



THE GRAVITATIONAL VOICE

number 11
APRIL 2009

“FLUCTUAT NEC MERGITUR”



NEWS FROM THE WORLD
IYA 2009
The Guardian of Nothing

**SCIENCE &
TECHNOLOGY**
SHARC attack at Virgo

NEWS FROM THE SITE
Commissioning in progress
EGO funded up to 2015



News from EGO and VIRGO

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NEWS FROM THE SITE AND THE COLLABORATION 3

Commissioning in progress
Youngsters visiting Virgo
EGO funded up to 2015
VESF School on GW

SCIENCE AND TECHNOLOGY 4

SHARC Attack at Virgo

NEWS FROM THE WORLD 6

IYA 2009
The Guardian of Nothing - Part 1

LIFE IN CASCINA 11

Who is protecting Cascina?

OUT & ABOUT 11

Sport and Leisure

PEOPLE 12

Adalberto Giazotto, who is he?

EDITORIAL

In this issue we have something new that will stay with us for a while. Starting with *h* 11 and continuing through *h* 12 and *h* 13, we publish our first comics strip "The Guardian of Nothing", divided in three episodes. The real surprise is that it is a story on gravitational wave research, published in 1987 on "L'Intrepido" (the dauntless), a popular Italian comics magazine. The original title is "La Guardia del Nulla". The authors are Cicogna for the text and Ricard for the design, the editor is Editrice Universo, Milano. Once more we have to warmly thank Piero Rapagnani who is the historical memory of the saga of gravitational waves in Italy. He preserved the original pages that we translated and publish.



The cover photo of this issue shows our site surrounded of flooded fields, with superimposed the Latin words "Fluctuat nec mergitur" (She is tossed by the waves, but is not sunk). That is the motto of the Ville de Paris; Paolo La Penna suggested that EGO takes over the motto and the related coat of arms after the quasi flooding of Friday, the 6th of February.

On that day we had the most intense and persistent rainfall for several years. In one day, in nearby Livorno, the same amount of rain fell as in a whole winter season. The EGO director declared a pre-emergency status and instructed all non-essential personnel to quit the site. Luckily there was no large flooding in the buildings. A moderate quantity entered into the basement of the Control building and on the floor of the electricity room at the middle of North arm, inducing the Infrastructure team to cut the local power sector for a few days. The next Monday, at the end of the emergency, no remaining damage was detected.

C. BRADASCHIA

Commissioning in progress

The commissioning of the interferometer is progressing toward the second Virgo Science Run (VSR2), the first Virgo+ data taking. In particular during the last weeks we had the installation of the new ADC and demodulation boards and part of the work has also been devoted to increasing the input power (some successful tests up to 13 Watts). The sensitivity has been improved especially in the region around 20-40 Hz: at the Vela frequency, 22.38 Hz, the present sensitivity would allow us to beat the spin-down limit* with the first 3 months of VSR2 data.

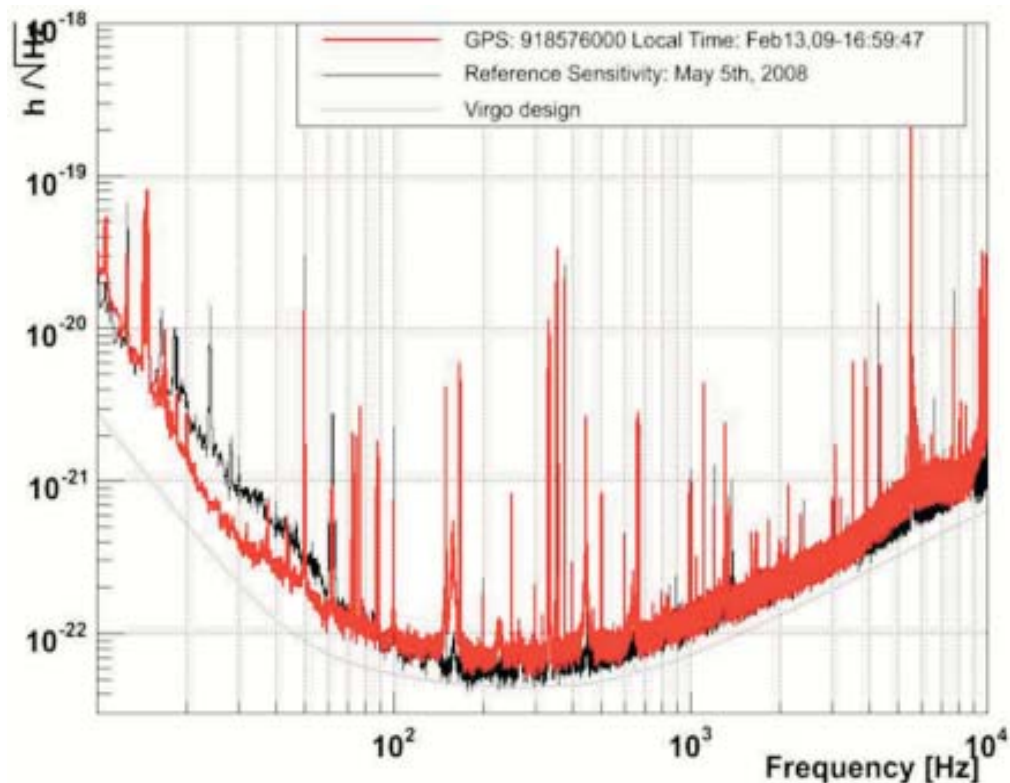
**To beat the spin down limit of a pulsar has the following meaning. Several pulsars (asymmetric rotating neutron stars emitting radio waves) are spinning down (rotating less rapidly) since they can lose energy through various mechanisms. If all this energy is lost by the emission of gravitational waves, given the known spinning frequency, the GW amplitude h can be evaluated. If GW's of such amplitude are not detected (integrating 3 months of data in the Vela case, at present sensitivity), this means that other dissipation mechanisms exist. Hence we can say that "the spin down limit has been beaten".*

