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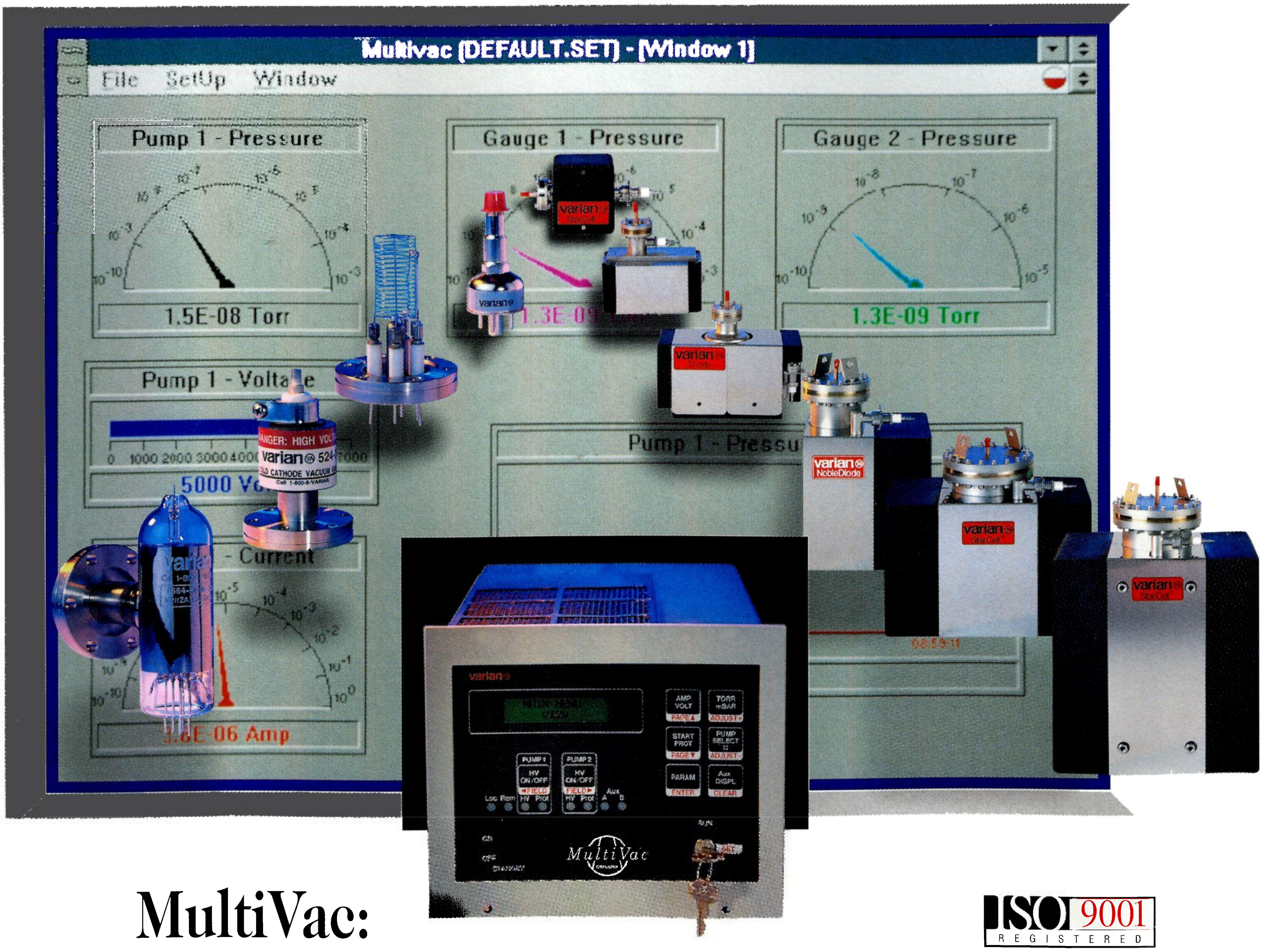

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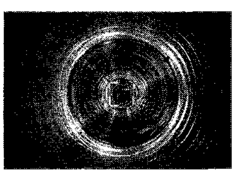


Cover photo: Central hall of the Quark2000 exhibition at Rome's Palazzo delle Esposizioni, dominated by a life-size replica of the Borexino experiment at the national Gran Sasso Laboratory. Quark2000 was organized by the Istituto Nazionale di Fisica Nucleare (INFN) in association with the City of Rome (see page 24 - Photo Roberto Baldini, Frascati).

Around the Laboratories

DESY Superconducting success

DESY's declared objectives took a mighty step forward at the beginning of June when the Hamburg laboratory's TESLA (TeV Superconducting Linear Accelerator) Test Facility (TTF) took an electron beam to 80 MeV* in a 12-metre module containing eight superconducting accelerator cavities - a world record in-beam accelerating gradient of 10 MV/metre. Following this initial success, the accelerating gradient after some processing reached 16.7 MV/m, well above the declared initial target of 15 MV/m. (*10 MeV is supplied by the injector.)

The ultimate objective is for the Laboratory to aim for a multi-hundred GeV electron-positron linear collider in collaboration with other institutions. As well as spearheading, along with CERN's LHC proton collider, particle physics at the start of the 21st century, the new linear collider would have an integrated X-ray production capability to preserve DESY's tradition of supplying synchrotron radiation for DESY's large user community in this field. Additional electron beams could also serve nuclear physics experiments.

Initially, research and development work for DESY's linear collider pushed ahead on two fronts - TESLA and a more conventional approach using S-band radiofrequency. However recently a specially-formed review committee appointed by DESY's Extended Scientific Council and chaired by Kurt Hübner of CERN, Alexander Skrinsky of Novosibirsk and Maury Tigner of Cornell advocated that the TESLA approach be selected as the front runner in the R&D race. The latest achievement underlines the wisdom of their recommendation. However continuing S-band work provides a fallback solution should the challenging new technology encounter unexpected difficulties.

The latest DESY results show that the careful preparation work needed to fabricate solid niobium accelerating cavities to the level of perfection needed to guarantee 25 MV/m is well on the way to being mastered. The next stage is a three-module line to deliver 390 MeV.

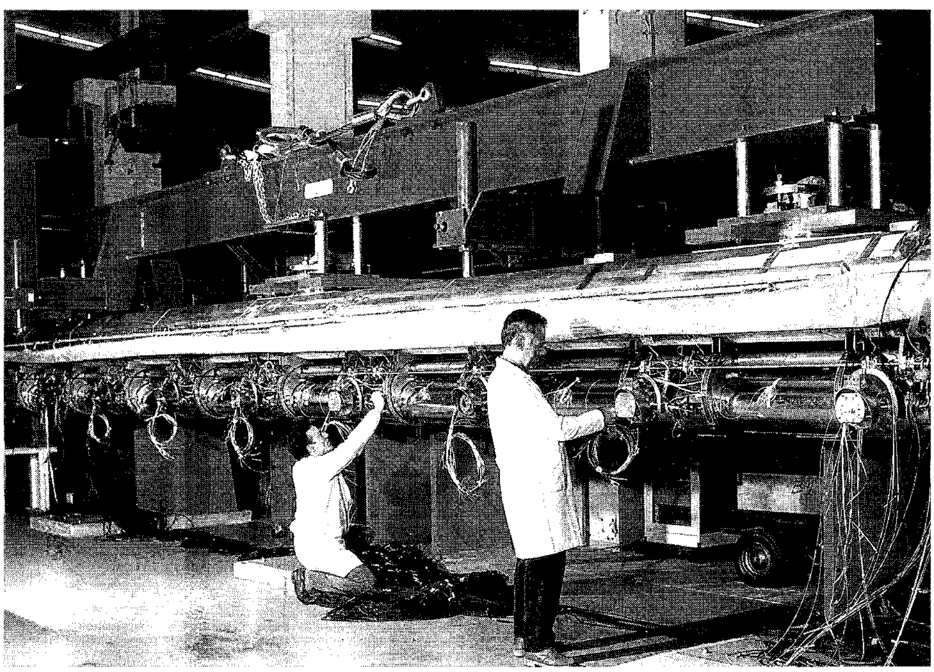
Each module is powered by a 1.3 GHz klystron providing 4.5 MW of power, and the electron beam is currently provided by a thermionic source. More powerful (10 MW) klystrons are envisaged, while the source will be upgraded to a laser-irradiated photocathode. The work is the result of an international collaboration by 25 institutions in China, Finland, France, Germany, Italy, Poland, Russia, and the USA.

To achieve the multi-hundred GeV electron-positron collider would mean building a 32 kilometre tunnel, some 15 metres underground, heading northwestwards from the DESY site to the neighbouring province of Schleswig-Holstein. It would be tangential to the existing 6.3 kilometre HERA proton ring to keep open the possibility of electron-proton collisions.

The proposed layout of the linear collider is already one of the standard items in DESY Director General Bjoern Wiik's kit of transparencies. Preparatory design and planning work is underway en route to a possible decision in 2001 or 2002.

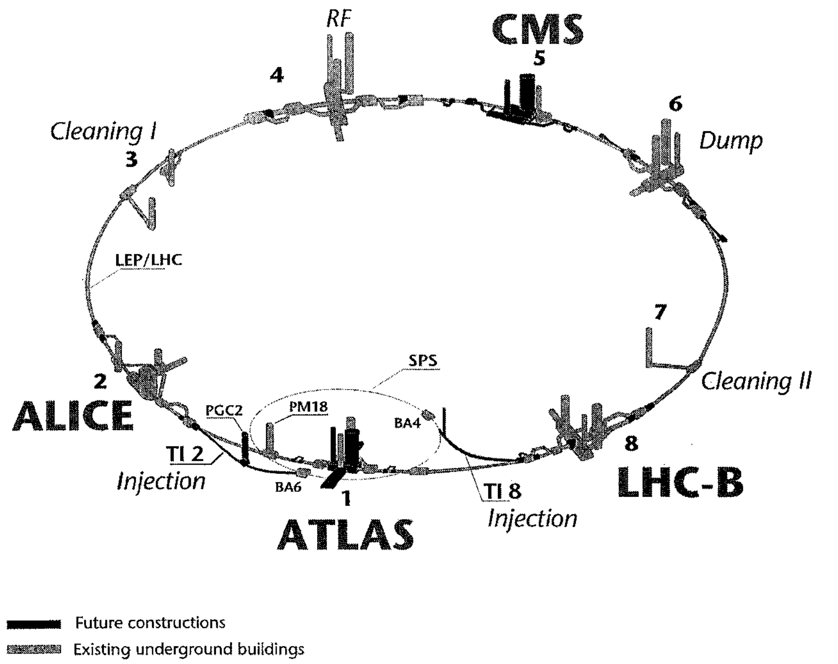
Containing eight solid niobium cavities, each of nine cells, this superconducting accelerating module at the DESY Laboratory, Hamburg, recently achieved world record accelerating gradients in excess of 15 MV/m, promising well for the future of high energy linear electron-positron colliders based on this technology.

(Photo Manfred Schulze-Alex)



Although CERN's LHC proton collider inherits the 27 kilometre tunnel constructed for the LEP electron-positron collider, much civil engineering work has to be done, including new experimental areas and beam transfer tunnels. Existing underground buildings are lightly shaded, whilst the future constructions are shown darker.

CERN LHC civil engineering



Despite the fact that CERN's LHC proton collider will occupy the 27-kilometre tunnel currently inhabited by the LEP electron-positron collider, there is still a lot of major civil engineering work to be done before the new accelerator and its detectors can be installed. Calls to tender are currently out, each worth around 100 million Swiss francs, for three contracts which divide the work approximately evenly. In addition, Switzerland, as part of its special contribution to the LHC project, is taking responsibility for one of the tunnels which will house transfer lines feeding protons from the SPS proton synchrotron to the LHC.

Two of the three big packages currently out to tender are for all the surface buildings and caverns for the big ATLAS and CMS experiments. The third encompasses the remaining work. A total of 15 consortia made up of 45 companies from CERN Member States are bidding for the projects, each of which has its own special demands. Offers are expected in July, and contracts are expected to be awarded before the end of the year for work to begin early in 1998.

