

Faces & Places

AWARDS

Engineering prize honours internet and Web pioneers

Five engineers whose work, beginning in the 1970s, led to the internet and the World Wide Web have together won the inaugural Queen Elizabeth Prize for Engineering. Robert Kahn, Vinton Cerf, Louis Pouzin, Tim Berners-Lee and Marc Andreessen were announced on 18 March as the winners at the Royal Academy of Engineering in London.

Kahn, Cerf and Pouzin receive the award for their contributions to the protocols that make up the fundamental architecture of the internet. French computer scientist Pouzin invented the datagram and designed an early packet communications network known as CYCLADES in the early 1970s. His work was broadly used by Americans Kahn and Cerf in the development of TCP/IP. Berners-Lee created the World Wide Web at CERN in 1989 and American Marc Andreessen wrote the Mosaic browser that is credited with popularizing the Web.

By sharing their work freely and without restriction these pioneers allowed the internet and the Web to be adopted rapidly around the world and to grow organically thanks to open and universal standards. Additionally, they have served as technical and political stewards of the internet and the web over the past 30 years as it has grown from its experimental phase to hosting 50 billion pages of information today. Today a third of the world's population uses the internet and it is estimated to carry around



Tim Berners-Lee is reunited with the historic NeXT computer at CERN during celebrations for the 20th anniversary of the web in 2009 (CERN Courier May 2009 p24). He used this computer to develop and run the first Web server, multimedia browser and Web editor.

330 petabytes of data a year – enough to transfer every character ever written in every book ever published 20 times over.

The Queen Elizabeth Prize for Engineering is a £1 million global engineering prize designed to reward and celebrate the individuals responsible

for a ground-breaking innovation in engineering that have benefited humanity. It is administered by the Royal Academy of Engineering.

The winners are due to come to London in June for the formal presentation of the prize at Buckingham Palace by Queen Elizabeth II.



Recipients of the Fundamental Physics Prize Foundation's special prize in fundamental physics, announced in December (CERN Courier January/February 2013 p36), accepted their awards at a ceremony in Geneva on 20 March. The prize was shared by leaders of the LHC

project and the CMS and ATLAS experiments from the time that the LHC was approved by the CERN Council in 1994. Here Guido Tonelli shares the stage with (left to right): Lyn Evans, Michel Della Negra, Tejinder Virdee, Peter Jenni, Joe Incandela and Fabiola Gianotti. Stephen



Hawking also received a special prize, while quantum-field theorist Alexander Polyakov received the 2013 Fundamental Physics Prize for his work in field theory and string theory. The event was hosted by the actor Morgan Freeman, who took the opportunity to visit CERN and the LHC tunnel (right).

Faces & Places

SYMPOSIUM

Imperial College celebrates Kibble's 80th birthday

Tom Kibble, one of the founding fathers of the Standard Model, turned 80 last December. To celebrate this milestone and Kibble's extraordinary contributions to theoretical physics, a one-day symposium was held on 13 March at Imperial College, London.

Kibble has made seminal contributions to the understanding of the mass-generating mechanism for elementary particles via symmetry breaking. Indeed, his profound papers of 1964 and 1967 provided key foundations for the Standard Model and inspired the search for the Higgs boson. He has also made significant contributions to the study of the dynamics of symmetry-breaking near phase transitions with diverse applications including to structure formation in the universe and vortices in helium-3.

The symposium profiled these and other aspects of Kibble's long scientific career. The two themes that resonated throughout the day were Kibble's extraordinary scientific achievements coupled with his humility.

The tenor of the meeting was set in the morning by Neil Turok, director of the Perimeter Institute for Theoretical Physics, who described Kibble as "our guru and example". He discussed Kibble's pioneering work on how topological defects might have formed in the early universe during symmetry-breaking phase transitions as the universe expanded and cooled. Wojciech Zurek of Los Alamos National Laboratory continued with this theme, surveying analogous processes within the context of condensed matter systems and explaining the famous Kibble-Zurek scaling phenomenon. Turok noted that while defects have been found everywhere in the lab, they are still



Tom Kibble, centre, with from left to right, Jim Virdee, John Hassard, Tariq Ali, Peter Dornan, John Pendry and Jordan Nash. (Images: Meilin Sancho, Imperial College.)



