

Faces & Places

APPOINTMENTS

New leader at Fermilab's next accelerator

On 1 March, accelerator physicist Lia Merminga was appointed project director for Fermilab's PIP II (Proton Improvement Plan II) and its new superconducting linear accelerator. Along with improvements to Fermilab's Main Injector and Recycler accelerators, PIP II will provide high-intensity proton beams for future experiments including the flagship Long-Baseline Neutrino Facility and the Deep Underground Neutrino Experiment. The new 800 MeV machine will double the energy of the existing linac at Fermilab and



Lia Merminga will lead the superconducting linac PIP II, serving neutrino experiments.

is the first particle accelerator to be built in the US with significant contributions from international partners. Merminga, previously associate laboratory director for accelerators at SLAC National Accelerator Laboratory, succeeds Fermilab's Stephen Holmes. She has more than 25 years' experience in accelerator and superconducting radio-frequency technology, and served as director of the Center for Advanced Studies of Accelerators at Jefferson Lab and as head of the accelerator division at Canada's TRIUMF laboratory.

Change of chairs for antimatter community

Experimentalists Stefan Ulmer of RIKEN and Chloé Malbrunot of CERN have been elected chairperson and deputy chairperson, respectively, of the Antiproton Decelerator (AD) user community. The roles involve representing the interests of the antimatter community to CERN management, requiring regular contact with the spokespersons of approved AD experiments and organising

beam time. The AD is a unique global research facility hosting the AEGIS, ALPHA, ASACUSA, ATRAP, BASE and GBAR experiments. Ulmer is founder and spokesperson of the BASE collaboration, while Malbrunot is involved with ASACUSA and AEGIS. For the past 17 years the AD user community has been represented by Walter Oelert and, since 2012, Horst Breuker.



Left to right: Walter Oelert, Chloé Malbrunot, Stefan Ulmer and Horst Breuker.

AWARDS

Pontecorvo award to Fogli and Lisi

The 2017 Bruno Pontecorvo Prize, which is given by the Joint Institute for Nuclear Research (JINR) in Dubna, Russia, has been awarded to Gianluigi Fogli and Eligio Lisi of the University of Bari and INFN in Italy for their pioneering contributions to the development of the global analysis of neutrino oscillation data from different experiments. The announcement followed the approval of



Gianluigi Fogli (left) and Eligio Lisi.

an international jury's recommendations by the JINR scientific council at its 123rd session on 22–23 February.

The work of Fogli, Lisi and the Bari neutrino group on the theory and phenomenology of neutrino and astroparticle physics has led to a detailed understanding of oscillation searches with solar, atmospheric, accelerator and reactor neutrinos, and of their interplay with non-oscillatory searches. The two laureates will report on their achievements at an awards ceremony at the next session of the JINR council on 20–21 September. The Pontecorvo Prize was established in 1995 to commemorate Bruno Pontecorvo, once Enrico Fermi's collaborator and often deemed the father of neutrino physics.

Gold medal for extreme nuclei

The 2017 Lomonosov Gold Medal, the highest accolade of the Russian Academy of Sciences, has been awarded to Yuri Oganessian of the Joint Institute for Nuclear Research (JINR) in Russia and Björn Jonson of Chalmers University of Technology in Sweden. The pair has extended our



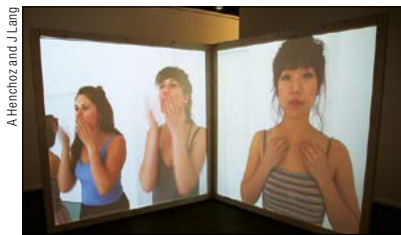
Björn Jonson (left) and Yuri Oganessian have extended the boundaries of the nuclear chart.

knowledge on nuclei at the extremes of existence in opposite ends of the nuclear chart. Oganessian has made fundamental contributions to the study of superheavy elements, also acknowledged in 2016 when element 118 was named Oganesson (Og), while Jonson, who has also played key roles in CERN's ISOLDE facility, has focused on the nuclear structure and stability at the boundaries of the nuclear chart for the lightest elements. The award ceremony took place in Moscow on 30 March.