The ATLAS package is the only one to require surface construction in Switzerland. ATLAS, at point 1 on the LEP/LHC ring, will be the closest LHC experiment to the CERN Meyrin site. Two access shafts already exist, and these will be reused. A further two will be added. The surface buildings have been designed by a local architect, and the main hall will be attractively clad in wood.

The ATLAS cavern will be the LHC's biggest, and quarter of a million tons of rock have to be excavated. The difficulty arises, however, not only from the sheer scale of the operation, but from the fact that the work will be taking place very close to the operating LEP accelerator, and such large scale work will inevitably cause ground movement in its vicinity. To make matters even more delicate, the precision polarimeter which measures the energy of LEP's beams is installed at point 1. Should LEP run in 2000, ground movements caused by the neighbouring excavations will necessitate frequent LEP realignment.

Compared to point 1, point 5, diametrically across the ring, where CMS will be located, is relatively undeveloped. Plans for the surface buildings aim to cause as little disturbance as possible. The main hall, where the CMS detector will be built, can be partially dismantled when its job is done. During installation, this hall will be up to 23 metres high and 183 metres long. Afterwards, its height will be reduced to 16 metres, and its length to around 100 metres.

Although CMS requires a smaller underground experimental cavern than ATLAS, difficulty is caused by the ground quality in the area. Because the ground contains a lot of water, it has to be frozen before work can begin on excavating the access shafts. The instability of the underlying rock has also led to a novel design for the cavern. There will in effect be two caverns, one for the detector, the other for its services. These will be separated by a 7 metre thick concrete supporting wall which will also act as shielding. The wall will be built first, and the full extent of the caverns excavated either side of it.

The largest element of the third package will be the tunnel for the transfer line feeding protons clockwise into the LHC. This will be extended from the existing West Area SPS extraction, and join the LHC near point 2. The anticlockwise transfer line will be built as part of the

Swiss host-state special contribution to the LHC. As it leaves the SPS, this tunnel will point directly at the Gran Sasso laboratory in Italy, opening up the possibility of long-baseline neutrino experiments in the future if funding allows.

The anticlockwise transfer tunnel is scheduled for completion before the clockwise one, since it will be the first to be used for injection tests planned for 2003. Package three also includes the beam dump tunnels, to be built at point 6, and enlargements to the access tunnels to accommodate the length of the LHC dipoles during transport. Because much of the work in this package is accessed through the existing tunnel, it can not begin until LEP operations finish.

The current timetable envisages experimental caverns to be delivered in 2002 and 2003, with all major civil engineering complete soon after.

Four rings in a quarter of a century

On 26 May, CERN's four-ring Booster synchrotron proudly celebrated 25 years of very successful operations. As well as looking back, the Booster now also looks forward to a challenging new career as an integral part of the chain feeding CERN's LHC proton collider, scheduled to be commissioned in 2005.

In the mid-1960s, as CERN's new 28 GeV Proton Synchrotron (PS) was getting into its stride, plans were being prepared for the next stage of CERN development. Talk of new machines, which would eventually become the Intersecting Storage Rings (ISR) and the SPS Super Proton Synchrotron, was in the air. (At that time, it was not even clear that a super proton synchrotron would be built on the CERN site, and the prospect was another laboratory, "CERN II" to be built somewhere else.)

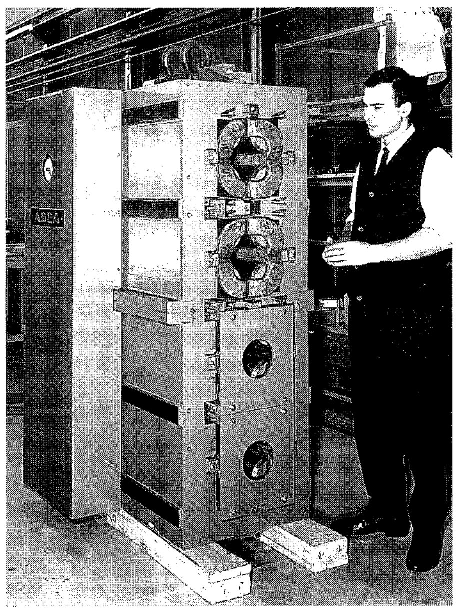
However, as the new machine debate continued, a clear requirement emerged for the proton yield of the PS to be boosted to 10^{13} per pulse. This would provide more punch to the ongoing PS physics programme, then eclipsed by achievements on the other side of the Atlantic, and prepare the way for what would come later.

At a special symposium to mark the 25th anniversary, Booster pioneer Helmut Reich explained how plans gradually focused on a multi-ring slow cycling synchrotron, in which particles from the component rings could be combined to inject a dense beam into the PS.

An initial proposal foresaw an Olympic five-ring machine, but this was discarded for a more modest, but more flexible, four-ring design. In this machine, one-quarter the PS circumference of 628 metres, the particles from each ring are transferred one after another to fill the PS in one pulse.

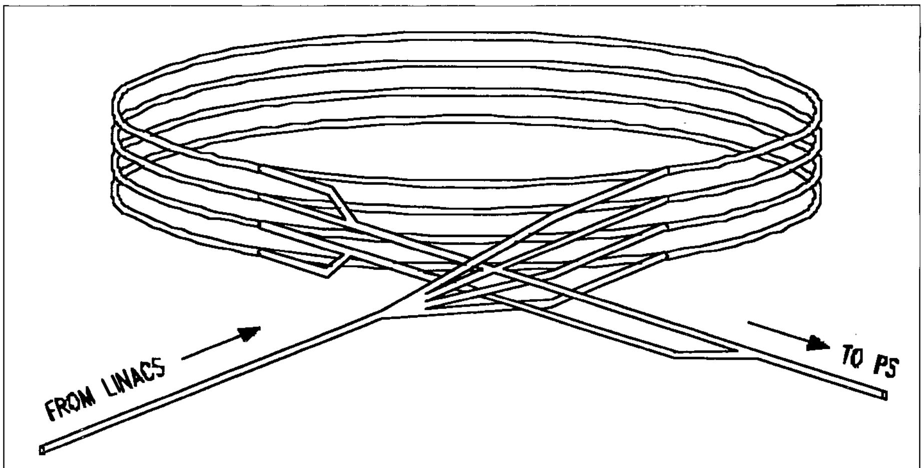
Construction began in 1968, with the centre of the machine exactly on the Franco-Swiss border of the newly-enlarged CERN site. At the anniversary symposium, Giorgio Brianti, project leader during Booster construction, related how different regulations in the two CERN host states led to the decision to site the visible Booster infrastructure on the Swiss, rather than the French, side. Construction of the Booster's quadru-

A special event at CERN on 26 May celebrated 25 years of very successful operations at CERN's four-ring Booster synchrotron. Left to right, Helmut Reich, Giorgio Brianti and Karlheinz Schindl covered the three Booster epochs of Genesis, Construction and Evolution.



Quadruple quadrupoles. 1969 photograph of construction of the focusing quadrupole magnets for CERN's four-ring Booster synchrotron.

In CERN's four-ring Booster synchrotron, one-quarter the Proton Synchrotron (PS) circumference of 628 metres, the particles from each ring are transferred one after another to fill the downstream PS in one pulse.



ple magnet yokes required considerable ingenuity.

On 26 May 1972 the Booster accelerated its first particles to the 800 MeV design energy.

Experiments did not have to wait long for the payoff, and in 1973 the neutral current search at the Gargamelle bubble chamber profited from the increased proton supply from the PS. The following year the Booster attained its design goal of 10^{13} particles per pulse (2.5 x 10^{12} per ring).

In 1988 the Booster, with its design goals long eclipsed by continually improved performances, was formally promoted to 1 GeV. Then in 1993 came preparation for the next stage in its career. The Booster will be the first in a fourfold chain of synchrotrons culminating in CERN's LHC proton collider. The special LHC requirements, with beam brilliances double the current level, will require special gymnastics to beat space-charge defocusing. For the LHC, the Booster will provide two-batch filling for the PS, injecting the four bunches from its four rings in one-half of the PS circumference. With the first such PS bunch having to wait for the second, the Booster obligingly increases its energy from 1 to 1.4 GeV to reduce unwelcome space-charge effects.

No matter what its achievements, the Booster had long been an orphan in the CERN family of synchrotrons, having no experimental area of its own. All its particles were eagerly devoured by the PS. But the built-in flexibility of its imaginative four-ring design had another unexpected pay-off. At the start of the 1990s, CERN's first machine, the 600 MeV synchro-cyclotron (SC), was reaching the end of its life. However the same could not be said for the ISOLDE on-line isotope separator, fed by SC beams and providing valuable pure and applied research material to a large scientific community.

Following a suggestion by Brian Allardyce and the late Roy Billinge, the decision was taken to resite ISOLDE at the Booster. In 1992, on its 20th anniversary, the Booster received a well-deserved coming-of-age present with its own experimental area. To mark that occasion, the Booster surpassed 3 x 10^{13} protons per pulse.

While the Booster, unlike its other CERN 'proton' synchrotron companions, has been exonerated from electron and positron running to supply LEP, it has had to handle a wide range of ions, beginning with deuterium and alpha particles in the early 1980s and gradually making its way up the Periodic Table to reach lead in 1994.

At a special event to celebrate the 25th anniversary, longtime Booster expert Karlheinz Schindl paid tribute to the foresight of those who had designed such a versatile and reliable machine all those years ago.

KEK
Major reorganization

The Japanese KEK Laboratory began a new chapter in its history on 1 April 1997 when it merged with the Institute for Nuclear Study (INS) and Meson Science Laboratory, both of the University of Tokyo.

The new name is the High Energy Accelerator Research Organization, but still KEK for short, the same abbreviation in Japanese. The new KEK consists of two research institutes, the Institute of Particle and Nuclear Studies and the Institute of Materials Structure Science. Directly under the Director-General of the new organization, the Accelerator Laboratory, the Applied Research Laboratory and the Administration Bureau have been created to support the research in the two institutes by providing services and by their own research and developments.

Currently, the 780 employees of the new organization are on two sites, about 60 km apart - the Tsukuba headquarters (the old KEK site) and Tanashi branch, Tanashi, Tokyo (the old INS site). The latter is expected to move to Tsukuba in a few years, but some people have the temporary

KEK directors at the unveiling ceremony commemorating the merger of the existing Japanese KEK laboratory with the Institute for Nuclear Study (INS) and Meson Science Laboratory, both of the University of Tokyo. The new name is the High Energy Accelerator Research Organization, but still KEK for short, the same abbreviation in Japanese. Left to right: Michiaki Takaishi, Secretary General of the Administration Bureau; Motohiro Kihara, Director, Accelerator Laboratory; Hirotaka Sugawara, KEK Director General; Sakue Yamada, Director, Institute of Particle and Nuclear Studies; Yoshitaka Kimura, Director, Institute of Materials Structure Science; and Kenjiro Kondo, Director, Applied Research Laboratory.

inconvenience of having to drive back and forth.

The new organization is led by Hirotaka Sugawara, the former director-general of National Laboratory for High Energy Physics (KEK). Other laboratory directors are Sakue Yamada (Particle and Nuclear Studies), Yoshitaka Kimura (Material Structure Science), Motoo Kihara (Accelerator) and Kenjiro Kondo (Applied Research).

The major aims of the reorganization are, with the combined forces of these three closely related laboratories, to accelerate the two future accelerator projects, the Japan Hadron Project and the Japan Linear Collider, and to foster interdisciplinary research for material sciences using high energy particle accelerators by the integration of facilities for synchrotron radiation (Photon Factory), slow positron, neutron scattering (KENS), and meson science.