E. CALLONI
Commissioning Coordinator

Youngsters visiting Virgo

On Saturday March 14th, a class of the "Nicola Pisano" primary school, from Pisa, came to visit Virgo.

It was a class IV, that is the children were all 9years old. This was the first visit to Virgo organized for



children so young. It was an unexpected success.

They followed attentively until the end the presentation "Alla ricerca delle onde baraoonde" which started with a trailer of the Walt Disney cartoon "Treasure planet" where a supernova explosion and a creation of black hole happened.

The children and their teachers were enthusiastic, and posed a lot of

questions: "Can we build an interferometer on another planet?" "The laser is visible?" "Are there stars greater than the sun!?!?" "Are you happy in doing this work?" It was an experience to be repeated.

E. CUOCO

Picture below: Elena explaining to the kids what people do in the control room.



EGO funded up to 2015

Even if in this *h* issue there are no births or weddings to be announced on the People page, we have a happy news, which is work related, but important to our private lives.

The EGO Council, on behalf of CNRS and INFN, has extended the validity of the EGO Consortium for five more years, starting from December 11th, 2010. This will bring us to the dawn of the Advanced Virgo data taking. Then all will depend on the success of all what we will have realized in the previous years.

School on GW: VESF stays the course!

The Virgo EGO Scientific Forum (VESF) is pleased to announce the 4th edition of the VESF School on Gravitational Waves, which will take place from May 25th to May 29th 2009 at the site of EGO in Cascina.

The lectures held at the VESF school aim to introduce young physicists and engineers to gravitational waves, their astrophysical sources and to the technologies used for their detection, in order to prepare for the next generation of scientists enthusiastic about GW.

Organized this year under the leadership of Andrea Viceré and Massimo Bassan, Co-Directors, the school has been slightly rethought and some changes have been done in particular in the program. Besides the fundamentals of GW, new topics will be taught with respect to the

former programs. Thus, the 2009 program will cover the following subjects:

Introduction to Gravitational Waves, LISA and future detectors, Sources of GW, Gamma and X-ray astronomy, Interferometric detectors, Radiotelescopes - pulsar timing - binary pulsars, Instrumental noises and control, Multimessenger astronomy, Quantum non demolition - squeezing, Data Analysis, State of the art of detectors.

Whereas in the past years the School was open to undergraduates, it is now intended only for graduates, in particular those looking for a thesis topic and for postdoctoral fellows. Henceforth the admissions to the school are limited to 20 participants. Application forms are available on the school web pages.

Deadline for applying is April 17th. For more information visit <http://www.ego-gw.it/public/events/vesf/2009/welcome.aspx>, or contact Severine Perus.

A second VESF school dedicated to gravitational wave data analysis, with a special focus on the technical aspects and on the procedures for extracting scientific results from the observations will be organized in early autumn of 2009. More information about this school will be provided later.

S. PERUS

SHARC Attack at Virgo

After more than ten years of uninterrupted operation the old Virgo Digital Signal Processors (DSP) will be replaced by high performance SHARC* DSPs.

Since 1994 when we started the design of our first DSP-based board the DSP market has grown by 30-

40% every year. More and more markets are opening up to DSP applications where, in the past, real-time signal processing was not feasible or too expensive. With DSPs diffusing into many practical applications, the demand for high-performance digital signal processors has expanded rapidly. Today embedded real-time systems are orders of magnitude more common than their more visible desktop and laptop companions. For each of our large desktop computers, our houses (and pockets) are crowded with dozens of smart consumer devices based on DSPs, ranging from cellular phones to mp3 players, from washing machines to cars.

DSPs success resides in exceptionally good performances combined with extremely low cost and power consumption.

