order that a decision on its funding is taken timely as the work plan indicates and as needed in order to have Advanced Virgo operative at the same time as Advanced LIGO.

5. Meeting with the staff representatives
The Council chairman welcomed the two newly elected staff representatives and firstly informed them on some decisions taken by the Council of direct interest for the staff. He informed them that the Council had decided to grant all personnel a bonus in 2007 in recognition of the successes obtained in the completion of the first Virgo Science Run, the completion of the main infrastructural works of the site culminating with completion of the new building and of the computing center. It had also decided to have the full recovery of the increase in the cost of life over the past year, by applying an increase to the salary scale. Other questions affecting the staff rules will be re-examined later on, by comparing and taking in consideration the situation in other international and national laboratories.

F. MENZINGER

Virgo in the news

When I first heard that the BBC would be coming to film at EGO I was both excited and curious. Like most of my compatriots I have a long-running affinity and affection for the Beeb. These days it is such a vast entity, covers so many subjects and caters to such a range of tastes that it is perhaps not easy to explain how such an almost omnipresent institution can be seen as anything other than a kind of Orwellian all-pervasive nightmare.

In reality, at least for people of my generation and, I suspect, above, the BBC provided an audio-visual canvas to our formative years. There are now so many different channels available, so many different alternatives, that it may be that the effect has been diluted, but for me, be it Ronnie Barker's 'four candles-fork handles', Delboy falling time-lessly through that open bar; or listening to Radio WM (West Midlands) on a Saturday afternoon, patiently awaiting the sound of the goal horn and the words, 'Goal at Villa Park!' (very patiently some seasons); there are so many memories in which 'Auntie' has been involved. After all, an institution with the motto 'Nation shall speak peace unto nation' can't be all that bad.

Maybe the phenomenon is worth explaining a little. One is inducted into the world of the BBC at a young age. I remember growing up watching programmes such as Bod, Bagpuss, Mr Benn, Playschool and the Magic Roundabout. Programmes in which one was as likely to be taught about the growth cycle of the amoeba or how a bottling plant works, as to follow some bizarre storyline, which could only have been concocted by someone who had spent the most part of the early seventies on mind-bending hallucinogenics and was now involved in some progressive rehabilitation programme, writing scripts for kids' TV. I note here that, having seen the Tellietubbies, the 'care in the Corporation' scheme is evidently still thriving.

One graduates from Children's BBC (it is actually called that, I'm not making it up) to a world populated with a vast panoply of available sources of information and entertainment, including numerous TV stations, vast quantities of international, national and regional radio stations and websites galore; each containing a lush fauna of comedies, dramas, documentaries, theatre, music, sport, discussion and, of course, news.

I admit my perspective is certainly rose-tinted. It is now more than six years since I lived in England (I even had to think a little about how to structure that sentence correctly. The first phrasing that came to mind was 'that I don't live in England' – Virglish is gradually taking me over!) and, as much as I can understand the benefits of interminable game shows, canned laughter, adverts during football matches and scantily-clad women prancing around every five minutes, I'm afraid my experience of Italian TV has probably only served to reinforce my chocolate box image of the BBC.

So, thus conditioned, it was with some satisfaction that I was charged with providing a report on the programme that was subsequently produced using the footage filmed here on site. I soon discovered that, as I expected, the programme had been produced under the remit of the Open University, a BBC institution created in 1969 with the aim of bringing higher education to people for whom access to it may

++ ON THE AGENDA ++

Open day at EGO on Saturday the 8th of March. For more information please contact Carlo Bradaschia or Severine Perus.

otherwise be impossible. With 180,000 students enrolled, it constitutes the largest academic institution in the UK and provides late night lectures on BBC2 on a range of subjects. Once famous for footage of dowdy lecturers with strange hair and appalling ties, the OU has undertaken something of an overhaul of late. The programme itself was titled, 'The Cosmos - A Beginner's Guide' and the presenter, Adam Hart-Davies, was as energetic and enthusiastic as ever. Using a tour of the Very Large Telescope (VLT) in Chile as a basis, basic introductory details on the universe and how it is being observed were provided. All was presented with the usual straightforward, unambiguous and easy on the eye style that is the trademark of BBC Science programmes.

Moving from the VLT, via Hubble, ESO and Max Planck, we arrive at EGO and begin by hurtling along the north arm of Virgo, not quite at the speed of one our many photons, but at a rapid rate nonetheless. The basic concepts underlying gravitational wave research are then outlined - particularly nice is the demonstration of the changes in the arm lengths during the passage of a gravitational wave - as we are led on a mini tour of various areas of the interferometer, notably the Central Building, with Carlo as tour guide.

From here, the programme transfers to the Control Room, in which Giovanni explains about chirps in a segment that is also used very nicely during the opening credits and may be viewed by clicking here. Many shots of the Control Room are shown, from various different angles, all including people diligently working or discussing new developments with very serious looks on their faces. Although, in our house, the highlight was undoubtedly seeing a shot of Paolo Ruggi sporting a hairstyle that can only be described as having seen a bit of a windy day.
Ultimately, the segment of the programme that focuses on Virgo lasts for around five minutes, but this is ample time to explain some of the basic concepts of the detector and provide an initial glimpse of the day-to-day workings on site. For more detailed information on not only how Virgo works, but also on the history of the project, the reader may wish to turn to the September 2007 edition of the French publication, Science & Vie. Put together against the background of the launch of the first science run, the eleven-page report provides a handy introduction to the experiment and gravitational wave detection in general. There's a very nice image of the interferometer, including semi-transparent super-attenuator towers, enabling the reader to visualise the chain of pendula and suspended mirrors, and quotations from many Virgo luminaries and some fantastic photographs – both old and new. The article also avoids a common pitfall of many articles of this type and does not just talk about how Virgo works. It rather delves into what is actually happening now, by looking at the process of noise-hunting and explaining sources and what is being done to reduce them.

For younger readers, Virgo is also featured in the December 2007 edition of Science & Vie Junior. Obviously, the information available here is less dense than in the parent issue, but there is a nice image of a binary star explosion and the consequent effect on the surrounding gravitational field. Information is nicely broken up into small boxes, in which questions are posed simply - such as 'What is a gravitational wave?' and 'Where are these waves born?' – and each one is then answered succinctly below. Additional images are also provided to explain things in a more straightforward and accessible manner.

Virgo was also featured heavily in the INFN tri-monthly magazine, Asimmetrie, which was entirely devoted to gravitational wave research, while an article on the status of Virgo was also published in the December issue of CERN Courier.
In addition to this flurry of international recognition of Virgo, it should be pointed out that a nice video, containing interviews and footage from the site, mixed with explanatory segments on gravitational waves, is available on the University of Pisa website. It can be accessed here:http://tv.unipi.it/ricerca/.

So, Virgo continues to receive coverage and is of interest outside of the Arno Valley. Let's hope coverage of it over the next few years turns from 'how Virgo listens' to 'how Virgo found'.

G. HEMMING

+++ NEW ON SITE +++

CAFETERIA/CANTINE/ MENSA/KANTINE

Among the novelties of 2008, there is one that is very welcome by everybody: the EGO Cafeteria, which has recently come into operation. It is part of the inheritance left by Filippo Menzinger.