Faces & Places

Winners of the 2018 Collide awards revealed

Arts at CERN, a project started in 2001, allows artists from all over the world to spend time at CERN and work alongside particle physicists and engineers. On 22 March the winners of the 2018 Collide International and Collide Geneva awards, organised in collaboration with Arts at CERN, were announced. London-based Polish artist Suzanne Treister won the Collide International award, a three-month artist residency in collaboration with the Foundation for Art and Creative Technology in the UK that will begin in May.



A previous work titled *Archipelago and Tempo* by Collide Geneva winners Sylvie Henchoz and Julie Lang.

Her investigation, titled *Holographic Universe*, aims to “explore the artists’ motivations and intentions through the history of art, from cave painting to modernism and global contemporary art”. The Collide Geneva award, a partnership between Arts at CERN and local authorities, was won by Anne Sylvie Henchoz and Julie Lang. The pair will spend three months at CERN during the autumn, further developing their project *Space Time Energy*, exploring potential analogies between the human body and particles.

MEETINGS

Defining technology for tomorrow's experiments

The scale and technological sophistication of the detectors at the LHC experiments is almost incomprehensible. In addition to several subdetector systems, they contain millions of detecting elements and support a research programme for an international community of thousands of scientists. The volume of data that will be produced during the high-luminosity upgrade of the LHC (HL-LHC) and by future colliders calls for even more sophisticated technologies.

In November 2017, CERN launched a process to define its R&D programme on new experiment technologies for 2020 onwards. The programme covers detector upgrades beyond the HL-LHC phase and includes concepts developed for the Compact Linear Collider (CLIC) and the Future Circular Collider (FCC) study. The first workshop took place at CERN on 16 March and more than 450 physicists and engineers took part.

Beyond the HL-LHC, explained organiser Christian Joram, the landscape of experiments is only vaguely defined and may evolve in different directions. Therefore, the aim is to launch an R&D programme that concentrates on advancing key technologies rather than developing specialised applications.

It has been shown before that developments in detectors for high-energy physics also benefit many other sectors, from healthcare and medical imaging to industry and quality monitoring. As noted by workshop co-organiser and head of CERN's experimental physics department Manfred Krammer, it is timely to think how industry can be involved in joint R&D efforts.



The CERN workshop discussed new experimental technologies for the 2020s.

Detector improvements envisioned for the 2020s and beyond include better electronic readout, modelling and simulation tools, and better computational techniques for reconstructing the recorded information. Increased timing accuracy to mitigate event pile-up in very high-luminosity environments will almost certainly impact the development of all classes of detectors, whether silicon, gas or photodetectors. The challenges of the HL-LHC and future colliders also places tough requirements on readout electronics and fast data links, while advances in data processing and storage are equally important.

Participants also discussed the special facilities and infrastructures needed to test chips under realistic conditions – presenting an impressive number of options

on advanced materials, design tools and production technologies, which could change the way we build detectors and boost their performance. R&D into magnet design for future colliders also demands progress in superconducting materials and cables to meet strict strength and cost requirements.

The talks at the March workshop covered a variety of topics reflecting CERN's diversity and strong collaboration with commercial and academic partners worldwide. They demonstrated that new concepts, manufacturing tools and materials, combined with the development of simulation tools and software, can open a new era in detector technologies.

A second workshop will take place this autumn to review progress.

● Panos Charitos, CERN.

Standard Model gets annual check up at Moriond

The 2018 Moriond sessions took place in La Thuile, Italy, from 10 to 24 March. The annual conference is an opportunity to review the progress taking place over the breadth of particle physics, from B physics to gravitational waves and from advances in electroweak precision tests to exploratory searches for dark matter. The quest for new particles covers an impressive 40 orders of magnitude, from the 10^{-22} eV region explored via neutron-spin precession to the 13 TeV energy of the LHC and the highest-energy phenomena in cosmic rays.

