

Faces & Places

APPOINTMENTS

Paolo Giubellino to lead FAIR and GSI

Italian physicist Paolo Giubellino, who is currently spokesperson for the ALICE experiment at the LHC, has been appointed the first joint scientific managing-director and spokesperson of the directorate of the Facility for Antiproton and Ion Research in Europe GmbH (FAIR GmbH) and GSI Helmholtzzentrum für Schwerionenforschung GmbH in Darmstadt, Germany. Giubellino will take up his new position on 1 January, succeeding Boris Sharkov of FAIR and Karlheinz Langanke of GSI.

Giubellino has participated in many heavy-ion experiments at CERN and has been ALICE spokesperson since 2011. He has worked at the Torino section of the Italian National Institute for Nuclear Physics



Gabry Ottavio/GSI

ALICE spokesperson Paolo Giubellino will be the first joint scientific managing-director of FAIR and GSI.

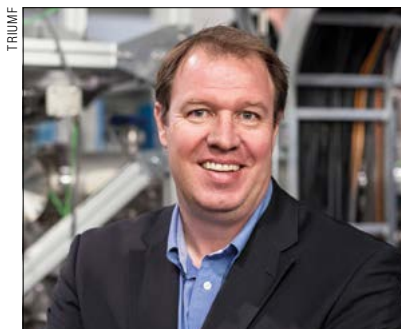
since 1985 and has served as research director since 2006.

“With the extensive international experience Paolo Giubellino gained at CERN in Switzerland, he has ideal prerequisites to tackle the assignment in Darmstadt,” says Otmar Wiestler, president of Germany’s Helmholtz Association. “Being able to attract people like Paolo Giubellino to FAIR shows the worldwide appeal of Helmholtz research. We have chosen the right path with our strategy to pursue a more international course.”

TRIUMF appoints new science associate director

Jens Dilling has been appointed TRIUMF’s new associate laboratory director (ALD) for its physical-sciences division, effective from 1 September. Dilling was recruited to TRIUMF in 2001 as a research scientist and has since served as deputy and department head for nuclear physics and deputy division head of the science division.

Dilling received both his diploma and PhD in physics from the University of Heidelberg, Germany. An expert on ion traps, his research interests include precision atomic-physics techniques applied to nuclear physics at accelerators. He led the design, construction



TRIUMF

Jens Dilling took up the ALD position on 1 September.

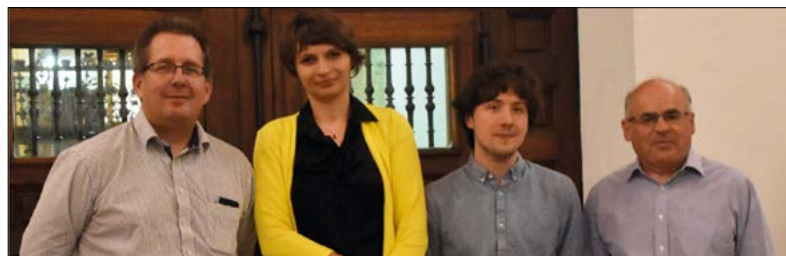
and operation of TRIUMF’s Ion Trap for Atomic and Nuclear science (TITAN) facility.

As ALD of physical sciences, Dilling will provide leadership and direction for TRIUMF’s local and international scientific programme in particle and nuclear physics and molecular and material sciences. He will also work closely with TRIUMF’s accelerator division to foster isotope delivery and prepare the lab for upcoming facilities including the Advanced Rare Isotope Laboratory (ARIEL).

AWARDS

LHCb recognises young scientists

The LHCb collaboration has announced the winners of its inaugural thesis prize, which recognises students who have produced the best theses and made exceptional contributions to the LHCb experiment. The recipients of the first awards for theses defended during 2015 are Lucio Anderlini of the University of Florence for his thesis “Measurement of the B_c^+ meson lifetime using $B_c^+ \rightarrow J/\psi \mu^+ \nu_\mu X$ decays with the LHCb experiment at CERN”; Daniel Craik of the



LHCb spokesperson Guy Wilkinson (left), with Agnieszka Dziurda, Daniel Craik and award-chair George Lafferty.

University of Warwick for “A measurement of the CKM angle γ from studies of $DK \pi$ Dalitz plots”; and Agnieszka Dziurda of the

Institute of Nuclear Physics PAN in Krakow for “Studies of time dependent CP violation in charm decays of B_s^0 mesons”.