Weinberg gave the keynote presentation.

to be seen in the universe, although many physicists remain hopeful.

The afternoon's events were concluded by Jim Virdee of Imperial College and the CMS experiment, who summarized the epic quest of finding the Higgs boson at the LHC. His talk surveyed the history of the LHC experiments and brought a rapt audience up to date with the latest data from CERN, all of which support the case that the new boson discovered last year is, indeed,

a Higgs boson. At the end of the talk, there was a standing ovation for Kibble that lasted several minutes.

In the evening, Nobel laureate Steven Weinberg gave a stunning keynote presentation to a capacity audience of 700. With no visual props, he talked eruditely on symmetry breaking and its role in elementary particle physics. He emphasized the role played by the three 1964 papers by Robert Brout, François Englert, Peter Higgs, Gerald Guralnik, Carl Hagen and Kibble himself. He also emphasized the significant impact of Kibble's sole-authored 1967 paper that, among other things, explains the mechanism whereby the W and Z boson get mass while the photon remains massless.

At the banquet, the UK Minister of Science, David Willetts, praised Kibble's contributions to fundamental knowledge and the important ongoing role of Imperial College and the UK more generally. Ed Copeland of the University of Nottingham and Kibble's most prolific collaborator, profiled Kibble's scientific leadership, vision and generosity. Robert Kibble recollected that while his father was doing his amazing work, family life continued as normal – although holiday destinations did strangely seem to coincide with venues for physics conferences. Frank Close of Oxford University concluded the banquet speeches by summarizing the significance of Kibble's contributions to the Standard Model, again highlighting how his 1967 paper inspired Abdus Salam and Weinberg to realize that symmetry breaking could be applied to a marriage of the weak and electromagnetic interactions.

Jerome Gauntlett, Imperial College.

NEW PRODUCTS

Kepeco Inc has announced new 1500 W and 3000 W models in its series of KLN automatic crossover, low-profile, high-performance, low-cost programmable power supplies. The KLN series offers stable DC power in a 1 U high, half-rack package for 750 W. They are now adding a 1 U high,

full-rack package at 1500 W and a 2 U high, full-rack package at 3000 W. Output voltages range from 0–6 V to 0–600 V with output currents from 0–400 A to 0–1.25 A. For details, contact Saul Kupferberg, tel +1 718 461 7000, e-mail saulk@kepecopower.com or visit www.kepecopower.com/kln.htm.

Maxon Motor has introduced a modular multi-axis motherboard that can be applied with a few simple steps to suit drive systems with up to 11 axes. The EPOS motor-controller family comprises efficient, dynamic positioning controllers to operate brushed and brushless DC motors.

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INAUGURATION

Ceremony marks completion of ALMA telescope

In the vast Atacama Desert of the Chilean Andes, an official ceremony marked the inauguration of the Atacama Large Millimeter/submillimeter Array (ALMA) (CERN Courier October 2007 p23). More than 500 people attended the 13 March event, which signalled the completion of all major systems of the giant telescope and the formal transition from a construction project into an observatory.

A select group, including guest of honour Sebastián Piñera, the President of Chile, had the opportunity to visit the telescope, located

5000 m above sea level. The assembly of ALMA's antennas was recently completed, with the last batch of seven out of the final total of 66 antennas currently being tested before entering into service. The telescope has already provided unprecedented views of the cosmos using only a portion of its full array (CERN Courier November 2011 p13).

The ALMA array consists of 54 antennas with 12-m dishes and 12 smaller 7-m dishes, which work together as a single telescope. The signals from the individual antennas are brought together and processed by the "ALMA correlator" supercomputer. The 66 antennas can be arranged in different configurations, where the maximum distance between each one can vary from 150 m to 16 km.

ALMA is a partnership between scientific organizations and funding bodies in Europe, North America and East Asia, in co-operation with the Republic of Chile.



Guests at the inauguration included the president of Chile, Sebastián Piñera, seen here (second from left) on an ALMA transporter with representatives from the European Southern Observatory, the US National Science Foundation, ALMA and Japan's Ministry of Education, Culture, Sports, Science and Technology. (Image credit: ESO/NAOJ/NRAO.)

