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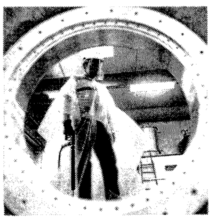

Cover photograph:
Preparing to clean a part of one of the large aluminium debunching cavities for CERN's new AC Antiproton Collector ring. The AC handled its first beams in June, en route to its goal of boosting CERN's supply of antiprotons. (Photo CERN X110.7.87)

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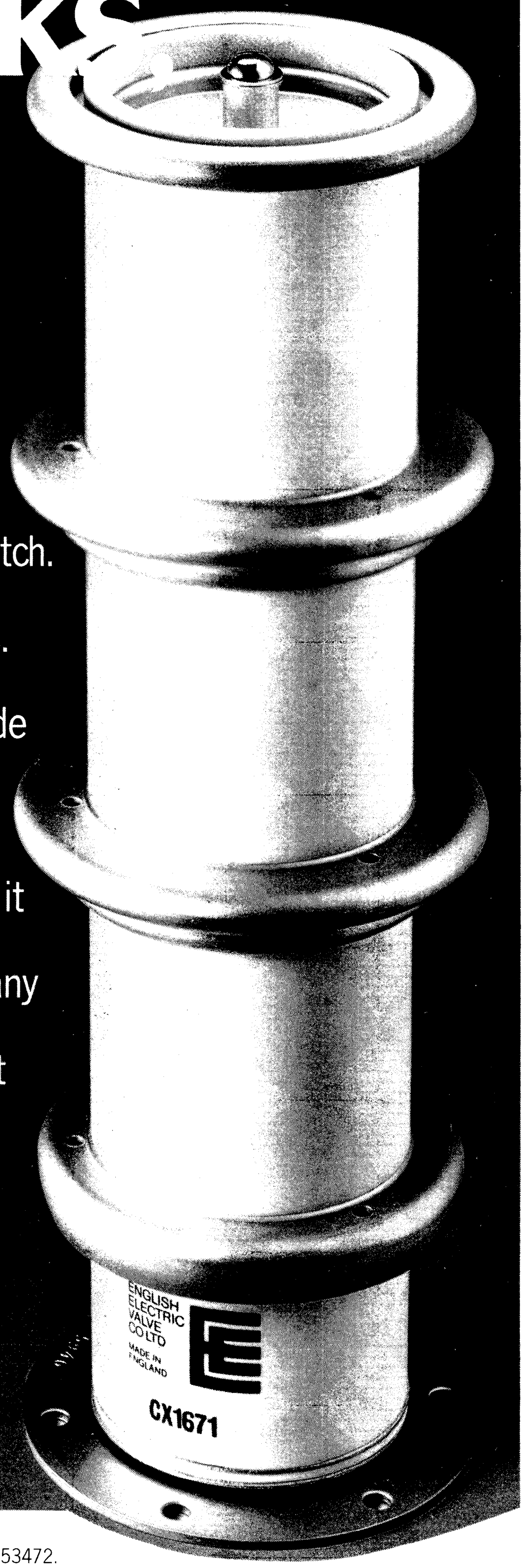

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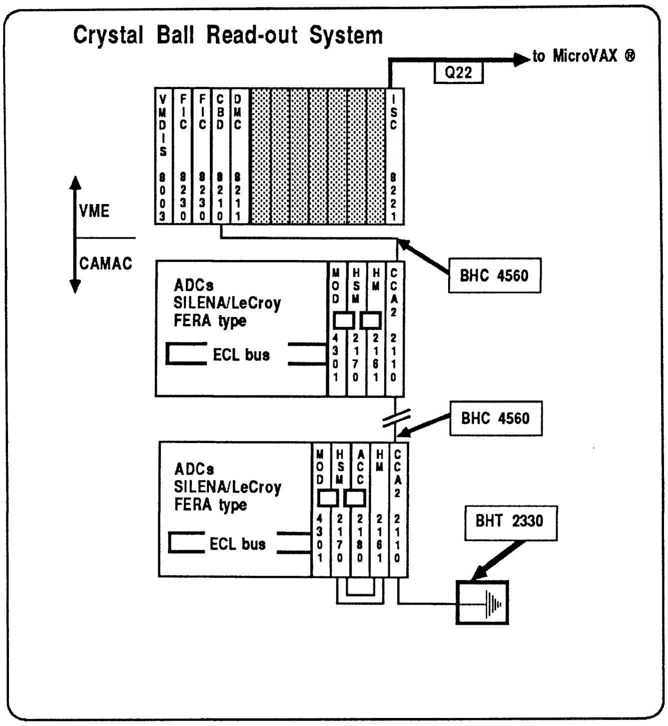

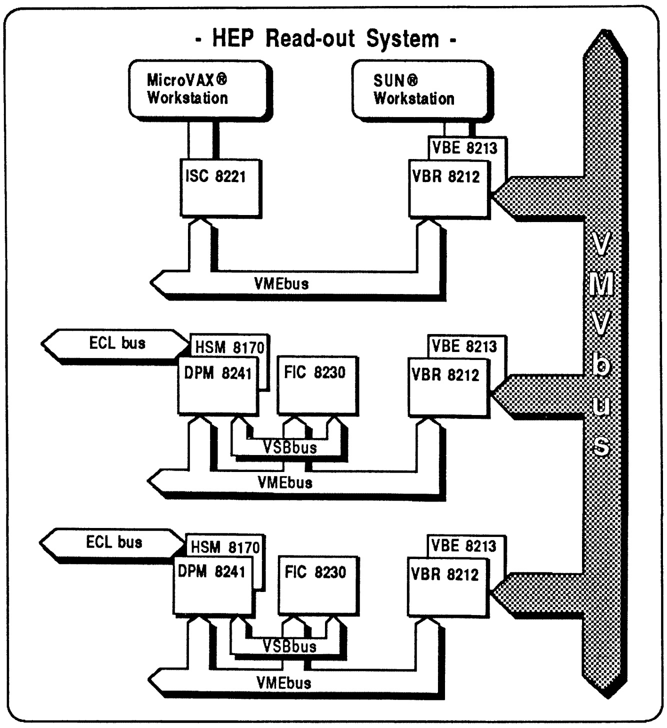

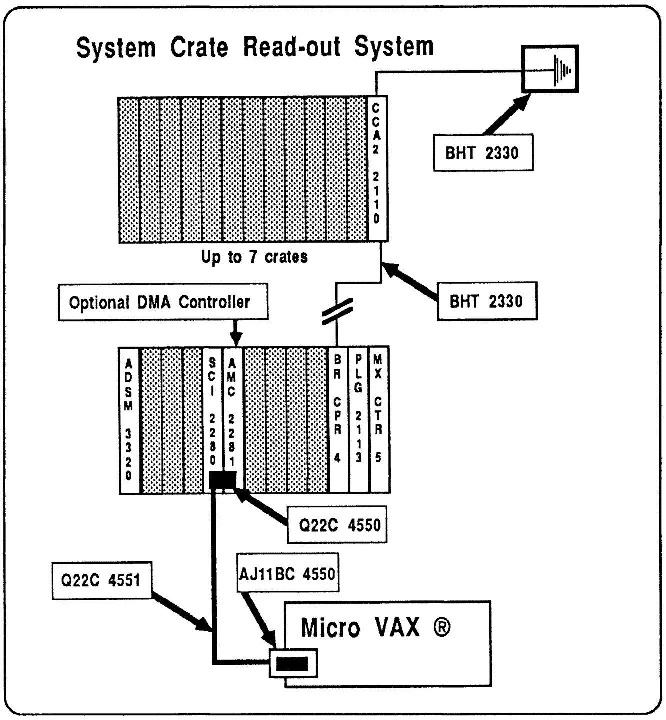

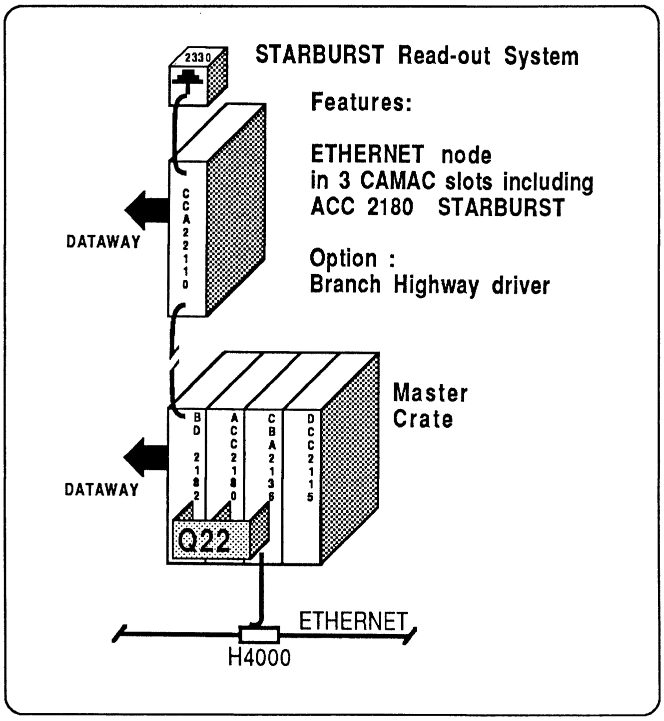

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Uppsala spells hope

Abdus Salam (front row, right) leads the notetakers at a plenary session of the recent EPS International High Energy Physics Conference, held in Uppsala, Sweden.

In the last few years, the particle physics community has experienced something of a backlash. Indications of effects beyond its Standard Model – the electroweak synthesis plus the quantum chromodynamics (QCD) picture of quark interactions – have disappeared on closer scrutiny, while the expected sixth ('top') quark is still missing. In addition, the proton does not appear to decay, at least not within 10^{32} years, ruling out the simplest 'grand unified' models encompassing both the electroweak and the quark interaction sectors.

However at the European Physical Society's International High Energy Physics Conference in Uppsala, Sweden, from 25 June to 1 July, the message was one of hope. There are excellent prospects of unravelling good physics with the impressive range of accelerators and storage rings planned or under construction. This transition to a new energy range was reflected in the plenary talks, including many status reports on new projects.

The 600 physicists who came to Sweden's oldest university, founded 510 years ago, heard the first results from the new Japanese TRISTAN electron-positron collider. With the machine running at 25 GeV per beam, the VENUS, AMY and TOPAZ experiments compare the production levels of hadrons and of muons. Their results so far are compatible with what was seen at slightly lower energies in the PETRA ring at the German DESY Laboratory several years ago and as yet show no signs of the top quark.

Key ingredients in the Standard Model are of course the W and Z bosons carrying the weak nuclear force. Uppsala marked the end of the monopoly of the UA1 and UA2 experiments at the CERN proton-antiproton collider for W and Z physics with the first W and Z candidate events from the CDF detector at the Fermilab Tevatron. Although presented as candidates, plenary speaker Pierre Darriulat of CERN and the UA2 experiment was convinced enough to invite the CDF team to join the W/Z club.

With CERN's new ACOL Antiproton Collector coming into operation to boost the antiproton supply, exciting competition is foreseen between Europe and the US.

In his summary, Guido Altarelli pointed out that two of the big physics discoveries of the past year were in other fields but nevertheless have important implications for high energy physics – the discovery of the new high temperature superconductors and the observation of the 1987 supernova.

One of the pioneers of the new boom in ceramic superconductors – Georg Bednorz of IBM Zurich – reviewed the present status of this research. It is not yet clear whether these materials will be suitable for making superconducting magnets. Dave Jackson, reviewing the status of the US SSC Superconducting Supercollider project, did not consider them significant at the present stage of the SSC design.

In his talk on particle physics and cosmology, John Ellis of CERN presented the emerging view on the supernova physics. He also stressed the importance of the 'dark matter' problem – gravitational indications that much of the material of the universe is electromagnetically invisible. Many proposed solutions imply the existence of new particles, and ingenious new detectors are being designed.

Terence Sloan reviewed quark interactions deep inside hadrons, and the measured structure functions describing the quark content of nucleons and other particles. Recent results from the European

Muon Collaboration on spin-dependent structure functions show that an expected condition (Ellis-Jaffe sum rule) does not work.

The 'superstring revolution' which has activated many theoretical physicists and mathematicians in recent years has now entered a consolidation phase. Although the hope for a unique theory has more or less evaporated, superstring advocate Michael Green was still optimistic as the enormous technical effort worldwide is being rewarded by a deeper understanding of the subtle mathematical issues involved.

Even if contact with experiment is difficult, the mere possibility of incorporating quantum gravity and the Standard Model into a common framework is itself a triumph for string theory.

In another theoretical plenary talk, Ludvig Faddeev of Leningrad reported on attempts to quantize theories containing mathematical anomalies. Although the physical properties of such systems remain to be determined, Faddeev emphasized that anomalies are not as disastrous as was once thought.

The tradition of the EPS High Energy Physics Conferences is for intense parallel sessions during the first days, providing a mass of information and Uppsala was no exception.

In the session of physics beyond the Standard Model, the UA1 and UA2 collaborations presented new and updated bounds on particles as yet unseen but implied by theoretical ideas such as supersymmetry and quark compositeness. According to UA1, the top quark now has to be heavier than 44 GeV.

Limits from 'beam dump' experiments on light short-lived electron-positron excitations do not support the intriguing signal seen at the Darmstadt GSI Laboratory, however a low energy positron scattering experiment in Stockholm does show an unusual peak in the same region as the GSI effect, supporting also an Oak Ridge study.

There was considerable theoretical discussion on the 'new physics' potential of the new machines.

In the session covering jet physics, Henry Suter of CERN presented recent results from the NA10 experiment at CERN on the production of muon pairs by different beams of hadrons (see July/August issue, page 17), where the angular distribution has an unexpected variation with transverse momentum. Preliminary results on hadron jets from the CDF experiment at the Fermilab Tevatron were presented by A. Garfinkel of Purdue. The produced jets extend out to 150 GeV transverse momentum.

Another embarrassment for the Standard Model – production of pairs of like sign muons in neutrino interactions – is evaporating, with results from the CCFR group at Fermilab (see also June issue, page 18).

A large part of the session on 'soft' hadronic interactions was devoted to a comparison of the multiparticle production seen in fixed target experiments and at the CERN Collider. Effects such as the (KNO) scaling violation or the development of strong forward-backward correlations were confirmed, and with improved accuracy.

New developments of 'fragmentation' models describing the formation of hadrons from quarks were presented and discussed, and it seemed as if the predictions

From Uppsala to Hamburg

Many of the results presented at the European Physical Society's International High Energy Physics Conference in Uppsala, Sweden, in June were underlined or further elaborated at the International Symposium on Lepton-Photon Interactions at High Energy in Hamburg a month later. A report of the Hamburg meeting will feature in our October issue.

of the various models are gradually converging.

Measurements from the CERN Collider on the detailed behaviour of forward elastic scattering show that the ratio of the real to the imaginary parts of the amplitude is higher than expected from extrapolation from lower energies. If this proves correct, it means a rapid increase in reaction rates above 1 TeV.

The session on lepton properties included an interesting talk by M. Roos (Helsinki) who discussed the ways of extracting information on the neutrino mass from this year's supernova information. An upper limit of around 20 eV or even less can be extracted, and there are arguments which pull the limit down even further. However Roos emphasized that given our limited understanding of what happenned in the supernova, these results should be used with care and laboratory experiments are as useful as ever.

Alvaro de Rújula of CERN also discussed the neutrino implications of the supernova, and speculated on the possibility that it banged twice, rather than once.

Despite reports earlier this year on the observation of neutrinoless double beta decay accompanied by the emission of new particles (majorons), the results presented at Uppsala gave no support. Likewise a hint of special 'second-class currents' in certain tau decays reported by the HRS group at the Stanford linac (see April issue, page 10) was ruled out by several groups.

A newcomer topic was high energy nuclear collisions. Five groups presented their results from data taken at CERN only seven months earlier. The great hope is to see the long-awaited quark-gluon plasma, when quarks break loose from their habitual nucleon environments. The dimuon signals reported by the NA38 collaboration hint at the suppression of the production of J/psi particles, as predicted for the plasma. Since all experiments also took data with protons, an effort is being made to sort out collective effects.

With new precision data on deep inelastic scattering probing the deep interior of the struck nucleons, the ratio of the longitudinal to transverse production rates measured at Stanford in certain kinematic regions (momentum transfer less than 10 GeV^2) is larger than the theoretical predictions. Elsewhere this ratio and the proton structure function behave as expected.

The session on the weak decays of quarks included the now famous result from the ARGUS experiment at DESY on particle mixing in the neutral B meson system. The high level of mixing seen places a restriction on the top quark mass. With three families of two quarks, the top quark has to be heavier than about 45 GeV.

The great message from the conference was the possibility of a second Copernican revolution. We are not at the centre of the universe and not even made of the most abundant form of matter in it.

While there were no spectacular new discoveries presented at this Conference, there was an impressive amount of solid experimental and theoretical work reported. Promising developments in experimental techniques were discussed such as high power acceleration devices – the free electron laser (1.8 GW, 8.6 mm), the relativistic klystron and the wake-field transformer (8 MeV/m). In the session on detector developments it was shown that energy in the TeV range can be measured with a precision of one per cent using calorimetric methods and that two-dimensional position measurements in the micron range can be made, promising for the future.

Beauty without charm

New physics result announced at the International Symposium on Lepton and Photon Interactions at High Energy held in Hamburg from 27-31 July was the evidence from the ARGUS experiment at the DORIS electron-positron collider of the German DESY Laboratory (also in Hamburg) for the decay of B mesons (carrying the beauty quantum number) without producing particles carrying the charm quantum number.

The highly unstable B mesons prefer to decay into charmed particles (also unstable) but less frequently they should decay directly into particles carrying everyday ('up' and 'down') quarks. ARGUS looked for B decays into two-body states disintegrating in turn into a proton and an antiproton together with one or two pions, and found them at the level of a few in ten thousand.

Together with recent results from the same experiment on the 'mixing' of electrically neutral B mesons, this information helps fill in the gaps in the (Kobayashi-Maskawa) matrix describing the transitions between the different types of quark, and hinting at where the long-awaited sixth ('top') quark might be found.

In his review talk at the Hamburg meeting, W. Schmidt-Parzefall of the ARGUS group gave the majority view of a top quark heavier than 50 GeV. The meson composed of this quark and its antiquark should thus be heavier than about 100 GeV, with implications for electron-positron colliders starting operations (TRISTAN, Japan), about to start operations (SLC, Stanford), and soon to start operations (LEP, CERN).

A full report on the Hamburg meeting will appear in our October issue.

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The atmosphere in Uppsala was full of enthusiasm when we now enter the era of post-W/Z physics. Maybe some of the hopes will have materialized by the time of the 1989 EPS conference in Madrid.

Reported by Lars Bergström and Sven Kullander.

Reinhold Rückl (left) and Roberto Peccei at the HEP 87 club.

(Photos UNT Bild Uppsala)

Pushing hard on the accelerator

The quest for new techniques to drive future generations of particle accelerators has been pushed hard in recent years, efforts having been highlighted by workshops in Europe, organized by the European Committee for Future Accelerators, and in the US.

The latest ECFA Workshop on New Developments in Particle Acceleration Techniques, held at Orsay from 29 June to 4 July, showed how the initial frantic search for innovation is now maturing.