Anomalies in the decays of beauty quarks found by the LHCb and B-factory experiments continue to entice theorists to look for explanations for these possible hints of lepton non-universality, and experimental updates are eagerly awaited (*CERN Courier* April 2018 p23). Progress continues in the field of CP violation in B and D mesons, while quantitative tests of the CKM matrix are being helped by precise calculations in lattice QCD. Progress on leptonic and semi-leptonic D-meson decays was reported from BES-III, while Belle showed hints of the decay $B^+ \rightarrow \mu^+ \nu$ and evidence of isospin violation. In the classic field of rare kaon decays, the CERN SPS experiment NA62 showed its first results, presenting one candidate event for the elusive decay $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ obtained using a novel in-flight technique (see p7).

Fundamental parameters of the Standard Model (SM), such as the masses of the top quark and W boson, are being measured with increasing precision. The SM is in very good shape, apart from the long-standing exception of forward-backward asymmetries. These asymmetries are also being studied at the LHC, and precise results continue to be produced at the Tevatron.

Results on top-quark production and properties are constantly being improved, while hadron spectroscopy is as lively as ever, both in the light meson sector (BESIII) and in heavy quarks (BaBar, Belle and LHCb). Data from HERA are still providing new inputs into structure functions, with c and b quarks now being included. Heavy-ion collisions at LHC and RHIC continue to explore the behaviour of the hot, dense quark-gluon plasma, while proton-ion collisions at fixed-target experiments (LHCb) provide useful inputs to constrain Monte Carlo event generators.

The news on the Brout-Englert-Higgs mechanism is good, with progress on many fronts. The amount of new results presented



Participants during a talk at the 2018 Moriond conference in Italy.

by ATLAS and CMS, including evidence of ttH production, and global combinations of production and decay channels shows that the precision on the couplings between the Higgs and other particles is improving fast. The study of rare decays of the Higgs boson is advancing rapidly, with the $H \rightarrow \mu^+ \mu^-$ decay within reach.

The search for heavy resonances is continuing at full speed, with CMS presenting one Z' analysis employing the full, available LHC data set (77.3 fb^{-1}), including 2017 data. Is supersymmetry hiding somewhere? Several analyses at ATLAS and CMS are now being recast to include more elusive signatures with various amounts of R-parity violation and degenerate spectra, and there is an emerging interest in performing searches beyond narrow-width approximations.

The search for dark matter is on, with WIMP direct searches maturing rapidly (XENON1T) and including novel experiments like DARKSIDE which, with just 20 l of very pure liquid argon, presented a new best limit at low masses. This field shows that, with ingenuity, there is still room to have an impact. Bounds on extremely light axion-like particles were presented by ADMX for QCD axions, and for neutron electric dipole moments. The interplay between these dedicated experiments and the search for directly produced dark matter at the LHC are highly complementary.

The field of neutrinos continues to offer steady progress with new and old puzzles being addressed. The latest results from T2K disfavour CP-conservation at the level of two sigma, while NOvA disfavours the inverted hierarchy at a similar level. A revival of decay-at-rest techniques and the measurement of coherent elastic neutrino-nucleus scattering by COHERENT (*CERN Courier*

October 2017 p8) were noticeable. The search for heavy neutral leptons is taking place at both fixed-target and collider experiments, while reactor experiments (like Daya Bay and STEREO) are meant to clarify the reactor antineutrino anomaly. The puzzle of sterile neutrinos is not yet completely clarified after 20 years. Deep-sea (ANTARES) and South Pole (IceCube) experiments are now mature, with ANTARES showing, among other things, searches for point-like sources. IceCube presented a brand new analysis looking for tau-neutrino appearance that is competitive with existing results. Neutrinoless double-beta decay experiments are now biting into the sensitivity of the inverted mass hierarchy (CUORE and EXO-200), with promising developments in the pipeline (CUPID).