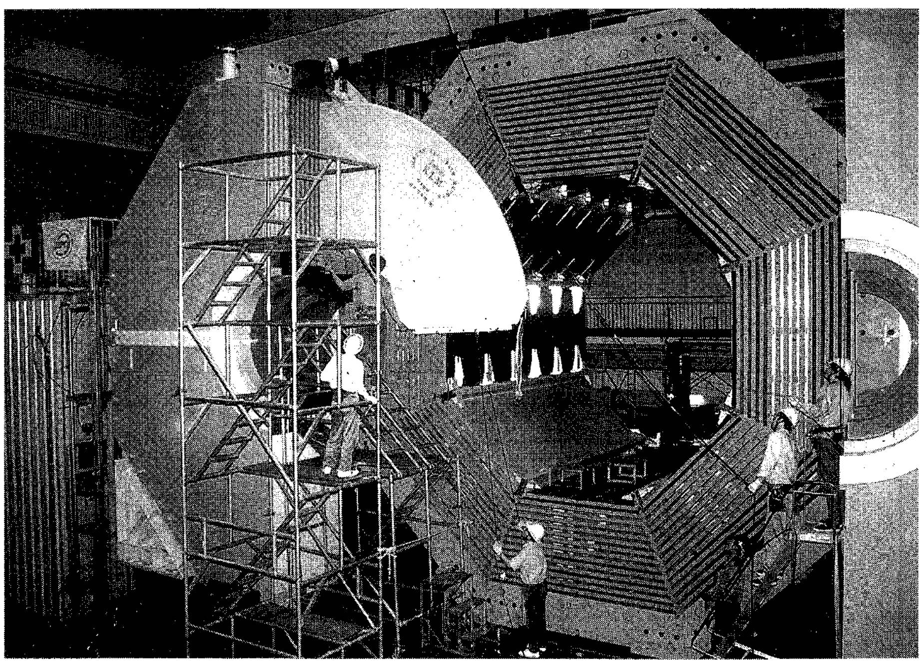
With the large and unified pool of accelerator resources, personnel as well as hardware, the new organization will be able to provide better and more efficient support to the current programmes, such as the B-factory and the long baseline neutrino projects, and to promote R&D work for future projects.

Particularly the two accelerator projects, JHP and JLC, are of the utmost importance to the future of the new organization, and two promotion offices have also been created, respectively headed by Shoji Nagamiya and Seigi Iwata.

The new KEK remains an interuniversity institute under the jurisdiction of Monbusho (the Ministry of Education, Science and Culture), and is expected to take on a more important role as the research centre of a broader area, covering not only particle and nuclear physics, but also chemistry, biology, engineering, and medical and agricultural sciences.

The enlarged KEK now looks increasingly towards international involvement. The reorganization was designed to improve communications with the outside community and to contribute more to global cooperation, establishing offices and committees to handle international affairs and assist visitors from other countries.

Fan-shaped RPC modules are being installed in the slots of the end yoke iron for the BELLE detector at the Japanese KEK Laboratory's B Factory. Also visible are some of the barrel RPC modules already installed in the barrel slots. See next story.



All's well at BELLE

After several years of planning and component production, assembly of the BELLE detector has begun at the Japanese KEK Laboratory's B Factory (KEKB - April 1994, page 18).

BELLE is the sole detector that will exploit the capabilities of this new asymmetric-energy electron-positron collider, expected to be commissioned sometime in the fall of 1998, and takes up the challenge of unveiling the secrets of CP violation (the mysterious disrespect Nature has for a combined particle/antiparticle and space reflection switch).

The BELLE collaboration has grown to about 250 physicists from 10 countries. Construction of the detector's iron structure was completed in March. Besides serving as a magnetic flux return for the 1.5 Tesla superconducting solenoid, it provides fifteen layers of slots, each with a 4.7-cm thick iron plate, and can be used as an absorber for detecting muons and long-lived kaons.

After fabrication, precision surveys were performed and the moving mechanisms for rolling in and out of the beam line and extracting the endcaps were thoroughly tested. Installation of the first detector components, the resistive plate counter (RPC) modules for detecting muons and long-lived kaons, began in April. The RPC detects charged tracks by collecting induced charges from streamer discharges between highly resistive electrodes.

This technology is well suited for charged track detectors which must cover a large area at relatively low cost. BELLE's muon and kaon detection system must cover 2000 square metres. A few years back, after extensive R&D, the collaboration decided to use electrode plates of 2-mm thick ordinary window glass. Its volume resistivity happens to be just in the right range for an RPC electrode.

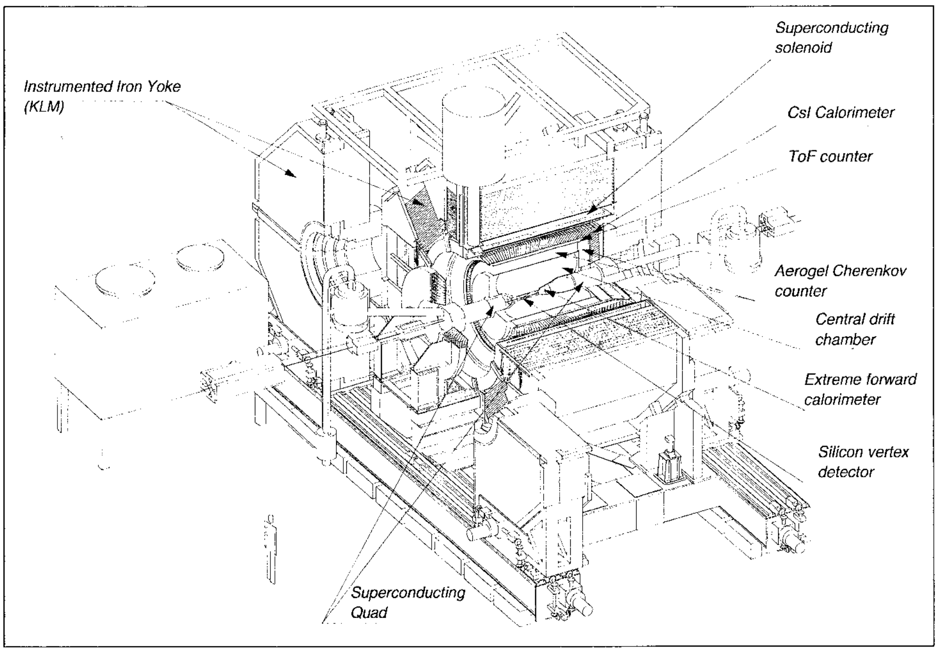
BELLE's RPC system consists of 240 rectangular-shaped barrel modules and 112 fan-shaped endcap modules. Each module provides one set of track coordinates with better than 99% efficiency. The barrel modules are being made by a Princeton/Virginia Tech team, while the endcap modules are the responsibility of an Osaka-City/Tohoku/Tohoku-Gakuin collaboration.

The RPC team managed to install about half the modules during April/May, before work around the iron yoke switched to installation of the superconducting solenoidal coil. For the remainder of 1997, the emphasis on the experimental floor will be on assembly and cooling tests of the cryogenic magnets.

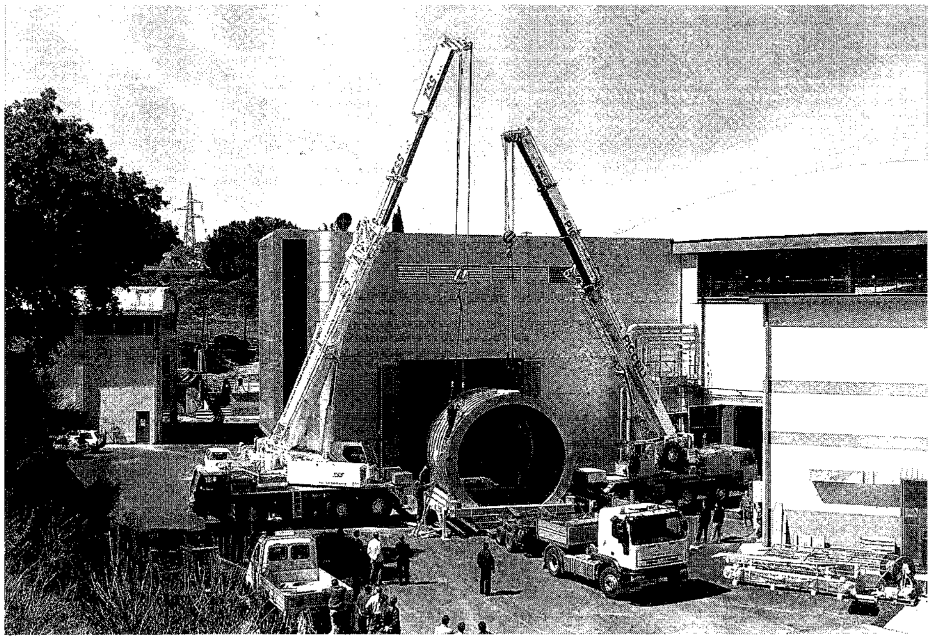
The 1.5 Tesla detector solenoid was successfully tested at the factory. After assembly, the iron structure will be moved to the collision point, and another cryostat housing a compensating solenoid and a focusing quadrupole will be mounted either side. Since these must be placed close to the collision point, and are well inside the iron yoke, the magnetic field in the detector volume must be carefully mapped during this period.

The iron structure will be moved out of the collision location in January 1998, and installation of the remaining RPCs and other detector components will resume. The collaboration plans to complete assembly by next summer, leaving sufficient time for a system test of the entire detector before machine commissioning.

Layout of the BELLE detector. The collaboration plans to complete assembly by next summer, leaving sufficient time for a system test of the entire detector before machine commissioning.



The arrival of the magnet coil, constructed by Oxford Instruments (UK), at Frascati INFN Laboratories (LNF) F -factory DAFNE (Double Annular F factory for Nice Experiments) on 17 April marked the first step in the assembly of KLOE (K LOng Experiment) en route to its precision study of kaon physics.



FRASCATI
A step nearer KLOE

KLOE (K LOng Experiment) is designed to study kaon physics at the Frascati INFN Laboratories (LNF) Φ -factory DAΦNE (Double Annular Φ factory for Nice Experiments). The F factory project, approved in June 1990, is now in a mature stage: the linac and the accumulator ring were successfully commissioned; the main rings vacuum will be closed by this summer and the first collisions are expected by fall.

KLOE is one of the three experiments which will operate at DAΦNE (the other two are FINUDA to study hypernuclei and DEAR to study kaonic hydrogen). KLOE's main goal is the measurement of CP-violation parameters (ε'/ε) with an accuracy of 10^{-4}.

As well as CP violation, KLOE will study rare decay modes of neutral kaons, eta and f^{o} (975) properties and non-perturbative effects in quantum chromodynamics (QCD - quark gluon field theory).

A Φ factory is well suited for CP violation studies because the daughter neutral kaons are odd under charge conjugation, forming an antisymmetric state of short-lived and long-lived kaons. Thus, in contrast to other CP violation experiments, in KLOE there is no uncertainty on the relative flux of short- and long-lived neutral kaons, which, in addition, are also monochromatic.

(The neutral kaon comes in two varieties - particle and antiparticle. To distinguish between them when the weak force is in operation, physicists invented the generalized mirror reflection of CP symmetry, which switches positive and negative electric charges and reverses space coordinates.

Even and odd CP states are defined by the sum and difference respectively of the neutral kaon and its antiparticle. If CP were conserved, the even state would decay into two pions, while the odd state would decay into three pions. Decaying into three pions is more difficult than decaying into two, so the even CP kaons are short-lived, while CP odd are long-lived. However in 1964 Jim Cronin and Val Fitch showed that at a level of about two per mil, long-lived kaons also decayed into two pions, violating CP.)

Measurement of the relative yield of charged and neutral two pion decay modes of short- and long-lived kaons, together with KLOE's unique opportunity to study the decay time correlation between the two neutral kaons, opens up a range of precision CP violation measurements.

DAΦNE's high luminosity, 5×10^{32} per sq cm per s, will ensure copious Φ production, giving KLOE about 5×10^{10} Φs per year at a rate of a few kHz. The Φs are produced at rest, so that the mean decay path of long-lived neutral kaons is about 3.5 metres. The pions from neutral kaon decays into two pions have momenta between 150 and 270 MeV/c, with a very large opening angle. Neutral two pions decays produce four photons with energies between 20 and 280 MeV.

The KLOE detector is designed with a large geometrical acceptance to contain long-lived kaon decays, good momentum and spatial resolution to control fiducial volumes, reconstruction efficiencies, and rejection of background from long-lived kaon decays in modes other than two pions.

