h

THE GRAVITATIONAL VOICE

number 6

OCTOBER 2007

NEWS FROM THE SITE
Virgo - The Run

SCIENCE AND TECHNOLOGY
Topography and Virgo
Relativity in everyday life

LIFE IN CASCINA
Flaminio's farewell

News from EGO and VIRGO

CONTENTS

"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.

Editor: Carlo Bradaschia

Editorial Staff:
Angela Di Virgilio
Gary Hemming
Paolo La Penna
Filippo Menzinger
Martin Mohan
Flavio Nocera

Design:
Severine Perus

Published in electronic format on the EGO Web:
www.ego-gw.it

EDITORIAL

Histoire d'*h*

Since the first edition of this newsletter we have been wondering about the origins of the use of the letter "*h*" to indicate the a-dimensional strain sensitivity in gravitational wave physics. The letter is commonly used by the whole GW community and, as is well known, represents the amplitude of the gravitational wave. In practical terms, for those involved with detectors, it expresses the variation in length of the measured sample, either the bar length in GW bar experiments, or the arm lengths in interferometric detection. Given the length L=3 km of the Virgo arms, *h* is the ΔL/L of the arms induced by the passage of an expected gravitational wave: for a GW characterized by $h=10^{-22}/\mathrm{Hz}^{½}$, the arm length variation is $hxL=10^{-19}\mathrm{m}/\ \mathrm{Hz}^{½}$. Of course there is all the GW physics behind that: sources, propagation, detection, and so on. However, this is not what has been piquing our curiosity.

What we have been asking ourselves is: why write this letter, and not another one, to define this quantity, and when was it first used?

General relativity was introduced, by Einstein, for the first time in 1916 ("Die Grundlage der allgemeinen Relativitaetstheorie", Annalen del Physik, n.7, p.50, 1916). In this paper Einstein used the linear approximation ("weakfield") scheme to solve the field equations of general relativity. No mention of GW was made. This approximation was corrected in 1918, when Einstein published the first paper on GW, "Über Gravitationswellen" (Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften Berlin (1918), 154–167). In this paper, for the first time, GW were predicted and their interaction with matter evaluated. The perturbation of the metric tensor g was written as $g_{\mu\nu} = -\delta_{\mu\nu} + \gamma_{\mu\nu}$. In the following, the letter *h* is never used.

Besides the papers above, Einstein published another paper in 1937. In a paper written by Einstein with Natan Rosen in 1936, with the title "Do gravitational waves exist?", Einstein even reached the conclusion that GW do not exist (he wrote to his friend Max Born that "*together with a young collaborator (Rosen) I arrived at the interesting result that gravitational waves do not exist, though they had been assumed a certainty to the first approximation …*". Einstein and Rosen sent a paper to Physical Review, which rejected it: I haven't been able to find it, but I've found the rejection letter by PR, the angry answer by Einstein, and the later answer by PR: apparently Einstein didn't accept an anonymous peer review (it was used in the USA, but not in Germany for established physicists at that time). Einstein withdrew the paper, so it was never published in its original form. He published later in the Journal of the Franklin Institute (Einstein, A., Rosen, N.: On Gravitational Waves. In: Journal of the Franklin Institute 223 (1937), 43–54).

FRONT COVER: Railway Cemetery, UYUNI (South-West Bolivia)
Photo taken by Mark GRAY

At that time, since Einstein had been convinced of a mistake by his friend H.P. Robertson, this paper was actually a correction of the former paper written with Rosen, and Einstein admitted that he "originally interpreted our formula results erroneously", he used the transformation to cylindrical coordinates and presented what are now called Einstein-Rosen cylindrical waves (these are locally isometric to plane waves). By the way, even there, the letter *h* for the a-dimensional strain or metric perturbation does not show up. On his side, Rosen, already back in the USSR, didn't like this change of mind, and apparently published the original version, I don't know where and when, and continued until at least 1970 affirming that GR doesn't actually predict GW.

Incidentally, and curiously enough, it is worth saying that, even if it is generally stated that Einstein admitted that GW are practically impossible to measure, I've not been able to find any trace of this admission. The three papers above are the only papers written by Einstein on GW, and it is never stated that they are too small to be measured. Einstein is supposed have said that a gravitational wave "*in allen nur denkbaren Fallen einen praktisch verschwindenden Wert haben muss.*" (should have, in all cases one could imagine, a practically disappearing value). This sentence I think is cited by E. Amaldi in "Einstein and Gravitational Radiation", Lecture Notes in Physics Publisher Springer Berlin / Heidelberg , ISSN 1616-6361, Volume 124/1980, Gravitational Radiation, Collapsed Objects and Exact Solutions (kindly pointed out to me by Prof. G.Pizzella), but I did not have the time to purchase this article (available on payment), so I could not find out where and when Einstein really expressed his opinion on the detectability of GW.

In the following years there was little interest and literature to this regard. The quadrupole formula should have appeared in 1947 in "Hu, N.: Radiation Damping in the Gravitational Field, Proceedings of the Royal Irish Academy 51° (1947), 87–111" (I couldn't find it), then Lorentz-invariant perturbation methods ("fast-motion approximation"), describing "unbounded systems", were developed at the beginning of the sixties. The first efforts in detecting GW were those of J. Weber, starting from 1959 (J. Weber, Phys.Rev., 117, p.306, 1960). In his paper of 1969 ("Evidence for discovery of gravitational radiation", Phys.Rev.Lett.22, 1320-1324 (1969)) there is no mention of strain sensitivity or of the letter *h*. The paper in which, to my knowledge, a real experiment for GW interferometric detection is explicitly described for the first time, is that by G.E. Moss, L.R. Miller and R.L. Forward, "Photon-Noise-Limited Laser Transducer for Gravitational Antenna", Appl.Opt., 10(11), 2495-2498, November 1971. In this paper, in which a prototype interferometer is shown (table-top, very small), there is still no mention of a-dimensional strain sensitivity, only the minimum relative displacement Δx between the mirrors is considered.

In this paper Forward says that the first time this idea had been suggested was in a telephone conversation between Forward and J. Weber in 1964. But, actually, the idea had already been suggested by two Soviet scientists, M.E. Gertsenshtein and V.I. Pustovoit, in 1962 (*Sov. Phys. – JETP* **16** 433). Some years after, R. Weiss in April 15, 1972, wrote "Electro-magnetically Coupled Broadband Gravitational Antenna", Quarterly Progress Report, Research Laboratory of Electronics, *MIT* **105**: 54 (1972), in which he described the basic setup of a Michelson-like interferometric detector with suspended masses and laser beams, which should be regarded as the first true proposal of the present interferometric GW detectors. After quite a long search (thanks to the help of a former colleague of mine, C. Ciamberlini, of the Istituto Nazionale di Ottica Applicata of Florence), I've also been able to find a copy of the Gertsenshtein et al. paper. There, after some formulas, one can find the unequivocal formula, referred to the length l_0 of an arm of a Michelson interferometer,

$$\frac{\Delta l}{l_0} = \frac{1}{2} h_{\alpha\beta} n^{\alpha} n^{\beta}$$

, $n^{\alpha,\beta}$ being the unitary vector in the a,b direction. This is the first time I've been able to find the letter *h* to denote the strain sensitivity referred to a detector, namely an interferometric one. Then, thanks to R.Weiss, I've been able to consult this rare manuscript, and found therein the perturbation $g_{ij}=\eta_{ij}+h_{ij}$, which would be, I think, the first trace of the use of *h* in a western experimental paper. However, I haven't been able to find the Russian paper yet, so I cannot say whether the letter *h* had already been used in it to denote the strain sensitivity. At the time of the paper by R.Weiss, the term *h* for a-dimensional strain sensitivity was apparently already normal, being widely used in the complete description of GW given in C.W. Misner, K.S. Thorne, J.A. Wheeler, "Gravitation", Chap.35 (copyright 1970), and later in Weinberg's "Gravitation and cosmology: principles and applications of the general relativity", Chap.7.6 (Wiley, 1972). So, when R.L. Forward wrote his paper "Wideband laser-interferometer gravitational *(sic)* – radiation experiment" in PRD, 17(2), 379-390 (15 January 1978), the first paper to my knowledge that really offers a complete description of a real experiment (the Malibu antenna), the formalism is very close to the present.

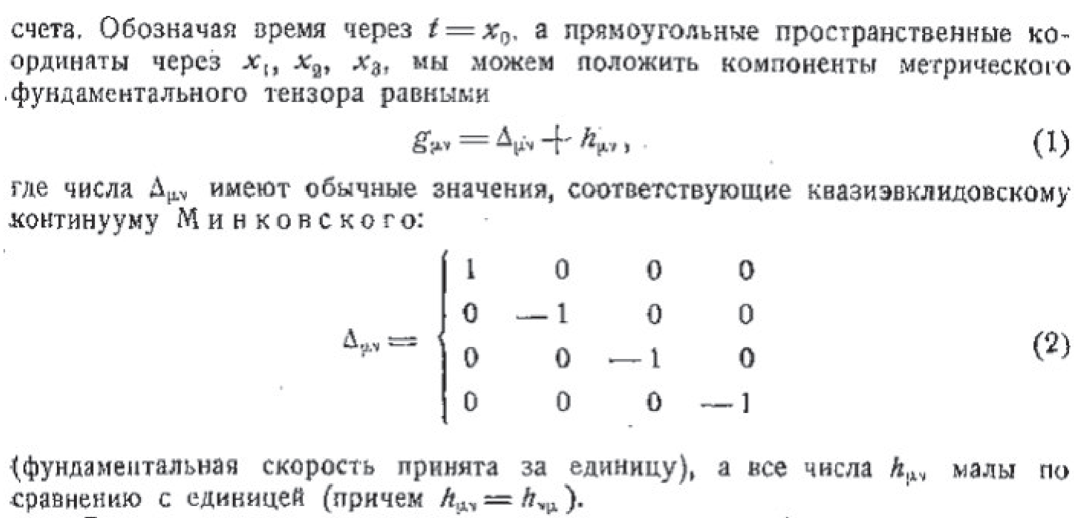
But, before the two textbooks above, *h* had already appeared in Landau's "Classical field theory" (Teorija Polja), namely in Chap.12 (in the 1976 edition revised by Lifshits). We find therein the perturbation $g_{\mu\nu} = g_{\mu\nu}^{(0)} + h_{\mu\nu}$, which then leads to the wave equation in vacuum for *h*.

