THE GRAVITATIONAL VOICE

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News from EGO and VIRGO

NEWS FROM THE COLLABORATION
Cryolinks for Advanced Virgo
Optical simulations
OSCAR certification program

LIFE IN CASCINA
Astronomy outside EGO
Mycology courses on site
.. and interviewing newcomers

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

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EDITORIAL

Despite the difficult tasks facing us, Advanced Virgo is showing progress as witnessed by the end of civil engineering works and the delivery of many components to the site. The External Injection Bench and its new seismic isolating support have been installed in the laser lab together with the laser bench (although it still has the old legs). The four 2 m diameter cylinders to transform the Signal Recycling Tower into a full sized tower are stored in the Central Building. The new Input Mode Cleaner mirror is ready in its payload. The first large cryotrap is in the West Terminal building, ready to be installed and the other three cryotraps are being tested in the factory (as can be seen in the cover picture). In comparison the cover of *h*23 represented a cryotrap only as a technical drawing.

The effort to achieve an operating Advanced Virgo is boosted by the recent discovery of the imprint of primordial gravitational waves on the cosmic microwave background (http://www.cfa.harvard.edu/news/2014-05). This is the second indirect evidence of the existence of gravitational waves, after the Hulse and Taylor binary. Only the direct detection is missing, which is the Virgo-LIGO duty.

The editorial team of *h* wishes all the best to Advanced Virgo and to all the readers.

C. BRADASCHIA

Editor-in-Chief

PS: We are sorry for the late publication of this issue and apologize to our readers for the delay!

Virgo at Vitrum 2013

Vitrum is an international exhibition of the glass industry which takes place every two years in Milan. It is described by the organizers as follows:

Every two years, Vitrum attracts trade people from all over the world and is the must-attend event where Italian glassmaking tradition is accompanied by the presentation of cutting-edge methods and technologies.

Vitrum, the international prestigious event at its 18th edition, is a time-tested, rich source of precious leads and business opportunities for companies in the sector, attended by an ever-increasing number of visitors and exhibitors (http://www.vitrum-milano.com/en/).

Having received by chance the notice of this exhibition, I thought that it would be interesting for us to show our extraordinary achievements in the realization of the Virgo mirrors. I also thought that it would be interesting for the glass industry to see that glass could be used to build instruments at the cutting edge of science. My request for a free stand for EGO/Virgo was promptly accepted.

On October 22 Nicola Menzione and Riccardo Romboli left for Milan on the EGO truck carrying our portable exhibition payload on board (the original Virgo payload remained at the entrance of the Central building). At the same time I left in my car carrying the model interferometer from the entrance of the Main Building, many posters and several hundred brochures about Virgo, Advanced Virgo and ET. At noon we met at Fiera di Milano and at the end of the afternoon we had assembled a nice stand with the title "Specchi molto speciali per uno scopo molto speciale". Later we enjoyed a nice dinner at home of my son Edoardo who lives in Milan.

Our successful exhibition was hailed as the *feather in the cap* of Vitrum in the Vitrum Newsletter (http://www.vitrum-milano.it/newsletter3_2013/ITA/Tecnologia-Ricerca-Cultura.html).

We were not able to cover the whole four days of the exhibition as we were busy on the upgrade of Advanced Virgo. I was there for two days of the four day exhibition, the opening day and the closing day. Of the 20,000 visitors to the exhibition the average number of visitors to each stand was approximately 200 and we were indeed visited by approximately 200 people. My throat swelled with pride at the success although it was a success limited to public outreach. I was a little disappointed that there was no interest from the industrial /technological companies which were also present.

We have no pictures of the event but below is the main poster about the long birth of a Virgo mirror, which was the theme of our stand.

C. BRADASCHIA

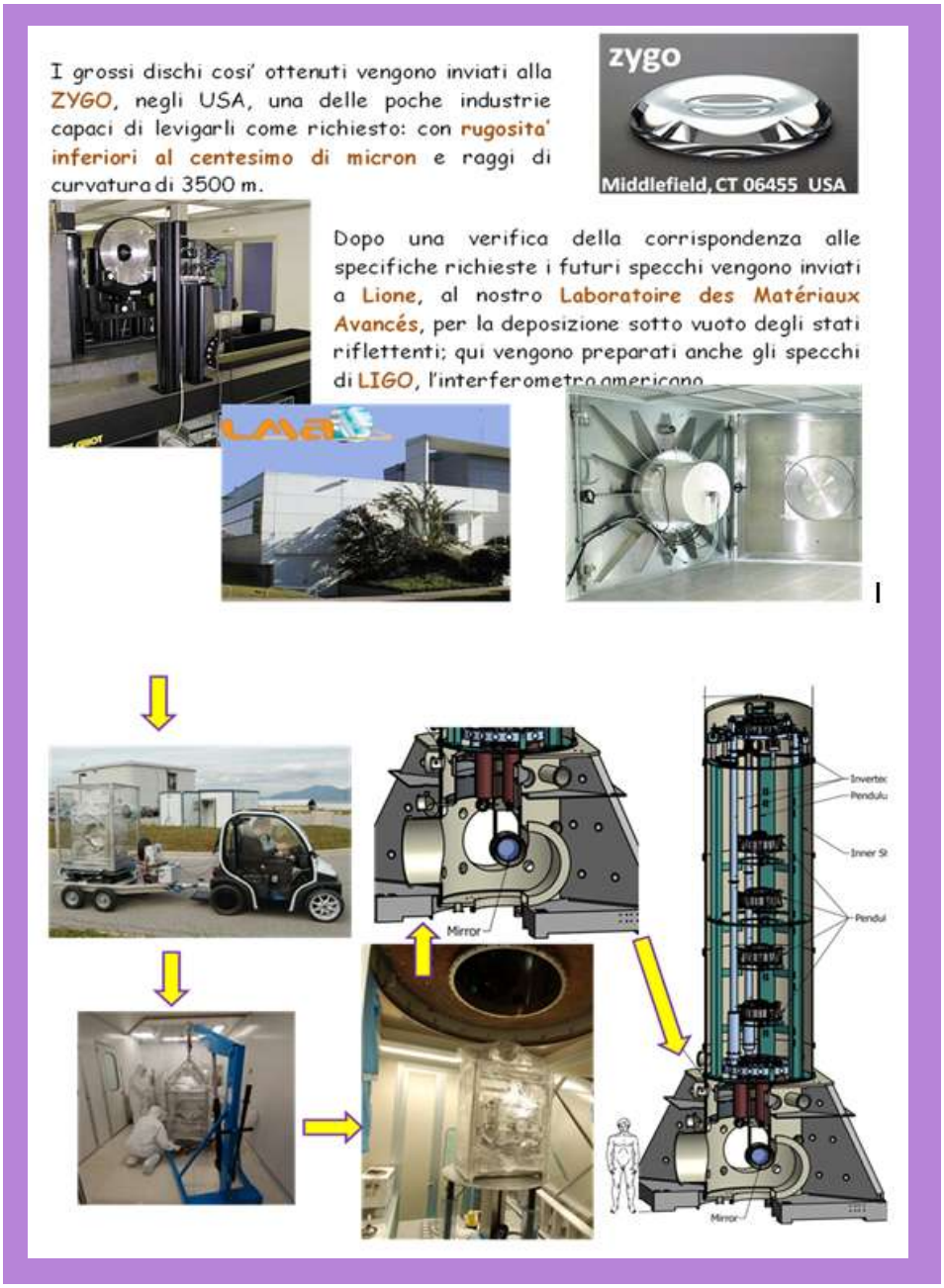


Figure above: Poster presented at the Vitrium exhibit.

W. Shakespeare: Gravitational Waves?

It is amazing how some verses from Shakespeare's "The merchant of Venice" could be interpreted as if Lorenzo was talking to Jessica about gravitational waves as the music of heaven.