The tracking system is as transparent as possible to avoid regeneration of short-lived kaons and to control multiple scattering. The apparatus is composed of a large (3m long and 4m diameter) cylindrical drift chamber surrounded

by a lead/scintillating fibre electromagnetic calorimeter with extremely good timing capacity. Both detectors are placed inside a superconducting coil with a 0.6 Tesla magnetic field.

The drift chamber has walls of material with low atomic mass and 52,140 wires, strung with stereo angles on alternate double layers. The expected performances are a spatial resolution of 200 microns (x-y) and 2 mm (z), momentum resolution 0.5%, and an accuracy of about 1 MeV over the neutral kaon invariant mass. A prototype was successfully tested with 50 GeV pions at CERN. The KLOE drift chamber is presently being wired at LNF.

The calorimeter is composed of 0.5 mm lead layers in which 1 mm diameter scintillating fibres are embedded. To reconstruct neutral kaon decays, the calorimeter has good resolution in space, energy and time. Moreover it is fully efficient down to a few MeV and highly hermetic. A prototype was tested at the Swiss PSI laboratory, and the measured spatial, energy and time performances fulfilled design requirements (achieving 9mm, 4.7% and 55 ps per square root of the energy respectively for space, energy and time resolution).

The KLOE calorimeter was constructed partly by Pol.Hi.Tech Ltd. (Italy) and partly by LNF, Pisa and Rome I INFN sections. All 24 barrel modules and 2x32 endcap modules are presently undergoing equipment or data acquisition tests at LNF.

The magnet coil was constructed by Oxford Instruments (UK - May, page 29) and arrived at LNF on 17 April, marking the first step in KLOE assembly. After cryogenic tests and measurement of the magnetic field, assembly will continue with the insertion of the calorimeter modules and the drift chamber.

KLOE is scheduled to take data in early 1998, almost five years after its formal approval in March 1993.

Argonne's Intense Pulsed Neutron Source (IPNS) accelerator group celebrate the facility's 5,000,000,000th pulse.

ARGONNE IPNS buzzes by 5 billionth pulse

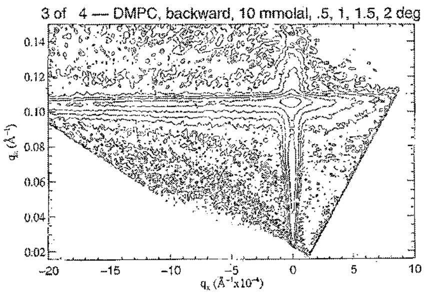
At 19:37:07 on March 21, Argonne's Intense Pulsed Neutron Source (IPNS) registered its 5,000,000,000th pulse. IPNS began operating in 1981, and after a few years, evolved to provide a time-averaged current of 15 microamps of 450 MeV protons to the uranium metal target. Proton pulses are about 100 nsec long, delivered at 30 Hz.

Particle accelerators and storage rings have to work long hours. IPNS runs twenty-four hours a day about 26 weeks per year. Much to the satisfaction of the users of the facility and enviable in accelerator circles, IPNS as a whole has compiled a reliability record over 95%. This proud record is the result of the spirit, skill, and dedication of the operating staff and a considerable amount of good luck. IPNS operators, who, with local scientists and the neutron facilities group, celebrated the 5,000,000,000 pulse landmark the day after its accomplishment. The chart to the right in the background of the photo plots the daily progress toward the milestone.

IPNS is a "user facility" operated by the Office of Energy Research of the US Department of Energy for materials science research using neutron scattering methods. Twelve ports admit beams to thirteen scattering instruments and one testing and development station.

Twice a year (and now in its twenty-ninth cycle) IPNS invites proposals from the scientific community, from which the Program Advisory Committee selects the best. An Instrument Scientist, aided by assistant scientists and engineering and technical personnel, maintains each instrument and helps visiting

Reflected intensity profile of DMPC (dimyristoylphosphatidylcholine) on silicon, recorded on the Argonne IPNS time-of-flight neutron reflectometer POSY-2, showing the sharp Bragg peak due to regularly spaced layers, while the horizontal off-specular reflection indicates a liquid-like disorder among the lipid molecules in the plane of the layers.



scientists. Each controls about 25% of the instrument time for maintenance and upgrading and for pursuing self-initiated programmes.

Yearly, about 300 experiments run and around 250 different researchers visit from other institutions. Experiments typically involve individuals or groups of two or three. Instruments have relatively stable configurations but support many capabilities for maintaining special sample conditions.

One of the experiments underway at the time of the productivity mark was that of polymer physicist Apollo Wong and postdocs Cheok Tam and Jamie Ku, who recorded the intensity of neutrons reflected from a 10-bilayer-thick coating of DMPC, dimyristoylphosphatidylcholine, on single crystal silicon. Wong worked with the POSY-2 reflectometer, which measures the variation of chemical composition of thin sample layers by their effect on reflectivity at glancing angles. A moderator of solid methane at about 25 K temperature provides a beam of cold neutrons to POSY-2.

DMPC is a lipid with a hydrophilic head and two hydrophobic tails, each with 14 carbon atoms.

In the vertical direction, perpendicular to the surface, the accompanying illustration shows a well-defined Bragg peak in the specular reflectivity, corresponding to regularly spaced layers. The shape of the off-specular reflection (horizontal, in the plane of the sample) intensity distribution indicates a liquid-like disorder among the lipid molecules in the plane of the layers. A position-sensitive proportional counter registers the entire reflectivity pattern simultaneously, using a broad band of neutron wavelengths and time-of-flight methodology. A model of biological cell membranes, this bilayer system has potential importance in the development of pharmaceuticals.

NEW MEXICO
Mining for supernovae neutrinos

The Supernova Neutrino Symposium, held March 17 - 18, saw a conclave of collaborators presenting papers on production from, and detection of, neutrinos from supernovae. The conference took place in Carlsbad, New Mexico, this location being chosen because the first phase of the Supernova Neutrino Burst Observatory (SNBO) is likely to be deployed nearby in the near future. This ambitious project would be located in a salt mine at a depth of 650 m (1000 m of water equivalent).

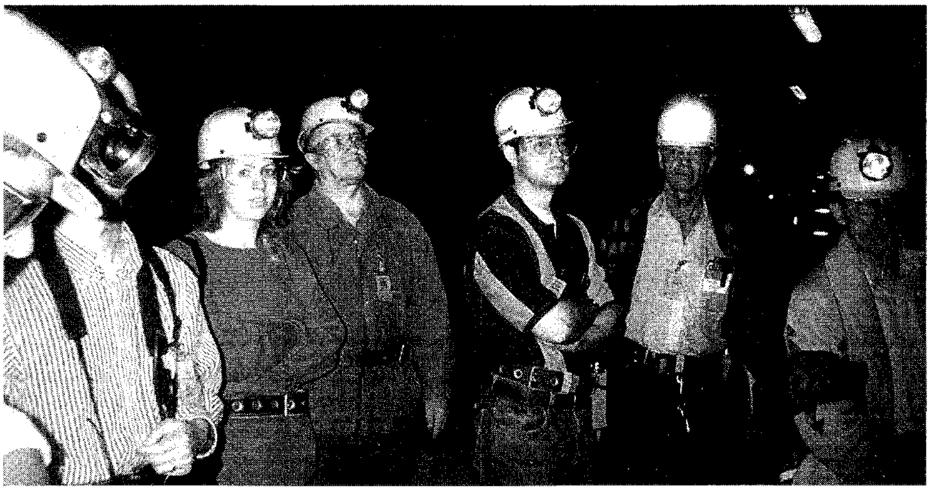
The meeting was sponsored by the Institute for Nuclear and Particle Astrophysics and Cosmology (INPAC) of the University of California (UC). Presently, collaborators on the SNBO project are from several UC campuses, Ohio State University, and Lawrence Livermore and Los Alamos Laboratories; additional collaborators are sought for this exciting enterprise.

Detection of neutrinos in the SNBO will depend on the interaction of supernova neutrinos with the very nuclei that compose the rock-salt walls of the mine. Such interactions produce secondary neutrons that would then be detected with a very large array of detectors such as boron trifloride proportional counters. If this detector configuration were chosen, the initial detection volume is envisaged to be several thousands of litres, geometrically optimized for efficiency with a neutron moderator. Other configurations, using plastic or liquid scintillators, are also being considered.

It is anticipated that supernovae explosions occur at the rate of roughly 1 every 30 years in our Galaxy. As detector volume and sensitivity are improved it is hoped that the frequency can be increased by including explosions from other galaxies within the Local Group (3000 light years) and eventually perhaps beyond. A hoped-for future target may be the hot star forming regions at a distance of about 13 million light years, from which one would expect about 1 supernova per year.

The mu and tau neutrinos from a supernova are predicted to have a somewhat higher energy than are the electron neutrinos. This results in the SNBO acting as a neutrino "flavour filter", since the reactions with the nuclei that would produce the secondary neutrons have energy thresholds that would discriminate between electron and mu or tau neutrinos. Hence, the observatory would provide not only diagnostics of the stellar collapse process, but, when run in time synchronisation with an electron neutrino sensitive detector such as Super-Kamiokande, At a recent Supernova Neutrino Symposium in Carlsbad, New Mexico, the possible location of a future Supernova Neutrino Burst Observatory (SNBO) in a salt mine at a depth of 650 m, attendees were treated to a tour of the underground installations.

(Photo Mark Vagins)



might also allow measurement of the masses of the different flavour neutrinos.

Preliminary measurements of the neutron background level in the site show it to be sufficiently low as to make an observatory of neutrinos from a galactic supernova quite feasible. Improvements in detectors might ultimately allow detection of extragalactic supernovae.

Attendees were treated to a tour of the salt mine which forms the proposed location. This is in fact the Waste Isolation Pilot Plant facility, chosen primarily for the very low level background radioactivity, together with a guaranteed stability over several decades. Each individual donned mining gear complete with hard hat, miner's light, breathing pack and guide. They toured the mine, the potential waste storage site, and then visited a tunnel terminus where detectors will be located.

For more information about collaboration opportunities, contact Alex Murphy at Ohio State University or e-mail asmurphy@mps.ohio-state.edu.

Letter to the Editor

The article "Supporting fundamental science in the former Soviet Union" (April, page 14) gives a comprehensive review of worldwide efforts to support scientists in the Former Soviet Union (FSU) following its dismemberment. George Soros and Carlo Rubbia, whose photos were published, played distinguished roles in initiating such efforts. The help from outside was crucial for many qualified scientists to survive and stay in Russia.

Still there are some points the article misses. In particular, it is worth mentioning NATO collaborative research grants in the framework of the NATO International Scientific Exchange Programmes. This is especially important at a moment when the hot political topic of the NATO expansion to the East is discussed with special emphasis on its military aspects only.

Also, the European Community Programme "Human Capital and Mobility" should be mentioned as involving FSU scientists in collaborative research in Europe. From the other side of the globe, help came from the Japan Society for Promotion of Science, established partly as a reward for help to post-war Japan science from the Soviet Academy of Sciences.

Some other funds and organizations (for example the Alexander von Humboldt Foundation) also stressed support for scientists from the FSU during these years.

Last, but not least, is support for participation in international conferences held abroad. Living (and sometimes travel) expenses have been covered by conference organizers (notably the Rencontres de Moriond, organized by J. Tran Thanh Van, and the Erice schools led by A. Zichichi, and others).

I wish to express the general opinion of FSU scientists by saying that this help is invaluable, and all of us are very grateful to our friends and colleagues for their efforts. Surely, all these efforts cannot be everlasting, and we should hope for better internal financial support of science in our own countries. Only this can prevent such situations as the former director of a high energy physics institute becoming a broker.

I.M. Dremin, Lebedev Physical Institute, Moscow

Computing - has the future arrived yet?

