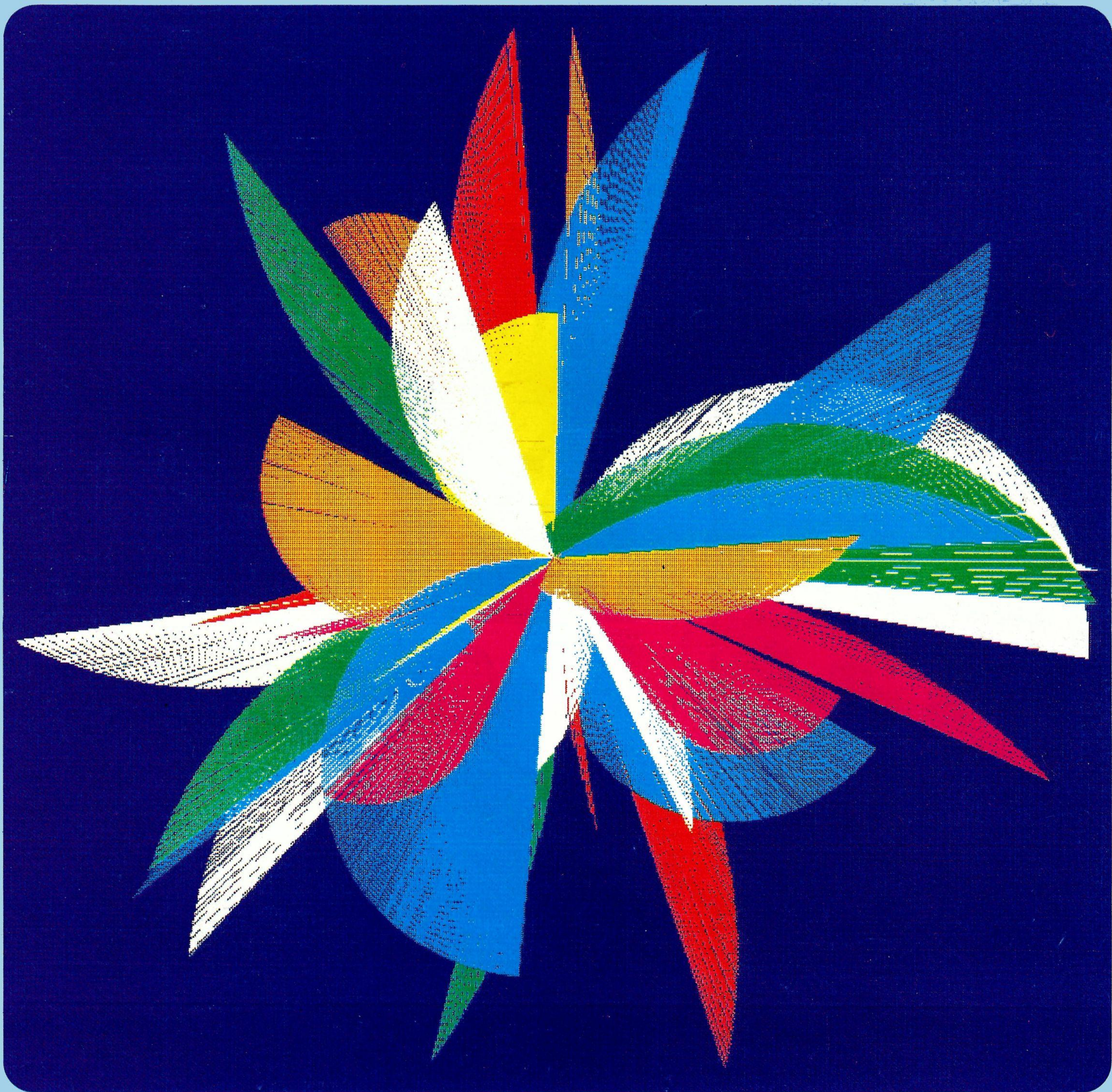