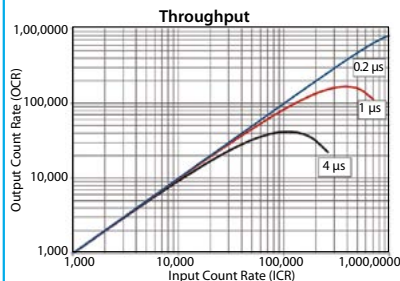
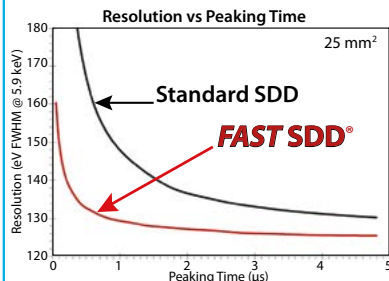
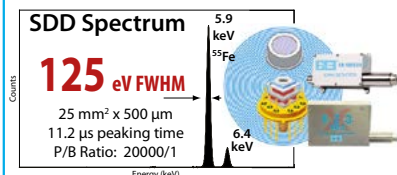
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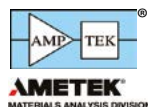
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CHIPP prize for neutrino researcher

The annual prize of the Swiss Institute of Particle Physics (CHIPP) 2016 goes to Mohamed Rameez, a 27 year old neutrino physicist who recently completed his PhD at the University of Geneva, for his leadership in searches for dark-matter annihilation in the Sun with the IceCube Neutrino Observatory and his contribution to their theoretical interpretation.



Mohamed Rameez.

Perimeter physicist wins early researcher award

Perimeter Institute faculty member Asimina Arvanitaki has received a grant of \$140,000 to advance her research. The Early Researcher Awards are administered by Ontario's Ministry of Research, Innovation and Science to help promising young faculty members build research teams. Arvanitaki, who holds the inaugural Stravros Niarchos Foundation Aristarchus Chair at the Perimeter Institute, is exploring novel experimental approaches to particle physics that may be done with small-scale experiments rather than large colliders.



Asimina Arvanitaki during a visit to CERN in July.

FACILITIES

DESY inaugurates new research halls



Ada Yonath in front of the building that bears her name.

On 14 September, the DESY laboratory in Hamburg, Germany, celebrated the opening of two new experimental halls at its synchrotron X-ray facility PETRA III. The halls, which will provide highly specialised experimental stations that allow synchrotron users to examine materials and structures on the atomic

scale, were named after two prominent scientists and X-ray users: Israeli Nobel laureate Ada Yonath, who conducted important research at DESY and other European light sources for her structural examination of ribosomes, and the late Paul P Ewald, who was one of the pioneers of structural analysis using X-rays.

CONFERENCES

CERN event links particles to astrophysics

The annual TeV Particle Astrophysics (TeVPA) conference series discusses the most recent advances in the booming field of astroparticle physics. This year's event took place on 12–16 September and for the first time was hosted by CERN. It was a fitting location, given the well-established implications of particle physics for astrophysics and cosmology, as well as the long-standing commitment of CERN on related activities such as the CAST solar-axion experiment.

The five-day-long event was attended by almost 300 people, with topics including gamma rays, gravitational waves and cosmology, indirect and direct dark-matter searches, and links with particle physics. The highlight of discussions was the Advanced LIGO discovery of gravitational waves from two binary black-hole mergers, which opens a new astrophysical window on the universe. Equally exciting were the broader perspectives of this field, including the mind-boggling reach of the space-based gravitational-wave detector LISA, which will target phenomena ranging from supermassive black-hole mergers to physics in the early universe.

During the conference, the POLAR gamma-ray burst polarimeter on board the Chinese TG-2 space lab was launched, and delegates also heard a report on preliminary observations made by the space-based DAMPE detector, which was launched at the beginning of the year. Whereas POLAR will focus on gamma-ray bursts, DAMPE targets cosmic-ray observations with an excellent energy resolution at TeV energies.

The field of charged cosmic rays also saw the presentation of the first scientific results of CALET, which is located on the Japanese module of the International Space Station. Launched 13 months ago,



Word cloud of terms used in the 247 abstracts that were presented at TeVPA 2016.