The merchant of Venice, Act V.
Sit, Jessica. Look how the floor of heaven
Is thick inlaid with patines of bright gold:
There's not the smallest orb which thou behold'st
But in his motion like an angel sings,
Still quiring to the young-eyed cherubins;
Such harmony is in immortal souls;
But whilst this muddy vesture of decay
Doth grossly close it in, we cannot hear it.

http://shakespeare.mit.edu/merchant/full.html

Il mercante di Venezia, Atto V.
Vieni, Gessica, siedi,
guarda l'immensa distesa del cielo
come scintilla di patène d'oro:
non c'è una stella, per quanto minuscola,
che non canti con una voce d'angelo
nel suo moto orbitale, e non s'unisca
sempre cantando in coro ai cherubini
dagli occhi giovani. E questa musica
sta pur nella nostra anima immortale,
anche se noi non possiamo sentirla,
finché resta racchiusa in questo involucro
nostro d'argilla, rozzo e corruttibile

http://www.liberliber.it/mediateca/libri/s/shakespeare/il_mercante_di_venezia/html/testo.htm

Le marchand de Venise, Acte V.
Assieds-toi, Jessica; vois comme la voûte des cieux
est incrustée de disques brillants.
Parmi tous ces globes que tu vois, il n'y a pas jusqu'au plus petit,
dont les mouvements ne produisent une musique angélique
en accord avec les concerts des chérubins, à l'oeil plein de jeunesse.
Telle est l'harmonie qui se révèle aux âmes immortelles:
mais tant que notre âme est enclose dans cette grossière enveloppe
d'une argile périssable, nous sommes incapables de l'entendre.

http://www.atramenta.net/lire/le-marchand-de-venise/11913

Letter to the Editors Archimedes mysteries - the answer

The first answer we received was by our dear previous director Jacques Colas. Of course it was a correct answer and we report it here, in the original French language:

"Ce serait faire injure à ta compétence d'expérimentateur d'imaginer que dans l'expérience des mystères d'Archimède le sac utilisé fuyait. Je peux par contre imaginer qu'il était assez grand, à l'origine bien enroulé autour de la bouteille pour occuper un volume minimal puis après, à l'ouverture de la valve, se gonfler suffisamment pour que la pression interne soit proche de la pression extérieure. Dans ce cas, que l'air soit à l'intérieur ou à l'extérieur du sac n'affecte pas la lecture sur la balance. J'imagine donc que la masse lue doit approcher celle de la bouteille "vide" avec sa valve plus celle du sac i.e. 44.4 + 15.4 = 59.8 g ."

59.8 g, that is correct!

We are now left with another mystery: the answer by Jacques was the first, but also the only one we received; not even an oral one, crossing in a corridor. Was the question too difficult? Was the question too simple? Dear readers, please, tell us!

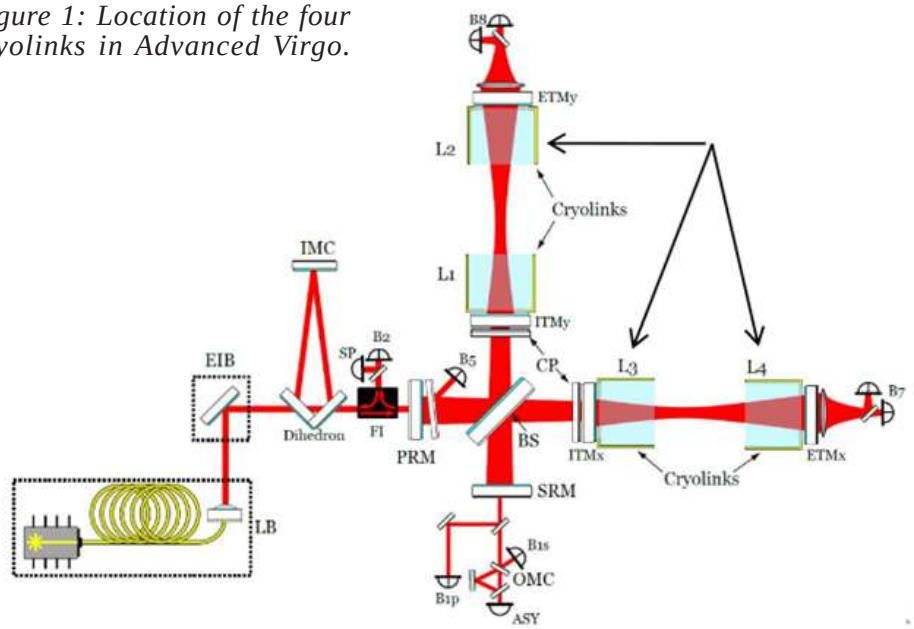
Archimedes mysteries on *h*24 was a physics problem, now, on *h*25 we propose a mathematics mystery. Three friends go to a pub and order thee three large special beers: 10 € each. The innkeeper makes a discount at the occasion of his birthday and gives back 5 €. 5 is not divisible by 3! The friends take back one € each and leave 2 € as a tip. Now 3 times 9 is 27, plus 2 € of the tip gives 29 €: there is one € missing to reach 30 €, the original cost of three beers! Where it is?

The h team

Cryolinks for Advanced Virgo

As we wrote on *h*23 (March 2013), Advanced Virgo requires cryolinks to be installed in order to overcome sensitivity limitations caused by phase noise due to scattering of YAG light from residual gas in the interferometer (ITF) arms. Four cryolinks will be installed to provide a vacuum transition from the mirror-towers to the ITF arms. By freezing out any water vapour from these towers holding the test masses, in combination with a subsequent bake out of the ITF arms, an operating vacuum level below 10^{-9} mbar can be realized. At present the system operates at about 10^{-7} mbar, with the partial pressures dominated by water. The four cryolinks will be installed in between the mirror-towers and the existing DN1000 valves, as is schematically shown in Figure 1:

Figure 1: Location of the four cryolinks in Advanced Virgo.



Each cryolink features a stainless steel outer vacuum vessel in which a cylinder-shaped aluminium vessel is suspended by two sets of air springs. The inner aluminium vessel wall is positioned in a non-concentric geometry to provide a relatively large surface area for gas boil-off. The dimensions of the aluminium vessel have been chosen to guarantee laminar flows in order to minimize displacement noise. The aluminium vessel is filled with liquid nitrogen and thereby cooled to a temperature of 77 K. The vacuum system is evacuated by a turbo-molecular drag pump and a dry scroll pump. Two titanium-sublimation pumps are used during normal UHV service. A description can be found in Ref.1.

A first prototype cryolink was constructed in 2012 and has been subjected to detailed tests at Nikhef (see Figure 2, next page). A first series of tests was performed in Q1 2013 in order to establish that the system complies with the requirements set by Advanced Virgo's Vacuum sub-system. The nitrogen consumption, vacuum level, mass spectra in different conditions, the temperature of the nitrogen vessel and the functioning of the liquid nitrogen supply system were all measured.

In addition it was shown that the cryolink prototype did not suffer from unwanted vibrations. This led to the awarding of the contract for the construction of the next three cryolinks. These cryolinks have been constructed and are now ready for factory acceptance tests, FAT (see front cover).

The requirements defined by the FAT involve mechanical compatibility with a temperature of -196 °C, and a vacuum pressure in the link below 10^{-9} mbar. The liquid nitrogen consumption must lie between 4 to 6 kg/h. A bake-out is also part of the FAT.

A second series of tests were carried out in Q3 2013. These tests focused on commission and controls of the system. CompactRIO (Real-time Industrial Controller) systems were used to realize the real-time control. Liquid nitrogen is transferred from large storage tanks to the phase separators to separate GN2 (gaseous nitrogen) from LN2 (liquid nitrogen). These separators will be located in the vicinity of each link. The LN2 level in the phase separator is controlled by the cRIO. The transfer of LN2 to the aluminium vessel is controlled in a second PID loop running in the cRIO. FIR (Finite Impulse Response) filtering is used on the sensor signals to improve the controls. A slight height difference in the phase separator outlet and the cryolink nitrogen inlet reduces the amount of gas bubbles in the liquid flow. To reduce vibrations, the liquid nitrogen flows via a slide into the nitrogen bath.