After Michel Davier, Head of the host Laboratoire de l'Accélérateur Linéaire at Orsay, opened the meeting by recalling some important milestones in accelerator history, business began with a series of invited talks. Chris Llewellyn-Smith reviewed the physics motivations for higher energies, underlining the rich rewards expected when constituent particles collide at energies around 1 TeV (1000 GeV). Major areas of new accelerator activity were described by H. Henke, S. Aronson, J.-L. Bobin, R. Palmer, J. Seeman and J. Sheppard, while Carlo Rubbia looked at the choices ahead (see page 11).

After this general survey, the mornings were given over to symposium-style talks on new developments, with the afternoons reserved for working groups in parallel sessions. The final day saw summaries from these working groups, together with a round-table discussion chaired by Kjell Johnsen.

After all the thought, discussion and experimental work of recent years, a certain confidence and consensus viewpoint is now emerging. The so-called 'semi-conventional linac' is a clear favourite for the next generation of electron-positron colliders, while the more exotic techniques using plasmas, laser switching, wake fields, crystals, etc., have not yet produced a definitive candidate, and are thought to be relevant to a subsequent generation of machines.

The semi-conventional linac work centres on the CLIC (CERN LInear Collider) and SC (Stanford Collider) schemes. These are both based on classical room temperature copper accelerating structures operating at high frequencies to optimize energy consumption. (The arrival of the new high temperature superconductors could change the optimal choice of operating conditions.)

The CLIC scheme currently foresees 1 TeV colliding electron and positron beams, operating at 29 GHz with a 5.8 kHz repetition rate and a collision luminosity of 10^{33} cm^{-2} s^{-1}, while the corresponding SC figures are 0.5 TeV, 17 GHz and 200 Hz for about the same luminosity.

Parameters have tended to converge recently, and there is general agreement on limitations such as 30 GHz being the highest frequency at which instabilities due to wake fields can be overcome. The fundamental differences are in the repetition frequencies, reflecting different ideas on efficiency and momentum spread and the large emittance ratio for the ribbon-like beam preferred by Stanford.

These studies have stimulated worldwide work on the design of power sources. The CERN design prefers a superconducting drive linac as power source while Stanford has several candidates under study. This vigorous development of gyrotrons, relativistic klystrons, lasertrons, etc., could lead to other valuable spinoffs. The lasertron and photocathode work is being pushed particularly in Japan, the US and France. Electron gun development is getting close to fulfilling the needs of the semi-conventional linacs.

In the more exotic domain, there is a flourishing worldwide programme. The DESY Wakefield Transformer Accelerator is a well-advanced proof-of-principle experiment, achieving a gain of 50 keV for a 20 keV electron beam — a gradient of 2 MeV/m. Another such experiment at UCLA has demonstrated a 1 GeV/m gradient using plasma beat waves. Ideas such as the 'Wakeatron' and the Plasma Wakefield Accelerator are being investigated at Argonne.

Guy Coignet of LAPP (Annecy) — chairman of the recent Workshop on New Developments in Particle Acceleration Techniques held at Orsay.

Plasmas are also very promising for final focus lenses. Another possibility is the SPL Switched Pulse Linac, where effort concentrates on developing switches triggered by 10 ps laser pulses. Several Laboratories are working on photodiodes, high pressure gas switches and solid-state switches, all good contenders for fruitful applications. CERN is also looking at the accelerating structure for an SPL.

This work is underpinned by theoretical studies exploring parameter interdependence, scaling, multi-bunch operation and final focusing. The problems of disruption and beamstrahlung are now rather well understood, though detailed computer studies are necessary for evaluating specific cases. A preliminary layout for a chromatically corrected final focus system was presented by A. Chao.

The Orsay meeting underlined how all the efforts of recent years

Participants at the Orsay workshop saw how the search for innovative acceleration techniques is now maturing.

are now paying dividends, promising a bright future for several generations of future particle accelerators.

(The meeting was jointly organized by ECFA, the CERN Accelerator School, The French Institut National de Physique Nucléaire et de Physique des Particules, the Institut de Recherche Fondamentale of the French Commissariat à l'Energie Atomique, and the European Physical Society. It was also sponsored by Thomson-CSF, Alsthom and the Compagnie Générale d'Electricité.)

From Philip Bryant

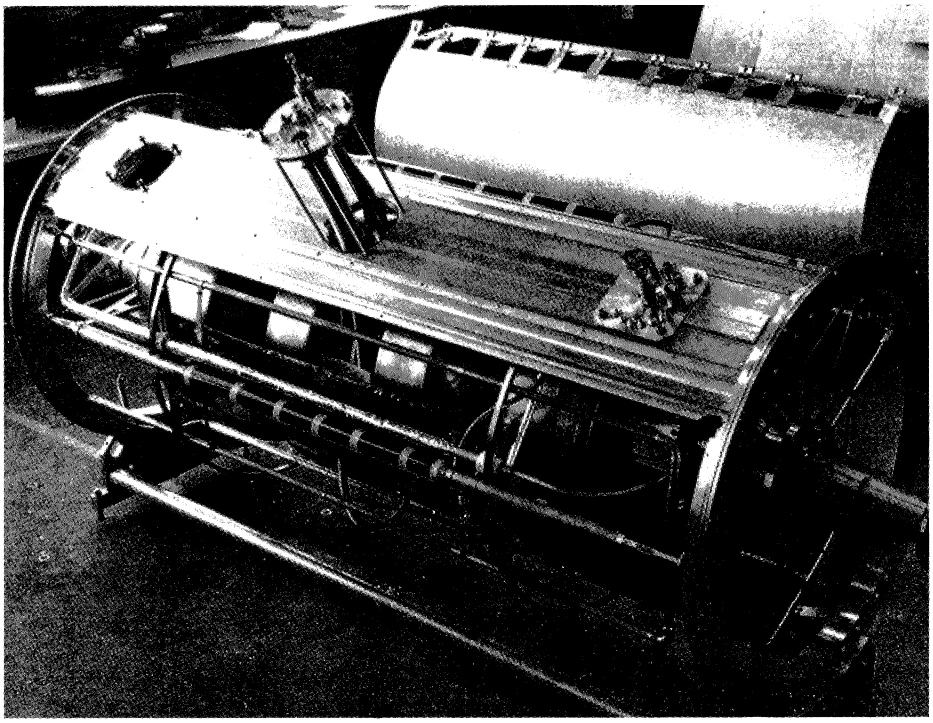
CERN prepares for the future

While the biannual sessions of CERN Council, bringing together representatives from all fourteen Member States, tend to be preoccupied with matters of the moment, this was not the case at the June session when the broad sweep of the Laboratory's ongoing research programme was under discussion. This was first reflected in the four-year forward look of Director General Herwig Schopper, extending beyond the initial phase of LEP construction.

Two new activities appear — the completion of LEP to its designed beam energy of about 100 GeV and the start of a significant research and development programme on accelerator and detector technologies.

LEP is optimized for operation at 100 GeV per beam but the initial construction phase only allows about half this energy. Now that the technology of superconducting radiofrequency cavities has been mastered, more energy without excessive power consumption can be envisaged. The plan is to install four such cavities for the start-up of LEP so as to gain operational experience as soon as possible.

If all goes well, starting from the summer of 1991 a further 28 cavities will be installed. These 32 cavities operating alone will sustain a beam energy of 56 GeV (with field gradients of 7 MeV per metre), or will take the energy to 67 GeV when operated in conjunction with the copper cavities. An additional 32 cavities could be introduced in the summer of 1992 and the simultaneous operation of all the cavities would then take the peak energy to 77 GeV. The final stage would be the replacement of the 128 copper cavities with superconducting cavities, when the energy would move to around 92 GeV (comfortably beyond the



A five-cell superconducting cavity being prepared for mounting in its cryostat. These cavities will play an important role in CERN's LEP electron-positron collider.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83 GeV level necessary for the production of pairs of W particles). Since one of the techniques used in the production of these cavities involves coating the inside surfaces with superconducting niobium, the possibility of substituting one of the newly discovered high temperature superconductors will be investigated.

The urgency of research and development on accelerator and detector technologies has been stressed by the Long Range Planning Committee led by Carlo Rubbia. For CERN to take appropriate decisions about its future direction the know-how of European scientists in these two areas needs to be taken a stage further. Work on high field superconducting magnets, on high energy colliding electron-positron linacs, and other novel acceleration techniques is to be pursued.

The high field magnet is required in the scheme to install a Large Hadron Collider, LHC, in the LEP tunnel. Work has already started, in collaboration with other European Laboratories and industry, trying two approaches — one uses niobium-titanium conductor cooled to 2 K; the other uses niobium-tin conductor. Progress with the high temperature superconductors is being watched very closely. Work on colliding linear accelerators will begin next year. Work on detector technologies is starting in the 'LAA' project (see box).

The ongoing programme also firmly intends to sustain the variety of CERN's research. This includes the unique low energy antiproton experiments on LEAR, the successful research on the isotope separator (ISOLDE 3, coming into action this year) at the synchro-cyclotron, the fixed target experiments at the SPS (at something like the present level of activity), the high energy ion programme and, of course, the proton-antiproton collider.

Another nuclear beam run (with sulphur) is scheduled for the end of this year and there is interest in moving to heavier nuclei. This would involve a major upgrade of the PS linac and a project funded by interested parties would probably be necessary. The collider is guaranteed a rejuvenated programme when ACOL steps up the antiproton supply by a factor of ten or more (see page 26). This will ensure competitivity for some time in the face of the impressive performance of the new Fermilab Tevatron Collider. The Tevatron will eventually take over leadership in this field and it is intended to review the CERN work around 1989.

Council unanimously endorsed the programme document presented by the Director General. Its budget estimates envisage the contributions of the Member States (with the exceptions of new Member States Spain and Portugal, whose contributions are rising progressively to their correct levels) staying at their present levels.

Into the next century

The vision of the Long Range Planning Committee sees CERN's leadership in particle physics extending further into the future. Carlo Rubbia summarized thinking so far — the final report will be available in December.

Experience suggests that machine energies should be increased by a factor of about ten beyond those currently available. Theory also hints that the 1 TeV range of colliding constituents should reveal significant new physics. The Committee examined the feasibility of reaching these energies in two complimentary machines — a hadron-hadron collider and a lepton-lepton collider — in the most cost-effective way.

The tunnel built for LEP would also accommodate a Large Hadron Collider capable of reaching about

LAA jamboree

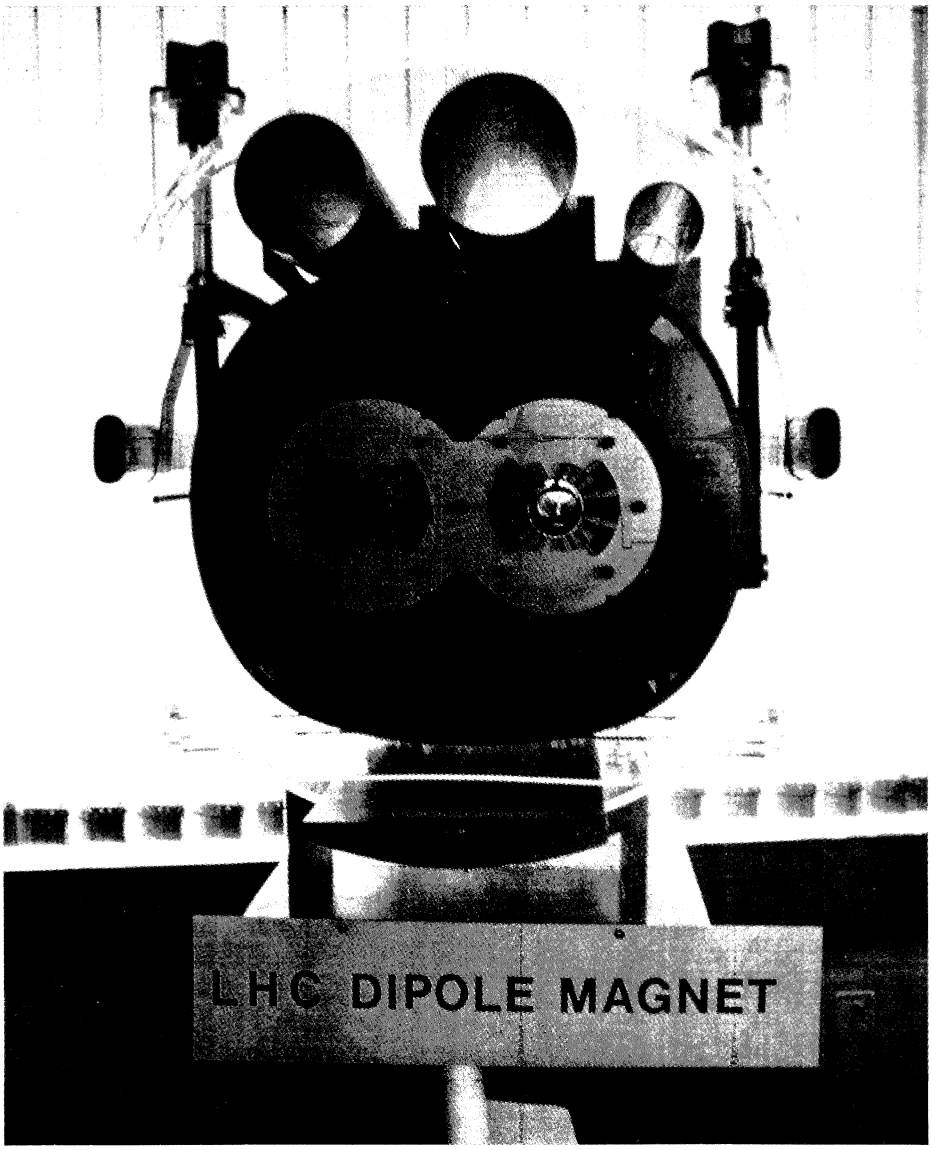
Three days after the June session of CERN Council, there was an open presentation at CERN of the 'LAA' project to develop new experimental technologies for a multi-TeV hadron collider detector. This is a five-year special programme supported by Italy under the leadership of Antonino Zichichi, helped by an Advisory Committee (see March issue, page 4). It is open to participation by all those interested in the topic for there is great concern to generate new ideas.

The technologies for study are — high precision tracking devices for the central region, calorimetry, leading particle detection down the beam directions, large area devices for muon detection, and data acquisition and analysis. The likely operating conditions of the collider need to be taken into account, including a luminosity of 10^{33} or more (giving lots of secondary particles), bunch intervals of some 100 ns (requiring high data handling rates), high magnetic fields and high radiation environments).

8 TeV per beam using high field superconducting magnets. (A rough rule of thumb for hadron colliders is that the constituent quarks collide carrying a tenth of the beam energy.) LHC would also open up proton-electron collisions, using the LEP beam, and ion-ion collisions in the PeV (10^{12} eV) range using the PS/SPS injection system.

Lepton collider energies of about 1 TeV per beam require much more research and development than the LHC. Nevertheless there is increasing optimism about the feasibility of such a machine and a scheme involving LEP-type superconducting radiofrequency cavities in a drive linac, with power transformed to the main linac to give field gradients of some 100 MV per metre, is under study (see page 7).

Rubbia maintained that the necessary R and D should be pushed. This is also true for detector technologies since present detectors could not cope with the output of the LHC with its exceptionally high luminosity of 5 x 10^{33}. This is being tackled in the LAA project.



Review Committee

Though not formally presented at the Council session, another preliminary report was presented to the CERN Member States by the CERN Review Committee, set up by Council in 1986 on the initiative of the UK government, to investigate how CERN operates. The Committee is chaired by Anatole Abragam and includes seven eminent Europeans from science and industry.

The report underlines the scientific and cultural success of the Laboratory and seeks ways of ensuring CERN's continuing prestige and creativity. There are a series of recommendations concerning the management of the Laboratory and its personnel and financial resources. These are to be studied in collaboration with CERN management over the coming months to assess their detailed implications. The aim is to present the final report in December.

A model of a high field superconducting magnet as proposed for the Large Hadron Collider which could be built in the LEP tunnel. Note the two-in-one configuration — a single yoke accommodates the vacuum pipes of the counter-rotating proton beams. This brings cost savings in cryostats and cryogenics. Work on the construction of prototypes of such magnets has started.

(Photo CERN X423.6.87)

HERAlding HERA

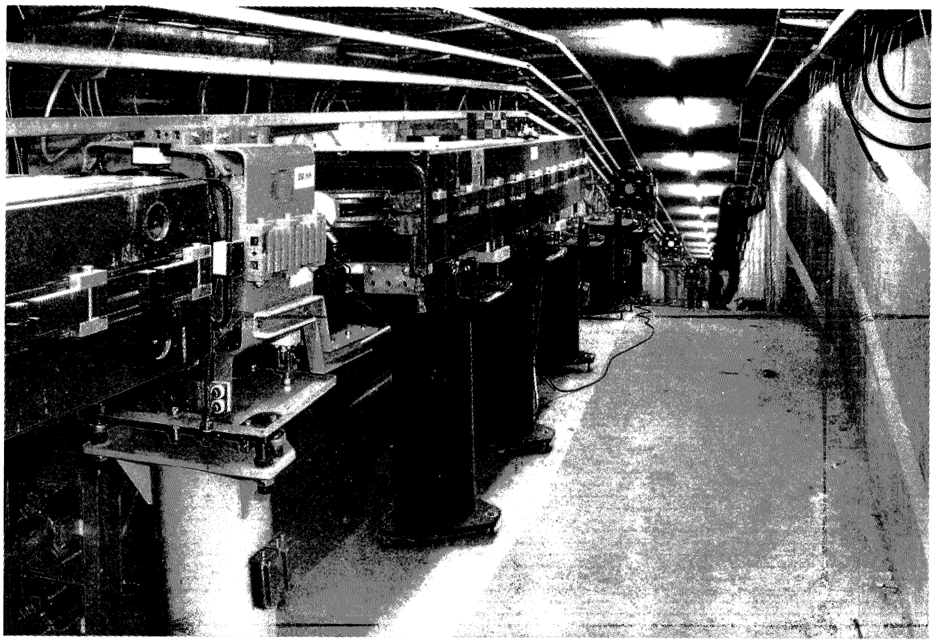
On Wednesday 19 August, the machine cutting the tunnel for the HERA electron-proton collider at the German DESY Laboratory in Hamburg arrived back at the South Hall, where it set out on its 6.3 kilometre circuit 27 months ago.

Behind the tunnelling machine, concrete finishing is going up fast, while further back installation is well underway, with large numbers of magnets already in place for the 30 GeV electron ring. Both the proton and electron injection lines from the neighbouring PETRA ring into HERA have been tested (the proton line with positrons pending the arrival of protons).

Having worked exclusively with electron beams throughout its 28-year history, the DESY Laboratory is having to add a proton plant. The radiofrequency quadrupoles (built by Frankfurt) to give the protons their first impulse have performed well (see June issue, page 1), but the new proton linac has been delayed. Beamline equipment to take protons from the linac to the synchrotron, supplied by Canada, has arrived.

For the protons, the original DESY electron synchrotron has been rebuilt as DESY III, with 32 additional quadrupoles giving the old combined function (bending and focusing) machine more the appearance of a latter-day separated function accelerator.

DESY III surrounds the new DESY II electron machine, impressively commissioned after only one month of running in. The original intention was to lower DESY III to enable the electron beams from DESY II to get out. However the old machine was built so solidly that it proved easier and cheaper to install the two machines in the same horizontal plane, with electron beams traversing the proton machine, and with the two vacuum systems delicately interlocked!