We are sure that this will bring many benefits to life at Cascina. We will save time and fuel. Relations and familiarity between EGO employees, Virgo members and occasional visitors will be greatly enhanced.

After just a few days, we can take the risk to say that food is at least as good as that which we are used to up to now.
But improvements are always possible. Knowing that, the EGO Director encourages, by means of h, the users of the cafeteria to express freely their comments and suggestions by sending an e-mail to Franco Tosi.

Enjoy your lunch!

How does a "recycled" interferometer work?

Gravitational wave detection, due to the extremely small amplitude of the signal to be detected, is a very difficult task. In order to increase the sensitivity of an interferometric antenna, and therefore the probability of detection, various techniques have been developed (http://www.einstein-online.info/en); two of these are generally well known: a) the use of Fabry-Perot (F-P) optical cavities as arms of the interferometer and b) the use of the power recycling technique. A third technique has been developed (presently used in GEO600) and it is known as signal recycling (c). The reasons to resort to these techniques are briefly described below:

a) the F-P arm cavities force every photon to go back and forth along the arms many times, multiplying correspondingly its phase change due to the arm elongation.

b) the power recycling consists in adding an "input" mirror which feeds back to the interferometer all the light returning to the laser, multiplying the effective laser power, hence reducing the photon number statistical fluctuations.

c) the signal recycling instead relies on the presence of an additional "output" mirror that allows a signal of a given frequency to resonate in the interferometer, enhancing its sensitivity at that frequency.

These three techniques are based on properties of the optical resonating cavities and all of them can be used at the same time. At this time Virgo and LIGO are using "only" the first two techniques with a lay-out as shown in figure 1.

In order to understand the principles of signal recycling, it is useful to have some familiarity with F-P cavities and power recycling. We devote this column to introduce these techniques; in a forthcoming h issue we will describe signal recycling. All this will be done in a simplified, approximate way favouring intuitive comprehension, assuming that our readers know the basic principles of a Michelson interferometer (http://en.wikipedia.org/wiki/Michelson_interferomter). Brave readers will profit of some simple equations used below.

What is a Fabry-Perot cavity and how does it work (http://en.wikipedia.org/wiki/Optical_cavity, and http://en.wikipedia.org/wiki/Longitudinal_mode)? In its simplest form, it is made of two facing parallel mirrors, S1 and S2, put at a distance L with reflection and transmission amplitude coefficients respectively r_1, t_1 and r_2, t_2 (http://en.wikipedia.org/wiki/Reflection_coefficient, and http://en.wikipedia.org/wiki/Fresnel_equations).

It has the configuration of each arm of the interferometer shown in figure 1.

Photons from a laser enter the cavity

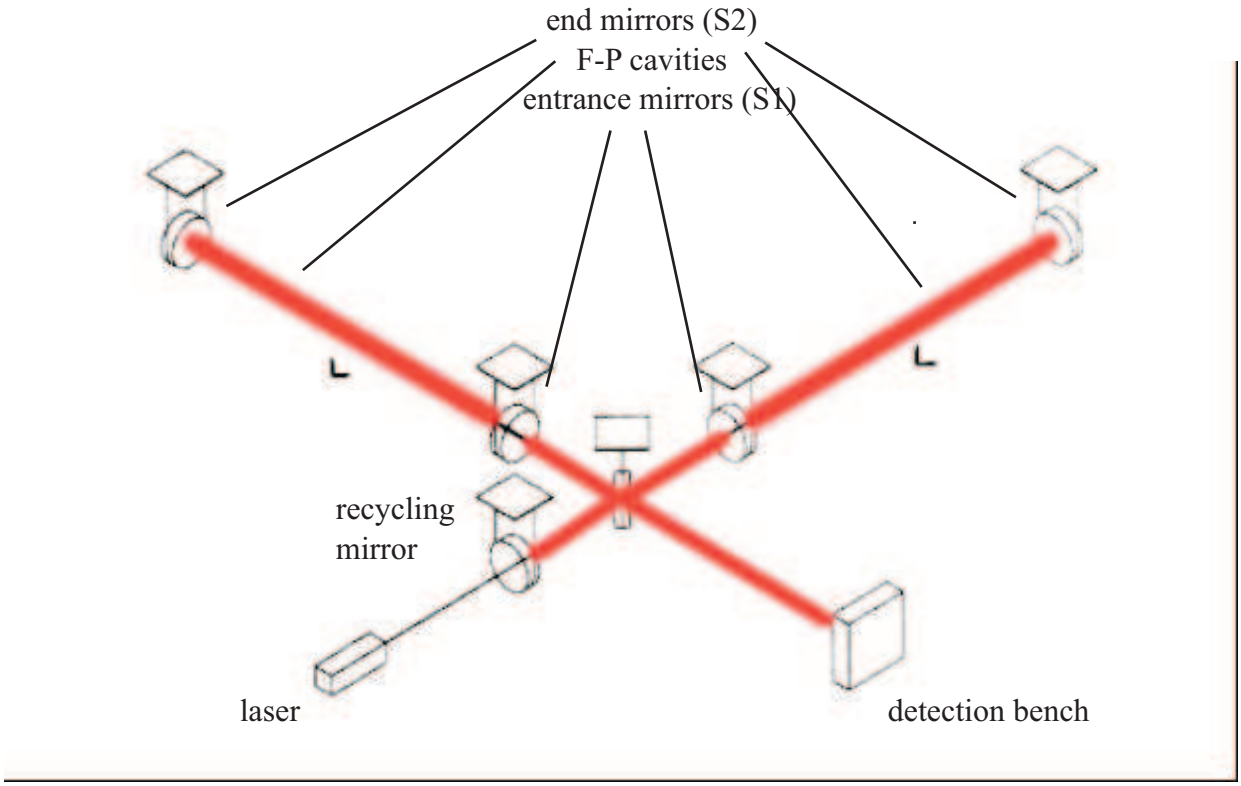


Figure 1 – A recycled interferometer configured as at the present Virgo and LIGO

through S1, bounce several times between S1 and S2 and eventually exit the cavity through S1 or S2 with probabilities determined by the values of r and t parameters. If there are no losses we have $r_1^2 + t_1^2 = 1$ and $r_2^2 + t_2^2 = 1$. From these relations we understand that when we say that a given mirror has a reflectivity of 10% of the light intensity and, excluding the losses, a transmittivity of 90% we are actually referring to the square values of the coefficients just mentioned ($r^2 = 10\%$, $t^2 = 90\%$). In order to qualitatively understand how such an optical system works, let us suppose that the second mirror, S2, is totally reflective, that is $r_2=1$. When the light enters the cavity through the first mirror it is partially reflected and partially transmitted; the transmitted part travels all the way to the end of the cavity and after being totally reflected by the second mirror, will return toward the first mirror. In turn this light will be partially transmitted from S1 toward the laser source and partially reflected back toward S2. If the round trip path length is an odd multiple of the laser half wavelength (resonant condition), the light coming from S2 and reflected by S1 will be in phase with that transmitted through S1 and coming from the source, increasing in this way the field amplitude inside the cavity. In these conditions the phase of the light coming from S2 and transmitted by S1 is the opposite of that coming from the source and reflected by S1. So, while initially the field amplitude inside the cavity grows up, the amplitude of the reflected one decreases. At the end, after a small fraction of a second, an equilibrium situation will be reached so that the absolute value of the field amplitude transmitted through S1 toward the source plus that coming from the source and reflected by S1 is equal to the amplitude of the source itself. In this way all the energy will be reflected back toward the source but with the phase reversed: it is exactly what we must expect due to the assumption of no losses at all (principle of energy conservation).

