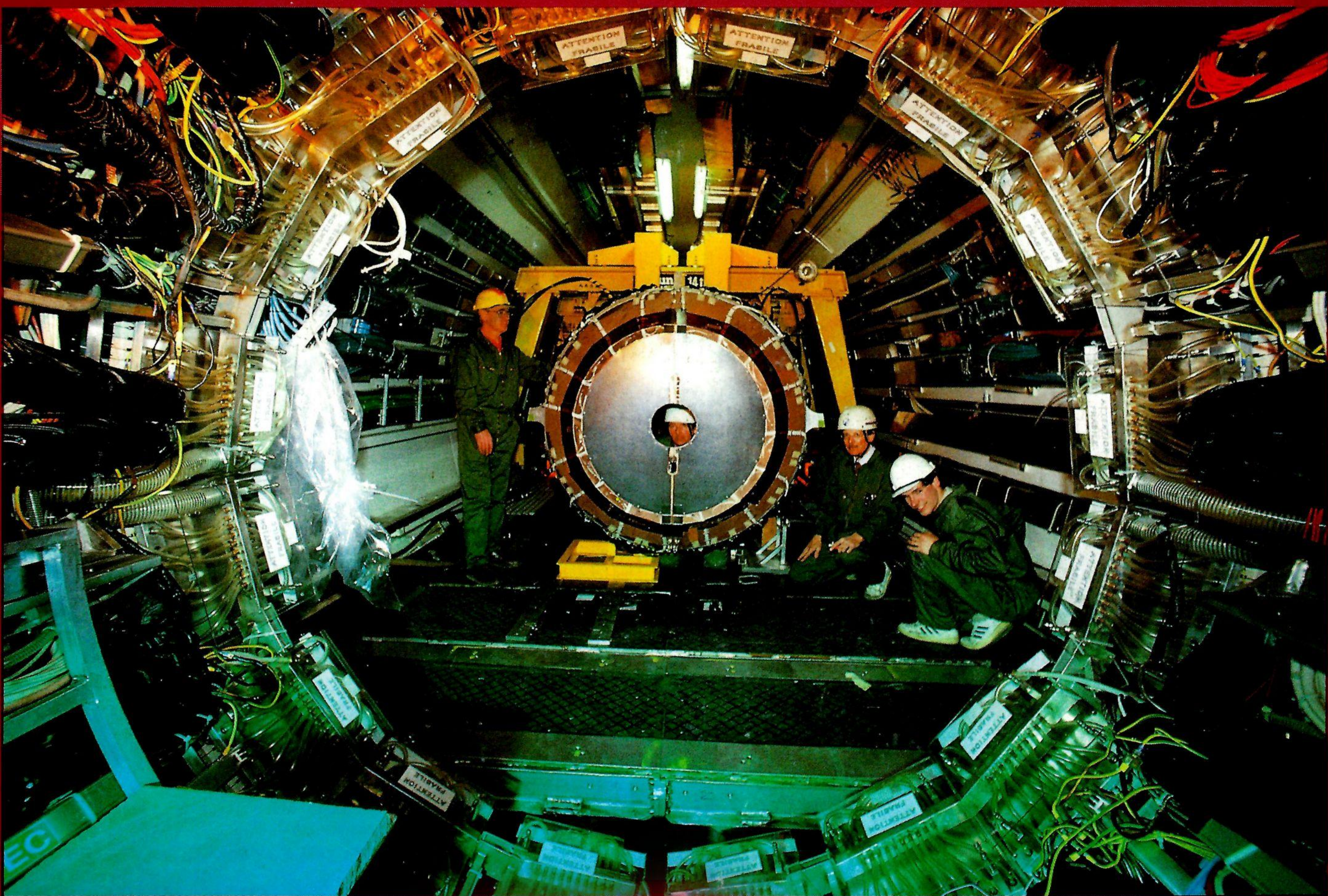
CERN COURIER

INTERNATIONAL JOURNAL OF HIGH ENERGY PHYSICS

VOLUME 33 **8** OCTOBER 1993



Distributed to Member State governments, institutes and laboratories affiliated with CERN, and to their personnel.

General distribution

Jacques Dallemagne
CERN, 1211 Geneva 23, Switzerland

In certain countries, copies are available on request from:

China

Dr. Qian Ke-Qin
Institute of High Energy Physics
P.O. Box 918, Beijing,
People's Republic of China

Germany

Gabriela Heessel or Kerstin Techritz
DESY, Notkestr. 85, 22603 Hamburg 52

Italy

Mrs. Pieri or Mrs. Montanari
INFN, Casella Postale 56
00044 Frascati, Roma

United Kingdom

Su Lockley
Rutherford Appleton Laboratory,
Chilton, Didcot, Oxfordshire OX11 0QX

USA/Canada

Cyndi Rathbun (B90904 @ FNALVM)
Fermilab, P.O. Box 500, Batavia
Illinois 60510

CERN COURIER is published ten times yearly in English and French editions. The views expressed in the Journal are not necessarily those of the CERN management.

Printed by: Drukkerij Lannoo nv
8700 Tielt, Belgium

Published by:

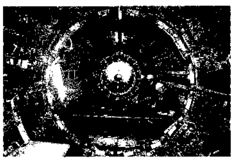
European Laboratory for Particle Physics
CERN, 1211 Geneva 23, Switzerland
tel.: +41 (22) 767 61 11,
telex: 419 000 CERN CH,
telefax: +41 (22) 767 65 55

CERN COURIER only:
tel. +41 (22) 767 41 03,
telefax +41 (22) 782 19 06

USA: Controlled Circulation
Postage paid at Batavia, Illinois

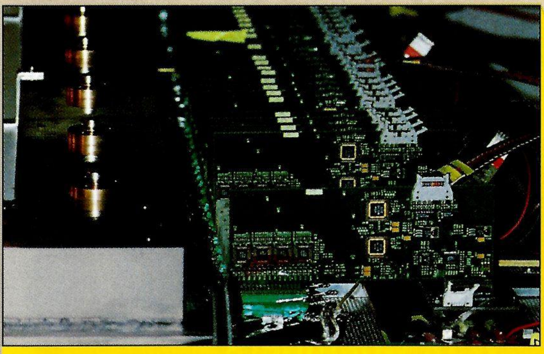
Volume 33
No. 8
October 1993

Covering current developments in high energy physics and related fields worldwide



Cover photograph: Earlier this year, the big experiments at CERN's LEP electron-positron collider got some well-earned attention during the machine's long shutdown. Here L3's endcap is readied for positioning deep inside the detector (Photo CERN EX 74.4.93/2).

Four Reasons to Use PCOS 4

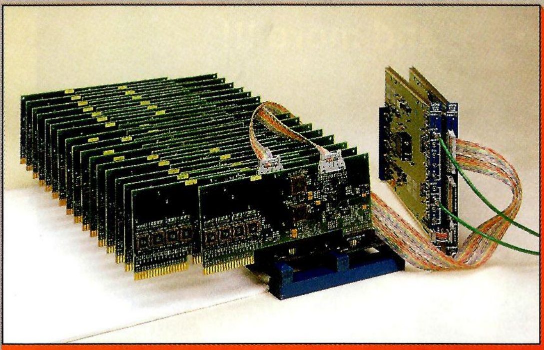


Introducing LeCroy's NEW Chamber System

Just as multi-wire proportional chambers have improved and evolved during the many years since their invention, so have the electronic readout systems.

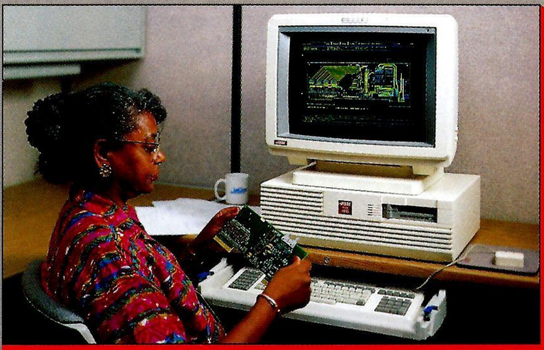
LeCroy's NEW PCOS 4 chamber system is the latest in a series which started in 1972.

PCOS 4 is an integrated system incorporating the amplifier, shaper, discriminator, delay, coincidence latch and readout on a 16-channel, chamber-mounted circuit board. This new system offers many benefits over existing proportional chamber readout systems including:

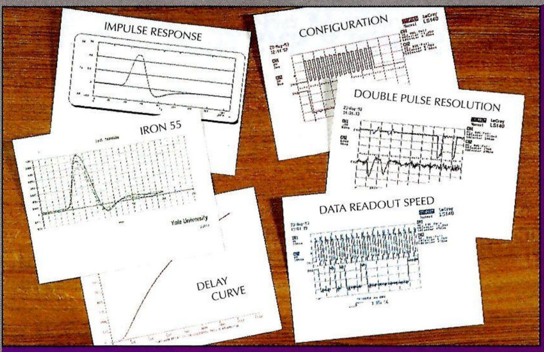


LOW COST - PCOS 4 was designed from the ground up for on-chamber mounting. The highly integrated design and simple cable requirements means low total system cost and high system reliability.

REDUCES CABLING - One 8 twisted-pair cable controls and reads out 256 wires, a 32:1 reduction over traditional proportional chamber systems! The serial readout (20 MHz clock rate) means low dead time with minimal cabling.



ADAPTABLE - Each experiment has different size, shape and density requirements. The two PCOS 4 custom integrated circuits make custom board design easy and reliable.



HIGH PERFORMANCE - The two PCOS 4 custom integrated circuits provide low noise, excellent double pulse resolution, precise signal delays, excellent coincidence resolution, built-in diagnostics and high speed readout.

PCOS 4 INCLUDES:

Model 2741 16-Channel Amp./Discriminator/Delay/Latch
Model 2748 Readout Controller for 1024 Wires
Model 2749 System Driver

*PCOS 4 was developed in cooperation with Yale University and Brookhaven National Lab. Photo courtesy of BNL.

LeCroy has been making innovative instrumentation like PCOS 4 for 30 years! Please write, call or fax us to receive more information on this new generation of chamber readout electronics.

LeCroy

Innovators in Instrumentation

700 Chestnut Ridge Road, Chestnut Ridge, NY 10977-6499 USA
Tel: (914) 578-6013 Fax: (914) 578-5984

Around the Laboratories

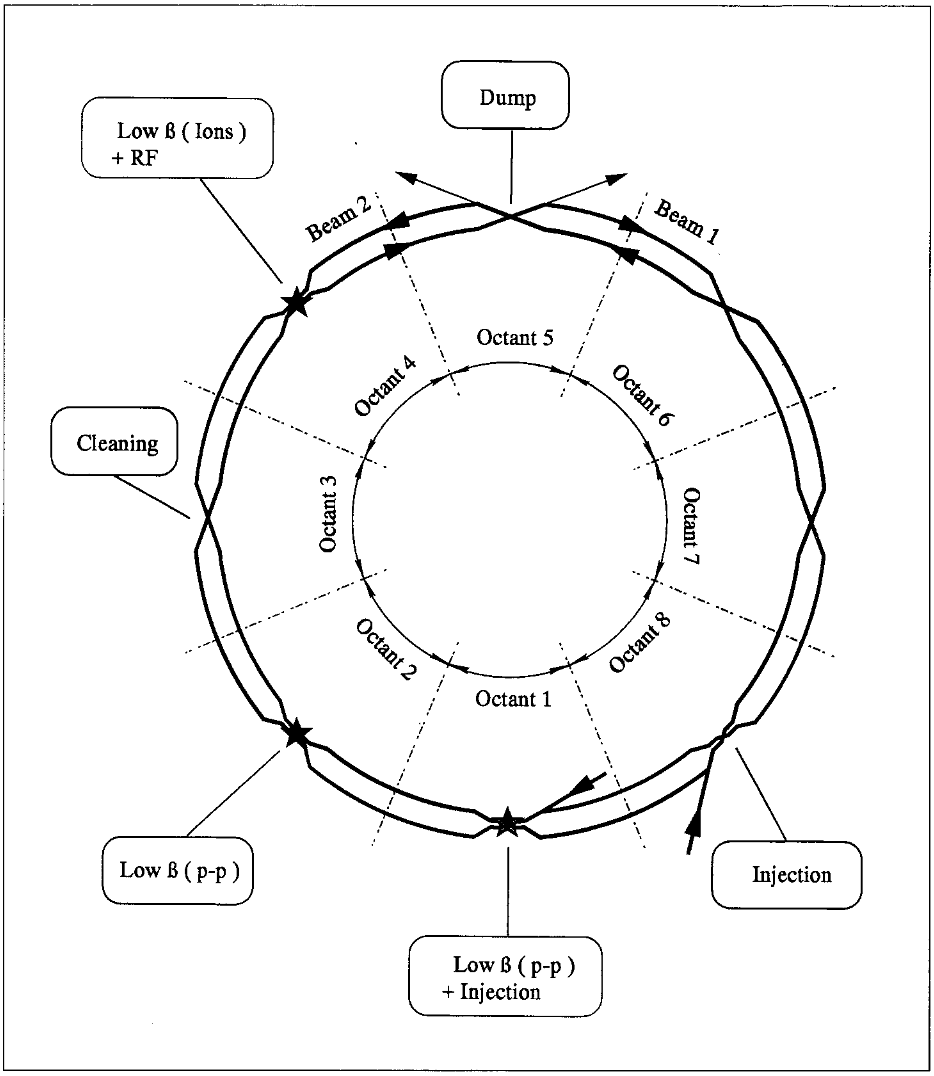
CERN
LHC progress

The push for CERN's next major project, the LHC proton collider to be built in the 27-kilometre LEP tunnel, is advancing on a wide front. For the machine itself, there has been considerable progress in the detailed design. While the main thrust is for proton-proton collisions, heavy ions are also on the LHC collision menu. On the experimental side, proposals are coming into sharper focus.

For the machine, the main aim is for the highest possible proton collision energies and collision rates in the confines of the existing LEP tunnel, and the original base design looked to achieve these goals in three collision regions. Early discussions on the experimental programme quickly established that the most probable configuration would have two collision regions rather than three. This, combined with hints that the electronics of several detectors would have to handle several bunch crossings at a time, raised the question whether the originally specified bunch spacing of 15 ns was still optimal.

A new analysis of machine performance for only two high luminosity experiments suggested that a longer gap between bunches could lead to higher luminosity per experiment, and this was later confirmed when the reduction in long range beam-beam forces was also taken into account. With 25ns bunch spacing, the attainable luminosity (beam-beam limit) in each of two collision points can be expected to be around 2.5 x 10^{34} $cm^{-2} s^{-1}$ instead of 1.6 x 10^{34}. This modest increase requires only a slightly higher bunch intensity, felt to be within the possibilities of the injectors and still far from single bunch instabilities.

When the gaps needed for injection and dumping are taken into account, a bunch spacing of 25 ns results in a total of 2835 possible bunches. This bunch spacing requires that the new radiofrequency cavities needed in the PS proton synchrotron (part of the LHC injector chain) should work at 40MHz instead of 67MHz. They are of course somewhat larger but can still be accommodated, while for acceleration in the SPS it was quickly established that 80 MHz would be the most appropriate frequency.



The LEP tunnel has eightfold symmetry, with the even-numbered pits currently housing major LEP experiments. For LHC, the intervening odd-numbered pits would also come into use. This shows a possible scenario, however many options remain open. Point 3 is reserved for the very important beam cleaning insertion, needed to prevent the beam halos reaching the superconducting magnets. The beam dump, also a complete straight section, will be installed at Point 5.