The tunnel leading from the PETRA ring down to the HERA Main Ring at DESY.

Conversion work is also needed to adapt the PETRA ring to handle 40 GeV proton beams, in particular for the protons to bypass the high-impedance radiofrequency accelerating cavities for electron beams. Work should start soon. The two new PETRA accelerating cavities for protons are nearing completion in Canada.

All orders for the superconducting magnets for HERA's proton ring have been placed with European industry. While reliable large-scale production of these vital units has yet to be demonstrated, hopes are high after successful tests of prototype 9-metre dipoles from DESY and BBC in Germany, quadrupoles (developed at Saclay) and correction coils from the Netherlands, hinting that protons could eventually be taken above the 820 GeV HERA design level.

To supply the proton ring and magnet testbed with liquid helium meant building the largest refrigeration plant in Europe. Sulzer has been awarded a supplementary contract to oversee the running of this complicated technology.

HERA's electrons require 30 GeV of energy. Most of this will be supplied by copper radiofrequency units taken from the PETRA ring. The hope is that the additional energy will be supplied by the twin four-cell 500 MHz superconducting niobium units developed in intense R and D during the past few years and which have proved so successful in bench tests.

Initial beam tests of the superconducting cavities in PETRA encountered unforeseen problems but this should be mastered for further beam tests later this year.

In the meantime installation has begun of the klystron equipment taken over from PETRA to drive the copper radiofrequency accelerating units for the electron beams. HERA will handle polarized (spin-oriented) electrons and making their appearance are the first rotator magnets to change the

Right, the new DESY II synchrotron, and left, the original DESY synchrotron, rebuilt to supply protons for the HERA electron-protons collider being built at the DESY Laboratory in Hamburg. The DESY II electron beam exits through the proton machine.

polarization direction of the electrons before and after each collision point.

Experiments

To exploit HERA's unique colliding electron and proton beams, (the plan is also to run with positrons and protons), the two big detectors – ZEUS and H1 – are pushing ahead at top speed to be ready for the first collisions in 1990. With almost 1000 GeV of proton energy slamming into a 30 GeV electron, the detectors are highly asymmetrical. This, together with the bunching of HERA's beams, posed special problems for the detector designers. Precise analysis of the produced hadrons (strongly interacting particles) will be needed, especially for the interesting interactions producing neutrinos. These will fly out undetected other than through detailed measurement of energy balance.

ZEUS uses a 'compensated' calorimeter design with interleaved sheets of depleted uranium and scintillator to give accurate energy measurement of electrons and hadrons, while H1 prefers liquid argon as the sensitive medium with iron plates as absorber. Some detailed work has gone into the development of optimal calorimeter configurations.

In addition to these two new HERA experiments, the ARGUS detector will continue to study electron-positron collisions in DESY's DORIS II ring, although DORIS operations are temporarily halted during the machine rebuilding.

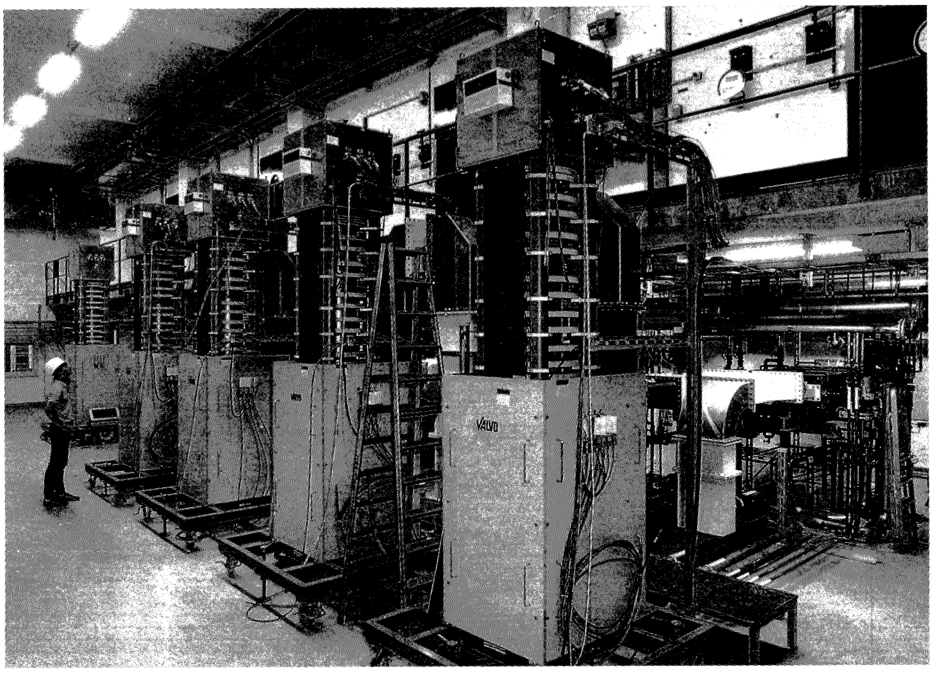
ARGUS hit the headlines earlier this year with the observation of the 'mixing' of electrically-neutral B mesons (see June issue, page 16). At the Symposium on Lepton-Photon Interactions at High Energies in Hamburg in July, the ARGUS collaboration reported evidence for the expectedly very rare decays of B mesons without the production of particles carrying the charm quantum number (see page 4).

More light

Electron machines produce intense beams of synchrotron radiation. This loss of electromagnetic energy is a curse for high energy electron beams but a blessing for scientists looking for a probe of matter structure.

At DESY, the DORIS ring runs for 30 per cent of its time with electron beams for the HASYLAB synchrotron radiation centre, while additional beam time comes from 'parasitic' running during high energy physics studies with colliding electron and positron beams, providing particularly interesting beam conditions.

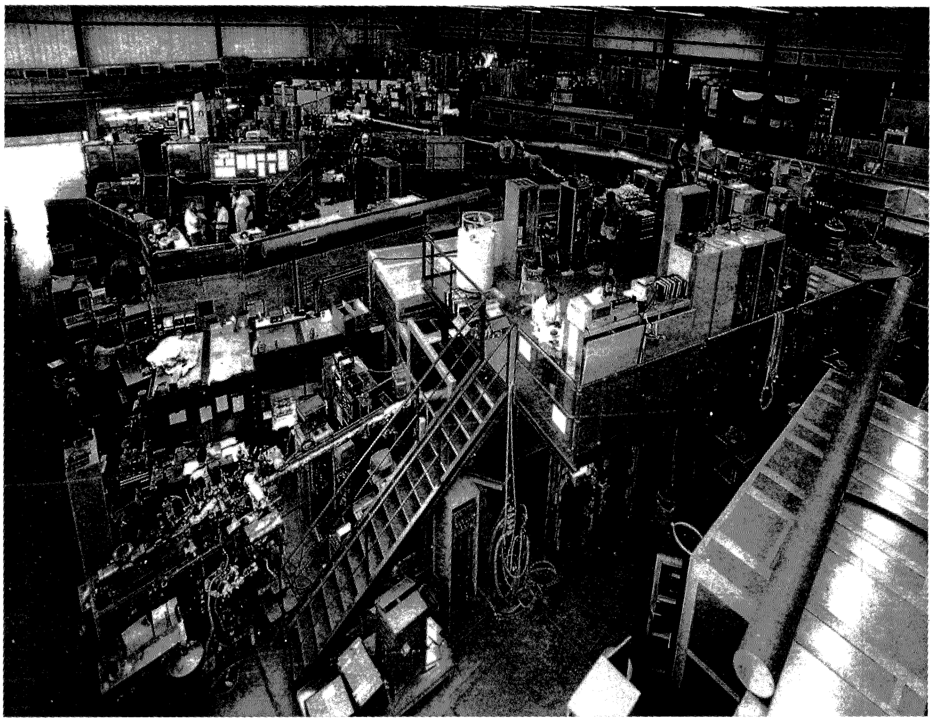
Each year, HASYLAB caters for some 500 scientists from 100 institutes. For the future, more synchrotron radiation might be available if a decision goes through to build a new bypass around the second DORIS collision region (previously used by the Crystal Ball experiment). This will contain six 'undulators', increasing both the quantity and quality of the available



Klystrons installed for HERA.

A view of the experimental floor at the HASYLAB synchrotron radiation laboratory at DESY.

(Photos DESY)



beams. Three wiggler magnets are already installed at DORIS and a new hall for high energy X-rays has been opened.

Although DESY manpower is almost completely taken up by the ambitious HERA project, farsighted efforts continue towards the development of new accelerating techniques for the full-scale machines of tomorrow. The DESY wakefield scheme has provided promising initial results (see page 7). A realistic proposal could emerge if these results can be scaled up appropriately.

With no immediate parallel anywhere, DESY's main HERA effort can look forward to many years of profitable exploitation in the 1990s to build up a comprehensive picture of the interactions of quarks with electrons and with positrons under all electron/positron spin possibilities.

As well as providing unique physics conditions, HERA has also blazed a new trail in international collaboration. Italy, France, the Netherlands and Canada are supplying components, while the US and Israel are contributing to the technological developments, and Poland and China, together with the UK, are supplying valuable manpower. With international involvement in big new projects being increasingly stressed, this HERA experience is especially useful.

By Gordon Fraser

Brookhaven — going for gold

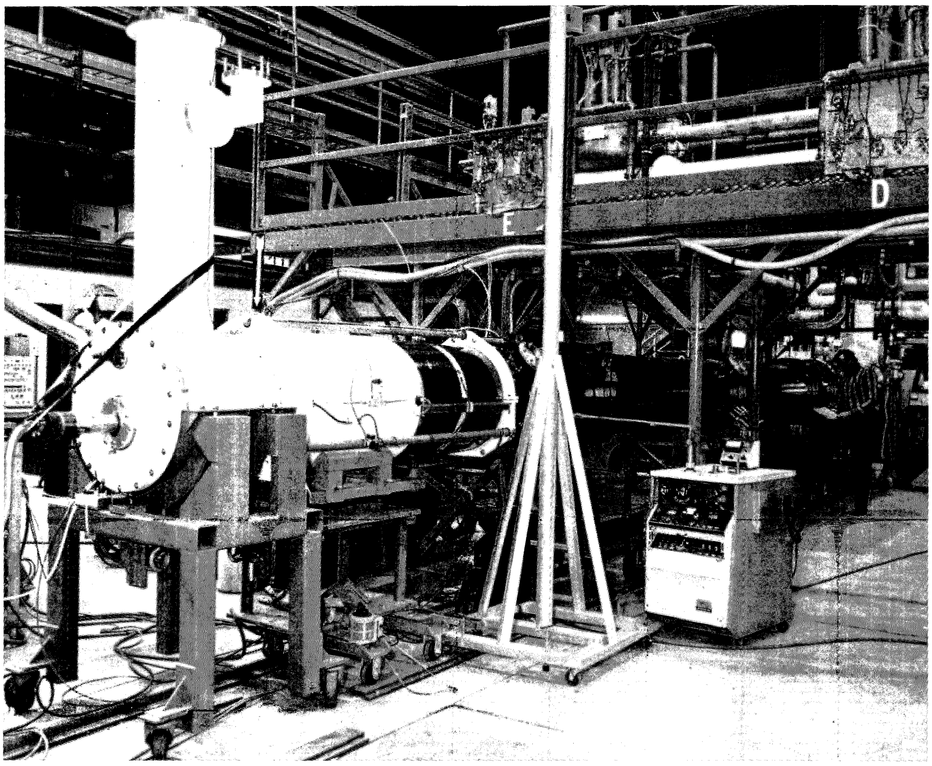
In September, the Brookhaven National Laboratory is celebrating its fortieth anniversary. It moves into middle age serving a larger user community than ever before and with research programmes and facility developments which should guarantee several more decades of front-line work.

Though the emphasis for the future has moved off particle physics, there are still some 350 physicists involved in particle physics experiments at the AGS Alternating Gradient Synchrotron, including some unique topics. The search for unusual kaon decays is a prime example and four detection systems are pushing the limits further out. During the past year, two of them (kaon to pion, muon, electron and kaon to muon, electron) passed previous best limits, reaching 10^{-9} and over the next year should be entering the interesting physics range of 10^{-10} or better.

The tantalizing situation with the results from two experiments searching for neutrino oscillations remains unresolved. Both see an excess of electrons, implying that the muon-neutrino is converting to electron-neutrino, but further analysis of other possible sources may whittle away the electron counts. To settle the question definitively, a two-detector experiment may well be needed so that any variation of electron counts with distance from the neutrino source could be studied.

Experiments using polarized (spin

Superconducting magnet under test at Brookhaven for the proposed RHIC Relativistic Heavy Ion Collider. The dipoles operate at the comparatively low field of 3.5T. Four have been built, three by industry in Germany under the Brookhaven/DESY collaboration on magnets. Tests so far have exceeded design field by over 30 per cent, with good field quality.



oriented) protons have a promising future at the Laboratory. It has proved easier than anticipated to get healthy beam intensities through depolarizing resonances in the acceleration cycle. Polarized sources are being improved considerably, and the advent of the Booster will enable accumulation of polarized beams before injection into the main ring. Adding these factors together indicates the possibility of colliding polarized proton beams in the proposed RHIC collider (of which more later) with a luminosity as high as 10^{32} and an energy of 350 GeV.

The newcomer to the programme at the AGS is the series of experiments with light ion beams drawn from the nearby tandem. These began last October with oxygen-8 and silicon-14 beams at energies up to 15 GeV per nucleon and 5 x 10^8 accelerated ions per pulse for oxygen. Ions with mass up to sulphur are available. There are thirteen approved experiments (three with very large detector arrays) and a user community of over 300. Obviously a major priority is the search for quark-gluon plasma.

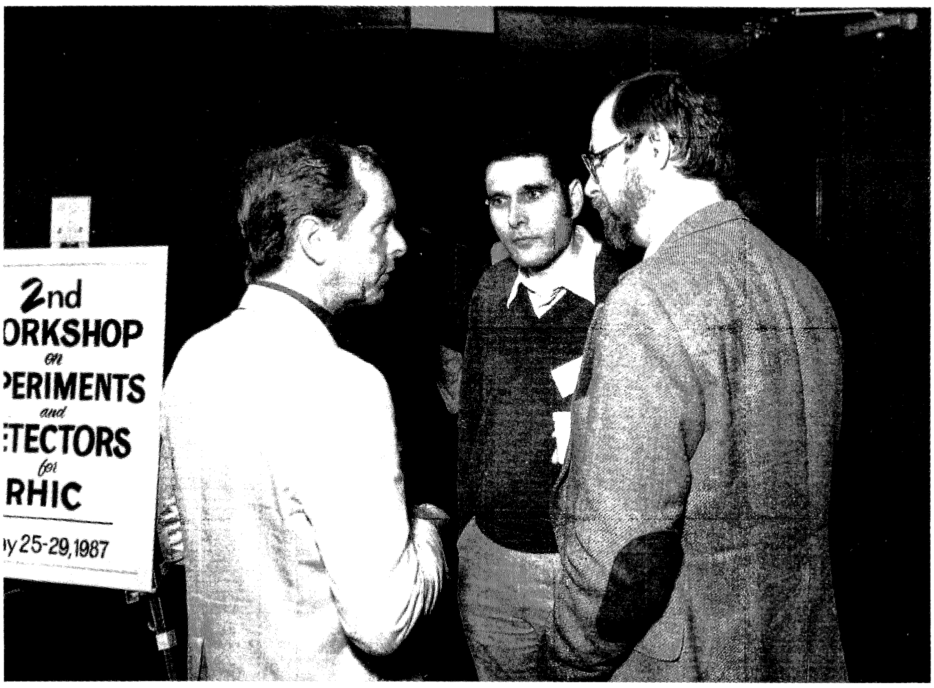
At first sight conditions are not as favourable as at the higher ion energies available at CERN but it is possible that high energy densities in colliding nuclei at the AGS could be achieved because of less transparency as the nuclei come together.

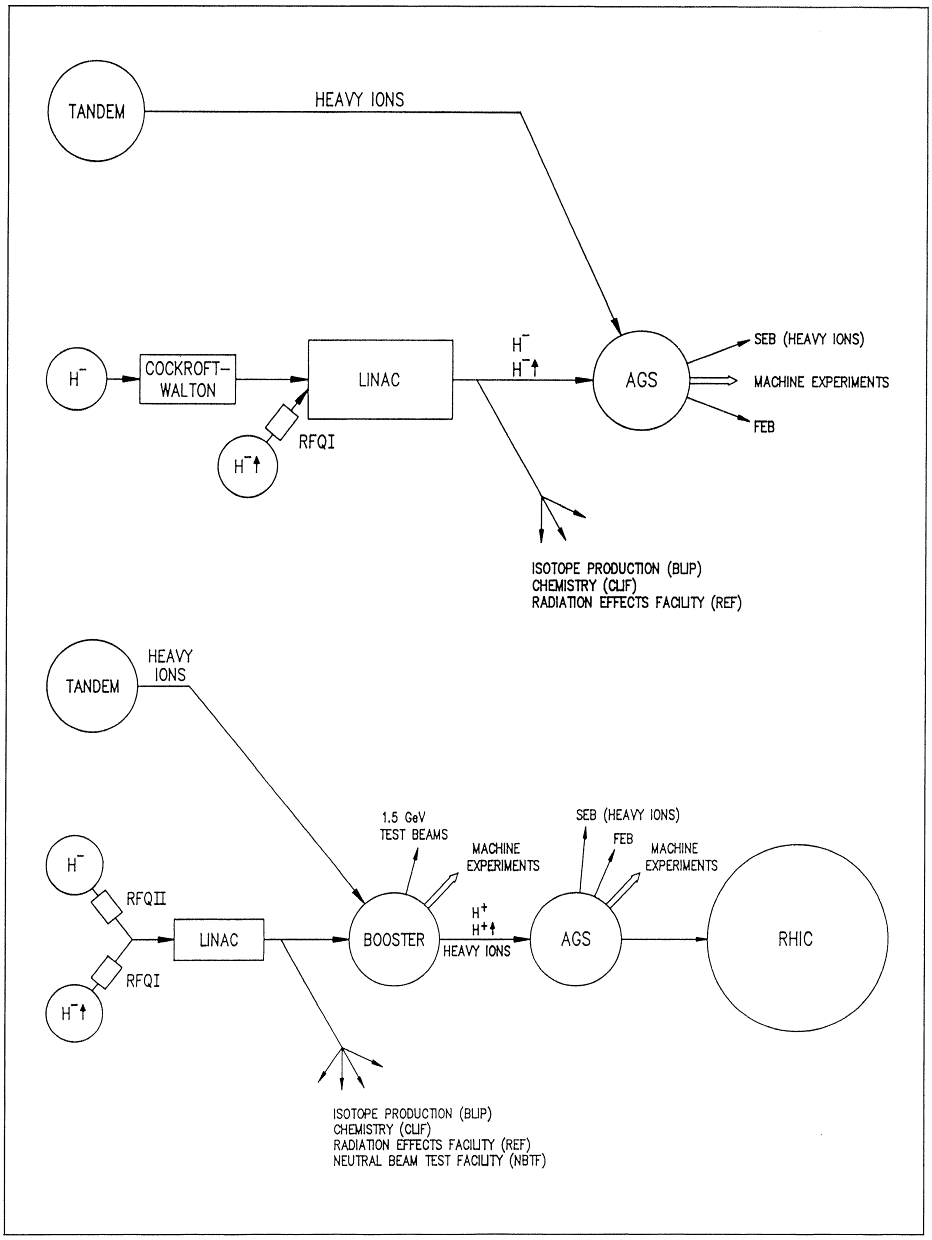
Preparing for the ion collider

These ion experiments are the overture for the major proposed development at the Laboratory. The goal is a Relativistic Heavy Ion Collider, RHIC, to collide ions up to gold at energies of 100 GeV per nucleon.