DSPs often do not have a conventional computer display or keyboard attached. The user doesn't interact directly with such devices as happens with standard computers, but rather with electro-mechanical equipment providing a given service (for example, our Superattenuators). Such systems must operate for days (years in our case) without stopping. The feedback controls implemented must be autonomous and a fail in these devices could produce great harm. In this class of systems, often referred as 'Hard Real Time', actions must be performed within specified deadlines that absolutely must be met. A missed deadline constitutes a system failure. The software for DSPs is usually more difficult to build than software for desktop computers. Custom software, written specifically for the application, requires detailed knowledge of the electrical properties and timing characteristics of the actual devices. Programmers must be able to determine which instruction is executed by a DSP at a given absolute time. Standard computing systems respond almost uniquely to users. Real-time systems may interact with the user, but the

principal counterpart is constituted by sensors and actuators. For these reasons (and many others), developing real-time software is generally much more difficult than developing other software. For Virgo operation, a fundamental tool for developing DSP code was designed for the purpose by Diego Passuello and continuously developed during the last decade. The application, named "Damping" from the first control loop which made use of it, can handle both old and new Virgo DSPs in a completely transparent way.

The old DSPs replacement was necessary for two independent reasons. A technical one, since several DSPs were using close to 90% of their computational capability. A practical one, since the old processors are no longer available on the market.

In Virgo, each old DSP (fig. 1) will be replaced by a cluster composed of 6 AnalogDevices ADSP-21160N processors (fig. 2).

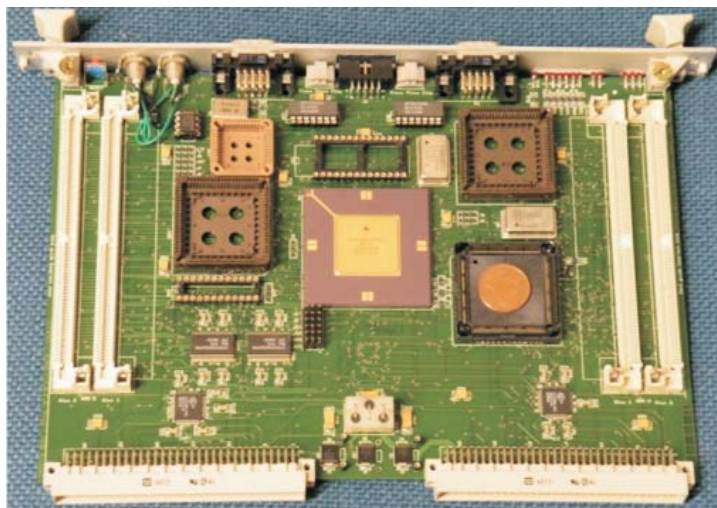


Fig. 1 - The old DSP card, hosting one DSP processor

The ADSP-21160N features include a 100 MHz core processor, a 4M-bit dual-ported on-chip SRAM (Static Random Access Memory), an integrated Input/Output processor that supports 14 DMA (Direct Memory Access) channels, multiple internal buses to eliminate I/O bottlenecks, two serial ports, six link ports, external parallel bus and

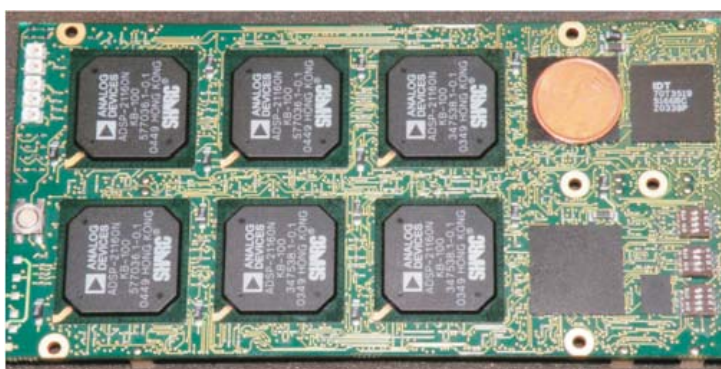


Fig. 2 - The new DSP board, hosting 6 DSP processors

multiprocessing support. The ADSP-21160N uses Single-Instruction, Multiple-Data (SIMD) processing, that has the capability of performing the same operation in parallel on multiple data. Using two computational units and with its SIMD computational hardware the ADSP-21160N can perform 570 million math operations per second.

All 6 DSPs share a 64-bit 50 MHz Local Bus. Additionally 6 x 100 MByte/sec Link Ports allow a total 'zero latency' (30 nsec) inter processor communication bandwidth of 1.8 GByte/sec. Total computational power adds up to more than 3 GigaFLOPS in an ultra compact format (149x74 mm) and with a power consumption of less than 4 Watts. Two Altera FPGAs (Field Programmable Gate Array) implement

bridges between DSP local bus and external PCI and VSB bus. PCI is used for DSP programming and DSP operation monitoring while VSB bus and a real-time variant of it named Virgo Expansion bus is used to access I/O devices.