Once it had been clearly established that the machine would be better suited to 25ns bunch spacing, it was the turn of the experimental proposals to establish if physics performance would be degraded by the increased number of overlapping events. Spokesmen for all three major Letters of Intent (CMS, ATLAS and L3P - see below) indicated their preference for 25ns in view of the potential luminosity benefits.

Dipole magnets and beam energy

The initial design was modified for a higher ratio of beam energy to magnetic field, 0.81 TeV/Tesla. Subsequent studies showed that this is better optimized if the main dipole inner coil diameters were increased from 50 to 56mm.

Ongoing studies have also suggested attacking two alternative options with slightly different magnetic fields and hence beam energies. One option retains the original design philosophy and subsequent modifications, while the second option acknowledges that some 30% increase in the amount of superconductor per metre produces only about a 5 % increase in the magnetic field.

This was signalled last year (June 1992, page 21) when a magnet using SSC superconductor exceeded 10 Tesla when cooled to 1.75 K (rather than the standard 4K SSC temperature).

This second option is therefore based on a magnet with cables of the SSC type with similar strands but with the number of strands and the copper/superconductor ratio adapted to the higher field.

This design is expected to provide a quench field of 9.5 Tesla and hence an operational energy (per beam) of at least 7 TeV, approaching that of the first option. Meanwhile a 1m model using SSC cable will see what field this cheaper cable will give for LHC. SSC cable cannot be used for full length LHC magnets as the copper to superconductor ratio is inadequate to ensure protection in case of a quench.

LHC experiments

Preparations for LHC experiments are advancing well. After presentations of initial Expressions of Interest at Evian in March 1992, the LHC Committee (LHCC) was set up to examine Letters of Intent for proton-proton experiments.

The LHCC was asked to recommend to the CERN management which collaborations should proceed with a Technical Proposal and monitor the development of these proposals, ensuring that an approved programme is in place when the LHC gets its official go-ahead.

Three Letters of Intent were publicly presented at the first Open LHCC Session last November - CMS, a compact design with strong emphasis on muon detection; L3P, using experience and equipment from the L3 experiment at LEP to make precision lepton and photon measurements far from the intersection point; and ATLAS, based on a large toroidal muon magnet complemented by an inner superconducting solenoid. ATLAS is a merger of the ASCOT and EAGLE ideas presented at Evian.

The LHCC felt that at least two proton-proton experiments were essential for a healthy programme, but cost clearly ruled out more than two. A major goal was therefore to see how the three Letters of Intent could be compressed into two Technical Proposals. The committee found that the detector concepts proposed by ATLAS and CMS addressed the essential issues more convincingly. After further discussion, the committee decided in June to recommend provisionally that ATLAS and CMS should proceed to a Technical Proposal, and agreed on milestones for a further review in November.

Other areas of physics have not been neglected. The ALICE Letter of Intent (July, page 4) aims to see quark-gluon plasma in the dense matter formed in ion-ion collisions.

To examine the LHC's considerable potential for B physics (particles containing the fifth - 'beauty', or b, quark), the LHCC held a B physics workshop in May. While the general-purpose experiments could do some interesting physics with B particles, their capabilities in this sector are limited. Dedicated experiments would be required to explore this physics to the full, and three different ideas were tabled. One (COBEX) would run in the proton-proton collider with an open-geometry forward detector. Another (GAJET) would use a gas jet target in one of the LHC proton beams. The third (LHB) would use a fixed target, with a beam extracted by a bent crystal in the halo of the circulating beam.

SUPERCOLLIDER
Pros and cons

As this issue goes to press, proponents and opponents of the US Superconducting Supercollider (SSC), now under construction in Ellis County, Texas, are preparing for a major confrontation in the US Senate. (In June, the House of Representatives voted 280-150 to

US Department of Energy Secretary Hazel O'Leary - looking hard at SSC management.

sponsibilities. The Department of Energy, the major SSC paymasters, will select an 'execution/integration' contractor with wide experience in managing large construction projects, while the current Universities Research Association - a non-profit consortium of universities - will remain as 'design/operate' contractor.

Meanwhile to drum up national support, a major 'STAR' (Science and Technology Assembly on Research at the SSC) meeting on 13 September at George Washington University, Washington DC, provided a focus for the pro-SSC lobby.

If the SSC goes down, a 'tidal wave' could sweep across this entire sector of US science, warned David Gross, concluding the recent International Symposium on Lepton-Photon Interactions, held at Cornell in August (see page 9).

pull the rug out from under the SSC's feet, and prematurely terminate construction of the 87-kilometre proton-proton collider.)

In the face of such uncertainty, the Texas National Research Laboratory Commission has withheld $79 million of state support, making for major SSC cash flow problems. Just as tunneling progress was starting to overtake the planned schedule, one of the four big tunneling machines has been stopped.

Other unexpected cash shortfalls have added to the pain. The big SDC (Solenoidal Detector Collaboration) was preparing to begin construction this year, but has been told instead to prepare for a three-year 'stretchout'.

However a Senate hearing on August 4 permitted the pro-SSC lobby a rare dose of optimism, with Steven Weinberg, SSC cheerleader Senator J. Bennett Johnston, White House Science Advisor Jack Gibbons, Motorola Chairman Robert Galvin, SSC Director Roy Schwitters and Secretary of Energy Hazel O'Leary all apparently scoring valuable points.

In the current crisis of confidence, Hazel O'Leary has announced steps to redefine SSC management re-

JUELICH
COSY acceleration and cooling

The COSY cooler synchrotron at the KFA Forschungszentrum Jülich, inaugurated on 1 April, is now well on its way towards precision-defined high energy beams to open new fields for Jülich physics experiments.

In two important goals, on 25 May the first beam cooled by electrons circulated inside the accelerator, then on 25 July physicists succeeded in accelerating the beam from the 270 MeV/c injection momentum to 600 MeV. Shortly after, this was pushed well above 1 GeV. Throughout the tuning process the number of stored particles increased steadily, finally peaking at 1.1×10^{11}, a value compatible with the predicted limit at the injection energy.

This success was the result of a painstaking search for the optimum parameter set, the commissioning crew being acutely aware that bringing such a large machine on line was a major experiment in its own right.

The 3.3 GeV/c COSY machine belongs to the new class of hadron storage and cooler synchrotrons which started with CERN's LEAR low energy antiproton ring. COSY will 'sharpen' its beams to a narrow momentum spread using both electron and stochastic cooling to control the circulating particles. In addition it will provide space for internal experiments. Both features will allow for novel experimental approaches, and more than 100 physicists are eagerly waiting for the first proton reactions in their detectors.

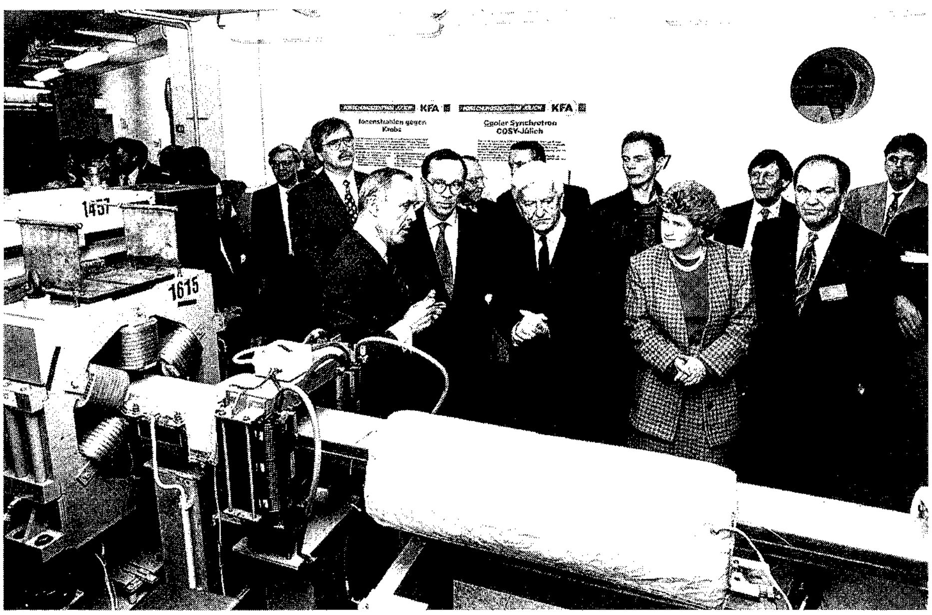
One of the machine's two 40m straight sections houses the electron cooler, the other contains target areas. These sections consist of 16 quadrupoles giving the experiments considerable freedom in shaping their beams. At the same time the straight section optics can be kept nearly transparent for the circulating beam.

Complexity was the price for such flexibility, putting enormous demands on the control system. Especially during commissioning, the vast parameter range that had to be explored increased the effort needed to master the system. Fifteen principal magnetic ramps and the radiofrequency and amplitude had to be precision matched.

Although all magnetic components had been precisely measured in bench tests, it was apparent from the beginning that the close mounting inside the ring would effect their magnetic properties. This, and the large number of elements involved, made the commissioning process tough.

The milestones reached so far prove that the ring is working according to its design - a major step en route to COSY becoming a viable source for high precision beams in the medium energy range.

VIP tour following the official inauguration of the COSY cooler synchrotron at the KFA Forschungszentrum, Jülich, on 1 April. Left to right, Rolf Theenhaus of KFA's Board of Directors; German Minister for Science and Technology Matthias Wissmann; German President Richard von Weizäcker; Regional Minister for Science and Technology Anke Brunn; and Joachim Treusch, Chairman of the KFA Board of Directors.



TRIUMF
Secrets of the red giant

Results from the first nuclear astrophysics experiment with the TISOL on-line isotope separator at the Canadian TRIUMF Laboratory for the first time allow accurate estimates to be made of the production of oxygen-16 in massive stars, and hence of heavier elements in supernova explosions.

Since its commissioning TISOL has been used to study properties of nuclides far from stability, similar to studies at CERN's ISOLDE. These new astrophysical results have shed light on a long-standing problem in the helium burning of massive stars and their subsequent demise by supernova explosions. Indeed, this problem has occupied many experimental and theoretical astrophysicists for the better part of the last two decades.

A key reaction in helium burning, an important stage in the nucleo-synthesis of the elements, is the interaction of an alpha particle with a carbon-12 nucleus, producing oxygen-16 (and a photon). In particular the ratio of its

Advertisements in CERN COURIER

Format A4 **Monthly publication**

All advertisements are published in both English and French editions. Second language versions accepted without extra charge.

Space (page)	Actual size (mm) width by height	Cost per insertion (Swiss Francs)			
		1 insertion	3 insertions	5 insertions	10 insertions
1/1	185 × 265	1980	1900	1830	1730
1/2	185 × 130 90 × 265	1170	1100	1040	960
1/4	90 × 130	690	630	590	550

These prices include no entitlement to special placing.

Supplement for:
— one additional colour 1500 SwF
— 1/2 page 900 SwF
— Covers:
Covers 2 and 3 (one colour) 2000 SwF
Cover 4 (one colour) 2500 SwF
Publication date 1st of month of cover date
Closing date for positive films and copy 1st of month preceding cover date
The cost of making films and of translation for advertisements are charged in addition.
Screen (offset) 60 or 54 Swiss (150 English)
Advertisements cancelled after 1st of month preceding cover date will be invoiced.
These rates are effective for the year 1993

Inquiries for Europe:
Micheline FALCIOLA / CERN COURIER – CERN
CH-1211 Geneva 23 Switzerland
Telephone: 022/767 41 03 **Telex 419 000 CER CH**
Telefax 022/782 19 06

***Inquiries for the rest of the world:* please see page III.**

EPAC94

FOURTH EUROPEAN PARTICLE ACCELERATOR CONFERENCE
Queen Elizabeth II Conference Centre, London,
27 June to 1 July 1994

After Rome, Nice and Berlin, the fourth conference in the series will be held at the prestigious Queen Elizabeth II Conference Centre, opposite Westminster Abbey and only a short walk from the Houses of Parliament, in the city of Westminster, London.

The conference aims to provide a comprehensive overview of research, technology and special applications in the field of accelerators. In the planning of the programme special emphasis is placed on excellent review papers and particular attention will be paid to high-intensity accelerators. The programme will include invited talks, contributed papers, oral poster presentations and poster sessions. Parallel sessions will be kept to a minimum.

Papers from the whole field of accelerators are solicited, including low- and high-energy machines and accelerators for medical and industrial purposes. The deadline for the receipt of Abstracts at the Scientific Secretariat is 15 December 1993.

An industrial exhibition, as well as an exhibition of CERN's proposed LHC Project, will be held during part of the conference and the conference programme will include a special session whose theme will be the transfer of technology from accelerator laboratories to industry. Information regarding the exhibition and seminar may be obtained from the Exhibition Manager.

Local organization is in the hands of the RAL and Daresbury laboratories. The registration fee is £225 if received before the deadline of 27 April 1994 and is increased to £250 thereafter. Due to the huge demand for accommodation in London in June and July, requests for accommodation should also be made prior to this date. Complete information concerning registration and accommodation may be obtained from the Conference Secretariat.

World-Wide Web (W3) and Internet Gopher will be used as additional means of disseminating information on the conference as it becomes available. Indications as to how to use these systems, as well as complete information on the conference are given in the First Announcement and Call for Papers available from the Conference Secretariats.

EPAC94 Conference Secretariat
Mrs. Susan Humphreys
Rutherford Appleton Laboratory
Chilton, Didcot
UK - Oxon OX11 0QX
Tel. +44 235 44 67 50
Fax. +44 235 44 66 65

Scientific Secretariat
Mrs. Ch. Petit-Jean-Genaz
EPAC Executive Secretary
CERN - AC
CH - 1211 Geneva 23
Tel. +41 22 767 3275
Fax. +41 22 767 86 66

Exhibition Secretariat
Neil Marks
Industrial Exhibition Manager
Daresbury Laboratory
Daresbury, Warrington
UK - Cheshire WA4 4AD
Tel. +44 925 603 148/432
Fax. +44 925 603 196

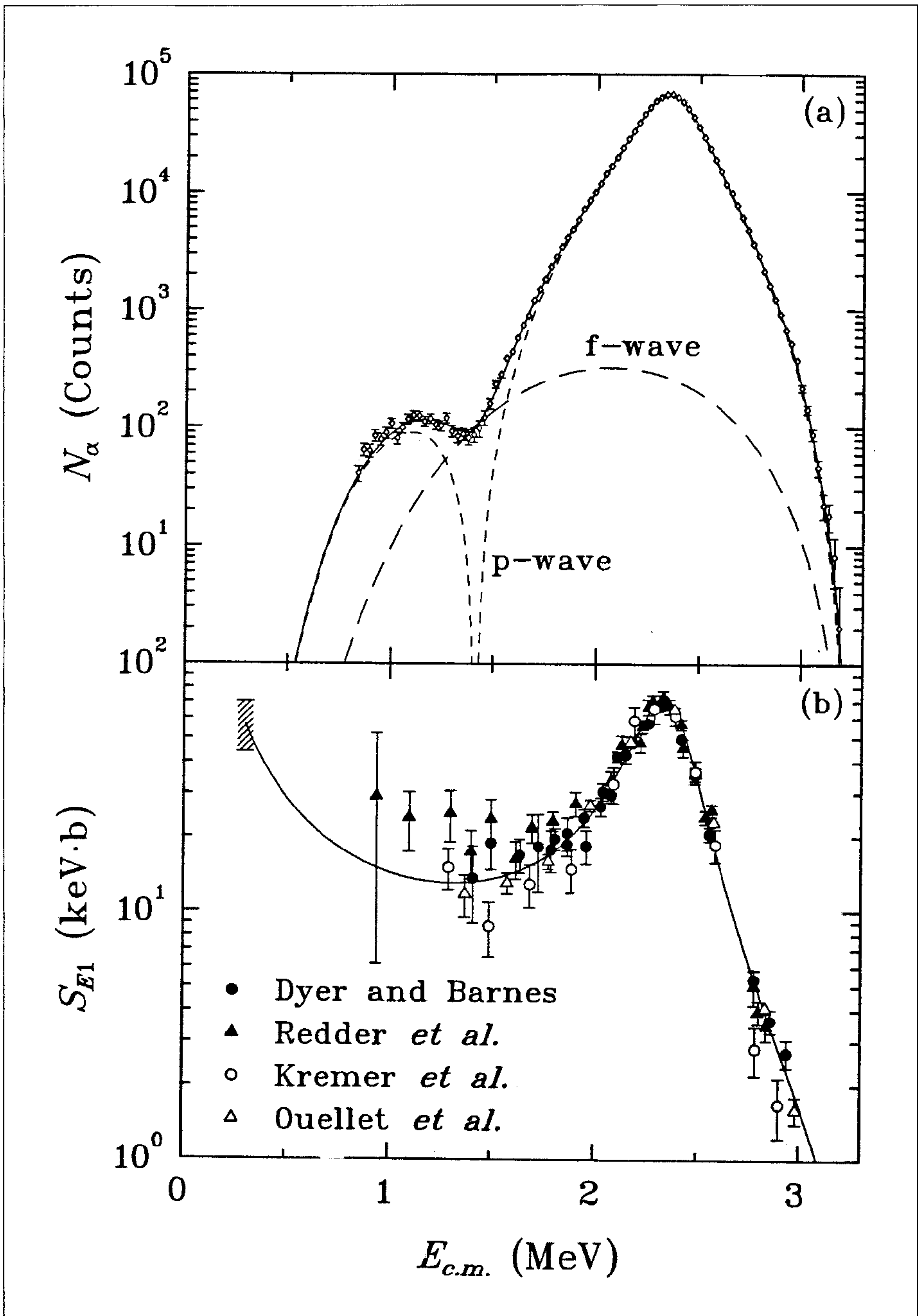
CENTRE DE PHYSIQUE DES PARTICULES DE MARSEILLE
- IN2P3/CNRS- UNIVERSITE AIX MARSEILLE II -

In the course of an expansion plan the Particle Physics Center at Marseille is expecting to recruit at a senior level, corresponding to a full professor position.