The construction of the Booster synchrotron at the AGS will open up the required range of ions. The

▼ At the second workshop at Berkeley in May on detectors for the proposed Brookhaven RHIC collider - left to right, Chris Fabjan (CERN), David Lissauer (Brookhaven), Dennis Kovar (Argonne).





Brookhaven present (above) and future (below). Research with ion beams, following the link with the tandem, is a new feature of the programme at the AGS Alternating Gradient Synchrotron. It is a step towards an envisaged larger scheme when the Booster (constructed approved) and the RHIC Relativistic Heavy Ion Collider (proposed) would open up a new region of nuclear physics research.

Booster will also benefit the particle physics programme giving higher intensities than the present usual operating level of 1.2 x 10^{13}. The machine has reached 1.9 and 5 will be feasible with the Booster. The AGS itself will obviously have a major revamp to cope with the ion beams and higher proton beam intensities. There are then conceptual design studies for a 'stretcher' ring to take the intensity into the 100 microamp range beloved of kaon factories.

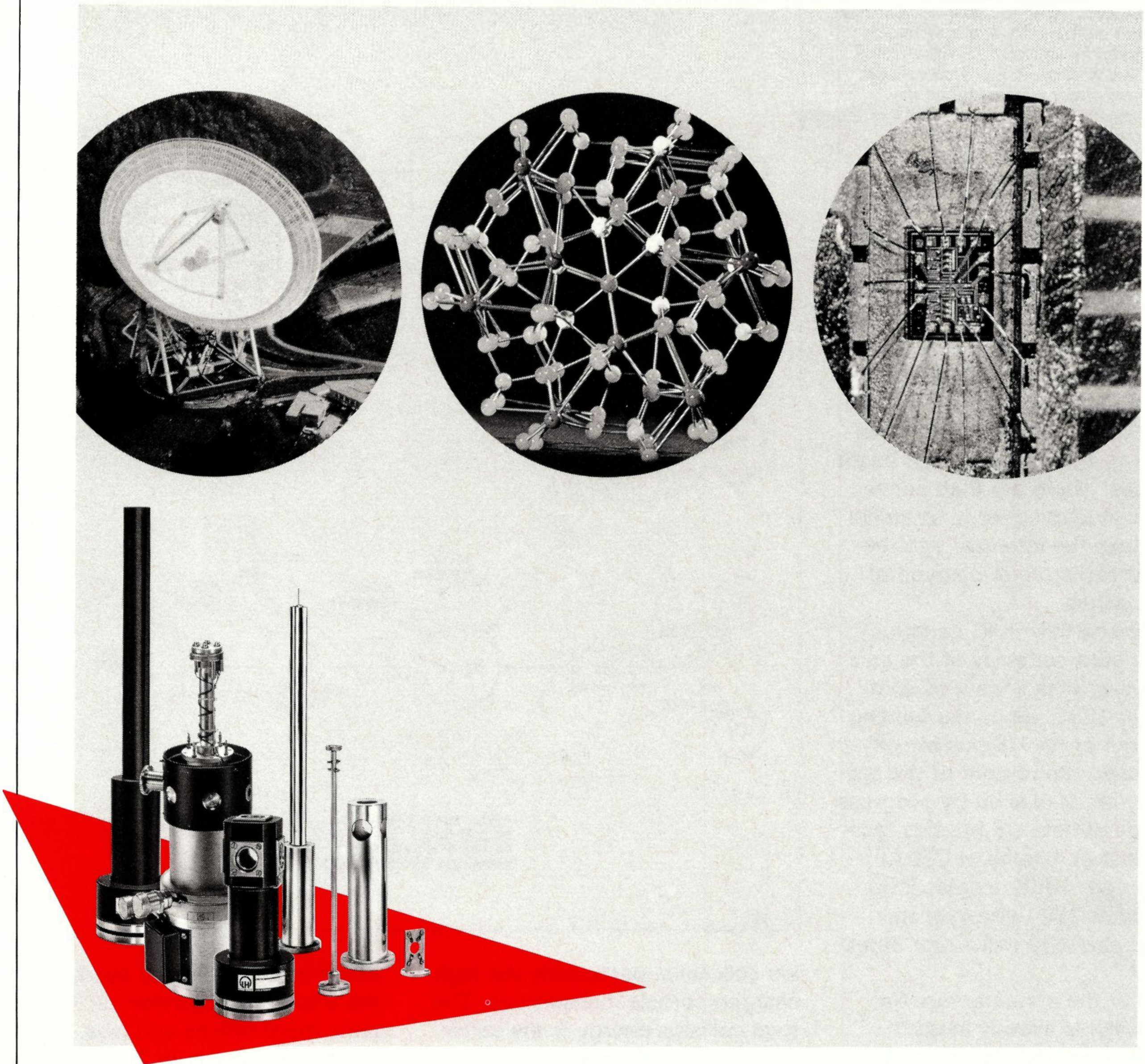
It is hoped that RHIC construction can start seriously at the end of next year with a view to completion in 1993. Since the funding comes out of the US nuclear physics pocket, the rhythm of the project may be influenced by progress on the other new US physics facility — electron beams at CEBAF. In fiscal year 1988 dollars, RHIC is costed at 230 million for the machine plus 100 million for detectors.

Much of the infrastructure for the machine is already in place since it will be installed in the tunnel of the late-lamented CBA. The refrigeration system for the RHIC superconducting magnets is also there. Work on the magnets is in good shape; four full-sized dipoles have been built (three in industry) and tests so far have given peak fields well in excess of the modest design field of 3.5 T with good field quality. Two further dipoles and two quadrupoles will be tested soon.

A second RHIC Detector Workshop was held in Berkeley in May, attracting over a hundred scientists. The first round of experiments will use four of the six intersection regions; the call for proposals is scheduled next year. Detector configurations have to confront the special features of high energy ion collisions, particularly the high charged particle multiplicities. The total collision energy is the same as at the SSC (some 40 TeV) but is carried away by thousands of comparatively low energy particles: calorimeters of comparatively modest scale can give the required efficiency. Nevertheless some detectors should be able to use the full RHIC luminosity to distinguish rare events, such as the predicted absence of the J/psi resonance in radiation from a quark-gluon plasma. Detector R and D projects have been identified for compact calorimetry, particle tracking in high multiplicity environments and picking out leptons from the hadron soup.

Another cause for celebration at Brookhaven in the fall will be the dedication of Phase II of the National Synchrotron Light Source. To cope with a user community which has rocketed to nearly 900 there is more experimental floor area, more offices and labs, and almost double (up to 80) the number of light ports with wigglers and undulators on the ultraviolet and X-ray rings. A station for angiography has been added. About 10 per cent of the beamlines are used by industry.

The Laboratory is playing a leading role in a particular industrial application — the development of a compact synchrotron for X-ray lithography. Similar work is underway in Japan, Germany and the UK. The semiconductor industry could probably use over a hundred of these machines capable of high density computer chip manufacture at the 0.25 micron level. Three workshops have brought industry and accelerator specialists together and the aim is to have a machine in operation by mid-1990.



Around the Laboratories

Phase III at the Light Source is, of course, already under consideration. Its main element would be a new injector linac (to avoid the pain experienced at many synchrotron radiation centres due to beam injection below operating energy) for positrons (to avoid positive ion trapping problems).

The Light Source has also become the base for a newly-created 'Centre for Accelerator Physics', headed jointly by Bob Palmer and Claudio Pellegrini. Its purpose is research and education in accelerator physics which underlies so much of the work in almost all Departments at the Laboratory. To give the Centre some teeth, a very low emittance 50 MeV electron linac is being built incorporating a laser-driven photocathode gun. The laser will also feed picosecond pulses to the output end of the linac for experiments.

New acceleration techniques to be studied include a 'laser linac' (with the linac and laser beams in a fine structure etched in silicon), a switched power microlasertron, and an inverse Cherenkov accelerator. Laser light scattered backwards from the electron beam should give intense 5 keV X-radiation of very low emittance for applications in solid state physics and medicine. Free electron lasers for radiation in the micron wavelength region are another subject for study.

Several of these topics are brand-new in the physics of accelerators, disproving the adage that no new ideas can come after the age of 40!

By Brian Southworth

KEK
Good TRISTAN performance

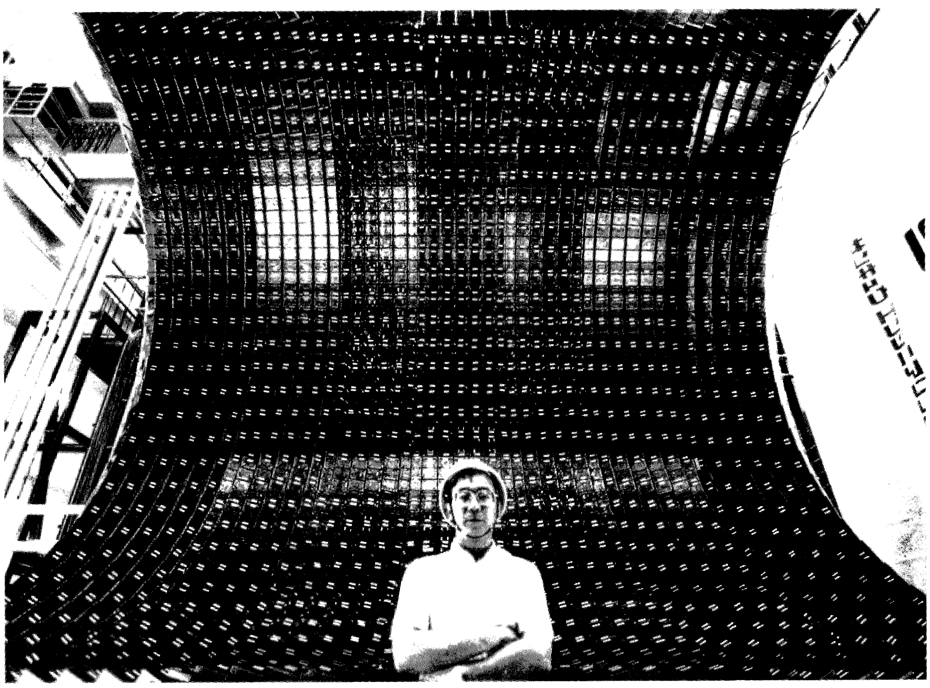
The TRISTAN electron-positron collider at the Japanese KEK Laboratory which came into operation towards the end of last year (see January/February issue, page 1) has continued to make good progress.

The big TOPAZ detector was used for the first time in May, so that the collider was working with its full complement of experiments (TOPAZ, VENUS, AMY and SHIP). Improvements in the main ring vacuum, upgrading injection energy from 7 to 7.5 GeV and some fine tuning paid rapid dividends in machine performance. Maximum luminosity climbed to 0.8 x 10^{31} cm^{-2} s^{-1}, already eighty per cent of the design value. Also with the improved vacuum, beam lifetime is lengthening, so that by June the daily catch of electron-positron collisions was ten times what it was earlier in the year. The TRISTAN team is particularly proud of having accomplished this in six months, or three months of actual machine operation.

The big VENUS, TOPAZ and AMY detectors intercepted integrated luminosities of 691, 509 and 672 nb^{-1} respectively at 25 GeV beam energy. The improved collision rates mean that TOPAZ has reached nearly the same score as the other two, despite having entered the ring only in Round 3.

For the subsequent run, the beam energy was notched up from 25 to 26 GeV. The rapid extraction of initial physics results from this data impressed many people at the international summer conferences (see page 1).

Takayuki Sumiyoshi poses for the fish-eye lens in front of the lead glass array for the VENUS detector at the KEK Japanese National Laboratory's TRISTAN electron-positron collider. VENUS, like its TOPAZ and AMY counterparts elsewhere in the TRISTAN ring, has amassed a good score of electron-positron annihilation into hadrons (strongly interacting particles).



It was a close thing, but it was just possible to squeeze the new Antiproton Collector ring around the Antiproton Accumulator without building a new hall. This new antiproton supply, ACOL, is designed to improve CERN's antiproton levels tenfold.

(Photo CERN X202.5.87)

STANFORD
Spot check

Construction of the new Stanford Linear Collider (SLC) was completed formally in March when beams of electrons and positrons were brought simultaneously to the interaction point. Since then commissioning work has pushed ahead to prepare the machine for its initial physics research effort.

The commissioning of this complex novel machine has gone fairly well, but there have been some problems. One difficulty was the behaviour of the electron beam as it passed through the bending magnets in the north arc of the machine on its way to the final focus and the interaction point, preventing it from being focused down to the few micron spot required for physics research.

This problem has now been solved, and in mid-July the electron beam was observed at the interaction point with a radius of about 5 microns (about one-fifth the thickness of a human hair). The eventual goal is half a micron, but 5 microns was the initial objective and is perfectly adequate for physics.

With the electron beam in good shape, emphasis turns to the positrons. The experience gained with the electrons in the north arc should simplify getting the positron beam through the south arc and final focus.

After the first electron-positron collisions with small spot beams have been obtained, the SLC will be shut down for a few months to install the large Mark II detector at the interaction point. Physics research at the SLC should start around December.

CERN
The quest for more antiprotons

One of the greatest achievements in accelerator technology is the production of sufficiently intense antiproton beams to do fruitful colliding beam experiments. It became possible by the invention of stochastic cooling to control antiproton beams and led to the historic discovery at CERN in 1983 of the W and Z carriers of the weak force.

The antiproton source at CERN first came into action in 1981. For the following five years, CERN's unique intense antiproton beams were exploited for experiments at energies of several hundred GeV in the SPS Super Proton Synchrotron, converted to a proton-antiproton Collider, and in the LEAR Low Energy Antiproton Ring predominantly for atomic and nuclear physics experiments (attracting a new community of some three hundred physicists to CERN).

Fermilab has now joined the antiproton ranks with an antiproton source excelling CERN's original one in available beam intensity and a potential for physics at energies heading for 1000 GeV per beam in the superconducting magnet ring of the Tevatron. CERN cannot

In June Portuguese President Mario Soares (left) visited CERN. He is seen here with CERN Director General Herwig Schopper.

(Photo CERN 427.6.87)

approach these energies but competitive antiproton physics is still possible if beam intensities can be pushed higher than those at Fermilab.

The goal at the Tevatron is to achieve a colliding beam luminosity of at least 10^{30} per cm^2 per s. Performance to date has exceeded 10^{29}. (The Collider at CERN started in 1981 with a luminosity of 5 x 10^{27} and climbed to a peak performance of 3.6 x 10^{29} in 1984.) Meanwhile CERN hopes to capitalize on its considerable experience by going for higher luminosity – ten times more than before thanks to an improvement programme including ACOL, the project to boost tenfold the performance of the antiproton source. It includes a rebuilt target station, the new AC antiproton collector and the refurbished antiproton accumulator, AA.

In the original CERN system, protons were accelerated to 26 GeV in the Proton Synchrotron, having been specially concentrated into five bunches, each 40 ns long. They were then fired at a target where they produced a spray of particles including antiprotons. Lenses sifted out antiprotons of around 3.5 GeV and guided them into the AA antiproton accumulator, where stochastic cooling systems treated the beam so that its intensity could be built up and the beam could be stored for many hours. From 1.3 x 10^{13} protons on the target at each pulse some 6 x 10^{6} antiprotons were collected and about 10^{11} antiprotons were accumulated daily for the beams.

The PS has now been modified (new radiofrequency manoeuvres) to concentrate the protons into five bunches only 25 ns long; it is hoped to have 2 x 10^{13} onto the antiproton production target. The target will initially be a passive iridium wire, 3 mm in diameter and about 55 mm long, followed by a lithium lens to focus the emerging antiprotons into the injection beamline. The antiprotons pass through a lithium rod (where the low atomic number avoids significant particle scattering) at the same time as a pulsed current of 420 kA. The magnetic field associated with the current acts as a linear focusing lens.

This type of lens, based on previous versions at Novosibirsk and Fermilab, has survived many millions of pulses in laboratory conditions while being pulsed at 450 kA but has not yet been exposed regularly in a beam. In case of difficulties, a more conventional lens, like the magnetic horn previously used at the AA but with a larger aperture and higher current-carrying capacity, is being held in reserve. A variety of target and lens configurations could be used.

The antiprotons are injected into a newly built ring – the antiproton collector, AC. This has been squeezed around the existing AA and largely relieves the AA of its preliminary task of precooling the injected beam, which obviously has a wide momentum spread, before transferring the newly injected particles to the store of low momentum spread antiprotons being built up ready for the experiments. In fact the AA was a two-in-one machine with its vacuum vessel, 70 cm wide, capable of being divided into two regions by a movable shutter. The outer region received the injected, uncooled beam and preliminary cooling was done before lowering the shutter and moving the particles to the main body of the chamber where the intense beam was accumulated.

The AC takes the injected beam and smooths out the five bunch structure. It precools in momentum and in horizontal and vertical planes using stochastic cooling. This takes about 2 s and there is still about 300 ms to rebunch and transfer to the AA ring before the next burst of antiprotons arrives. The AA has also been refurbished to be able to take beams ten times more intense. Some pre-cooling for the injected beam is still available and the cooling systems for the accumulated beam have been improved.

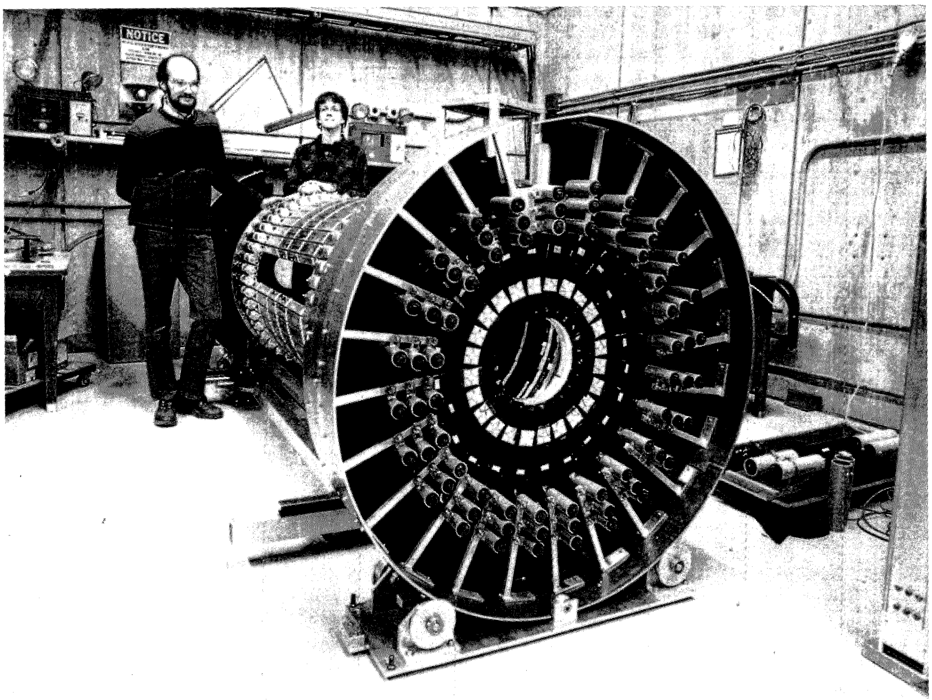
To make best use of the more intense beams the PS and SPS have joined in a general facelift carried out a five-month shutdown of the CERN machines in the first half of this year. The PS was taken apart and fitted with a new vacuum chamber (a pre-LEP manoeuvre to cope with radiation from the coming electron beams), and 'figure-of-eight' loops were added to the magnets so that the field configuration can be adjusted in a more refined way at high fields. This addition will increase the ability of the PS to handle high antiproton fluxes. When the PS switched on at the beginning of June, protons were accelerated within one hour of first injection despite the months of upheaval.

