

Faces & Places

AWARDS

APS announces 2017 prize recipients



Top: Michel Della Negra, Peter Jenni and Tejinder Virdee (Panofsky Prize); James Bjorken, Sekazi Mtingwa and Anton Piwinski (Wilson Prize). Bottom: Sally Dawson, Howard Haber, John Gunion and Gordon Kane (J J Sakurai Prize).

The American Physical Society (APS) has awarded its prizes for 2017, several of which are devoted to the fields of high-energy and nuclear physics. The W K H Panofsky Prize in Experimental Particle Physics went to Michel Della Negra and Peter Jenni, CERN, and Tejinder Virdee, Imperial College London, for their “distinguished leadership in the conception, design and construction of the ATLAS and CMS detectors, which were instrumental in the discovery of the Higgs boson”. The award recognises and encourages outstanding achievements in experimental particle physics.

The J J Sakurai Prize for Theoretical Particle Physics went to Sally Dawson of Brookhaven National Laboratory, John Gunion of the University of California at Davis, Howard Haber of the University of California at Santa Cruz, and Gordon Kane of the University of Michigan, for their

instrumental contributions to the theory of the properties, reactions and signatures of the Higgs boson.

Recognising achievements in the physics of particle accelerators, this year’s Robert R Wilson Prize was awarded to James Bjorken, SLAC, Sekazi Mtingwa, Massachusetts Institute of Technology, and Anton Piwinski, DESY, “for the detailed, theoretical description of intrabeam scattering, which has empowered major discoveries in a broad range of disciplines by a wide variety of accelerators, including hadron colliders, damping rings/linear colliders, and low emittance synchrotron light sources”.

In the nuclear-physics domain, the APS Herman Feshbach Prize in Theoretical Nuclear Physics went to Joseph Carlson of Los Alamos National Laboratory, “for pioneering the development of quantum Monte Carlo techniques to solve key

problems in nuclear-structure physics, cold-atom physics, and dense-matter theory of relevance to neutron stars”. The Tom W Bonner Prize in Nuclear Physics, meanwhile, was awarded to Charles Perdrisat of the College of William and Mary, “for groundbreaking measurements of nucleon structure, and discovering the unexpected behaviour of the magnetic and electric nucleon form factors with changing momentum transfer”.

Completing the prize tally in the high-energy physics arena, the Dannie Heineman Prize for Mathematical Physics went to Carl Bender of Washington University, for developing the theory of PT symmetry in quantum systems and sustained seminal contributions that have generated profound and creative new mathematics and impacted broad areas of experimental physics.

ANNIVERSARY

Marking 15 years of humanitarian mapping

On 11 October, a United Nations programme called UNOSAT, which delivers satellite images to regions affected by natural disaster or conflict, celebrated 15 years of success in helping relief and development organisations. UNOSAT has been hosted by CERN’s IT department since its inception in 2001, and relies on the laboratory’s IT infrastructure – in particular, the Worldwide LHC Computing Grid – to produce maps with a resolution as



high as 30 cm. Raw satellite images made available by space agencies and public and private satellite data providers are stored on CERN’s servers and then transformed into legible, downloadable maps. The tool has become essential for arranging aid and sustainable reconstruction such as that

required in West Africa since 2014 in the fight against the Ebola epidemic, or currently in the context of the Syrian conflict. “CERN’s support is essential,” says UNOSAT manager Einar Bjorgo. “Without its powerful IT infrastructure, we wouldn’t be able to compile the satellite data we receive to make it usable.”

Members of UNOSAT work on satellite images of Haiti in October to assess the damage of Hurricane Matthew.

Faces & Places



EXHIBITION

CERN science on display in Vienna

On 19 October, a new exhibition about particle physics and cosmology, produced in collaboration with the Institute of High Energy Physics of the Austrian Academy of Sciences, opened at the Natural History Museum of Vienna. Called “The beginning of everything”, it promises to take visitors on a journey more than 13 billion years into the past, and to communicate the most recent scientific knowledge of particle physics and cosmology from different visual, optical and acoustic angles and perspectives. Part of the exhibition is devoted to CERN, and the exhibition will run until 1 May 2017.