At the present time we are involved in LEP, CP LEAR experiments and in ATLAS detector R & D. The Laboratory plans to expand its manpower during the next four years.
Physicists and technical staff number around 100, and the institute has just moved into a new building offering very attractive working conditions.

Further information can be obtained from :
J.J AUBERT
Centre de Physique des Particules de Marseille
Faculté des sciences Luminy
Case 907
163, Avenue de Luminy
13288 MARSEILLE Cedex 09
Tél : 91 82 72 01

Improved knowledge from precision measurements of nuclear reactions makes astrophysical calculations more reliable. This shows the beta-delayed alpha-spectrum of nitrogen-16 measured by the Red Giant group at TRIUMF (a), simultaneous fit of this spectrum with data of other groups for the interaction of an alpha particle with a carbon-12 nucleus, producing oxygen-16 together with a photon (b), and the extrapolation of the S-factor (cross section) to the astrophysically important energy of 0.3 MeV.



rate to that of the formation of carbon-12 from three alphas is of great interest. This ratio determines the ratio of carbon-12 to oxygen-16 at the end of helium burning. In later burning stages of the star, these nuclei are the basis for all subsequent heavy-element nucleosynthesis.

The rate at which carbon-12 converted to oxygen-16 during helium burning in the cores of red giant stars cannot be well determined by radiative capture experiments since the capture is dominated by the tail of a sub-threshold state seen only through interference with a broad unbound state. The reaction rate (cross-section) at energies appropriate to helium burning (0.3 MeV) is very small and extrapolation of data to this low cross-section region is very uncertain.

However the most uncertain part of the reaction can be studied in the reverse direction by observing the alpha-decay of the oxygen-16 states in question after they are populated in the beta-decay of nitrogen-16. Since the beta-branching to the lower energy state is about 5000 times that of the higher energy state, the contribution of the lower state is much enhanced over its contribution in the capture reaction. The interference between the states is seen in the form of a small peak (approx 0.2%), on the lower energy side of the dominant alpha-decay peak.

The Red Giant group at TRIUMF (a collaboration of the Universities of Toronto, Simon Fraser and Alberta, with TRIUMF and Caltech) used TISOL, coupled with an ECR ion source, to produce an intense beam of nitrogen-16 nuclei and collected more than 1 million alpha/carbon-12 coincidences.

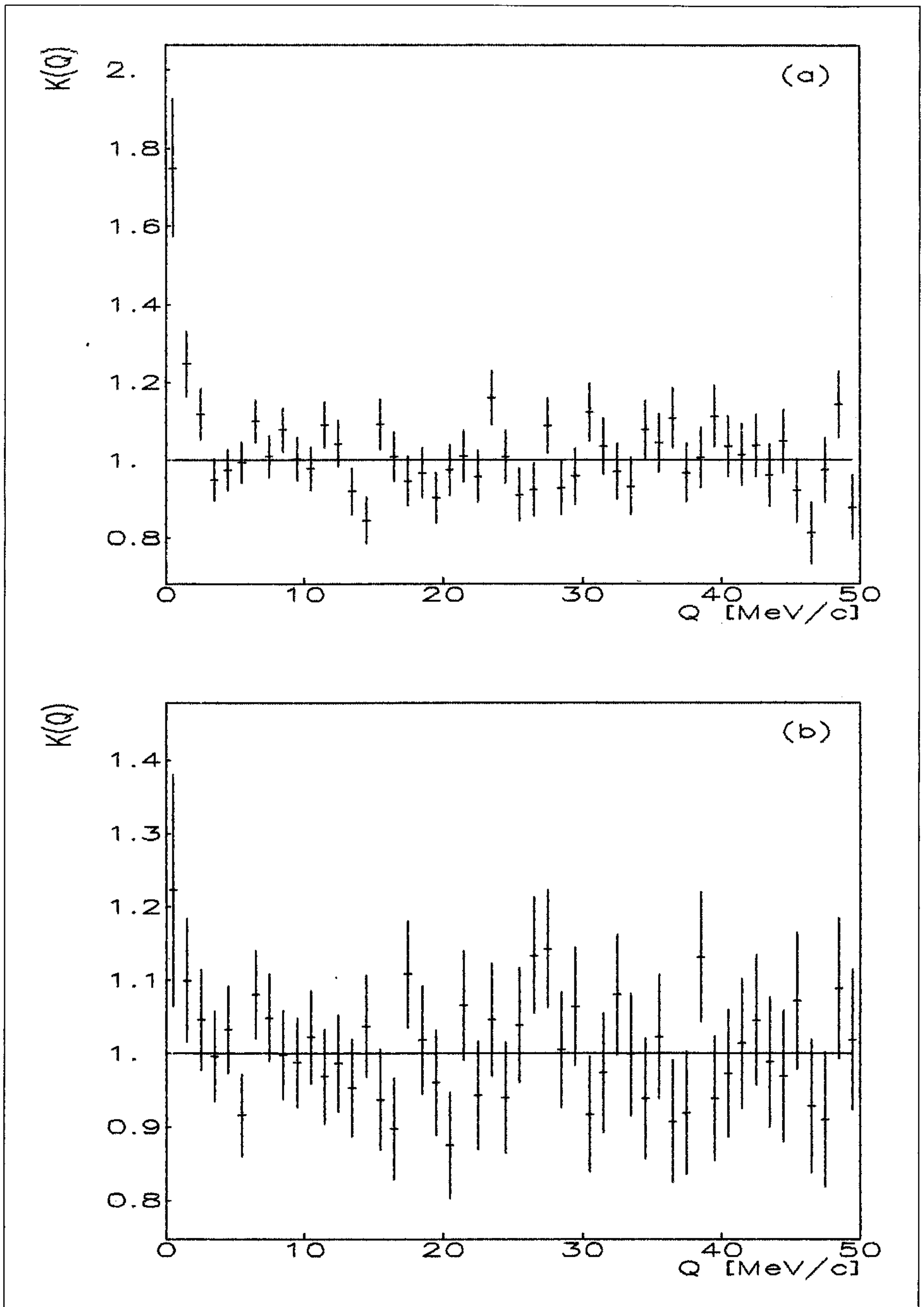
Coincidence was used to obtain an alpha-spectrum void of carbon-12 events, background or tails due to the detector response function. The resulting alpha-spectrum clearly showed an interference minimum and the expected low energy anomaly (see figure). To extrapolate the cross-section of the carbon-12/oxygen-16 conversion a simultaneous fit was made with the data for the direct measurement of this reaction.

In astrophysics, cross-sections are normally displayed in a way which has the steep Coulomb (electromagnetic) barrier effect removed, called

the S-factor. The lower part of the figure shows the S-factor data of other groups together with the simultaneous fit to the nitrogen-16 data. This fit has sharply reduced the uncertainty in the reaction rate in carbon-12/oxygen-16 conversion in the 0.3 MeV region. An experiment has also been carried out at the Yale tandem, using different production and detection techniques.

This improved knowledge will allow theorists to predict more precisely the ultimate fates of massive stars (e.g. likelihood of black holes) and the production of the medium-heavy elements (A=20-40).

Future plans for TISOL call for an upgrade to allow the use of proton beam intensities up to 10microamps with thick targets. Remote target handling systems are now being designed for this upgrade.



Pionium - atomic bound states of oppositely charged pions seen by a Moscow/Dubna collaboration. The top spectrum shows the distribution of pion pairs produced in an 8 micron foil target, relative to the distribution of free pion pairs, with a clear excess at low relative momentum (Q). For a thinner (1.4 micron) target (below) the pionium does not have time to ionize and no significant signal is seen.

DUBNA/SERPUKHOV Pionium

Electromagnetically bound 'atoms' of oppositely charged pions (pionium) have been seen by physicists from the Joint Institute for Nuclear Research, Dubna, and from Moscow State University, working at the Serpukhov proton synchrotron near Moscow.

When two pions thus orbit round each other in Bohr 'orbits' they can interact strongly at very low momentum. The pionium lifetime is governed by these interactions and its measurement gives information on strong interactions inaccessible by other methods.

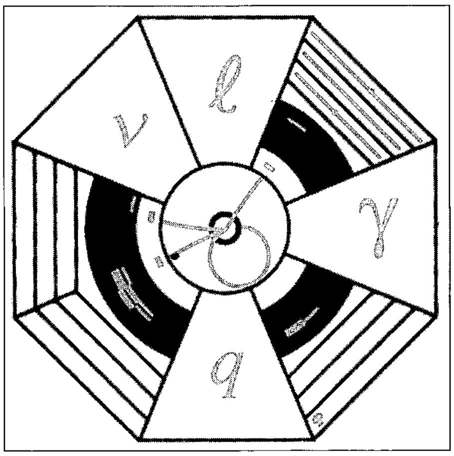
The measurements were carried out with the same apparatus used to study electromagnetic effects between pions (October 1991, page 8), giving good resolution on pion relative momentum. Pionium atoms were produced by a 70 GeV internal proton beam hitting an 8 micron tantalum foil.

In the target the resultant pionia can annihilate due to strong interactions into two neutral pions, while there is also a 40 per cent probability that they will ionize (break up) on hitting target atoms, producing charged pion pairs with low relative momentum.

The pionia were seen as excess charged pion pairs around 2 MeV relative momentum. 272 ± 49 pionium atoms were produced with momenta from 1.6-4.8 GeV, with a lifetime lower limit of 3×10^{-16}s.

For a 1.4 micron target the probability of pionium ionization is smaller and no excess signal is seen.

Physics monitor



The logo of the Cornell Lepton-Photon Symposium, showing a radiative decay of two taus as seen in the CLEO detector (Simon Patten, Minnesota).

Cornell and Marseille

This year's major high energy physics jamborees were at Marseille (the European Physical Society's 'Europhysics' International High Energy Physics Conference in July) and Cornell (the International Symposium on Lepton-Photon Interactions in August).

With the milestone 'Rochester' biennial meeting falling in odd-numbered years, the intervening years feature this regular programme dilemma. In 1991, the Europhysics and Lepton-Photon conferences were usefully combined in a single meeting in Geneva, but thereafter continued to go their own ways. A feature of the Lepton-Photon meeting is that it usually, but not always, picks a venue at an electron Laboratory.

With the Standard Model continuing to reign supreme, the two 1993 meetings largely overlapped. After authoritative feedback from Marseille, the CERN Courier Editor did the rounds at Cornell.

Cornell

A major theme running through the Cornell meeting, as with most physics meetings these days, was the need to look hard at suppressed or forbidden reactions for signs of an excess or positive signal, suggesting that at last something new might be happening. At Cornell, Jack Ritchie (Texas) covered the kaon front, while Anthony Sanda (Nagoya) gave an overall status report. Rare processes mediated by second order effects (two quarks mechanisms coupled back-to-back) have been seen by the CLEO detector at Cornell (June page 1), and Sanda suggested that other such effects could now begin to show up.

Last year's major international meeting at Dallas marked the debut of physics results from the Zeus and H1 experiments at the new and unique HERA electron-proton collider at DESY, Hamburg.

This year HERA's collision rate is climbing, and the entire 1992 collision score was matched in just one weekend at the end of July.

Cornell's plenary-only programme featured back-to-back presentations from H1 (John Dainton, Liverpool) and Zeus (John Martin, Toronto). Both experiments are beginning to see signs of the tight particle clusters ('jets') indicative of constituent quark/gluon interactions deep inside the 'target' protons.

HERA probes the structure of the proton in an unexplored kinematical region (quark momentum fraction x approaching 10^{-4}), and H1 was the first to see how this structure develops as x decreases. As the proton is probed in increasingly finer detail, it shows a richer quark content as more transient ('virtual') quark/gluon contributions come into play. This structure evolution provides important information for quark field theory, with additional mechanisms opening up.

The Zeus experiment was the first to see the 'rapidity gap' behaviour (September, page 6). While the hadronic energy flow is spread right across the kinematically-allowed region, there is a pile-up on the electron side, with the scattered proton (or neutron) disappearing down the beam pipe. Zeus is installing extra detecting equipment to pick up these forward particles.

While HERA still has a lot of luminosity to deliver, the collected data sample already includes isolated events which reach out to the edges of the allowed kinematics.

However nucleon structure results from conventional fixed target experiments have not yet been overtaken by HERA. Rudiger Voss (CERN) pointed to a generally coherent picture with results fitting smoothly together. Preliminary results using polarized beams/targets from Stanford (SLAC) and the Spin Muon collaboration (SMC) at CERN (May, page 9) had hinted at a possible disagreement with the fundamental (Bjorken) sum rule (relating proton and neutron spin structure), but Voss pointed to recent analyses which discourage looking for disagreement. Whatever the outcome on this point, it is clear that valence quarks make up only a portion of the proton spin.

Another sector where more data is needed, as always, is with neutrinos. These transient particles are difficult to detect and concrete results take time. Alexei Smirnov of Moscow reconciled mass limits on the tau neutrino from laboratory experiments

Quark/gluon structure of the proton as measured in a new kinematical range by the H1 experiment at DESY's electron-proton collider, showing the evolution from conditions at fixed-target experiments (right).