The SPS was successfully tested in 1986 with six bunches of particles per beam, making maximum use of the antiprotons while operating in the collider mode. To keep luminosity high (and the background rate seen by the experiments low) in these conditions, the beams need to be separated at the crossing points where experiments are not installed. Electrostatic separators are installed to deflect the beams in the horizontal plane, and have operated satisfactorily.

Both the big collider experiments, UA1 and UA2, have undergone major upgrades to profit from the extra antiprotons (see November 1985 issue, page 384). Also the physicists who are interested in lower energy antiprotons at the LEAR ring have prepared for a second generation of experiments using much higher antiproton fluxes (see December 1986 issue, page 9).

The construction of the Antiproton Collector and all the modifications to the existing machines were accomplished very rapidly. The AC ring has been successfully tested with protons prior to full ACOL operation. The antiproton programme should be reaping full benefit in 1988.

(In August, the new AC ring handled its first beams of antiprotons. The antiproton levels from the new source were high, promising well for the future.)



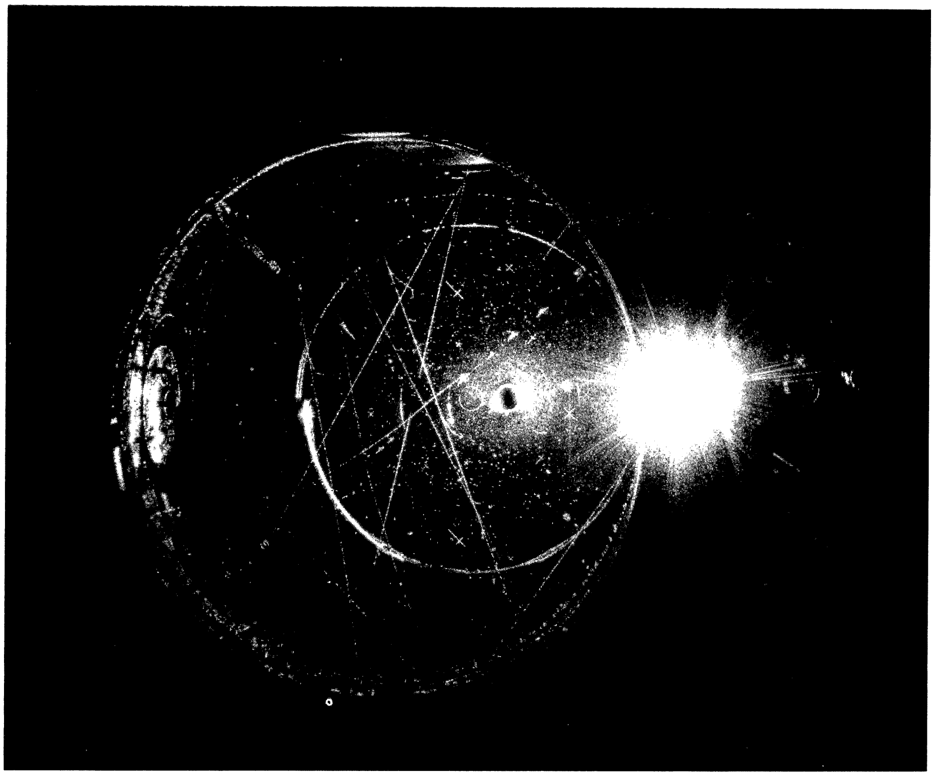
Clark Lindsey (Iowa State, left) and Ramsey Harcourt (Reed College) with apparatus for the Experiment 735 designed to search for new kinds of hadronic matter at the Fermilab Tevatron proton-antiproton collider.

(Photo Fermilab)

FERMILAB 'Small' collider experiments

Though frequently overlooked due to the understandable attention given to their larger and better-known brethren, three 'small' experiments have been installed in the Tevatron tunnel. Although these experiments are small in comparison to the two large general-purpose Tevatron collider detectors, some are nevertheless comparable in size to fixed-target experiments. All three are aimed at specific areas of physics not covered fully (or at all) by the large detectors. In addition, they generally do not require high collision rates, at least initially, and thus can produce results from initial Collider runs.

The three experiments are — E-710 looking at total cross-sec-



A conventional photograph of a holographic image from the Tohoku Bubble Chamber at Fermilab. The high resolution chamber, 1.1 metres in diameter and 1.4 metres in depth, is filled with a freon mixture. The photo shows a hologram of the entire chamber with the large circle being the front window and the small circle the rear window. The bright flare on the right is the reference laser beam. The neutrino beam will enter from the left. The chamber achieves high resolution — 35-50 microns — despite its large volume. The picture was taken during a test run with cosmic rays prior to embarking on the fixed target physics programme.

tions (reaction rates) and elastic scattering at the E0 point in the ring, E-713 searching for highly ionizing particles at D0, and E-735 searching for signs of quark-gluon plasma at C0.

(In addition, the smallest-angle silicon strip detectors of the mighty CDF detector are located in the tunnel outside the B0 Hall. For many purposes, including impact on the accelerator, this can be considered as another small Collider experiment.)

All three experiments are in Tevatron locations used primarily for other purposes, and this has affected their design. C0 is the home of the Main Ring and Tevatron abort systems; D0 contains extraction septa when the fixed-target program is running, and is being prepared for installation of the D0 detector; E0 is used for transfer of both protons and antiprotons from the Main Ring to the Tevatron.

Experiment 710 will measure proton-antiproton total cross-sections and elastic scattering over the collision energy range from 300 to 2000 GeV. The apparatus is capable of observing very small scattering angles, allowing measurements into the Coulomb scattering region. It uses scintillation counters and drift chambers around the interaction point, as well as detectors placed close to the circulating beams inside 'Roman Pots' on either side of the interaction point.

The goal of E-713 is a search for highly ionizing particles such as magnetic monopoles. There are thin arrays of glass detectors inside the vacuum pipe and plastic detectors (CR-39 and Lexan) outside, covering a large fraction of the total solid angle. Etching these detectors after exposure to collisions shows up particle tracks, and their ionization can be measured.

Experiment 735 is a search for a quark-gluon phase where these matter constituents would become liberated from their usual nucleon confinement. It uses a central tracking chamber almost surrounding the interaction point, and a magnetic spectrometer off to one side.

All three experiments are now analysing data taken during the 1987 Collider run.

CERN/ORSAY
Fruitful collaboration

Preparations for CERN's new LEP electron-positron collider gather momentum. A short ceremony at CERN on 7 July marked the formal inauguration of CERN's new LEP Injector Linacs (LIL) and the end of the special collaboration between CERN and the French Laboratoire de l'Accélérateur Linéaire (LAL) at Orsay established some five years ago to bring LIL into being.

The LEP Pre-Injector (LPI) consists of the two LIL linacs and the EPA Electron-Positron Accumulator. Positrons are created when a 200 MeV high current electron beam in the upstream linac strikes a target, and the positrons, together with electrons, are taken to 600 MeV in the downstream linac. The EPA ring acts as a buffer between the fast cycling (100 Hz) linacs and the slow cycling (0.8 Hz) 'Proton' Synchrotron downstream. This takes the particles from 600 MeV to 3.5 GeV, ready for injection into the SPS synchrotron. There the beams move up in energy from 3.5 to 20 GeV before injection into the LEP Main Ring.

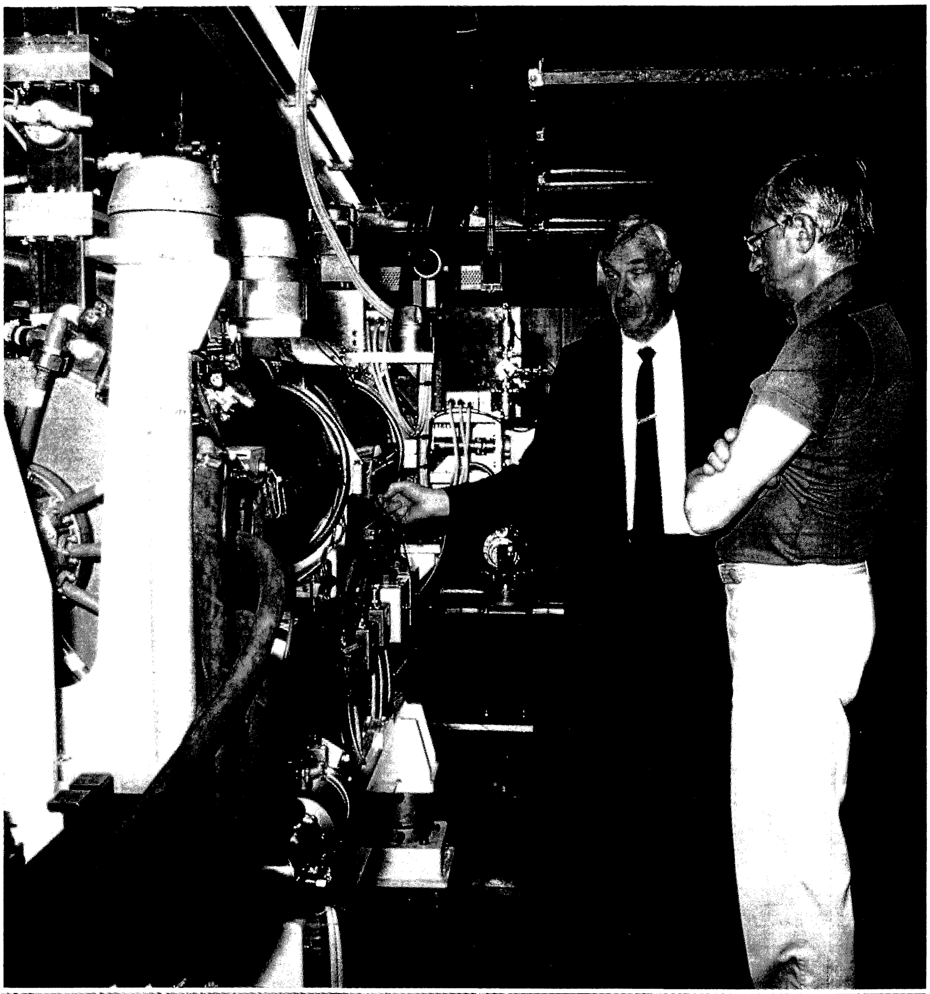
LPI supplied its first electron beams last year to the PS, and this year attention turned to positrons. An initial LIL positron beam appeared in March, accumulation in EPA was tested in April, and in June the PS received its first positrons. In July, a positron beam was transferred to the SPS through the line normally used for protons.

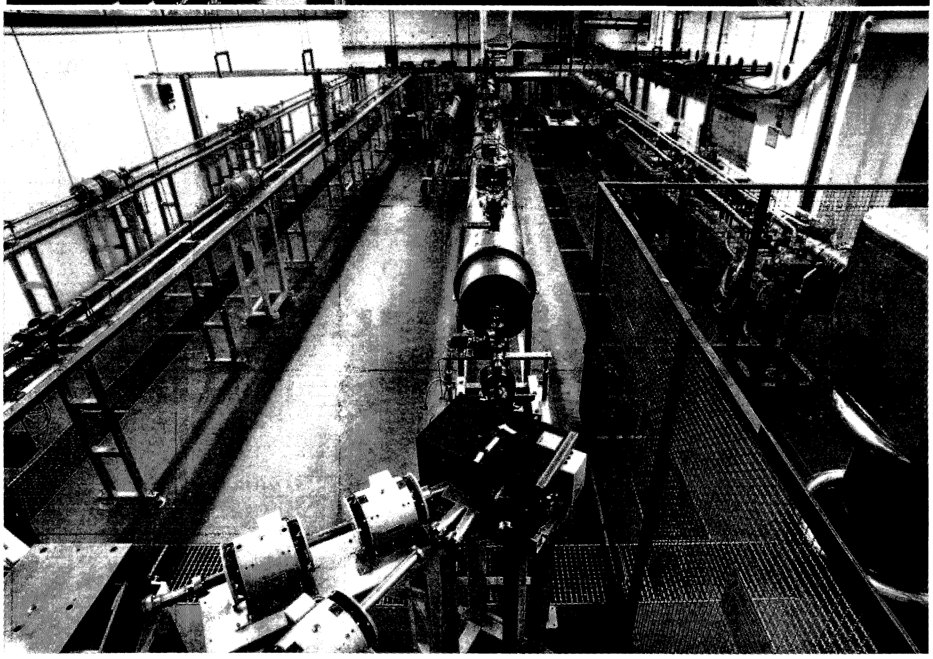
The CERN/LAL collaboration brought together the expertise of a dedicated linac team and the

(Above) David Warner (left) explains the LEP Injector Linac to Franco Bonaudi.

(Below) The superconducting electron accelerator at Darmstadt. On the right is the preacceleration and injection beamline into the 10 MeV injector together with the liquid helium transfer line extending through the wall into the injector cryostat. After the beam has passed through the 40 MeV linac in the middle it is recirculated twice magnetically through the two beamlines at the left.

(Photo Darmstadt)





know-how and resources of one of the world's largest scientific laboratories. Responsibility for the design and manufacture of the myriad of LIL components was split between the two Laboratories. Much work was contracted to industry but the special requirements and exacting specifications meant that the Laboratories retained special responsibilities.

A notable example was the fabrication of the 2500 cells of the linac accelerating sections to rigorous specifications, calling for detailed design, choice of materials, and machining accurate to a few microns.

This intimate collaboration is something of a new departure in accelerator physics, where collaboration normally means delegating total responsibility for a component or task within an overall project to one or more research centres. For LIL, both CERN and LAL were involved in everything, and on an equal footing. 'It may have been complicated, but we've shown it works,' said a member of the team.

DARMSTADT Superconducting radiofrequency accelerator milestone

In May, the superconducting radiofrequency electron accelerator presently under construction at the Nuclear Physics Institute of the Technische Hochschule Darmstadt passed a major milestone when it produced its first accelerated electron beam by operating two 3 GHz multicell cavities (a 25 cm 5 cell

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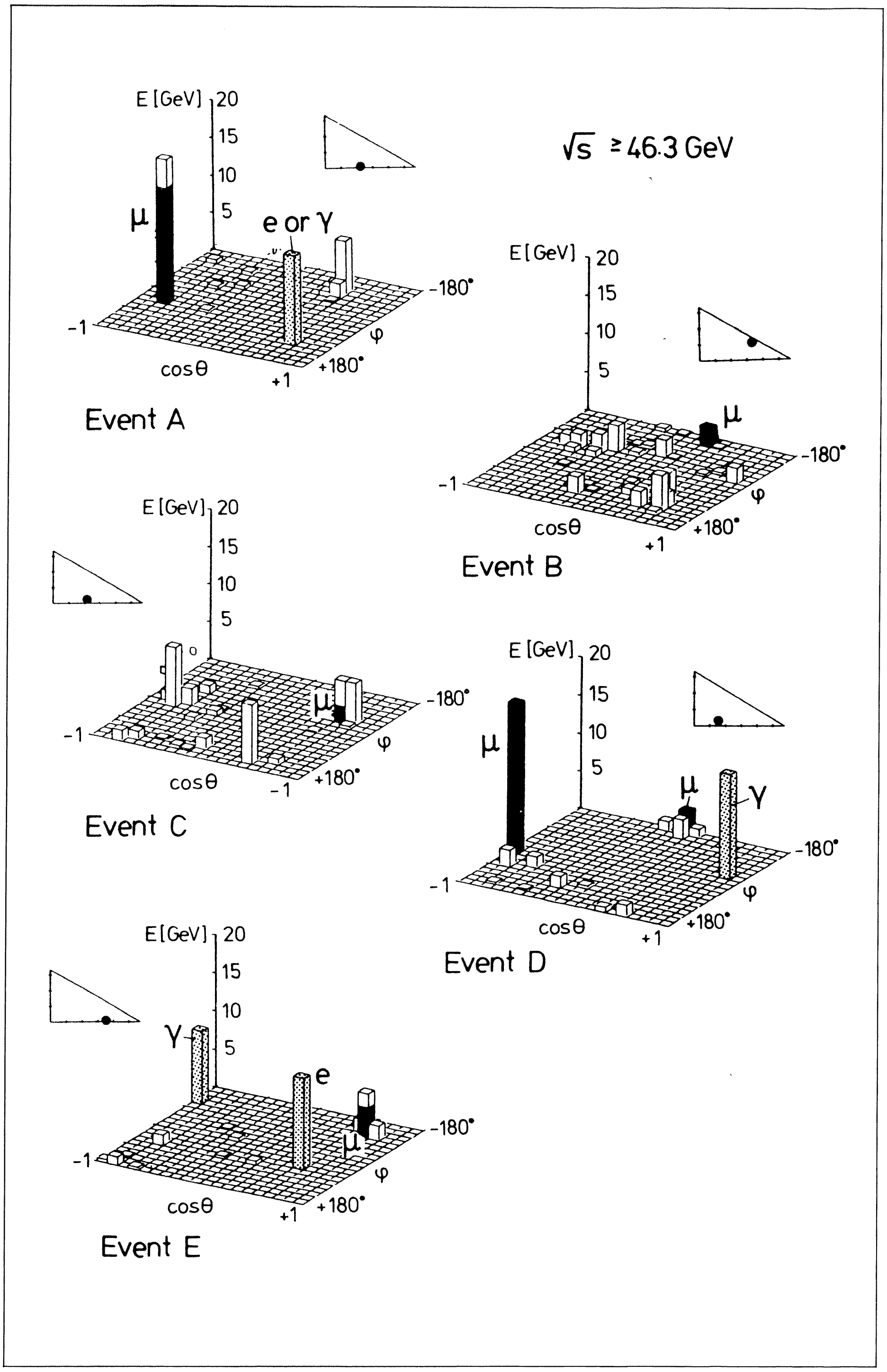


Unexplained — five examples of an isolated muon with a broad production of hadrons as seen by the JADE detector in high energy electron-positron annihilations in the PETRA ring at DESY, Hamburg. At the International Lepton-Photon Symposium at Hamburg at the end of July, the VENUS detector at TRISTAN reported preliminary evidence for these events. A report of the meeting will appear in our October issue.

and a 100 cm 20-cell cavity) in a phase-locked mode. This success was reached after simultaneous electronic tuning of the high-Q accelerating cavities, very sensitive to mechanical vibrations.

The 130 MeV accelerator, designed mainly for nuclear physics research, has been planned and installed by a Wuppertal/Technische Hochschule Darmstadt collaboration after a successful test of a homemade superconducting linear accelerator with a five cell prototype cavity (see October 1982 issue, page 326). It consists of a 10 MeV injector (housing a five-cell capture section and two 20-cell niobium metal accelerating structures) and the 40 MeV main linear accelerator (with 8 more 20-cell structures). The electron beam is then recirculated twice isochronously back into the main linac yielding electron energies of 90 MeV and 130 MeV, respectively. The anticipated cw current of the beam is more than 20 microamps.

