
Physics monitor

Theoretical Physics in Trieste, Italy, now a world-class research establishment, where promising young scientists from all over the world get a taste of front-line research early in their careers.

Salam's deceptively soft, husky voice masked an iron will and ruthless ambition. He could be arrogant, but also used argument as an intellectual weapon to prise open a difficult problem or seek new ideas. A consummate international, he was equally at home with P.G. Wodehouse or the Koran.

Despite being the only Pakistani to have won a Nobel Prize, and despite his impressive international achievements, Salam's position in his home country was ambivalent. Under the powerful rule of Ayub Khan, Salam once wielded considerable influence. However as a member of the minority Ahmedi Islamic sect, he resigned his influential position as chief scientific adviser in 1974 when Pakistan's National Assembly under Zulfikar Ali Bhutto excommunicated the Ahmedis from Islam. The Ahmedis claim that Mirza Ahmed, born in Qadian in northern India in the late 19th century, was the Mahdi, or Messiah, a view which is sacrilege to conventional Islam. Mainly confined to Pakistan, India and East Africa, the small Ahmedi sect is a frequent target of intolerance and discrimination, both from the religious orthodoxy and the mass of people. In 1979, after the announcement of his Nobel award, Salam was initially invited to Pakistan by General Zia ul-Haq, but other pressures soon blew an icy wind of excommunication.

With Salam stricken by illness, at Trieste it became clear he could not function much longer as the Institute's Director. As a tribute to its founder, which he would be still able

to appreciate before his powers waned completely, in 1993 the centre organized a three-day physics meeting which was attended by colleagues, admirers and former students from all over the world. One was Frank Yang, whose talk on mirror symmetry in 1956 had so much impressed the young Salam.

The culmination of the meeting was the award of an honorary degree of the University of St. Petersburg, Russia. The rector of the University made the trip specially. Salam listened from his wheelchair but could not speak. After the formal ceremony, participants stood patiently in line to offer their own congratulations. There was little response from Salam, but all hoped their message was getting across.

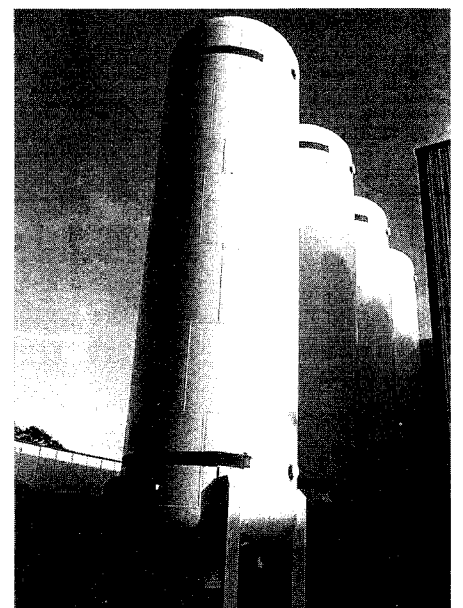
After famous names, it was the turn of younger students. One of the last was a nervous young man from Pakistan, a young researcher who had succeeded in gaining one of the highly-prized scholarships to Salam's centre. As he bent towards Salam hunched in his wheelchair, he said 'Sir, I am a student from Pakistan. We are very proud of you.' Salam's shoulders shook and tears ran down his face.

Large-scale cryogenics for CERN's LEP electron-positron collider - liquid helium reservoirs from Russia.

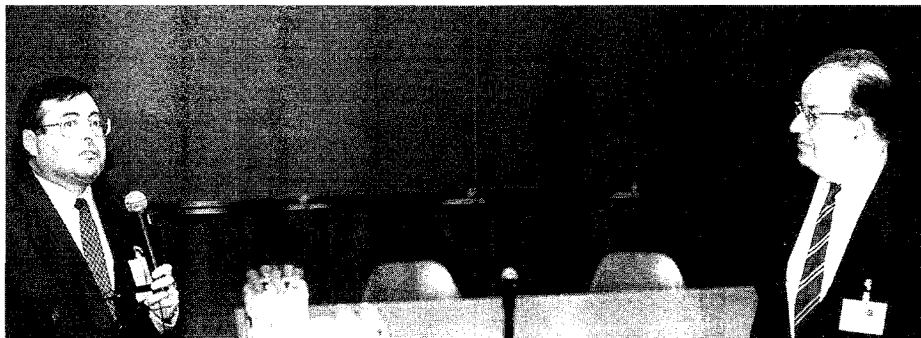
A cold welcome

Cryogenics is one of the big technological success stories of particle physics, and it was fitting that CERN recently hosted an International Symposium on Cryogenics in Industry which attracted specialists from all walks of cryogenics life.