Let $|A|$ be the modulus of the amplitude of the field coming from the source and $|B|$ be the modulus of the one inside the cavity; a very simple calculus shows that:

$$|B|\, t_1 - |A|\, r_1 = |A|$$

$$\Rightarrow \quad |B| = |A|\frac{1+r_1}{t_1} = |A|\frac{t_1}{1-r_1}$$

We can clearly see that with a high reflective input mirror the field inside the cavity can reach very high values:

$r_1^2 = 99\%$ $\quad t_1^2 = 1\%$

$|B| = 0.1/(1 - 0.995)\,|A| = 20\,|A|$

On the other hand if the round trip path length is an integer number of wavelengths (antiresonant condition), the field coming from S2 and reflected by S1 has a phase opposite to that of the field coming from the source and transmitted by S1; in these conditions the value of the field inside the cavity will reach a minimum and the cavity itself will reflect all the light coming from the source without the phase inversion. Also in this case a simple calculus shows that:

$$|B|\, t_1 + |A|\, r_1 = |A|$$

$$\Rightarrow \quad |B| = |A|\frac{1-r_1}{t_1} = |A|\frac{t_1}{1+r_1}$$

that is for high values of the input mirror reflectivity the field inside the cavity assumes very weak values. Instead of changing the cavity length, with the aim of bringing the cavity to resonance, we can change the frequency (i.e. the wavelength) of the radiation, keeping the cavity length fixed. One can show that the field intensity inside the cavity is at least 50% of the maximum value reached at resonance, when the frequency varies in the range (the so-called cavity line width) given by:

$$\delta\nu = \frac{c}{2L}\,\frac{1-r_1}{\pi\sqrt{r_1}}$$

where:

$\frac{c}{2L}$ is called "free spectral range" and

$F = \frac{\pi\sqrt{r_1}}{1-r_1}$ is called cavity "finesse".

The cavity finesse is essentially the equivalent of the quality factor of a resonant circuit and roughly represents the average number of roundtrips made by each photon before exiting the cavity. One can show that when changing the frequency in this same interval, or equivalently for cavity lengths varying from $L-\lambda/(4F)$ to $L+\lambda/(4F)$, the reflected wave experiences a 180° phase variation: in order to obtain the same phase variation with only one roundtrip one should change the cavity length by $\lambda/4$. Therefore a high finesse cavity will amplify the phase variation induced by a relative displacement of the mirrors (possibly due to gravitational waves) and it is exactly for this reason that in the interferometer the arms are replaced by optical resonant cavities.

Let us now consider an interferometer as in figure 1. The light coming back from each arm is shared by the beam splitter in two halves, one directed towards the photodiode on the detection bench, the other sent back to the laser. On both these two directions there is superimposition, hence interference, of light coming back from the two interferometer arms. Tuning the positions of the arm mirrors one can obtain destructive interference between the two superimposed beams going towards the detection photodiode, which receives no power, hence delivers no signal apart its noise. If the arm lengths are changed by a passing gravitational wave, the destructive interference condition is lost and a little light reaches the photodiode, which delivers a tiny signal. This condition, called "dark fringe" is chosen for Virgo operation, since it is easier to recognize a small signal with respect to a zero.

At the dark fringe, no light power goes to the photodiode, hence, given the negligible losses on the mirrors, all the power injected by the laser has to return to it. The interferometer acts as a highly reflecting mirror placed at a distance from the light source which is the mean value of the distances of the two terminal mirrors. Placing a partially reflecting mirror, called recycling mirror, between the source and the beam splitter we obtain the "recycling cavity", limited at the entrance by this mirror and having the whole interferometer as end mirror. The position of the recycling mirror can be tuned to reflect back the light returning from the interferometer in phase with the light coming from the laser. We obtain an increase by a factor $[t_1/(1- r_1)]^2$ of the intensity of the light impinging on the beam splitter, reducing the noise due to the statistical fluctuations of the number of photons. Working along this principle, the power recycling technique is equivalent to using a much more powerful laser, not available at present.

In a forthcoming *h* issue we will describe the signal recycling technique that is planned to be used in Advanced Virgo and Advanced LIGO.

D. PASSUELLO

A new book on GW by Michele Maggiore

I was asked by the editor of "*h*", the EGO/Virgo newsletter, to write a review about Michele Maggiore's new book "Gravitational Waves" (Oxford University Press). It is a pleasure for me to do that. I have known Michele since I was a graduate student at the University of Pisa. At that time he was a young researcher, and I remember clearly the vivacious and informal atmosphere of the research group he was able to build (regrettably, I was not a part of it....). Several talented young physicists came out of there, and many of them are now making relevant contributions to science. Michele is now Professor of Physics at the University of Geneva, focusing his interests on gravitational waves, and he is well known by all of the experimental and theoretical community. The second reason I'm glad to write this review is that this gave me the opportunity of having a copy of the book for some weeks, when it was not yet possible to find it in the shops.

So, here are my impressions. First of all, there is a subtitle: volume I: theory and experiments. As you can learn from the preface, the reason is that another volume is foreseen, which will be dedicated to the astrophysical and cosmological information that will be derived from the study of gravitational waves. This first volume can be seen as a toolkit that one needs in order to get a working knowledge of gravitational wave physics.

The first half of the book addresses theoretical issues. Gravitational waves and basic tools to deal with them are introduced in the first three chapters, using both the geometrical point of view and the field theory approach. It should be pointed out that "Gravitational Waves" does not contain an introductory section about general relativity, and a prerequisite for the reader is a basic knowledge of this subject, at the level, for example, of the Schutz's book. Some basic notion of classical field theory can also be useful.

Keeping this in mind, it should be said that the chosen approach is very pedagogical and effective. The important results are introduced taking great care in explaining the details of their derivations, and each chapter is supplemented by a set of completely worked out exercises. The remaining three chapters of the theoretical part discuss applications of the theory to a set of some very relevant subjects. The chapter about the post-Newtonian formalism is in my opinion a very clear introduction to this technically involved subject. In the following chapter, I found the discussion about the emission of gravitational waves from compact binaries very enjoyable, with an extensive discussion of the Hulse and Taylor results, which is difficult to find elsewhere.

Let us come to the second part of the book, which is dedicated to experimental techniques to detect gravitational waves. Data analysis is discussed before detectors and their noises (maybe this reflects the fact that the author is a theorist...). Here, the aim of the book is to give, another time, a pedagogical introduction to the most important issues. I can say that this is fully accomplished.

The last two chapters contain a thorough discussion of resonant bar detectors and interferometric ones. In both cases, the coupling to gravitational waves is discussed in great detail, together with a very careful analysis of noise sources. To draw to a conclusion, I think that "Gravitational Waves" is a very good book, and it fills a gap in the literature.

In my opinion, we can look at this book in a couple of ways. It is an ideal textbook for a monographic introductory course on gravitational waves, for graduates or advanced undergraduates. However, it could also be the basic reference text for researchers, both experimentalists and theoreticians, in particular young ones, who are working in the field. Of course, it is also the book that a physicist working on a different subject but curious about gravitational waves should read as an introduction.