CALET has a very deep calorimeter and excellent nuclear-identification capabilities. Energetic electron candidates above the TeV have been identified and the experiment has also placed upper limits on the gamma-ray counterparts of the gravitational-wave merger event of last December. An update on AMS-02 results was also presented, hinting that the positron spectrum “turns off” at sub-TeV energies. The conference also brought physicists up to date with the latest positive progress of the innovative cosmic-ray anti-deuteron experiment GAPS – a high-altitude balloon experiment that aims to stop and capture anti-nuclei and identify them spectroscopically.

The maturity of gamma-ray astrophysics thanks to space-based instruments like Fermi and ground-based Cherenkov telescopes, both for galactic and extragalactic objects, was manifest. There was also a report on the first results from HAWC, which is the latest realisation

of a “Cherenkov water pool” to detect byproducts of gamma-ray showers on the ground. In its first year of operation, HAWC already found around 40 galactic sources in the multi-TeV range, about 10 of which were unknown until now, and the instrument is ideally placed to study possible gamma counterparts to IceCube neutrino events.

Even fields in which no direct discoveries have yet been made have experienced a remarkable boost in sensitivity in recent years: the latest limits from LUX and PandaX, for example, are around 10 times better than those set by Xenon in 2012 for spin-independent cross-sections. The still puzzling interpretation of astrophysical neutrinos, which have now been detected up to energies of several PeV by IceCube, was another discussion point at TeVPA 2016. Plans to increase the performance of MeV–GeV neutrino detectors such as SuperKamiokande via gadolinium doping, which are important for diffuse supernova neutrino detection, are also proceeding well.

The path towards further key measurements from cosmology to particle physics, notably in the neutrino sector, was highlighted – as were some of the current difficulties of the cold dark-matter model and possible strategies to address them. The importance of the forward-physics programme at the LHC for cosmic-ray shower simulations, the role of effective field theories and simplified theories for dark-matter searches at the LHC, and the role of ongoing LHCb measurements of proton–helium cross-sections for cosmic-ray antiproton calculations were just a few examples of the numerous links between particle physics and the astroparticle field.

The next TeVPA meeting will be held next summer at Ohio State University, Columbus, in the US.

Netherlands focus for 2016 ENLIGHT meeting

The annual meeting of the ENLIGHT network, which gathers experts working on particle therapy for cancer treatment, was hosted by Nikhef and held at the University of Utrecht in the Netherlands on 15–17 September. Around 100 participants from 15 countries attended, and one of the key discussion topics was the design and realisation of four new centres for proton

therapy in the Netherlands, following the recent approval by the Dutch government to make proton therapy available nationwide.

The new Dutch centres for proton therapy are distributed across the entire country. The Holland Proton Therapy Centre (PTC) in Delft and the UMC Groningen PTC are already under construction and foresee first patient treatments in autumn–winter

2017. The PTC in Maastricht is heading towards the construction phase and expects treatments to start in 2018, while the fourth PTC in Amsterdam is currently tendering for technical equipment and plans to enter into operation at the end of 2018. All four centres will have one or two treatment rooms equipped with gantries that allow a complete rotation of the beam axis to better target

Faces & Places

the tumour, and together are expected to treat more than 1000 patients each year.

The institutions involved in establishing the new centres are members of the ENLIGHT network, which was created in 2002 to co-ordinate and accelerate the activities of European centres (including CERN) and research groups working on particle therapy. A major achievement of ENLIGHT has been the blending of traditionally separate communities to allow clinicians, physicists, biologists and engineers to work towards a common goal. The flourishing of new centres such as those in the Netherlands is both an achievement and a *raison d'être* for the network.

In addition to the collaborative and interactive model of the new Dutch centres, many other hot topics were discussed, including recent breakthroughs in medical imaging. This is vital to deliver effective treatment while avoiding side effects caused by damage to healthy cells. Positron emission tomography (PET), magnetic resonance imaging (MRI) and computed tomography (CT) scans are used alone or in combination (multi-modal imaging) to assess the volume and the position of the tumour before, after and during treatment, whenever possible. In the case of moving organs such as the lungs, the situation is more complicated because it is necessary to monitor the patient during treatment. The integration of MRI with a linear accelerator, for example, can provide image-guidance



Participants of this year's ENLIGHT meeting included leading radio-oncologists and directors of major European radiotherapy clinics.

concurrent with treatment, reducing the patient exposure to the additional ionising radiation of CT scans.