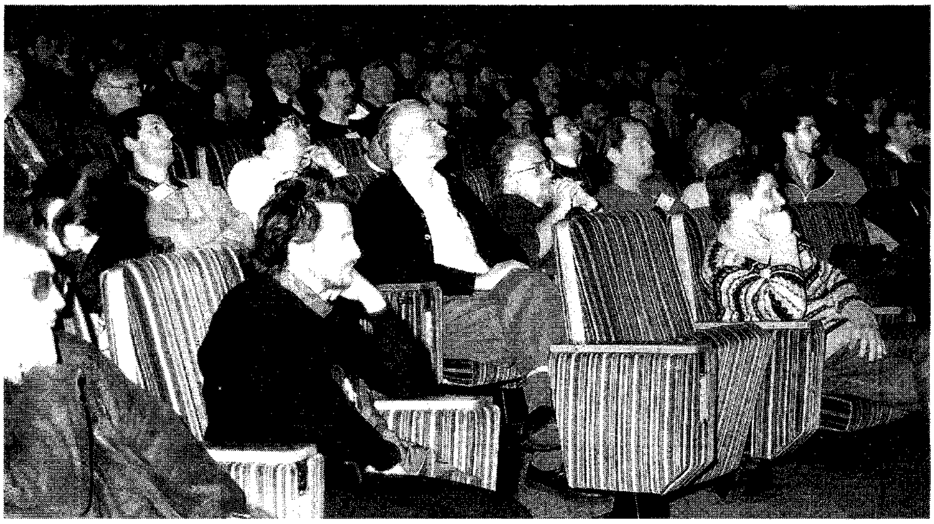
The latest International Conference on Computing in High Energy Physics, CHEP'97, was held at Lichtenberger Congress Center in Berlin from April 7 - 11.

Every one and a half years, the International Conference on Computing in High Energy Physics brings together the computing experts of the field for thorough exchange of ideas and presentation of their projects. The latest meeting, CHEP'97, was held at Lichtenberger Congress Center in Berlin from April 7 - 11. The location was chosen only five days before the conference opened, after a fire severely damaged the Rathaus Schöneberg originally selected as the conference venue.

For the organizer, DESY, the conference was a chance to present its site in Zeuthen (South-East of Berlin), which became part of the laboratory in the course of German reunification, and which hosted a HEPiX meeting following CHEP. The conference was also a convenient opportunity to present the capital of re-united Germany to a broad international audience. The change of location from the former parliament building of West Berlin to the former headquarters of the "Staatssicherheit der DDR (STASI)" in East Berlin added an interesting historical flavour!

The conference was attended by 464 people from 22 countries. The majority of the attendees came from Europe, the US, and Japan. Participation from countries of the Former Soviet Union and South America was partially supported by DESY and the DFG, the German Research Society. The conference featured plenary and parallel sessions, poster presentations (with direct submission to this event), an industrial exhibition, and a vendor session.

As a novelty, the plenary sessions were widely organized as panels, which focused on four of the most burning questions: Internet Computing and Collaborative Work Issues; The Emergence of Object Technology in HEP; Commodity and Special Purpose Computing Platforms; Computing Models and Infrastructure of HEP Institutes and Experiments. Each topic was allocated half a day, during which the panels achieved a broad coverage of each subject, with presentations of more than one point of view.



The conference opened with a keynote on "Java and Internet Computing" (John Gage, Sun), followed by a panel on collaborative tools in the Internet. The panel gave overviews of video conferencing (H. Newman, Caltech) and collaborative computing environments (J. Bunn, CERN) in HEP, and a wrap-up of a workshop on "Networking for HEP and the ICFA Initiative" (D. Williams, CERN), which was held the previous Sunday.

The Tuesday afternoon panels were one of the conference highlights, providing a detailed review of computing infrastructure and needs of the High Energy Physics community. In the first panel, representatives from CERN, DESY, Fermilab, KEK (Japan), and SLAC (Stanford) reported on computing setups, trends and strategic directions at their respective laboratories. At the advent of a new generation of experiments, agreement was reached that data management was the biggest concern, as there still seemed to be no integrated commercial solution available suitable for HEP environments.

New hardware and new storage media are being investigated, e.g. Digital Versatile Disks (Y. Morita, KEK), and Object Technology was applied for improved architecture and standards compliance (L. Robertson, CERN, and R. Mount, SLAC). PCs and UNIX systems are competing in costs and performance on the desktop and in physics computing farms, but the crux for each system will be to provide for a coherent system management solution (S. Wolbers, Fermilab, and M. Ernst, DESY).

The importance of networking was stressed, although it generally seemed to be in good shape and evolvable towards higher performance and larger environments. There

Conference Chairman Ulrich Gensch of DESY opens CHEP'97

was some consent that a uniform development environment should created for HEP, including C++ class libraries and configuration management.

The report from the laboratories was followed by a review of computing models of major HEP experiments. Speakers from the upcoming B-experiments (H. Albrecht, HERA-B, DESY; N. Katayama, Belle, KEK; and N. Geddes, BaBar, SLAC), from two LHC experiments at CERN (M. Pimia, CMS, and J. Knobloch, ATLAS), and from Fermilab (S. Lammel for CDF and DO) specified their central processor, bandwidth and mass storage requirements, and introduced their system architecture. They unanimously reported that they were either using or migrating to object-oriented methods for their software development.

Wednesday was devoted to the ubiquitous object technology. First, a panel evaluated experience gained in different application domains. There were reports on the use of a formal method for developing an online computing system (T. Kozlowski, PHENIX), on the introduction of object-oriented software development to large collaborations (B. Jacobsen, BaBar, and R. D. Schaffer, ATLAS), and on the development of the Geant4 simulation software (J. Allison, Manchester). The panel showed that there are now already numerous people with OO experience in HEP, and that object orientation is the way to go, especially as younger and better prepared people from universities are joining HEP.

Following the panel came a presentation on "A Software Engineering Service Center for Scientific Software Production" (G. Pawlitzek, DLR), which took a broader view of scientific software development and stressed that also in scientific environments software engineering should be a discipline in its own right. The talk reported the successful setup and operation of a software engineering service center within the DLR, the German Aerospace Research Establishment.

Thursday's talks covered processors, architecture, and operating systems. There were overviews of "End User Computing - Today, Tomorrow and in the New Millennium" (S. Levin, Gartner Group), models of multi-processor computing (D. Lenoski, Silicon Graphics), and lattice (QCD) computing (R. Tripiccione, INFN). The latter included a report on the APE/Quadrics project, a development effort of a massively parallel computer which was pioneered by INFN and now joined by DESY (November 1996, page 4).

The conference closed with a panel discussion on the "Future of HEP Computing" (chaired by Tom Nash of Fermilab). It was controversially debated whether the era of large computer centres is over, and if regional centres are better suited for the needs of multi-national collaborations such as the LHC experiments or BaBar. The panellists agreed on the need for more professional management for HEP projects, especially for software developments.

The parallel programme was organized into seven sessions. In preparation of the conference, the session convenors performed a strict paper selection, as many more abstracts were received than could be accommodated in five days.

Finally 207 papers out of the more than 300 abstract submissions (including 50 for posters) were accepted for oral (161) or poster (46) presentation. "Data Acquisition & Control Systems" and "Data Analysis & Presentation" were the sessions which received the largest number of abstracts.

At the conference, the sessions on "Mass Storage & Data Management" and on "Commodity Hardware & Software" saw the largest audiences, underlining once more the importance of these areas for the near future of HEP computing.

The session on "Tools & Methods" had been created when software engineering was gaining relevance in the community, and was now well established with an increasing number of contributions. "Networking & Communication" was dominated by contributions on the Internet and collaborative tools, and a session on "Large Systems & Specific Solutions" including contributions on supercomputing rounded up the programme.

Physics monitor

Papers had to be submitted three weeks before the conference, enabling the organizers to hand out preliminary conference proceedings containing 85% of the papers upon registration. Final proceedings will be published on CD-ROM, and selected papers were submitted for publication in a special issue of "Computer Physics Communications".

As a special event, CHEP'97 was linked via video conferencing with the WWW6 conference, held simultaneously in Santa Clara, California. CHEP participants had the opportunity to attend one of the WWW6 tutorials and listen to the WWW6 keynote, and some parallel talks were made available to both audiences, but experience has shown that a substantial effort is still required to obtain a video transmission worth watching.

Industrial participation was encouraged in three different areas: the scientific programme, a dedicated vendor session, and a vendor's exhibition. The latter was well received by both companies and participants, especially as it was located in the same hall as the coffee breaks, the welcome reception, and the poster session, guaranteeing interaction and discussion.

On Thursday evening the attendees were invited to the "Deutsches Technikmuseum", with live jazz and bars among ancient steam engines and other technical achievements, including a copy of Konrad Zuse's famous Z1, the world's first binary digital computer.

The next conference in this series is planned for September 1998 in Chicago and will be organized by Larry Price (Argonne).

By L. Hagge and J.-H. Peters

CHEP speaker David Williams of CERN admires Konrad Zuse's pioneer Z1 computer. (Photos DESY)

Cosmic gamma-ray bursts in a new light

Fascinating new results have come in this year on the mysterious 'gamma-ray 'bursters', occasional flashes of energy from outer space. These bursts have intrigued astrophysicists ever since the phenomenon was discovered by chance in 1967 by the Vela spy satellite, deployed to monitor the gamma radiation produced from terrestrial nuclear tests.

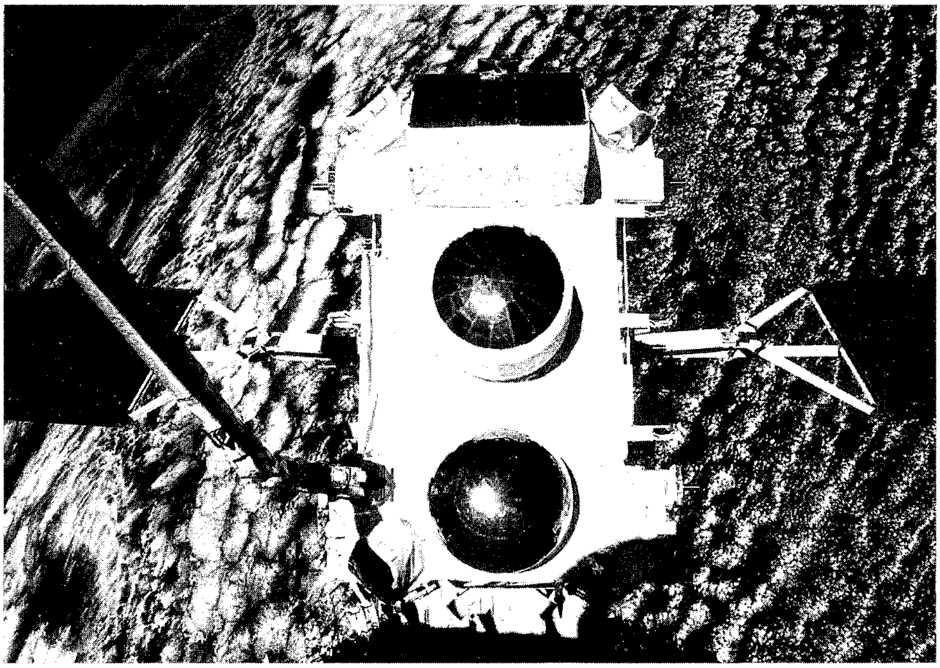
More recently, NASA's Compton Gamma Ray Observatory has detected bursts almost daily. The flashes appear from random directions in space and typically last a few seconds.

Competing theories on gamma-ray bursts generally fall into two types: one supposes the bursts to originate from some as-yet unknown sources within our own Milky Way Galaxy, while the other proposes that the bursts originate in distant galaxies.

If the latter (as was indirectly supported by the Compton observatory's observations) then the bursts are amongst the most violent events and the most brilliant bursts in the Universe.

One objective has always been to correlate the gamma ray bursts with activity at other wavelengths, and this year has produced new sightings, thanks to the astronomy satellite BeppoSAX (Satellite per Astronomia X, and "Beppo" in honour of Giuseppe Occhialini).

BeppoSAX is a project of the Italian Space Agency (ASI) with the participation of the Netherlands Agency for Aerospace Programmes (NIVR). The satellite is developed with the support of a consortium of institutes in Italy and The Nether-



NASA's Compton Gamma Ray Observatory has made major contributions to short wavelength astronomy.
(Photo NASA/Max Planck Institut für Extraterrestrische Physik, Garching)

lands and of the Space Science Department of ESA. (A collaboration with the Max Planck Institute for Extraterrestrial Physics looks after X-ray mirror testing and the calibration of the concentrator/spectrometer system.)