(Top left) CMS featured at the exhibition.

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ANNIVERSARY

YITP celebrates 50 years



The C N Yang Institute for Theoretical Physics (YITP) at Stony Brook University in the US celebrated its 50th anniversary with

a symposium on 9–10 October. The YITP was founded in 1966, when Chen Ning Yang came to the then almost-unknown Stony Brook University, at the invitation of the university's president John Toll. Together with Tsung-Dao Lee, Yang shared the 1957 Nobel Prize in Physics for his work on parity non-conservation in weak interactions.

The YITP is associated with several advances in the areas of supergravity, gauge-theory renormalisation, neutrinos and QCD collider theory, in addition to statistical mechanics. A video message from Yang saw the 94 year-old theorist refer to his years at Stony Brook as a “second career” after his time at the Institute for Advanced Study. He recalled the earliest days of supergravity and informal lectures from mathematician James Simons, which eventually “contributed to the increasingly close contact between the world communities of physicists and mathematicians”.

CONFERENCES

LHC sheds light on extreme cosmic rays

The 19th International Symposium on Very High Energy Cosmic Ray Interactions (ISVHECRI) took place on 22–27 August in Moscow, Russia, attracting more than 100 physicists. At the core of discussions was the status of our understanding of hadronic particle production as observed in interactions involving cosmic rays, and as measured in accelerator experiments.

The impact of LHC measurements on the interpretation of cosmic-ray data was a central theme. Important general observations of direct relevance to cosmic-ray physics include: the moderate growth of the inelastic cross-section and secondary particle multiplicity; the absence of rapid changes of the particle distributions close to the beamline; and the overall agreement between charm-particle production and perturbative QCD calculations. Thanks to LHC data, the ambiguity in the interpretation of air-shower data of ultra-high-energy cosmic rays has been significantly reduced and a mixed composition of primary elements is now favoured at energies above 10^{19} eV (previously the data were considered compatible with a flux of only protons). Moreover, good agreement is found between the composition data of the two biggest air-shower detectors, the Pierre Auger Observatory and Telescope Array.

Comparing ALICE data relating to atmospheric muons with state-of-the-art



Participants of ISVHECRI '16 discussed the implications of LHC data.

simulations, an excess in high-multiplicity muon bundles previously reported by several LEP experiments has not been confirmed. Still, the muonic component of air showers is a source of many puzzles. For example, the Auger collaboration reported that the measured muon number in air showers with energies of 10^{19} eV exceeds the model expectations. In addition, the high-statistics data on muon and electron numbers recorded by the KASCADE air-shower array can still not be consistently interpreted with contemporary interaction models – even after accounting for LHC data, which are taken at an energy higher than that of the famous “knee” in the cosmic-ray spectrum (which corresponds to an energy of around 3×10^{15} eV). On the other hand, at lower energies, the muon data from IceTop (the air-shower array located above IceCube) are still bracketed by expectations for proton and iron particles as primaries. Data relating to pion–nucleus interactions taken with fixed-target experiments, such as NA61 at

CERN, are expected to help to resolve these muon puzzles.

The high-energy neutrinos measured by IceCube continue to be a focus of this community. Neutrinos produced in interactions of cosmic rays in the atmosphere constitute the dominant background to those from astrophysical sources. Fortunately, the LHC probes the energy region that is most important for understanding this background, which stems mainly from the production and decay of charm particles. Although the good overall agreement of the charm measurements with predictions is very encouraging, it was reported that the LHC measurements cover only about 12% of the phase space needed for calculating PeV-energy neutrino fluxes.

ISVHECRI participants were also reminded of the early pioneering work on particle physics using cosmic-ray interactions recorded with emulsion chambers, which still harbour phenomena that are yet to be understood. The symposium concluded with a discussion of the most important future accelerator measurements needed for improving our understanding of cosmic-ray data. Studying proton interactions with light nuclei at the LHC is top of the wish list, followed by pion–nucleus interactions in fixed-target experiments at the highest energies possible. The next symposium of the biennial ISVHECRI series will take place in Nagoya, Japan, in spring 2018.