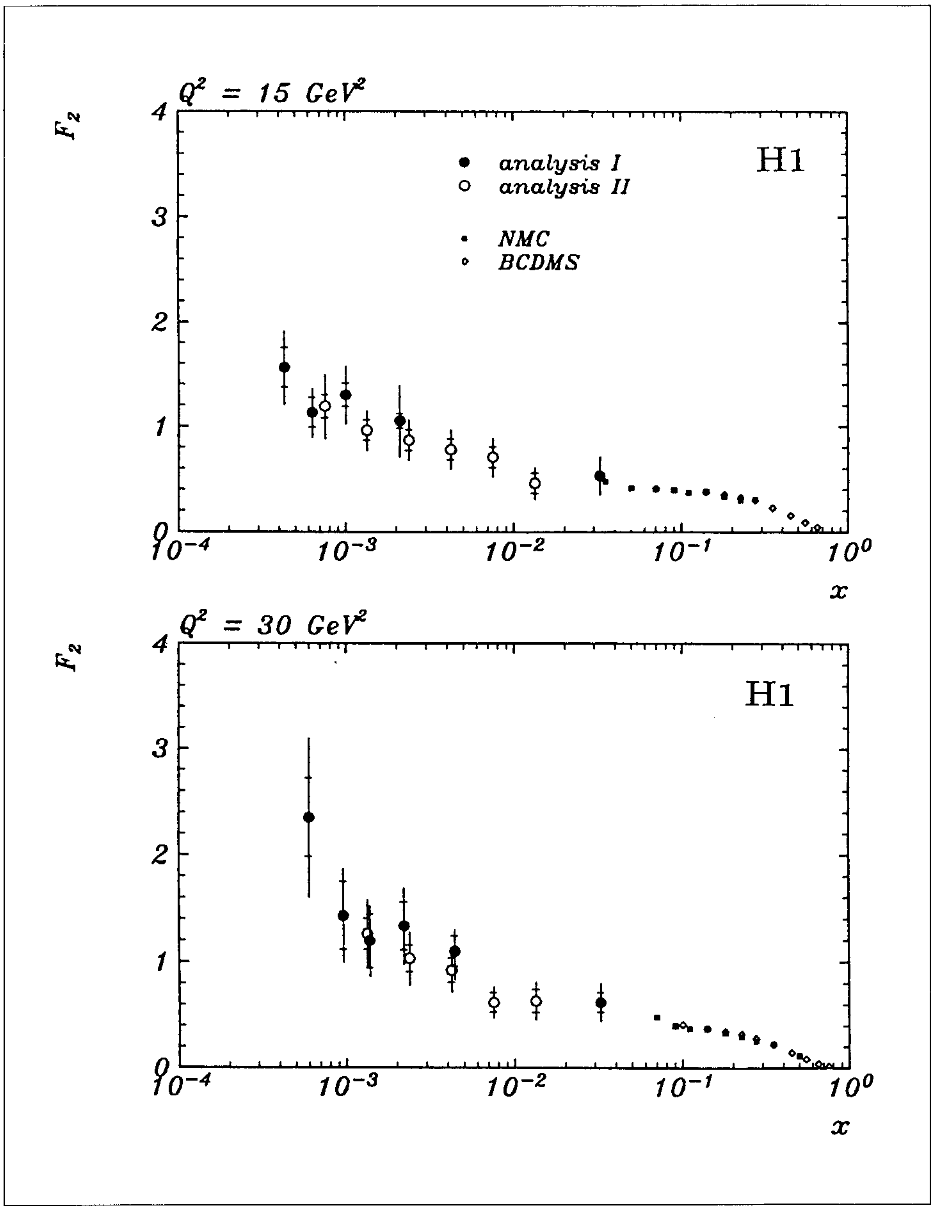
(below 32 MeV) with implications from cosmological nucleosynthesis. The result, said Smirnov, is that the tau neutrino is probably lighter than the electron, so that the ratio of the masses of the tau neutrino and the tau particle is extremely small.

New data from the Soudan underground detector in the US rounds out the picture of atmospheric neutrinos, with less evidence for a deficit of muon-type particles previously reported from water-based detectors.

On the solar neutrino front, where gallium-based detectors are now picking up particles from the Sun's primary proton-proton fusion reaction, Smirnov thought that there is still evidence for a deficit, so that something happens to solar neutrinos in transit.

Today's physics is characterized by big collaborations working hard on detailed processes. This high level of industry and workmanship was reflected in a range of Cornell reviews packed with detailed results - Michael Witherell (Santa Barbara) on charm, David Besson (Cornell) on B meson physics at the production threshold, Wilbur Venus (Rutherford Appleton) on B results at higher energies, and Andreas Schwartz (MPI Munich) on tau leptons. Guy Coignet of Annecy described how even searching for new particles is now a major industry.

While all experimental results tie in with the Standard Model, a new theoretical tool in the shape of Heavy Quark Effective Theory provides a new way of analysing some quark mechanisms. The relative heaviness of certain quarks enables useful approximations to be made, simplifying the theoretical description and opening up some calculations which otherwise would be inaccessible. Specialist Mark Wise of Caltech explained how and why.



The only gap in the Standard Model is the sixth ('top') quark. Although unseen, it is nevertheless playing an important role deep inside quark mechanisms. Indirect evidence, especially from the big precision experiments at CERN's LEP electron-positron collider, point to the top being found around 164 GeV.

The front line of the top search is at the big CDF and D0 experiments at Fermilab's Tevatron collider. Rumours abound, and every major meeting seems to launch a new wave of top speculation. The truth is sombre, with an experimental limit above 113 GeV. Paul Tipton (Rochester, CDF) and Nicholas Hadley (Maryland, D0) explained how finding the top amidst the clutter of high energy proton-antiproton collisions is tough. The data accumu-

Smooth operators - Cornell Local Organizing Committee Chairman Richard Galik and Coordinator Ellen Marsh.

lated so far does not push any candidate top signal above the significant accompanying background. Depending on the mass, up to 2000 examples of top could be lurking inside the latest CDF data sample, but even this optimistic estimate is still only a tiny fraction of the total sample.

Perhaps more worrying than the background is how the top production rate decreases with its mass, dropping by a factor of 20 over the probable range indicated by Standard Model consistency. Already D0 says that a top quark heavier than 140 GeV most probably will not be visible in their next major run, which begins later this year.

While Morris Swartz of SLAC and Wolfgang Hollick of MPI Munich explained how these consistency checks inside the Standard Model provide powerful limits on the top quark mass, the same is not true of the 'higgs' particle responsible for the model's electroweak symmetry breaking. 'The higgs makes everything possible but is itself highly elusive,' said Hollick. A light higgs particle could be intercepted at LEP when its energy is increased, but otherwise the higgs will have to await the next generation of proton colliders. Swartz said that new results from the Stanford linac on Z production using polarized beams are still in the pipeline.

Partnering the electroweak mechanism in the Standard Model powerhouse is the field theory of quarks and gluons - quantum chromodynamics (QCD). Marjorie Shapiro of Berkeley stressed that QCD is now fully tested, and, with extra levels of intricacy now being built into the calculations, is now being used to probe other processes. Frank Wilczek (IAS Princeton) suggested new applications of QCD in accelerator physics, astrophysics and cosmology.

Concluding the Cornell meeting, Vera Lüth of the SSC gave an excellent review of experimental results. On the theoretical side, David Gross of Princeton told physicists they should stop worrying that the Standard Model works so well. They should be 'proud' and 'happy' so have such a good theory, but suggested that the name should be changed to something more suitable, like 'Quantum Particle Dynamics'. At least the term 'model' should be dropped, he recommended.

Although the 'model' has recognizable deficiencies, it can still predict the mass of the top quark with uncanny accuracy. Progress could come from understanding what underlies quark dynamics, said Gross, where new dimensions of space and time could be lurking.

The next Lepton-Photon Symposium will be held in Beijing, from 17-22 August 1995.

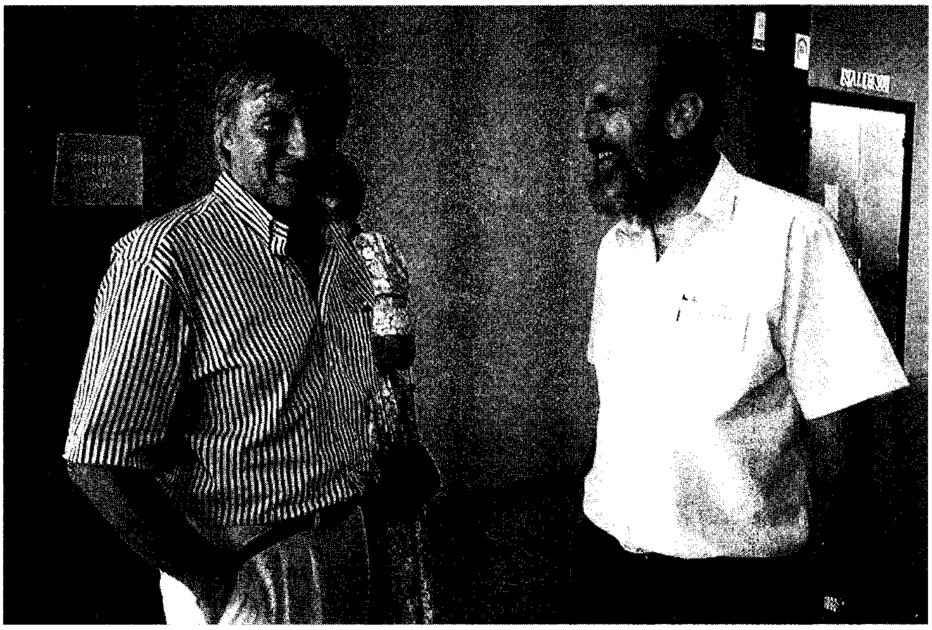
Marseille highlights

Featuring parallel sessions as well as plenaries, the Marseille 'Europhysics' meeting also ranged wider than Cornell. Advances in physics follow from advances in accelerators and detectors. Complementing physics coverage at Marseille, DESY Director Bjorn Wiik and Enzo Iarocci, Chairman of CERN's Detector R&D Committee, reviewed recent developments in accelerators and detectors respectively.

Under LEP conditions, the Standard Model works perfectly. It gives a value for the 'running' coupling constant of quantum chromodynamics, QCD, and pins down the sixth quark to the range 130-200 GeV (Jacques Lefrançois).

On the theoretical side, Guido Altarelli and Lev Okun emphasized the tricky nature of radiative corrections. If the electroweak strength is taken as the 1/129 value at the mass of the Z (rather than the low energy value of 1/137), all radiative corrections 'conspire' to cancel. This calls for a top quark around 150 GeV, and

Marseille Conference Chairman R. Gatsmans (right), with rapporteur Daniel Treille (CERN).



vided by its new complement of superconducting radiofrequency cavities will bring great promise.

The value of physics data will also be improved by new techniques of 'tagging' b-quarks.

implies that any new physics effect under these conditions will be small.

K. Zalewski reported good progress on measuring the elements of the (Cabibbo-Kobayashi-Maskawa) matrix describing quark decays, where new impetus has come from the radiative quark ('penguin') decay seen at Cornell and with neutral B meson oscillation seen in real time at the Aleph detector at LEP.

Tau physics (E. Fernandez, Barcelona) is a precision area, now giving a useful reference value for the quark coupling constant.

Emlyn Hughes (SLAC, Stanford) covered nucleon structure results using polarized beams/targets, indicating that there is no deep reason to question basic nucleon sum rules.

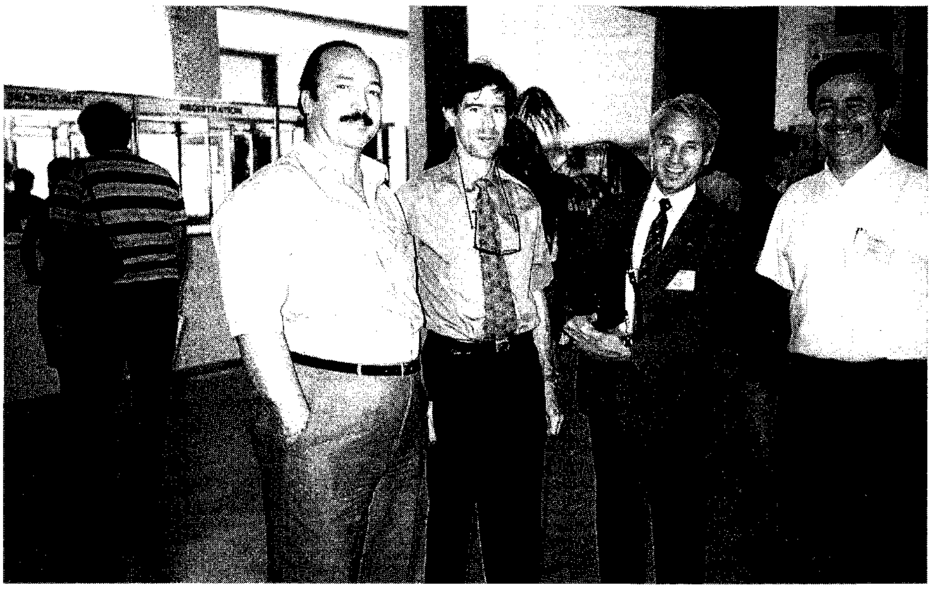
The H1 and Zeus experiments at HERA (A. de Roeck and R. Klanner respectively) with their increased kinematical reach added interest.

M. Spiro of Saclay covered extraterrestrial neutrinos, where he thought there was no significant discrepancy between the solar model predictions and the levels seen by gallium-based detectors. Attention is turning more to what depletes the beryllium and boron neutrinos yields.

Daniel Treille of CERN said that LEP, operating at the Z resonance around 91 GeV, is not far from exhausting its physics potential. However the higher energies pro-

Marseille organizers (left-right) Pierre Mery, Pierre Chiappetta, Jacques Soffer and Jean-Jacques Aubert.

(Photo Maurice Jacob).



The Liblice castle in Melnik, Czech Republic, with the participants of Beauty '93.

Beauty...

B-physics - the study of particles containing the fifth (beauty, or 'b') quark - is at a turning point. After the discovery of this quark at a proton machine - Fermilab - in 1977, most of our knowledge of its physics subsequently has come from experiments at electron-positron colliding beam machines.

Although this tradition is continuing with the latest results emerging from the upgraded CLEO detector at Cornell (June 1993, page 1) and from the major B contributions of the LEP experiments at CERN, experiments at hadron colliders have begun to produce complementary results.

First, the UA1 experiment at CERN's proton-antiproton collider saw the oscillation between different neutral B-mesons. Subsequently UA1 saw evidence for B-baryons (December 1991, page 29). Now, the CDF experiment at Fermilab's Tevatron collider has demonstrated that very clean samples of exclusive B-meson final states can routinely be obtained at hadron colliders and, using a silicon microvertex detector, has shown that B-meson lifetimes can be well measured. An ever-increasing flow of new B-physics is expected from CDF in the near future.

The First International Workshop on B-Physics at Hadron Machines, Beauty '93, held earlier this year at Liblice Castle, near Prague, in the new Czech Republic, reflected this trend. Representatives from most existing and proposed B-physics enterprises attended, providing a forum for detailed comparisons of all proposed methods of B experimentation.

In the next generation of B experiments, the search for CP violation - the breakdown of the conservation of combined particle-antiparticle and left-right substitution - will figure prominently. Although CP violation has been known for almost 30 years in the decay of K-mesons, its discovery and study in the decay of B-mesons is a contemporary physics goal of the highest rank, because it will probe deep into the standard model and may lead to new physics beyond. However, because the effects of CP violation in B-decay are only seen in rare decays, its study will require a lot of data.

While electron-positron collider B-factories, with their unique and well understood environment, will continue to play an important role in the future of B physics, it is crucial that experiments at hadron machines, with their much larger B yields, also be pushed.