Image-guided proton therapy (IGPT) is an instance of the shift to more personalised and precise oncology, where treatments are tailor-made for each patient. Another strand of this paradigm shift in medicine is informatics based on past cases to assist doctors in selecting the best combination of treatments. Such systems can be built only if clinical data are accessible. This is controversial due to privacy concerns, but important changes in society are taking place towards massive data gathering and sharing.

Since its establishment, ENLIGHT has

given primary importance to the training of young researchers and physicians in this specialised field. PTCs require highly trained staff comprising medical doctors, physicists, radiobiologists and technicians, yet few experts exist in this emerging field. Therefore, in a first for the ENLIGHT consortium, this year's meeting included a one-day training event devoted to key aspects of particle therapy, including radiobiology, medical imaging and data sharing.

The next annual ENLIGHT meeting will be held in June 2017 in Aarhus, where Denmark's first particle-therapy centre is under construction.

Higgs Hunting 2016

The seventh Higgs Hunting workshop took place in Paris between 31 August and 2 September, attracting 130 physicists for lively discussions about recent results in the Higgs sector. ATLAS and CMS presented results based on more than 13 fb^{-1} of data recorded at an energy of 13 TeV, which corresponds to around half of the data that has been taken so far at the LHC. The uncertainty on some measured properties of the Higgs boson discovered at CERN in 2012, such as the production cross-section, is already smaller with the 13 TeV data than it was after LHC Run 1 at 7 and 8 TeV – especially in cases where the measurement is dominated by statistical errors.

Several searches for phenomena beyond the Standard Model, in particular for additional Higgs bosons, were presented. In particular, ATLAS and CMS did not confirm with the 2016 data the small excess around a mass of 750 GeV in the diphoton invariant mass spectrum that was present in



Participants at the September Higgs event held in Paris.

the 2015 data, which was thought by many theorists to be a spin-0 Higgs-like object. At the end of the 2016 run, which is expected to increase the recorded luminosity at 13 TeV by a factor of three, searches for heavier Higgs-like objects will be possible. The

increased luminosity will also decrease the statistical errors by almost a factor of two, demanding that the experiments work hard to reduce systematic uncertainties.

The next Higgs Hunting workshop will be held in Orsay and Paris on 17–19 July 2017.

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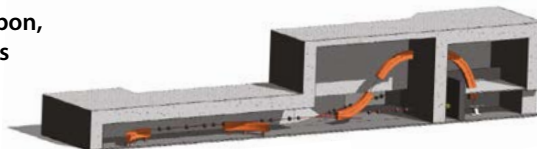
Cyclotron	Energy (MeV)	Isotopes Produced
Best 15	15	F^{18} , Tc^{99m} , C^{11} , N^{13} , O^{15} , Cu^{64} , Ga^{67} , I^{124} , Pd^{103}
Best 20u/25	20, 25	Best 15 + I^{123} , In^{111} , Ge^{68}/Ga^{68}
Best 28u (Upgradeable)	20, 28	Best 15 + I^{123} , In^{111} , Ge^{68}/Ga^{68}
Best 35	35–15	Greater production of Best 15, 25 isotopes plus Tl^{201} , Rb^{81}/Kr^{81}
Best 70	70–35	Sr^{82}/Rb^{82} , I^{123} , Cu^{67} , Kr^{81} + research

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African school goes from strength to strength

The fourth biennial African School of Fundamental Physics and Applications took place on 1–19 August in Kigali, Rwanda.

The event saw 75 students, who were chosen from 439 applicants from around the African continent, spend three weeks at the University of Rwanda's College of Sciences and Technology, during which 40 lecturers from different fields in physics flew in from CERN and many parts of the world to teach and mentor the students.

"What makes this programme unique is that we tailor-make each programme according to what area of physics is interesting to the host country," says Ketevi Assamagan, a physicist at Brookhaven National Laboratory in New York and member of the International Organising Committee of the school. "The ultimate goal is to host the school in as many countries on the continent as possible, with the help of host-country governments."

The biennial summer school, which was launched in South Africa in 2010, has previously been hosted by Ghana in 2012 and by Senegal in 2014. This year, the school received financial support from CERN and 19 other institutions, including the International



Delegates at the 2016 African school in Rwanda.

Centre for Theoretical Physics (ICTP), Brookhaven National Laboratory, the South African National Research Foundation and Department of Technology, the Rwandan Ministry of Education, INFN and other major particle-physics laboratories.