KNOWLEDGE TRANSFER

CERN sets bar for cryogenic safety



CERN is a world leader in cryogenic safety.

Around 120 experts in cryogenic safety met at CERN on 21–23 September for the first cryogenic-safety seminar. In addition to discussions about best practice and regulatory frameworks, a highlight of the event was a new CERN technology called Kryolize developed for the cryomagnets of the LHC and other CERN facilities.

Kryolize is a software tool tailored for

sizing cryogenic pressure-relief devices that protect against overpressure, such as that encountered by the LHC shortly after it switched on in 2008. It is based on international and European standards and was originally conceived to respond to the specific needs of CERN to develop valves for use with liquid helium at extremely low temperatures. The LHC uses an unprecedented 120 tonnes of liquid helium to cool 36,000 tonnes of superconducting magnets to just 1.9 K.

Kryolize is supported by CERN's Knowledge Transfer group and currently has 30 users at CERN. Six licences have so far been granted to other research laboratories and it is anticipated that, once the project reaches its conclusion in mid-2017, the tool will have applications in domains ranging from the food industry to medicine.

AWARD

Lifetime achievement



Smits was one of the architects of Horizon 2020.

Robert-Jan Smits, director general for research and innovation at the European Commission, is the first recipient of a new award: Recognition of Lifetime Achievements for European Science and Society. Created by EuroScience, an association of

researchers in Europe and founder of the EuroScience Open Forum (ESOF), the award cites Smits' ability to help create new and more effective EU policies and structures, co-ordinate EU tools with national policies and align all of these towards the broader needs of society.

Faces & Places

Deep discussions at DIS 2016

The 24th workshop on Deep Inelastic Scattering and related subjects (DIS2016) took place on 11–15 April at DESY in Hamburg, Germany. The event acted as a melting pot for worldwide investigations of the proton structure and strong interactions at the LHC, HERA, Tevatron, RHIC, JLAB, COMPASS and other experiments. It also covered related theory advances, future experiments and results from the high-energy frontier. The workshop was organised into seven separate working groups, and selected highlights from each are given here.

Concerning structure functions and parton densities, the final combined HERA (H1 and ZEUS) inclusive DIS data have had a significant impact on parton-distribution functions (PDFs) and resulting predictions of LHC processes. ATLAS, CMS and LHCb presented the first production measurements of W and Z bosons and of jets made at LHC Run 2, which will help to further constrain the PDFs.

In the electroweak and beyond-the-Standard-Model sector, many final Run 1 results were reported by ATLAS and CMS on the Higgs boson as well as on precision measurements of multiboson production. No deviations from the Standard Model were observed, and it is clear that the community is in need of calculations including next-to-leading order (NLO) electroweak corrections if it is to compete with the LHC's experimental precision.

A wealth of new LHC results concerning QCD and hadronic final states were presented, which often probe the final-state kinematics in great detail. Theorists are attempting to match the improved experimental precision, for example with generators based on full next-to-next-to-leading order (NNLO) calculations. The description of the underlying event and double-parton scattering was another important topic, with many new experimental and theoretical results being debated.

In the heavy-flavour community, new CMS top-pair production data from Run 2 have been compared to the first complete



This year's DIS workshop was attended by 327 participants representing 33 countries, presenting 270 talks on a variety of subjects.

NNLO QCD predictions for differential distributions, which have only recently become available. These calculations improve the description of the observed top-quark transverse-momentum spectrum and open a new precision era in top physics. Many new beauty and charm results were presented such as the first Run 2 measurements of open-charm production by LHCb.

Regarding low-x, diffraction and vector mesons, theorists propose to carry out extended studies at the LHC with events containing "Mueller–Navelet" jets (two forward jets with a large rapidity gap between them). Several advances were presented on the phenomenology of diffractive vector-meson production at HERA, where the first measurement of the reaction $\gamma + p \rightarrow \rho^0 \pi^+ n$ was reported by H1. Ultra-peripheral collisions in nuclear collisions at the LHC and RHIC are another hot topic in the low-x community at this time.

