



NEWSLETTER 60

Istituto Nazionale di Fisica Nucleare

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ITALIAN EXCELLENCE FOR GLOBAL RESEARCH

Interview with Caterina Biscari, INFN Researcher and General Manager of the ALBA Synchrotron Laboratory in Barcelona since 2012.

*In 2012, at the head of the largest and most innovative scientific infrastructure on the Iberian peninsula, was appointed an excellent Italian physicist. Technology Director of the INFN Frascati National Laboratories, a graduate in physics from the Complutense University of Madrid, Caterina Biscari was born in Italy, in Modica and returned to Italy after her studies to start her scientific career. The laboratory she has been managing for 7 years is the ALBA Synchrotron, to be found in the scientific park of Cerdanyola del Vallès, 15 kilometres away from Barcelona: a laboratory with a strong international vocation, dedicated to basic research and its application in fields ranging from technological innovation to medicine. An internationally recognised expert in particle accelerators for scientific research and medical applications, Caterina Biscari has also worked at CERN in Geneva and at the CNAO in Pavia, the National Centre for Oncological Hadrotherapy, whose accelerator was implemented with the fundamental contribution of INFN and its researchers, before moving on to manage the ALBA Synchrotron. She is a Fellow of the European Physical Society, member of several committees including the Scientific Policy Committee of CERN, the Scientific Advisory Committee of KEK and the PSI Advisory Board. In 2013 she was awarded the official honour of the **Order of the Star** by the President of the Italian Republic for her role in developing collaborations between Italy and other countries. We asked her to tell us how things are going and how she sees the future of her laboratory.*

First of all, I would like to know how it came about: from research in Italy to managing the most prestigious scientific laboratory in Spain. It doesn't seem like a career step for everyone.

As in all steps in life there is always a combination of personal initiative and opportunity that arrive at the right time. During my scientific career, I have always maintained an interest in projects that were proposed in Spain based on particle accelerators. In 2012, at ALBA, they opened the position of facility manager with an international competition, in which I successfully participated. So I was appointed

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"directora", of which I immediately appreciated the use of the feminine version of the word. I would like to thank Spain, ALBA and its Council for offering me the opportunity to manage a fantastic group of people and to reap the benefits of the previous work of building and fine-tuning all the systems. My first visit to ALBA, immediately after the appointment, coincided with the day when the first official user began collecting data on a synchrotron beamline, thus starting the period of use of the beamlines. My initial task was therefore to organise and consolidate the operation, both from the point of view of the functioning of the technological systems as well as of user services, to then turn to the development and growth of the infrastructure and its scientific lines. Now we are in the process of defining in which technologies we want to invest in the near future with the construction of new beamlines, based on our capabilities, on those of the national and international user community and, above all, on the needs and challenges of the society of the future.

CERN teaches that research in physics with particle accelerators, but also with other tools, is increasingly global and shared: made of large collaborations and based on the exchange of knowledge, methods and technological innovations. What is the scientific community of ALBA like and how does it liaise with the rest of the world?

ALBA is a research infrastructure and a user facility, financed by the Spanish government and the regional government of Catalonia in equal measure. Despite being a national project, it has a clear international vocation. 25% of the personnel, currently consisting of 220 people, comes from outside Spain and, in this percentage, the most represented foreign community is that of Italy. Furthermore, the ALBA beamlines are used by an ever-increasing number of researchers, which last year reached 2200, with 35-40% coming from foreign institutions. Since 2012 to date, we have welcomed researchers from 35 different countries in our laboratories. And, finally, an essential part of our activity is the development of research and technology programs in collaboration with other institutions and research centres. In this context, our collaborations are dominated by the programs undertaken with similar infrastructures, especially European ones, through joint projects presented to the European community, or collaborative projects on a specific scientific line.

We are among the main actors of LEAPS (League European of Accelerator-based Photon Sources), which includes about twenty European synchrotrons and FELs (Free Electron Lasers). The network was created with the strategic mission of unifying the means and specialisations of each individual structure, so as to optimise scientific and technical capacities in each country and offer European users complete and compatible tools and services. Next year I will have the honour of being Chair of LEAPS and, therefore, the voice of a European community that includes approx. 40,000 researchers engaged in responding to the

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challenges of our society on topics like health, energy, nutrition, new materials, big data and much more. And finally I would like to mention our collaboration with CERN, dedicated in particular to the development of future accelerators, from the FCC, CLIC and CompactX, and of course with INFN.