It is worth mentioning that, from the manufacturing point of view, the new DSP is close to the limit of technological capabilities for European firms. Each mezzanine board is composed by about 400

components linked together by more than 4'000, 127 μ m width, connections on 16 layers, cross connected by about 7200 metalized 250 μ m diameter holes.

This enormous computational power will be necessary to improve digital controllers used in our Suspensions. In Virgo digital controllers are designed using a classical design approach where a discrete time controller is derived from a continuous time one (the so called 'indirect design technique'). Any multi dimensional system is split into several Single Input Single Output (SISO) systems and a controller is designed for each of them. Additional computational power will allow implementing Multiple Input Multiple Output (MIMO) and adaptive controllers, with major advantages in terms of performances.

After the complete DSP replacement, in June, the computing power to control the Superattenuators will be multiplied by about 30 times, assuring a carefree operation for several years to come.

A. GENNAI

**SHARC stands for "Super Harvard ARchitecture Computer". The general architecture of microprocessors falls into two categories: Harvard architecture and von Neumann architecture. Harvard architecture, used by DSPs, has separate memory spaces for program and data, allowing simultaneous access to both memories. The von Neumann architecture, used by general purpose processors, assumes that there is no intrinsic difference between the instructions and the data.*

A DSP (http://en.wikipedia.org/wiki/Digital_signal_processor) is a microprocessor developed originally to process audio signals digitally sampled; in general DSPs are processors optimized for performing intensive operations at high rate. In comparison to general-purpose processors, DSPs have higher speed, lower power consumption and lower cost. People interested in Digital Signal Processing can find, as introductory reading, a good free book at <http://www.dspguide.com>.

** NEW RELEASE IN LIBRARY **

A very useful manual has been recently published in a worldwide known series. It will be very helpful for many of us, willing to contribute to the success of Advanced Virgo. We have been informed that LIGO has immediately requested a new version, more compliant with the

characteristics of the American advanced interferometers.

The h Team

Advanced Virgo logo contest

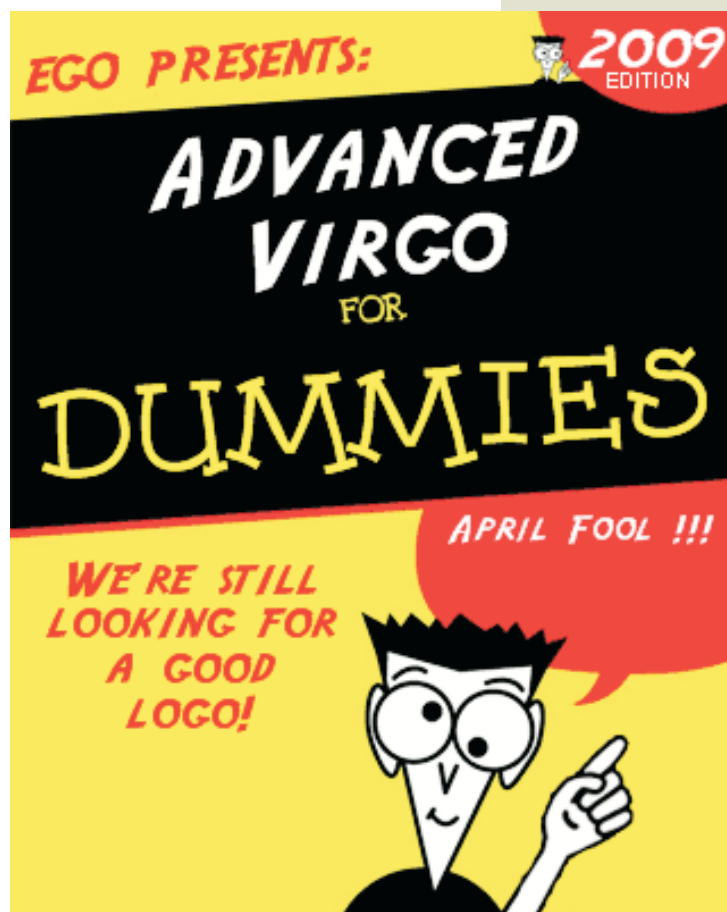
While confidently awaiting the approval of Advanced Virgo we again publish the call for the contest for the Advanced Virgo logo.

As soon as the project starts we need a logo for AdV. I propose to hold a contest: everybody can draw and propose a new logo for AdV. The draft logos must be sent to the AdV coordinator by April 30th 2009.

The entire Virgo Collaboration will be called to vote and the most voted will become the official logo of the project.

The author of the most voted logo wins a bottle of good wine offered by the AdV Coordinator (who will end his mandate with the release of the Final Design).

G. LOSURDO



IYA 2009

This is just a short update to keep your attention alive with respect to the events of the International Year of Astronomy that we announced in h10. To keep up to date we invite you to consult regularly the official web-site

<http://www.astronomy2009.org/> of this global effort to celebrate the first observations of the sky by Galileo, 400 years ago.