The nitrogen level could be controlled to accuracy better than 1 mm by a pneumatic valve and a capacitive level sensor or a pressure difference level sensor in the aluminium vessel. The LN2 consumption measured for normal operation amounts to 2.75 kg/hr with no water coverage on the cryolink. After admitting 28 ml of water, the LN2 consumption increases to 6 kg/h at 90% level of the cryolink. For the phase separator the most important conclusion is that the evaporation is level dependent and at 70% (30%) level amounts to 0.82 (0.55) kg/h. Vibration levels due to nitrogen boiling in the inner vessel have been measured and a reduction in transfer to the outer vessel has been observed.

The prototype cryolink meets all specifications and was delivered to EGO in November 2013. The installation of this system is foreseen early 2014.

K. de Roo, F. Schimmel, L. Jansen,
B. Munneke, M. Doets, J. van den Brand

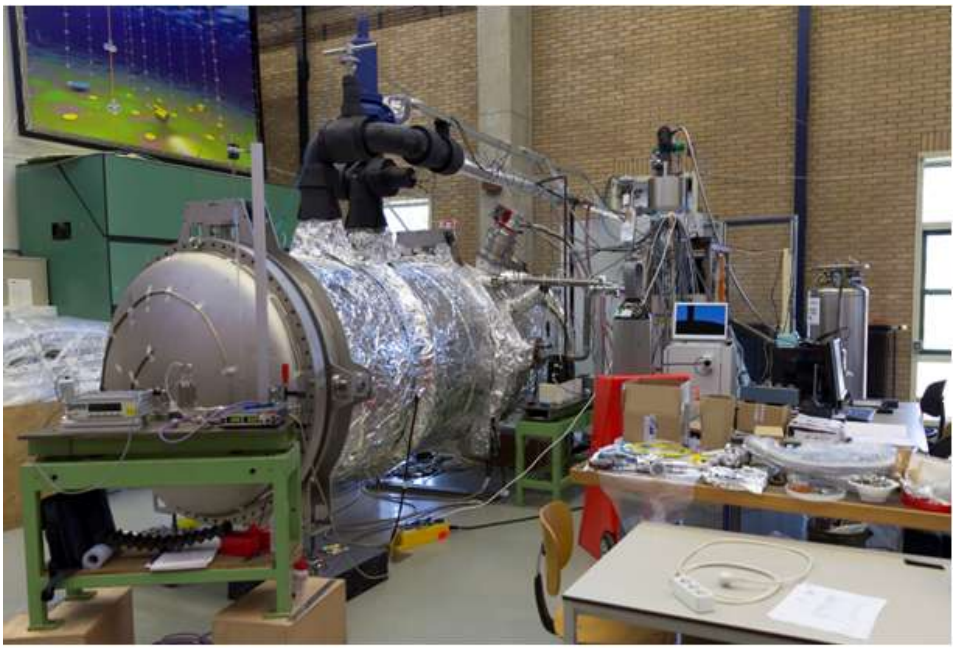


Figure 2: Test set-up of prototype at Nikhef.

References:

1. K. de Roo, L. Jansen, B. Munneke, M. Doets, J. van den Brand, 2013, 'Cryolinks for Advanced Virgo', h The Gravitational Voice, March 2013, no. 23, p. 6 - 7.

The 2013 Stefano Braccini Prize

In my summary published in *h*24 about the Amaldi 10 conference which took place in Warsaw, I neglected to mention some discussions about the Stefano Braccini Prize which took place there. I stimulated discussions between Eugenio Coccia (GWIC chairman), Stan Whitcomb (GWIC executive secretary) and myself (acting as delegate on behalf of Stefano's Friends and the supporters of the Braccini Prize).

The discussions were about the similarity of the aims of the GWIC and Braccini prizes and the possibility to create a synergy. Starting from that point and after a few iterations with the various involved people we reached a very satisfactory result in the following months which is summarized in the announcement on the GWIC web page (https://gwic.ligo.org/thesisprize/):

"The Gravitational Wave International Committee is pleased to announce that nominations for the 2013 GWIC Thesis Prize and for the 2013 Stefano Braccini Thesis Prize will soon be open. Both prizes recognize outstanding PhD theses in the general area of gravitational waves. To better serve the community, GWIC and the Friends of Stefano Braccini have moved to coordinate the two Prizes. From now on, there will be a common call for nominations, and all theses submitted will be considered for both awards by a joint selection committee……."

In accordance with this decision both prizes will have the same payout of $ 1,000 and an additional $ 500 will be awarded by Springer, who agreed to publish both winning theses in the book series Springer Theses. We are very happy with this result.

C. BRADASCHIA

Some personal thoughts after the Hannover LVC Meeting

"We're about to discover gravitational waves". It was the first sentence of the after-dinner talk given by Peter Saulson during the recent LVC meeting at Hannover (September 23-27, 2013). And in fact, this sense of confidence could be inhaled in conference rooms (too much confidence, perhaps…). Peter gave a touching talk, looking back over a century of GW research, starting with Einstein's prediction and remembering the contributions of all of the people who convinced us that GW are real and can in fact be detected. It was an emotional moment when the last slide was projected: "Look around this room. We come from multiple projects and many countries. But in common, we are the inheritors of a great legacy, and we are about to make scientific history. It is a great privilege to have reached this moment. We're doing great things together. Let's finish the job as soon as we can!". There was a sense of pride in these words, which crossed the whole room. I felt part of a real community, striving to accomplish a fantastic scientific mission.

The importance of coming from "multiple projects" was confirmed by what I consider a major event of the conference: during the joint VSC-LSC exec, the executive boards of Virgo and LIGO gave the green light to the new joint MoU, the foundation for the operation of the 2nd generation network. I was lucky enough to be part of the Virgo negotiating committee, which prepared the document, together with the LIGO one, and I have witnessed the strong will of both parties to continue the collaboration. The 2nd generation network is now a reality, though the difficult part is yet to come: turning the detectors under construction into extremely sensitive and reliable machines. A challenge for our commissioners!

The presence of Virgo members at this meeting was important (~50) and so was the number of Virgo talks. To mention one presentation in particular, I was rather impressed by the talk given by Ryan De Rosa on the commissioning progress at Livingston. After a long time we could see once again the results of a locked interferometer, though not in full configuration (it was a dual-recycled Michelson), and the photo of a dark fringe: this talk made it evident that we are entering a new phase, which will be commissioning -dominated rather than construction-dominated. Advanced Virgo will enter this phase in mid-2014, when the input mode cleaner cavity will be ready for commissioning.

In conclusion, I would like to mention a special evening event organised by the LSC Diversity Committee. Gudrun Wanner, the "equal opportunity officer" at AEI, presented the issues and activities at Max Planck. We learned that being a working mother is also difficult in Germany, but that MPI is committed to make things easier, for instance providing child care facilities with long opening hours. I believe that having the chance to compare experiences is very helpful: it helps to increase the awareness of the problems, to discuss possible solutions and tighten the links between our scientist's niche and the wider world.

G. LOSURDO
AdV Project Leader

Simulating with Hiro

Introduction

Optical simulation has a really important role for the designing and debugging of Gravitational Wave interferometers. In an ideal world we would describe the interferometer using an analytical approach, which means that we would use mathematics to describe the entire system. Then we would look into the formulas and see how the different parameters affect everything. We could even then put numbers into the formulas and the numbers coming out would tell us everything that we need to know. Unfortunately the analytical approach is very difficult. It takes a lot of time and a lot of brains to put all of these equations together, making them simple and especially not making any mistakes. So the people who are short of time and short of brain power have turned to optical simulations. The basic idea of an optical simulation is to set up a few simple rules that are based on physics that has been known for more than a hundred years. These basic rules will describe how the light travels and what the light should do when it hits an optical element such as a mirror or a lens or an aperture. As the light travels through an optical system, we basically just apply the rules one after the other until the light has reached the end of its path.