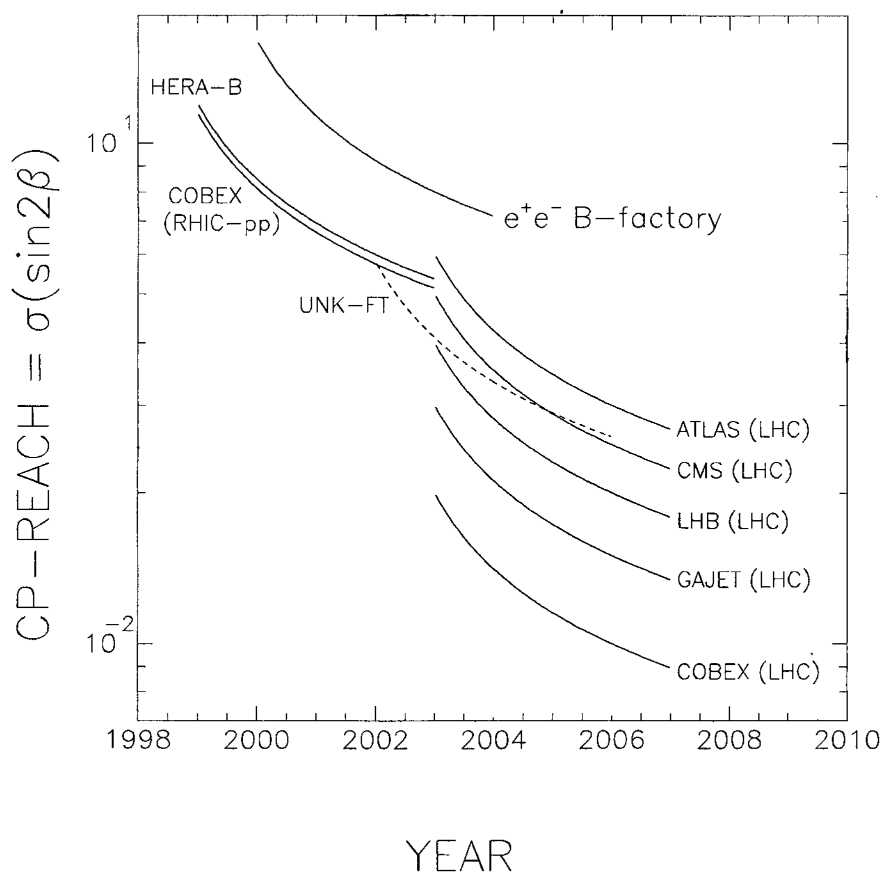
For example, proton-proton collisions at the future Large Hadron Collider (LHC) at CERN will produce at least 7000 times more B-mesons per second than will electron-positron collisions at a B-factory. Although the overall efficiency for using hadronic events to study CP violation is about 100 times smaller (due to a variety of reasons) a net improvement factor of about 70 remains.

At the workshop, the full range of possibilities for B-physics at hadron machines was discussed. Many simulation studies and much specialized detector R&D work have been carried out during the last few years.

Looking forward to this next generation of hadronic B-physics, there were three talks on CP violation studies with the general purpose detectors proposed for CERN's LHC. P. Eerola (CERN) presented prospects of the ATLAS detector, N. Neumeister (Vienna) discussed the CMS detector and D. Denegri discussed the L3P detector.

The prospects for dedicated B experiments at proton machines were discussed in a series of five presentations. P. Schlein (UCLA) talked about the COBEX open geometry forward collider detector

CP reach - expected progress in measuring the CP-violation parameter for different proposed experiments measuring 'gold-plated' B decays to J/psi and a short-lived kaon (in most experiments, the uncertainty can be reduced by about a factor of 0.6 by combining data from several final states). The curve for COBEX at Brookhaven's RHIC 'heavy ion' collider assumes proton-proton running for half the time.



being proposed for LHC. F. Costantini (Pisa) described LHB, a fixed target B experiment being proposed for LHC which would use an external proton beam obtained with crystal extraction. Y. Lemoigne (Saclay) discussed the GAJET proposal, which would use a gas-jet target in the circulating LHC proton beam.

(This LHC B physics potential was examined in a special LHC workshop in May - see page 2.)

S. Conetti (Virginia) described recent experiences of fixed-target experiment E771 at the Tevatron and the prospects for the proposed SFT experiment in a 20 TeV crystal-extracted beam at the US SSC. W. Hofmann (MPI-Heidelberg) considered the use of a configuration of internal wire targets positioned in the halo of the circulating HERA proton beam at DESY, with B decays detected in a forward spectrometer.

There were three talks on the UNK accelerator project at the Institute for High Energy Physics at Protvino in Russia. A. Zaitsev (Protvino) reviewed the diversity of the entire 3 TeV fixed target programme. V. Gurov looked at the design and operation of the asymmetric UNK collider as a proton-proton collider B-factory, and A. Zlobin (Protvino) summarized superconducting magnet development for the 3 TeV ring.

With the disruption of science in the former Soviet Union by the events of the past few years, there was some discussion of possible political and financial mechanisms for underwriting the completion of the UNK project.

The meeting closed with reports from five working groups: one on theoretical questions connected with the physics of beauty-charm states (convener: G. Nardulli, Bari), one on the problems of studying the rare and difficult decay of B-mesons into two pions (convener: S. Erhan - UCLA), one on some general questions of detector design (convener: M. Medinnis - UCLA), and one on problems of triggering and data acquisition common to all optimized B experiments at hadron machines (convener: J. Zweizig - UCLA).

Finally, there was a report from the "CP-Reach" working group (convener: P. Harrison - QMW, London), making a first attempt to compare all proposed experiments using the same criteria.

There was little doubt at the end of the workshop that B-physics, and in particular CP violation studies, has a bright future at hadron machines. Further developments will be reported at Beauty '94, already in the planning stage.

The workshop was supported by The Czech Academy of Sciences, their Institute of Physics in Prague, and INFN-Rome I. The proceedings of the Beauty '93 workshop have recently appeared as a special issue of Nuclear Instruments & Methods, Volume A333, No. 1 (August 1, 1993). There are 19 papers, plus the reports from the five working groups.

From Peter Schlein (UCLA)

.....tau and charm

The Standard Model of particle physics has six quarks, grouped in three pairs (up/down, charm/strange, top/beauty), each pair being partnered with a lepton and its corresponding neutrino - respectively electron, muon, and tau. Probing the Standard Model in depth to see what makes it work means peering into all quark/lepton corners. While B physics, with its potential at proton and electron-positron machines, is being pushed hard (see previous article), other physicists underline the need for complementary information from other sectors.

Essential experimental tools for exploring out-of-the-ordinary particles are a Tau-Charm Factory and a Beauty Factory. These machines address similar basic questions in the Standard Model, but in complementary ways: the Beauty Factory is optimized for beauty particles and CP violation in B decays; and the TCF is optimized for the tau lepton, charm particles, and the spectroscopy of hidden charm states and light hadrons.

In early June about 100 physicists - theorists, experimentalists and accelerator physicists - from Europe and beyond gathered in Marbella, Spain, for the 3rd Workshop on the Tau-Charm Factory (TCF). The workshop aimed to reassess the TCF physics potential in the light of recent progress, to develop further the designs of the machine and the detector, and to discuss the experimental programme.

At the workshop, particular emphasis was placed on the prospects for tau and charm physics at current machines and at future B Factories. Whereas both a BF and a TCF generate large tau and charm statistics (a few 10^7 events per year), the workshop indicated that the key element of future precision measurements will not be statistics but systematic errors. Here the unique environment of the TCF, with its backgrounds that are both small and experimentally measurable, is likely to prove a decisive advantage.

Among the most challenging TCF goals are: measurement of a possibly finite tau-neutrino mass with a sensitivity of about 1 MeV, measurements of CP-violation asymmetries in the decays of D (charmed) mesons and hyperons, precision measurements of the space-time structure of tau decay, and a comprehensive study of light quark, gluon and hybrid spectroscopy.

There was considerable discussion at Marbella about new calculations of direct CP-violation in D decays. Seeing CP violation with these relatively short-lived particles has traditionally been written off, but new Rome/Naples calculations suggest that this highly constrained sector should be worth investigating.
The calculations indicate decay rate asymmetries at the 10^{-3} level, close to the TCF's experimental reach.

In the light meson spectroscopy sector there was a consensus among the participants that with the detail of information available from the huge data samples (more than 10^{10} J/psi decays per year), in an optimized detector, a definitive understanding of the full picture of light quark-, hybrid-, and glueball-states should be possible.

The TCF double storage ring can achieve luminosities of 10^{33} cm^{-2} s^{-1} with a fairly conservative design based on head-on collisions, reasonable beam currents, moderate heat load on vacuum chambers, etc.
Ideas were explored at the workshop for reducing the bunch spacing at a later stage (with a finite crossing angle) to attain luminosities beyond 10^{33}. Another option is to reduce the collision energy spread to 0.1 MeV using a monochromator optics, which is important for resonance and threshold running. Longitudinal beam polarization is also possible for the future.

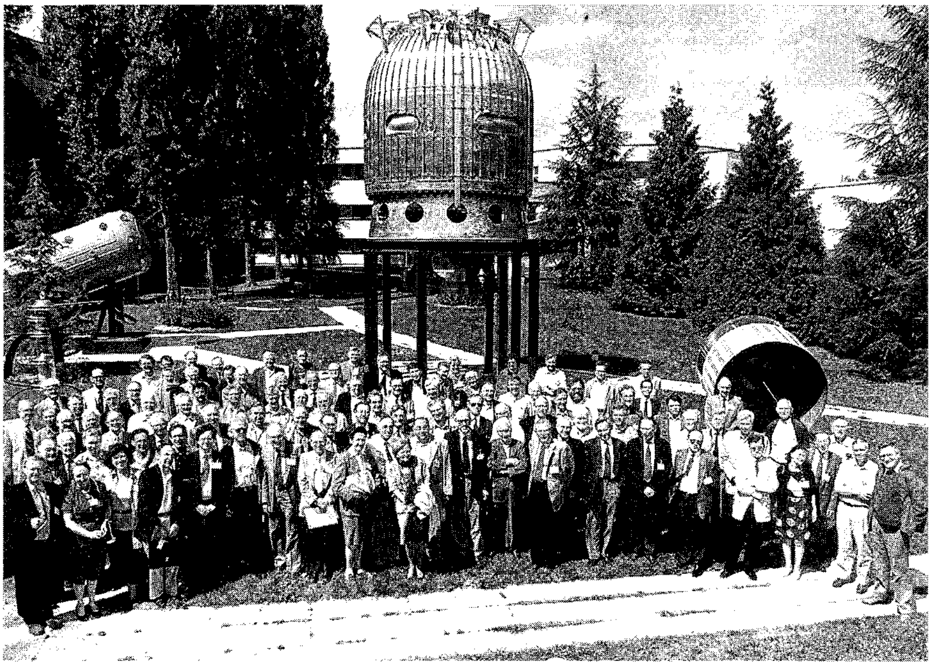
The detector concept is technically sound and incorporates broad experience from previous detectors. At the workshop, test beam results were presented from several groups which confirmed the design performance of certain novel aspects of the detector. These included the tests of the longitudinally segmented cesium iodide calorimeter by US groups and the Valencia tests of 6m-long scintillating fibre time-of-flight counters which achieve 120 ps. A detailed simulation of the detector has been prepared by the Seville group which will be used to study TCF physics performance in detail. A proto-collaboration representing about 20 institutes from 9 countries has formed to prepare by mid 1994 a proposal for the Tau-Charm Factory.

Bubbling away

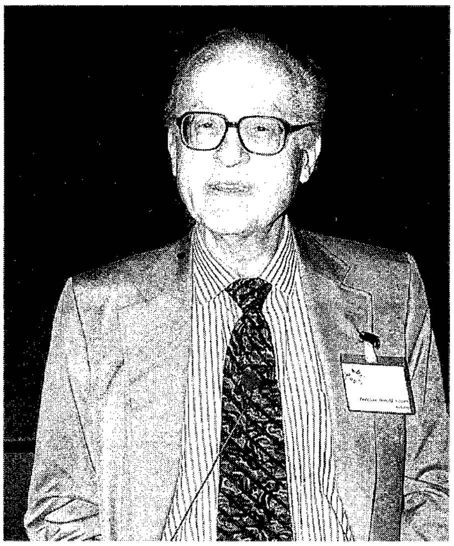
Bubble chambers may have almost vanished from the front line of physics research, but the vivid memory of their intricate and sometimes beautiful patterns of particle tracks lives on, and has greatly influenced the computer graphics of track reconstruction in today's big experiments. 'Seeing' an interaction makes it more understandable.

Bubble chambers, with their big collaborations of physicists from many widely scattered research institutes, started another ball rolling. The groups formed are even now

In July, about 130 physicists gathered at CERN to commemorate the 40th anniversary of the invention of the bubble chamber. Here participants pose with in front of CERN's two giant bubble chambers - BEBC (centre, with its piston, right) and Gargamelle (left) - now permanently mounted outside the Microcosm exhibition centre. (Photo CERN HI24.7.93)



Bubble chamber pioneer Donald Glaser - 'more than watching beer bubble rise up the side of the glass'.



only surpassed in size by the big collaborations working on today's major detectors at colliding beam machines.

From 14-16 July, about 130 physicists gathered at CERN to commemorate the 40th anniversary of the invention of the bubble chamber by Donald Glaser. The meeting, organized by Derek C. Colley from Birmingham, gave a comprehensive overview of bubble chamber contributions to physics, their challenging technology, and the usefulness of bubble chamber photographs in education, both for physics and the public at large.

After opening remarks by CERN Director Carlo Rubbia, Donald Glaser began with a brief review of the work which led to his invention - there was much more to it than idly watching beer bubbles rise up the wall of the glass - before turning to his present line of research, biophysics, also very visually oriented.

After its invention, the usefulness of the bubble chamber was quickly recognized in US Laboratories like Berkeley and Brookhaven, and soon spread to Europe.

Bubble chambers covered a wide range of technology - complex cryogenic installations to handle hydrogen, deuterium and neon; large and powerful superconducting magnets cooled by liquid helium; fisheye windows for stereoscopic viewing; advanced holography; complex expansion mechanisms; rapid-cycling expansion; data processing; replay machines; separated beams....... These developments brought economic feedback and industrial spinoff. Even a specialized conference could not do justice to all the challenges that were met, such as innovative expansion systems and exotic liquids like xenon. During their lifetime, bubble chambers grew in size from the few cubic centimetres of the early prototypes to giants, 35 cubic metres in volume, but with their accompanying infrastructure much larger.

Early chambers were aimed primarily at hadron physics, and contributed to the resonance bonanza of the late 50s and early 60s. Attention then shifted to big chambers for neutrino physics. Later still, they were combined with electronic counters to form 'hybrid' spectrometers, or were complemented with electronic 'fences' to intercept outgoing muons.

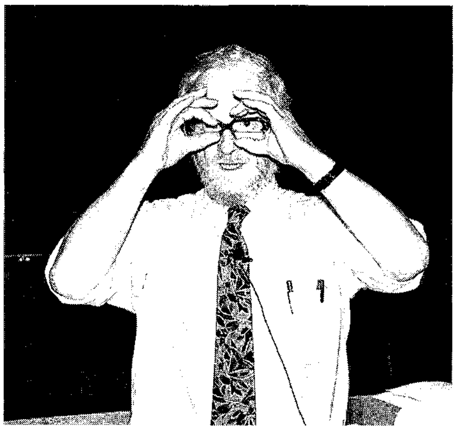
The wealth of physics contributions covered at the meeting included high energy interactions, stable particles, meson resonances, baryon resonances, and production processes, a major milestone having been the historic discovery of the omega minus at Brookhaven in 1964.

In weak interactions, many people point to the vital neutrino physics contributions of bubble chambers in the development of new understanding, culminating in today's Standard Model picture of electroweak processes and quark interactions.