The formalism is already the one used later in the book by Misner, Thorne and Wheeler. The first edition of Landau's book was in 1939, and was first published by Pergamon Press in 1954. In his paper, Gertsenshtein actually quotes Landau's 1960 edition when deriving his formula.
Even if I have no means of consulting the first editions of the book by Landau, I think that he took the formalism from someone else: actually the first trace I could find of the use of *h* as the perturbation of *g* is in a work by Matvei Petrovich Bronstein (1906-1938), a brilliant Russian physicist, one of the first to study quantum gravity, who was arrested in Stalin's Great Purge of 1937, and soon executed.
Landau and Bronstein knew each other very well. Landau had also been arrested and jailed in the Lubjanka (April 1937) in the same period (and survived only thanks to a personal request to Stalin by Pyotr Kapitsa, even though in jail he had been very brave). One of the accusations against him was that he had informed Bronstein of the diffusion of a subversive leaflet, presumably written by Landau himself. By the way, in a paper in 1934 ("On the question of a relativistic generalization of the indeterminacy principle", Doklady Akademy Nauk SSSR 1, 388-390), Bronstein was the first to assert that the Planck mass $(hc/G)^{1/2}$, where *h* is the Planck constant and *G* the gravitational constant, should be regarded as the quantum-gravitational scale, thus asserting the quantum limits of General Relativity for the first time, in a time in which in physics there was a great expectation for a so-called cGh-theory, unifying the three known universal constants, a discussion in which both Bronstein and Landau were deeply involved (see on this regard:http://people.bu.edu/gorelik/cGh_FirstSteps92_MPB36/cGh_FirstSteps92_text.htm).In Bronstein's paper (I haven't found the 1934 original, only a reliable account of it, but I've found two papers from 1936) Bronstein proceeded from the weak-field approximation, using, if I didn't get the wrong information, the expression: $g_{\mu\nu} = \delta_{\mu\nu} + h_{\mu\nu}$, then,

$$\Box h_{\mu\nu} = \kappa\left(T_{\mu\nu} - \frac{1}{2}\delta_{\mu\nu}T\right)$$

etc. This would be the first appearance of the letter *h* to indicate the quantity that would have later described the amplitude of the gravitational radiation. That was in 1934, and is at least the first one that I've been able to find. I don't know what happened between Einstein's 1918 paper on GW and Bronstein's paper from 1934.
I couldn't consult all the possible literature on this subject. By the way I retain as possible that, from its appearance in the Russian scientific world, the letter *h* would have found its way, through Landau's famous course in theoretical physics and papers like the one by Gerstsenshtein, into the American textbooks of Misner, Thorne and Wheeler, and later of Weinberg. At this point, experimentalists used what had become a standard formalism, and continue to do so up to our days and to our newsletter. So, even if not explicitly mentioned by Einstein, the letter *h* has been in use since at least 1934, and could be a legacy of the Soviet world, even if from a victim of Stalin.
Now, a last question could be: why the letter *h*, instead of another one? Was there any special reason for choosing this letter? Was there any meaning? Any hidden mystery? At the beginning, after discovering the writing by Bronstein, in which quantum theory was involved, I had thought that there had been a secluded reference to the Planck constant, maybe with some attempt at identification, connection, I don't know what, so that the origins of the use of that letter are related to the early discussion in gravitational quantum physics. Actually, it's now clear that this is out of discussion. So, my personal opinion is now that the letter is there only because *h* is the first letter coming after g, so that It would be natural to write: $g_{\mu\nu} = g_{\mu\nu}^{(0)} + h_{\mu\nu}$.
Therefore, no mystery, nothing surprising. If anybody has any better ideas, or information, their contribution would be most welcome. The discussion is still open.

P. LA PENNA



счета. Обозначая время через $t = x_0$, а прямоугольные пространственные координаты через x_1, x_2, x_3, мы можем положить компоненты метрического фундаментального тензора равными

$$g_{\mu\nu} = \Delta_{\mu\nu} + h_{\mu\nu}, \qquad (1)$$

где числа $\Delta_{\mu\nu}$ имеют обычные значения, соответствующие квазиэвклидовскому континууму Минковского:

$$\Delta_{\mu\nu} = \left\{\begin{matrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{matrix}\right. \qquad (2)$$

(фундаментальная скорость принята за единицу), а все числа $h_{\mu\nu}$ малы по сравнению с единицей (причем $h_{\mu\nu} = h_{\nu\mu}$).

Fig.: An extract from M.P. Bronstein, "Kvantovanie gravitatsionnyki voln" (Quantization of Gravitational Waves) Zh. Eksp. Tear. Fiz. 6 195 (1936).

V S R 1
Virgo - The Run

The first long Virgo science run has finished. It is now time for a summary of why we did it and how well we performed.

The goal of the run was to measure 4 months of data simultaneously with the Ligo S5 run. For a science run coincident measurements with other detectors are important for excluding what we think is an interesting event from what in reality is just a passing truck. The idea is that a gravitational wave must be seen worldwide so only coincident events detected on several detectors merit a closer investigation from the astrophysical point of view. The S5 run of the LSC community (Ligo and Geo) was scheduled to finish on the 1st of October so we decided to finish theVirgo run the same day. After this we could recommence work on the machine in view of the Virgo+ upgrade.
The words mainly heard during the last months are *horizon* and *duty cycle*. They stand for the two main aspects of the functioning of the interferometer, namely sensitivity (to gravitational waves) and robustness (against perturbations).

The horizon tells us how far away we are able to detect a standard gravitational wave event (a coalescence of two neutron stars). It was 3.5 Mega-parsec (http://en.wikipedia.org/wiki/Parsec) at the beginning of the run. Due to various improvements, we are now around 4.5 (see Fig.1). This means that we are sensitive enough to see an event as far away as 15 million light-years: 6 times the distance from our neighbouring galaxy, the Andromeda nebula. This is still not our design sensitivity, but it is not bad either.

The duty cycle refers to the percentage of total time we are locked (the interferometer is under control and the light is resonant in the arms and recycled into the interferometer). For the data analysis people it is more interesting to know the duty cycle in science mode (the interferometer is not only locked but gives good quality data: no noise injections etc.). The duty cycle is now approaching 84% (locking) and 81% (science mode). About 6% of the duty cycle was sacrificed for commissioning and maintenance breaks and the rest was due to occasional failures such as earthquakes and other problems which make the interferometer unlock. The longest lock was 94.5 hours. Only Geo had a longer lock with 102 hours.

During the time of the run, every perturbation of the interferometer had to be avoided and so access to the buildings was forbidden and traffic was denied access around the buildings. Some unavoidable noise like running the vacuum pumps or cutting the grass (to reduce the risk of fire) was planned during the maintenance break once a week. People in the control room eagerly awaited these occasions every Wednesday morning and invaded the buildings armed with all kinds of measurement instruments in order to test ideas they had developed during the week: knocking on the optical tables for observing how the vibrations propagate, measuring the magnetic field near the towers, tuning the air conditioning system for better temperature stability and many other things. Since the weekly maintenance period was always very noisy we also had a second period for tests called the commissioning breaks. During these periods the interferometer was kept in a quiet condition and people injected noise to measure its propagation or tried new control configurations. The ever-present challenge was to avoid an unlock due to excessive perturbation.
Returning to the standard working condition always takes at least 30 minutes or more (since we must wait until after incident laser power has finished heating up the mirrors) .The worst case was when we spent16 hours trying to relock, which is not very nice if you consider that every hour of unlock means lost data and makes the duty cycle drop a little bit more.

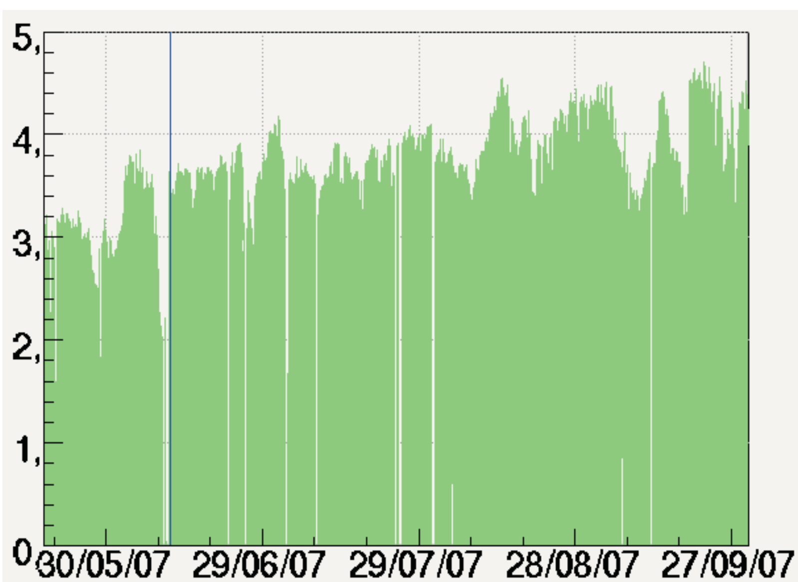


Fig. 1. Evolution of the horizon since the beginning of the run (in Mega-parsec). Apart from fluctuations which are not yet fully understood, there is a steady increase, due to the work carried out during the maintenance and commissioning breaks.