The accelerating cavities developed at Wuppertal and manufactured at Interatom, Bensberg, W. Germany, are of the now standard spherical design. They are operated at a frequency of 2997 MHz and a temperature of 2 K. Quality (Q) factors and accelerating fields are around some 10^9 and 5 MV/m respectively.

So far the electron gun, the 250 keV preaccelerator, chopper and prebuncher and the superconducting injector linac have been in operation, although much more equipment has been installed.

After the successful first acceleration tests more tests are scheduled in which the second 20-cell structure in the injector and two more 20-cell structures of the main linac will be added and operated in a phase-locked mode. Experience with the first beam recirculation through the main superconducting linac will soon be gained.

DESY Peephole?

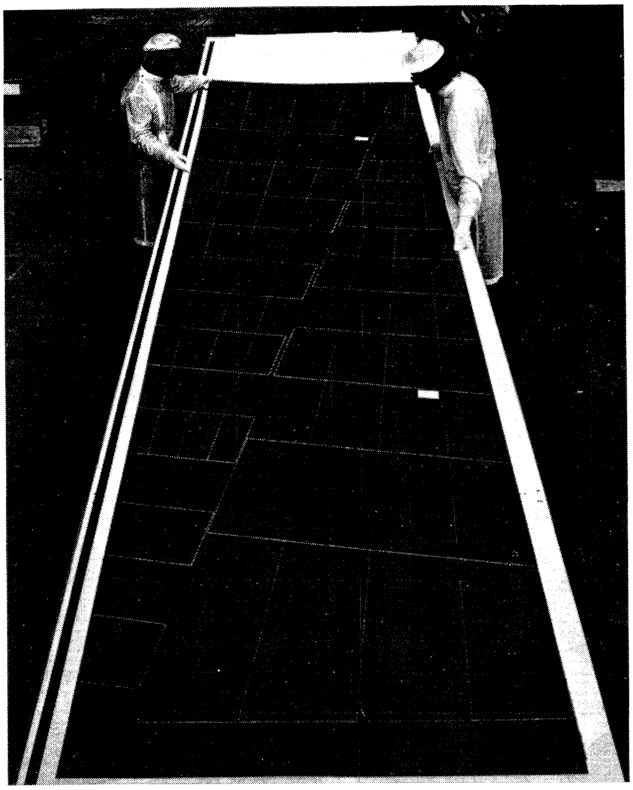
In 1984, all available space at the PETRA electron-positron collider at the German DESY Laboratory was crammed with extra radiofrequency power in a bid to push the collision energy as high as possible.

In a hectic few months which left their mark on the Laboratory's electricity bill, PETRA's collision energy went above the 45 GeV design figure, eventually attaining almost 47 GeV (see January/February 1984 issue, page 16).

The experiments eagerly scanned for the onset of new behaviour resulting from heavy particles, such as the sixth ('top') quark. However 47 GeV was not high enough to reach the top, so that the sixth quark had to await higher collision energies. The waiting continues.

But the Mark J detector at PETRA did see something else. Looking at produced hadrons accompanied by penetrating muons, Mark J found seven high collision

Giant Read-Out Boards?



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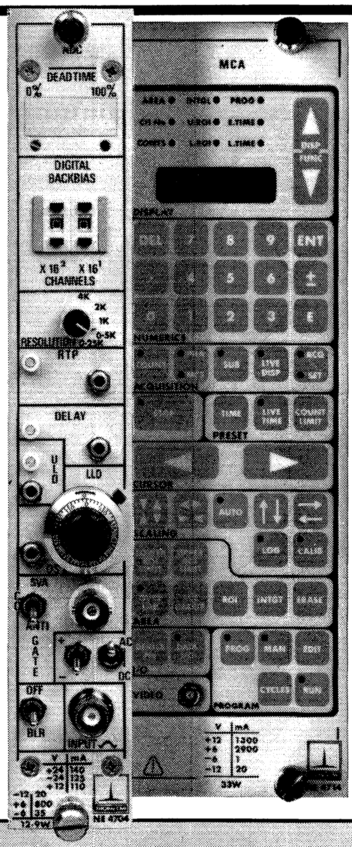

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energy examples of a broad spread of hadron energy accompanied by a very isolated muon.

Based on what was seen at lower collision energies, only about one such event was expected. Picking up eight was suspiciously interesting, but at the time none of the other three PETRA experiments had anything to report.

The PETRA machine was not able to remain in this high energy region for long, and the matter remained closed for a while. Then the JADE collaboration presented a new analysis of the high energy data, concentrating on the search for isolated muons or electrons. Five examples were found of an isolated muon accompanied by a broad hadron signal, consistent with the Mark J findings. No such effect was seen with electrons.

The CELLO group found only one example of an isolated muon accompanying a broad spread of hadrons, consistent with what they saw at lower collision energies. The group concluded that the data 'do not support the observations of the Mark J and JADE collaborations of an excess of muon events of this type'.

At a meeting in Santa Monica earlier this year, physicists looked at the possibilities of quarks and leptons heavier than those already known (or, in the case of the 'top' quark, firmly anticipated). Any such particles would have immediate consequences for the cosy interpretation of modern particle physics in terms of just three 'families', each containing two (known) quarks and a lepton.

Harald Fritzsch admitted that the interpretation of the Mark J and JADE signals was 'unclear'. He hinted that PETRA could have been falling just short of an important new threshold, so that experiments had 'just a short look through the peehole before the slide came down'.

The new TRISTAN electron-positron collider at the Japanese KEK Laboratory should certainly enlarge any such peephole.

Physics monitor

Hadron spectroscopy 1987

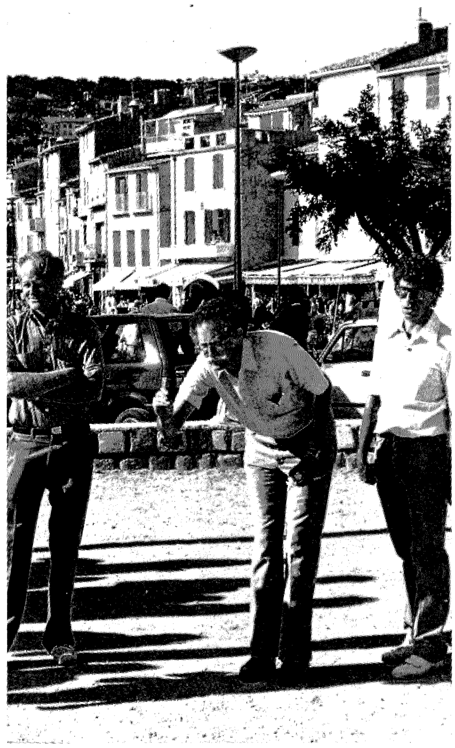
With much particle physics research using particle beams to probe the behaviour of the quark constituents deep inside nucleons and other strongly interacting particles (hadrons), it is easy to overlook the progress being made through hadron spectroscopy — the search for and classification of rare particles — and the way it has increased our understanding of quark physics.

One way of remedying this was to attend the stimulating and encouraging Hadron 87 meeting held earlier this year at the Japanese KEK Laboratory, where Jonathan Rosner from Chicago's Enrico Fermi Institute gave the concluding talk.

'Questions that were asked as long as twenty or more years ago are actually being answered,' he observed, thanks to the patient efforts of experimentalists and theorists. We need to be more bold in sharing these pleasures with students, for the study of new spectroscopies... builds on the old'.

A comparison of the 1974 and 1987 classifications of mesons (composed of a quark and an antiquark) underlined the progress made in recent years. Many conventional spectroscopy labels (radial and angular momentum excitations — as in atomic physics) are needed, while candidates have been found for a variety of exotic states.

Jon Rosner — answering questions from twenty or more years ago.



Complementing the particle spectra are the results on proton-antiproton annihilation at rest from the ASTERIX experiment at CERN's LEAR Low Energy Antiproton Ring.

'Glueballs' are particles built up of gluons (the transmitters of the inter-quark force) rather than quarks. A good test of a glueball candidate is to see if it can be formed in photon-photon collisions (a by-product of electron-positron annihilation) as glueballs do not carry electric charge. Rosner reeled off a list of glueball possibilities — the iota 1460 (a 'good candidate'), many scalar particles (spin zero, positive parity), all resonances above 1 GeV (apart from the f_2 prime 1525) seen in final states of a neutral kaon pair and a pion or a pion and an eta (because of the photon-photon criterion), the theta/f_2 1720 (interesting for its possible links with the 'Pomeron' mediating elastic scattering) etc. Some states, such as the eta prime 958, could have a small gluonic component.

Baryon (three quark) states abound, but Rosner covered also the Skyrme model, used with some success in the analysis of meson-baryon scattering, providing an alternative approach to quark models, with similar though not identical results. New experiments could shed further light.

Other variations of hadronic matter are the 'hybrid' states containing gluons in addition to quarks, and exotic states with configurations other than the habitual quark-antiquark (meson) and three quark (baryon) forms.

Rosner also looked at the possibility of hadron 'molecules', where the allowable stable configurations of complicated structures is a challenge for lattice gauge theories.

Spectroscopy has certainly blossomed for heavy quarks beyond strangeness, unknown before 1974. The physics of 'charmonium' (bound pairs of charm quarks and antiquarks) is now a subject of special study. While not yet as well explored as the charm quark, the b quark provides another spectroscopy dimension. The mixing of B mesons (containing b quarks) gives an indication of where the sixth ('top') quark might be found one day.

As well as the top quark, Rosner included in possible future spectroscopies a variety of theoretically admissible quarks and leptons.

He concluded that hadron spectroscopy has a bright future, with results possible from machines existing, entering service, shortly to enter service, or still on the drawing board.

Electronic postcards

Over 200 specialists gathered at Asilomar State Beach in California earlier this year for a Conference on Computing in High Energy Physics.

The organizers decided to restrict presentations to topics often talked about in corridors but rarely covered in open session. The theme was thus 'the computing environment' and all but two review talks dealt with software issues. There were 35 speakers during the 4½ days of presentations, with another 30 topics covered during the 3 hour poster session. In addition, lively panel discussions were held in the evenings.

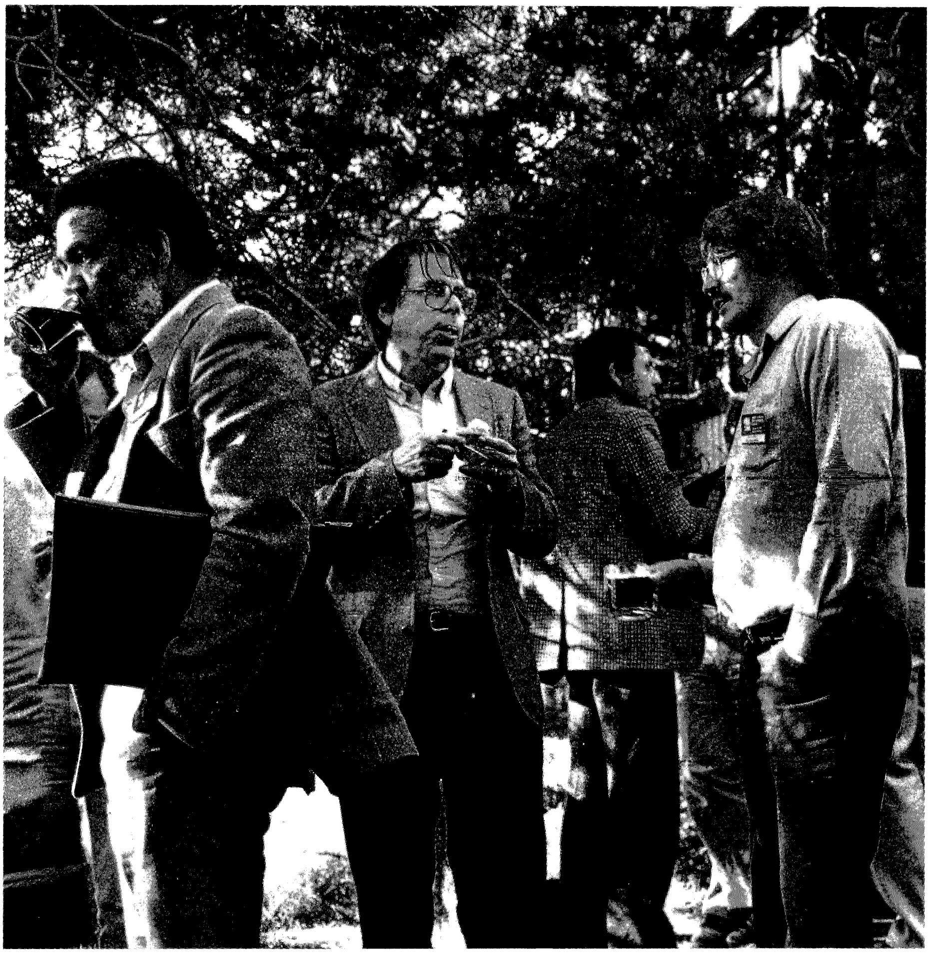
A highly topical area was computer networking. Reports from Hugh Montgomery (Fermilab) on the US perspective and Brian Carpenter (CERN) on the European scene showed that the long sought goal of network unification and standardization is still many years away. Meanwhile the various ad hoc networks (BITNET/EARN, DECNets, X.25 based networks, etc.) continue to grow and be heavily used by the particle physics community.

Another area of growing interest is the use of supercomputers. Although these machines have successfully handled lattice gauge calculations and some aspects of accelerator modeling, they have yet to make their mark across the experimental scene. There were two very different illustrations of recent progress. Kenichi Miura (Fujitsu) showed one method to vectorize particle generation in the Stanford (SLAC) EGS simulation package, with significant benefits (although his lead brick geometry was very simple), while David Levinthal, taking another approach, achieved high levels of vectorization in track finding code for his Fermilab experiment.

The most colourful part of the conference was the graphics session. 3-D colour event displays from the UA1 experiment at the CERN collider were presented by Jean-Pierre Vialle (LAPP-Annecy) while Ralph Nelson (SLAC) presented 3-D colour showers from the EGS simulation program. However it was clear that particle physics is only beginning to learn how to exploit the latest 3-D colour graphics terminals and workstations.

Three sessions covered various aspects of program development and management and the computing environment for physics analysis. New words such as PAW, IDA, GEP, TANAGRA, ADAMO, and SASD were explained. With interactive computing readily avail-

Time out at the Conference on Computing in High Energy Physics at Asilomar State Beach, California, earlier this year - (left to right) Dennis Judd (Florida A and M), David Pellett (UC Davis), Rene Brun (back to camera, CERN) and Tony Hey (Southampton).



able, be it on personal computers, workstations, or mainframes, new techniques have led to rapid progress in program development and physics analysis.

A no-nonsense talk by John Manzo of Digital Equipment Corp. on 'Managing Large Scale Projects' explored sources of complexity in large projects and showed some simple remedies. One needs to understand the causes of the complexity in order to manage them, otherwise one will get managed by them.

No particle physics computing conference would be complete without a discussion of FORTRAN. Michael Metcalf (CERN) reviewed the status of the FORTRAN 8X standard, while Jim Russell (SLAC) pointed out the advantages of other languages. Some groups have tried to get around some of FORTRAN's deficiencies by using a FORTRAN preprocessor and Tony Johnston (Boston) reviewed experience.

With an audience of computer types, the conference naturally made heavy use of computers. From the submission of abstracts for contributed papers to the distribution of the final programme, nearly 90 per cent of the conference mail went via the BITNET/EARN network. Conference chairmen Paul Kunz of SLAC and Terry Schalk of Santa Cruz reported that the network saved them lots of time and contributed greatly to the meeting's success.

Thanks to the loan of a microVAX by Digital Equipment Corporation and the Jnet software by Joiner Associates, there was a BITNET computer node on the conference grounds. Every participant was given an account and 150 sent or received electronic mail. The four terminals were constantly in use from early in the morning until late at night, except during the sessions, of course. In spite of having to queue, the participants managed to send or receive over 2000 messages, while the telephones remained largely idle. However it is suspected that some of the outgoing mail might have been of a new electronic postcard form '...weather is fine... wish you were here...'.

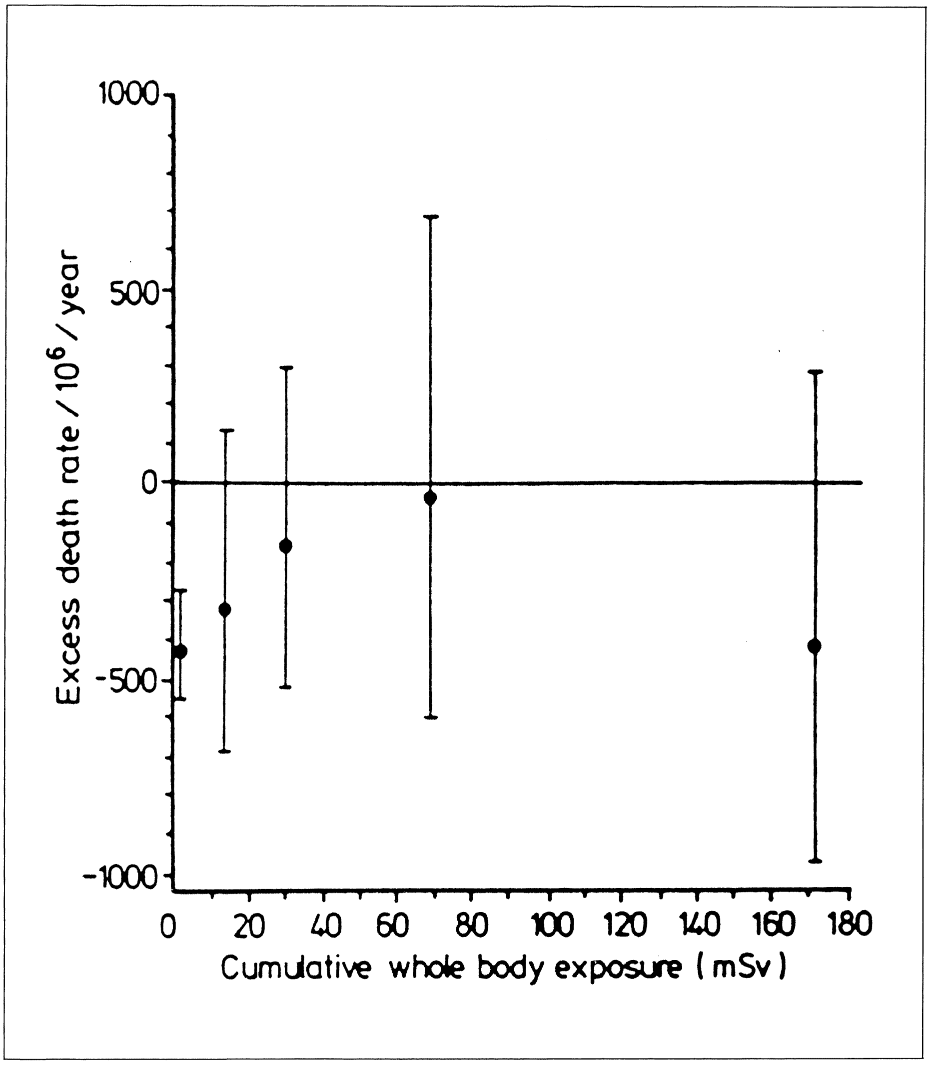
Participants enjoyed a pre-conference reception sponsored by Digital Equipment Corporation and a conference banquet at the Monterey Bay Aquarium sponsored by IBM.