Completing the programme of the electroweak session was a glimpse into the physics of cosmic rays and gravitation. The sensitivity of AUGER is now such that mapping the origin of the cosmic rays on the sky becomes feasible. With the observation of a binary neutron-star collapse by LIGO and VIRGO, 2017 saw the birth of multi-messenger astronomy.

On the theory side, one continues to learn from the abundance of experimental results, and there is still so much to be learned by the study of the Higgs and further high-energy exploration. SM computations are breaking records in terms of the numbers of loops and legs involved. Electroweak and flavour physics can indicate the way to new physics scales and extend the motivation to search for dark matter at very low energies. The case to study neutrinos remains as compelling as ever, with many outstanding questions still waiting for answers.

● *Augusto Ceccucci, CERN.*

Faces & Places

Industry rises to FCC conductor challenge

Superconductivity underpins large particle accelerators such as the LHC. It is also a key enabling technology for a future circular proton–proton collider reaching energies of 100 TeV, as is currently being explored by the Future Circular Collider (FCC) study. To address the considerable challenges of this project, a conductor development workshop was held at CERN on 5 and 6 March to create momentum for the FCC study and bring together industrial and academic partners.

The alloy niobium tin is the most successful practical superconductor to date, and has been used in all superconducting particle accelerators and detectors. But the higher magnetic fields required for the high-luminosity LHC (11 T) and FCC (16 T) call for new materials. A potential superconducting technology suitable for accelerator magnets beyond fields of 10 T is the compound niobium tin (Nb_3Sn), which is the workhorse of the 16 T magnet-development programme at CERN.

The FCC conductor programme aims to develop Nb_3Sn multi-filamentary wires with a critical current-density performance of at least 1500 A/mm² at 16 T and at a temperature of 4.2 K. This is 30 to 50% higher than the conductor for the HL-LHC, and a significant R&D effort – including fundamental research on superconductors – is needed to meet the magnet requirements of future higher-energy accelerators. The FCC magnets will also require thousands of tonnes of superconductor, calling for a



The first Future Circular Collider conductor-development workshop at CERN in March.

wire design suitable for industrial-scale production at a considerably lower cost than current high-field conductors.

CERN is engaged in collaborative conductor development activities with a number of industrial and academic partners to achieve these challenging targets, and the initial phase of the programme will last for four years. Representatives from five research institutes and seven companies from the US, Japan, Korea, Russia, China and Europe attended the March meeting to discuss progress and opportunities. Firms already producing Nb_3Sn superconducting wire for the FCC programme are Kiswire Advanced Technology (KAT); the TVEL Fuel Company working with the Bochvar Institute (JSC VNIINM); and, from Japan, Furukawa Electric and Japan Superconductor Technology (JASTEC), both coordinated by the KEK laboratory. Columbus Superconductor SpA is participating in the programme for other superconducting materials, while two additional companies – Luvata and Western Superconducting Technologies (WST) – expressed their interest in the CERN conductor programme and attended the workshop.

The early involvement of industry is crucial

and the event provided an environment in which industrial partners were free to discuss their proposed technical solutions openly. In the past, most companies produced a bronze-route Nb_3Sn superconductor, which has no potential to reach the target for FCC. Thanks to their commitment to the programme, and with CERN's support, companies are now investing in a transition to internal tin processes. Innovative approaches for characterising superconducting wires are also coming out of academia. Developments include the correlation of microstructures, compositional variations and superconducting properties at TU Wien, research into promising internal-oxidation routes at the University of Geneva, phase transformation studies at TU Bergakademie Freiberg and research of novel superconductors for high-fields at SPIN in Genova.

The FCC initiative is similar to the process that took place during the R&D period for niobium titanium for the LHC. Participants agreed that this could result in a new class of high-performance Nb_3Sn material suitable not only for accelerator magnets, but also for other large-scale applications such as high-field NMR and laboratory solenoids.

● Panos Charitos, CERN.