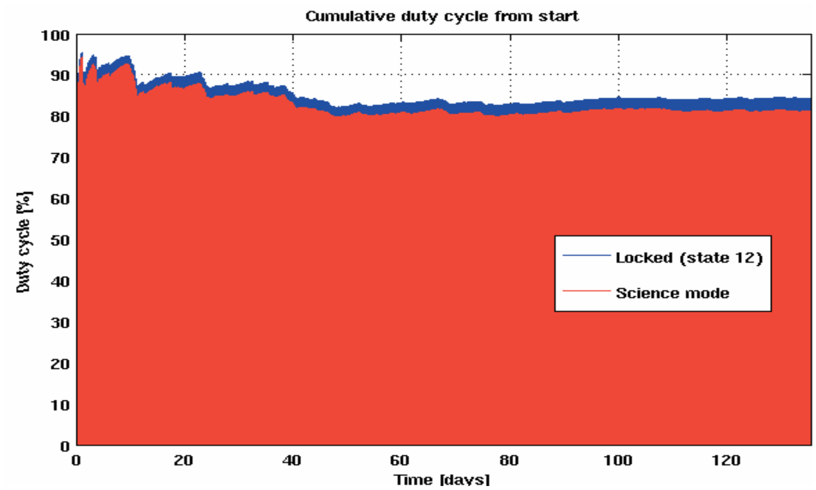
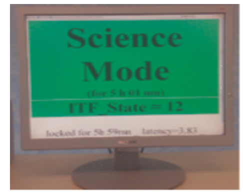


Fig.2. The duty cycle since the start of the run. We started very well (around 90 %) and are now somewhat lower, but still not bad at all (above 80 %).

As previously mentioned, the interferometer is very sensitive to ground vibrations. Fortunately the run took place during the summer, which is a calm season in Tuscany. When the weather is bad, both the wind and the sea waves hitting the shore create vibrations which are transmitted to the mirrors, thereby reducing the sensitivity, and sometimes even causing a loss of lock. We are so sensitive that even an earthquake on the other side of the globe can unlock the interferometer and make it impossible to lock again for a long time (we need to wait until the earth and the suspended mirror swing has calmed down).

Therefore the suspension people developed an "earthquake guardian" which watches out for arriving earthquake waves and hopefully switches the suspension control system to a more robust configuration in time. This has helped several times in keeping the interferometer locked while waiting for the earthquake aftershocks to pass.

The latest glorious achievement was the discovery of a tiny noise source on the suspended injection bench. Some piezoelectric actuators used for initial alignment of the mirrors were kept in position by a constant voltage but superimposed on this voltage was an almost imperceptible noise. It was enough to shake the bench, the mirrors, and the beam entering the interferometer thereby reducing the sensitivity. After filtering out this power supply noise the horizon increased by 0.5 Mpc. This was the first step forward into the unknown 100-500 Hz where exist as yet unexplained excess noise that we call "Mystery Noise". It is the enemy to fight in the preparation of Virgo+.



That's how we like it!.....

... and that's not so nice!

Considering how everybody struggled until the final hours before the run in order to get a stable configuration and a good sensitivity we can say that the run has been a very nice success. It rewarded the many hours invested day and night and provides motivation to continue for the upcoming improvements.

H. HEITMANN

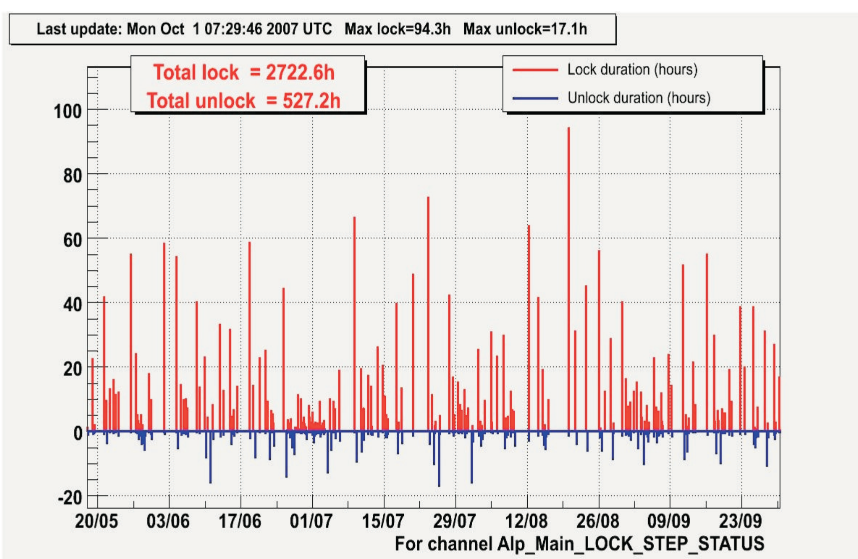


Fig. 3. The upper red bars represent the duration of the lock periods, in hours; the lower blue bars represent the duration of the unlock periods.

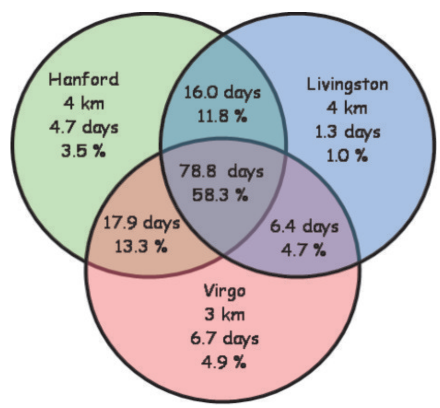


Fig. 4. Coincidence duty cycles between the three longest interferometers (Virgo, Ligo Hanford 4 km, and Ligo Livingston) until Oct. 1st. The numbers shown are the times when only one, only two or all three interferometers were simultaneously in science mode. The quadruple coincidence including H2 (Hanford 2 km) is 54%, and quintuple coincidence with Geo 40% (they were in commissioning mode). Thanks to Shourov for the plot and the data!

The ground on which we stand!

The construction and the operation of Virgo have widely used topographic measurements. From construction start until the present day there have been many GPS and traditional measurement activities connected to the experiment.

The first GPS survey determining the territorial positioning of Virgo was performed in January 1997 with the aim of determining the first net of reference points. Two subsequent surveys have been carried out in November 2004 and in June 2005 in order to fix the Virgo position with respect to the official Italian GPS reference network and determine the GPS coordinates of Virgo vertexes. The table below summarizes the above mentioned coordinates, on the global reference ellipsoid for GPS surveys WGS84 (World Geodetic System '84, centred on earth centre of mass), with the addition of the height with respect to the ellipsoid surface.

The geometry of Virgo is determinded by two orthogonal straight vacuum tubes 3 km-long. The size of the experiment requires earth curvature correction. The centre of the Beam Splitter mirror and of the North Terminal mirror are 6.530 m above sea level while the beam in the middle of the arm is travelling at only 6.354 m above sea level. As a consequence the axis of the tube turns out to be lower at mid arm by 176 mm in relation to its height at the towers. Moreover, while the Beam Splitter and the North Terminal Tower centres have the same topographic height, the West Terminal Tower centre has been built at the different height of -1.351 m with respect to the BS centre. This was done to follow the natural ground slope [Fig. 1]. Both the Virgo layout and the very strict tolerances (a few cm) required very precise topographic measurements for the construction. The measurements are much more accurate than usually requested by civil engineering works. It must be emphasised that the achieved geometrical precision is relative with regards to the different interferometer components. The exact position of the whole apparatus with respect to the earth coordinates or to the "fixed stars" is much less important.

A consequence of the difference between the need of building a straight tube and the earth surface curvature is that the traditional, straightforward methods used to build roads based on bubble levels and plumb lines could not be applied. Another amazing effect of this is that if we pour water at one end of the North tube, the liquid would run quickly to the middle of the tube until 176 mm of water accumulated; only at this point would water begin to drip out at the tube ends!

For the alignment of the two 3 km-long vacuum tubes and for all the other parts of the experimental apparatus (towers, big valves, mirrors, optical benches, etc.) an "*ad hoc*" indoor reference points' network was created. All the points of the Virgo networks have been surveyed with high accuracy topographic traditional instruments, while some of them, the so called GPS points have been surveyed with GPS antennas and receivers. The Virgo reference points' network includes 457 points, and specifically:

- 1 GPS master point located on the roof of the Technical Building;
- 11 GPS points located along the North Tunnel;
- 11 GPS points located along the West Tunnel;
- 22 points located in the Central Building, in the Mode Cleaner and along the Tunnel Mode Cleaner;
- 200 points located along the North Tunnel + 6 points located in the North Terminal Building;