The EPOS2 Module 36/2 is designed as a plug-in module for OEM system integration. For details, contact Eva Maria Amstutz, tel +41 41 666 1500, e-mail evamaria.amstutz@maxonmotor.com or visit www.maxonmotor.com.

PI (Physik Instrumente) LP has introduced the C-884, 4-axis digital servo controller, designed to control motorized linear translation stages and rotary positioners with high accuracy and repeatability. The high-speed encoder interface allows the use of direct-metrology linear and angular scales with resolutions below the nanometre and microrad regions. The controller has a dual-core architecture for fast servo handling and command interpretation. Communication is through

industry standard TCP/IP, USB and RS-232 interfaces. For details, contact tel +1 508 832 3456, e-mail info@pi-usa.us or see www.pi-usa.us.

Southern Scientific has announced the DoseRAE 2, a compact, direct-reading, electronic personal radiation detector with alarm, which accurately accumulates real-time dose-data to allow immediate reaction in case of radiation occurrences. The device uses a compensated PIN diode and a caesium-iodide scintillation crystal to detect X and γ -radiation and provide high dose-rate range coverage, accurate dose measurements and fast response to low-level radiation. For more information, tel +44 1273 497600, or e-mail info@southernscientific.co.uk.

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OBITUARIES

Hugh Hereward 1920–2013

Hugh Hereward, one of the founding fathers of CERN, died on 20 February. As one of the leading accelerator physicists, he made essential contributions to the Proton Synchrotron (PS) and the Intersecting Storage Rings (ISR).

Hugh was born in 1920 in London to the family of an ocean-going captain of merchant vessels. He attended King Edward's High School in Birmingham, where a physics teacher who believed in his abilities encouraged him to specialize in the subject. With a scholarship to St John's College, Cambridge, where John Cockcroft was at the time, he took a shortened degree course and chose in 1942 to continue research rather than join the army. He was one of several physicists who, during the Second World War, contributed to the development of atomic energy in Hans von Halban's group at Cambridge, before moving to Montreal in 1943.

After joining CERN in 1953, Hugh led the group that built the first 50 MeV linear accelerator used to inject protons into the PS, but he soon went on to study more general problems of accelerator theory. He became the great intellect whose chosen role was to study and analyse whatever knotty problems in accelerator theory were preventing a full understanding of the PS – and afterwards the ISR – to exploit the potential of each machine to the fullest.

He made essential contributions to the theory of linear accelerators, proposed and analysed in detail the slow resonant extraction of the PS beam and produced a number of now classic reports and lectures



Hugh Hereward, left, at CERN in 1961.

on matching and mismatching beams, beam instabilities and Landau damping, as well as on stochastic cooling. He also was one of the proponents of the ISR. Some of his memos were circulated in handwritten form but were so clear that his colleagues, when asked about these subjects 40 years later, will still search their filing cabinets for “something that Hereward wrote on this”.

On first meeting, Hugh seemed a rather reserved and eccentric person. His well worn flannel trousers were supported by a broad leather belt whose tarnished buckle was fashioned into the insignia of the Boy Scouts, complete with the motto “Be

prepared”. We dared not ask if this was a reminder to himself or an exhortation to others. Colleagues would often consult him – the experience was reminiscent of a trip to Delphi. The question would be posed and a silence would follow, often long enough to induce unease in the questioner, who might be tempted to rephrase the question. This was unwise, for the clock would be restarted and another long pause would ensue – Hugh would seem disturbed that his thought process had been interrupted. Usually, the verdict would be delivered with gravity and precision but, failing that, the question would rebound in quite a different formulation, requiring further research on the part of the questioner.

Hugh's heyday was when he led the Machine Studies Team that developed the performance of the PS in the 1960s. He became leader by common acclaim and went on to fill the same role at the ISR. When by the mid-1970s, both the PS and the ISR had reached performance levels far beyond what anyone would have dared to forecast, he chose to retire from CERN, to live quietly in a village in the UK, while occasionally accepting consulting engagements for other laboratories in the US, Canada and Europe. Despite the decades that have passed since he left CERN, Hugh has remained vivid in the memory of all who had contact with him and benefited from his precious advice during those early years.