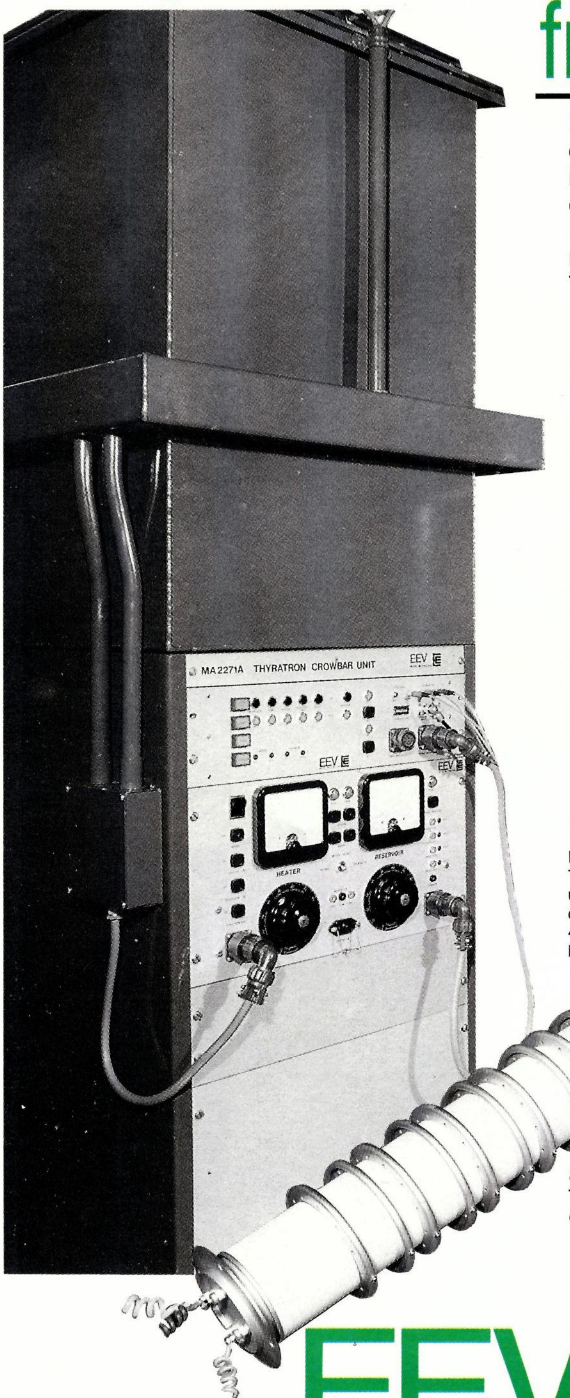
CERN COURIER