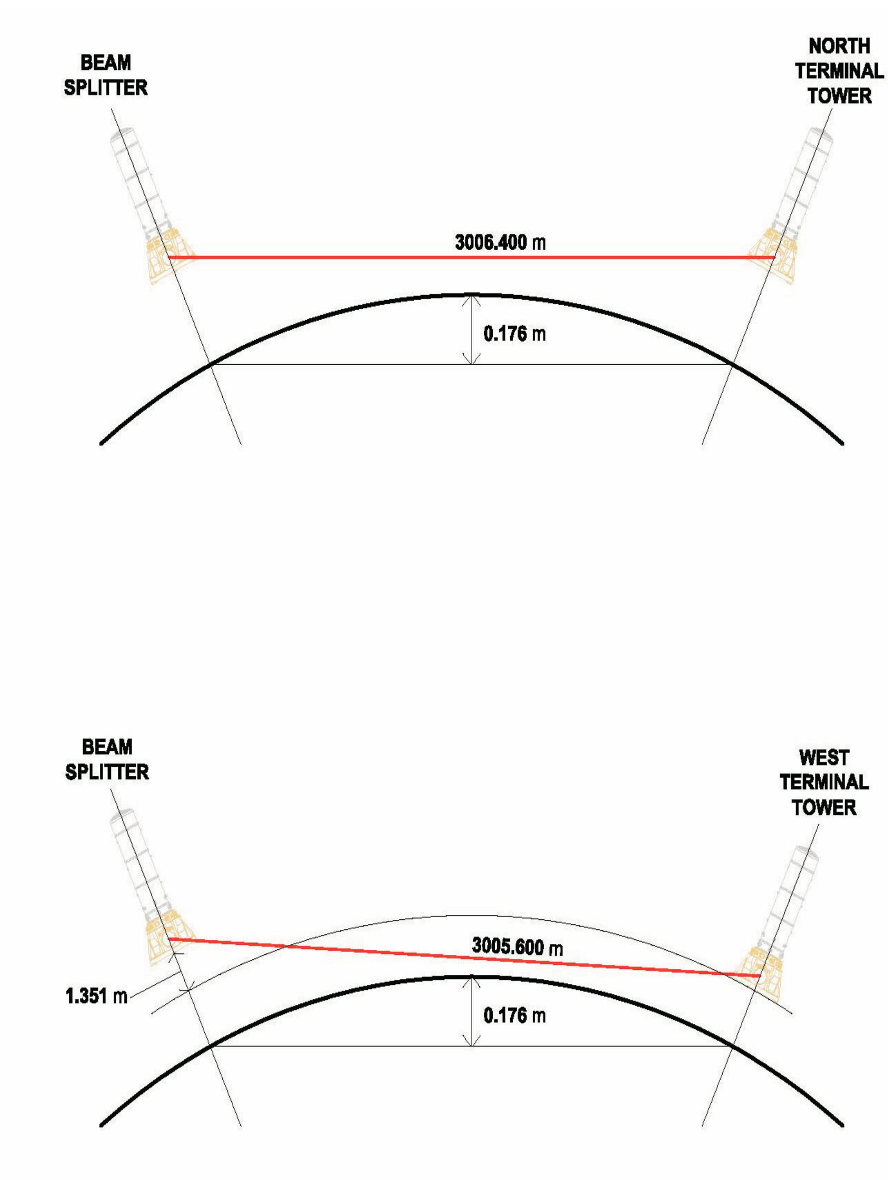
Tab. 1 GPS coordinates of the Virgo vertexes

Point	Latitude	Longitude	Ellip. Hgt [m]
BS	43° 37' 53".0880 N	10° 30' 16".1885 E	53.238
NTT	43° 39' 24".9479 N	10° 31' 00".8264 E	53.069
WTT	43° 38' 25".4694 N	10° 28' 09".7319 E	51.749

- 200 points located along the West Tunnel + 6 points located in the West Terminal Building.

All the points of the network are marked by precision brass hubs set in the floor of the various buildings and these are able to house the forced centring pins.
This network enables both levelling and planimetric measurement of very high accuracy using the high-precision instruments available. The error of closure of the tunnel's levelling never exceeds 0.3 mm/km, with an average value of 0.11 mm/km.

[Fig. 1]



Many topographic measurements were also carried out after the termination of the construction and the installation of the scientific apparatus. These were carried out in order to monitor the positions of the civil engineering structures over time with respect to both the vertical and the horizontal displacements.

The mainly vertical soil movements are due to the subsidence caused by water being extracted for agriculture and the increased load on the ground. This was foreseen when designing the tunnels and buildings with a settling time of 10-20 years.

Ground subsidence is a relevant issue at Virgo and in general in the whole Pisa area because the area is an alluvial clay pack, interleaved with limited sand and gravel layers. The problem has been well known since the Middle Age as is shown in the "Vasari" box, in these pages.

Ground monitoring measurements are essential to provide up-to date values of the tubes' module positions and provide the basis for carrying out the fundamental operations of re-alignment. This is the main goal of the surveys.

Two constraints need to be taken into account. From the optics point of view, the arm tubes have to be straight to better than +/-50 mm in order to avoid interference with the laser beams. From the mechanics point of view two adjacent tube supports have to be aligned to better than 10 mm in order to avoid dangerous stresses to the tube welds. If tolerances are exceeded realignment is necessary. This can be easily performed using the adjustment capabilities of the tube supports which, in the "as built" configuration enable vertical adjustments of up to 150 mm. This limit could be easily exceeded two or three times by replacing the current support legs with longer ones. The real limit is the roof of the tunnel which is about one meter above the tube!

Starting from the initial survey in 2001 for the tubes' alignment, several measurement campaigns for the height and planimetric displacements have been carried out, roughly in the following sequence:

- Height surveys:

- All points of Virgo Tunnels: 2 times/year;
- All points from Central Building to Mode Cleaner: 1 time/year.

- Planimetric surveys:

- All GPS points: 1 time/ 2 year;
- All points of Virgo Tunnels: 1 time/ 2 year;
- All points from Central Building to Mode Cleaner: 1 time/2 year.

The EGO Infrastructure Survey team is eagerly waiting the end of the VSR1 data collection in order to perform the next height survey in October. Planimetric measurements will be performed at a later time.

The following diagrams show some results displaying the progressive settlements of the North and West Tunnels [Fig. 2, 3] and the differential settlement between the Tunnels and the Terminal Buildings [Fig. 4].

The tunnels may sink more rapidly as they have less stable foundations than the Terminal Buildings. It must be emphasised that Fig. 2 and 3 represent the tunnels floor profile. The tubes by contrast have been kept straight to within design specifications by performing appropriate realignment campaigns.

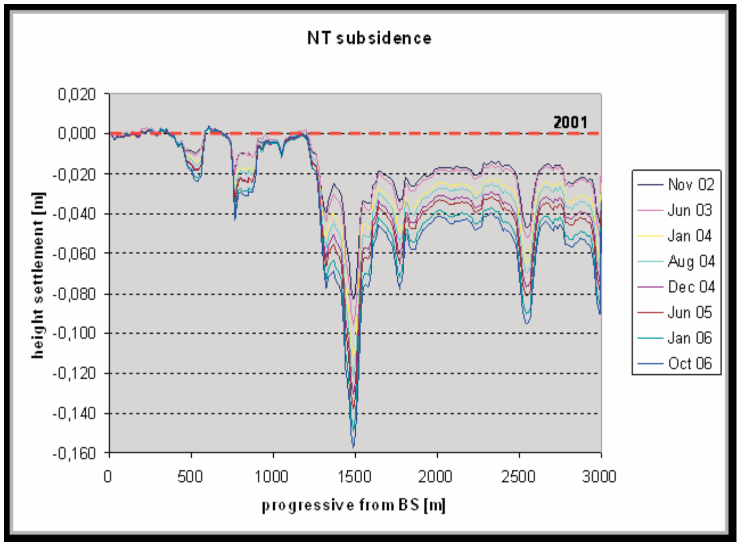
Two conclusions may be derived from this data:

At particular locations the ground lowering is quite large, e.g. in the middle of North arm and at the far end of the West arm. The displacements are however well within the alignment recovery possibility of tube supports. Settlements of this amplitude are commonly encountered in civil engineering buildings built on this type of ground.

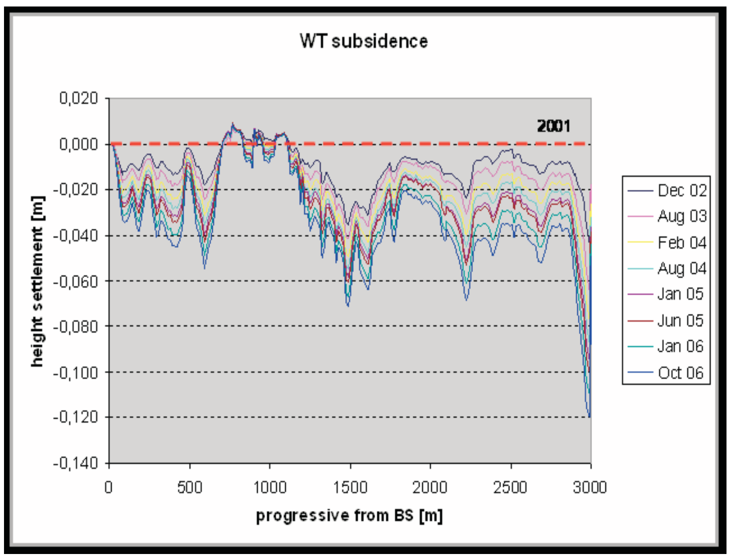
In general the speed of ground subsidence is showing only moderate decrease. This differs from zone to zone but remains far from an asymptotic behaviour. This is unexpected but even so it will remain inside the recovery capability until well beyond the time of Advanced Virgo.