From Paul Kunz

Low-dose ionizing radiation — is it harmful to health?

A conference on the health effects of low-dose ionizing radiation organized in London earlier this year by the British Nuclear Energy Society brought together epidemiologists who have been investigating the mortality of workers from the nuclear industry in an attempt to put low-level radiation risk estimates on a scientific basis.

*Death rates from cancers in excess of those expected on the basis of mortality in England and Wales, in relation to cumulative radiation exposure, according to V. Beral et al, Brit. Med. J., **291**, 440 (1985). Bars represent 95 % confidence intervals for excess death rate (10 mSv = 1 rem).*



Current risk estimates of radiation health effects as recommended by the International Commission on Radiological Protection (ICRP) are based on extrapolations from effects observed at high-dose levels, principally among survivors of the atomic bombs and of persons who have undergone radiation therapy. Controversy rages over the applicability of such estimates to long-term exposure to low-levels of radiation.

Papers were presented covering a spectrum of viewpoints ranging from the assertion that atomic bomb survival data can be interpreted as showing a negative risk of leukaemia from low levels of radiation to claiming that natural terrestrial gamma radiation is making a significant contribution to childhood leukaemia. Between these extremes the main weight of the conference rested on analyses of the causes of death among 39 500 persons employed by the United Kingdom Atomic Energy Authority (UKAEA) between 1946 and 1979, and an equivalent study of 14 300 employees from the fuel-element reprocessing plant at Sellafield, currently operated by British Nuclear Fuels. Both studies were carried out by groups from the Department of Epidemiology at the London School of Hygiene and Tropical Medicine.

Several papers were presented describing the efforts taken to eliminate bias and the problems associated with re-estimating dose from archived film dosimeters and records. It was emphasized that the total radiation exposure involved would be expected to result in insufficient radiation-caused deaths to quantitatively prove or disprove current risk estimates. Both studies show there to be no significant difference in death rate between workers with or without a radiation record and that the death rates of nuclear workers are significantly below those of the general population when standardized for age and sex distribution. Death due to cancer was even found to be less frequent amongst radiation workers than other employees in the UKAEA during the first 10 years of service.

There appeared to be only a very weak correlation between cancer mortality and level of radiation exposure, which in the UKAEA study led to a risk estimate of 12.5 deaths per year per million persons per 10 mSv* but with an uncertainty (95 % confidence limit) of about ± 40 deaths. The best fit to the Sellafield data gave a negative correlation of -6 ± 17 deaths per year per million persons per 10 mSv. These estimates need to be compared to the ICRP lifetime risk estimate of 100 deaths per 10^6 persons and per 10 mSv. This lifetime risk was interpreted as being averaged over 25 years,

**The Sievert (Sv) is the S.I. unit of radiation dose (10 mSv = 1 rem). The current annual dose limit for radiation workers is 50 mSv.*

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PHYSICIST PROGRAMMER

There is a vacancy for a Physicist Programmer with the Particle Physics Group at Imperial College. The primary task concerns data acquisition for the ALEPH Inner Tracking Chamber which has recently been constructed at Imperial. This involves the use of FASTBUS and powerful microprocessor based on the Motorola 68020. In addition the successful candidate will be responsible for integrating this chamber readout into the overall ALEPH data acquisition which is based on FASTBUS and clustered VAX's. Other projects involve CAMAC and PDP11 based systems. A PhD in Particle Physics and/or experience in real time systems is desirable, however enthusiasm to learn and exploit the latest techniques in this area is the most important requirement.

The post will be three years in the first instance and salary will be in the range £ 10 698-£ 16 218 per annum (including London Allowance).

Applications with C V and the names and addresses of at least two referees should be sent to

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7-GeV Advanced Photon Source Construction Project

Argonne National Laboratory plans to construct a 7-GeV Advanced Photon Source, a high-brilliance synchrotron x-ray facility strongly endorsed by national research advisory groups and favorably reviewed by the Department of Energy. Preconstruction R&D and the conceptual design are at an advanced stage, and construction funding is scheduled to begin in October 1988. Current plans indicate a total project cost of about $400 million with an expected completion date in 1994.

We seek an individual to direct construction of this major project. Responsibilities will include direct managerial leadership for the APS Project through its detailed engineering design phase, assembly of a project team responsible for the construction, and direction of the construction project. The successful candidate must have the capability to direct a large, complex technical construction project and to meet well-defined schedule and cost objectives, preferably demonstrated by past accomplishment. A background in technical design and construction is essential, but both accelerator design and construction management experience is preferred. This background will normally include an advanced degree in either physics or engineering. The importance of this project to advancing our national technological competitiveness and the magnitude of the undertaking make this a challenging and rewarding position that requires a highly capable and experienced person.

Candidates should submit a resume by October 1, 1987, detailing relevant experience, explicitly describing involvement with construction projects and including the names of at least three persons who can provide letters of recommendation, to

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Faculty Position

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Applications will be considered as they are received with a closing date of December 15, 1987. Applicants are requested to provide a curriculum vitae, a list of publications, and a brief statement of research interests and plans, and to arrange to have three letters of recommendation sent to the search committee. Inquiries, applications, and recommendation letters should be addressed to

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which gives 4 deaths per year per 10^6 persons per 10 mSv, which is rather less than the upper limit determined from the epidemiological data.

Excess mortality risk due to radiation will not necessarily remain constant with time after exposure. The possible mechanisms and models by which radiation may either initiate cancer or act as a catalyst in the chain of events that lead up to cancer was an important topic of discussion. Attempts to assess excess risk of cancer with a time lag of 15 years after irradiation resulted in an estimate of 17 ± 50 deaths per year per 10^6 persons per 10 mSv from the Sellafield data, although it was pointed out that the analysis would automatically include the deaths of persons taken off radiation work for health reasons which introduces a bias.

A significant excess mortality due to prostatic cancer was found in UKAEA employees with more than 50 mSv accumulated dose, but it was also noted that some of the persons concerned had been monitored for tritium and other radionuclide contamination at some time during their employment. No statistically significant excess of specific cancers was found at Sellafield.

Assessments of mortality among US nuclear industry workers were also reported, where there have been more than 600 000 persons employed dating back to the Manhattan project. Seven individual plants have been studied to date, where in all cases cancer mortality was found to be less than, or similar to, that expected among comparison populations, although unexplained increases in mortality from different cancers have been found at different sites. A paper analysing data from the Rocky Flats plutonium production facility showed no deaths due to bone cancer but an unexplained excess of brain tumours. Detailed analysis of mortality of workers from the Hanford Plant shows a negative correlation of all cancer deaths and specifically of deaths from leukaemia with level of irradiation although the upper statistical limit is again many times the ICRP risk estimate.

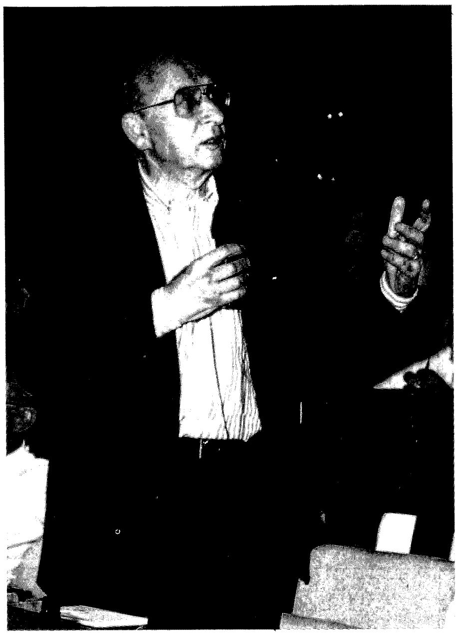
A number of studies of cancer mortality in the populations living near to nuclear sites were reported. Uneasiness had been provoked by a U.K. television programme reporting high childhood leukaemia incidence around Sellafield, which resulted in a governmental investigation followed by an official report. The mass of epidemiological data that has been assessed in case/control studies near nuclear installations has indeed shown a clustering of leukaemia but this does not appear to correlate with the proximity of the nuclear centres.

Another possible radiation-induced health effect of importance is the exposure of populations to the radioactivity from natural radon gas. A particularly interesting study was based on the fact that the average radon levels in Denmark are less than half of those in Sweden which might be expected to result in a significant difference in lung cancer incidence. Epidemiology studies show that lung cancer mortality is in fact twice as high in Denmark than in Sweden and that death from lung cancer follows the same pattern as death from other respiratory diseases independent of radon level.

The results of all the studies presented have in common the aspect that radiation effects appear insignificant compared to variations in cancer mortality due to other causes. Studies will need to be continued and results pooled to reduce the statistical uncertainty and to make sure that any possible long-term effects are fully investigated.

Even though the upper limit of risk estimates determined from the epidemiological studies is several times those presently accepted, the evidence points towards the possibility that low-level radiation may be harmless to health or even slightly beneficial. Whatever the exact conclusion, the studies experimentally confirm that radiation risks — at presently accepted exposure levels — are very low indeed and any deleterious health effects will be masked by non-specified confounding factors. Undue concern with radiation may therefore be having a negative effect on health by tying up limited resources that could be much more beneficially used to investigate the factors that are masking radiation carcinogenesis.

By A.H. Sullivan,
CERN Radiation Protection Group



Val Telegdi – 'worth spending forty years in physics to have friends like these.'

Festi-val

'It was worth spending forty years in physics to have friends like these,' confessed Val Telegdi at the end of the special meeting organized at CERN in July to mark his 65th birthday.

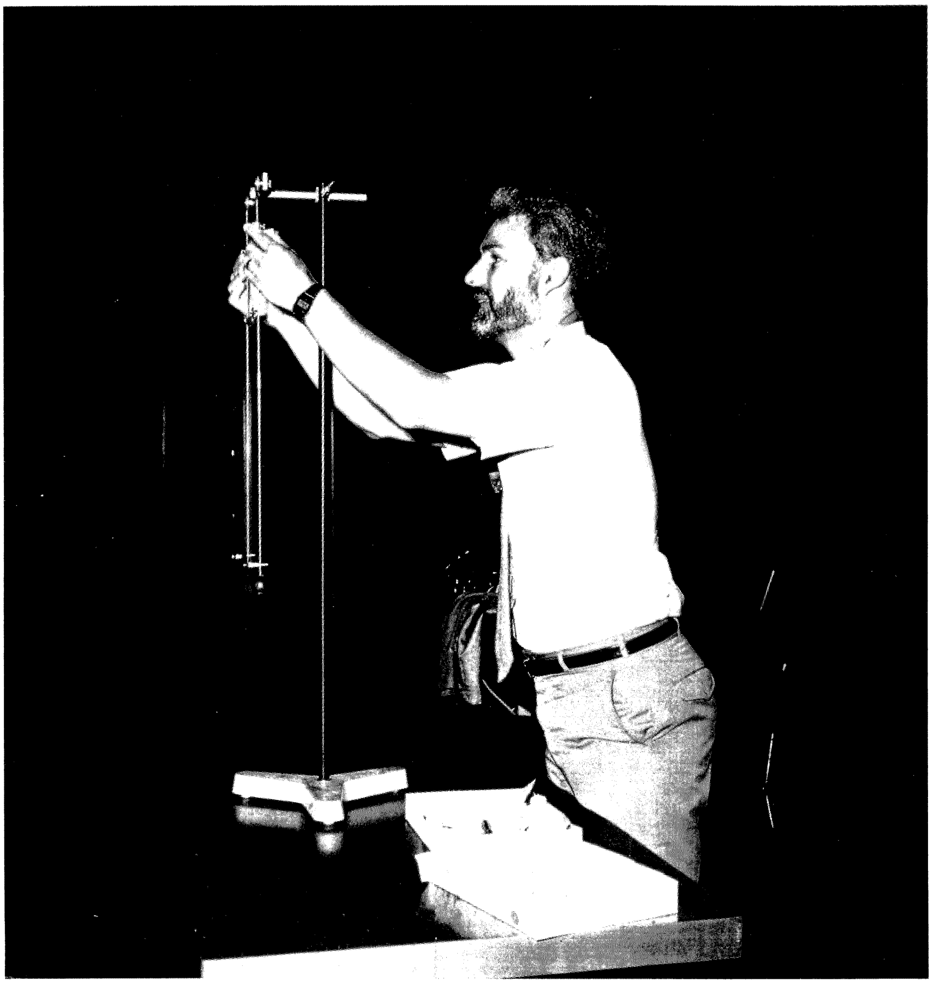
Master of Ceremonies Viktor Weisskopf had set the scene by recalling both Einstein's and Telegdi's youthful association with Patent Offices and by running through a formidable list of Telegdi attributes, including scientific integrity, experimental prowess, polyglotism and a gift for imitating people.

Bruce Winstein of Chicago spoke on the violation of CP symmetry, an area where Telegdi has made significant contributions to physics, and displayed some of the subtle behaviour of the offending neutral kaons using an analog system of two coupled oscillating pendulums.

Oscillations of another kind were provided by Louis Michel of the French Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, who alternated rapidly between French and English. His theme was the increasing importance of mathematical structures in theoretical physics, a message spelled out by Dirac in the early thirties and which has continued to the present day.

Murray Gell-Mann claimed some responsibility for luring Telegdi away from nuclear physics and turning his attention towards the physics potential of particles like muons. In his subsequent talk, Gell-Mann looked at the possible role of quantum mechanics in the formation of the Universe, heady stuff which leads to some very far-reaching conclusions (see July/August issue, page 22).

A star-studded Festschrift for Val Telegdi, edited by Klaus Winter, is available from Ms. C. Schilpp at North-Holland Physics Publishing, PO Box 103, 1000 AC Amsterdam.



Bruce Winstein of Chicago prepares his coupled pendulum analog of neutral kaon oscillations.

(Photo CERN 70.7.87)

People and things

On people

A. Minten of CERN becomes Chairman of the DESY Scientific Committee for three years, succeeding J. Drees of Wuppertal.

Alessandro Ruggiero has joined the staff of the Accelerator Development Department at Brookhaven National Laboratory as Head of the Accelerator Physics Division. The Division will be heavily involved in the design of new accelerators and colliders. At present, Brookhaven has the AGS Booster under construction and is gearing up for construction of the Relativistic Heavy Ion Collider (RHIC), which is anticipated to begin in Fiscal Year 1989. In addition, the Accelerator Physics Division will contribute to the upgrade of the AGS, which is required by the time the Booster comes on line.

Alessandro Ruggiero

Tributes from all over West Germany and from further afield flowed in this summer to mark the 75th birthday of Carl-Friedrich von Weizsäcker, distinguished theoretical physicist and social scientist, and brother of Federal German President Richard von Weizsäcker. After initial important contributions to physics, Carl-Friedrich von Weizsäcker became Departmental Director of the Max Planck Institute for Physics in Göttingen from 1946-57. After being Professor of Philosophy at Hamburg from 1957-69, he went on to the directorship of the Max Planck Institute for social science in Starnberg. With research interests extending from basic physics (fusion, particle production) to philosphy, and with his strong motivation for peace and disarmament, he has long been an influential figure in German scientific and cultural circles.

Leon Lederman, Director of Fermilab, discoverer of the upsilon, and orator extraordinary, celebrated his 65th birthday on 15 July. Introduced at a recent meeting as an ancient physicist, he replied 'I am so ancient I knew the Dead Sea when it was only sick!'. A longtime admirer of his style, the CERN COURIER adds its congratulations to one of the world's youngest ancients, and looks forward eagerly to the publication of his famous joke book.

Leon Lederman - looking back to when the Dead Sea was only sick?

Two eminent figures from the glorious years of bubble chamber physics pass retirement milestones at CERN this year.

Before coming to CERN in 1961 and being given the responsibility of looking after CERN bubble chamber groups, Rafael Armenteros had already made important contributions to strange particle physics using cosmic rays and had participated in the pioneering study of antiprotons at Berkeley. At CERN, his low energy antiproton work provided a rich harvest of important results. Later he initiated the classic investigation of the kaon-nucleon system by the CERN/Heidelberg / Saclay collaboration, which went on to provide valuable insights into particle classification. His lifelong interest in antiprotons continues with the ASTERIX experiment at CERN's LEAR ring.

Yves Goldschmidt-Clermont saw early progress with pion physics before becoming one of the first physicists at CERN, joining in 1953, before the Meyrin site was

operational. Together with the late Lew Kowarski, he founded what was eventually to become the present EF division. He oversaw construction of the first track measuring machines at CERN before going on to bubble chamber experiments both at CERN and at Serpukhov studying antiprotons and kaons. He switched to counter physics with the Omega spectrometer, where recently he has been spokesman of the Athens / Bombay / CERN group investigating soft photon production using Omega.

Both physicists are well known for their kindness to younger colleagues, who acknowledge the debt they owe them.

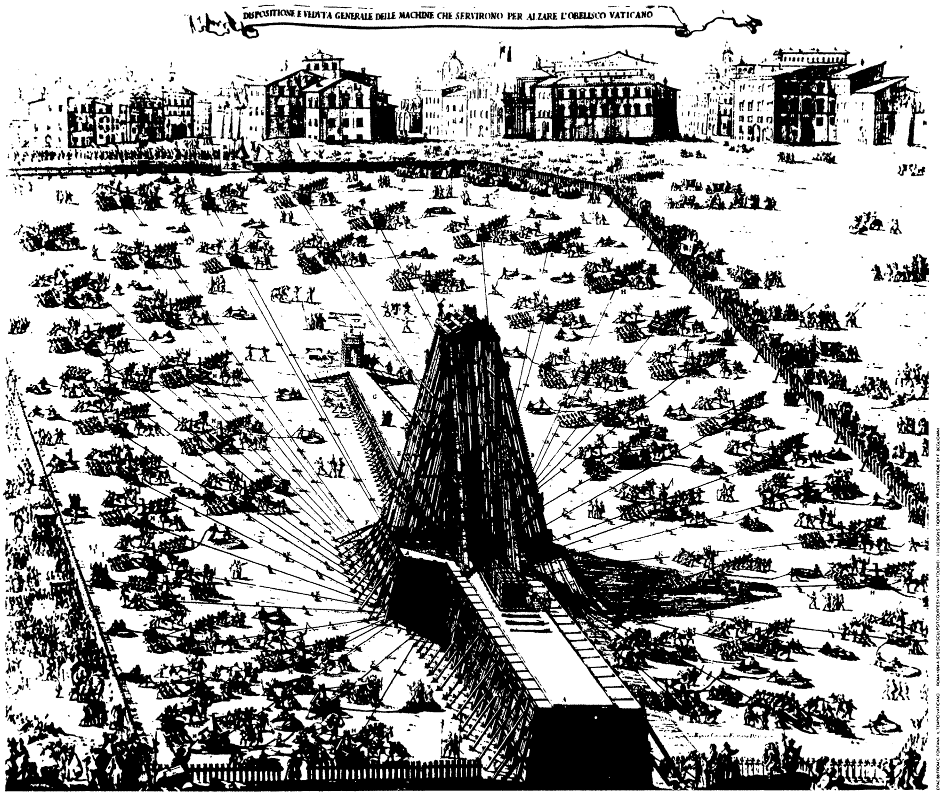
Barton up the wrong tree

In our report of the Washington Particle Accelerator Conference (May issue, page 15) we inadvertently mixed up our Brookhaven Bartons. It was Don, not Mark, Barton who reported on the Relativistic Heavy Ion Collider (RHIC) project.