For particle physics, low temperature equipment was first needed on a large scale for Luis Alvarez' pioneer big liquid hydrogen bubble chambers in the late 1950s. For subsequent developments, cryogenics has been frequently, but not always, synonymous with the improved performance provided by superconductivity, particularly the high magnetic fields provided by superconducting magnets. For bubble chambers, demand for cryogenic plant increased with the advent in the late 1960s of large detectors equipped with superconducting magnets, where the



A cold welcome. At the opening of the recent International Symposium on Cryogenics in Industry at CERN: Organizing Committee Chairman Philippe Lebrun of CERN (left) with Bernard Hébral, Chairman of Commission A 1/2 of the International Institute of Refrigeration.



12-foot chamber at Argonne was subsequently upstaged by BEBC at CERN and the 15-foot chamber at Fermilab.

A new horizon opened with the construction of Fermilab's Tevatron with its four-mile ring of superconducting magnets. Superconducting magnets had been used in beamlines, in low-beta insertions to squeeze colliding beams, and in spectrometers, while research and development work had led to revolutionary new types of filamentary conductors which went on to make a major impact on this technology. But the Tevatron, with a thirst for 5000 litres of liquid helium per hour, blazed a new trail and was the first industrial-scale cryoplant at a particle physics laboratory. Subsequently, the 6.3 kilometre HERA proton ring at DESY Hamburg and the CEBAF recirculating linac arrangement at the Jefferson Laboratory, Newport News, Virginia, swelled the ranks of big superconducting magnet rings.

Subsequently, the high magnetic fields required for the new generation of colliders, such as RHIC at Brookhaven and the LHC at CERN, can only be supplied by superconducting magnets - conventional magnets being limited to fields of about 2 tesla. In addition, superconductivity gives considerable

savings in power - about 6 MW is needed to cool the 800 GeV HERA proton ring, while on average several times this figure is needed to drive the CERN SPS synchrotron at 450 GeV.

While protons are heavy and 'stiff' proton beams need lots of bending effort, electrons are very light and the beams pliable. However electron beams lose a lot of energy due to synchrotron radiation as they are bent, so that electron rings are therefore are hungry for input power. For protons, the superconducting spotlight falls on magnets to guide the beams, while for electrons the superconducting goal is more on accelerating power.

Development work to harness the efficiency of superconductivity to drive radiofrequency cavities began at Stanford University (in the context of a linear accelerator) where electrons were first accelerated in a superconducting resonator in 1965. By the 1980s cavities had been installed at several electron machines and major programmes were underway at Cornell, CERN, KEK (Japan), CEBAF/Jefferson....

To increase its energy, CERN's 27-kilometre LEP electron-positron collider is being fitted with superconducting accelerating cavities, a scheme launched by the far-sighted John Adams back in 1979, and the

associated cryogenic plants will be capitalized for the LHC proton collider to be built in the LEP tunnel.

Introducing the cryogenics conference proper, Oscar Barbalat of CERN looked at the impact of 'megascience' - as defined by the Organization for Economic Cooperation and Development - on cryogenics and applied superconductivity. While installations in many physics areas use cryogenics and superconductivity on a large scale, Barbalat still saw the move from megascience to industrial technology as a major obstacle.

Jorg Schmid of CERN sketched the use of cryogenics in particle accelerators, both for bending and focusing magnets and for the radiofrequency accelerating cavities.

Giorgio Passardi of CERN outlined the wide range of cryogenic options now in use in detectors for particle physics experiments. As well as the advent and demise of the cryogenic bubble chamber, polarized target requirements had also helped to introduce cryogenics to the particle physics scene. For large detectors, cryogenic requirements are centred around spectrometer magnets and calorimeter technology.

One of the best known major cryogenic applications area for physics is in the big push to control thermonuclear fusion, where superconductivity is indispensable for the next generation of containment machines. Bernard Turck of the French Atomic Energy Commission's Cadarache centre described the French Toresupra, the German W7X Stellarator and the ITER international scheme, requiring respectively 35, 45 and 1200 tonnes of superconductor.