A. PAOLI

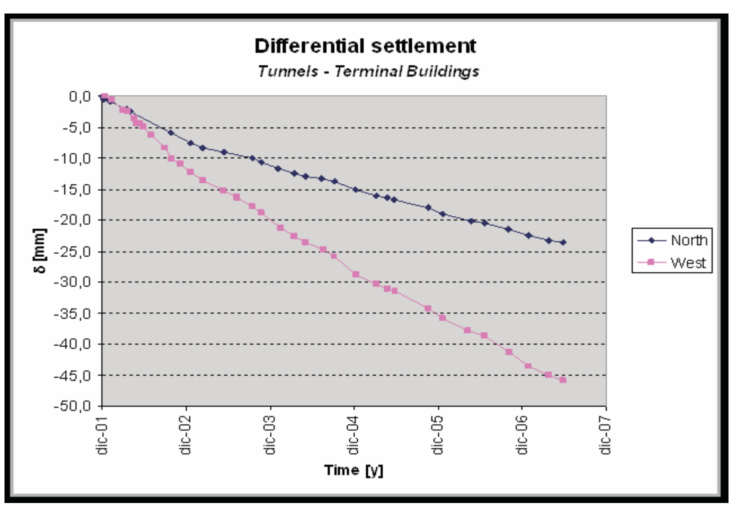
[Fig. 2]



[Fig. 3]



[Fig. 4]



Relativity in everyday life

The Global Positioning System (GPS, http://physicscentral.com/writers/2000/will.html, http://en.wikipedia.org/wiki/Gps) is, to our knowledge, the only instrument in common use which requires the use of Special and General Relativity laws to make it work correctly.

The pocket GPS receiver acquires radio signals broadcast by a network of 24 satellites orbiting the earth at regular intervals. The receiver uses the time difference in the arrival of radio pulses from the satellites to compute their distances and then computes its own position on the earth's surface using triangulation to an accuracy of 10 m.
Correct operation requires that the whole system be synchronized. This is achieved by high precision atomic clocks on each satellite and on the control stations on earth.
The beat frequencies of the various clocks differ for two reasons .The first reason is due to Special Relativity which states that space-time distances between two events are different if measured in reference systems moving one with respect to the other. This effect is negligible at normal velocities but becomes much more relevant as the speed of light is approached. The effect can be experienced in an accelerator laboratory, were physicists (sitting in the counting room) measure every day that a fast moving muon lives thousands of times longer when it is not measured within its own reference system (where it is steady). This means that if a stationary earth clock and a clock aboard a satellite moving at 14000 km/hour were perfectly synchronized at a given instant, then after one day the satellite clock would register a time lag of approximately 7 microseconds. This time lag provides an error in the satellite-earth distance measurement of

$$- 7.2 \cdot 10^{-6}\ s \cdot c = - 2200\ m$$

(radio waves carrying satellite signals to the receiver travel at the speed of light, c = 300000 km/s), This error in turn produces an error of the same order of magnitude in the triangulated position of the GPS on the earth's surface.
The second reason is due to General Relativity. General Relativity states that a gravitational field distorts space-time (which is why Virgo is expected to detect gravitational waves). In particular a non zero gravitational field slows down the speed of time, hence clocks (and time itself) on the earth's surface run slower than clocks on satellites located at 27000 km above the earth's centre because the clocks experience a gravitational field which is 4 times weaker than that on the earth. The resulting time difference measured over one day is approximately 46 microseconds. This delay produces an error in the satellite-earth distance measurement of

$$+ 46 \cdot 10^{-6}\ s \cdot c = + 13800\ m$$

This error in turn produces an error of the same order of magnitude in the triangulated position of the GPS on the earth's surface.
The two effects have opposite signs but as they have different magnitudes they do not cancel each other out.
The net result is that after one day the position of a GPS receiver would be reconstructed with an error of the order of 10 km which, if uncorrected, would render the system useless. A simple trick is used to overcome this problem. Earth time is deceived by measuring it with "wrong" clocks supplied with an oscillator with a frequency of 10.22999999543 MHz instead of the 10.23 MHz oscillator on the satellites. More subtle relativistic effects such as the Sagnac effect have also to be taken into account.
There are several amusing stories about the GPS and the traditional beliefs that engineers don't know physics and scientists don't know reality. It is said that the first design of the GPS system was made (by an engineer, of course) in a pre-Michelson-world, were ether still existed! It is also said that a famous relativist tried unsuccessfully to find the effects I have just described in a GPS system. He was desperately disappointed not to find them but he didn't know that clever engineers had already corrected for relativity.

C. BRADASCHIA

Time and tide wait for no man!

Everybody knows about sea tides and their spectacular effects along the coast. In quiet conditions, we are fascinated by the unusual environment revealed by the calm breathing of the sea and people living along the coast are used to coping with it.

Tidal phenomenon is clearly evident at the border between the water, a liquid, and the ground, a solid. The Earth is a deformable solid body. Its surface, the ground where we walk, goes up and down under the gravitational field due to a combination of the effects of the other bodies surrounding the planet and the "centrifugal" effect of earth rotation. (http://en.wikipedia.org/wiki/Tide).

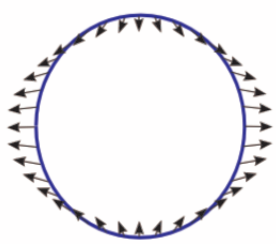


Fig. 1: tidal deformation along a circular cross section.

Due to the Earth's rotation, the ground is alternatively pushed and pulled above and below a mean circular cross-section twice per day, over a period of 12h24m (Fig.1). The overall tide amplitude depends mainly on the reciprocal position of three bodies, namely the Earth, the Moon and the Sun, and is modulated by the revolutionary motion of the Earth-Moon system (27.3 days).

The deformation direction is almost perfectly aligned towards the Moon, with a small lag, of about one hour, caused by natural vibration of the Earth's lithosphere. This is not true for the sea, whose redistribution over the globe occurs over several hours. Indeed, if the globe were uniformly covered by water, a dynamic equilibrium of the sea level would be reached. Instead, the Earth reacts with elastic stiffness and hence the ground deformation turns out to be smaller than ocean tides, albeit rather large, up to half a metre!!!

Virgo is sitting on the ground and we claim to be able to detect gravitational waves by isolating its test masses from external disturbance. Suitably featured pendulums, equipped with digital acceleration control, will easily perform the job! Well, it is not so obvious, we need to apply small forces to perform noiseless control of the test mass positions, since they are mirrors of an optical interferometer meant for gravitational wave detection.

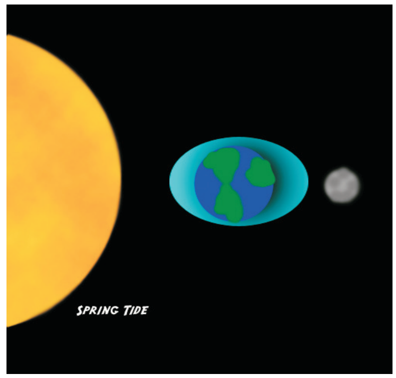
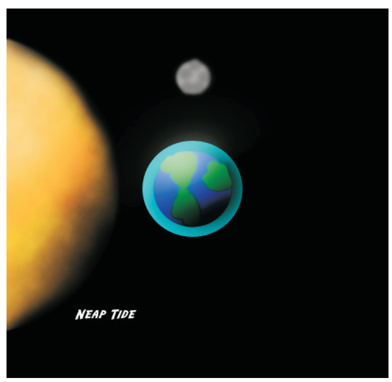


Fig. 2 and 3: tide phases (spring tide and neap tide).



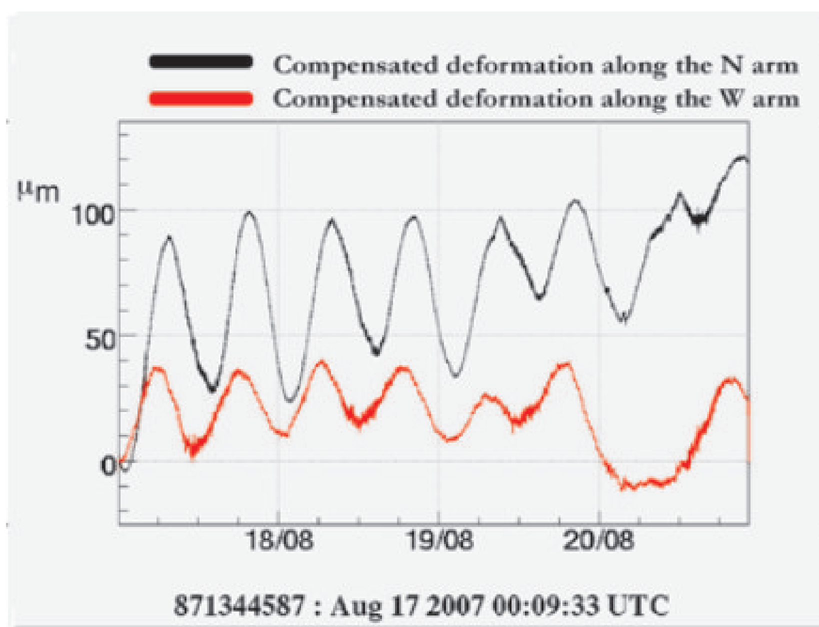
As tide deformation forces the ground upwards, the 3-km-long baseline of the Virgo Fabry-Perot cavities becomes longer and the mirrors, 20 kg in mass, drift apart. Six hours later the contrary happens: the ground goes down and the arms are shortened.

We adopted the technique of using the interferometric measurement of each Virgo Fabry-Perot cavity to continuously re-arrange the suspension point by roughly 100 µm (Fig. 4). This allows us to keep each Fabry-Perot cavity length *constant*. Indeed, we still have to apply tiny corrections on the Virgo mirror positions, of the order of 1 µm, to lock the cavities on resonance.

E. MAJORANA

FIGURES: WWW.WIKIPEDIA.ORG

Fig. 4: Semi-diurnal tidal corrections applied at the top of Virgo suspensions during the on-going science run. The effect is clearly different along the two arms of the interferometer.



Giorgio VASARI

Le vite dei più eccellenti scultori, pittori e architetti
Firenze, 1568

VITA D'ARNOLFO DI LAPO ARCHITETTO FIORENTINO

"......ma non avendo questi due architetti (Guglielmo Tedesco e Bonanno Pisano, 1174, n. d. r.) molta pratica di fondare in Pisa, e percio' non palificando la platea come dovevano, prima che fussero al mezzo di quella fabrica (il campanile del duomo di Pisa, n. d. r.), ella inclino' da un lato, e piego' in sul piu' debole, in maniera che il detto campanile pende sei braccia e mezzo fuor del diritto suo, secondo che da quella banda calo' il fondamento......"