International Journal of High Energy Physics



VOLUME 31 10 DECEMBER 1991

New High Voltage 160kV Thyratron Crowbar Protection Unit from EEV.



8 GAP
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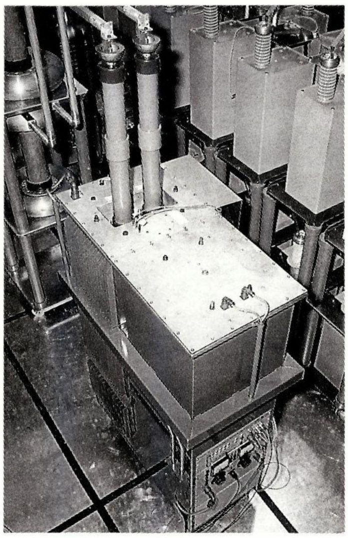

EEV's TEST FACILITY
The thyratron crowbar unit being tested on EEV's 200kV $4\mu F$ capacitor bank.

- 100% reliability of firing – the system is fail safe.
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- Large dynamic range – the system operates from 10% to 100% of the rated voltage.
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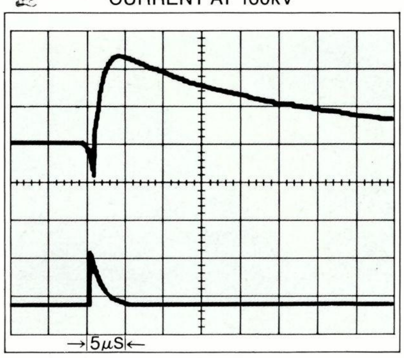
- Very low prefire rates – current operating experience is less than one prefire per week.
- Compactness – the system is fully enclosed in an oil filled tank.
- Cost competitive with systems based on other switch technologies.

FAULT CURRENT AND THYRATRON CURRENT AT 160kV



THYRATRON CURRENT 10kA DIVISION

FAULT CURRENT 10kA DIVISION

EEV Thyratrons

For further information, contact Peter Maggs

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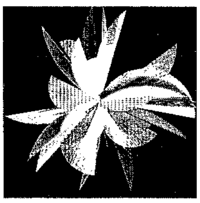

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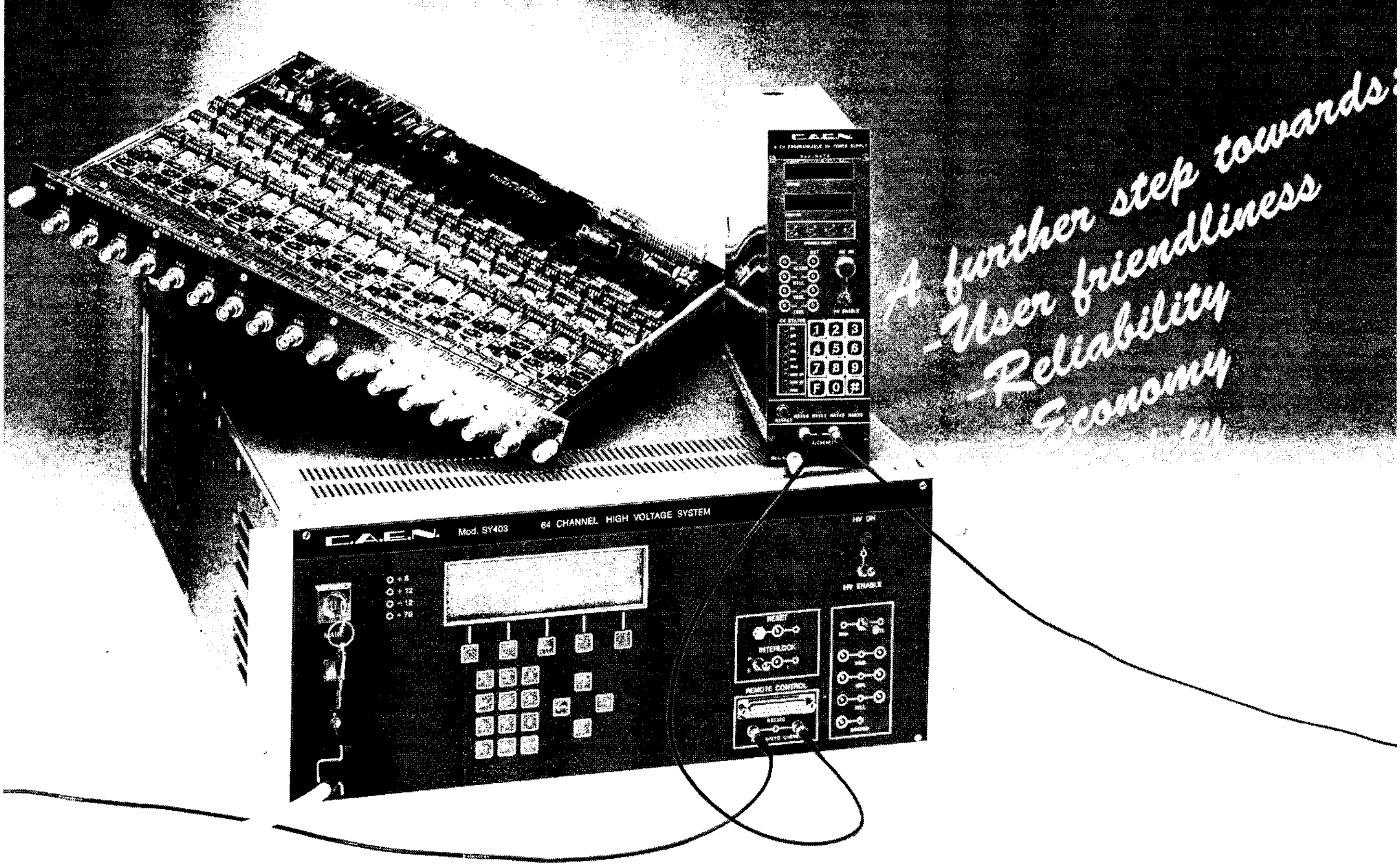