Concerning the long-standing spin puzzle – i.e. the question of how the nucleon's spin is distributed among its constituent partons – new spin-asymmetry results were presented by COMPASS as well as by the PHENIX and STAR experiments at RHIC,

adding significant constraints on the quark and gluon spin contributions. COMPASS, HERMES and JLAB also presented new studies of semi-inclusive DIS.

Finally, with regard to future experiments, there is much to look forward to. JLAB will continue its 3D-hadron-imaging studies with a second generation of experiments using its 12 GeV electron beam, while COMPASS and STAR will take further data until 2017. Despite the achievements by these facilities, the lack of experimental information for $x \leq 0.01$ remains a severe limitation. As such, there is great hope that the Electron Ion Collider (EIC) project in the US will lead to comprehensive 3D hadron imaging and solve the spin puzzle. On the energy frontier there is also the intriguing opportunity of an electron–ion collider in the envisaged 54 km ring accelerator complex in China. Such machines could provide a unique precision tool for a complete flavour decomposition of the proton structure and would cover a broad spectrum of strong and electroweak physics.

The next DIS workshop will take place in Birmingham, UK, from 3 to 7 April 2017.

LETTERS

Following Blackett's advice

Your review of Antonino Zichichi's tribute to Patrick Blackett (*CERN Courier* September 2016 p59) touched upon Blackett's conviction that physicists should communicate to society the contribution of science to the progress of our civilisation. Never before has this been more pertinent.

You do not have to look very far to find the enemies of fundamental research. First there are those journalists looking for a dramatic storyline and the growing band of unqualified commentators on the internet. Then there are the politicians following an "impact" agenda that favours perceived short-term economic benefits of research

over academic excellence. There is also a tendency for research councils, university presidents and learned societies to toe the government line, encouraging some fellow scientists to claim that attention and money should be diverted away from high-energy physics.

The discovery of the Higgs boson in 2012

and gravitational waves in 2016 were triumphs of experimental physics that confirmed theoretical ideas first put forward in 1964 and 1916, respectively. Yet fundamental physics sometimes receives negative publicity because attempts to achieve the much more difficult goals of going beyond the Standard Model and unifying gravity with the other forces have not met some stricter artificial deadlines. Of course we must continually remind the politicians and the media of the economic benefits of fundamental physics: PET scans from the Dirac equation, GPS from general relativity, the Web from CERN, etc. But let us not fall into the trap of boasting only about these populist benefits, lest we be judged on them alone; let us also recall with Zichichi Blackett's exhortation to communicate the progress of civilisation brought about by discovering the laws of nature.

● Michael Duff, Blackett Lab, Imperial College London.

Blackett, the UK and CERN

As pointed out in your review of Antonino Zichichi's book about Patrick M S Blackett (*CERN Courier* September 2016 p59), the author offers his personal testimony, from the first time he heard Blackett's name to when he went to work with him, and then about the research he could be involved in. I would like to add one important point, outlined in the book, which was not mentioned in the review: namely the decisive role of Blackett in the foundation of CERN.

The important role of I I Rabi and other scientists, who initiated the foundation of CERN via UNESCO, has been outlined on many occasions. Zichichi's book, however, describes the important role played by Blackett in getting the UK, which had been an observer until then, to ratify the CERN convention on 30 December 1953. Indeed, the influence that Blackett – who was a former chief adviser for operational research in the Admiralty during the Second World War – had at government level allowed him to overcome the initial resistance in the UK government, which was willing to accept expenditure on nuclear projects but reluctant to spend comparable sums on fundamental research in a European organisation.

Hence, in the words of physicist Lew Kowarski written in 1973 (*CERN Courier* September 2016 p62), "important events such as the creation of CERN – only a few years after World War II, with Germany joining and Britain among the signatories of the CERN Convention – do not happen without the engagement of strong personalities".

● Horst Wenninger, CERN.