● *His former colleagues and friends.*

Based on an account in *Engines of Discovery* (World Scientific 2007) by Andrew Sessler and Edmund Wilson.

Theodoros Kalogeropoulos 1931–2012

Theodoros (Ted) Kalogeropoulos, a distinguished physicist in elementary particle physics, and professor emeritus of Syracuse University, passed away on 7 September in Athens, Greece. His burial took place in Mallota – “the navel (the centre) of the earth” – as he used to call his village.

Ted was born on 20 January 1931 in the small village of Mallota in the prefecture of Arcadia, Greece, where his father was the village priest. His primary education began in Mallota and continued with high

school in Magalopolis and later in Athens. He qualified in the Physics Department of the National and Kapodistrian University of Athens and received his diploma with high honours in 1954.

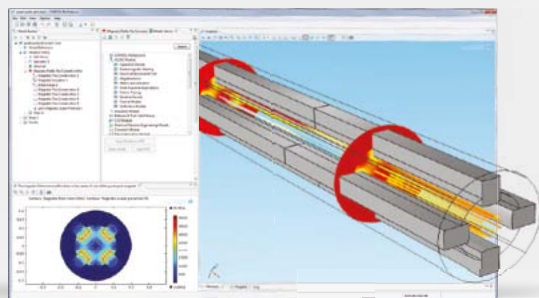
He then began graduate studies at the University of California, Berkeley, where he received his PhD in 1959 under Gerson Goldhaber. It was a golden period for Berkeley, where the antiproton had recently (1955) been discovered at the Bevatron at the Lawrence Radiation Laboratory. Ted's dissertation, “A study of the Antiproton

Annihilation Process in Complex Nuclei”, was an experiment with photographic emulsions. He collaborated with Owen Chamberlain, Emilio Segrè and Dick Dalitz and also participated in a bubble chamber experiment on pion-pion correlations in antiproton-annihilation events.

After receiving his PhD, Ted worked as a postdoc at Columbia University before joining the physics faculty at Syracuse University in 1962. There he continued his studies of antiproton interactions with protons and neutrons at rest and in flight at ▷