In particular we underline the “24 hour live webcast” from all the observatories around the globe, that will take place on the 3rd of April, just two days after the publication of h11.

Looking on the dedicated page you will see the list of participating observatories (<http://www.100hoursofastronomy.org/program/75-live-24-hour-research-observatory-webcast>); We will participate together with all other GW interferometers. You will also find the information about the exact times of appearance in due time. The provisional times are the following, but have still to be confirmed:

GEO 600, Hannover 2009-04-03 12:20 UT (14:20 local time)

VIRGO (European Gravitational Observatory) 2009-04-03 16:20 UT (18:20 local time)

Laser Interferometer Gravitational-Wave Observatory (LIGO) 2009-04-03 20:00 UT

Australian Interferometric Gravitational Observatory 2009-04-04 01:20 UT TAMA 300 2009-04-04 06:00 UT.

It is possible that VIRGO and GEO600 will be squeezed in one single 20 minutes time slot, due to the high number of requests by European observatories.

Besides the 24 hour webcast, there will be many more events, also in Pisa, that will also be announced in due time.

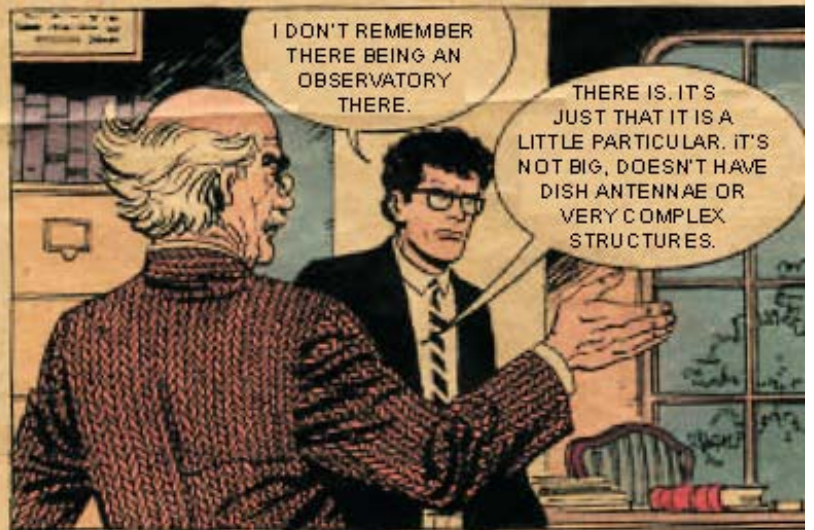
The Ludoteca Scientifica (<http://www.ludotecascientifica.it/>) on this special year will be operative twice, in April-May and in September-October, with special Galilean themes.