BeppoSAX was launched by an Atlas G-Centaur directly into a 600 km orbit at 3.9 degrees inclination on April 30 1996. During each orbit, up to 450 Mbits of data are stored onboard and relayed to the ground station, near the equator (Malindi, Kenya), on each orbit. The Operational Control Center (OCC) in Rome is connected to the ground station by a relay satellite.

In January, a gamma-ray burst was observed by BeppoSAX and studied in detail just 16 hours later, compared with the previous record of about 18 days. On 28 February, a gamma ray burst was picked up simultaneously in the data from the BeppoSAX Gamma Ray Burst Monitor and Wide Field Cameras. Scientists were able to reschedule the satellite observations and point the BeppoSAX narrow field X-ray telescopes at the gamma-ray burst source in just 8 hours. This revealed a hitherto unseen X-ray source, in the constellation of Orion, localized to one hundredth of a degree. A second follow-up, after about 2 days, showed a strong decrease, by a factor of about 20, in the intensity. On 8 May came another gamma ray burst, and follow-up observations have revealed a relatively bright, but slowly decreasing, X-ray source.

Ground-based astronomers quickly turned their big telescopes to the points accurately indicated by the BeppoSAX sightings and have obtained important new evidence.

Scientists at the Space Telescope Science Institute initially reported the object based on measurements at Kitt Peak National Observatory. Astronomers were able to bring telescopes at Palomar Observatory to bear within a few hours, when a Caltech team noticed a starlike object at the position of the burst that was changing brightness in an unusual fashion.

A team of astronomers using the world's largest telescope, the W.M. Keck 10-metre telescope on Mauna Kea, Hawaii, locked onto visible light coming from a gamma-ray burst. Analysis of its optical spectrum showed its minimum distance to be about seven billion light-years away, thus resolving a crucial piece of the puzzle. The variable object showed characteristic features in its spectrum known to originate in intergalactic clouds.

By measuring the wavelengths of these features, astronomers were able for the first time to measure the distance to a gamma-ray burst. Their measurements place the burst several billion light years away, over one half the size of the observable universe, showing that gamma-ray bursts originate from far outside our own galaxy.

Recent observations show the starlike object fading away. As such rapid fading had been seen with the burst in March, the Caltech astronomers had to make an extra effort to identify this counterpart quickly so that the Keck observations could be carried out when the object was bright.

For just a few seconds, the burst was over a million times brighter than an entire galaxy. No other phenomena are known that produce this much energy in such a short time.

At other wavelengths, radio astronomers have also joined the party. The US National Science Foundation's Very Large Array (VLA) radio telescope at the National Radio Astronomy Observatory (NRAO) in Socorro, New Mexico, has made the first detection of radio emission from a cosmic gamma-ray burst.

The VLA was trained on the May 8 burst less than four hours after the burst's discovery, but no radio emission was found until May 13. A repeat VLA observation early on May 15 showed that the radio emission is increasing in intensity. The May 15 VLA observations also show that the radio emission increases in intensity at shorter radio wavelengths.

While these new observations have shown that the bursts come from cosmological distances, what actually causes them remains shrouded in mystery.

COSMIC RAYS
Colour coherence

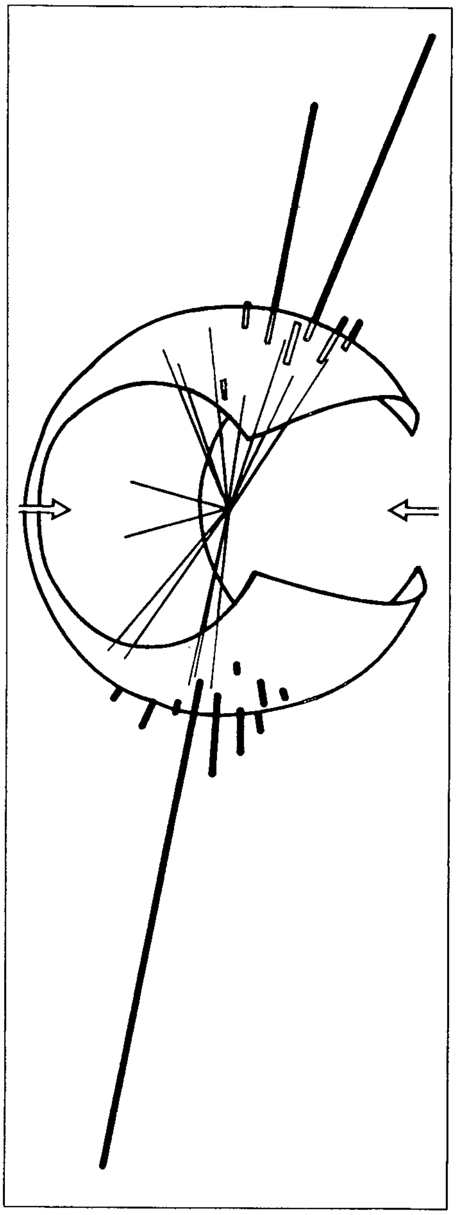
A recent article (April page 15) reported that ultra-high energy cosmic ray studies by a Paris/Tokyo collaboration have revealed a high energy gamma ray shower in which the individual gammas line up impressively together in a plane, or sheet.

The event, intercepted using emulsion chambers on a Concorde flying at a height of 17 kilometres, corresponded to a stratospheric gamma ray shower at 10^7 GeV, containing over 200 photons above 200 GeV.

Such sheet-like alignments have also been seen in a dozen or so events by the large chambers (several hundred tonnes) on the Pamir mountains in Central Asia.

Interpreted in terms of the interactions of the quarks and gluons deep inside the nucleons of the primary cosmic ray collision high in the stratosphere, such highly planar alignment of emerging particles can be interpreted as 'colour coherence' effects which reflect the quark/gluon processes at work deep inside the colliding nucleons.

A classic example of a three-jet pattern seen by the UA2 experiment at CERN's proton-antiproton collider in 1982.



The powerful forces holding quarks inside their nucleon habitats are carried by gluons, so the deep interior of particles like protons is full of gluons as well as constituent quarks. Permanently locked inside their protons (or other strongly interacting particles), these quarks and gluons cannot be studied in isolation. Individual quarks and gluons are not totally free to recoil, and energy is absorbed by the surrounding quark-gluon mesh.

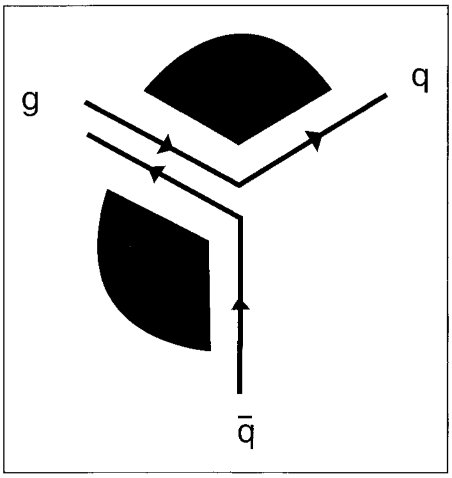
However collisions are occasionally powerful enough to catch the quarks unawares and snap the gluon bonds. When these bonds are broken, fresh quarks appear on the broken ends, in the same way that a bar magnet snapped in half becomes two bar magnets, each with its own set of magnetic poles.

These broken pieces of quark debris emerge in the direction that the quark bonds were stretched, giving rise to characteristic 'jets' - sprays of strongly interacting particles (hadrons). These jets reflect the direction of the quark collision and provide a valuable insight into the underlying quark-gluon mechanisms deep inside the proton.

When a quark link snaps, the two resultant jets emerge back-to-back (to conserve energy/momentum), as seen by an observer moving with the collision. However the broken quark link can also spit out additional energy, giving additional particles and a more complicated jet pattern.

When an incoming high energy particle such as a cosmic ray primary proton smashes into a nuclear particle in the atmosphere, or in a high energy laboratory collision process, the most common jet configuration is a trident pattern, with a central beam jet from the residual constituents of the oncoming particle, and two accompanying final state jets from the collision debris. These three jets will tend to lie in a plane, as was pointed out by Francis Halzen and Duncan Morris at Madison, Wisconsin, in 1990.

With the participating quarks and gluons carrying colour, the detailed colour mechanisms define antenna-



An example of colour coherence. Electron-positron annihilation can produce a quark and an antiquark, together with an accompanying gluon, giving a characteristic three-jet structure. However the underlying colour mechanism restricts the production of accompanying 'soft' particles to the shaded region.

Colour channels

The constituent quarks hidden deep inside strongly interacting particles like protons carry a charge-like quantum number, 'colour', which can have one of three values, 'red', 'green' or 'blue'. The colour labels of the constituent quarks have to add to zero, so that the proton, or other strongly interacting particle, is colourless, or 'white'.

(Of course the quarks are not coloured in the physical sense - the picture is just a convenient way of describing charges in a three-dimensional space.)

The gluons carrying the forces between the quarks are also coloured, but a gluon carries two colour labels. At a typical quark-gluon vertex, the colour forces define a plane, with a clearly indicated trident-like pattern. These colour channels act as antennae which direct the flow of quark/gluon energy and suppress accompanying 'soft' particles.

like channels which can further restrict more complex jet patterns (see box).

Hadron jets are also seen emerging from high energy electron-positron annihilations, and in the production of three such jets, the trident pattern is especially clear, with hadron production in the intervening directions strongly suppressed by the absence of colour channels.

Hadron jets were clearly seen when CERN's high energy proton-antiproton collider began operation in the early 1980s, and jet phenomena have been further studied at the higher energies available from Fermilab's Tevatron (1.8 TeV proton-antiproton collisions).

In 1994, the CDF collaboration at the Tevatron saw directional effects in more complicated jet patterns, interpreted also as colour coherence, and such effects would be expected to continue at higher energies, such as those available with cosmic rays.

(The Editor would like to acknowledge valuable help from Michelangelo Mangano.)

The ultimate limbo dance

A team of UK astronomers at Sussex and Glasgow universities could have resolved the embarrassing paradox that the Universe appears to be younger than its oldest stars.

They use a simple new technique to measure the age of the Universe and the sizes of galaxies. As a bonus, the team has also found that our Milky Way Galaxy is an average member of the Universe.

The key measurement is the Hubble constant (H). In the expanding Universe, the further away a celestial object is, the more the intervening space has expanded since the Big Bang and the faster the distant object appears to recede. The Hubble constant links distance to velocity: previous estimates have been in the range from 40 to 80 in standard units, but favouring values above 60. (The larger the value of H, the higher the expansion rate, and the smaller, and therefore younger, the Universe.) This led to the bar in the limbo dance of the Universe being placed at about 10 billion years - apparently excluding stars at least 12 billion years old.

Simon Goodwin and John Gribbin at Sussex, working with Martin Hendry in Glasgow, have cut through the confusion of this 'age dilemma' by finding a way to measure distances to very remote galaxies. This tells us how big the Universe is, and therefore how long it has been expanding since the Big Bang.

The technique is very simple in principle. The apparent size of a galaxy depends on its actual size and how far away it is. So if we know how big galaxies really are, we can estimate their distances from their apparent sizes.

Distances to nearby galaxies can now be measured directly, using the Hubble Space Telescope, which monitors variable stars known as Cepheids in those galaxies. So the team were able to calculate the average size of all the galaxies like our Milky Way in our neighbourhood of the Universe. This shows that the Milky Way is very close to the average size of a spiral galaxy.

The team then looked at a sample of more than 3000 galaxies, all too far away for their distances to be measured directly using the Cepheid technique. The apparent size of each of these galaxies on the sky (its angular diameter) is known, and so is its red shift (the shift in the wavelength of its light due to its recession). The calculated linear size of each galaxy depends only on its angular diameter and the value assigned to the Hubble constant.

To make the average size of all these galaxies match the average size of nearby galaxies, H must be about 50, and the Universe must be at least 13 billion years old, according to the standard Big Bang theory.

Until a few weeks ago, the best estimates for the ages of the oldest stars were about 14 billion years, and estimates for the age of the Universe were about 11 billion years, or less (May, page 20).