I've got my copy, and I will not give it back.

M. Maggiore - Gravitational Waves Volume 1. Theory and Experiments, Oxford University Press (Oct. 2007) 576 pages, 131 figures (http://www.oup.co.uk/isbn/9780198570745).

G. CELLA

Planet E$O

One of the first days in which I was here at ESO, I joined an all-day-meeting with the participants of a consortium charged to develop the design study of a big deformable mirror (2.4 m diameter, 1.9 mm thickness, 5,000 actuators, …), a Kick Off meeting (also called KO meeting, in all senses). Among these participants there were several Italians. Many of them came from an astronomical observatory in Lombardia. During the lunch I was talking with them, and they asked me where did I come from, and what was I doing before working at ESO. As I said I had been working in gravitational waves, they said to me: "So, are you a theorist?". When I said that no, I am an experimentalist, they said: "Why, is there any experimental activity in gravitational waves?". And these guys were astronomers, Italians, from the country hosting one of the biggest gravitational wave interferometers, and having the largest number of bar antennas in the world, all instruments having the ambition to do, one day, astronomy. This was just one of the episodes that gave me an idea of how different the world was in which I had landed, how isolated the GW community is, and how little renown Virgo and the GW research have (notwithstanding the generous effort of our newsletter, which is probably read only by GW people).

Things at ESO are quite different, not surprisingly. Starting with the coffee, which is awful, so terrible to the point that I decided to purchase a small electrical moka machine (and to keep it in my office, because it is not possible to keep it in the cafeteria). But things are not that simple: the device has to be tested by the security officer, who, after checking (in particular he was very concerned by its electrical grounding), put a red stamp under it (with two years expiration date). Ending with the MPI canteen, whose ill-fame was already widespread in Europe, and I had the privilege to confirm it. I'm sure it will take some time before some scenes for a James Bond movie will be shot at the Virgo site, as is happening at the Paranal ESO observatory (maybe some episode of Maresciallo Rocca could be suggested, there is surely potential subject matter in the in EGO/Virgo environment).

But, putting aside these anecdotes, even if I've not been at ESO long, I think I could already try, keeping as impartial as possible, to make some comparisons between EGO/Virgo and ESO. In many aspects EGO/Virgo (or other GW experiments) has some similarity with ESO, besides the name: both are organizations with the goal of handling some big facility for making science, namely astrophysics, and to design and plan upgrades of future ones. Both employ people to commission and run the instrument, in order to make available data to scientists for observation. Both are at the edge of their respective technological fields, so they mix engineering and R&D. Of course, ESO is a much bigger organization, with 14 financing countries, I don't know how many others collaborating and more than 200 M€ yearly budget. It runs three observational sites and several hundred people in two continents work for it, operating in a technological field which is the oldest of the modern age, the telescope can be considered the first instrument that triggered the scientific, and later industrial, revolution. So it is a well respected and established field, at the very centre of our culture, which has continuously seen progress, even in recent times. With instruments like telescopes you know that, if you make them better or bigger, you see more. This is not the case of things like the gravitational interferometers: one could say that ten times better than zero could still be zero. So, it is clear that the governments are much more prepared to finance that kind of research: even if maybe more expensive, it's less risky. The working procedures at ESO are also different, and maybe this helps them, despite all the inevitable problems, work in a more efficient way. First of all, ESO is not a scientific collaboration between groups or laboratories. ESO leads, at least as far as the telescopes are concerned, all the operations. To be clear, there is no VSC. Already, when starting with the comparison, I use the expression EGO/Virgo: one would not use for example ESO/VLT, there is not such confusion here (maybe things are a little bit different with the ALMA project, the large array for submillimeter detection, to which ESO is participating in an international consortium). Conceptual designs, specifications, guidelines, are decided by ESO. Then part of the installations are performed by ESO, but a large part is contracted to industrial companies. ESO provides documentation including the specifications to be fulfilled, the company has to propose the technical solution and, in collaboration with ESO, carry out the component design and construction. This of course is much easier when you have a lot of money to spend. But it's also true that the governments (at least many governments) are much more willing to finance an organization if there

NB: ESO is the intergovernmental European Organisation for Astronomical Research in the Southern Hemisphere. On behalf of its thirteen member states ESO operates a suite of the world's most advanced ground-based astronomical telescopes located at the La Silla Paranal Observatory in the Atacama desert in Chile. The ESO Headquarters are situated in Garching near Munich, Germany. (http://www.eso.org/public/)

The Max-Planck-Institut Garching is one of the institutes of the Max-Planck-Gesellschaft which is equivalent to the CNR in Italy and to the CNRS in France.

is consistent benifit to national industries. But it's also true that the governments (at least many governments) are much more willing to finance an organization if there is consistent benifit to national industries.

It is true that, in a system in which the components are delivered by laboratories, it is much more difficult to plan an activity in this robust way. But in many cases, by the comparison with what is considered absolutely normal at ESO, it seems that even the basics of an organized engineering practice are absent. In Virgo I've never seen something like a "compliance matrix", in which, for example, a laboratory, charged to build part of the apparatus, is asked to demonstrate that this part will perform according to specifications which satisfy a list of requirements, even if there are cases, as the laser, or the vacuum tubes, in which substantial parts have been essentially contracted to an industry. Even in the case of an activity carried out by a laboratory, an exhaustive list of requirements is seldom made. In principle, given the objectives to be reached, one should be able to state what are the requirements for the various parts, not only in a general way, but entering into the technical details. This does not happen in Virgo and, as far as I know, it happens seldom also in LIGO, at least not in a systematic way. I've never heard in GW interferometers about expressions, which are obvious in any complex technological enterprise, like "top requirements", from which an "error budget" descends, with a list of requirements and specifications which has to be satisfied by the installed components. In Virgo, I have only seen a tolerance study a number of times , which is the closest thing to an error budget evaluation, and which, in principle, should describe how a variation of one parameter propagates among the other systems, and teaches how this variability can be kept under control in order to fulfil the top requirements (in Virgo I would say that it should be the design sensitivity curve). And, as already said, there is no "compliance matrix", in which it is shown whether the requirements are satisfied or those which are not and why. There is no formal "risk assessment", or "risk mitigation": it seems that one simply hopes that things work, without a clear idea of which are the weak points. I've never heard, either in Virgo or in LIGO, of a definition of the organization of the "interfaces" between the different systems, which should take care of the requirements posed by each system to the systems which it has to work with (it must be recognized that Daniel Enard made a strong effort in this sense, arriving at Virgo; but the friction he encountered was even stronger). I've heard several times here that people working at ESO need to interface continuously one with the other, all working as system engineers in a sense, and that's considered important (but I've still to verify whether it is true or not). "There is no war inside ESO, and that's why ESO works well". In order to operate constructively, the meetings have to be efficient: meetings, of which there are also a lot (unfortunately), never start without a list of actions to be examined, never end without a list of actions, with respective deadlines, for the next meeting, and very often, at least for the most important meetings, there is even a final reading and correction of the minutes taken during the meeting (and usually nobody takes his own PC there).