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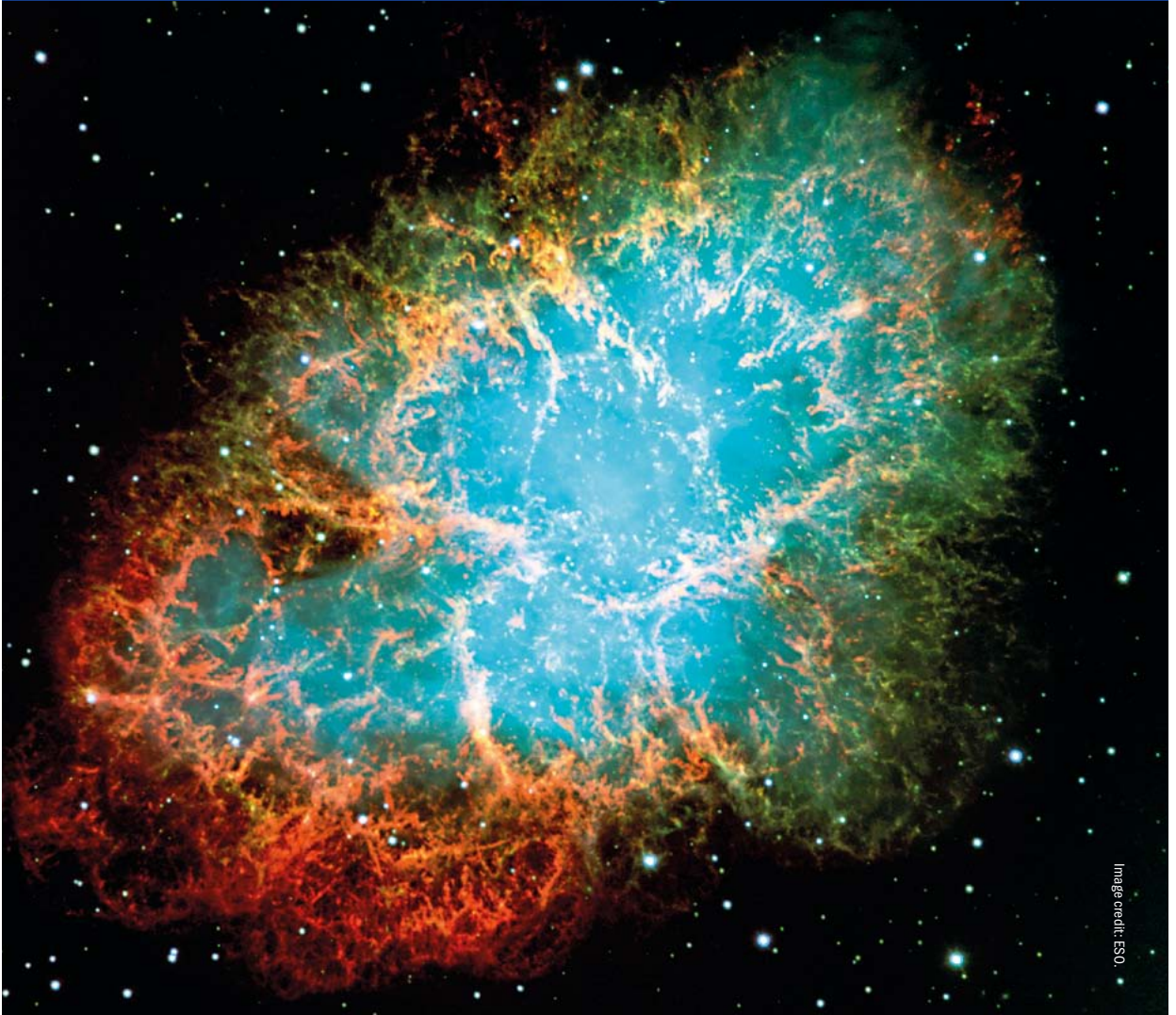


Image credit: ESO.

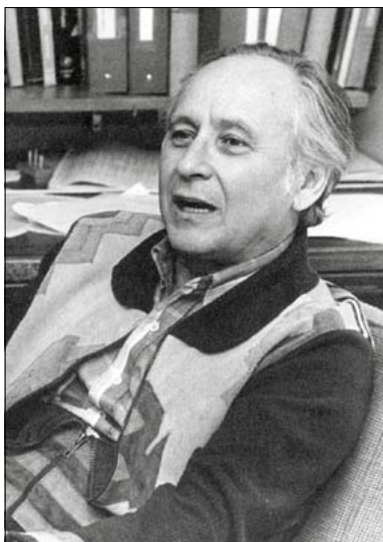
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low energies, using bubble chambers, spark chambers, wire chambers, sodium-iodide crystals and novel time-of-flight techniques. From 1963 to 1984 he led an experimental group at Brookhaven National Laboratory. He was one of the world experts in the field of antiproton annihilations.

Ted played an important role when he joined the high-energy-physics experimental group of the “Demokritos” research centre in Greece during his sabbatical from Syracuse University and he continued this collaboration after his return to the US. From then on, he was concerned with organizing the development and progress of the Greek group. As a teacher he shared his enthusiasm, inspiring his students, including several Greek physicists who received their PhDs under his supervision, all of whom later became professors in Greek universities.

After a long involvement with the pure physics of antiprotons, Ted made use of their properties in medicine, diagnostic imaging and for therapeutic purposes. He published



Kalogeropoulos. (Image credit: Syracuse.)

interesting basic papers on this subject, which has recently been revived by people working on the idea of using antiprotons for cancer therapy. After his retirement in 1998, Ted became professor emeritus at Syracuse and moved to Athens where he continued to work on research in medicine.

As a graduate student Ted married Nafsika, who died in Athens in 2009. She was always a great help to him, especially in the early years in the US. During the Syracuse period their house was an oasis for the Greek graduate students. To the students, the couple and their daughter Julie were like their own people at home.