C. BRADASCHIA

THE GUARDIAN OF NOTHING

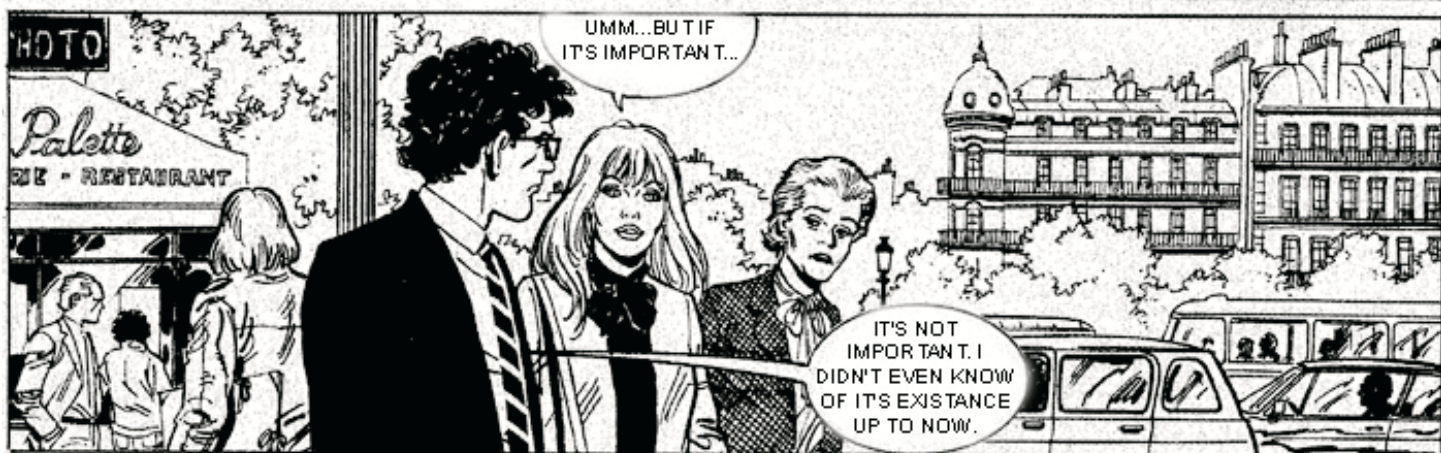
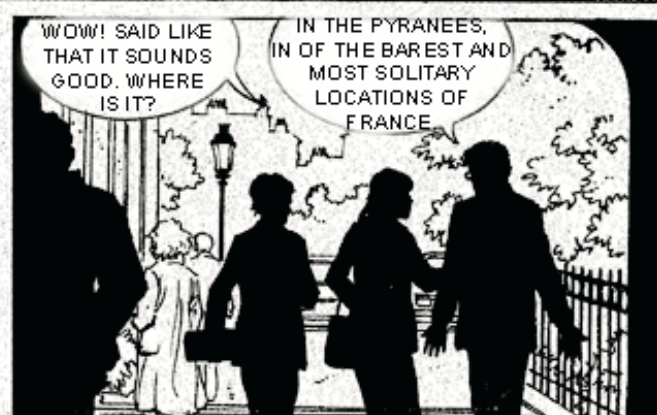
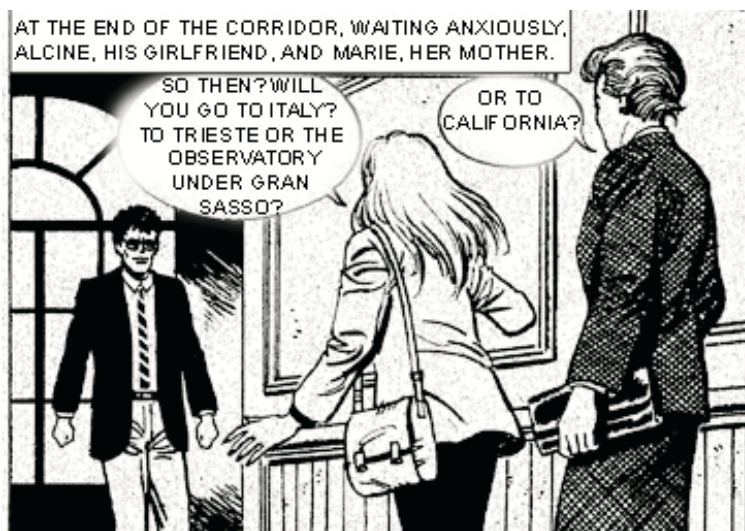
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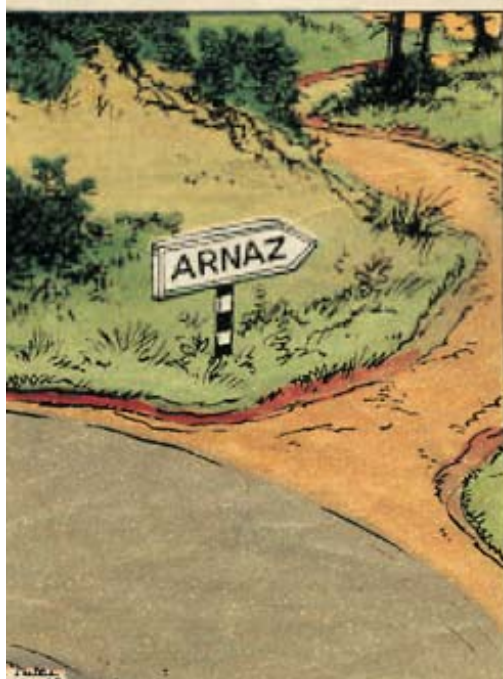
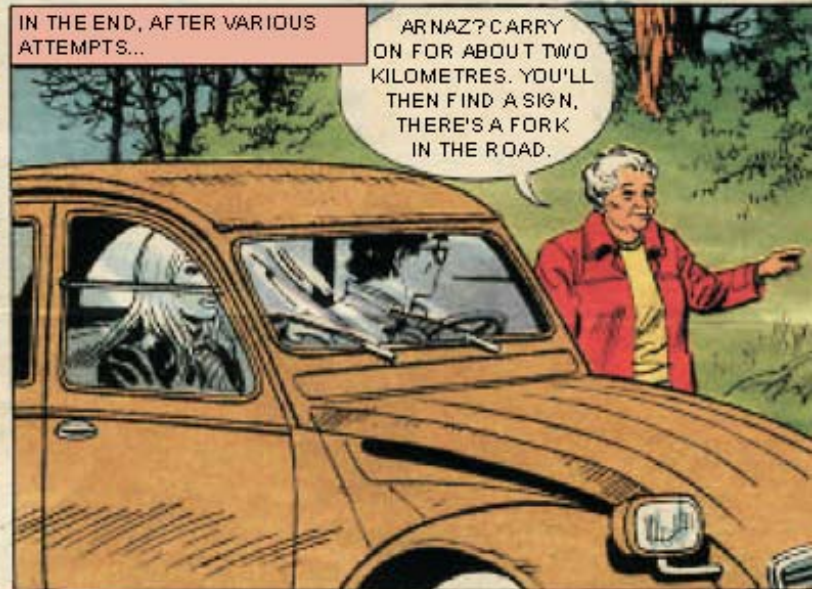
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Design: RICARD
English: GARY