VITA DI NICOLA E GIOVANNI PISANI SCULTORI ET ARCHITETTI

"......Fece similmente Nicola in Pisa molti altri palazzi e chiese, e fu il primo, essendosi smarrito il buon modo di fabricar, che mise in uso fondar gli edifizi a Pisa in su pilastri, e sopra quelli voltare archi, avendo prima palificato sotto i detti pilastri; perche' facendovi altrimenti, rotto il primo piano sodo del fondamento, le muraglie calavano sempre; dove il palificare renda sicurissimo l'edifizio, si come la sperienza ne dimostra......"
"......la chiesa nuova de' frati Predicatori a Perugia.....
......e minaccia, per essere stata male fondata, rovina. E nel vero, chi mette mano a fabricare et a fare cose d'importanza, non da chi sa poco, ma dai migliori dovrebbe sempre pigliar consiglio, per non avere, dopo il fatto, con danno e vergogna a pentirsi d'essersi, dove piu' bisognava, mal consigliato...."

LE VITE
DE' PIV ECCELLENTI PITTORI,
SCVLTORI, E ARCHITETTORI

Scritte
DA M. GIORGIO VASARI PITTORE
ET ARCHITETTO ARETINO,
Di Nuouo dal Medesimo Riuiste
Et Ampliate
CON I RITRATTI LORO
Et con l'aggiunta delle Vite de' viui, & de' morti
Dall'anno 1550. insino al 1567.
Prima, e Seconda Parte.
Con le Tauole in ciascun volume, Delle cose piu Notabili,
De' Ritratti, Delle vite degli Artefici, Et dei
Luoghi doue sono l'opere loro.

CON LICENZA E PRIVILEGIO DI N. S. PIO V. ET
DEL DVCA DI FIORENZA E SIENA.

IN FIORENZA, Appresso i Giunti 1568.

Giorgio VASARI

Lifes of the most excellent sculptors, painters and architects
Florence, 1568

LIFE OF ARNOLFO DI LAPO ARCHITETTO FIORENTINO

"...but not having these two architects (Guglielmo Tedesco and Bonanno Pisano, 1174, e. n.) great experience in the founding of buildings in Pisa, that is not inserting poles in the foundations as should be necessary, afore the half of that building (the bell tower of the cathedral of Pisa, e. n.) were reached, it leaned to one side, and deviated on the weakest, in such manner that said tower leans by six arms and a half from the plumb line, as on that side the foundations have sunk…"

LIFE OF NICOLA AND GIOVANNI PISANI SCULPTORS AND ARCHITECTS

"…Similarly Nicola built in Pisa many other buildings and churches, and became the first, being lost the good fashion to build, to establish in Pisa the use of founding buildings on pillars, with arches thereupon, having first driven poles under said pillars; as doing otherwise, the first hard floor of foundations should break, the walls always sank; where the insertion of poles renders the building most robust, as experience shows…"
"…the new church of preacher friars in Perugia…
… and threatens, being not well founded, ruin. In truth, they who begin to build and make things of importance, not from those who know little, but from those who know better, should always seek council, for not to have, after the fact, with damage and shame, the obligation to repent of poor council…"

ENGLISH TRANSLATION: G. HEMMING

The Amaldi 7 Conference in Sydney

The seventh of our biennial conferences on gravitational waves: "Amaldi 7", took place in Sydney, from the 8th to the 14th of July 2007. Amaldi 7 was held together with the 18th International Conference on General Relativity and Gravitation as previously decided by the GWIC (Gravitational Wave International Committee). The aim of the conference was "to create a unique environment bringing together the world's leading scientists working in the fields of General Relativity and Gravitation".

It was in general a good conference and I particularly appreciated the morning plenary sessions, which consisted of three one hour talks. The various talks illustrated the state of the art of core subjects such as dark energy, quantum gravity, gravitational lensing and of course gravitational wave astronomy. It was winter but a mild Australian winter and the Sydney sights of Darling Harbor, the Bay Bridge and the Opera House were spectacular. The Convention Centre is Australia's premier conference venue and the largest of its kind in Australia. The lecture halls were excellent, the organisation was efficient and the receptionists were very helpful. We did however find the costs "unacceptable" as I pointed out on the post conference evaluation enquiry from Malcolm McCallum. The conference and some lectures were sponsored by universities or private companies. Despite this sponsorship the conference fee of 680 AU$ (780, if paid after May 18) did not include several basic utilities. The proceeding book additional cost was 85 AU$, the cost for the wireless connection was 22 AU$ per day (hotel prices) and each "Public Lecture" (Public?) ticket for an accompanying person was 30 AU$. In relation to science Amaldi 7 was the largest of the parallel sessions of GR18. Our sessions were always crowded with many interesting talks and though we would have appreciated more time we were grateful of the time we had. Even if no particularly relevant results have been presented, I had the impression of a "sparkling" atmosphere, probably generated by the diffused feeling that Virgo, LIGO and GEO are now one single force marching forward to the discovery of gravitational waves and by the knowledge that, at the time of the conference, there were five detectors taking data together, on the two sides of the Atlantic and on the East side of the Pacific.

I would like to particularly mention a short talk by Yoichi Aso in which he proposed a network made of LIGO, Virgo and Amanda (the South Pole neutrino telescope, http://www.amanda.uci.edu/index.html,). Yoichi did not give much information but I believe that it is timely to begin thinking of the analysis methods for the information provided by neutrino, gamma ray burst data and gravitational wave signals together in order to have a complete description of many astrophysical phenomena.

Amaldi 8 will be held at Columbia University, NY, in 2009 by which time we should have the first indications of the performances of Enhanced LIGO and Virgo+. I hope this conference will also be a success. New York is probably the most famous city in the world but it will not beat the fascination of a country like Australia.
Several of the Amaldi and GR participants spent from several days to several weeks discovering the charms of Australia, from Ayers Rock, to the rain forest, to the barrier reef. I also toured some of Australia

and was pleasantly surprised to meet Virgo colleagues and their families more than 2000 km from Sydney. Damir Buskulic has kindly provided a few beautiful pictures.

C.BRADASCHIA

The ET Project

The design study for ET – the Einstein gravitational wave Telescope - was submitted to the European Commission in the context of the 7th Framework Programme FP7.

The call for design studies for new research infrastructures was opened on 22 December 2006 with the deadline of 2 May 2007. The ET proposal was made by a coalition of eight institutions:

- European Gravitational Observatory, that has the role of coordination/management of ET
- Istituto Nazionale di Fisica Nucleare, Italy, through most of its Virgo groups
- Max-Planck-Institut fuer Gravitationsphysik, Germany, through its divisions in Hannover and Golm/Potsdam
- Centre National de la Recherche Scientifique, France, through most of its Virgo groups
- University of Birmingham, United Kingdom
- University of Glasgow, United Kingdom
- Vrije Universiteit Amsterdam with NIKHEF through their Gravitational Physics Group, The Netherlands
- University of Cardiff, United Kingdom.

ET concerns the conceptual design study of a 3rd Generation Interferometer that will bring Europe to the forefront of the field of Gravitational Wave Astronomy. The study is foreseen to last 38 months and to cost close to 3 M€.

The preparation of the proposal was coordinated by Michele Punturo together with Harald Lück of GEO, while F.Menzinger acts as the project coordinator.

Currently, several first generation gravitational wave (GW) detectors are active in Europe and the USA. If the current instruments do not make the first detections of gravitational waves it can confidently be expected that this will be done by the second-generation interferometers. Third-generation detectors will be required to create gravitational wave observatories that are capable of complementing optical and X-ray observatories in the study of fundamental systems and processes in the Universe.

The main objective of the ET design study is the realization of the conceptual design of a 3rd generation gravitational wave detector, i.e. a GW observatory that could cover the complete frequency range of approximately1 Hz to 10 kHz that is potentially observable from ground with a sensitivity more than hundred times higher than that achieved in present first generation interferometers.
This main objective will be reached centring three specific targets. The first target of this design study is to identify the strategies to reach a further reduction of the seismic noise effects with respect to the second generation detectors expectations. This is expected to be attained in two parallel ways: identification of a site with a lower seismic noise and improvement of the mirror vibration isolation and of the controllability of the suspension.

The second target of the ET design study is the identification of the specifications of the last stage suspension that can satisfy the thermal noise requirements of a third generation GW detector in terms of mechanical Q and stress strength of the suspension system, optical absorption and heat extraction capability needed to support a multi-megawatt circulating power in a cryogenic environment.

The third target is the definition of a detector design that minimizes the so-called quantum noise (the shot noise component of the quantum noise is currently limiting all the GW detectors in the high frequency range). Many technologies are currently under study: signal recycling techniques, squeezed light techniques and very high power lasers.

The European Commission, among the 51 submitted proposals, has retained ET for formal negotiation of a Grant Agreement together with other 13 design studies ranging over a wide variety of topics, including one other design study regarding astroparticles. It is foreseen that the negotiation phase will last through November 2007 followed by the signature of a Grant Agreement with the European Commission.