We all recall Ted's generosity, his enthusiasm for research and his deep love for physics. Each time he was around his laugh could be heard from tens of metres away. His students, friends and colleagues will always remember him as a great personality.

● *Manolis Dris and Theodora Papadopoulou, National Technical University of Athens.*

Paul Kienle 1931–2013

Paul Kienle began studying physics at the Technische Hochschule München (TH München) in 1949. For his diploma thesis he developed position sensitive Geiger-Müller counters, which he used in work for his doctoral thesis (1957) to measure radiation fields. Subsequently he spent more than a year at Brookhaven National Laboratory, where he was trained in health physics and radiation safety. Back at TH München he built up a radiation safety group at the new Research Reactor (FRM) in Garching and in parallel he started work on the application of the Mössbauer-effect, which led to his habilitation degree in 1962.

Shortly afterwards Paul became professor of radiation and nuclear physics at the Technische Hochschule Darmstadt, but in 1965 he returned to TH München (which was to be renamed the Technische Universität (TU) München) to become professor of experimental physics, joining his former teacher Heinz Maier-Leibnitz and his fellow student and friend Rudolf Mössbauer. In the following years, he and Ulrich Mayer-Berkhout from the Ludwig-Maximilians-Universität München were responsible for the construction of the Tandem Accelerator Laboratory of both Munich universities, which started operation in Garching in 1970.

In 1984 Paul became director of GSI in Darmstadt and led the design and



Paul Kienle. (Image credit: SML.)

construction of the Heavy Ion Synchrotron and the Experimental Storage Ring (ESR), which started operation in 1990. Two years later he returned again to TU München, but continued research in medium-energy heavy-ion physics at GSI. There he and his colleagues at the ESR discovered a new decay mode, bound β -decay, opening a new field in nuclear astrophysics and in studies of weak decays. In 1996, together with his long-time collaborators from Japan, he was involved in the discovery of deeply bound pionic nuclear states at GSI, which

led to some of the first evidence for the partial restoration of spontaneous chiral symmetry-breaking of QCD in a nuclear medium.

Paul's vision to create new tools for the future is beautifully illustrated with his proposal in 1998 for the construction of the High Energy Storage Ring, as a new approach for physics with antiproton annihilation, which should soon become available at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt.

As professor emeritus at TU München from 1999, he continued his research and in 2002 became director of the Stefan Meyer Institute for Subatomic Physics in Vienna, focusing on experimental studies at GSI (the FOPI experiment), FAIR (PANDA) and the INFN Frascati National Laboratories (SIDDHARTA).

It was a great honour and pleasure to work with Paul and we would like to express our gratitude for, and appreciation of, his tremendous impact on modern nuclear science. We admired his enthusiasm in creating new methods and in triggering work on new technologies to solve open problems in physics. His passion for physics and his motto, *niemals aufgeben*, (never give up), will provide guidance and an obligation for us all.

● *His colleagues and friends from TU München, GSI, LNF-INFN and the SML.*

Faces & Places

Wiktor Peryt 1944–2013

Wiktor Peryt, one of the pioneers who introduced and developed heavy-ion physics at Warsaw University of Technology (WUT), passed away on 15 January.

Peryt graduated from Warsaw University in 1968, where he specialized in nuclear physics. For his PhD, at JINR, Dubna, he made a quantitative comparison of results from bubble chambers with the theoretical predictions of the nuclear cascade model developed in Dubna, revealing new features in the reactions studied. As a by-product he developed useful computer methods for data analysis.

At WUT, Peryt introduced computer methods into practical work in the student laboratories, allowing real physics data analysis. This led him later to organize the first national conference on Microcomputers in Physics Teaching, held at WUT in 1987. He also pioneered the introduction of CAMAC and VME systems into the teaching programme and organized “CAMAC”, an academic circle where students learned how to use modular electronics and data-handling systems interfaced to computers.