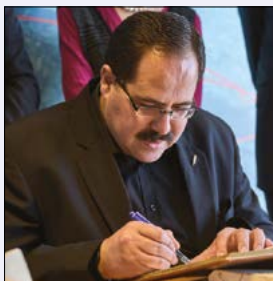
J. Jordan/CERN



On 27 March, seven L'Oréal-UNESCO For Women in Science "international rising talents" visited CERN, following the 20th edition of the international award at a ceremony in Paris. Left to right: Selene Lizbeth Fernandez; Valverde from Mexico; Areej Abuhammad from Jordan; Anna Kudryavtseva from Russia; CERN Director-General Fabiola Gianotti; Ibtissem Guefrachi from Tunisia; Yukiko Ogawa from Japan; Danielle Twilley from South Africa; and Hiep Nguyen from Vietnam.

VISITS

J. Jordan/CERN



Sabri Saidam, minister of education and higher education, Palestine, came to CERN on 21 March. He toured the ATLAS visitor centre and CERN Data Centre.

J. Jordan/CERN



Olga Nachtmannová, state secretary for Slovakia's ministry of education, science, research and sport, came to CERN on 22 and 23 March. She visited ALICE and met with the CERN-Slovak community.

Training tomorrow's accelerator scientists

More than 100 people attended an event organised by the European Scientific Institute (ESI), Archamps, on 15 February to mark the 25th anniversary of the Joint Universities Accelerator School (JUAS) and the fifth anniversary of its sister school, the European School of Instrumentation in Particle and Astroparticle Physics (ESIPAP). Among them were current and former students of both schools, as well as PhD and technical students from CERN who had participated in JUAS or ESIPAP in recent years.



Frédéric Bordry, CERN director of accelerators and technology, marking the 25th edition of JUAS at ESI in February.

Overall, more than 1000 physicists and engineers have been trained at JUAS since it was founded. ESI president, Hans Hoffmann, stressed the need for international and interdisciplinary collaboration in order to tackle major societal challenges, and explained how this goal drives the ESI's thematic schools. Philippe Lebrun, former head of accelerator technologies at CERN and JUAS director since 2017, reiterated that JUAS exists to teach "the science and technology of accelerators, which are specific domains of physics and engineering in their own right, along with their latest developments, to the designers, builders and operators of tomorrow's machines".

These thoughts were echoed by ESIPAP director and a long-standing member of the ATLAS collaboration, Johann Collot. Citing the unprecedented international effort under way to reconcile microscopic physics and modern astronomy, he told students they were lucky to be able to focus their imaginations on such a noble task, "which stems from experimentation and whose conclusion will be revealed through experimentation". In concluding remarks, CERN director of accelerators and technology, Frédéric Bordry, affirmed

the importance of JUAS and ESIPAP in preparing the next generation of particle-accelerator and detector scientists, and assured ESI of CERN's ongoing support.

Recruitment is already underway for the next editions of JUAS and ESIPAP, which will be held at ESI from January to March 2019. Both schools propose an innovative pedagogical approach, with an intensive

mix of lectures, tutorials, seminars, group workshops, laboratory visits and practical sessions. They also include practical sessions at CERN and other internationally renowned facilities, such as the European Synchrotron Radiation Facility in Grenoble and Switzerland's Paul Scherrer Institut. Find out more at: esi-archamps.eu.

● Bob Holland, ESI.

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Faces & Places

OBITUARIES

Jon Peter Berge 1935–2017

Jon Peter Berge, known as Peter to his friends and family, passed away on 14 November. He was born in Madison, Wisconsin, to Norwegian immigrant parents and his early years were marked by the Great Depression and World War II, which forced his family to move frequently. He went on to attend the University of California, Berkeley, where he obtained his BA in physics (1956), MA (1958) and his PhD (1964).

At Berkeley, he joined the group under Nobel Prize winner Luis Alvarez at the Lawrence Radiation Laboratory, where he participated on the development of the bubble chamber. While working there, he met his future wife, Louise Holstein. In 1967, Peter obtained a postdoctoral award to work



Peter Berge was a member of the CDF experiment at Fermilab.

with John Mulvey in Oxford, and three years later he accepted a position at CERN.