Setting aside for a moment the different dimensions of the two structures, I would say that the comparison between the approach to the activities I've already taken part in, with respect to what I was used to in GW, seems quite significant. I don't think it's a peculiarity of GW research only, it is probably quite a common aspect of the research, even in astronomy, when it's made at a laboratory level. A cited example is the one of telescope interferometry: it has been tried many times in the past, in some cases it has also worked, for a short time in precarious conditions, but it has never been really reliable. That is until ESO took the matter into it's own hands and built VLTI, which has essentially worked, and is working in a quite robust way. The explanation given is that this happened because of the systematic way to face the problem, the engineering, the big contracting to industry, the capacity of ESO to take decisions autonomously.

I don't know whether similar approaches could work also for projects like Virgo. Probably the most important difference resides in the fact that when dealing with telescopes (but also with accelerators to cite other "big instruments"), for example, you know more or less where you are going. These are more or less known instruments, to which standard procedures can be applied. In GW, many things are tried for the first time, and when you don't know exactly how to make things work, and you have to work until late in the morning to fix unexpected problems, it

Paolo, this way

is already difficult to be able to have a realistic schedule, not to mention error budgets and risk mitigations. In many aspects, not present in more established technologies, Virgo researchers, scientists and research laboratories are needed to develop original components and procedures, and too much engineering could go, in some cases, to the detriment of originality. Moreover, there are more people in ESO doing this work, and much of the work is contracted, which also makes things easier.

I also think that the main reason for not having this approach is that most of those who have been working in Virgo, including myself, essentially don't know how to work in a different way, and maybe don't want to. It should not be claimed that everything coming from other organisations is better and should be aped, that in Virgo nothing works, and so on. For example, videoconferences at ESO are also a mess, half an hour to make them work, and then they go for Skype. But there is surely much to learn, and further comparison with other organizations, for example CERN, could be interesting. I'm convinced that everybody is aware that GW interferometers are now becoming less experiments and more detectors, with years of technological background, and mature enough so that some more professionalism in defining the activity would surely make no harm to them, rather speed up the work and make it more robust, maybe making many problems less unexpected. It is also certain that fewer religious wars inside the collaboration would also be of some benefit.

P. LA PENNA AT ESO

The Hannover LSC/Virgo meeting

Going for the first time to an LSC/Virgo meeting is like visiting a big multicultural capital after having lived in a small town; the size and the intensity of the meeting, the level of discussion, the amount of people involved, the parallel meeting at 8 o'clock in the cold Hannover morning. Everything seems to tell me that now more pressure will be on Virgo but it will also be more stimulating for everybody, and especially for the youngsters. New exchange opportunities have suddenly been opened.

First of all, we will have to improve our common language. Traditionally, talks in this kind of meetings are full of acronyms. Some of them, like OMC (output mode-cleaner) or BNS (binary neutron star), are common. Some, like CARM (common arm) or DARM (differential arm), have become common thanks to the exchange we have had for the commissioning. But we still see some like HAM SEI, EQG, Refl I1 or Gx_B7p_PosX on the slides and they sound weird for most of the audience. However, in many cases, people do the effort of "translating" the acronyms they use or adding clear labels on the plots to explain what is being plotted, and this is certainly due to the growing awareness that the community is getting larger.

The first evidence is that the amount of scientists involved on LIGO side is much larger, especially on data analysis and R&D. We knew this, on paper. In fact, counting the attendees at the meeting is really impressive. On the other hand, this same fact is a reason of pride: Virgo is working almost as well as LIGO, despite the smaller number of labs and people involved. Virgo has already demonstrated an unprecedented sensitivity at low frequency and has a real chance to get closer to the design sensitivity target in the next months.
A long session was dedicated to discussing what to do in the case that a claim of discovery has to be made. How to choose the location for the press conference? How to limit the risk of a leak? To which journal to submit the discovery paper? When you are still fighting to understand the detector noise, this kind of discussion may sound a bit unreal. But once again, it gave me the feeling of belonging to a larger science community, which requires a change of mentality and a more rigorous planning for all possible scenarios.

One fact that I found really striking is that each LSC meeting is attended by a representative of the NSF (National Science Foundation, US). He gave his talk, reporting on the LIGO reviews, the actions for Advanced LIGO, the status of the funding process, the open funding opportunities for the students. Afterwards, he remained at the meeting listening to the talks and taking notes. This could be a good model also for Virgo, in order to tighten the link between the funding agencies and the Collaboration. The Hannover meeting was also the chance to present Advanced Virgo to our LIGO colleagues. ET (Einstein gravitational wave Telescope: the third generation interferometer, being developed as "design study" within FP7, the seventh European Framework Programme) was also presented, in a special session dedicated to start the work of a GWIC (Gravitational Wave International Committee http://gwic.gravity.psu.edu/index.shtml) subcommittee that should propose a roadmap towards a 3rd generation detector. We could say that, on this side, Europe has started first.

Two side meetings deserve to be mentioned. An evening meeting of the ILIAS-WG1 (Integrated Large Infrastructures for Astroparticle Science, an activity started inside the sixth European Framework Programme, http://www.ego-gw.it/ILIAS-GW/), open to LIGO, was held and dedicated to discuss the GEO "mystery noise". The participation was very good and there was pizza and beers for everybody. The next day Michele, Mikael and I attended a GEO

simulation meeting (with the participation of LIGO). The number of LSC people committed to simulation is quite large (we could count almost 20 people) and the simulation tools are continuously growing in number and quality. Hannover was cold, but everybody felt warmly welcomed. The common path with LSC has just started, but it might take very long and hopefully towards a joint program for advanced detectors.

G. LOSURDO

LIGO Bids Farewell to S5 - Now onto Enhanced LIGO!

by David Reitze

On October 1, 2007 at precisely 00:00:00 UTC, LIGO reached a significant milestone in its history – the final moment of 'S5', LIGO's 5th science run that began almost two years earlier and the first major data-taking run of the LIGO Scientific Collaboration (LSC). Unlike its four predecessor science runs, S5 had a significantly more ambitious agenda. S5 was the first long duration data-taking run where all of the interferometers were operating with astrophysically interesting sensitivities. The main goal of S5 was to collect data in triple coincidence for one year – the end of S5 occurred only after LIGO's three interferometers, the 4 km and 2 km interferometers at the Hanford Washington Observatory and the 4 km interferometer at the Livingston Louisiana Observatory had operated synchronously (all locked simultaneously) to acquire a total of one full year of science quality data. During much of S5, the GEO600 detector in Hannover, Germany was running in coincidence with LIGO.

For the Observatories' staff, the end of S5 meant a return to normal life – no more 24/7 monitoring of the interferometers by the interferometer operators, and no more 3 AM phone calls from a 'Scimon' (scientist monitoring the interferometer) to the run manager for advice on how to diagnose a particularly difficult problem with the interferometer. For members of the LSC, S5's end meant no more long trips to the Observatories to watch over the interferometers as an expert Scimon. For the LIGO Lab staff at the California Institute of Technology, the end of S5 meant a really good cake (Figure 1).

The end of S5 is celebrated at Caltech - the sweetest sensitivity curve ever generated.