Thanks to Peryt's contacts, the group at WUT joined the STAR experiment at Brookhaven, participating in R&D for the silicon vertex tracker. He also introduced the group to the NA49 and NA61/SHINE experiments at CERN. Under his leadership, WUT participated in all of the phases of NA61/SHINE, starting with the preparation of the project, then called “NA49 future”. He led the work to replace the detector control system (DCS) almost completely and implement a new one based on EPICS (Experimental Physics and Industrial Control System), while still maintaining and



Wiktor with the old electronics of the NA49 experiment. (Image credit: Jan Pluta.)

operating the NA61 DCS. He attracted many talented students to NA61/SHINE, who have greatly contributed to software, detector and physics, and he organized numerous meetings of the NA49 and NA61/SHINE collaborations in WUT.

Peryt was also deputy leader of the WUT group in the ALICE collaboration at the LHC, contributing in particular to the construction and operation of the inner tracking system and the T0 trigger detector. However, Peryt's main responsibility concerned the design and implementation of the detector-construction database (DCDB), for which he mobilized a large number of students from several faculties at WUT. It was a big challenge and effort for him and for the young people to make project successful.

Recently, Peryt reactivated WUT's participation in experiments at JINR, Dubna. Using his experience from CERN, he initiated the group's contribution to the DCDB and DCS for the experimental

Nuclotron-based Ion Collider Facility (NICA) and Multi-Purpose Detector (MPD) at Dubna. In parallel, he was involved in a new education programme at WUT, leading a project supported by the European Union, in close collaboration with other nuclear institutions both in Poland and abroad.

As a collaborator, colleague and teacher, Peryt was rather restrained and far from making publicity of his activity and results. It was therefore sometimes surprising that he was able to attract many young people to work with him. Maybe, to understand this phenomenon, we should recall his poetic phrase on the role of electronics in physics experiments as “the grey roots of beautiful flowers” – not visible but leading to spectacular results. Now, after his passing, we see him also as “grey roots” – not promoting himself, but giving young people the possibilities of interesting work and a rapid rise in their career.

● *His former colleagues and friends.*

MEETINGS

The **XXIX International Workshop on High Energy Physics** “New Results and Actual Problems in Particle & Astroparticle Physics and Cosmology” will take place on 26–28 June in Protvino, Moscow region. The purpose is to present a more complete and coherent picture of the understanding of the structure and dynamics of the microcosm, the megacosm and its evolution, and the relationship between these two extremes of modern physics. The workshop will cover both theory and experiment/observations. The aim will be to encourage much more critical discussion at the meeting than is usual, with workshop reports accompanied by discussion panels and talks. For details

and deadlines (especially regarding Russian visas) see <https://indico.cern.ch/conferenceDisplay.py?confId=211539>.

EPS-HEP 2013, the 2013 Europhysics conference on High Energy Physics, organized by the High Energy and Particle Physics Division of the European Physical Society, will take place in Stockholm, on 18–24 July. Parallel and plenary sessions will be held at the Royal Institute of Technology and the Aula Magna at Stockholm University, respectively, with poster sessions throughout the conference. There will also be a joint ECFA-EPS session on Particle Physics after the European Strategy Update

on the 20 July. For details and registration, see <http://eps-hep2013.eu>.

HEP-MAD 13, the 6th High-Energy Physics International Conference in Madagascar will be held on 4–10 September in Antananarivo. The conference, which is part specialized meeting and part introductory school, will discuss a range of theoretical and experimental physics from high-energy physics to astroparticle physics. These topics will be presented in the form of introductory reviews, short contributions and posters, complemented by national talks in other areas of physics. For details, see www.lpta.univ-montp2.fr/users/qcd/qcd2012/hepmad13/Welcome.html.

William (Bill) J Willis 1932–2012

Today's vast and highly sophisticated particle detectors rely not only on many intertwining technological developments, but also on the ambition and vision of the particle physicists themselves. Over the past 50 years few have contributed as profoundly to the evolution of these detectors as Bill Willis, who died last November at the age of 80, after a short illness.

Bill was an undergraduate and PhD student at Yale and in the early part of his career he worked on the development of the bubble-chamber technique. He was an author on the famous 1964 paper announcing the discovery of the Ω^- and participated in several studies of hyperon decays at Brookhaven. He joined the Yale faculty in 1965 and, after initially seeking resources to pursue research with bubble chambers, he recognized the power and potential of what were at the time referred to as "counters", so he switched. He would later recall, with appreciation, the response of the Yale department-head to whom he announced this volte-face: "I worry much more about professors who never change their mind."