Which of the leading sectors of the laboratory do you think are the most promising? Have you established a hierarchy in ALBA between basic research and applied research?

A synchrotron light source is more dedicated to applied research, although very often the dividing line between the two types of research is blurred. The hierarchy among the hundreds of experiment proposals that researchers submit to our call for proposals is based on their scientific excellence, which is evaluated by external committees of international experts and allows the selection of experiments that will be carried out: on average, about half of those proposed.

As an example of interaction between applied and basic research, I can mention the field of nanomagnetism, which develops in three of our beamlines, complementing different light-matter interaction techniques. Materials are studied for computing, spintronics, high critical temperature superconductor applications and many others for different uses. But, to return to the question concerning the relationship between basic and applied physics, when studying images of the magnetic properties of surfaces, or of magnetic moments in very thin layers of material, of a few tens of nanometres, or of skyrmions (particular states of sub-nuclear matter), these respond to questions of fundamental physics, increasing the theoretical knowledge in the field of magnetic materials.

Another field in which the current tools of ALBA excel is the development of new drugs, thanks to a line based on a transmission microscope, where 3D images of cells are obtained with a resolution of a few tens of nanometres and that complement the diffraction line of macromolecules where protein structures at atomic resolution are resolved. This is one of the three or four lines of this type in the world, available to the global research community.

I would also like to mention the applications in the field of chemical catalysis, essential for the development of technologies with low environmental impact, a research field for the development of which we also make recourse to the collaboration of Spanish research institutes among the most recognised in the world. And, finally, developments in the energy materials sector, for the construction of solar cells or batteries.

Ultimately, the over 1,500 experiments that took place during these first years of operation in ALBA are extremely diversified, with researchers from thousands of research institutes and universities.

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The ALBA laboratory is engaged in numerous activities concerning the dissemination of scientific culture. What role do you attribute to teaching in general and to early scientific training, more specifically?

I think that we scientists have a significant responsibility in disseminating the value of science. We are called upon to participate in the training of the various players in society. Our message must reach politicians, the media, the public that approaches us through the activities we regularly organise, but above all we must try to reach those who do not have the curiosity to know what lies behind the door of a research laboratory. Convince them that without research, without a commitment of the country to research, there is no future.

I would like to make the example of a project conceived by the communication department of our laboratory, the "ALBA Mission" project: a project developed via web and aimed at children between 9 and 11 years of age of schools distributed throughout Spain. We organised four simple experiments that the teachers can easily carry out in their classrooms, guided by our researchers and with the possibility of connecting directly to us. In this way we reached 250 teachers and more than 7,000 children who now know — because they worked with us and saw our videos — that synchrotrons exist and that they are useful for the development of new drugs, or new materials to build batteries or to restore our archaeological treasures. We set up a visit to the winning school as a prize: three of our young researchers went to a school in Guadalupe, a small village of 2000 inhabitants in Extremadura, where they were welcomed as heroes. Next year, in the second edition, we will expand the project to involve up to 20,000 students.

On the other hand, I think that children and young people should have a complete education, including basic science, but not forgetting humanistic education, history and philosophy. This knowledge is necessary to train any individual and provide them with critical skills, so that they can recognise, among other things, how technology can contribute to the development of humanity, but always with the focus on human beings.

In all areas of work, great attention is now being dedicated to the issue of gender equality. Has being a woman influenced, for better or for worse, your career? How do you encourage your younger female researchers to break down the prejudices and acquired insecurities?

Being a woman is unlikely to positively influence a career path in a highly male-dominated environment. In some countries active policies in this regard have been developed in addition to the attention to the issue of gender equality. Spain is certainly ahead of Italy in not discriminating on the basis of gender, as I have been able to personally experience, even though there is still a long way to go. In any case, during

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my career I have not experienced significant obstacles due to being a woman. The obstacles can be overcome with tenacity and work, without reflecting too much on the fact that they can be due to being a woman, and with the knowledge that they are sometimes inevitable given the circumstances. And once the glass ceiling has been broken, you get a recognition, sometimes even too much, just because you're a woman. We are so few that we are treated as if we were special, although there are sometimes chauvinist episodes which it is easier to smile about when you have already reached a mature age or a recognised position. My advice to young female researchers is not to be afraid, to work hard to make their dreams come true and to tactfully point out the error in certain attitudes. I hope that my position, which enjoys a certain visibility, serves as an example for girls, for children.