Given the complexity of the interferometers, the run went very smoothly for the most part. However, over a two year long period, problems are bound to occur. One of the more amusing, but ultimately enlightening, problems occurred in May 2006, when a dump truck working on a construction project at the Livingston Observatory site broke the speed limit, exciting excessive low frequency ground motion. As a result, one of the interferometer mirrors swung violently in its suspension and got stuck on its safety stops – completely disabling the Livingston interferometer. Despite several attempts to free the mass from outside the vacuum, nothing worked. A team of scientists eventually had to breach the vacuum and physically 'unstick' the mirror from its safety stops. The benefit? When the interferometer came back online, its sensitivity had increased by about 10%! It is generally believed that when the mirror touched the safety stops, excess charge on the mirror was discharged. By increasing the gap between the mirror and the safety stops, noise due to mirror-suspension charge coupling was reduced.

We are still analyzing the S5 data and while no gravitational waves have been detected, S5 has already begun to yield interesting astrophysical results. One example - an intense gamma ray burst (GRB) occurring on February 1, 2007 was detected by gamma ray satellites originating from the direction of Andromeda (M31) galaxy, possibly due of the merger of a neutron star or black hole binary system or possibly, a soft gamma repeater. Analyzing data from the Hanford 4 km and 2 km interferometers, we have found that GRB070201 could not have originated in Andromeda if its progenitor had been a binary merger. Other causes for the event, such as a soft gamma ray repeater or a binary merger from a much further distance, are now the most likely contenders. This is the first

time that gravitational wave detectors have made a contribution to gamma ray astronomy, by searching for GRBs in a way that electromagnetic observations simply cannot.

While much of the LSC is still busy analyzing the data from S5, a team of instrument scientists is now intensely focused on another task – Enhanced LIGO. A series of upgrades will make 'E-LIGO' approximately two times more sensitive to passing gravitational wave strains than initial LIGO. To achieve this increase, LIGO's laser will be replaced to increase the power from 10 W to 35 W. The increased power requires significant changes to LIGO's input optics and a boost to the thermal compensation system that will permit the interferometer mirrors to handle the addition power. The other significant change to LIGO involves the 'readout' of the gravitational wave signal. LIGO currently uses a readout scheme based on RF sidebands, which serve as a reference to measure the gravitational waves at the output of the interferometer. E-LIGO will use a direct readout scheme, whereby the laser light modulated by a passing gravitational wave is directly read out by the output photodiode. This readout method is less susceptible to noise couplings that plague RF readout schemes and will eventually be used in Advanced LIGO.

If all goes well, the E-LIGO upgrades and commissioning activities will be finished in early 2009, to be followed by another long science run, S6, scheduled for mid 2009 and 2010. At the same time, Virgo will be completing its upgrades for Virgo+ with VSR2 scheduled to follow. The prospects of a joint VSR2-S6 runs with increased sensitivity makes for very exciting times for LIGO and Virgo!

David Reitze is Professor at the University of Florida and Spokesperson of the LIGO Science Collaboration.

F.Menzinger: Farewell

When this issue of *h* will appear I will have completed my mandate as Director of EGO on the 30th of November.
Many things have happened since I have been here.
When I came to Cascina a little more than 5 years ago, Virgo had just completed the central interferometer commissioning. And now that I leave the first Science Run has been successfully completed, Virgo+ is in preparation, Advanced Virgo has started moving towards approvals and funding and the ET (Einstein gravitational wave Telescope) design study for a 3rd generation Interferometer for GW detection is completing its final negotiation phase with the European Commission.
On EGO's side, I may recall the strengthening of support to Virgo through the creation of the operators group, the reinforcement of the electronics, optics and SW groups, and that of all the other groups directly or indirectly involved in the functioning of Virgo. I remember the creation of the computing center in the new computing room with its high-level facilities which include an important storage farm capable of 170 TB and the 300Gflops computing farm as well as the large band connection to Bologna and Lyon, that permit, respectively, the on-line analysis of data and off-line Data Analysis activities of the Virgo collaboration. The EGO administration has been organized to deal all the administrative tasks pertaining to a complex structure such as EGO, backing up the Virgo collaboration with great efficiency and rapidity with a minimal personnel. On the infrastructure side, we have all seen the completion of the site infrastructures (that included a fence around the site, the site video surveillance, the central area re-organization and management, the realisation of a seminar room and of the new control room, the construction of the new main building, the realisation of the R&D and preparation labs at 1500 m Nord, etc.).
I want to say that these last five years have been for me very rewarding. It was an honor and a pleasure to work at EGO where I could count on a team of highly motivated persons like those that form the Virgo collaboration and the EGO staff.
Virgo, supported by EGO, has gone very successfully through a series of complex tasks during these years. These successes are primarily the merit of the people in the Virgo collaboration and the staff of EGO with their professionalism and enthusiasm.
Now, the EGO Council has foreseen some re-organization that affects both EGO and the Virgo collaboration. I hope that this will help increasing the efficiency and the spirit of collaboration that exists between these two bodies.
I wish all my best to everyone in EGO and the Virgo collaboration for further successes and satisfaction in your future work and career. I hope that you will soon be rewarded with the observation of the first GW to be directly detected and, therefore, ushering in the era of GW astronomy.

Let me end by wishing my successor, Jacques Colas, enjoyment in the future and, with the support of the EGO staff and of the Virgo collaboration, even bigger and more important successes for EGO and Virgo.

F. MENZINGER

Photo: M. PERCIBALLI

Arrival at EGO

I was moving slowly forward on the straight road that was lost on the horizon in the middle of fields. The car was moaning while lurching on the pot-holed pavement. And yet, it was not a dream; the notice with the VIRGO EGO CNRS-INFN logo was indicating this direction. Then, on the left, I saw a blue building from which a long hall covered with a same-coloured roof was coming out. I was not wrong: EGO, my destination, was there. Surely, the chaos on the road is so little for the super attenuators of which I have heard much of their performance …

This surprising arrival could not prevent myself from discovering, during the two months I spent on site before taking over as EGO director, teams both happy about the success obtained with the first long science run and determined to still improve the performance of the Virgo antenna. Being a stranger in the laboratory, unknown to its members, I could have met difficulties in the form of incomprehension and reluctances, like the ruts I met on the access road. But I found only people open-minded and ready-to-collaborate. I would like to thank all of those who I have come across for that. Of course, like in everyplace, difficulties exist and we will have to face them together. But I have noticed the quality and the commitment of the various teams: they are real assets for success. With Advanced Virgo and its preliminary step Virgo+, the laboratory has a well-defined, clear and motivating work path which will make it busy with for many years.We have to succeed, and without falling behind our American colleagues, LIGO.We can do this with the efforts of everyone.

Coming from a mountain area, I never get enough of contemplating the reddening sun going down at the end of the road which runs alongside the west arm of the interferometer. I like thinking that this gorgeous spectacle announces the beautiful results that Virgo will yield.

J. COLAS

Say it in English, not in Virglish!