Data from the European Space Agency's Hipparcos satellite have reduced values of the ages of the oldest stars from 14 to 12 billion years, while the new UK study has increased the calculated time since the Big Bang to 13 billion years. Pushing up the bar in the cosmic limbo dance and decreasing the age 'height' of the oldest stars gives a time slot just wide enough for the stars to have squeezed into the Universe after the Big Bang.

People and things

New director for Gran Sasso National Laboratory

Alessandro Bettini has been appointed Director of the Italian Gran Sasso National Laboratory, replacing Piero Monacelli. As full professor of Physics at the University of Padua, he first worked in the Padua bubble chamber group, and developed an automatic measuring device for bubble chamber pictures (PEPR). Then he took part in the construction and operation of the European Hybrid Spectrometer and was member of the UA1 collaboration at CERN. Recently his research interests have concentrated in developing the liquid Argon TPC proposed by Carlo Rubbia for the ICARUS experiment. Prof. Bettini has served in various INFN positions of responsibility: he chaired the National Scientific Committee for Experimental Subnuclear Physics with Visual Techniques from 1978 - 84, was Director of the Padua Section from1983 - 1990, a member of the Executive Council from 1990 - 96 and INFN vice-president from 1994 - 1996.

On people

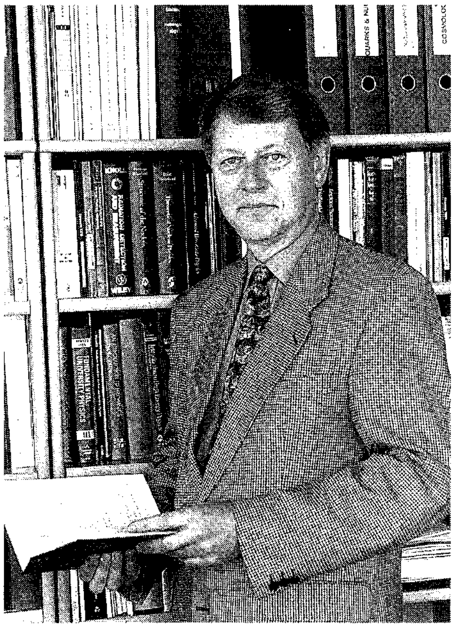
David Norman, Assistant Director of the Synchrotron Radiation Department at the UK Daresbury Laboratory, becomes its Director, succeeding Ian Munro, who retired at the end of May after more than 30 years in synchrotron radiation research, beginning at the then new NINA electron synchrotron.

Bjorn Jonson, distinguished nuclear and atomic physicist at Chalmers University of Technology, Goteborg, Sweden, longtime Group Leader at CERN's ISOLDE on-line isotope separator, and formerly chairman of the ISOLDE Committee at CERN, has received a prestigious Alexander von Humboldt Research Award from Germany for his accomplishments in research and teaching. He is particularly well known for his role in the discoveries of new forms of radioactivity and seminal work on halo nuclei.

An electrical fire in a power supply at CERN will delay the restart of operations at the SPS proton synchrotron and the LEP electron-positron collider. Specialist personnel are working round the clock to repair the damage, exacerbated by acid soot contamination of adjoining areas

Bjorn Jonson - von Humboldt award

CERN Director General Chris Llewellyn Smith (left) welcomes UK Ambassador to Switzerland Christopher Hulse on 13 May.



Robert Serber 1909-97

Talented and highly respected US theorist Robert Serber died on 1 June. As one of the early collaborators of J. Robert Oppenheimer in California, with whom he developed important astrophysics and cosmic ray ideas, he was a first generation US theorist. In the 1930s, he was one of the pioneers of 'renormalization' techniques to make field theory tractable. His name also became enshrined in the annals of machine physics when in 1941, at Illinois, he developed with Donald Kerst the orbit theory of betatrons, opening the way to the successful operation of such a machine. Before moving to the war effort, he developed with his student Sidney Dancoff what would become standard work in meson theory. Moving from Illinois to Berkeley after the war, he introduced the fruitful concept of the optical model to describe collision processes, and carried out seminal work on deuteron stripping. In the early 50s, Serber migrated from Berkeley to Columbia.

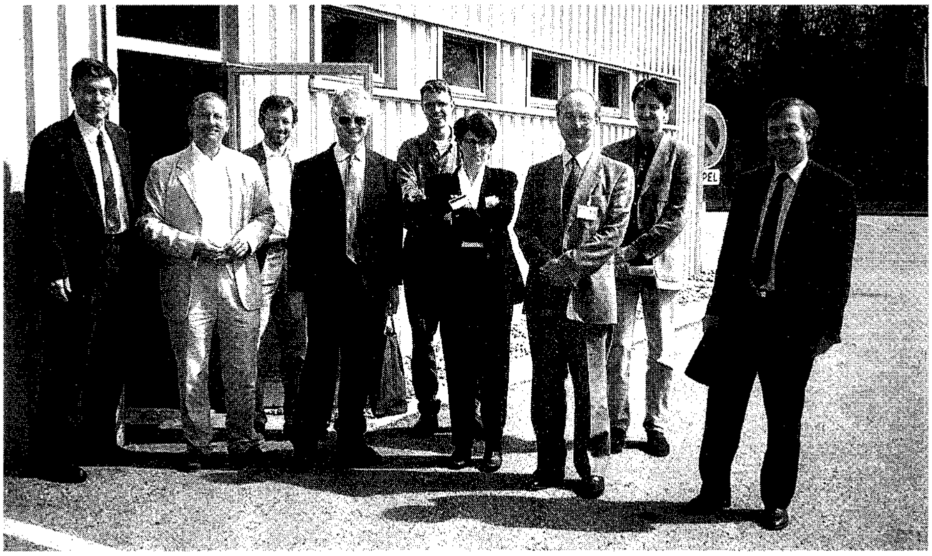
In addition to pursuing his own ideas, sometimes difficult and offbeat, he was a prolific source of inspiration to his colleagues. Murray Gell-Mann's historic 1964 quark paper credits Serber for having stimulated the idea when Gell-Mann visited Columbia in 1963. Serber was also a major influence for the physics of kaon interactions. Credits and acknowledgements to him abound in the literature. In 1971 he was elected President of the American Physical Society, and, appropriately, as longtime Oppenheimer collaborator, was awarded the Oppenheimer Prize in 1972 for his contributions to theoretical physics.

In his fascinating 1994 reminiscences published in Annual Review of Nuclear and Particle Physics, he recalls his teaching experience: 'I dreamt I died and went to heaven, and Saint Peter led me into the presence of God. And God said "You won't remember me, but I took your Quantum Mechanics Course in Berkeley in 1947"'.

CERN Accelerator School

The CERN Accelerator School (CAS) continues its full programme. Forthcoming courses are:
Intermediate Level Accelerator Physics, at the Rica Park hotel, Gjøvik, Norway, 1–12 September 1997;
Joint School on Beam Dynamics and Measurements, organized by the CERN, US, KEK and Russian accelerator schools, Montreux and CERN, Switzerland, 11–20 May 1998;
Introduction to Accelerator Physics, Lady Margaret Hall, Oxford, UK, 14-25 September 1998.

Future proposed courses include: Linacs, perhaps in Spain in late 1998, and Vacuum Technology, probably in Denmark in Spring 1999. Further information is available on the Web at http//www.cern.ch/Schools/CAS/ or by e-mail, During a visit of Dutch physics notables to CERN on 14 May: left to right - W. Kittel (Nijmegen), M. Pohl (ETH Zurich), G. de Rijk (CERN), G. Bobbink (CERN), M. Sanders (Nijmegen), H. van Pinxteren (FOM Secretary), A. de Monchy (FOM Chairman), A. Colÿn (NIKHEF, Amsterdam), G. van Middelkoop (Director, NIKHEF).



Suzanne.von.Wartburg@cern.ch or fax +41 22 767 5460.

PAC'97

Over 1200 accelerator scientists got together in May for the 1997 Particle Accelerator Conference in Vancouver, Canada. Accelerators have come a long way since pioneers like Rolf Wideröe and Ernest Lawrence developed machines for particle physics, and this was reflected in the size and diversity of the conference. Although particle physics applications formed a major part of the proceedings, other outlets for accelerator technology were equally well represented. From applied research in structural biology at synchrotron light sources to contraband detection in harbours and airports, accelerators are becoming increasingly prevalent in modern society.

Present and future shared the honours as the US Particle Accelerator School prize was awarded at the conference to CERN's Daniel Boussard and UCLA's Chandrashekhar Joshi. Boussard was cited for his "original contributions to the fields of RF, longitudinal beam dynamics, and feedback, and for the realization of superconducting acceleration systems", Joshi for his "pioneering experiments on high gradient, laser-driven, plasma beat-wave acceleration". Ka-Ngo Leung and David F. Sutter received the IEEE Particle Accelerator Conference award, Leung for work on ion sources, and Sutter for his management of the US federal R&D programme for accelerator technologies.

A full conference report by James Gillies will appear in the September issue of the CERN Courier.

Meetings

The Strange Particle Jubilee Conference will be held in Manchester on 16 -17 September to celebrate the discovery of V-particles by Rochester and Butler in the Department of Physics, Manchester, in 1947.

Participants in the CAS 'Introduction to Accelerator Physics' course held at the hotel Estoril Sol, Cascais, Portugal in October 1996. The many students coming from CERN Member States were joined, in some cases with the help of UNESCO and European Physical Society Interdivisional Group on Accelerators scholarships, by representatives from Brazil, India, Mexico, Nigeria, Roumania, Russia, Ukraine and USA.

Photo S. Turner

At the inauguration of the Quark2000 exhibition in Rome, INFN and CERN Council President Luciano Maiani (right) guides Italian President Oscar Luigi Scalfato and accompanying VIPs.

(Photo Stefano Gris)

Speakers will include Sir Clifford Butler, John Ellis, Ken Peach, Samuel C. C. Ting, Sir Arnold Wolfendale, George Rochester (on video) and Sir Bernard Lovell (Blackett Centenary Lecture). Preliminary registration can be made by e-mail to strange@m2.ph.man.ac.uk or by post to Prof. Robin Marshall, Dept of Physics and Astronomy, The University of Manchester, M13 9PL, England.

The XXVII International Symposium on Multipartcle Dynamics will be held from 8 - 12 September at the Laboratori Nazionali di Frascati dell'INFN, Frascati, Italy. http://www.lnf.infn.it/conference/ismd97.html

The fourth biennial meeting in the series Frontiers in High Energy and Astroparticle Physics initiated in Valencia in 1991 will take place in Valencia, Spain, October 13-17. The 1997 meeting "Beyond the Standard Model: from Theory to Experiment" is organized by Ignatius Antoniadis, Luis Ibanez and Jose' W. F. Valle. Subsequent information will be posted at Website http://neutrinos.uv.

Quark2000 in 1997

Quark2000, an exhibition on perspectives in fundamental physics research at the opening of the new millennium, has been produced by the Istituto Nazionale di Fisica Nucleare (INFN) in cooperation with the City of Rome to present to the general public, and in particular to high school students, the current and planned researches in nuclear, elementary particle and astroparticle physics, relating them to their history and stressing the contributions of these sciences to the culture of our century.