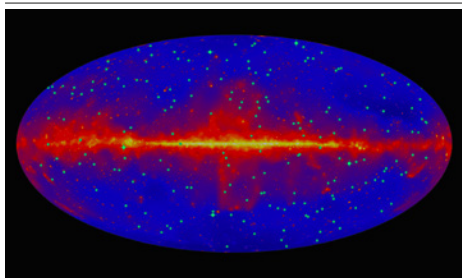
The role model still prevalent for women often leads girls to choose service activities, those that are of help to others. It is normal to want to be a teacher, a doctor, to take care of someone. My message is that being a scientist, an engineer or an IT expert is a perfect way of really helping society. Moreover, these are also wonderful jobs, which also allow you to have fun and find personal gratification: it is therefore our right and duty to access them. ■



INSTITUTIONS

ITALIAN PRESIDENT SERGIO MATTARELLA VISITS CERN

On 10 June, the Italian President Sergio Mattarella visited CERN. President Mattarella was welcomed by the CERN General Director, the Italian Fabiola Gianotti, the INFN President Fernando Ferroni and the Italian delegation, which included, among others, the INFN Executive Board, the Nobel Prize winner Carlo Rubbia and Professor Antonino Zichichi, President of the Tera Ugo Amaldi Foundation. At the end of the underground visit, President Mattarella met the Italians working at CERN at the Globe. Of the more than twelve thousand people who animate CERN, the Italian community has almost two thousand, many of whom have held or still hold positions of great responsibility in major research projects: to name a few, in addition to the General Director Gianotti, coordination of large experiments with Federico Antinori, Roberto Carlin and Giovanni Passaleva of the ALICE, CMS and LHCb collaborations, respectively, and the management assigned to Lucio Rossi of the future High Luminosity LHC project, which will be the most important in this field of research for the next decade. ■



RESEARCH

GAMMA RAY BURSTS: CATALOGUE OF THE MOST ENERGETIC OBSERVED BY FERMI

186 high energy gamma ray bursts recorded by the Fermi satellite telescope for gamma rays in ten years of observation: these are the protagonists of [*"The Second GRB Catalog"*](#), published on 13 June in

The Astrophysical Journal. These Gamma Ray Bursts (GRBs) were detected by the Large Area Telescope (LAT), a Fermi instrument designed and implemented with a decisive contribution from Italy, thanks to the Italian Space Agency ASI, the National Institute for Nuclear Physics INFN and the National Institute of Astrophysics INAF. The catalogue, which provides new indications on the origin and evolution of gamma ray bursts, is the result of the work of 120 scientists and Fermi collaboration scientists, coordinated by Elisabetta Bissaldi, researcher at INFN and the Polytechnic University of Bari, by Magnus Axelsson of the University of Stockholm and by Nicola Omodei and Giacomo Vianello of Stanford University.

Both the collapse of a star and the collision of two neutron stars can give rise to relativistic jets of particles that move at a speed close to that of light. When the particles in the jets collide with each other or interact with the environment around the stars they give rise to gamma rays. The Fermi Large Area Telescope (LAT) records gamma rays with energies between 20 MeV and 300 GeV (millions of times more energetic than visible light) and works in close collaboration with the Gamma-ray Burst Monitor (GBM) which, on the other hand, observes less energetic gamma rays (between 8 keV and 40 MeV) coming from the entire sky.

Among the GRBs presented in this catalogue are also GRB 081102B, GRB 160623A, GRB 130427A and GRB 080916C, which are the shortest, longest, most energetic and farthest bursts, respectively, ever observed by the Fermi LAT. ■



APPLIED RESEARCH

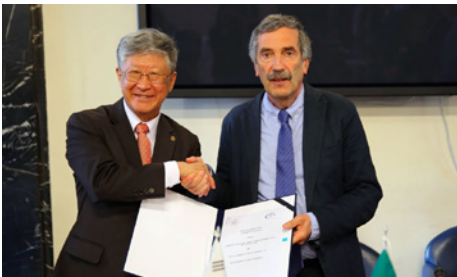
MICADO, A EUROPEAN PROJECT FOR THE MONITORING OF RADIOACTIVE WASTE, GETS UNDERWAY

Standardising the management of radioactive waste, starting from its non-destructive characterisation to transport, storage and real-time monitoring. This is the goal of the MICADO (Measurement and

Instrumentation for Cleaning And Decommissioning Operations) Project, launched on 3 June, thanks to Euratom funding, and to the synergy among 8 European partners with solid experience in the field of radioactive waste, nuclear techniques, electronics and information technology.