30 - 39







Who is protecting Cascina?

and all those working therein?

by Paolo La Penna

All the EGO employees, and those working at the Virgo site, know that, at about the end of every May, there is a one day holiday in Cascina. As in every other Italian town, this is the holiday for the patron saint of the place. But, according to our knowledge, almost nobody knows who this patron saint is (or are), and why it is (or are) celebrated on that day. Actually, there are a couple of strange things about this holiday. First of all, quite unusually, there is no fixed day in the month. The holiday falls on the Tuesday of the last week starting in May. This is very convenient from two points of view: First, it can never fall on Saturday or Sunday. Second, if the last week of May starts on the 31st, this Tuesday can be the 1st of June, opportunely close to the Italian Republic national holiday (and very opportunely, this will happen in 2010, next year). Why is it like that and who is the Saint protector of Cascina? If you search the internet for the “Cascina santo patrono” you get different answers. For example, if you look in wikipedia (<http://it.wikipedia.org/wiki/Cascina>), the patron saints are indicated as being SS. Innocenzo and Fiorentino, and their holiday should be the last Tuesday of May (not exactly). S. Innocenzo seems to be a martyred boy, whose remains came to Cascina from Calci in 1678 and originated from Catacombs in Rome. Who is he? Is it the same S. Innocenzo (Martire) whose reliquary is in the Sanctuary of Visora (Catanzaro) or the one whose bones are venerated in S. Maria del Gamio (Cosenza)? S. Fiorentino (Martyr) is another saint, whose remains are also assumed to come from roman Catacombs. The bones were obtained by Cascina from Florence

in 1681 and were later venerated (1685) together with S. Innocenzo on the last Sunday of July but not on the last Tuesday of May (luckily, but why?). Who is this S. Fiorentino, whose body is preserved in the pieve of S. Maria of Cascina? Is he the known S. Fiorentino Martyred in 311 A.D. by the impious Massentius (just a few years before the blessed Constantin edict, one of the last opportunities to become a martyr, what luck!). Together with Saint Modestino and Saint Flaviano (all from Antiochia) his body is venerated in the cathedral of Avellino. S. Fiorentino is venerated in San Fiorentino a Quistello, close to Nuvolato (Mantova). So, whose bodies are those venerated in Cascina? It's not possible to find more information in the most important portals about Italian saint patrons (e.g. <http://www.enrosadira.it/santi/patroni/italia.htm> or [http://it.wikipedia.org/wiki/Lista_di_santi_patroni_cattolici_\(per_no_me\)#I](http://it.wikipedia.org/wiki/Lista_di_santi_patroni_cattolici_(per_no_me)#I)).

However this is not the end of the story. If you look into the most exhaustive page about Cascina's santo patrono (<http://www.parrocchiacascina.it/frame/santipatroni.htm>), it starts with “San

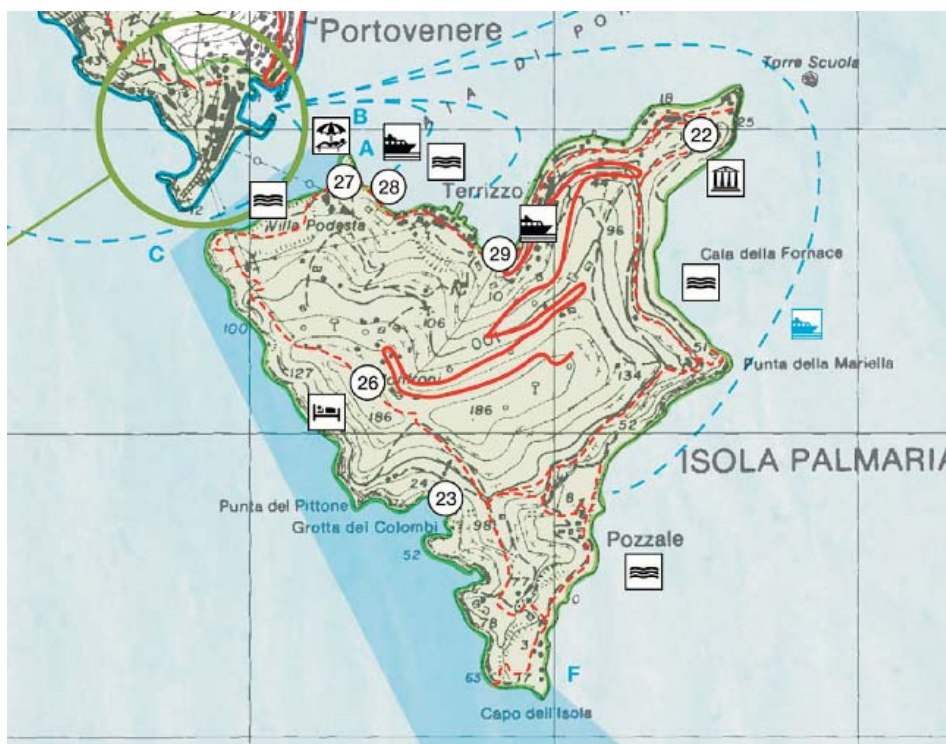
Sebastiano (di Roma, the one with the arrows) patrono della città di Cascina” (Saint Sebastian, patron saint of Cascina). His holiday should be 21st of January. This is not the only place where this is claimed. Therefore, even if it were clear that the holiday were for some SS. Innocenzo and Fiorentino, there is some confusion about who is the true patron saint of Cascina and who one should pray to for pardon and protection. Many people from Pisa and its surroundings would not like to know they should invoke someone from Florence (Fiorentino).