The weak interaction survey began with surveys of kaon decays and of charmed particles, with the Gargamelle chamber's discovery of neutral currents providing a natural focus (see following story).

Historian John Krige's view on the contribution of bubble chambers to

John Mulvey - bubble chamber legacy.



European scientific collaboration sparked a lively discussion, while the impressive legacy of bubble chambers for today's physics was described by John Mulvey.

The meeting concluding with thoughtful remarks by Victor Weisskopf (see page 23).

As well as the sessions, the meeting was a wonderful opportunity for participants to meet old friends and colleagues.

Neutral currents, 20 years on

On 19 July 1973, the late Paul Musset took the microphone in CERN's main auditorium to announce the existence of electroweak interactions mediated by 'neutral currents'. For the first time, the weak interaction had been seen to operate without permuting electric charges.

The Gargamelle bubble chamber collaboration which Musset represented had measured the rate for these transitions in interactions with neutrinos and antineutrinos. It was one of CERN's major scientific achievements.

The 20th anniversary of this event was marked at CERN on 29 April and in the US from 3-5 February (May, page 4), and it was natural that it should be commemorated also at the Paris Ecole Polytechnique, scene of the birth of André Lagarrigue's idea for the Gargamelle heavy liquid bubble chamber, the key element in the discovery. Thus a major meeting 'Neutral Currents, 20 years on' was held 6-9 July in the institute's former premises in Paris.

180 physicists from throughout the world took part in the five days of discussions on the role and the importance of neutral current transitions in particle physics, astrophysics and atomic physics. Among them were many from Europe and the US who had taken part in the often heated 1973 debates. One day was given over to recalling the underlying theoretical understanding and the contributions from pioneer experiments.

While neutral current measurements are difficult in atomic physics, the impact on the particle physics front is impressive. The entire programme at CERN's LEP electron-positron collider is geared to the Z particle, the carrier of the neutral current. Neutral current measurements are a primary tool for probing the Standard Model to reveal any shortcomings.

Neutral current behaviour is less susceptible than the charged current to uncertainties in quark decay parameters and to hadronic effects.

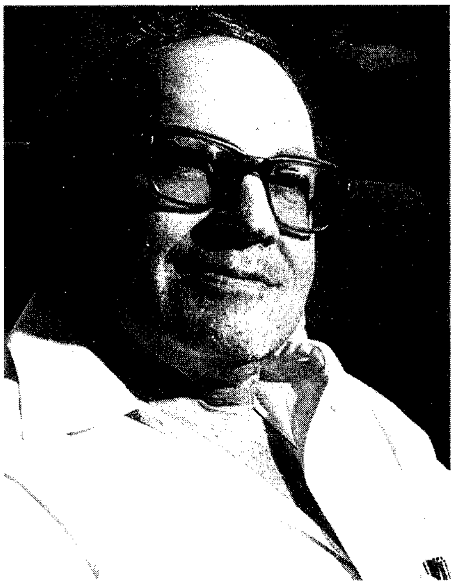
Astrophysics too has benefited from the increased understanding which has followed from neutrino interactions at accelerators, whether it be for neutrinos from the sun or from more distant sources.

As well as proudly surveying the enormous progress made in the last twenty years, the meeting could look forward to the enormous potential this physics still offers.

Participants at the 'Neutral currents - 20 years on' meeting held in July in the old premises of Paris Ecole Polytechnique. It was here that the Gargamelle heavy liquid bubble chamber project was launched, the tool which made the discovery possible.

(Photo Ecole Polytechnique)

Yuval Ne'eman - group theory in depth (Photo Kathleen Blumenfeld)



Group therapy

In his review 'Genesis of Unified Gauge Theories' at the symposium in Honour of Abdus Salam (June, page 23), Tom Kibble of Imperial College, London, looked back to the physics events around Salam from 1959-67.

He described how, in the early 1960s, people were pushing to enlarge the symmetry of strong interactions beyond the SU(2) of isospin and incorporate the additional strangeness quantum number.

Kibble wrote - 'Salam had students working on every conceivable symmetry group. One of these was Yuval Ne'eman, who had the good fortune and/or prescience to work on SU(3). From that work, and of course from the independent work of Murray Gell-Mann, stemmed the Eightfold Way, with its triumphant vindication in the discovery of the omega-minus in 1964.'

Yuval Ne'eman writes - 'I was the Defence Attaché at the Israeli Embassy in London and was admitted by Salam as a part-time graduate student when I arrived in 1958. I started research after resigning from the Embassy in May 1960.

Salam suggested a problem: provide vector mesons with mass - the problem which was eventually solved by Higgs, Guralnik, Kibble,.... (as described by Kibble in his article). I explained to Salam that I had become interested in symmetry. Nobody at Imperial College at the time, other than Salam himself, was doing anything in groups, and attention further afield was focused on the rotation - SO(N) - groups. Reacting to my own half-baked schemes, Salam told me to forget about the rotation groups he taught us, and study group theory in depth, directing me to Eugene Dynkin's classification of Lie subalgebras, about which he had heard from Morton Hamermesh.

I found Dynkin incomprehensible without first learning about Lie algebras from Henri Cartan's thesis, which luckily had been reproduced by Dynkin in his 1946 thesis, using his diagram method.

From a copy of a translation of Dynkin's thesis which I found in the British Museum Library, I learned my group theory and studied the classification of semi-simple Lie algebras. I found SU(3) and chose the octet for the baryons in October 1960.

Showing it to Salam on his return from the Rochester Conference, he told me the group had just been proposed by Ohnuki for the Sakata Model (which tried to explain particles as combinations of protons, neutrons and lambdas). However the octet assignment was new and worth publishing. I also explained to Salam what I had learned about Lie algebras, and immediately other Imperial students were channeled in this direction. From the Spring of 1961 groups were everywhere.'

Crisis - Weisskopf's view

'We are facing a crisis, not only in particle physics but in the whole of fundamental science', said Victor Weisskopf, doyen of quantum physics, during his traditional summer CERN stopover. 'Basic science - science for its own sake - and especially high energy physics, is really in danger.'

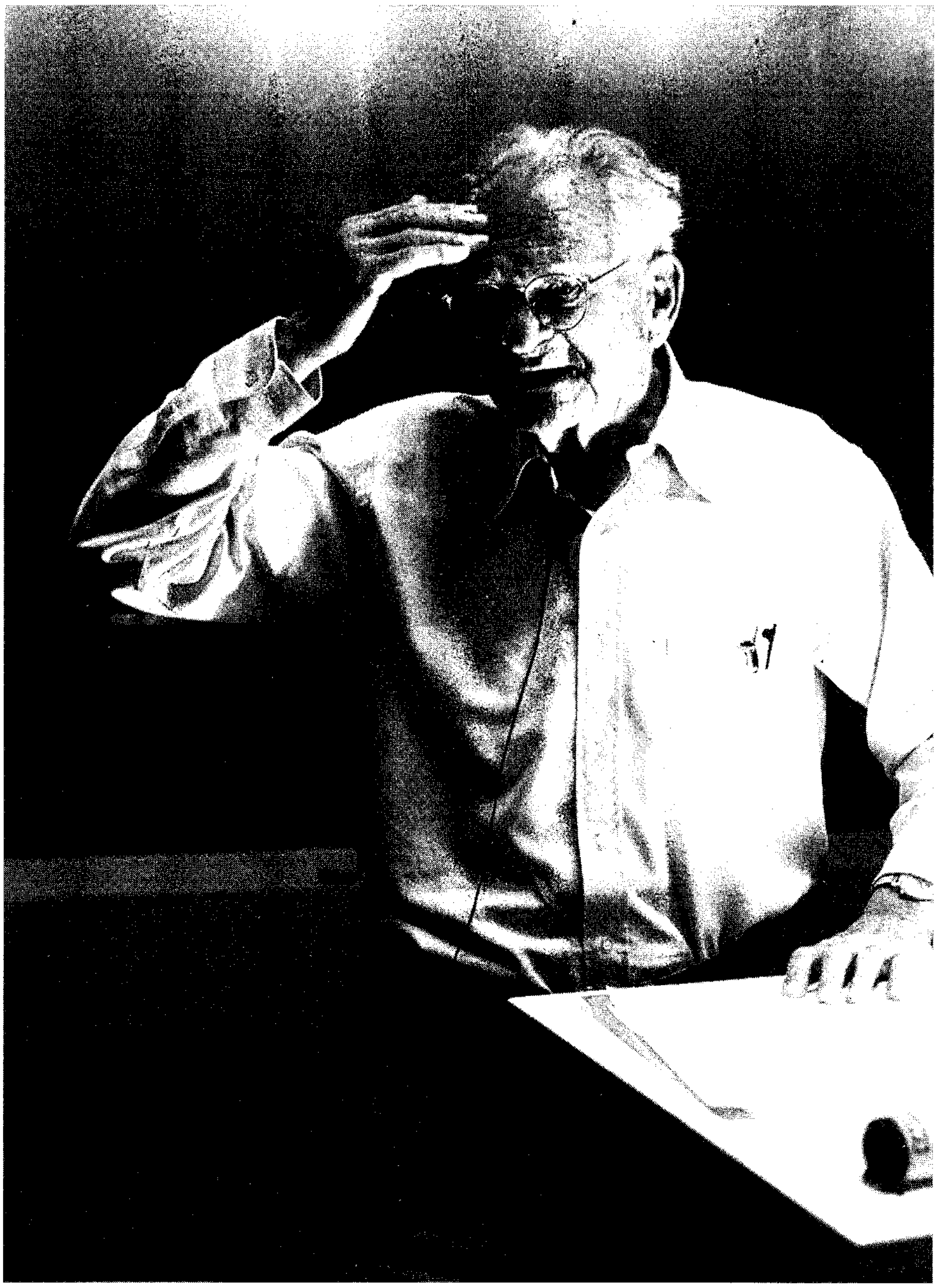
As well as explaining how this has come about, the former CERN Director General (1961-5) proposed action to reverse the trend.

Rather than dividing science into the conventional 'big' and 'small' camps, he slices across another axis. On one hand there is obviously applicable 'terrestrial science' - biology, medicine, solid state, much of the nuclear sector, nonlinear behaviour, chaos,....all directly connected with processes that happen on Earth. On the other there is 'cosmic science' - astronomy, astrophysics, particle physics and some of the nuclear sector - addressing deeper issues, not attainable naturally on this planet at all, and where applications are less immediately obvious. (This classification is not completely watertight - even cosmic science can, and does, foster immediate spinoff, Weisskopf points out, citing Georges Charpak's detector work.)

Tracing the evolution of science in this century, Weisskopf sees the rapid evolution of American influence in the 1930s as a turning point. Before then, the United States had not been in the front line, and it had been important for US researchers to spend some time in Europe.

During the Second World War, other factors came into play. The development and skilled application of radar in the UK showed how scientific talent could be harnessed. The Manhattan Project for the development of the Bomb showed how

Victor Weisskopf - concern for basic science
(Photo CERN HI37.7.93)



longhair physicists could also make good project managers and engineers. After the war, science and scientists emerged with a high reputation, and with this new prestige, science boomed.

This 'lavish' support for basic research meant that large numbers of motivated physicists were available 'in case'. This era brought no fundamental new understanding at the level of quantum mechanics or relativity which had revolutionized thinking early in the century, but it did bring many new applications. Weisskopf cites the computer as the outstanding example of spinoff from this period. Computational science became established as a new avenue of approach, taking its place alongside theory and experiment.

At the beginning of the 1970s several things conspired. There was a global economic downturn. At the same time, cosmic science became bigger and more expensive. 'Recreating the first minutes of the Universe costs a lot of money,' Weisskopf observes. At the same time the early 1970s saw the justifiably growing awareness of concern for the environment. Terrestrial science boomed, while cosmic science went into decline. 'Why support the non-applicable,' was the cry heard from many unenlightened sectors.

It was inevitable that cosmic science support would eventually be cut after the halcyon days of 1950-70, but Weisskopf maintains that support must not dip below a 'critical level', where significant areas would 'wither away'. If the next generation of proton colliders is substantially delayed, this will deter promising young scientists who will launch their careers elsewhere.

To remedy this shortsightedness, he stresses the importance of promoting the impact - cultural, ethical and intellectual - of cosmic science; the spirit of enquiry and the search for truth and deeper understanding; the critical spirit, the readiness (in principle) to admit that mistakes have been made and that new attitudes have to be adopted, and that all results are initially tentative; the increasing role in international collaboration, where young researchers from many different countries and cultures learn to work closely together.

'This is not recognized,' declares

Reader survey

Weisskopf, 'the public and the press are sceptical about fundamental science.' 'The scientific community is partially to blame,' he continues. 'We did not fulfil our task of explaining the beauty, depth and significance of fundamental research.'

'There are few good journalists in the field, and even they only know this science second-hand,' he affirms. 'As well as communicating new developments, the task is to explain difficult concepts of the past, such as quantum mechanics and relativity, even Maxwell's equations and thermodynamics.'

Meanwhile nationalism and over-specialization are taking their toll. To counteract this increasing 'materialistic' attitude, 'scientists have a duty to do more than we ever did before to help,' Weisskopf maintains, 'using public talks, books, articles, TV, media, and educational programmes to explain the scientific message and convey the emotional appeal of a deep familiarity with the way nature works. Much more must be done to show what science really is and how everything is interrelated.'

'Fundamental science is at the roots of applied science,' he concludes. 'Cut the roots and the tree will wither. Science needs basic research stimulated by curiosity. Science cannot develop unless it is pursued for the sake of pure knowledge and insight.'

Many thanks to the hundreds of people who took the time to reply to the CERN Courier readership survey questionnaire published in our May issue.

Bringing out a monthly journal is a lonely business. Issue after issue goes out, and the only response is when there's an occasional factual error. Send out a readership survey and a faint echo comes back.

Most striking was the sheer enthusiasm of the replies. Despite the current erosion of support in the US (see page 2), subatomic physics has significant world-wide box-office appeal.

Most important was to find out who our readers are. 61% of the replies came from Europe, 21% from the USA, 14% from elsewhere (including the former Soviet Union), and 4% from inside CERN.

Not surprisingly, the main audience (37%) is in the high energy physics sector. Then comes teaching (31%), followed closely by accelerators operations and design (12%) and industry (11%).

Apart from detailed breakdowns of readership and feedback on the journal's content and style, the replies revealed several major features. Firstly, the CERN Courier is widely read and appreciated. There are a lot of people outside the immediate research field who want to keep broadly up to date with the latest developments in high energy physics and related fields, without getting too involved in details. It was gratifying to receive replies from far-flung places (Nepal, Indonesia,....), and learn how much distant readers appreciate getting such regular information. 'It helps us feel part of the world scene,' was a typical such reply, from Australia. Despite jet airplanes, fax and electronic mail, our planet is still big.

As well as being geographically far-flung, the readership spans a wide area of science. Researchers from many fields (solid-state, computing, astronomy, environment,...) regularly read these columns.

Opinion on coverage of physics, accelerators, Europe, the US, people and conferences all peaked around 'just right'. The only sector readers didn't think is 'just right' is books. More of that later.

63% of the replies thought physics review coverage is 'just right'. However 31% of the replies, mainly from outside research centres directly involved in this research, said they would appreciate having more explanations. Some people said they want to be reminded of what the Standard Model or quantum chromodynamics is all about, and to have more 'review-type' material.

Our apologies to these stoic readers. But just as a stock market summary for a financial newspaper cannot step back every time and explain to non-specialists what a 'future' or an 'option' is, and sometimes has to go 'long' on jargon, likewise the CERN Courier is aiming at a particular audience and cannot overindulge in continual parentheses. However an important aspect of any newspaper is to provide explanation and background, usually on feature pages or in weekend editions. This aspect of the CERN Courier has been underexploited, and we will make an effort to provide more of this material. For those eager for background information, there are many books on the market these days which admirably complement our news coverage.