The next event will be hosted by Namibia in 2018, and promises to attract an even greater number of applications from students across Africa. Visit www.africanschoolofphysics.org for more information.

VISITS

Sophia Bennett



Around 70 participants in the Virgin Galactic space programme were joined by **Richard Branson** (third from left), founder of the Virgin group, on 31 August for a tour of CERN, which took in the SM18 hall.

Julius Ordan



On 13 September, Canadian rock group **Nickelback** took a day out of their European tour to visit CERN, which included a trip to the CMS building.

EVENT SPOTLIGHT



The first **Future Circular Collider (FCC) physics workshop** will take place at CERN on **16–20 January 2017**, focusing on the broad physics opportunities offered by the FCC programme. The workshop will also address experimental requirements and machine–detector interface issues that are directly relevant to the physics programme. All sessions will be plenary, with an emphasis on the complementarity of the different components of the programme (ee, hh and eh). Original ideas and contributions on alternative experimental approaches in the global context of the FCC – also including physics with beam dumps and the injector complex, and physics in the forward region – are strongly encouraged. The event will precede the 2017 FCC week due to take place in Berlin from 29 May to 2 June (fccw2017.web.cern.ch).

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OBITUARIES

Siegmund Brandt 1936–2016

Siegmund Brandt was born on 17 July 1936 in Berlin and studied physics at Bonn University in Germany. In his diploma work, which was carried out under the supervision of Wolfgang Paul, he constructed a small bubble chamber for experiments at the Bonn 500 MeV electron synchrotron. As early as 1961, Brandt worked at CERN on bubble-chamber physics studying pion–proton interactions, which became the topic of his PhD thesis.

After his habilitation in 1966, he became associate professor at Heidelberg University, and in 1972 he became professor, founding senator of physics and vice rector at the newly founded University of Siegen. At Siegen, Brandt's interest turned to electronic detectors and he worked at DESY on the PLUTO experiment at DORIS and PETRA. He contributed to the three-jet analysis with the “triplicity” method, which led to the discovery of gluons in 1979. After PLUTO, Brandt continued with the PETRA experiments by joining TASSO. During this time, Brandt



Siegmund Brandt was a member of the ALEPH experiment.

was also member of the Scientific Council of DESY, which he chaired from 1990 to 1993, and he was later elected to the Polish Academy of Arts and Sciences.

Brandt left DESY for CERN in the late 1980s, where he joined the ALEPH experiment at LEP and contributed to the ALEPH forward detectors and the analysis

of Bhabha scattering and jet production. Brandt was an extremely creative author – his books include *Data Analysis: Statistical and Computational Methods for Scientists and Engineers* (1975) and *The Harvest of a Century: Discoveries of Modern Physics* (2013). He is also well known by many students as one of the authors of the general-physics textbook series he wrote with his theory colleague Hans Dieter Dahmen.

Brandt was a versatile physicist. His work spanned the operation of now-historic detectors such as bubble chambers and the construction and analysis of modern electronic high-resolution instruments, and his successes will live on in his books on basic science. Brandt passed away peacefully in Munich on 28 August after a long period of illness, leaving behind his son and his grandchildren. He will be dearly missed by his friends and colleagues.

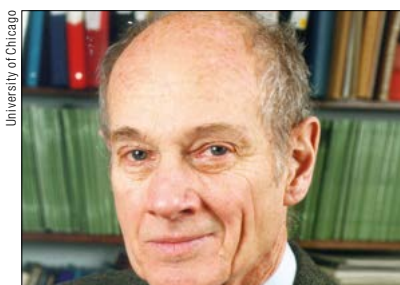
● *Hans Dieter Dahmen, Claus Grupen and Thomas Mannel, Siegen University.*

James Cronin 1931–2016

Jim Cronin, who shared the 1980 Nobel Prize in Physics with Val Fitch for the discovery of CP violation, died on 25 August 2016. He was a brilliant experimentalist and data analyst who had remarkable careers in both particle and cosmic-ray physics.

Jim was a man of extraordinary drive. Born in Chicago, he was raised in Dallas where his father was a classics professor. In 1953 he moved to Brookhaven and then Princeton, where he honed the spark-chamber technique before returning to the University of Chicago in 1971. He was appointed to head the colliding-beams division at Fermilab in 1977, but he soon resigned: a largely administrative role was not for him. In 1982, while on leave at CERN, he led a small team to make the best direct measurement of the lifetime of the π^0 .