VISITS



Elisabeth Laurin, ambassador and permanent representative of France to the United Nations Office at Geneva and international organisations in Switzerland (right), with CERN Director-General **Fabiola Gianotti** at the 14th edition of France@CERN on 3–4 October. The annual event welcomed representatives from 37 companies covering a wide range of sectors including engineering mechanics, energy, transport and information technology.

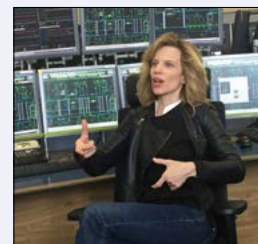
S Bennett



Glenys Beauchamp, secretary, Department of Industry, Innovation and Science, Australian government, visited CERN on 26 October and signed the guestbook in the presence of CERN director for international relations **Charlotte Warakaulle** (left) and Director-General **Fabiola Gianotti**.

S Bennett

Italian actress **Sonia Bergamasco**, who's work includes a role in the 2008 Italian television movie *Einstein*, visited CERN on 13 October, during which she took in the surroundings of the CERN Control Centre.



P Catapano



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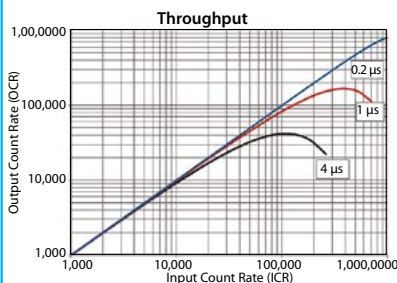
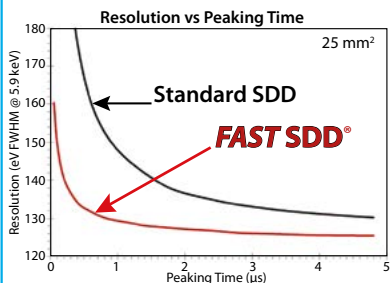
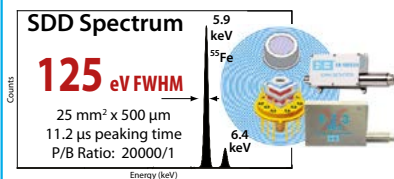
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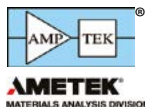
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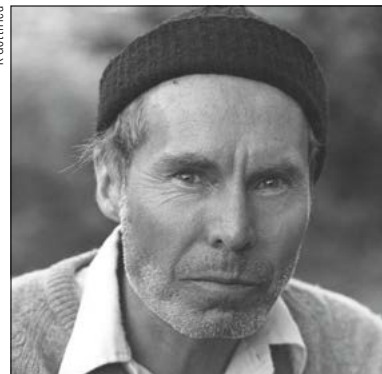
OBITUARIES

David Jackson 1925–2016

The life of John David Jackson bridged the era of tabletop nuclear-physics experiments and the modern age of large, complex accelerators. Jackson's first professional appointment was in 1949 as assistant professor of mathematics at McGill University in Montreal, Canada, where, half a century earlier, Ernest Rutherford first showed that radioactive matter emits three distinct types of radiation. Shortly after moving to Manchester, UK, Rutherford performed the famous alpha-particle scattering experiment, which demonstrated the existence of the nucleus. When Jackson arrived at McGill, much of Canadian physics was still under the spell of Rutherford: theoretical physicists were often only found in mathematics departments, and quantum mechanics was not even taught. Jackson played a significant role in changing this character of physics in Canada.

Jackson was born in London, Ontario, and obtained his undergraduate education at the University of Western Ontario. In 1946 he was admitted to MIT, where he obtained his doctorate under Victor Weisskopf. His thesis on neutron-proton scattering, published in a widely known paper with John Blatt, led to an offer of a postdoc position from Hans Bethe at Cornell at a time when Feynman was doing his famous work there. Although Cornell was among the hottest destinations in theoretical physics at the time, Jackson felt an obligation to return to Canada. He later wrote that "the foolishness and chauvinism of youth is evident in my acceptance of the [McGill] offer." But it was at McGill that Jackson first displayed his remarkable talents as a teacher of theoretical physics and developed the first draft of what was to become the first (1962) edition of his famous textbook, *Classical Electrodynamics*.