Simulation methods

The basic rules that we apply depend on what kind of simulation method we decide to use. Here are three very well know simulation methods:

Ray tracing: This is definitely the easiest method to understand because it is very intuitive. When we send out out rays they go in

a straight line until they are reflected by a mirror or refracted by the glass of a lens. Therefore the rules that we use to describe how they travel, reflect, refract and transmit are very simple. The big problem with ray tracing is that they cannot simulate diffraction. In order to understand diffraction, we can think of the light beam being made up of lots of point sources. Every one of these point sources travels in all directions. When these point sources interfere with each other after they have traveled some distance we can get some very strange effects. All of these strange effects are important to simulate properly the interferometer.

Modal simulation: Modal simulation says that the light can be represented as a sum of a family of light beams (called modes). Figure 1 shows an example of what one of these families of modes could look like. These particular modes are called Hermite-Gaussian modes. The interesting thing about splitting the light beam into these separate modes is that the rules that we use to describe how each individual mode travels, reflects, refracts and transmits are very simple. It is therefore pretty fast to simulate quite complicated configurations. The big problem with this method is that if the light beam that we want to simulate is very messy looking then we need to have lots and lots of modes to describe it properly. If that is the case then it can in fact take a very long time to simulate.

FFT simulation: The previously mentioned methods are all extremely useful and are alive and well in the Gravitational Wave community. However, in this article we will talk more about FFT simulation. FFT stands for Fast Fourier Transform and refers to the way we simulate the traveling light. We start with a light beam which is made up of a grid of points like a camera image. In Figure 2 we see in the left image what the intensity of the light beam looks like. This is the kind of thing we would see if we sent the light beam to a camera. In order to calculate how the light beam travels we need a second piece of information called the phase which is shown on the right of figure 2. The phase is needed because the slope of the phase tells us in what direction each part of the beam is going. In order to calculate what the light beam looks like after traveling over a certain distance we carry out three steps:

1. We take a two dimensional fast Fourier transform of the light beam. This acts to separate the beam into its different frequency components.
2. We then modify the phase of each pixel by a certain amount. The phase change that we apply is determined using a special formula and depends on the distance that we want to travel.
3. We then take the inverse two dimensional fast Fourier transform of the modified grid of points. This converts the different frequency components back into the final light beam.

This simple process magically gives us what the light beam will look like after traveling over the specified distance. In Figure 3 we show an example of how well this works. Figure 3a shows a perfect Gaussian beam. Figure 3b shows what it looks like after traveling a certain distance. Now we pretend that we are sending the starting beam through a small slit and we get fig 3c. We do this by setting the part of the beam that doesn't get through the slit to zero. We then look again at the beam after

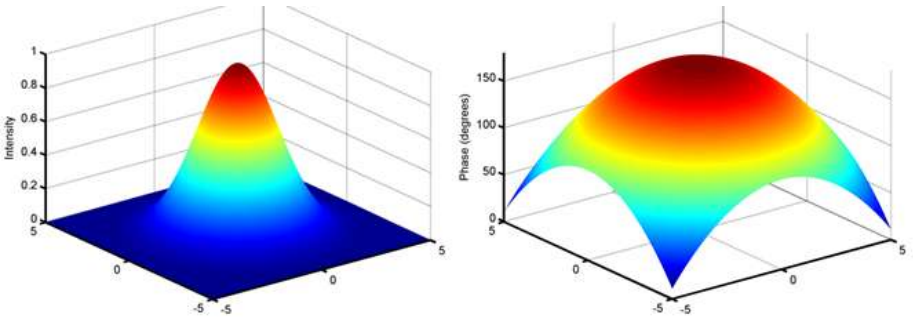
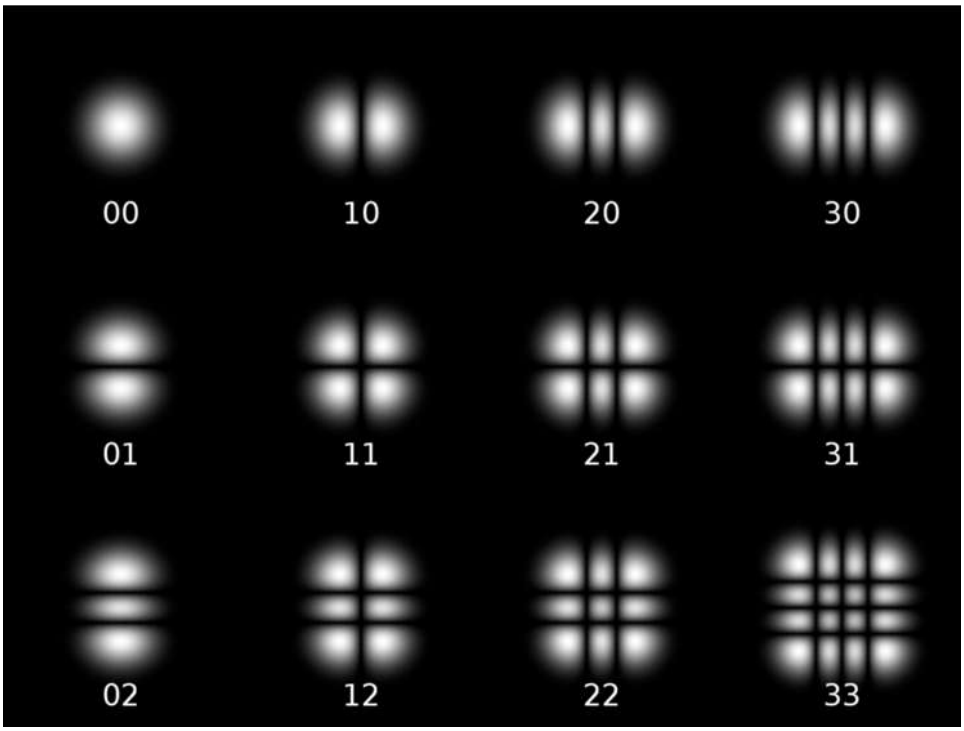


Figure 2:
Left image: Intensity of the light beam. Right image: phase of the light beam.