In 1986, to the surprise of many, Jim turned to cosmic rays and started to discuss his design for an air-shower array that could search for PeV gamma rays from the binary source Cygnus X-3. His visit to Leeds, UK, in November 1986 led to a lasting friendship, and in 1991 we embarked on an effort to build a collaboration and raise money to construct an instrument of unprecedented



Nobel laureate Jim Cronin.

size to study cosmic rays with energies up to 10^{20} eV. Thirteen years later, the Pierre Auger Observatory, which covers 3000 km² of Western Argentina, began data-taking, and continues to do so with a team of more than 400 scientists from 16 countries.

The route to this achievement was strewn with difficulties, which were largely overcome through Jim's formidable drive and his discrete and modest use of his status. He obtained \$100,000 from UNESCO to bring scientists from developing countries to Fermilab for a six-month-long design study, won support for us to tour the Far East

to raise interest, and prised \$1 million from the University of Chicago to build a new centre at the site. Evaluation of our plans by an international body proved impossible, so Jim invited a panel of experts, including CERN's Jack Steinberger, to assess us. Their report helped to raise \$50 million, although one agency commented “Of course it is a favourable report: you chose the committee.”

The success of the Auger project has greatly enhanced the profile of fundamental physics in Argentina, Brazil, Mexico and Vietnam, while the host town of Malargüe is home to the James Cronin School. Despite the large size of the collaboration, Jim stimulated young people while carrying out key analyses alone using FORTRAN 77 and “TopDrawer” – an ancient graphics package hosted on a dedicated Chicago computer.

Jim will be sorely missed by all who knew him. Without his strong sense of direction and his persuasive skills, the Pierre Auger Observatory and many other projects would never have succeeded. He is survived by his second wife, Carol, and by a daughter, a son and six grandchildren. His first wife, Annette, and an older daughter pre-deceased him.

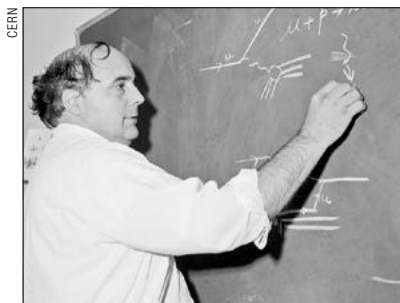
● *Alan Watson, University of Leeds, UK.*

Erwin Gabathuler 1933–2016

Erwin Gabathuler, a highly respected experimental physicist and former CERN research director, passed away on 29 August 2016. Gabathuler was born in 1933 in Maghera, Northern Ireland, the son of the manager of an embroidery factory. He graduated in physics from Queen's University Belfast in 1956 and was awarded his PhD from the University of Glasgow in 1961. After a postdoc at Cornell University he returned to the UK in 1964 to work on the NINA electron synchrotron at the Daresbury Laboratory, where, among a number of experiments, he made a pivotal measurement of " p - ω interference" in wide-angle electron-positron pair production.

In 1974, Gabathuler moved to CERN and led the European Muon collaboration, which was aimed at understanding the quark structure of nucleons and nuclei. He became head of the CERN experimental division in 1978 and CERN research director in 1981, guiding CERN's programme in the years leading to the discovery of the W and Z bosons.

In 1983, Gabathuler was appointed to a chair at the University of Liverpool and to the position of head of the particle-physics group, taking charge of the leadership of the group's programme as it entered the collider era. He initiated major Liverpool involvement



Erwin Gabathuler discussing the NA2 experiment in 1977.

in the H1 and HERMES experiments at the HERA electron-proton collider at DESY, while also nurturing Liverpool's contribution to the DELPHI experiment at LEP. At the same time, his interest in the role of fundamental symmetries in physics led him to also conceive and establish CERN's unique CPLEAR experiment to study kaon decay. While continuing his interest in deeply inelastic lepton-hadron physics with colleagues on H1, and following the completion of CPLEAR, Gabathuler took Liverpool into the BaBar experiment at SLAC, California.

His appointment to Liverpool led

Gabathuler to have a substantial influence on the development of high-energy physics in the UK, at a time when the then UK government was considering possible withdrawal from CERN. His commitment contributed greatly to the success of his colleagues in physics and in other fields. He helped to secure funding for the Liverpool Surface Science Centre, and initiated new undergraduate courses with the Astrophysics Research Institute at Liverpool John Moores University.