Another major outlet for superconducting magnets is for magnetic resonance imaging, mainly



Imperial College of Science Technology
and Medicine, Department of Physics,
South Kensington, London SW7

Two post doctoral Research Associates

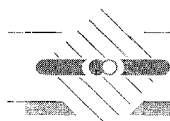
Applications are invited for two PPARC-funded two year posts to join the UK collaboration searching for the direct signatures of the dark matter of the Universe, in the form of new, Weakly Interacting Massive Particles (WIMPS). The experiments are being deployed in the Boulby mine, N. Yorkshire and the posts are both connected with the development of liquid Xe scintillation detectors to achieve higher sensitivity to dark matter signals.

Post 1 is to be initially at ICSTM with visits to Boulby envisaged later. The post holder will assist in the building and commissioning of prototype Xe chambers. Knowledge of cryogenic and/or nuclear counting techniques is desirable.

Post 2 is to be mainly located at the Rutherford Appleton Laboratory, near Oxford but in close collaboration with ICSTM and also involving experimental work at Boulby Mine. It will involve design and production of a background veto system and other design and analysis work related to the Xenon experiment. Experience in both particle counting techniques and computer skills are required.

The candidates will join an established team and there are reasonable prospects of extension of the posts beyond the two years.

Salary in the PPARC 1A range. Closing date, March 15. Posts available from April/May, 1997. Send CVs and the names of two referees or requests for further details to Dr W.G. Jones tel. 0171 594 7805 or Dr J.J. Quenby tel. 0171 594 7527 Department of Physics, ICSTM, Prince Consort Rd. London SW7 2BZ, UK.



Max-Planck-Institut für Kernphysik
Postfach 103980, D-69029 Heidelberg

The Max-Planck-Institute in Heidelberg, offers a Postdoctoral Position

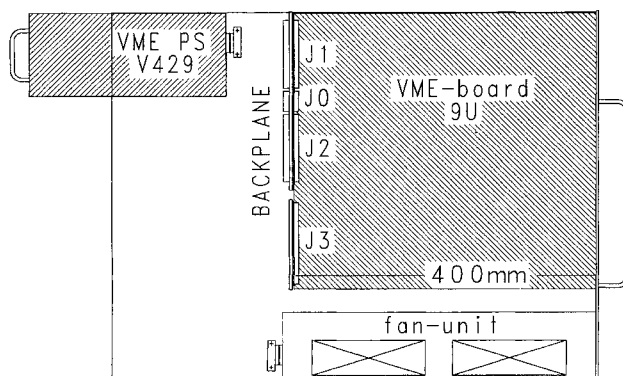
for the project HERA-B in the group of Prof. Dr. W. Hofmann. The goal of the HERA-B experiment is the first observation of CP-violation in decays of B-mesons. The MPI Heidelberg is involved in the construction of the silicon vertex detector, which is placed inside a vacuum tank in order to achieve the best possible resolution for secondary vertices. The successful candidate will participate in the construction and commissioning of the vertex detector and in the analysis of the HERA-B data.

The applicant should have a university degree with a Ph.D. in experimental high energy physics, hardware experience as well as knowledge in on-line computing, data analysis and Monte-Carlo simulation.

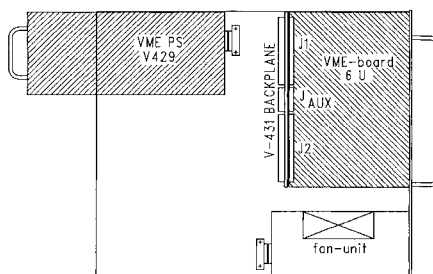
The position will be free from May 1st, 1997. The contract will initially be for 2 years, with possible extension to 5 years, and a salary according to BAT IIa. Handicapped applicants will be given preference to others with the same qualification. Applications should be sent under Reference 03/1997 to *Max-Planck-Institut für Kernphysik, Personalverwaltung, Postfach 103980, D-69029 Heidelberg.*

Powered Crates

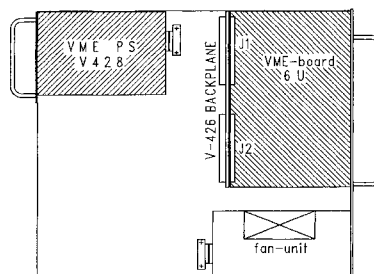
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Wes-Crates GmbH
Pattburger Bogen 33
D-24955 Harrislee/Flensburg
Germany

Telefon 0461 - 77 41 77
Telefax 0461 - 77 41 41
International +49 461

Your contact in Geneva: HiTech Systems Sa, Abenue Wendt 16,
1203 Geneva, Tel.: 022 / 344 77 88, Fax: 022 / 45 65 51