Figure 1: Family of Hermite-Gaussian modes. Credit: Wikipedia



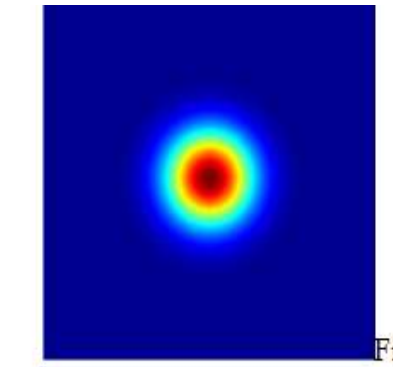


Fig 3a

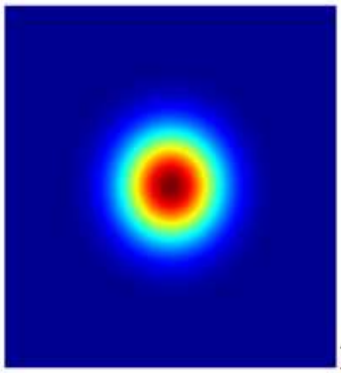


Fig 3b

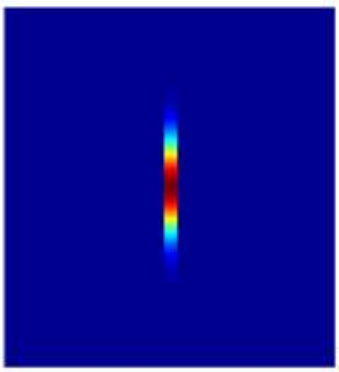


Fig 3c

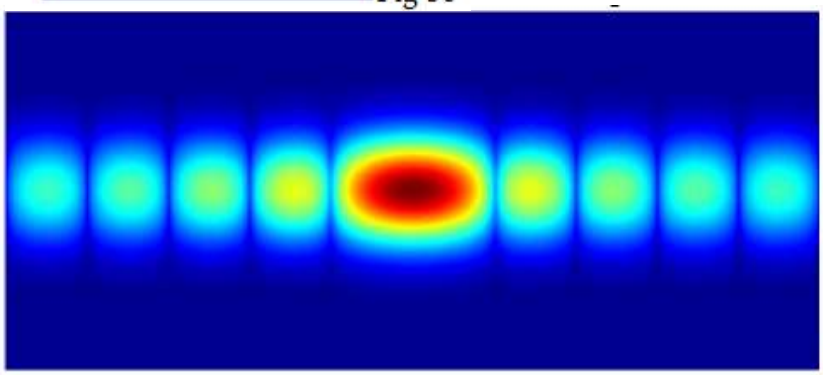


Fig 3d

Figure 3. Intensity patterns of light beams. Color scale has been modified to accentuate diffracting lobes a) starting light beam. b) light beam after traveling certain distance. c) starting light beam after passing through a slit. c) light beam after traveling same distance as in figure 3b.

having traveled the same distance as in the first case. We see exactly the same diffraction pattern that we would see in a real experiment. So far we have talked about the rule for traveling the light. The rules for reflecting and transmitting are easier.

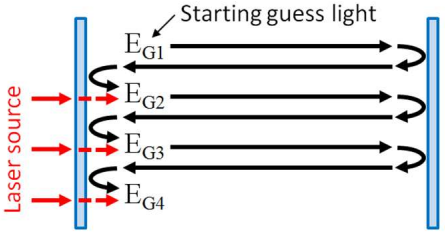
For example if we reflect off a mirror which reflects 30% of the light we simply reduce the intensity part of the beam by 70%. If the mirror is curved then we add this curvature to the phase part of the beam.

Putting it all together

Virgo is quite a complicated optical configuration. One of the things that make it complicated for optical simulation is that it contains a lot of cavities. We have to think carefully when we want to simulate a cavity. A basic cavity is just made of two mirrors facing each other like we show in figure 4. The light is transmitted through the first mirror, which is not fully reflective, from the source and travels to the second mirror. Then it is reflected and travels back to the first mirror. Some of the light will be transmitted through the mirror, but some of this light will be reflected and then go back to the second mirror again. We therefore see that some of the light is trapped between the two mirrors and so this going back and forth could last forever, or at least for a very long time. The good news is that it turns out that we can use some simple rules to find out what the light in the cavity will become. In figure 4 we describe what this would look like. We start with something that we will call the guess light. At the beginning this can be pretty much anything, but as we go through our simulation it will get closer and closer to what light in the cavity should actually look like. We start by taking this guess light on a round-trip; travels to second mirror -> reflects off second mirror -> travels to first mirror -> reflects off first mirror. The light coming from the left and transmitted through the first mirror is the source and is what will make the light power in the cavity build up. So we add that to the guess field that has done the round trip and this gives us the new guess light. We now carry out a round-trip on this new guess light and add the source light to get the next guess light. We then carry on doing this many times. If we were to look at the power of the guess light as we continue these iterations we would see that the power first increases very quickly and then plateaus out. Once we get to this plateau, we get to a point where we can barely see the power increasing anymore. We therefore decide that we have reached a good estimation of what the light would really be like in the cavity (we call this steady state) and we stop the simulation. We have now successfully simulated an optical cavity.

This is a good example of what optical simulation is all about. We created something really quite complicated by applying some simple rules over and over again. This is made possible by the fact that computers are fast enough to complete all of these iterations in an acceptable time.

Figure 4. Process used to calculate the buildup of light in an optical cavity.



Using FFT simulation

Here we will look at a few examples of how FFT simulations have been used in Virgo+ and Advanced Virgo: The simplest simulation that we can do of the interferometer is one single arm cavity. However, even such a simple simulation can give us a wealth of information. An example of this is when we put in new mirrors in Virgo+. When we switched on the interferometer again we had a nasty surprise. The dark fringe was not so dark, the losses were higher and the interferometer alignment was unstable. To understand what was happening we turned to FFT simulations of a single arm cavity. We put the measured height map of the mirror surface into the simulation. We found out that the mirrors had a certain radius of curvature that was creating complicated beam patterns called Higher Order Modes (HOM's). In figure 5 we show the result of a simulation showing what these HOM's can look like on the dark fringe. These HOM's were throwing light out of the cavity and making it difficult to align the interferometer. These simulations showed us that if we changed the radius of curvature of the mirrors then we could get the interferometer working properly again. The solution was to thermally modify the mirror surface with the CHRoCC that was described in the April 2011 issue of *h*.

These single cavity simulations were also really important for Advanced Virgo. For Advanced Virgo we want to have an extremely high power in the arm cavities. This can only be achieved if the mirrors are very very smooth. But how smooth? Thanks to the simulations we can set requirements on how smooth the mirrors should actually be. What's more is that once the mirrors have been polished, we can measure the height map of the mirror surface and simulate how well it will perform in the interferometer. One of the big challenges in Advanced Virgo is the use of a marginally stable recycling cavity. The recycling

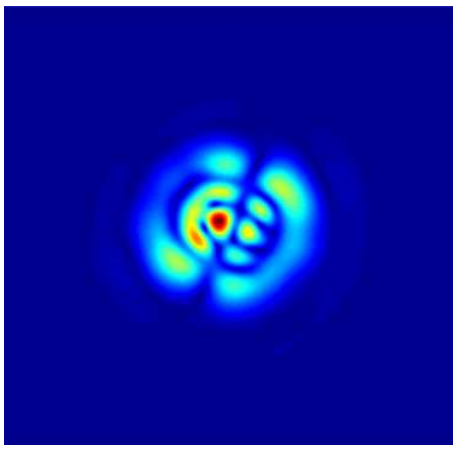


Figure 5. Simulation showing what higher order modes (HOM's) inside an arm cavity can look like on the dark fringe.

cavity is created by the power recycling mirror at the input of the interferometer. If there were no power recycling mirror then almost all the light that we sent into the interferometer would be reflected back. This power recycling mirror is used to send the light back into the interferometer and increase its sensitivity. The problem with a marginally stable cavity is that it lets lots of HOM's resonate in the cavity. The simulations show us that if the optical aberrations are too high then we have trouble keeping all the power in the cavity. The FFT simulations were very important to determine how smooth the mirror surfaces would have to be. They also told us that corrections to the mirrors would be necessary using a specially designed thermal compensation system. You can find out more about the thermal compensation system in the April 2011 issue of *h*. We also used the simulations to find what signals we could use in order to fine tune the thermal compensation system. Finally we can use the FFT simulations to simulate the entire interferometer including the arm cavities, the power recycling cavity and the signal recycling cavity. This is ongoing work, but it will be extremely important in order to anticipate potential problems and to help with the commissioning of Advanced Virgo.

Who makes FFT simulators?

We are very lucky in the Virgo collaboration because there are a lot of people who are interested in doing FFT simulations. Most people who write their own simulations are people who want to understand better what is happening in the interferometer. Either they are people who are debugging the interferometer or they are people who are trying to design a new interferometer. The first ever FFT simulator for GW interferometers was started by Jean-Yves Vinet and is called DarkF. This showed everybody how useful such a tool could be. Mikhaël Pichot is currently maintaining and improving this code. Another simulator that has been around for a long time is SIESTA that was developed at Lapp by many different people. This simulator not only does FFT simulations but also modal simulations. It was used a lot at the beginning of Virgo and also during Virgo+. Massimo Galimberti was the last person to be working on this simulator, but unfortunately there is no one working on it at the moment. Another simulator was written by Jerome Degallaix and is called OSCAR. He started writing this during his PhD and created his first public release when he was working at GEO. He wrote his simulator in Matlab with a very thick user manual so there are a lot of people who use this simulator for their own studies. Then I decided to take the best of DarkF and OSCAR to write my own simulator called FOG. I started writing FOG when I wanted to choose the polishing requirements for the input mode cleaner mirrors for Advanced Virgo. LIGO also have their own simulator called SIS which was written by Hiro Yamamoto and is also used by a lot of people around the world. We are very fortunate that Hiro came to stay with us at EGO for two months this year. He is in the process of writing a brand new version of SIS which will be more versatile, faster and easier to use. As there are so many people

working on simulation in the Virgo collaboration he thought that it would be more inspiring for him to complete his new version of SIS here in Europe.