In 1990, Gabathuler was elected to the fellowship of the Royal Society. He was also a fellow of the UK Institute of Physics, received the institute's Rutherford Medal and Prize in 1992, and was awarded the Order of the British Empire in 2001 for services to physics. He received two honorary doctorates in science, and during his emeritus years continued to contribute as a member of national and international scientific advisory committees.

As a colleague in Liverpool, he was widely admired and respected. He was a friend and mentor who exhibited unwavering support and concern for his colleagues' individual well-being and career advancement, while demanding in return delivery of physics of the very highest standard.

● John Dainton and Themis Bowcock, University of Liverpool.

Werner Kienzle 1936–2016

Experimental particle-physicist Werner Kienzle was born in Wiernsheim, a small town in Baden-Württemberg close to Stuttgart. His childhood was profoundly marked by the war and the death of his father on the German eastern front. Despite life after the war being difficult for his family, he was very successful in his academic studies and earned a fellowship at the University of Göttingen, where he did his PhD in solid-state physics.

Werner joined CERN in 1964 as a postdoc fellow and he remained at the Organization for his entire career. Concerned and eager for peace in the tense context of the Cold War, he was deeply involved in collaboration with Russian colleagues and participated in experiments in Serpukhov from 1968 to 1972. Back at CERN, his work concentrated on searching for evidence of the presence of quarks in hadrons. He was among the main



Werner Kienzle spent most of his career at CERN.

initiators of the NA3 experiment at the Super Proton Synchrotron (SPS), which allowed measurements of the structure functions of pions. The results indicated a cross-section about twice as high as anticipated, corresponding to QCD high-order

corrections, and this enhancement was named the "K" factor by the collaboration, as recognition of Werner's contribution.

Werner was appointed SPS co-ordinator at the beginning of the 1980s and participated in the discovery of the W and Z bosons. In parallel, he became involved in new outreach programmes: in particular, he was promoter of the Microcosm in 1988 and editor of the *Hadrons for Health* reference booklet in 1996. While reaching his retirement age, Werner participated in the development of the total cross-section measurement set-ups that initiated the TOTEM experiment at the LHC.

Werner was a fantastic and enthusiastic storyteller, an adventurer and an innovator. His wife, Maria, and his sons, Francesco and Marco, can be proud of everything he did for CERN.

● His colleagues and friends.

Faces & Places

Stanley Mandelstam 1928–2016

The great theoretician Stanley Mandelstam passed away in June, aged 87. He was born in Johannesburg, South Africa, from a Jewish family originating in Latvia, and studied in the UK under doctoral adviser Richard Dalitz. He became a professor at the University of Birmingham in 1960, then at the University of California at Berkeley in 1963.

His initial reputation came from his 1958 proposal of what is called the Mandelstam representation, which implies that the scattering amplitude is the boundary value of an analytic function in a 2D domain in which the only singularities are cuts. Some people could say, now that we have the Standard Model of particle physics, that all this was useless. This is not the case historically, however, since it supported the idea that interesting results could be obtained from the combination of analyticity and unitarity.

The main example is the “Froissart



Stanley Mandelstam.

Bound” obtained in 1961, which says that the cross-section cannot increase faster than the square of the logarithm of the energy. In 1966, a proof of the Froissart bound was obtained without the Mandelstam representation. Around that time, V N Gribov also used the Mandelstam representation to predict that the scattering amplitude does not behave as was

expected at high energies. It is also clear that the Veneziano amplitude, which was proposed in 1968 and led to dual models in which particles interact via “strings”, was inspired by the Mandelstam representation. The surprise was that theoreticians proposed that particles themselves be strings or superstrings. It is precisely in this domain that Mandelstam made further fundamental contributions.

It's not possible to list all of his papers here, but let me single out his proof that $N = 4$ supersymmetry is finite, an important result for which he sought absolutely no publicity. Mandelstam was a fellow of the Royal Society and of the American Academy of Arts and Sciences. He received the Dirac Medal in 1991 and the Dannie Heineman Prize in 1992. Testimonies from students say that he was an excellent lecturer, including in undergraduate courses. Stanley Mandelstam was an affable person and incredibly modest. We shall miss him.

● André Martin, CERN.

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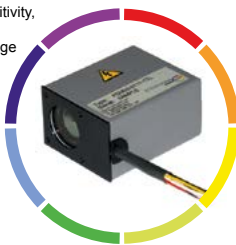


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