Motivated by his research on weak decays, Bill began to think about ways to study decays into a lepton plus a neutrino in the environment of a hadron collider. He met Veljko Radeka, starting a life-long collaboration and friendship. One day in the early 1970s he drew on Radeka's blackboard a large circle, representing a sphere, with two tiny circles at the poles, explaining that the smaller circles were the holes for the colliding beams, and the large circle represented the volume in which the total energy of all particles (charged and neutral) should be measured and the leptons identified. Bill called his concept the "impactometer": it has become the standard approach for collider experiments.

The only hadron collider at the time being the Intersecting Storage Rings (ISR), Jack Steinberger was able to attract Bill to CERN, where he introduced him as "the cleverest physicist I know". There followed a decade of pioneering developments, notably liquid argon calorimetry, the detailed study of calorimeter resolution and transition radiation detectors. Deployment in experiments at the ISR led to the first observation of single-photon production at high p_t and the co-discovery (with CERN's SppS collider) of high- p_t jets, the latter through a first (approximate) realization of the "impactometer" in the form of the



Bill Willis. (Image credit: Columbia Univ.)

Axial Field Spectrometer. Throughout this period, Bill continued to collaborate closely with Radeka and with new colleagues at CERN, notably Chris Fabjan. He also developed fruitful links with several Russian colleagues, led by Boris Dolgoshein, who became collaborators and friends.

Starting in 1975, and extending for over 30 years, Bill spent some of his time at Brookhaven, initially to guide the development of experimentation for ISABELLE. But with ISABELLE's cancellation and the end of the ISR programme in the early 1980s, he seized the opportunity to promote a whole new field: the study of nuclear matter under extreme conditions of temperature and density as a means of searching for new forms of matter. He convinced the CERN management to adapt the Super Proton Synchrotron (SPS) to heavy-ion operation and to support an exploratory round of experiments. He was also instrumental in building the case for the Relativistic Heavy-Ion Collider (RHIC), which began operations at Brookhaven in 2000. The discoveries of a "new form of matter" at the SPS and of the strongly coupled quark-gluon plasma at RHIC are directly traceable to Bill's scientific vision. This programme continues today as a major research topic at the LHC.

Bill returned to the US in 1990,

taking up a professorship at Columbia University, and became engaged in the Superconducting Super Collider (SSC). He was co-spokesperson of the GEM collaboration for the SSC and then, using his understanding and experience of both CERN and the US, he played a key co-ordinating role in bringing a large number of US scientists to the LHC programme, with major involvements in both ATLAS and CMS. Bill served as the US ATLAS Construction Project Manager until 2005 and was a member of the ATLAS Executive Board for four years. The performance of the ATLAS liquid argon calorimeter, not least in the discovery of the Higgs boson, should have given him a sense of real satisfaction – not that he would ever show it.

His range of activities and enthusiasm continued almost unabated. He was highly active in the International Linear Collider and most recently was involved in the MicroBooNE experiment, in which he combined his talent for developing ingenious approaches and his interest in novel detectors in the field of neutrino physics.

He served on numerous committees and panels, both in Europe and in the US, and, fittingly for someone who had close ties with many Russian physicists, as a Member of the Scientific Policy Committee of the Russian Ministry of Science. In 1993 he was elected to the American Academy of Science and in 2003 he received the W K H Panofsky Prize of the American Physical Society for "his leading role in the development and exploitation of innovative techniques now widely adopted in particle physics, including liquid argon calorimetry, electron identification by detection of transition radiation, and hyperon beams".

Bill was hugely respected for his incisive and original mind and for his many contributions to our field. But there was also the sheer delight of interacting with him at a personal level: none of us involved in the preparation of this article can remember him raising his voice, to anyone, ever. Two close collaborators concluded a review article on calorimetry in the early 1980s by writing "It is a pleasure to acknowledge the stimulation and interest arising from our association with W J Willis". In its quietly understated style it is a fitting tribute to a quietly understated man, who was one of the finest physicists of his generation. We are privileged to have known him and worked with him.

● *His friends and colleagues.*