Sport and leisure

The second half of May promises much physical activity for the Cascina population. We shall have a “Spring Excursion” on Sunday, the 17th of May and the traditional EGO Virgo Biathlon on the 28th of May, during the VESF School.

Spring excursion

The spring excursion will bring us to Palmaria island on May 17. This lies at South the gulf of La Spezia. It is a green island, covered by typical mediterranean vegetation.



It has a triangular shape with sides of 2 – 3 km with a maximum elevation of about 200 m. In one full day we shall be able to explore it thoroughly, visiting ruined castles and basking on small beaches or sunny rocks and swimming too. There are several tracks remaining at sea level, adapted also for lazy hikers and babies.

We will reach La Spezia by car in one hour and then take a 30 minute motor boat ride to Palmaria. A detailed plan is being prepared, foreseeing the departure from Pisa at about 9:00 and return at around 19:00. A pizza dinner may be organized for those willing to extend further the excursion.

You are invited to subscribe with your families as soon as possible, to facilitate the organization, e-mailing to Severine.

EGO Virgo Biathlon

The EGO Virgo Biathlon 2009 will take place in last week of May which is a week full of events:

- 25-29 VESF School on GW
- 26 Holiday of the Patron Saint of Cascina
- 27-28 Advanced Virgo Review
- 28 EGO Virgo Biathlon
- 28 VESF School dinner & Biathlon buffet
- 29 STAC meeting

As in the past years it will be a relay run made of four stretches, three on foot, one on bike.

The program and the final formula will be arranged and announced in due time but from now you know that you have to train.

C. BRADASCHIA

Open doors at EGO

Last Saturday a new record for the number of visitors at the EGO site has been established. In the morning 45 students from a school in Venice have been guided by Franco Frascioni and Federico

Paoletti in a classical every-Saturday visit.

The traditional "Open doors day" took place in the afternoon. More than 70 visitors filled the Auditorium attending the introductory seminar by Francesco Fidecaro; thereafter the help of Carlo Bradaschia and Diego Passuello was necessary to guide them through the wonders of Virgo.

Adalberto Giazotto, who is he?

If you search for this name with the help of Google, the first three answers will be the following, which are all on crystals and minerals. Then follows a long list of links alternating between physics and minerals.

• [Sainte-Marie-aux-mines official web site](#)

12 Jun 2003... E-mail: adalberto.giazotto@pi.infn.it. Click here to read about the GIAZOTTO Collection. All photos are copyrighted to Adalberto GIAZOTTO...

www.minerapole.com/a_/b_ofc3.html

• [Libri di Adalberto Giazotto, Federico Pezzotta, Giovanni Pratesi - BOL](#)

Tutti i libri scritti da *Adalberto Giazotto*, Federico Pezzotta, Giovanni Pratesi. Entra nel catalogo online di BOL per scoprire tutti i libri scritti dal.

www.bol.it/libri/ricerca?tp...7&g=Adalberto%20Giazotto,%20Federico%20

• [Cristalli. L'ordine del caos, Adalberto Giazotto, Federico...](#)

Cristalli. L'ordine dal caos di *Adalberto Giazotto*, Federico Pezzotta, Giovanni Pratesi: Oltre 150 cristalli unici al mondo, da una collezione invidiata.

www.bol.it/libri/scheda/ea978880906146.html

This is not surprising for several Virgo "old boys" who have had the pleasure of visiting Adalberto's home and seeing his fantastic mineral collection. I use the adjective fantastic not because I am talking about a friend but because that word is the bare minimum appropriate for that collection.

From now on, anyone can verify my judgment by visiting the exposition of more than 500 samples that was inaugurated on March 31st at La Specola museum in Florence, close to Palazzo Pitti, via Romana 17. The exposition is planned to last for the next five years or more.

Those who cannot wait to visit the exposition can jump to Adalberto's home page (<http://www.giazotto.com>) and enjoy a virtual visit to the collection. I am sure this will increase your desire for a real visit.

C. BRADASCHIA

Picture below:

GYPSUM on SULPHUR

Cozzodisi mine, Casteltermini, Caltanissetta, Sicily, Italy.