The Italian partners, in addition to INFN which brings its expertise on new radiation detection techniques, are CAEN, a company with 40 years of experience in the field of nuclear electronics and project leader, and ENEA, which has specific expertise on materials and on techniques for their management. The international partners are ORANO and CEA for France, SCK-CEN for Belgium, CTU for the Czech Republic, and XIE for Germany.

The Digi-Waste RCMS solution proposed in the MICADO project will produce a modular hardware and software system to unify and standardise procedures and methods for non-destructive characterisation and monitoring of nuclear waste, proposing itself as an international benchmark for all nuclear operators, research laboratories and security authorities, facilitating the exchange of fundamental and often critical information. In detail, INFN is participating with the Southern National Laboratories (LNS) which is entrusted with the task of creating the detector system for monitoring gamma and neutron radiation. ■



INTERNATIONAL COLLABORATIONS

FRAMEWORK AGREEMENT SIGNED FOR TECHNOLOGICAL DEVELOPMENT AND TRAINING BETWEEN INFN AND SOUTH-KOREAN IBS

Synergy on technologies and training of the new generations of physicists are the issues at the centre of the recent framework agreement signed between the INFN and the South Korean IBS Institute for Basic Science. The discussion on technologies developed for research on dark matter and neutrinoless double beta decay, the development of the new generation of radioactive beams and the opportunity for young researchers to carry out work and training in Italy and in South Korea will thus be facilitated and encouraged. The prospects for nuclear and particle physics in the various research areas drive the existing and emerging structures of the two institutions towards full cooperation, supporting the exchange of ideas, information and skills. The agreement was signed by the President of INFN Fernando Ferroni and by the President of IBS Doochul Kim during a ceremony at the offices of the INFN President, which took place at the end of two days of meetings between the two scientific communities, during which the South Korean delegation also visited the Gran Sasso National Laboratories (LNGS). ■

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SUPERCOMPUTING: ITALY SELECTED AS ONE OF THE COUNTRIES THAT WILL HOST THE PRE-EXASCALE SUPERCOMPUTER

Italy will host one of the supercomputers that will build up the European network for supercomputing, a strategic European digital infrastructure in which Europe has invested a total of approx. 900 million euros. The EURO-HPC (European High Performance Computing) project envisages the commissioning, in the coming years, of pre-exascale class computers, i.e. machines with very high computing capacity, at three major European supercomputing centres: one in Italy, based in Bologna, one in Finland in Kajaani, and one in Spain, in Barcelona. The project also involves the construction of four peta-scale computers that will be hosted by Bulgaria, in Sofia, the Czech Republic, in Ostrava, Luxembourg, in Bissen, Portugal, in Minho, and Slovenia, in Maribor. All the centres will be interconnected with the European Géant network and, in Italy, the Bologna node will be connected with a double 100 Gbps connection with the GARR network.

50% of the computing power generated by each machine will be available to research institutes, universities, but also companies, in the host country; the remaining part, on the other hand, will be used by the countries participating in the project. The European supercomputing network will support European researchers, industry and companies in the development of new applications in a wide range of sectors, from research in physics and astrophysics to the design of medicines and new materials, from the fight against climate change to non-destructive field surveys, artificial intelligence and cyber security.

The Italian supercomputer will be called Leonardo and will have a peak power of 270 petaflops. It will be hosted at the Technical Hub in Bologna, formerly the INFN Tier-1 site, the data centre that manages the data produced by the Institute's largest international projects such as LHC and Virgo.

Our country put itself forward last January, thanks to a joint Consortium with Slovenia led by the CINECA Inter-university Consortium, together with the INFN and the International School for Advanced Studies (SISSA). The appointment as a host country was announced on 10 June at a press conference at the MIUR (Italian

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Ministry of Education, Universities and Research) and took place in the last Governing Board of the EuroHPC Joint Undertaking, a body sponsored by the European Commission to promote the development of a network of supercomputers, which had the task of choosing the locations of this international project. The overall financial commitment of the MIUR amounting to 120 million euros will be distributed over the years from 2019 to 2025. A further 120 million euros will be made available by the European Commission, for a total investment of approx. 240 million euros.

In the coming weeks, the tender for the acquisition of the machine components will be launched. The assembly, commissioning and testing of the computer will start in the second half of 2020. With the installation of these machines, the Bologna Technical Hub will become a unique hub of its kind and will attract skills from around the world. ■

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