On the book front, almost 50% of replies thought there are not enough book reviews. For replies from Europe, this figure was even higher, while 51% of US replies said that

book coverage was OK. Do Europeans really read more books? Or do they want long reviews to be able to talk knowledgeably about them without actually investing in a copy?

More surprising was the number of readers who complained about the volume of advertising we carry. Like commercial TV, the CERN Courier comes for free, all paid for by this advertising. Others found the advertising content interesting and considered it an intrinsic part of the journal!

We specifically asked canvassed opinion on the coverage of the European and the US scenes separately. This was a 'trick' question designed to reveal latent jingoism, allegations of which sometimes reach the Editor's desk.

However the result did not change significantly. Both European and US readers thought that coverage of both geographical areas is balanced. However the 'too little US coverage' contingent did increase from 14% worldwide to 20% on the basis of US replies alone.

In the additional comments, enlightened US readers said that they understood the magazine's commitment to CERN affairs and were prepared to discount it in their reading. (International readers accept a similar natural home bias in major US weekly newsmagazines.)

Likewise analysing replies by job area maintained the 'just right' look (outside the book sector). Two-thirds of the accelerator community replies thought that accelerators got the right sort of coverage.

Two-thirds of all explicit comments were complimentary, the most frequent being 'a good source of information', 'interesting journal', 'enjoy reading it', 'excellent', 'well done', etc. Just over half the US replies contained such explicit comments, while this figure dropped to 37% for European replies. The most frequently encountered criticism was the volume of advertising. This, for the reasons stated above, we ignore, and was anyway almost balanced by an enthusiastic pro-ad faction.

Despite this pat on the back, the CERN Courier cannot wallow in complacency. High standards have to be maintained, and interest maintained in the face of possible stagnation due to an all-conquering Standard Model.

Our thanks to Teresa Oliveira for her enthusiastic processing of all the replies, and to Dorothée Duret for writing the software.

Many readers also took the opportunity to ask for their addresses to be updated. No problem, but this could only be put into the pipeline once the replies had been processed, so it might take some time.

The Editor

External correspondents

Argonne National Laboratory, (USA)
D. Ayres

Brookhaven, National Laboratory, (USA)
P. Yamin

CEBAF Laboratory, (USA)
S. Corneliussen

Cornell University, (USA)
D. G. Cassel

DESY Laboratory, (Germany)
P. Waloschek

Fermi National Accelerator Laboratory, (USA)
J. Cooper, J. Holt

GSI Darmstadt, (Germany)
G. Siegert

INFN, (Italy)
A. Pascolini

IHEP, Beijing, (China)
Qi Nading

JINR Dubna, (Russia)
B. Starchenko

KEK National Laboratory, (Japan)
S. Iwata

Lawrence Berkeley Laboratory, (USA)
B. Feinberg

Los Alamos National Laboratory, (USA)
C. Hoffmann

Novosibirsk, Institute, (Russia)
V. Balakin

Orsay Laboratory, (France)
Anne-Marie Lutz

PSI Laboratory, (Switzerland)
R. Frosch

Rutherford Appleton Laboratory, (UK)
Jacky Hutchinson

Saclay Laboratory, (France)
Elisabeth Locci

IHEP, Serpukhov, (Russia)
Yu. Ryabov

Stanford Linear Accelerator Center, (USA)
M. Riordan

Superconducting Super Collider, (USA)
N. V. Baggett

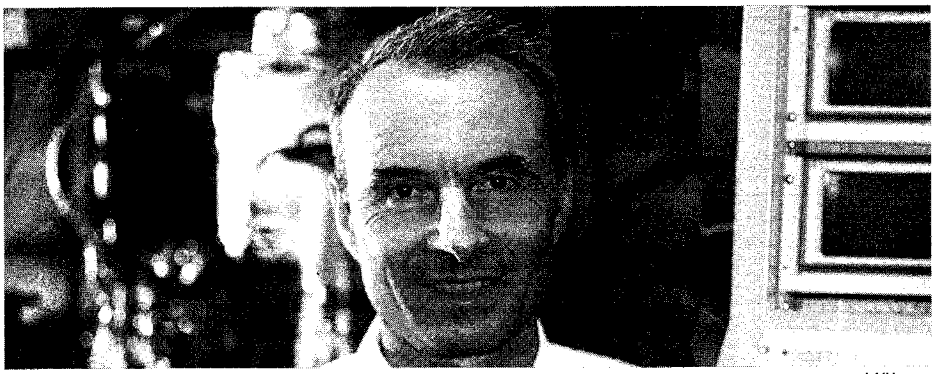
TRIUMF Laboratory, (Canada)
M. K. Craddock

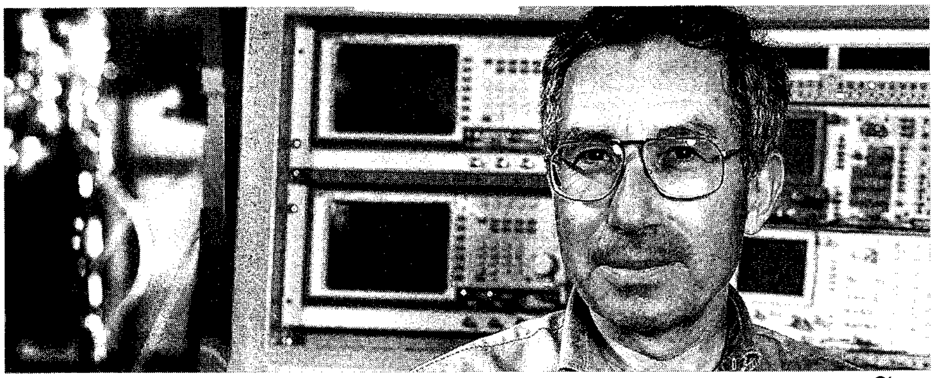
At CERN's latest Council meeting, a new management structure was approved for January 1994, when Christopher Llewellyn Smith will begin his five-year term as Director General, succeeding Carlo Rubbia.
Helmut Weber continues as Director of Administration for 1 year. Pierre Darriulat and Walter Hoogland continue as Research Directors until 30 June 1994, when Lorenzo Foa will take over for 3 years.
Horst Wenninger will become Research/ Technical Director for 3 years.
Kurt Hübner will become Director of Accelerators for 3 years, with Daniel Simon taking his place as Leader of the Proton Synchrotron (PS) Division. Lyndon Evans will become Associate Director for Future Accelerators for 3 years, with Karl-Heinz Kissler taking his place as Leader of SPS/LEP (SL) Division.


Weber

Wenninger


Foa


Hübner


Simon


Evans


Kissler

People and things

Distinguished UK science journalist and TV producer Nigel Calder (left) with Scientific American Editor Jonathan Piel at a Conference of the International Federation of Science Editors at the Mario Negri Sud Centre, Italy, in July. The meeting looked at communications objectives common to the whole range of science.

On people

Recent awards by the American Astronomical Society include the new Annenberg Foundation Award, to Carl Sagan for his worldwide promotion of astronomy through TV, books and articles, and the biennial Tinsley Prize, to Robert Dicke of Princeton for his contributions to astronomical measurement techniques.

August saw the 80th birthday of Wolfgang Paul of Bonn, former Director at DESY, Jülich and CERN, who shared the 1989 Nobel Prize.

The Andrew Sessler Symposium on the Physics of Beams, to be held at Berkeley on 6 December, will mark the 65th birthday of one of this generation's outstanding accelerator physicists and a former Director of the Lawrence Berkeley Laboratory.

DOE Office of Energy Research

Martha Krebs, associate director for planning and development at Lawrence Berkeley Laboratory, becomes Director of the Office of Energy Research of the US Department of Energy, succeeding Will Happer Jr.

ICTP Dirac Awards

The 1993 Dirac medals of the International Centre for Theoretical Physics, Trieste, have been awarded to Sergio Ferrera of CERN's Theory Division, Daniel Z. Freedman of MIT and Peter van Nieuwenhuizen of the State University of New York, Stony Brook, for their discovery of the theory of supergravity in 1976 and major contributions to the theory's subsequent development.
The ICTP Dirac medals were instituted in 1985 and are awarded annually on 8 August, Dirac's birthday, for contributions to theoretical physics, but are not awarded to Nobel or Wolf prizewinners.

Perkinsfest

More than 100 friends and colleagues from across the world met at Oxford on 12-13 July to pay tribute to Don Perkins, who retires this year as Professor of Elementary Particle Physics. His career spans more than 50 years of particle physics, and mirrors the changing emphasis in the subject. He began research in the heady days of cosmic-ray discoveries in the late 1940s, proceeded to accelerator experiments, notably on neutrino studies of weak and quark interactions, and more recently has returned again to non-accelerator experiments, to search for proton decay and to study cosmic neutrinos. The presentations at the "Perkinsfest" reflected this long and illustrious career, with contributions from a variety of experts, beginning with Peter Fowler, who described the early days of cosmic ray physics (with a delightful film of balloon launches), and finishing with a look to the future by CERN Director General designate Chris Llewellyn Smith.

Donald Kerst 1911-1993

Betatron pioneer Donald Kerst died in August. While the idea of accelerating particles by the electric field set up by a changing magnetic field had been looked at previously, notably by Rolf Wideroë, injection remained a problem until Donald Kerst built the first major operational such machine, reaching 2 MeV in 1941. This opened a first route to electron acceleration, avoiding the relativistic difficulties of conventional cyclotrons.

After Manhattan Project work Kerst became Technical Director of the Midwest University Research Association, and went on to join General Dynamics before returning to physics at Wisconsin in 1962.

UNIVERSITÄT WÜRZBURG

An der Fakultät für Physik und Astronomie der Universität Würzburg ist zum 01.10.1994 die Stelle

einer Universitätsprofessorin / eines Universitätsprofessors der BesGr. C 4 (Lehrstuhl) für Theoretische Physik

wieder zu besetzen.

Zu den Aufgaben gehört, das Fachgebiet in Forschung und Lehre zu vertreten. Gesucht werden Bewerberinnen/Bewerber mit der Forschungsrichtung **Elementarteilchentheorie/Quantenfeldtheorie**.

Erwartet werden die Beteiligung an den Lehraufgaben der Fakultät im Fach Theoretische Physik und die Bereitschaft zur Zusammenarbeit mit anderen Arbeitsgruppen.

Einstellungsvoraussetzungen sind abgeschlossenes Hochschulstudium, pädagogische Eignung, Promotion und Habilitation. Bewerber dürfen das 52. Lebensjahr zum Zeitpunkt der Ernennung noch nicht vollendet haben. Schwerbehinderte werden bei gleicher Eignung bevorzugt berücksichtigt.

Bewerbungen sind mit den üblichen Unterlagen (Lebenslauf, wissenschaftlicher Werdegang, Zeugnisse, Urkunden, Schriftenverzeichnis und Verzeichnis der Lehrtätigkeit) **bis zum 02. November 1993** einzureichen beim Dekan der Fakultät für Physik und Astronomie der Universität Würzburg, Am Hubland, 97074 Würzburg, Germany.

BROOKHAVEN
NATIONAL LABORATORY

PHYSICS DEPARTMENT

Brookhaven National Laboratory is seeking a scientist with an advanced degree in experimental physics (preferred) or computer science to play a significant role in developing software for data acquisition for STAR, an experiment at the Relativistic Heavy Ion Collider based on a TPC. Data rates and event sizes at STAR present challenges to data acquisition hardware which will be met by a network of 600 RISC processors. It is expected that the successful candidate will share responsibility for designing and implementing the tools necessary to manage this network.

Experience in implementing complex data acquisition systems involving multiple processors and high data rates is required. The position also requires familiarity with Fortran and C, object-oriented languages, database management, code management, and embedded processors.

Candidates should submit a curriculum vitae and the names of three references to: Dr. M.J. LeVine, Physics Department, Building 510D, Brookhaven National Laboratory, Associated Universities, Inc., P.O. Box 5000, Upton, Long Island, NY 11973-5000. Equal opportunity employer m/f/d/v.

bnl aui BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.

at the center of science, beside the sea

Post-doc position
Max-Planck-Institute of Physics
Munich, Germany

The Max-Planck-Institute of Physics in Munich invites applications for a post-doc position in the fields of instrumentation and detector development, sponsored by the Human Capital and Mobility Programme of the Commission of the European Communities.

Specific areas of interest are the development of superconducting phase-transition thermometers for the detection of Dark Matter, silicon microstrip and pixel detectors, cosmic air-shower detectors, liquid-argon calorimeters and high-precision gaseous wire chambers.

Interested persons originating from a European Community Member State other than Germany, or from an associated state, and holding a PhD or equivalent in physics, should send a curriculum vitæ, a list of publications, a summary of past and present research interests, and the names of three referees to:

Frau Ursula Grenzemann
Max-Planck-Institut für Physik
Postfach 40 12 12
Föhringer Ring 6
D-80805 MÜNCHEN
(Email URG@dmumpiwh.bitnet)

where also further information can be obtained. Applications should be sent as soon as possible, at the latest by 15 October 1993.

GSI DARMSTADT

Die Gesellschaft für Schwerionenforschung mbH, Darmstadt (GSI), eine von der Bundesrepublik Deutschland und dem Land Hessen getragene Großforschungseinrichtung, schreibt die Stelle eines/einer

Leitenden Wissenschaftlers/in
(Bes.-Gr. C4 BBesG)
aus.

Der/Die Stelleninhaber/in soll den neu-geschaffenen Bereich "Wissenschaftlich-Technische Infrastruktur" mit etwa 180 Mit-arbeitern leiten. Der Bereich enthält die Zentrale Datenverarbeitung, Experiment-Elektronik, Detektorentwicklung, Dokumen-tation, Zentrale Technik mit Konstruktion und Werkstätten und Betriebstechnik. Erwartet werden insbesondere Erfahrungen im Aufbau und Betrieb großer Experimente sowie Organisations- und Führungsqualitäten. Der Leiter des Bereichs ist Mitglied des Wissenschaftlichen Direktoriums und wird laut Satzung auf 5 Jahre berufen; Wiederberufung ist möglich.

Bewerbungen mit den üblichen Unterlagen sind bis zum 31. Oktober 1993 zu richten an die

Geschäftsführung der
Gesellschaft für Schwerionenforschung mbH
Postfach 11 05 52
D - 64 220 Darmstadt, Tel. (06151) 359 648/9

Nikolaus Hamann 1952-93

Nikolaus Hamann, a leading physicist at CERN's LEAR low energy antiproton ring, died on 19 August. His enthusiasm and energy brought him the responsibility of physics coordinator for LEAR and the PS machine in 1992.

Los Alamos revisited

Is there any interest in yet another book on the building of the atomic bomb? Lilian Hoddeson, Paul W. Henriksen, and Catherine Westfall have put together a "technical history of Los Alamos during the Oppenheimer years, 1943 -1945" (Cambridge University Press ISBN 0 521 44132 3) under the title "Critical Assembly". Given its avowed aim of covering the much-trodden ground with technical intent, it is not surprising that the writing is rather dour. But that does not extinguish the extraordinary fascination of this piece of history.

The extent to which the Los Alamos team was feeling in the dark comes across very well. Crucial issues were unknown - like the physics of spontaneous fission in plutonium which could have caused premature ignition or the technology of achieving a symmetric implosion. The combination of intense motivation, brilliant scientists and almost unlimited money crushed all problems and completed the project in twenty-seven months. It is easy to see how, once the motivation was in place with the deep conviction that the future of civilization depended on being first to the Bomb, the most humane of scientists were swept along by the intellectual and technical challenges.