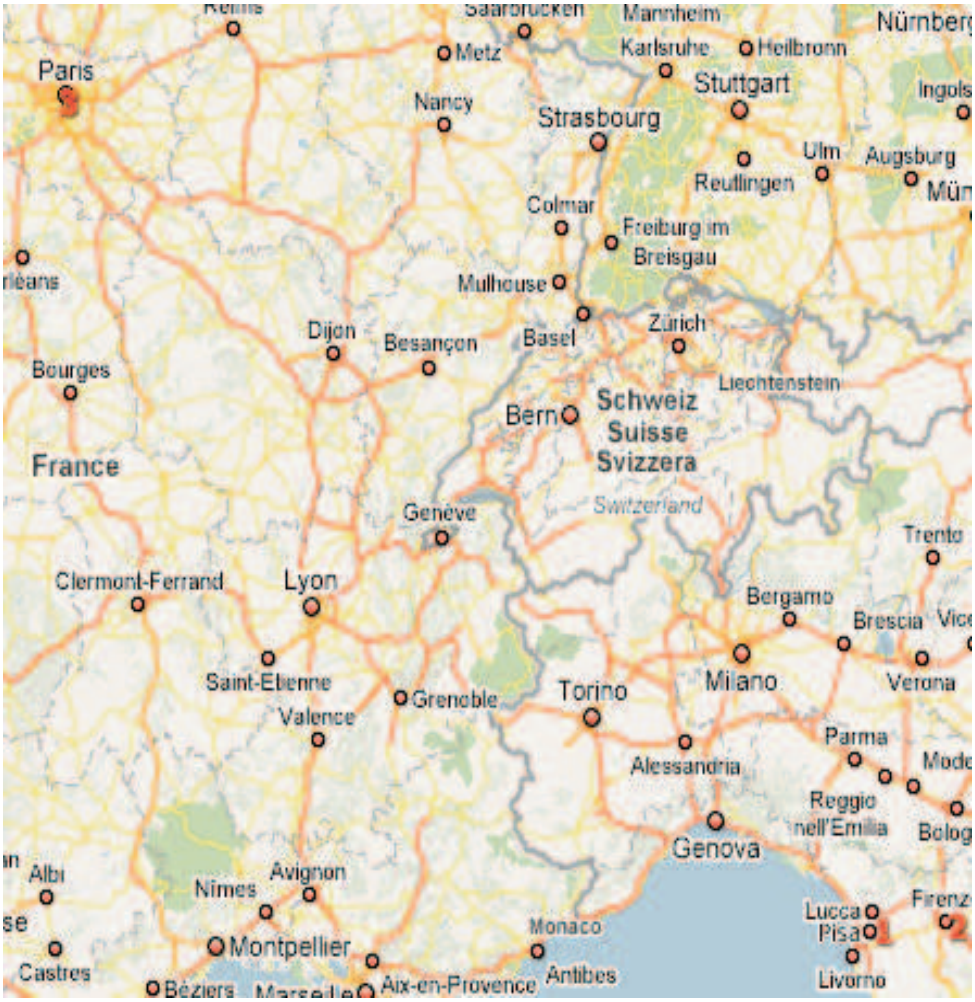
A new language has evolved within the community of people working at Virgo and EGO and it is called Virglish (We wrote about this in editions *h*4 and *h*5). Besides a peculiar syntax and use of words, Virglish also implies an odd pronunciation personalised by each one of us.
Starting from this issue of h, we will exploit the trilingual composition of the h editorial staff to publish a list of the most abused words and indicating the correct pronunciation. We will do this for French speaking people and for Italian speaking people, writing each word phonetically in the two languages (enjoy, it's really funny! But you have to be careful, you must read it exactly as real French or Italian words). We will also include the official English phonetic spelling. We will not make the effort for Dutch speaking people, since their approximation to British English is orders of magnitude better than the Mediterranean one. An accent will be put before the accented syllable. We hope this is helpful and that you can appreciate the results.
You can hear the correct pronunciation of words at: http://www.howjsay.com/.

First list of butchered words

English spelling	Phonetic spelling	French transcription	Traduction francaise	Italian transcription	Traduzione italiana
accelerometer	ak,selə'rɒmitəʳ	ac,sele'romite	accéléromètre	aksele'rometaa	accelerometro
advantage	əd'vɑːn.tɪdʒ	ed'vaantidg	avantage	ad'vantæig	vantaggio
allowed	ə'laʊd	e'laoud	permis	œ'laud	permesso
character	'kær.ɪk.təʳ	'caricte(r)	caractère, personnage	'caracter	carattere
to cite	tʊ 'saɪt	tou 'sait	citer	tu 'sait	citare
to coincide	tʊ ˌkəʊ.ɪn'saɪd	tou keouin'said	coïncider	tu coin'said	coincidere
controlled	kən'trəʊld	ken'treould	contrôlé	con'trold	controllato
coupling	'kʌp.lɪŋ	'coepling	couplage	'caplin	accoppiamento
curvature	'kɜː.və.tʃəʳ	'koe:vetche(r)	courbure	'cœvaciaa	curvatura
early	'ɜː.li	'oe:li	tôt	'eeli	presto
edge	edʒ	èdg	bord, tranchant	æg	spigolo, bordo
further	'fɜː.ðəʳ	'fœ:the(r)	supplémentaire, ultérieur	'fœthaa	ulteriore

Out & About

Route 6: That way madness lies
Distance: ~1500 km (one-way)
Duration: ~2 days



Dear reader, this issue we will be taking a short break from our usual trimestral tour around EGO and its environs. This should not be confused with a shortage of potential places to visit, far from it. Instead, we will undertake a journey on a slightly different scale. As usual, we will commence from in Pisa, but we will soon move well beyond the centre of the city, even beyond the confines of the province and subsequently the country. The journey will include various modes of transport, sundry different cities, the bright light of day and the cover of darkness. We will even pass beneath the sea. This is a journey that I undertook in December, from which I am still recovering, and which is at once so ludicrous and romantic that I feel impelled to recount it here. So, let us begin our journey, route number six in our series, and travel by a series of means - air travel excluded - from Pisa to Worcester, in the heart of England.