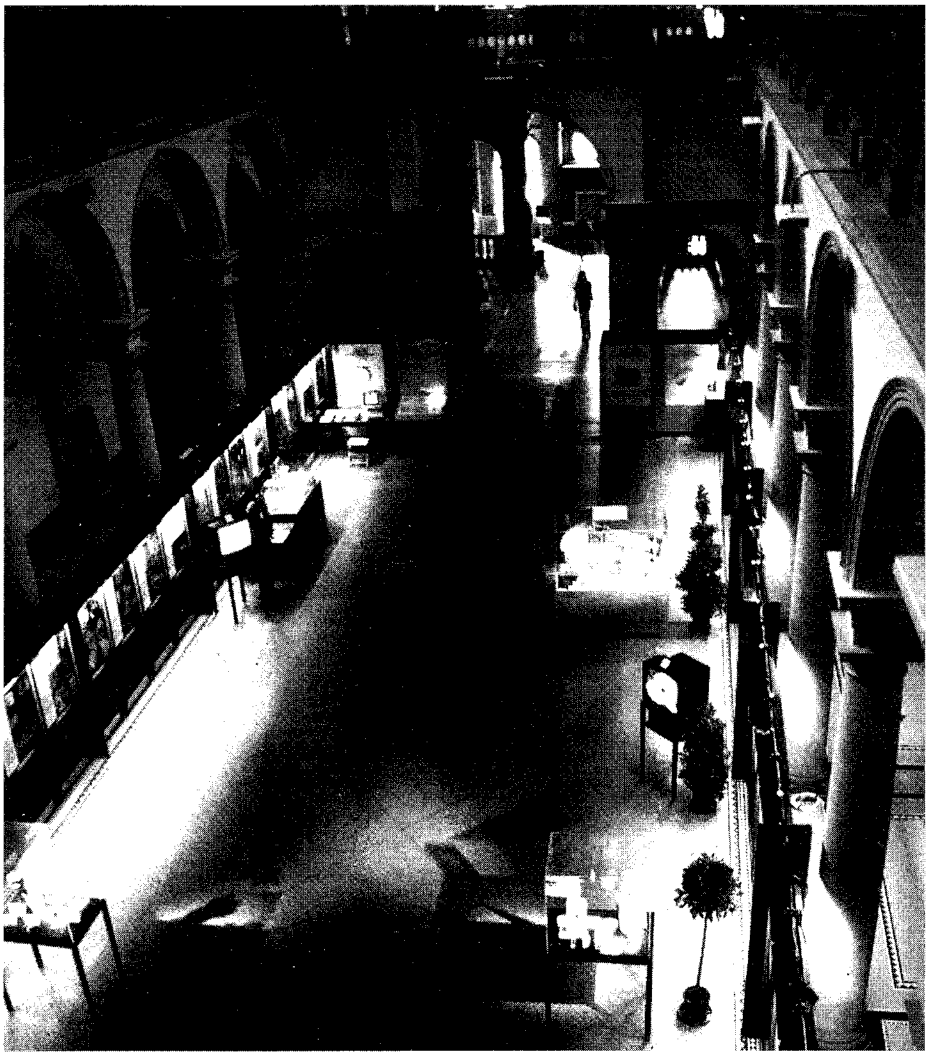
Attention has also been paid to spinoffs of fundamental research in high tecnology, biology and medicine, environmental control and fine arts. The exhibition was inaugurated by the President of the Italian Republic on April 16 and closed on June 9, registering nearly 80 000 visitors. The main world laboratories, and in particular CERN, contributed to the exhibition with apparatus, pictures and audiovisuals: internet links allowed virtual visits to the laboratories, science museums

Antonino Zichichi (centre) explains LAA detector development work at CERN to Italian Ambassador G. Baldocci. Left are F. Menzinger and A. Contin, with R. De Salvo on the right.
(Photo CERN HI 22.4.97)

Top, an international symposium on mathematical physics in Kiev in May celebrated the 70th birthday of eminent Austrian theorist Walter Thirring. On this occasion the new Walter Thirring International Prize was awarded to an Austrian, Julius Wess, and to a Ukrainian, the late Dimitri Volkov, for the discovery of supersymmetry. This photo by André Martin shows Thirring (centre) between his ex-student Wess (left), currently a Director of the Max Planck Institute, Munich, and Alex G. Sitenko, Director of the Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of the Ukraine.

Below, CERN's Medical Technology Exhibition is now in its second year of touring Europe, having visited 10 cities in 12 months in 1995/6. On its way north, it visited Zurich, where the photo shows the impressive setting at the venerable ETH (Federal Technical University) building. From Zurich the exhibition moved to Darmstadt for the official opening of the Therapy Centre at the GSI heavy ion laboratory, followed by Berlin's Humboldt University and Hahn Meitner Institute this summer. Oslo, Venice and Athens are also on the 1987 plan, with no shortage of candidate sites for 1998.

and science centres. The exhibition was completed by a programme of meetings and conferences, the publication of a book, the production of a film and of several audiovisuals.



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TRIUMF Laboratory, (Canada)
M. K. Craddock

Best performance by a ladies' team in this year's traditional CERN relay race was by 'The Mercenaries' - left to right Paula Collins, Helenka Przysiezniak, Renilde Vanden Broeck, Ainsley Normand, Catriona Gillies and Helen Korsmo.

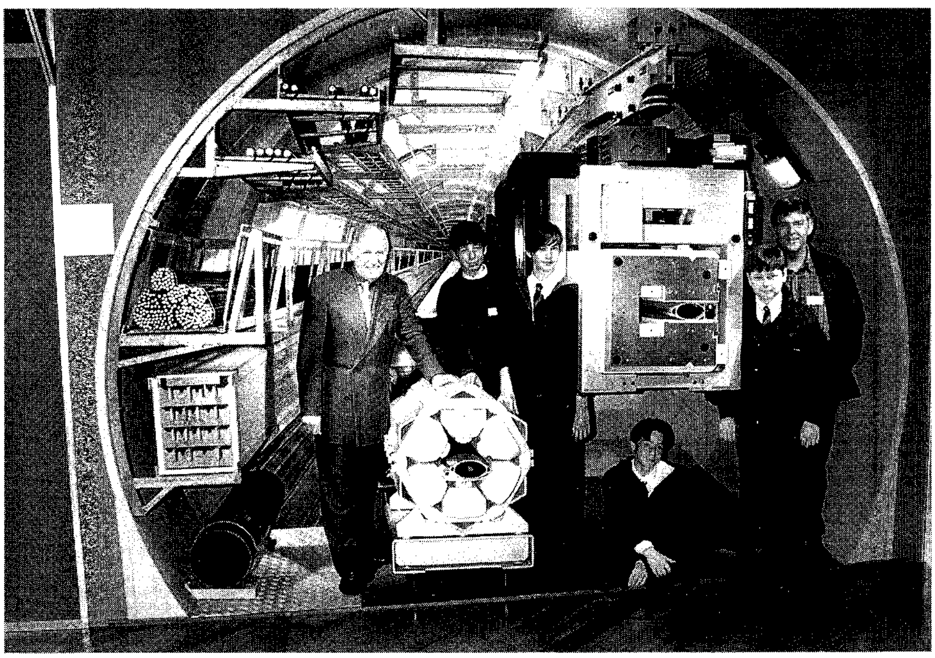
CERN Courier contributions

The Editor welcomes contributions. These should be sent via electronic mail to cern.courier@cern.ch

Plain text (ASCII) is preferred. Illustrations should follow by mail (CERN Courier, 1211 Geneva 23, Switzerland).

Contributors, particularly conference organizers, contemplating lengthy efforts (more than about 500 words) should contact the Editor (by e-mail, or fax +41 22 782 1906) beforehand.

Centrepiece of the Electron100 extravaganza at the University of Glasgow was the CERN Particle Physics Exhibition in the University's Hunterian Museum. Glasgow University Rector (elected by the students) and UK TV personality Richard Wilson poses with some young visitors.



Books received

Collider Physics - Updated Edition, by Vernon D. Barger and Roger J.N. Phillips in Addision Wesley's Frontiers of Physics series, ISBN 0 201 14945 1

A new edition of this useful book, which first appeared in 1987.

Harmonic Maps, Loop Groups, and Integrable Systems, by Martin A Guest, Cambridge University Press, ISBN 0 521 58085 4 (£40, $59.95, hbk), 0 521 58932 0 (£14.95, $21.95, pbk)

In the series of Student Texts of the London Mathematical Society.

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The concerned area will be theoretical computer science: computational geometry, algorithms, complexity theory. Information about the activities of the Department can be obtained on the WWW at http://diwww.epfl.ch/

2. **DISTRIBUTED SYSTEMS**
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The concerned area will be distributed systems: reliability, open standards (eg. CORBA), temporal constraints in distributed information systems. Information about the activities of the Department can be obtained on the WWW at http://diwww.epfl.ch/

3. **ELECTRONICS FOR MICROSYSTEMS**
   in the Electrical Engineering Department

The new professor will have a strong professional experience in microsystems applications. This experience should cover sensor and actuator interfaces, data acquisition, analogue and/or digital signal processing, as well as overall microsystems design. A skill in integrated circuits technology, silicon micromachining, silicon sensors and microactuators would be greatly appreciated.

4. **NON-NEWTONIAN FLUID MECHANICS**
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For the four positions: the activities will take place within the concerned Departments and will also involve other units of the EPFL as well as other Swiss and international academic institutions and manufacturers. An aptitude for teaching to students of graduate and undergraduate level and for conducting original and high level research projects is essential. The new professors will also be called on to supervise and guide students on semester projects, on engineering degrees and Ph.D. degree work. They should possess a confirmed skill in leading projects. Candidates are invited to propose and send an original research program together with their application form. Applications are encouraged from people who fulfill the requirements of the Swiss program for ensuring the continuity of competent university faculty. *Deadline for applications: October 16, 1997.* Starting date: as mutually convenient. The EPFL has about 4000 undergraduate and 600 doctoral students. It consists of 12 departments in all the major engineering sciences. Applications from women are particularly welcome. For further information, please contact by writing to: **Présidence de l'Ecole polytechnique fédérale de Lausanne, CE-Ecublens, CH 1015 Lausanne, Switzerland.**

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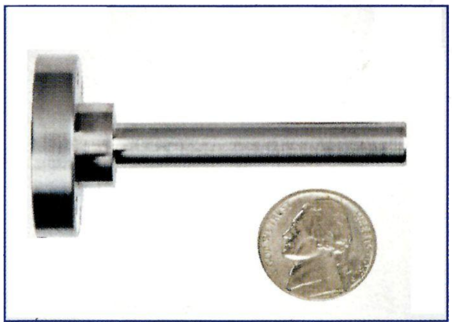

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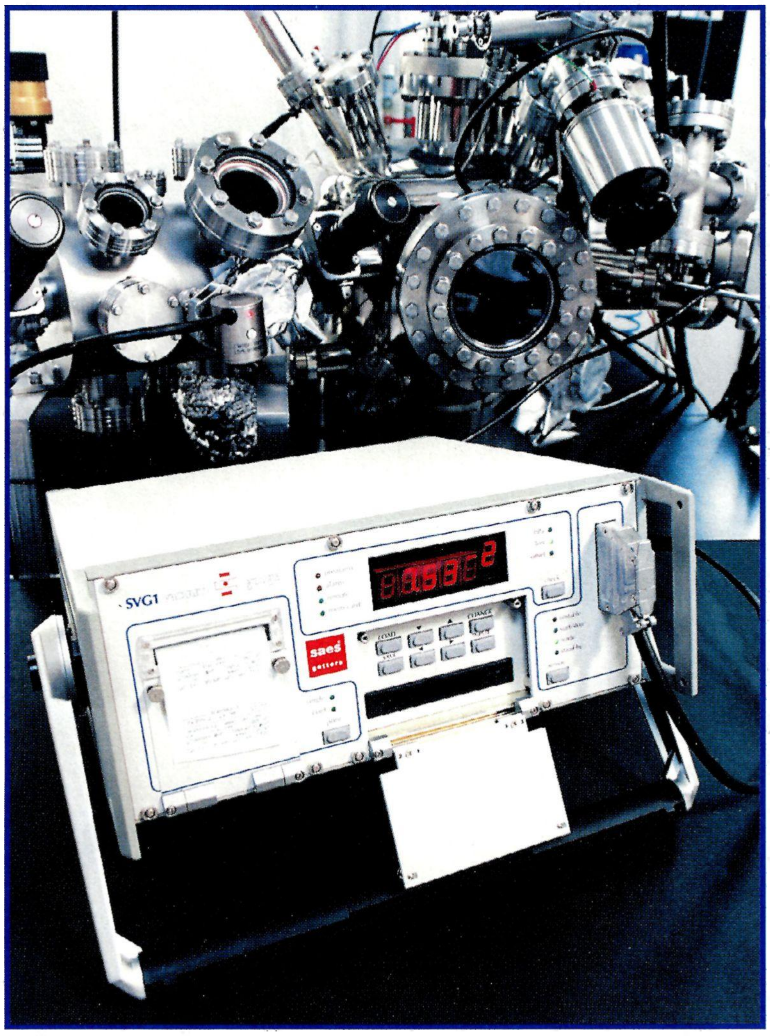

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