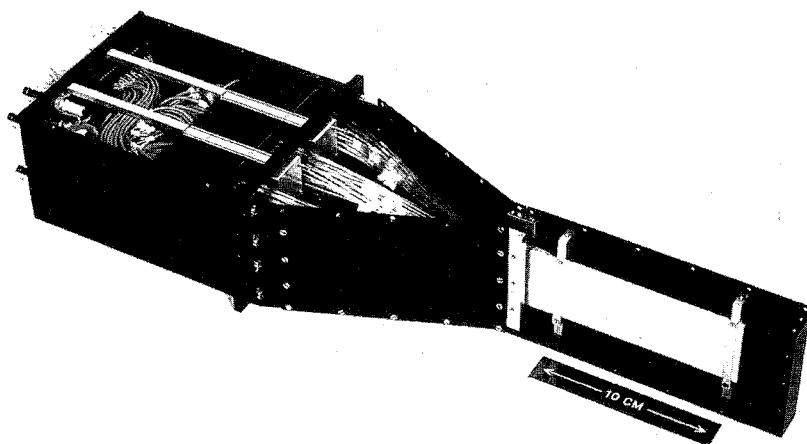
Your contact at PSI and ETH Zürich: Dipl.-Ing. Kramert AG,
Villigerstr. 370, CH-5236 Remigen, Tel.: 056 / 44 15 55, Fax: 44 50 55
E-mail: sales@wes-crates.de

Generic prototype of a scintillating-fibre detector for the DIRAC pionic atom experiment at CERN. The design uses a modular position-sensitive photomultiplier (PSPM) housing structure accommodating 48 channels. As well as making for flexibility in the final size of the full detector, this also allows a rapid repair or exchange of defective modules or PSPMs.

for medical tomography, where David Hawsworth of Oxford Magnet Technology pointed out that since the introduction of this technology in the early 1980s, the market has grown to some 12,000 installations worldwide. For the future, René Flückiger of Geneva described the impact of new superconductors.

Summarizing the status of particle physics at the meeting, Pierre Darriulat of CERN drew attention to the need for low temperature detectors, especially in spaceborne experiments, to make precision measurements.

As well as these major scientific areas, more specific projects were covered in brief oral presentations and poster sessions, while the parallel industrial exhibition attracted considerable interest. But the real star of the show was CERN's own installations, cryogenic and otherwise. The delegate tours of the Delphi experiment at the LEP, electron-positron collider, the superconducting magnet and cavity test area and the central cryolab were fully booked.



but also a simple and reliable means of handling the position information in real time.

To meet this demand, a scintillating-fibre detector is in preparation for the 'DIRAC' (Dimeson Relativistic Atom Complex) experiment at CERN's proton synchrotron based on the technical achievements of RD17 research and development project - fast readout of scintillating fibres using position-sensitive photomultipliers (PSPM). The technique fully profits from the advantages photomultiplier technology developed over the last several decades.

The unusual DIRAC experiment sets out to measure pion-pion scattering by synthesizing atoms consisting of a positive and a negative pion rotating round each other. Precision measurements of the lifetime of these atoms will reveal new information on pion-pion interaction, vital to test emerging ideas in quark-gluon field theory (quantum chromodynamics - QCD).

For the experiment, a generic prototype with 96 channels, corresponding to a fifth of the full detector, has recently been produced and successfully tested by a

LAPP(Annecy)/CERN/ IHEP/Kyoto-Sangyo/Trieste/UOEH/Waseda team. It is based on a new series of PSPM, H6568 from Hamamatsu Photonics, followed by specially designed front-end electronics and a peak-sensing circuit (PSC), which digitizes the track position in real time by suppressing annoying cross-talk between adjacent channels.

With an array of 0.5 mm diameter fibres, the space resolution for individual minimum ionizing particle 'hits' is about 130 micron with a detection efficiency higher than 95 %. Double tracks were also detected with a minimum two-hit separation of about 0.4 mm. As required for the DIRAC experiment, the distance between two tracks was successfully digitized in real time with a simple logic circuit. The time jitter of signals through the electronics (PSPM + PSC) was less than 500 ps. A finer or coarser granularity of detector elements could be achieved by using fibres of appropriate diameter without any major modification of the present setup.

With proven photomultiplier technology, such a device could have a wide range of ongoing applications for high-luminosity experiments.

DETECTORS

Scintillating fibres at work (1)

To help in the search for rarer physics events, one emerging trend is to pull together more precise information on the pattern of produced particles early in the event selection process. This requires a detector which assures not only good space and time resolution while acting as such a topological trigger,