The book is of particular interest to the particle physics community because so many of the great personalities of the post-war era in our field cut their theoretical and experimental teeth on the atomic bomb project. From Richard Feynman to Bob Wilson, from Victor Weisskopf to Luis Alvarez ... they were there. The book also brings out what an important step the project was in the rise of the methodology of Big Science. Science practice and managerial procedures from industry meshed with the academic world as they had never done before. Los Alamos was the cradle of more than the Bomb.
BS

The Principles of Circular Accelerators and Storage Rings, by Philip J. Bryant and Kjell Johnsen (Cambridge University Press - ISBN 0 521 35578 8, £55/$100).

The reader of this book can expect, from the identity of the authors, a work of solid excellence and he will not be disappointed. The behaviour of charged particles in circular machines, singly or in dense space charges, is covered with skill and clarity and the student is relieved of the necessity for delving into the 306 references tabulated at the end of the book.

Only two modest suggestions for improvement: design sketches of accelerator types and components do not convey to the beginner as good a feeling for these devices as would a few photographs; a few numerical substitutions in the formulae of earlier chapters might give the beginner a more down-to-earth appreciation of the theory.

These comments detract in no way from the quality of this really comprehensive opus. The authors have many years of teaching experience in the CERN Accelerator School; their appreciation of their students' difficulties is evident in their lucid presentation of the complex problems presented by alternating gradient machines.

John Blewett

(Kjell Johnsen was one of the early members of CERN; in design work for the PS he was responsible for originating some of the elegant treatments presented in this book. He was also Founding Head of the CERN Accelerator School. Philip Bryant had a number of key responsibilities at CERN's Intersecting Storage Rings and took over from Johnsen as Head of the CERN Accelerator School.)

EPAC94

The fourth European Particle Accelerator Conference (EPAC) will take place at the Queen Elizabeth II Conference Centre, London, from 27 June to 1 July 1994.

Organized jointly by Rutherford Appleton Laboratory and Daresbury Laboratory, the conference will provide an overview of research, technology and special applications in the field of accelerators. In the planning of the programme particular attention will be paid to high-intensity accelerators. The deadline for the submission of Abstracts at the Scientific Secretariat is 15 December 1993.

An industrial exhibition, as well as an exhibition of CERN's proposed LHC Project, will be held during part of the conference and the conference programme will include a special session whose theme will be the

CERN

How to visit CERN

Comment visiter le CERN

Organized visits take place only on Saturdays, at 9.30 a.m., and/or 2.30 p.m. The visits last about three hours and are free. The minimum age limit is 16 years.

Les visites commentées ont lieu seulement le samedi, à 9 h. 30 et/ou à 14 h. 30. Elles durent environ trois heures et sont gratuites. La limite d'âge minimum imposée est de seize ans.

Please write or call:
Ecrire ou téléphoner:

CERN
Visits Organization / Organisation des visites
1211 GENEVA 23 Switzerland
Tel. 022/767 84 84
Telex 419 000 CER

transfer of technology from accelerator laboratories to industry.

Further general information from Mrs Susan Humphreys, EPAC94 Secretariat, Building R71, RAL, Chilton, Didcot, Oxon, OX11 0QX, Great Britain. Fax: +44 235 44 6665. Information concerning the scientific programme may be obtained from Mrs Christine Petit-Jean-Genaz, EPAC Executive Secretary, CERN-AC, 1211 Geneva 23, Switzerland. Fax: +41 22 767 86 66.

HEPAP

The new makeup of the US High Energy Physics Advisory Panel (HEPAP) is: Stanley G. Wojcicki (Stanford) Chairman, Robert K. Adair (Yale), Edmond L. Berger (Argonne), Jonathan M. Dorfan (SLAC), Mary K. Gaillard (Berkeley), Frederick J. Gilman (SSC), Donald L. Hartill (Cornell), Derek I. Lowenstein (Brookhaven), Roberto D. Peccei (UCLA), Claudio Pellegrini (UCLA), Pierre M. Ramond (Gainsville, Florida), Don D. Reeder (Madison, Wisconsin), Melvyn J. Shochet (Enrico Fermi Institute), A. J. Stewart Smith (Princeton), Alvin V. Tollestrup (Fermilab), Sau Lan Wu (Madison, Wisconsin).

Spin physics

The next International Symposium on High Energy Spin Physics and Polarization Phenomena in Nuclear Physics will be held from 15-22 September 1994 in Bloomington, Indiana, USA.

Topics include the spin/polarization aspects of - tests for physics beyond the standard model, quark effects in hadrons and nuclear matter, hadron structure and the spin crisis, fundamental symmetries, inclusive and exclusive particle production, nucleon-nucleon scattering, few-body scattering and reactions, electroweak interactions, nuclear reactions and structure, nucleus-nucleus collision mechanisms and the technology of polarized ion sources, polarized solid and gas targets, polarimetry, spin in accelerators and storage rings. Contact: conference secretary - Ms. Janet Meadows, Indiana University Cyclotron Facility, 2401 Milo B. Sampson Lane, Bloomington, IN 47408, USA. Phone: 812-855-9365, fax: 812-855-6645, e-mail internet: SPIN94@VENUS.IUCF.INDIANA.EDU bitnet: SPIN94@IUCF

Superconducting radiofrequency cavity breakthrough - 25 MV/m accelerating field

The TeV Superconducting Linear Accelerator - TESLA - approach is a very attractive option for future TeV electron-positron linear colliders (November 1992, page 23). One of the obstacles has been the accelerating gradient of 25 MV/m (continuous wave - cw) required from the superconducting cavities. This goal has now been achieved in a five-cell niobium cavity tested at Cornell, in the framework of a collaboration with DESY and Fermilab.

Two key approaches were essential to attain the gradient - high purity niobium for thermal stability, and high pulsed radiofrequency processing (HPP) to destroy field emission sources that otherwise absorb rf power and lower the resonating cavity's quality factor (Q).

With 150-microsecond pulses at a peak klystron power near 1 MW, a surface electric field of 84 MV/m suppressed field emission. After the pulsed conditioning stage, it became possible to operate cw at a maximum surface field of 66 MV/m (accelerating 25 MV/m), at a Q of 2×10^9.

With the optimized cell geometry now developed for TESLA, the same surface field opens the way to an accelerating field of 32 MV/m! The focus of this development is soon to shift from Cornell to DESY, where construction of a TESLA test facility is well underway.

Special November issue

November's CERN Courier will be a special issue on Neutrino Physics, featuring commissioned articles and including contributions from Laboratories active in this sector.

ION SOURCE STAFF PHYSICIST NATIONAL SUPERCONDUCTING CYCLOTRON LABORATORY MICHIGAN STATE UNIVERSITY

The National Superconducting Cyclotron Laboratory at Michigan State University is seeking to fill the position of Ion Source Staff Physicist. The NSCL has a staff of approximately 130 people and is funded by the National Science Foundation for research in basic nuclear physics, accelerator physics, and related instrumentation R&D. The ECR Ion Source Staff Physicist is to become a member of the ion source group at the NSCL. Duties include developing beams of highly charged positive ions for cyclotron operation, design and construction of advanced ion sources and research directed towards understanding ECR ion sources. Requirements include a PhD in physics related to ECR ion sources and a minimum of four years experience operating and developing ECR ion sources. Knowledge of transport of space charge limited beams and low voltage injection into accelerators as evidenced by publications in that field or relevant work experience is required.
Positions in the NSCL Continuing Appointment system parallel tenure system ranks at MSU. Applicants should send resume by **November 1, 1993** to Ms. Chris Townsend, Laboratory Administrator, Cyclotron Laboratory, Michigan State University, East Lansing, MI 48824-1321. Michigan State University is an affirmative action/equal opportunity institution. Women and minorities are especially encouraged to apply.

Faculty Opening in Physics University of California at Berkeley

The Physics Department of the University of California at Berkeley, pending budgetary approval, intends to make one (or more) faculty appointment(s) effective July 1, 1994. Candidates from all fields of physics will be considered, but those in the fields of atomic physics, experimental particle physics and particle theory are especially encouraged to apply. Appointment(s) at the tenure-track assistant professor level are preferred, but tenure level appointments will also be considered.
Please send a curriculum vitæ, bibliography, statement of research interests, and a list of references to **Professor Herbert Steiner, Chairman, Department of Physics, University of California, Berkeley, CA 94720**, before December 10, 1993. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer.

Research Associate position Max-Planck-Institute of Physics Munich, Germany

The Max-Planck-Institute of Physics in Munich invites applications for the position of a Research Associate. The position is primarily for work on the ALEPH experiment at LEP, however an active interest in the ATLAS project of the Institute would be expected.
The contract will be limited to two years, with the possibility of extension up to five years.
Candidates should have good knowledge of the hardware aspects and data analysis of modern experiments in particle physics, and should hold a PhD or equivalent in physics. They should send a curriculum vitæ, a list of publications, a summary of past and present research interests, and the names of three referees to:

Frau Renate Saffert
Max-Planck-Institut für Physik
Postfach 40 12 12
Föhringer Ring 6
D-80805 MUNCHEN
(Email REL@dmumpiwh.bitnet)

where also further information can be obtained. Applications should be sent as soon as possible, at the latest by 30 November 1993.

EPAC94

FOURTH EUROPEAN PARTICLE ACCELERATOR CONFERENCE
Queen Elizabeth II Conference Centre, London,
27 June to 1 July 1994

After Rome, Nice and Berlin, the fourth conference in the series will be held at the prestigious Queen Elizabeth II Conference Centre, opposite Westminster Abbey and only a short walk from the Houses of Parliament, in the city of Westminster, London.

The conference aims to provide a comprehensive overview of research, technology and special applications in the field of accelerators. In the planning of the programme special emphasis is placed on excellent review papers and particular attention will be paid to high-intensity accelerators. The programme will include invited talks, contributed papers, oral poster presentations and poster sessions. Parallel sessions will be kept to a minimum.

Papers from the whole field of accelerators are solicited, including low- and high-energy machines and accelerators for medical and industrial purposes. The deadline for the receipt of Abstracts at the Scientific Secretariat is 15 December 1993.

An industrial exhibition, as well as an exhibition of CERN's proposed LHC Project, will be held during part of the conference and the conference programme will include a special session whose theme will be the transfer of technology from accelerator laboratories to industry. Information regarding the exhibition and seminar may be obtained from the Exhibition Manager.

Local organization is in the hands of the RAL and Daresbury laboratories. The registration fee is £225 if received before the deadline of 27 April 1994 and is increased to £250 thereafter. Due to the huge demand for accommodation in London in June and July, requests for accommodation should also be made prior to this date. Complete information concerning registration and accommodation may be obtained from the Conference Secretariat.

World-Wide Web (W3) and Internet Gopher will be used as additional means of disseminating information on the conference as it becomes available. Indications as to how to use these systems, as well as complete information on the conference are given in the First Announcement and Call for Papers available from the Conference Secretariats.

EPAC94 Conference Secretariat
Mrs. Susan Humphreys
Rutherford Appleton Laboratory
Chilton, Didcot
UK - Oxon OX11 0QX
Tel. +44 235 44 67 50
Fax. +44 235 44 66 65

Scientific Secretariat
Mrs. Ch. Petit-Jean-Genaz
EPAC Executive Secretary
CERN - AC
CH - 1211 Geneva 23
Tel. +41 22 767 3275
Fax. +41 22 767 86 66

Exhibition Secretariat
Neil Marks
Industrial Exhibition Manager
Daresbury Laboratory
Daresbury, Warrington
UK - Cheshire WA4 4AD
Tel. +44 925 603 148/432
Fax. +44 925 603 196

NORDITA
COPENHAGEN
PROFESSORSHIP IN THEORETICAL PHYSICS

NORDITA, The Nordic Institute for Theoretical Physics in Copenhagen, announces a tenured full professorship in theoretical physics (after Ben Mottelson). Research at the institute is at present carried out mainly in astrophysics and cosmology, complex systems (including neural nets), condensed matter physics, high energy physics and nuclear physics. In filling the vacant position the Institute wishes to maintain close links between the subfields.

NORDITA's primary responsibility is to support physics in the Nordic countries on the basis of the research programme in Copenhagen and through an extensive international collaboration in theoretical physics, especially with Nordic institutes. The scientific staff includes six positions as permanent professors, four positions as assistant professors, and Nordic assistant professors. In addition there is a programme for Nordic graduate students and prostdoctoral fellows.

The professor should contribute to the activity of the institute by initiating and directing research in theoretical physics. An essential part of this is the supervision of the work of research fellows. The professor is expected to maintain and strengthen the scientific collaboration between NORDITA and both theoretical and experimental research groups in the Nordic area. In addition, the professor has important duties in connection with proposing and organizing symposia, workshops and the visitors' programme at NORDITA.

NORDITA is supported by the five Nordic countries - Denmark, Finland, Iceland, Norway and Sweden - and is located at the Niels Bohr Institute of Copenhagen University, and there is close cooperation between the two institutes.

The appointment is from September 1, 1994, but somewhat earlier or later dates may, if necessary, be arranged. Those interested in the appointment should send a curriculum vitæ, a list of publications and the names of three referees to the Director, NORDITA, Blegdamsvej 17, DK-2100 Copenhagen ø, Denmark. Telephone: +45-35 32 55 00. Telefax: +45-31 38 91 57. E-mail: nordita@nordita.dk The deadline for receipt of applications is November 15,1993. Those wishing to recommend suitable candidates are urged to contact the Director.

UNIVERSITY OF MONTREAL

Post-Doctoral Position in Experimental Particle Physics

Applications are invited for a post-doctoral position in experimental particle physics for participation in the OPAL collaboration at LEP. The successful candidate will be responsible for data analysis and maintenance of the various systems of the Z chambers, one of the subdetectors of OPAL. She/he will also be expected to work closely with graduate students and to contribute to the running of the OPAL detector. The position requires a permanent presence at CERN. Candidates should send their resume and three letters of reference by November 1st, 1993 to:

Hannes Jeremie
Laboratoire de Physique Nucléaire
Université de Montréal
Case postale 6128, succursale "A"
Montréal, Québec
Canada H3C 3J7
e-mail: JEREMIE@LPS.umontreal.ca
telefax: (514) 343-6215;
phone: (514) 343-6729

LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

In der Fakultät für Physik ist ab sofort eine

Professur (C 4)
für Experimentalphysik (Lehrstuhl)

zu besetzen. Zu den Aufgaben gehört die Vertretung des Faches in Forschung und Lehre. Der Lehrstuhl ist der experimentellen Elementarteilchenphysik gewidmet.

Einstellungsvoraussetzungen sind abgeschlossenes Hochschulstudium, pädagogische Eignung, Promotion und Habilitation oder gleichwertige Qualifikation.

Bewerber und Bewerberinnen sollen das 52. Lebensjahr zum Zeitpunkt der Ernennung noch nicht vollendet haben.

Die Universität München ist bestrebt, den Anteil der Wissenschaftlerinnen zu erhöhen, ihre Unterlagen einzureichen.

Bewerbungen sind mit den üblichen Unterlagen (Lebenslauf, Zeugnisse, Urkunden, Schriftenverzeichnis) bis **30. November 1993** beim **Dekanat der Fakultät für Physik der Ludwig-Maximilians-Universität München, Schellingstraße 4/IV, 80799 München**, einzureichen.

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

MOVING?

Please remember to let us know in good time. All notices of change of address must be accompanied by old and new addresses. (Include label from magazine wrapper.)

Any enquiries regarding subscriptions should be addressed to:

Jacques DALLEMAGNE
CERN COURIER/CERN
1211 Geneva 23 Switzerland