Conclusion

In this article I tried to give you an idea of what optical simulation is all about. There are lots of people writing optical simulators in Virgo and they have shown that these tools have been very useful for understanding what was happening in Virgo+ but also for helping to understand what problems we could encounter in Advanced Virgo. I think that there is something that is very important to remember when trying to use optical simulations to understand a real-life system. Even if we would like to believe otherwise, it is VERY difficult to reproduce exactly what we see in the real experiment. I don't think that a simulator should be used to reproduce the results in an experiment. I think that a simulator should be used as an experiment in its own right to help us understand the physics of what's going on and to point us in the right direction. If a simulator is used in the right way it can be a very powerful tool that will open our eyes and teach us what we're doing wrong and how we can do things better.

R. DAY

The OSCAR certification program

The first public release of OSCAR was already more than five years ago and as the program is gaining more and more users and visibility in the field of optical simulations, I started to receive enquiries about how to highlight OSCAR skills on a resume.

On this point, the typical email I would receive from OSCAR aficionados is along the lines of: "Hi, I used OSCAR for work / hobby and I would like to know how can I capitalize on my OSCAR experience to stand up in the job market?". The first reaction of shock (and awe, how can someone using OSCAR be jobless?) having passed, I decided to think about this issue.

In this issue of *h*, I am proud to announce the grand opening of the OSCAR certification program. The goal of this certification is for users to be able to bank on their skills with OSCAR and also for human resource officers to be able to distinguish different levels in optical simulation proficiency.

To reflect the wide variety of users, the certification has been divided into the three following levels, ranging from beginners to experts:

OSCAR associates: this is the first level. To reach this stage, the user must have a global understanding of the working of the FFT code. They must be able to adapt the examples provided to match the situation in which they are interested and know how to deal with the different outputs (2D complex amplitude fields or scalar numbers).

OSCAR developers: this is for more advanced users. It implies being able to modify the codes to create a new class of optical configuration, to develop new functions (using the Matlab parser) and have a good understanding of the advantages and also limits of OSCAR. The user must be able to install OSCAR on different platforms and know how to fix common error messages (as they happen as soon as the code is modified). As I am not recommending a dogmatic or partisan approach, a global understanding of the simulations ecosystem is also required. In particular, certified developers must know the advantages and weaknesses of the different simulation techniques and must be able to choose the suitable tool, according to needs. That means questions on other codes or simulation techniques may also be proposed during the test.

OSCAR gurus: or the ultimate goal, the nirvana sought by many, but only reached by few. This celestial level can only be obtained after years of equations, coding, debugging and materialist renouncement. The certified members of this cast live by the Maxwell equations, feel like a photon and understand the pain of the higher order Laguerre Gauss modes when reflected by a rough mirror.

This level must not be obtained for glory or fame, as there is none, but it comes with responsibilities and duties. The gurus must be able to teach young users, while remembering they also started at the bottom level. They must hit the roads of conferences to spread the word, but with no excessive proselytism. The temptations will be lurking around under the form of polished user interfaces or fast execution codes, but no 256 color, fancy 3D plot will make them deviate from OSCAR as they know it is the only way.

So, how to gain the certification? To answer this crucial question, here are some practical details. To pass the two first levels, a test with multiple choice answers is proposed, at the end a small code must also be written to confirm your ability to use OSCAR. The tests are proposed in accredited centers from our partner Pearson-Thomson, and are available in all large cities. To help in the organisation, a modest fee of 375 euros is required before passing the test, which should cover all of the implementation and correction costs. This fee should only be seen as an investment, since a successful result will increase your bargaining power during the salary discussion for your next job.

To obtain the guru level is more tricky since a test may evaluate the technical knowledge, but not how this knowledge is used, which is as important. The guru certification is mainly through an interview, with a demonstration of what has been achieved by the contestant. In any case, if you are as good as you pretend I must have heard of you.

J. DEGALLAIX from LMA

Astronomy "outside" EGO

On the night of November 29, starting at 18.00 our friends at the ACA (*Associazione Cascinese Astrofili*) presented a public astronomical observation in the area just outside the main EGO entrance. It was an event of the "Agenda Scientifica 2013", organized by the Comune di Cascina and La Limonaia (http://www.lalimonaia.pisa.it/), in collaboration with EGO. For information we publish the report kindly written for us by Domenico Antonacci, the president of ACA.

"*Serata di Osservazione della Volta Celeste*"
First of all I would like to thank EGO/Virgo, La Limonaia and the Comune di Cascina for asking us to participate in the Agenda Scientifica 2013.

We would also like to thank our good friends Luca Billeri and Guido Pampaloni, members of "Astronomical centre", the Montecatini Val di Cecina Observatory, where we have spent wonderful photography nights below their very dark sky.
We started observations by looking at a splendid Venus sickle, in an absolutely clear sky.
Going beyond our solar system we saw the beautiful M13 cluster in the Hercules constellation, the Pleiades open cluster M45 in the Taurus constellation and the wonderful globular cluster M15, in the Pegasus constellation, which is one of the densest clusters in our galaxy, the Milky Way.

Upon exiting our galaxy, at a distance of only 2.5 million light years, we encountered the Andromeda spiral galaxy in the constellation of the same name. We saw the ensemble of the 300 billion stars as it was 2.5 million years ago! Closer to home we observed Albireo in the Cygnus constellation, at only 433 light years. Magnification by telescope reveals its surprising secret. It is a binary star, composed of a large orange star and a smaller secondary blue-white star. Next was the beautiful Aldebaran in Taurus, the red supergiant Betelgeuse in Orion, together with the M42 nebula. A little further out, at 4000 light years we also observed the open cluster M37 in Auriga. Low temperature and fog forced us home but not before admiring the colored bands of Jupiter, the giant of our solar system, together with its main moons.

Domenico Antonacci
President of ACA

ASSOCIAZIONE CASCINESE ASTROFILI

Celebrating Pontecorvo

Within the framework of the 2013 Researchers' Night, an initiative that has now been promoted for many years by the European Commission, for the fourth time, EGO organised a series of activities open to the general public on Friday the 27th and Saturday the 28th of September. Our primary scope being to promote Virgo, we scheduled the usual site visits allowing our visitors to hear about the blue apparatus extending its arms across the Cascinese countryside.

Different sessions of the "build your own interferometer" workshop were also planned on both days, especially for school students, who were happy to take the results of their practical work, i.e. a mini interferometer, back to their schools.

In addition, a special event was also inserted into the 2013 programme: an event at the theatre of Cascina was organised on the Saturday evening in memory of Bruno Pontecorvo, who was born 100 years ago.
Three actors from the "*Teatri della Resistenza*" company (the same company who played *Copenaghen* in 2012) interpreted Pontecorvo and two other characters in an original way: they read texts, written especially for the event, characterising important events and periods in Pontecorvo's life. Although the stage was almost empty, providing only chairs to the actors, this did not take anything away from the atmosphere, which was very intense. This was made possible thanks to the solemn voices of the actors, which rang out for almost 90 minutes in the theatre and gave depth and emotion to their interpretations.
The audience were very appreciative and passed a beautiful evening, feeling closer to a singular man whose life choices likely still remain misunderstood by many people.