In 1974 he took up a permanent position at Fermilab, where he worked on the CDF experiment. He was highly regarded for his skill in writing software used to control high-energy physics experiments, including that which led to the discovery of the top quark in 1995. He remained at the lab until his retirement in 2000.

Peter was an active fencer and competed in tournaments until the mid-1970s. He appreciated chess, good wine, fine dining, classical music and history. He was an astounding writer of endless postcards, including (post-office permitting) beer coasters. He had many lifelong friends and was known as a generous host.

● *His friends and colleagues.*

Daniel Boussard 1937–2018

The world of radio-frequency (RF) technology lost an outstanding inventor and leader when Daniel Boussard passed away on 6 January. Daniel made vast contributions to the design of RF systems for accelerating and controlling particle beams. He furthered our understanding in particle-beam dynamics and in the intricacies of controlling high-intensity beams. He was a technical innovator across low- and high-power electronics, right through to the sophisticated RF cavities required in the accelerators.

Daniel started at CERN in the late 1960s, working on the PS machine, but was soon recruited to design the beam control systems for the then new SPS accelerator. He made observations of the microwave signals disrupting the beams, putting forward his famous criterion for avoiding them. This started a programme that continues at CERN to this day to understand and control parasitic impedances, which drive beam instabilities, and to invent methods to counteract their effect. With increasing intensity in the SPS, formerly unobserved beam instabilities raised their heads. To deal with this, Daniel pioneered the use of new digital electronics, incorporating them in the one-turn feedback system that he invented to subdue the instabilities.

In the SPS, thoughts quickly turned towards using the machine for the P-PBAR project. Here the problem was to understand and control the noise sources inherent in the RF systems, which destroyed the circulating beams. Pinpointing the critical elements and



Daniel Boussard in March 2012.

finding solutions increased the lifetime of the beams from minutes to hundreds of hours.

To accelerate leptons in the SPS for the new LEP accelerator required high RF voltages. Daniel dared to consider installing, for the first time, a superconducting cavity into an environment with high-intensity proton beams. While helping to accelerate the leptons to higher LEP injection energies, it was essential to make this cavity “invisible” to the high-intensity proton beams. He solved this by using sophisticated RF feedback techniques, and the SPS subsequently happily “multi-cycled” protons and leptons for the lifetime of LEP. In these areas, Daniel became an acknowledged leader in the world and his ideas are essential to all modern machines.

With his extensive knowledge of

superconducting (SC) RF systems, Daniel was asked to lead the project to install the huge SC RF cavities required for the LEP energy upgrade. While the cavities themselves had to be technically robust, careful design of the electronics to control the voltage and cope with unexpected problems (such as ponderomotive oscillation instabilities) was essential. The experience and understanding gained from SC RF systems in the SPS and in LEP led to their selection for the LHC, and Daniel led the design and implementation of these highly successful accelerating elements.

The tutorials and lectures given by Daniel at CERN accelerator schools on beam loading, RF noise and Schottky diagnostics have become classical references, continuing to serve generations of scientists all over the world. He mastered the art of explaining complex issues in a simple manner.

As a leader, Daniel was kind, fair and highly esteemed, giving clear and carefully thought-out decisions. The remarkable person he was, he took good care of the people entrusted to him and gave honest credit to all those working with him. His natural authority derived from his human qualities and his undoubted technical expertise.

He greatly loved the mountains, going on long hikes both on foot and on skis. It is not surprising, knowing his CERN career, that in his retirement in the south of France Daniel built a guided solar-panel array and became mayor of his village, Valavoire.

● *His friends and colleagues.*

Violette Brisson 1934–2018

Violette Brisson, a highly respected member of the French particle-physics community who played a leading role in the discovery of neutral currents, passed away on 18 February at the age of 83. She led her long career at the Laboratoire Leprince-Ringuet (LLR) at École polytechnique, and the Laboratoire de l'Accélérateur Linéaire (LAL) in Orsay.