F. MENZINGER

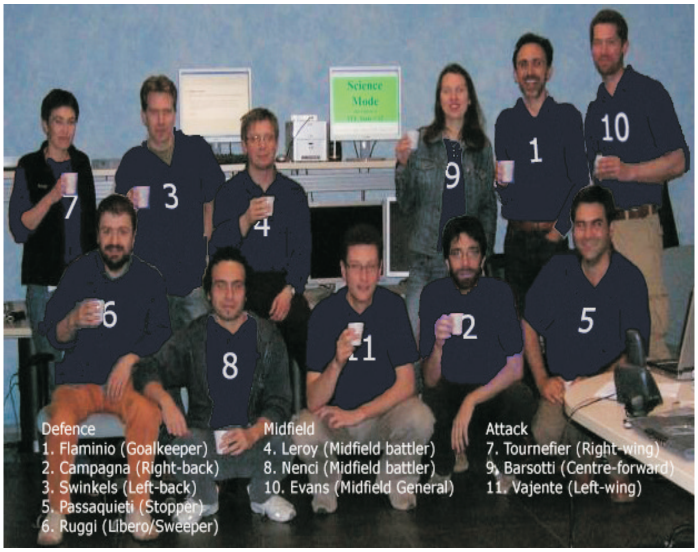
LATEST NEWS

The possibility to take part in a local 5-a-side football league has arisen. In order to understand whether there is sufficient interest, we are looking to put together a list of names of people who wish to participate.

It would be a shame to miss out on this opportunity. Therefore, if you are interested in participating in the EGO 5-a-side team, please let Gary Hemming know as soon as possible. The deadline - at the very latest - is Wednesday the 10th of October.

For more information, contact R. Cosci (President EGO Cral).

Raffaele's Farewell



April 1990. I'm in Adalberto's office. 'We'll detect gravitational waves' – he says – 'meanwhile we are testing these sophisticated gas springs'. He gives me the Virgo proposal but omits to say that the project is not yet approved. In the proposal it is written that Virgo will start taking data in 1997. This date seemed pretty far in the future and gas springs looked old fashioned physics, even if sophisticated… On the other hand the quantum relativistic theory examination I had just passed with Prof Adriano Di Giacomo was also dealing with harmonic oscillators (just a bit more sophisticated) and Virgo looked a promising project. The following day I was back in Adalberto's laboratory, watching Angela and Federico pushing the keys of an HP spectrum analyzer.

May 18th 2007. I'm in the Virgo control room. Finally it is going to happen and I'm still there. Virgo is starting to collect data. There is a lot of excitement in the control room. We look at the screen showing the state of all interferometers in the world. Suddenly LIGO is unlocked. Federichino exults as if it was a football game (we are 11 in the control room -Fig.1)). Big innovative projects always take longer than initially foreseen. My mind goes back to 2001 when, together with Paolo, Matteo, Giovanni and Ettore, we sent the first photons into the 6 m long central interferometer. Everything was manually tuned. Today we have a 3 km long interferometer, automatically aligned and locked, running 24h a day and producing data that are continuously sent to the other side of the ocean. Both Virgo and EGO people can be proud of the result. Meanwhile I have learned Adalberto's lesson: in 2003, when we moved to the site, Agnes asked me: 'Shall we take our furniture with us?'. 'I don't think so' I answered 'we will stay just a year'.

After four years spent in Pisa and two additional sons, last August we moved back to France. Agnes is starting her n^{th} job and the children are in a French 'banlieue' school where they discover brown children (nice isn'it?). On my side, I have just started working at the Laboratoire des Matériaux Avancés (LMA). I will work on the mirrors for Virgo+ and Advanced Virgo with Jean-Marie Mackowski and his team. As I'll continue to work for the project this is not really an adieu but more an au-revoir.

Nevertheless a page is over and I would like to take this opportunity to thank Virgo and EGO for having given me the possibility to work at the site, first as commissioning coordinator and then as EGO deputy-director. Being there during the exciting phase of commissioning has been a great experience, not only interesting but also very instructive.

I want to thank Adalberto, who was so convincing 17 years ago and who, in 2003, invited me to come to the site to work on the Virgo commissioning. I want also to thank Filippo who offered me the possibility to join EGO and taught me a lot about the dark side of research that is its administration. I would also like to thank all of the EGO personnel for the important work they are doing at the site and for the collaborative attitude they have always had during these years. A special thank you goes to the personnel of the EGO administration department, Emanuela, Lara, Séverine, Susanna and Veronica (those that Franco calls 'his girls'), who kindly hosted me during these years at EGO and always helped me in solving all the problems I encountered. They are doing a great job even if not as visible as some of the scientific and technical work done for the Virgo project.

Many thanks to all of you!

R. FLAMINIO

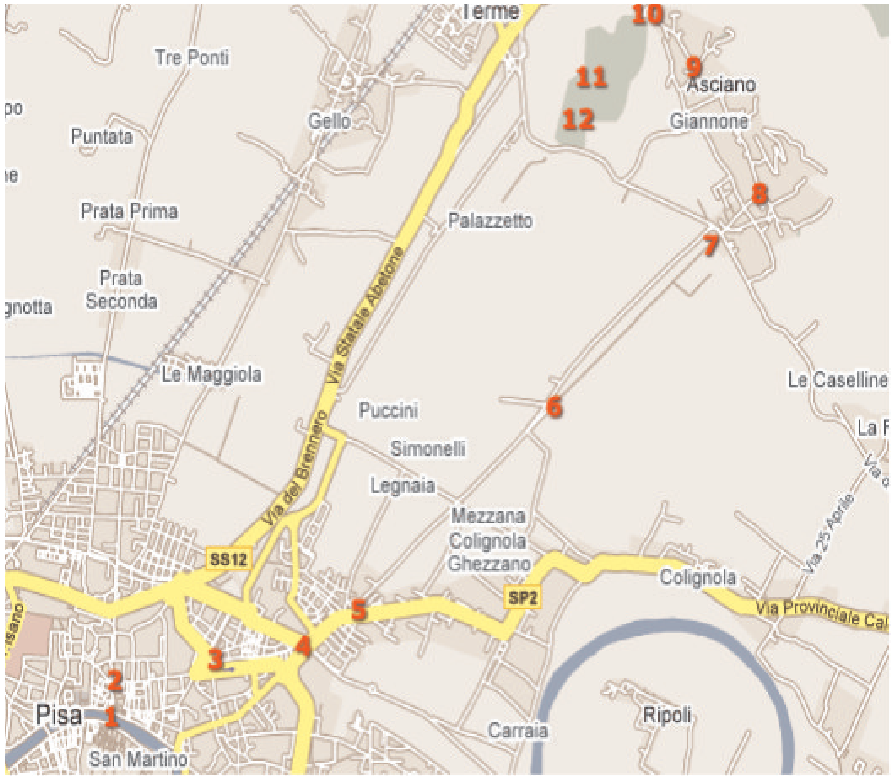
Out & about

Route 5: Betwixt a rock and a hard place
Distance: 12 km
Duration: 60 minutes

When Sigismondo De Bosniascki arrived in Italy from Poland in 1873, he chose to make his home on Monte Castellare – the outcrop of rock that separates Asciano from San Giuliano Terme, and constitutes a foothill of the Monti Pisani.
The villa that he constructed – to house not only himself, but also a fossil collection of some significance, which is now in the hands of the University of Pisa – must have been a fascinating feature in the landscape of the time. It still exists, although since his death in 1921 it has gradually fallen into disrepair. The skeleton of the building, replete with beautiful black and white tiling in some of the downstairs rooms, still exists, however, and is now interspersed with local flora. The garden of the villa is still accessible and includes an open and spacious lawn and a number of wisened, old trees.

The fragrant broom and spectacular view of the Monti Pisani, Pisa itself and the surrounding plain – the sea is easily visible on clearer days – make the location a special place to visit. So let's begin our journey…

As previously, we will begin our trip from Ponte di Mezzo in the centre of Pisa (1). Anyone unfamiliar with the route to this location from EGO can reverse Route 1, 'Pisa - EGO', in our series. From the centre of the bridge we head north and into Piazza Garibaldi, before continuing down Borgo Stretto. As Borgo Stretto becomes Borgo Largo, we turn right down Via San Francesco (2), which we will stay on until we reach the crossroads of Via San Giovanni Bosco and Via Battelli. Here, we go straight on, following Via Bosco, and keeping to the left-hand side of the road. Don't worry, we aren't cycling in Britain or Ireland, but are on a one-way street! At the first opportunity we turn left onto Via Centofanti (3), which skirts the western side of a small park, and then take our first right onto Via Vettori. At this point we take an immediate right onto Via Parini, at which point we join the aqueduct that will accompany us all the way to Asciano.



After approximately six hundred metres, Via Parini becomes Via Averani, which brings us to the Via di Pratale. We turn right here and take Via di Pratale for only a short distance, passing under the aqueduct and then go left at the small roundabout next to CNR (4). We are now on Via Calcesana – the SP2. This is the road with the most traffic in our journey, but outside of peak hours it is relatively calm. We stay on it for a few hundred metres and, following the bend to the right, turn left onto Via dei Condotti (5), where we rejoin the aqueduct and head towards the mountains. The aqueduct is soon accompanied by a small cycle path (6), which allows us to cycle in peace and safety for the remainder of the journey to Asciano.

Upon arrival at Asciano, we meet a crossroads with the Via delle Sorgenti (7). Here we go straight over, remaining on the Via dei Condotti until we reach a T-junction and turn left onto Via Trieste (8). By now, although we are still in a residential area, we have a real feeling of being in the countryside and are cycling along the base of the Monti Pisani. We stay on Via Trieste until its end. When we reach Passo Meceni we follow the road round to the right and take Via di Valle (9), which brings us in a gradual incline towards Monte Castellare. After a while, Via di Valle merges into Casale di Valle, which we follow, uphill, for a couple of hundred metres until it becomes a gravel track.

At this point it's time to park the bicycles up and complete the rest of our journey on foot (10).
The villa is signposted from here and the time required to complete the journey is approximately 45-60 minutes, depending upon walking speed. The path is uphill for the first two-thirds, before it levels out (11) on the lead in to the grounds of the villa (12).