Meetings

The International Conference on Neutron Scattering (ICNS'88), a satellite of the Paris International Conference on Magnetism (ICM'88), will be held from 12-15 July in Grenoble, France, organized jointly by the Centre d'Etudes Nucléaires and the Institut Laue-Langevin, both at Grenoble. Further information from J. Schweizer, ICNS'88, Centre d'Etudes Nucléaires, DRF/SPh-MDN, 85 X, 38041 Grenoble Cedex, France.

This etching showing the combined effort necessary for the erection of the obelisk in St. Peters Square in Rome has been taken as the theme for the first European Particle Accelerator Conference to be held in Rome from 7-11 June 1988. The Conference will cover the whole field, low and high energy machines, and medical and industrial accelerators, and is open to world-wide participation. Students are particularly encouraged. Further information is available from S. Tazzari at INFN-LNF Frascati, PO Box 13, I-00044 Frascati, Rome, Italy.

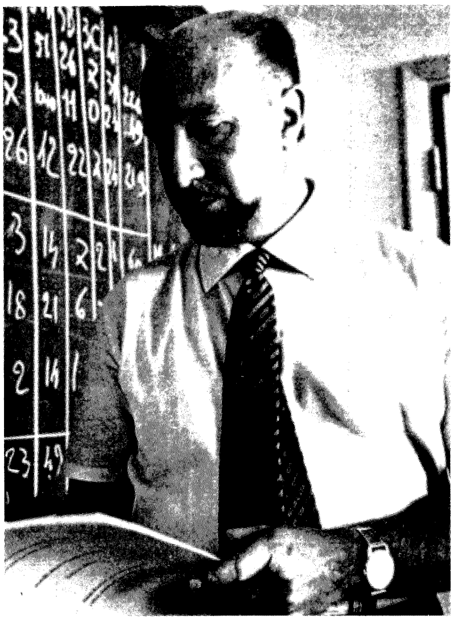


The International Conference on Mathematical Modelling in Science and Technology will be held at the Indian Institute of Technology, Madras, from 11-14 August 1988. Applications covered will include engineering, theoretical physics, biomedicine, industry, energy, economics, etc. Further information from S.N. Majhi, ICMMST (88), Department of Mathematics, Madras 600 036, India.

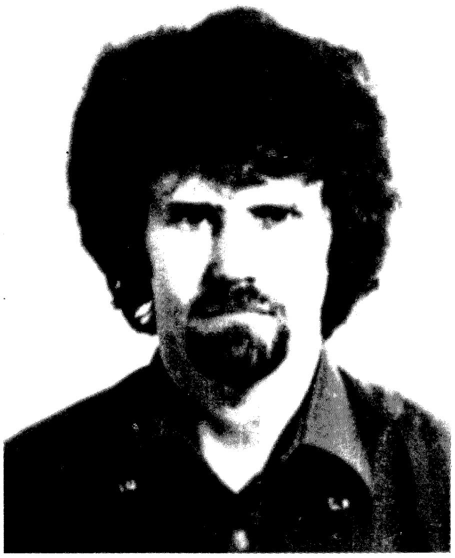
A workshop on high sensitivity 'beauty' physics is being organized at Fermilab from 11-14 November. The objectives are to study the potential of the collider and/or fixed target environments at Fermilab, and to look at the problems of detector design. The chairperson of the organizing committee is Jean Slaughter of Yale, c/o Fermilab.

The 9th Workshop on Grand Unification (WOGU) will be held in Aix-les-Bains (France) from 28-30 April 1988. It is organized jointly by the Département de Physique des Particules Elémentaires (DPhPE) of the Institute of Fundamental Research (IRF) of the French Atomic Energy Commission, and the Institute for Nuclear and Particle Physics (IN2P3) of the Centre National de la Recherche Scientifique (CNRS). Further information from the Chairman (R. Barloutaud, tel. 69 08 45 59) or the Secretariat (J. Boratav, tel. 69 08 23 50) at DPhPE/SEPh, CEN-Saclay, 91191 Gif-sur-Yvette Cedex, France.

Torsten Gustafson (here opening the CERN exhibition at Lund, Sweden, in 1985).



Italo Federico Quercia 1921-1987



Yuri Petrovykh 1947-1987

Torsten Gustafson 1904-1987

The eminent Swedish theorist Torsten Gustafson died in May at the age of 83. After early researches into airfoils and ocean currents, he turned in the 1930s to the emerging theory of quantum electrodynamics, and later to nuclei. A close friend of Niels Bohr, and long-time Swedish Prime Minister Tage Erlander, he played a prominent role in the development of nuclear and particle physics and the exploitation of nuclear energy in Sweden. He was attached to the University of Lund, becoming Professor in 1939. A member of CERN Council from 1953 to 1964, his signature appears on behalf of the Swedish Government on the Convention establishing CERN. He was on the board of Noridita in Copenhagen from 1957 to 1970, including a spell as chairman. He also had a lifelong interest in birds, having published papers on bird flight.

Italo Federico Quercia 1921-1987

Distinguished Italian Physicist Italo Federico Quercia died in June. After making his mark in cosmic ray physics using the most advanced gas detectors of the time, he courageously turned his attention to the realization of a 1100 MeV electron synchrotron and the foundation of the Frascati National Laboratories, despite the difficulties of those times. The outcome was of great benefit to his country. He was Frascati's Director for two periods, during the construction of the pioneer AdA electron-positron collider, and later when the ADONE ring began its research programme. For more than thirty years he was a major source of inspiration, urging those who worked with him to think along unconventional lines, and motivating people with his relaxed manner and incomparable humour. For ten years he kept the chair of Nuclear Physics in Catania, and recently was Professor of Energy Studies at Rome.

From Giorgio Salvini

Yuri Petrovykh 1947-1987

Yuri Petrovykh, Soviet physicist from the Institute for High Energy Physics, Serpukhov, succumbed to a mortal illness in Moscow on 7 July. After bubble chamber experiments at Serpukhov and CERN, he joined the preparations for the DELPHI experiment. In addition, he took administrative responsibility for the Serpukhov physicists working at CERN and acted as linkman for the CERN-USSR collaboration, strengthening the scientific ties which transcend political frontiers.

Jim Allaby and Lucien Montanet write: 'During his long period of active international collaboration, Yuri showed his excellent qualities both as a physicist and as a man. He had been resident in Geneva with his family for two years and indeed only returned to his home country a few days before his death. Those who saw his valiant struggle against his illness were moved by his strength of character and determination. The physicists of both CERN and Serpukhov have lost a valuable colleague and a good friend.'

Pierre Amiot

One of CERN's early employees, Pierre Amiot, died in Osaka on 4 May at the age of 61. He was one of the principal craftsmen involved in the building of CERN's first bubble chambers in the late fifties.

Supercollider detector technology

A Generic Detector Research and Development Coordinating Office for the proposed US Superconducting Supercollider (SSC) has been set up to focus the national effort. With M. Gilchriese of Cornell as interim coordinator, the office will concentrate on overall technology issues relevant to SSC experiments (rather than specific SSC experiments).

In addition, an International Advisory Committee has been appointed under the chairmanship of H. H. Williams of Pennsylvania with members from Europe and Japan as well as the US. It met for the first time earlier this year and considered two dozen proposals for generic detector R and D for the SSC and discussed the appropriate scope and funding level for this work in the coming financial year. More SSC news next month.

Looking for a fifth force

Suggestions that there might be a difference between the strength of gravity measured in geophysical studies and in laboratory experiments have fired speculation about a possible fifth force in nature (see April 1986 issue, page 9). New information should come from a US team lowering a gravity meter into a 6700 foot borehole in the Greenland icecap. Other studies have tested gravity in mine shafts, where the results are dependent on the density of the surrounding rock. The density of ice is better known.

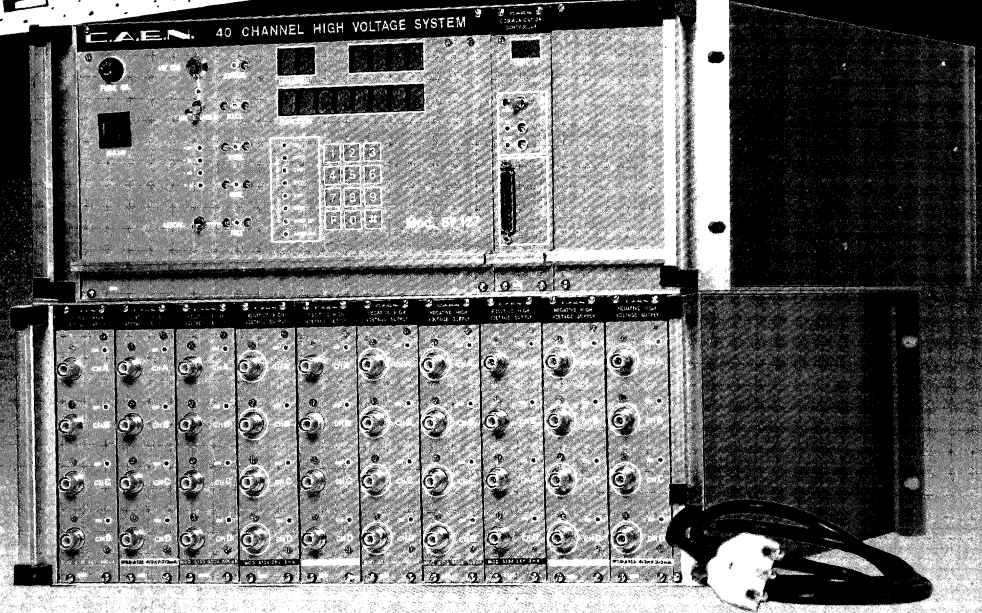
Dictionary

Somè 4500 entries are included in a new Dictionary of High Energy Physics, edited by Ralf Sube and published by Elsevier, (PO Box 330, 1000 AH Amsterdam, or PO Box 1663, Grand Central Station, New York 10163). The master listing gives German, French and Russian equivalents of English terms, while indexes for the other three languages greatly extend the book's usefulness.

Electronic Mail

The CERN Courier editorial desk can be contacted through electronic mail using the EARN/BITNET communications network. The Editor's address is

COURIER@CERNVM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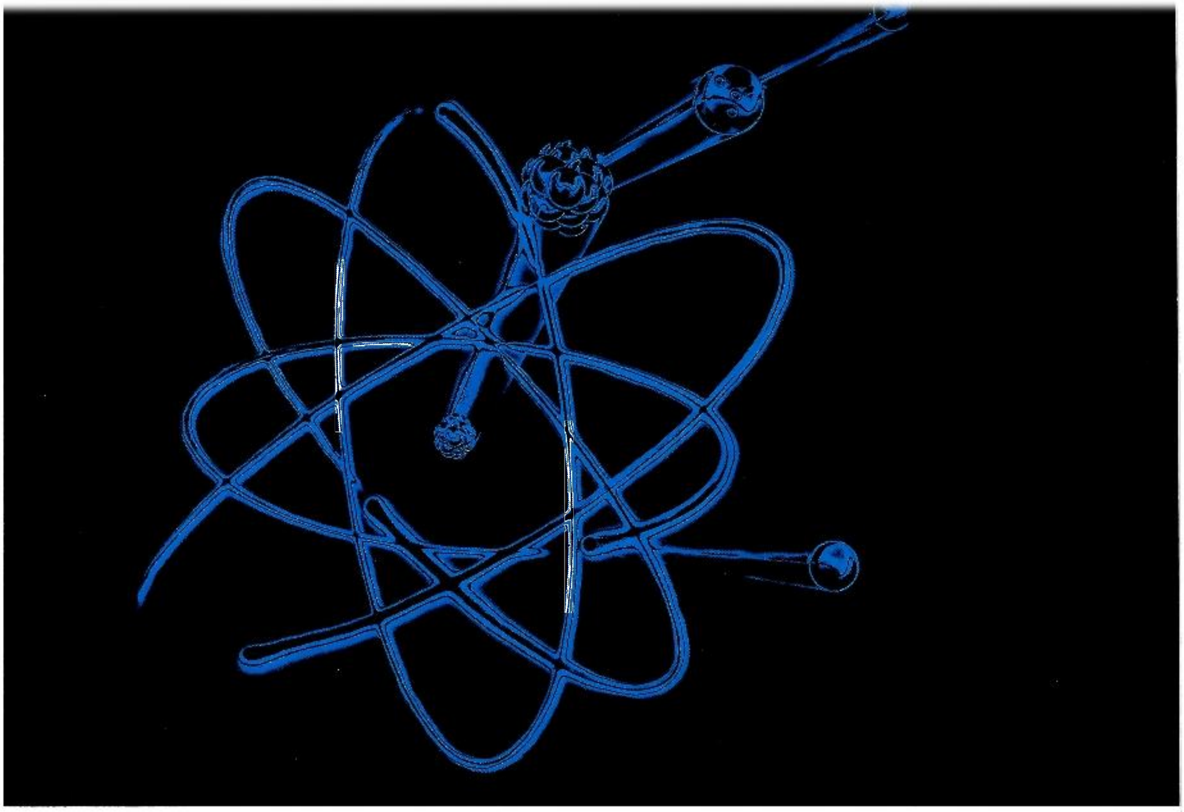

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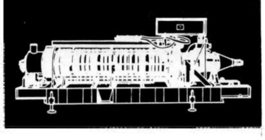

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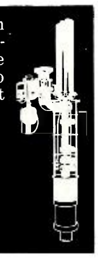

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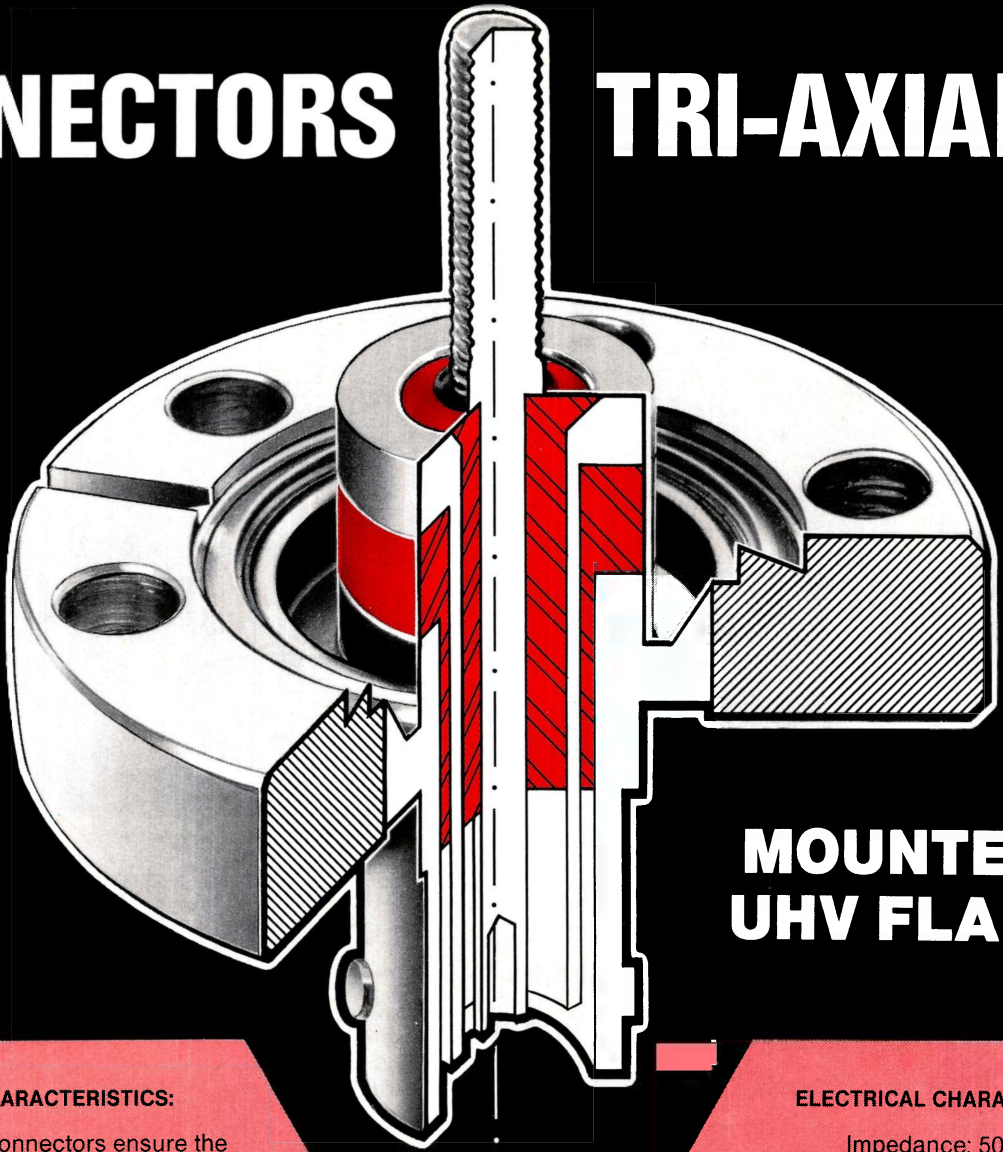

Germany at CERN

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D-2398 Harrislee
Telephone: (04 61) 75 202/72 494
Teletex: (26 27) 46 13 09 = Kristen

Contact persons at the stand:
Jørgen L. Kristensen, Kay Peters

Contact person in the enterprise:
Jørgen L. Kristensen

Production line:
CAMAC – Crates (acc. to CERN-Spec.)
– Power Supplies, Linear and Switch Mode
– Dataways and Fan Units

FAST-BUS – Crates (acc. to CERN-Spec.)
– Power Supplies, Switch Mode
– Backplanes and Fan Units

VME Crates – Power Supplies, Custom Design
– Backplanes and Fan Units

Electronic modules and equipment on request
Measuring and control systems. Sensors for temperature, pressure, Dew Point, CO_2. Printed circuit boards

Products exhibited:
CAMAC-Crate with Switch Power Supply, Dataway and Fan Unit
FAST-BUS-Crate with Switch Power Supply, Backplane and Fan Unit
VME-Crate with Custom Design Power Supply, Backplane and Fan Unit

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WIENER

Hans Wiener GmbH + Co.
Müllersbaum, 18, Postf. 2220
D-5093 Burscheid 2 (Hilgen)
Telephone: (0 21 74) 20 34-36
Telex: 8 51 55 23 wiel d

Contact person at the stand and in the enterprise:
Bernhard Boden

General representative (CH)
Elcotron SA
1, Rue de la Morache
1260 Nyon
Telephone: (022) 61 53 52
Telex: 421 565

Production line:
– NIM-crates and CAMAC-crates
– CAMAC-crates, switching power supplies
– Europa type, switching power supplies
– VME type, Multibus II-type switching power supplies
– custom designed power supplies

Products exhibited:
– NIM-crate CERN-type N 8053
– CAMAC-crates CERN-type 099. CERN-type 337
– switching power supplies (Europa type, Multibus II, custom designed)
– FAST Bus-crate, CERN type F 6852
– FAST Bus-crates, switching power supplies

Organization of the exhibition: Dipl. Kfm. Wilh. H. Esser, Schubertstr. 9, D-7515 Linkenheim-Hochstetten