Violette joined the LLR in 1954 as a pioneering young woman in a domain then strongly dominated by male physicists. After a PhD devoted to measurements with cosmic rays, she was invited to work on the first hydrogen bubble-chamber experiment at Brookhaven's Alternating Gradient Synchrotron. On her return to France, she joined André Lagarrigue's heavy-liquid detector group. The highlight of the mid-1960s was the design and construction of Gargamelle, a giant bubble chamber to be located on the CERN PS neutrino and antineutrino beams. Violette's expertise from the US was a strong asset to the project. She took part in the design of the illumination system of the chamber and was responsible for the implementation at LLR of the special scanning and measurement devices needed to handle Gargamelle pictures. Her parallel participation in the stopped-kaon experiment X2 allowed her group to master modern computing techniques for photo analysis.

When Gargamelle started operation in 1971, the focus turned to the search for weak neutral current (NC) events predicted by the Glashow–Weinberg–Salam model. Violette played a leading role in the analysis of the leptonic channel, which turned out to be decisive: a single and by now famous leptonic event with negligible background, together with hadronic events, were the basis of the ground-breaking NC



Violette played important roles in the Gargamelle, H1 and VIRGO projects.

discovery published in 1973. (This saga and the associated controversy with the US competition were related with humour by Violette during CERN's 50th anniversary celebrations.) Afterwards, she became interested in nucleon structure functions in several experiments with Gargamelle and the Big European Bubble Chamber.

In the early 1980s, when the electron–proton collider HERA entered the scene, Violette fully engaged with this new project. She played a major role in the French contribution to HERA and to one of its experiments, H1. She joined LAL in 1988 and was personally strongly involved in the construction of the H1 liquid-argon calorimeter, going into every detail of its design and not hesitating to spend months within the cryostat to install the complex cabling with the technical teams. Later on she worked on the HERA Fabry–Pérot polarimeter for the high-luminosity phase. HERA did not find the hoped-for quark substructures or leptiquarks, but delivered

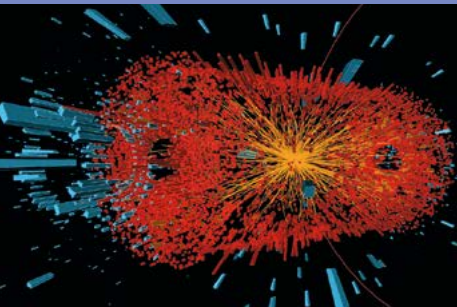
a wealth of textbook results that provides reference proton-structure measurements for the LHC and, together with LEP and the Tevatron, fully unveiled the mechanism of electroweak unification first hinted at by the Gargamelle discovery of neutral currents.

In the 1990s, though already well advanced in her career, Violette was bold enough to move to a completely new domain – the quest for gravitational waves – within the French–Italian VIRGO experiment. She again took on a major technical component of the detector, the 3 km-long vacuum chambers of the interferometer arms, taking care of the design of the complex ultra-high-vacuum system. This was a key ingredient to the success. It is comforting that, after many years of constant improvements of the interferometer, Violette was able to experience the first detection of a gravitational wave by VIRGO.

Beyond her talents as physicist, Violette had a deep sense of responsibility and outstanding organisational skills. She took on many collective duties, including assistant management of LLR for many years, the secretariat of the physics committee of the French Science Academy, French representation in international organisations such as IUPAP, and participation on conference committees. In 2003 she was nominated Chevalier de la Légion d'honneur.

Violette was not only a physicist: she was also a spouse, a mother and a faithful friend of many around the world, including a lot of colleagues. She led her life with passion, with a long and dense career crowned by two major discoveries. She will remain an inspiring model for all of us, and in particular to young female physicists.

● *Her friends and colleagues.*



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Typical Applications

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- Medical Applications and Scientific Research;
- Superconducting Cyclotron Laboratories;
- Synchrotron Laboratories and special projects;
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