In 1956, Jackson spent a year at Princeton. In that year he produced a brilliant study of the muon-catalysed fusion of protons and deuterons into He^3 , and participated actively in the stream of developments unleashed by the discovery of parity violation. In the summer of 1957, Jackson accepted a professorship at the University of Illinois at Urbana, where his research focus began to turn to particle and high-energy physics, and in 1963–1964 he undertook a sabbatical at CERN. In



Jackson is well known for his *Classical Electrodynamics* textbook.

1967, he accepted a professorship at the University of California in Berkeley, where he remained for the rest of his life. The "November Revolution" of 1974 gave Jackson the opportunity to display his mastery of "simple" nuclear physics and quantum mechanics in his overnight analysis of the amazingly narrow J/ψ resonance discovered in electron-positron collisions at SPEAR. At first his calculation of the J/ψ width was controversial, but before long he was shown to be correct.

Owing to his outstanding personality and superb technical ability, Dave (as he was often known) was in great demand for public service. In addition to membership of the National Academy of Sciences and many important committees, he was acting head of the Fermilab theory department (1972–1973), editor of *Annual Reviews of Particle and Nuclear Physics* (1977–1993), chair of the Berkeley physics department (1978–1981) and deputy director of the central design group for the Superconducting Super Collider (1984–1987). Jackson was also a strong proponent of increasing the participation of women in physics.

David Jackson inspired many because of the character traits he displayed to his colleagues, in his lectures, his publications and even in his infamous homework problems: intellectual rigour, tenacity and self-discipline in the pursuit of demanding goals, strict honesty, and a total absence of vanity.

• Kurt Gottfried and Maury Tigner, Cornell University.

Edward J Lofgren 1914–2016

One of the few remaining physicists who worked on the Manhattan Project, Ed Lofgren passed away peacefully on 6 September at the age of 102. He was a key figure in the development of the Bevatron at Lawrence Berkeley National Laboratory and was its first director during the early days of large-scale particle physics.

Lofgren was born in Chicago as the youngest of seven in a family of Swedish immigrants, and attended Los Angeles Junior College in 1931. He was accepted by Caltech but could not find a job that paid enough to be able to afford it. Later, he transferred to the University of California at Berkeley and received his undergraduate degree in 1938. In 1941, Lofgren interrupted his graduate studies at Berkeley to contribute to the war effort, in which he developed uranium-hexafluoride sources used in the Calutron “farm” at Oak Ridge for uranium enrichment (which would later become the topic of this PhD thesis). In 1944 he moved to Los Alamos and manned a radiation-monitoring site located 9 km from Ground Zero, where the first nuclear test was carried out.

After the war, Lofgren worked on an experimental verification of the McMillan–Veksler “phase-stability” principle by converting the 37” Cyclotron into the world’s first synchro-cyclotron. This led to the redesign of the 184” Cyclotron, offering a



Bevatron pioneer Ed Lofgren.

substantially higher accelerating efficiency and a maximum energy almost 10 times higher than the initial design. Following a brief stint at the University of Minnesota investigating cosmic rays with high-altitude balloons, Lofgren returned to the “Rad Lab” at Berkeley in 1948 and served as director of the Bevatron from 1954. He continued his stewardship of this accelerator until his retirement as a laboratory associate director in 1979.

Starting from its first operations in 1954, when the Bevatron was the world’s highest-energy machine, seminal experiments contributed to the foundations for particle physics. The antiproton was discovered in 1955, swiftly followed by the antineutron in 1956 and multiple resonances thereafter. The

Bevatron era also saw the first industrial-scale physics collaborations, where large groups would systematically analyse millions of photos taken at bubble chambers. The dozens of meson and baryon resonances that were discovered provided the impetus for the introduction of the quark model.

Later, in 1965, Lofgren led the “200 BeV” design study at Berkeley, but after the decision was made to build Fermilab in Illinois he did not take part in the project. By 1970, when the Bevatron’s 6 GeV beams had fallen far behind other accelerators, Lofgren and Herman Grunier gave it a new lease of life by converting it into a heavy-ion accelerator: the Bevalac. The Bevalac pioneered the fields of relativistic heavy-ion physics, high-energy calibration of satellite cosmic-ray instrumentation, and medical treatments with heavy-ion beams. Many hundreds of cancer patients were treated with neon and other beams at the facility, laying the foundations for today’s hadron-therapy programmes.