More information on Pontecorvo: http://en.wikipedia.org/wiki/Bruno_Pontecorvo

Mycology for pedestrians

Upon insistent requests from a few colleagues, Massimo D'Andrea has proposed at the beginning of December, to those interested, three sessions in the late afternoon to explain the basics about mycology and mycophagy: the practice of eating fungi, especially mushrooms collected in the wild.
I was among the attendees and I enjoyed it a lot.

Why Massimo you should tell me? Quite simply because he is an expert in the discipline. As a matter of fact, our Electrical Systems Manager is one out of about 2000 accredited and registered Italian mycologists, so a suitable person to deal with this appetizing science, that is different from mycology (gastronomically speaking)!

But let me succinctly describe the introduction to this fascinating science.
Whereas the first session, dedicated to the environment around the mushrooms and myth busting was quite simple to follow, it got complicated with the second one through an introduction to the reproduction mechanisms and a first (rough on purpose) presentation of the existing species.

There are more than 14 000 different species all around the world, up to 3500 in Italy, about 1600 in the Tuscany region! It goes without saying that there is no way to keep in mind each mushroom, so, Massimo explained us during the third session the keys to characterise mushrooms.

But more than the notions in per se, I have retained the way to approach mushrooms understanding how it is important to be methodical and humble in the quest for mushrooms.

In fact, it is a safe bet that without these two qualities mushrooms hunters will make a lethal choice.

F. RICHARD

Picture below:
Massimo D'Andrea while giving the lecture in front of a fascinated audience.

Some common types of mushrooms :

Right:
Agaricus Campestris

Left:
Amanita Verna

In the second half of 2013, the personnel on site could see some new faces around. What about knowing more about them?

Alessio Buggiani

Allow me to present myself. My name is Alessio Buggiani and I am still surprised to find myself here, working in EGO, because everything has happened at the speed of light, even if my road has been all but quick and linear.
I come from a long journey, where my training started in a mechanical workshop, building various components at the milling machine. From there my dream began: to plan and design varied machinary. Years of technical office work followed, for various companies, along with a university education; then, one hot summer's day, I landed here, with the impression of being on another planet, far away from the land I knew.
The dream continues with Advanced Virgo and the objective and wish to offer my experience and, at the same time, explore new spaces, but with renewed enthusiasm.

Domiziana Mele

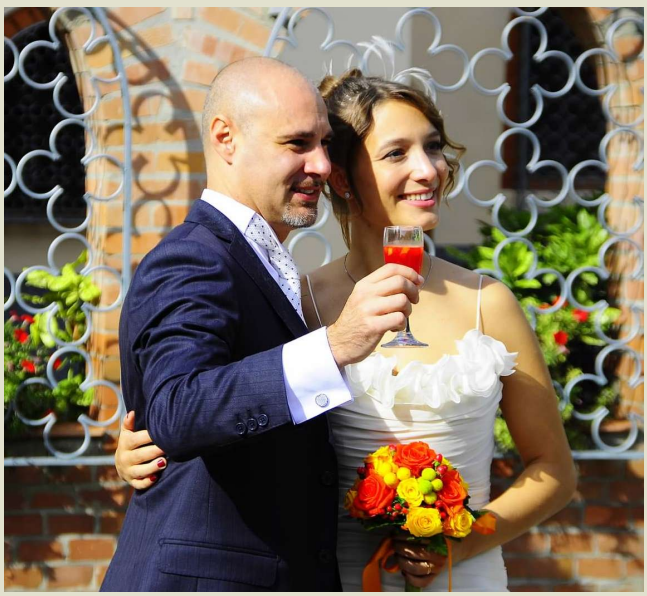
I arrived at EGO a few months ago, ready to start my Master's thesis in electronic engineering. The aim of the thesis is to design, build and test an RF sensor in the RAMS system of the electro-optic modulator in AdV.
Before starting this experience, I didn't know the world of gravitational waves. I accidentally encountered the Virgo website, but immediately understood that the AdV experiment would be a great opportunity.
My very first impression upon arriving here was the different "landscape" with respect to Rome, and, even if at first I had some problems with reaching the site… I love it. I was assigned to the electronics group, in which I have had the fortune of finding such kind and competent people. They've been very patient and taught me so much: from electronics to the Livornese dialect! Thanks to them, I'm really enjoying my experience here and I'm passing my thesis period in the most exciting way.
I'm really happy with how my work is progressing and I hope to finish in the same way too.

NB: at the time of publishing, Domiziana finished her stage at EGO and came back to Rome to graduate.

GOOD NEWS

Our colleague, Giuseppe Di Biase married Camilla on October 19, 2013.

Congratulations to them!



GOOD NEWS!

Welcome to Francesco, born on 16/11/2013 and congratulations to his parents Davide Soldani and Daniela!

Mirko Prijatelj

Hello! You might have noticed a new face at the site over the past five months. My name is Mirko Prijatelj and I have started as an optical engineer here at EGO. I was born in Hannover Germany, where I also studied physics. I specialised in optics and wrote my diploma thesis on ultra-fast XUV light sources. I then changed fields to gravitational waves and worked on the commissioning of the German-British GEO600 detector. For my work there, which focused on

GEO600's output mode cleaner sub-system, I received my PhD. I then decided to continue in the field. I was drawn to Italy not only by the good food and excellent coffee, but also by the chance to contribute to the development and commissioning of the Virgo detector.
Up to now, I have spent my free time settling in, exploring Italy, and of course learning Italian.

Viswanath Bavigadda

Viswanath comes from Hyderabad (India), and works as an Optical Engineer in the Optics Group.
He likes working in Optics engineering, especially in the building of various instruments, such as interferometers, spectroscopes and optical instruments for medical applications. He is excited to learn new techniques and to handle the large optical components that are going to be used in AdV. He also enjoys playing ping-pong, as does the rest of the Optics Group.

Ciao Franco!

As all of you know by now, Franco Tosi left EGO at the end of 2013 to retire after a long career starting as Professor at the Pisa University and terminating as Deputy Director of EGO.
Franco belongs to the people who contributed to build EGO, in particular its administration, with passion and devotion. We warmly thank him for the deep committment he demonstrated to the Consortium all these years.

PERSONNEL MOVEMENTS

Latest arrivals

Beatrice Montanari and Gianmatteo Sposito
Both members of the Electronics group

Erika Morucci
Team member of the GraWIToN coordination group

Departures

Julien Marque
Engineer of the EGO optics group

Franco Tosi
Former Head of the EGO Administration till 01/01/2013 and Vice Director of EGO

Power lifting

Dear Readers,

It appears that nothing can stop our colleague!

Indeed, you surely remember that Federico won on March 2012 an important power lifting competition (lift the heaviest weight from a bench press, see *h*21, page 12).

And now, from last November, he has become the "*Campione Italiano Assoluto*" through the Italian National Olympic Committee (*Comitato Olimpico Nazionale Italiano-CONI*).

Precisely, he is the only person of his category (under 69 kg), up to now, who reaches to lift 145 kg.

In this way, Federico has accumulated along these last two years prizes and articles in the newspapers, rising in that way to fame, but I still hardly dare to imagine the situation in the picture below.

The articles on the right were published on La Nazione on 28 November 2013 and Il Tirreno on 29 November 2013.