We can now relax and enjoy the fresh air and fine views, maybe having a bite to eat, before either beginning our return journey or contemplating a longer walk encompassing other sites of interest on the nearby hills.

G. HEMMING

MAPS: WWW.GOOGLE.COM

PLP uncensored

by F.NOCERA

My farewell interview with Paolo La Penna started in what I would describe as a somewhat somber mood but it picked up as it went on. Perhaps being interrupted five or six times by various people wishing to say goodbye helped. As usual with PLP our conversation was crammed with improper jokes and very educated quotations. I will omit the former and share with you some of the latter.

Paolo, to start with let me remark you're responsible, among other things, for this interview. What I mean is that one of the reasons why I'm about to ask you some questions is that it was you who lured me into coming back cunningly hinting at the possibility to work for EGO, when we met at Caltech at the beginning of 2005. Look what you did...

Yeah, I know, should I say I'm sorry? Don't give me all the fault.

It's ok. Moving on, let's begin with this: what is your first thought about your last day here in Virgo?

As they say in the movies, I'm pleading the Fifth Amendment.

C'mon, try to be serious...

To leave is a little like to die.... what should I say? The last day is always a sad day. I have been working for Virgo now for about 13 years, starting in February 1995. At that time VIRGO as we know did not exist at all. I still remember my first day, when P. Puppo and I were greeted at San Piero's gate by a young student, M. Barsuglia and...

Ok, experience tells me it is better if we skip this; shall we?

Oh, ok.

Let's go on with your recollection of Virgo's early days.

Back in 1995 nobody had a clear idea about how to control all the mechanical suspension's degrees of freedom, many thought it was going to be almost impossible, there was still no inverted pendulum and the interferometer optical setup was a serious concern... in short, things have changed dramatically. I was proud to be part of the team who was trying to bring this new field of Physics to life and that is why, after a two-year break, I came back to work in Virgo in 2000 first with the INFN and then with EGO. Virgo's progress has been impressive, especially if one considers the skepticism of the early days and the common expectations people had when working on the Central Interferometer in 2000-2001. Of course now that it works, what is really needed is a first detection. Did you know I was the very first person to witness the fringes of the locked Michelson?

That is a nice memory indeed. Tell me more about it

I think was Jun 1st 2001. After weeks of frustrating attempts at locking the simple Michelson (no recycling, auxiliary laser) I was working in the old Control Room, the one we call now Data Acquisition, and I, out of sheer luck, was the one who typed the famous "Cntl-G" command on the DSP filter. Miraculously, the fringe locked for almost 100 seconds. R. Flaminio was there with me and probably F. Cavalier too, if I'm not mistaken. I was also the one who saw the first light at the end of the tunnel (an HeNe beam from Laser Lab to NE).

Is there any lesson you've learned in the past years you would like to share with the ones who you're temporarily leaving behind?

I think the activities in Virgo could be managed better. The number of people working on improving performances is too limited and they are working too many hours, often in the dead of the night. The workload should be better split among the available forces. Often even if someone volunteers to be part of the effort he/she is kept at a distance. This is my major complaint. Maybe it is not a conscious choice or maybe it is because in Virgo we simply work like that, I do not know. This is how I have felt recently. Perhaps it has also been my fault. In any case, this is one of the reasons why I am curious to see if things are different in other projects. The idea is to learn something from others.

Yeah, I see your point. A last question on Virgo and then we'll move to EGO. Considering what has happened recently (Visiting Committee) and could happen in the future (Einstein Telescope) what do you think is the future of Virgo?

Oddly enough, I'm quite optimistic. I do not think this research field is going to be a dead end. The financing agencies do not seem to be looking for an exit strategy. The only potential risk I see for the future, say 8-10 years, is that they will start giving enough money to keep it alive but not investing enough to make it grow even further. As I said, what we really need soon is a first detection. That would change everything. At that point the entire field could bloom. Then, the whole discipline would definitely become a more respectable field of physics and talks about future generation interferometers and space interferometers would become more realistic.

Let's talk about EGO now; care to comment on the way it is, or it is not, working?

EGO is a very good organization, especially if compared with similar structures in Italy. People working in EGO are talented and everybody in Virgo recognizes their contribution to the success of Virgo. The management structure has proven essential to the smooth daily activity but EGO has to grow and do more. At the beginning of its activities EGO was supposed to become a wide European Organization, able to pull in people from GEO and other European institutes. So far that has not happened but that is the way ahead. EGO is in a good position to lead the field of Gravitational Research in Europe and it has to seize the day.

Now tell me something about your two-term experience as EGO Staff representative. This was, I guess, an interesting and privileged angle to see what people in EGO feel and observe what the Collaboration opinion on them is.

I learned a lot about rules and labor laws but the reality is that Staff Representatives can do very little to change things also, but not exclusively, because the personnel rarely agree on reasonable proposals to pursue. Often you end up arguing both with the Management and Council on one side and EGO's employees on the other. Some effort is needed to single out few important goals and try to achieve them.

How about EGO's future? Do you think it is going to disappear in Dec 2010 or it will go on?

I think it is going to be around for at least five more years, especially if Advanced Virgo is approved.

Is there anything you would like to leave us, the lucky ones who have had a chance to work with you, as legacy?

Two things. First, of course, never forget that it is a cruel, cruel world. Second, it's always worth working in the research field, no matter how frustrating it can be at times. It is one of the best goals one can set for one's life. Even contributing a small step towards knowledge is enough to justify anybody's work. At this point I need to quote an episode from my childhood, connected to a Greek Myth, that fits in our discussion (I guess that's also what is expected from me). When I was just a child (five years old I think) I was taught about the Judgement of Paris (Judicium Paridis). When Thetis married Peleus, Jupiter invited all the gods except Eris to a feast. When Eris showed up anyway but was not admitted, to spoil the party she tossed a golden apple into the room where the guests where and said that only the most beautiful among the goddesses should pick it up. Juno, Minerva and Venus claimed to have the right to get the apple and no one was willing to back down. To settle the matter Paris was put in charge of picking one of them. Juno promised Paris treasures and power, Minerva wisdom and knowledge and Venus pledged him the most beautiful of all women, Helen (not yet of Troy). He chose the latter. I said to my parents that I would have chosen Minerva (I was already hopelessly, idealistically silly). I still keep my word, and I'm convinced that it was the right choice.

That is so you. I like it a lot. Last thing now; as you probably know, there is a running bet on the date you will come back to EGO. If you let me know in advance, I'll place a bet and then we'll split the jackpot. Deal?

Deal

Ok. Well, good luck Paolo and see you soon

Paolo LaPenna left Cascina for one year's leave at ESO in Munich. We are confident that he will be back, hopefully sooner rather than later, more learned than ever.

INTRODUCING BENJAMIN CANUEL

I arrived in Pisa one month ago to replace Slim Hamdani in the optics group. During September I have been actively mentored by Slim who has introduced me to the complexities of working on the VIRGO experiment!

I finished my PhD a few months ago in atomic physic and therefore come from a different field of science (but not that different!). I graduated from the "University Paris Sud" with a specialization in laser and optics and then I completed my thesis on atomic interferometry.

The aim of this very challenging PhD project was to create an inertial sensor for navigation (providing both rotation and acceleration measurement) using the matter wave interference of Cesium atoms manipulated by lasers. This type of device is adapted for inertial navigation where long term stability is crucial (e.g. for submarines). At the end of my thesis, I could demonstrate a level of stability competitive with the best state-of-the-art optical gyroscopes. This sensor also proved to be very sensitive to acceleration measurement in the vertical direction, which means that it can be used to do very precise gravimetry. Coming from this field of physics the VIRGO setup is quite impressive (In comparison, an atomic interferometer is about four orders of magnitude smaller than this experiment!).

After the PhD project I was very motivated to work abroad. The position in the optics group of EGO was also a good opportunity to gain experience in a new type of physics. I arrived during the "VIRGO week" and I was both impressed and very satisfied to see the extent of multidisciplinary work at VIRGO. This "week" also gave me a very good introduction to the setup.

My first impressions of the project are very good and Slim has proven to be a very good (and very patient!) mentor. His introduction covered many things from the different controls of the injection system to the right way to cook the "sauce bolognaise".

Concerning life in the area my impressions are very good (although I shall need to get accustomed to the unusual method of Italian driving...). I will not elaborate on the weather, the food, the wine, the mountains, the sun, etc, etc… which are very good! I'm looking forward to learning Italian in order to be able to fully appreciate my stay in Tuscany.

B.CANUEL

PERSONNEL MOVEMENTS
30 June 2007 - 1 Oct 2007

DEPARTURES

Raffaele Flamino left his position as EGO deputy director to become the director of LMA in Lyon in place of Jean-Marie Mackowski. He will continue to contribute to Virgo in this new role.

Slim Hamdani left EGO on October 1st. We regret his departure but we are very happy for him and Adeline who gave birth to the beautiful Mélissa on August 30th.

Salem Hebri acheived the goal of several years of study and work on September 25 at the Observatoire de la Cote d'Azur in Nice. In front of an international "juri" he defended his PhD thesis on the effect of radiation pressure on large interferometers. He was awarded the "Mention très honorable".

ARRIVALS

Jacques Colas, former director at LAPP, will start his mandate as EGO director on December 1st. Filippo Menzinger introduced him to the EGO personnel and Benoit Mours introduced him to the Virgo collaboration at the September Virgo week. We warmly welcome Jacques and wish him great success in Cascina.

GOOD NEWS!

Our commissioning coordinator Edwige Tournefier got married on September 8th. We are confident that managing a marriage will be easier and much more fun than coordinating a team of crazy scientists. Best wishes!