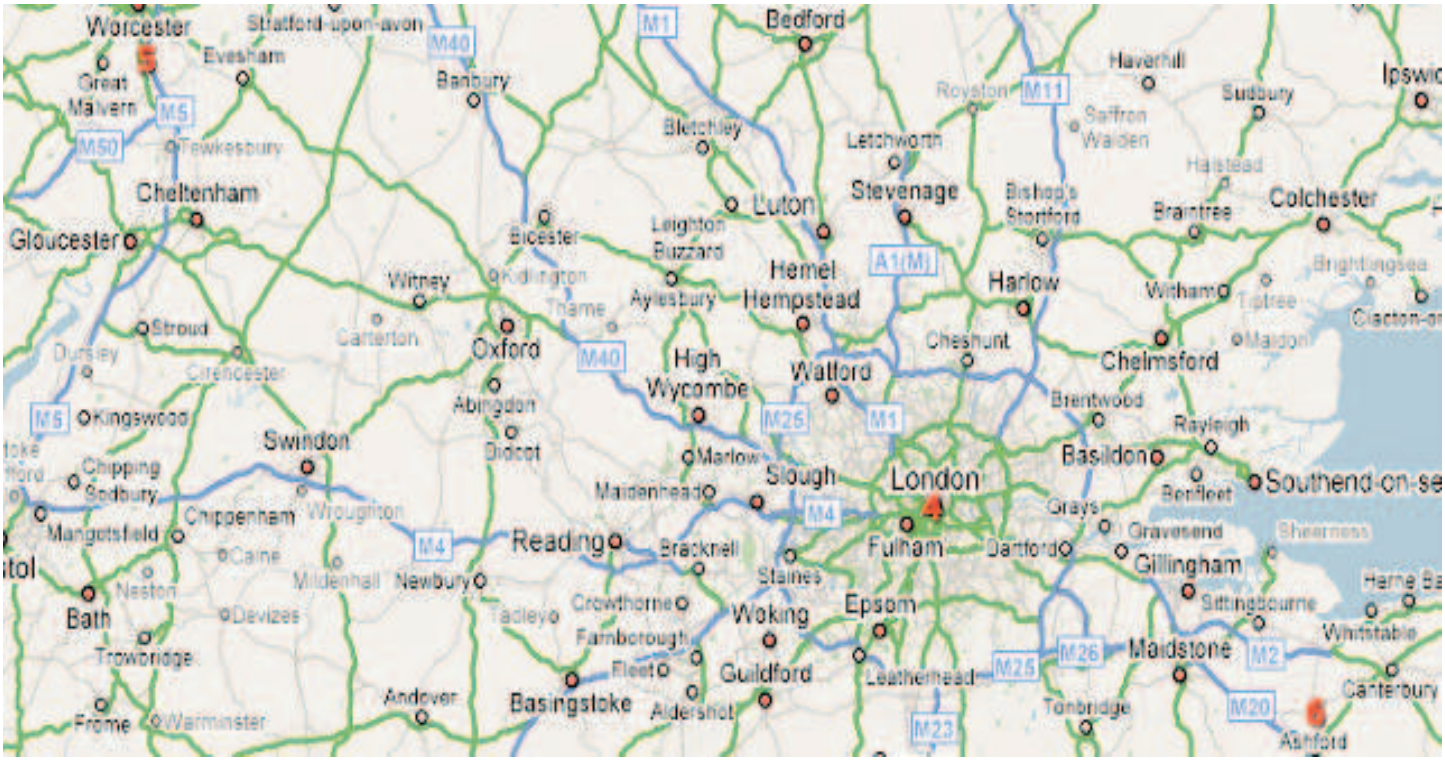
We start, as always, on the old stalwart, Ponte di Mezzo, in the centre of Pisa. From here we head straight down Corso Italia and head through - or rather round – Piazza Vittorio Emanuele and its eternal restructuring works, until we reach the train station. From here we head to Florence, alighting at Rifredi rather than Santa Maria Novella, and take the short train ride to Campo di Marte. At this point we wait…and wait. The tedium may be alleviated somewhat by taking a coffee in the obscenely over-priced bar just opposite the entrance to the station. I particularly recommend the seat in front of the toilet. Look carefully, for it is probably being hidden by an elderly woman, her mother and her dog, losing their pensions on the gambling machines.

Once finished in the bar we head back to the station and wait outside on the platform in the freezing cold for a train which arrives with approximately one hour of delay, before battling our way to our carriage and securing our roughly 20cm too short bed. Shortly, we will be attended to by a chatty ticket inspector, whose friendliness soon turns to an almost over-bearing discourse on social degeneration. Not to worry though, we are soon tucked tightly up in bed and falling in and out of sleep to the rhythm of the train. A process which goes on all night.

Roughly fourteen hours later, we arrive at our destination, Paris Bercy, and at this point are free to enjoy the delights that this famous city has to offer. I recommend taking a break in the journey at this point and stopping at least over-night.

When we re-start our journey, we head to Gare du Nord and the Eurostar under the Channel to London. Don't expect anything spectacular, we certainly won't be seeing any goldfish, but the journey is comfortable and only lasts two and a quarter hours – now that the British high-speed rail line is finally complete - including a twenty minute transit time in the channel tunnel or 'chunnel' as it is affectionately known.

Upon arrival at the newly refurbished Saint Pancras Station, next to Kings Cross, we head to Paddington in the west of the city. A black cab takes ten minutes to make the journey, while the Tube requires approximately the same amount of time. From Paddington we take the two-hour journey to Worcester and, once past Oxford pass through the glorious Cotswolds, stopping in tiny stations with names, such as Moreton-in-Marsh, reminiscent of another age, and



where leaving the train is often only possible from the first three carriages owing to the size of the platforms.

Broadway Tower

Once we arrive in Worcester we have a host of different places to visit, not least the cathedrals of Worcester, Gloucester and Hereford, the first two containing the tombs of Kings John and Edward II respectively, while the cathedral at Hereford is home to the beautiful Mappa Mundi, the oldest map of the world still in existence. Interestingly, the only part of the world represented correctly, in terms of form, is Sicily, while Pisa is not represented by the tower - its fame obviously not yet of international renown. Other areas of local interest include the spectacular Malvern and Bredon Hills, the home of Shakespeare, Stratford-upon-Avon, the market towns of Pershore and Evesham, the Cotswolds and its beautiful villages of Broadway and Winchcombe, the latter of which can be reached by the remarkably well maintained steam railway running from Cheltenham, in itself worth a visit for its regency architecture, literary festival and famous racing tradition.

For the return trip, an alternative means of transport is worth considering in order to return us to the Eurostar. By hiring a car in Worcester we are free to tour Oxford and can even find the time to visit Canterbury and its famous old cathedral, before leaving the car at Ashford International and returning to Paris.

When we make it back to the station at Bercy we recommence the wait for the train back to Florence. This time the wait is only four hours in the freezing cold, the first locomotive having broken down and the second having broken down while on the way to replace the first one. The final arrival time is only just over five hours behind schedule. Nevermind, however, as the sleep is better on the way back, despite being disturbed at 01:20 by the mistaken pulling of the emergency brake by the unfortunate lady sleeping on one of the lower bunks. Sleep tight!

Winchombe GWR Station

G. HEMMING

MAPS: COURTESY OF GOOGLEMAPS

CIAO MARIO!

The collaboration of Mario Favati with EGO ended on the 31st of December.

We would like to express a really hearty "goodbye" to Mario. If EGO today has a small but well equipped and efficient mechanical workshop, it is largely due to Mario. When, several years ago, the workshop had been installed in its first location, the North gallery of the Central Building, Mario selected the necessary machines, efficient and economic. After several years of operation, the workshop had to be moved from that place to leave room for the passage of the North arm.

Mario took care of moving the machines to a temporary placement in the INFN storage hall, necessary to keep at least a minimal workshop active. Then, there was the final displacement to its present location in the Mid-Arm North Building, where Mario also organized a small raw material storage. Under the clever hands of Mario, with the help of Michele, Riccardo, Riccardo and Roberto, those machines ran restlessly; one can see the signs of the intense usage on their surface, which arrived brand new at Cascina. We know that Mario's customers never complained: rapidity, quality and precision of the products have always been excellent. Mario is one who looks for more work when the previous has been completed, as do the majority of people here at EGO.

As all of us Mario has a strong character with some angles, but this is negligible and not a matter appropriate for a farewell. We shall miss Mario as a friend of many of us and as a contributor to everyday progress, in particular in the first half of this year, during the installation of lots of new hardware all over the site.

Good bye and thank you SuperMario!

C. BRADASCHIA

GOOD NEWS!

Welcome to Diego, born on September 28th, 2007 and our congratulations to Erika and Federico Nenci!

Bernhard Lopez, former member of the editorial staff has become a father! Congratulations to him and his wife Veronica, parents of Fermin, who was born on October 15th, 2007.

h also received this very nice picture from our Commissioning Coordinator, Edwige Tournefier who was married last September. It would be a pity not to share it with our readers!

Latest news !!

Anna, daughter of Nicola Menzione and Agnese was born on Tuesday 29th, January 2008! Welcome Anna!