PESI

UN CAMPIONE DI CASA NOSTRA

L'ATLETA LABRONICO, DI 33 ANNI, FA PARTE DELLA A.S.D. MILLENIUM DI MARCO MORGANTI CHE È RESPONSABILE TECNICO DELLA SOCIETÀ

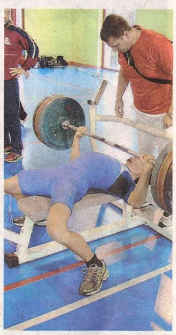
FEDERICO NENCI TRICOLORE

A Vedano Olona l'atleta livornese ha conquistato il titolo nella categoria sotto i 69 chili

Cinzia Gorla
Livorno

«SONO contentissimo. Un'esperienza unica competere con gli atleti più forti e per di più conclusa nel migliore dei modi. La gara è stata dura e combattuta perché il livello della competizione era davvero alto ed eravamo tutti molto vicini tecnicamente. Ma io mi sentivo in forma. Ho chiuso la prima alzata con 140 chili ma a complicarmi la gara nella seconda alzata sono incorso in un nullo con alzata da 145 chili. E quindi la prova mi è stata data non valida. Meno male che nella terza prova sono riuscito a replicare di nuovo i 145 chili di alzata e nessuno è riuscito ad andare oltre. Peccato che la distensione su panca per il momento è presente solo nelle paraolimpiadi altrimenti avrei strappato un bel pass!. A chi dedico il titolo? A mia moglie Erica, ai miei bambini Diego e Luca, a tutta la mia famiglia. Con un ringraziamento speciale a Marco Morganti e Gabriele Fioletti». Campione italiano. Un titolo assoluto conquistato da esordiente. Alla sua prima partecipazione alla rassegna tricolore di distensione su panca. Non si tiene dalla felicità Federico Nenci, che, dopo essersi qualificato per la prima volta tra i migliori otto d'Italia nella categoria sotto i 69 chili di peso, 67 per la precisione, nella finale nazionale a Vedano Olona, in provincia di Varese, è addirittura salito sul gradino più alto del podio. Medaglia d'oro addirittura alla sua prima esperienza in un campionato italiano. Il più forte d'Italia.

SCUDETTO Il campione livornese Federico Nenci al centro con Marco Morganti, a destra, e Gabriela Jalah Fioletti. Accanto Federico durante la fase di riscaldamento prima di scendere in pedana



IL 33ENNE atleta livornese, che fa parte della A.S.D. Millenium di Marco Morganti, responsabile tecnico della società, ha dovuto superarsi, stabilendo il suo record personale alzando due volte 145 chili, vincendo con un punteggio complessivo di 198,36 punti. Una escalation incredibile per il neo campione italiano, che si era qualificato agli Assoluti con la seconda miglior prestazione dell'anno, alzando 140 chili, alle spalle del salentino Rino Restivo, che aveva messo a segno 143 chili. Restivo che alla finale nazionale ha dovuto lasciare il gradino più alto del podio proprio a Federico, accontentandosi, si fa per dire, della medaglia d'argento. Pensare che Federico Nenci, allenatore personal trainer federale, tecnico elettronico, ha iniziato questo sport, che fa parte della Federpesistica riconosciuta dal Coni, in modo agonistico solo nel 2011, dopo molti anni di nuoto, vincendo subito il titolo toscano nel 2012 e confermandosi miglior atleta regionale anche quest'anno.

XVIII | Livorno Sport

IL TIRRENO VENERDÌ 29 NOVEMBRE 2013

Federico Nenci re d'Italia di distensione su panca

Il livornese, debuttante a livello nazionale, conquista il tricolore dei 69 chili «Ho alzato 145 chili, nessuno ce l'ha fatta. Lo dedico alla mia famiglia»

LIVORNO

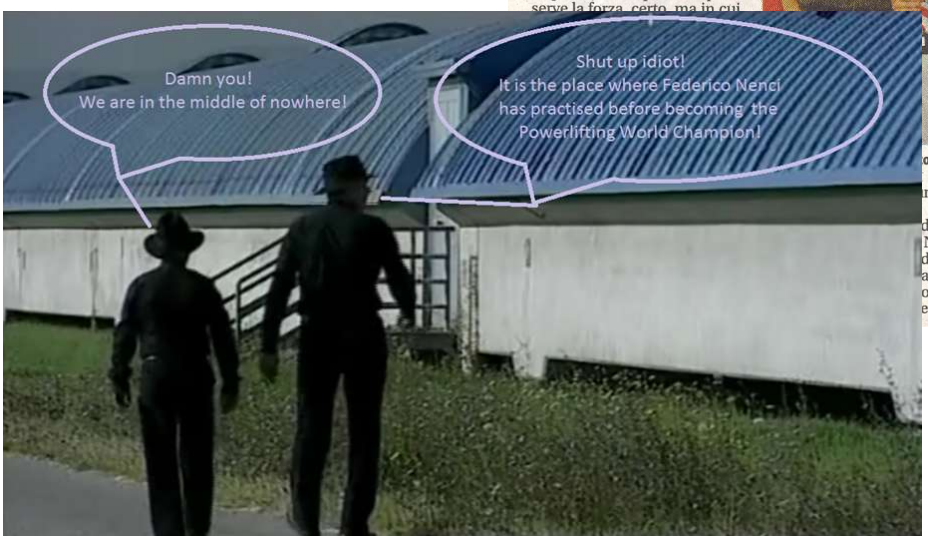
La città dello sport ha trovato un altro campionissimo, capace di prendersi lo scudetto tricolore in una disciplina ancora lontana dal grande pubblico ma non per questo meno dura e affascinante. Il suo nome è Federico Nenci e l'impresa è ancora più grande perchè il livornese era alla sua prima partecipazione a un campionato nazionale di distensione su panca. Uno sport nel quale serve la forza, certo, ma in cui

on la coppa di campione d'Italia

no inl-
dura e
Nenci,
dopo il
a - per-
orrenti
ed era-

vamo tutti molto vicini. Mi sentivo in forma e ho chiuso la prima alzata con 140 chilogrammi ma a complicarmi la gara nella seconda alzata ho preso un nullo (quindi mi è stata data la prova non valida) e non ho avuto la possibilità di rilanciare nella terza prova dove avevo ancora qualcosa da dare.

Fortunatamente però in terza prova sono riuscito a replicare di nuovo i 145kg e nessuno è riuscito ad andare oltre questo 'muro' (nuovo mio record personale) e questo mi ha consentito di portare a casa il titolo assoluto all'esordio nelle finali del campionato italiano. Purtroppo la distensione su panca per il momento è presente solo nelle Paraolimpiadi altrimenti avrei strappato un bel pass.. È stata un'esperienza bellissima conclusa nel migliore dei modi, conoscere di persona e competere con grandi atleti mi ha dato un ulteriore stimolo a migliorarmi. Ottima l'organizzazione e la location scelta dalla Federazione Italiana di Pesistica. Ringrazio tutti quelli che mi sono stati vicino in questi giorni, in particolare Marco Morganti amico e responsabile tecnico dell' ASD Millenium (destra in foto) e Gabriele Fioletti (sinistra). Dedico questa vittoria a mia moglie, i miei figli e tutta la mia famiglia».



Congrats, Champion!

WORKSHOP

GRAVITATIONAL PHYSICS IN THE NEXT 20 YEARS

April, 2nd 2014

Aula E. Caianiello
Dipartimento di Fisica – Università degli Studi di Napoli "Federico II"
Complesso Universitario di Monte S. Angelo
Via Cintia – 80126 Napoli

PROGRAM

10:15 -12:30
– Welcome address
– Gravitational Waves research with Ground Based Detectors (F. Fidecaro)
– Gravitational Waves research with Space Detectors (S. Vitale)

12:30 -14:30 Lunch Buffet

14:30 -17:00
– Overview on Gravitational and Multi-messenger research (E. Coccia)
– New experiments in Gravitation (F. Ricci)
– Open questions in Theoretical Gravitational Physics (L.Gualtieri)

Each talk will be followed by a general and open discussion.
Students are warmly invited to participate.
During the lunch break will be held the inauguration of the Laboratorio di Fisica della Gravitazione.

LOCAL ORGANIZER COMMITTEE:

P. Maddalena
G. La Rana
E. Calloni
S. Capozziello
M.F. De Laurentis
M. De Laurentis
R. De Rosa
L. Di Fiore
G. Esposito
F. Garufi
L. Milano
S. Solimeno

Image: NASA/ESA Hubble Space Telescope - Design: www.mgdesign.com