His three daughters remember him as a caring father always willing to describe the natural wonders around him to anybody who would listen. Even in his last weeks of life, he was seen explaining the famous San Francisco fog to fellow residents at his Oakland retirement centre. He will be greatly missed.

● *Jose Alonso, Lawrence Berkeley National Laboratory.*

Peter Weilhammer 1938–2016

Peter Weilhammer passed away on 27 May. He was born in 1938 in Munich and obtained his PhD in physics at the Ludwig Maximilian University in 1969, after which he became a research staff member of the Max Planck Institute and worked with Werner Heisenberg. In 1971 he came to CERN, where his achievements covered the whole spectra of work from particle-physics analysis, detector technology and steering the future of CERN.

Peter’s managerial capabilities were recognised very early, and his record is impressive. In the early 1970s he was an official CERN observer at Brookhaven National Laboratory and a member of its scientific council. In the period 1972–1976, he was a physics programme co-ordinator at CERN, a secretary of the nuclear-physics research board and an adviser to the then Director-General. In the periods 1974–1981



Peter Weilhammer held many roles at CERN.

and 1984–1989 he was spokesperson of the ACCMOR collaboration; led the WA3 and NA32 experiments; and, later, led the DELPHI micro-vertex team. From 1986–1999 he was head of CERN’s solid-state detector group, and also

headed two international collaborations on radiation-hard silicon and diamond detectors. Following this, he was chairman of BELLE’s silicon-vertex-detector review committee, a member of the CERN technical advisory board to the Director-General and elected spokesman of the CIMA collaboration for the development of novel SPECT and PET instrumentation.

Peter made outstanding contributions to high-precision semiconductor detectors, entering this domain at the beginning of the 1980s with the NA11 experiment. He was one of the main proponents and constructors of high-precision vertex detectors for the NA11, NA32, DELPHI and ATLAS experiments, showing continuous initiative in developing new devices and pursuing systematic studies in heavy-radiation environments and for different applications. ▷

Faces & Places

Peter was full of initiative, very energetic and not afraid of taking risks. He worked closely with people from all over the world, helping them as much as he could.

In addition to all of this, Peter was a professional ski instructor and a climber, and many of us have enjoyed trips with him in the mountains. He inspired many of us

both in our professional and private lives. Our thoughts go to his family and many friends.

● *His friends and colleagues.*

Wolfhart Zimmermann 1928–2016

Wolfhart Zimmermann, who passed away on 18 September, was one of the outstanding German theoretical physicists of the second part of the 20th century. He made influential discoveries and in 1991 he received the Max Planck medal for contributions to quantum field theory and renormalisation theory.

Zimmermann studied physics and mathematics in Freiburg and Göttingen, completing his thesis in cohomology in 1950. He spent several years in the US, at the Institute for Advanced Study, the Courant Institute of Mathematical Science and the University of Chicago. He then returned to Europe, becoming a fellow at the Max Planck Institute for Physics and Astrophysics in Munich, followed by director in 1991.

His scientific work concerned



perturbative-renormalisation theory, and the development of a general theory of quantised fields. Guided by the experience from renormalised-perturbation theory, Lehmann, Simanzyk and Zimmermann based their

Zimmermann (left) with Rolf Hagedorn.

“LSZ” theory on a weak-convergence asymptotic condition for the field operators by asymptotic free fields, thus establishing a connection between the physical interpretation in terms of particles and the collision cross-section. The LSZ approach was the starting point of the proof of the experimentally verified dispersion relations and also led to experimentally verifiable predictions that can be extended to cover situations with composite particles.

Zimmermann was closely involved in the physics and physicists of CERN and particularly with Henri Epstein, Yurko Glaser, André Martin and Raymond Stora.

● *Philippe Blanchard, Bielefeld University.*

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