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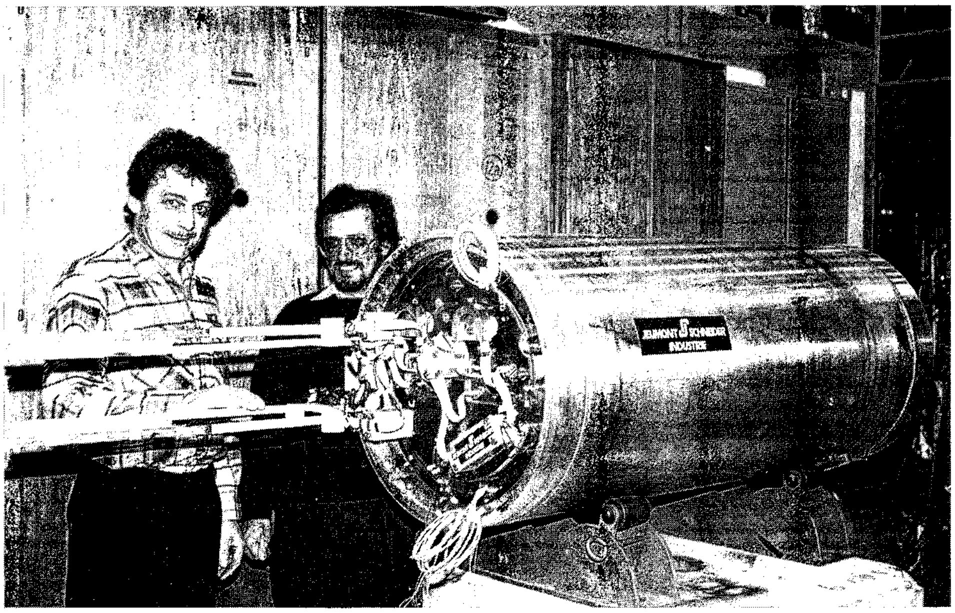
Around the Laboratories

This 1 metre-long model twin aperture dipole of the type envisaged for CERN's proposed LHC proton collider in the 27 kilometre LEP tunnel has attained more than 10 Tesla – a new world record field for an accelerator magnet.

(Photo CERN 97.2.91)



CERN
Ten-Tesla twin

An important step in the development of the high field superconducting magnets for CERN's proposed LHC proton collider came on 21 October when a 1 metre-long model of the proposed twin-dipole magnet produced a field of 10 Tesla in its two beam apertures at the design temperature of 1.8K.

The LHC designers have to plan for proton beams approaching 8 TeV to attain the right conditions for the quarks and gluons hidden deep inside protons to produce new physics. To contain these very high energy protons in the tight track of the 27-kilometre LEP tunnel would need the strongest magnetic bending power ever used in a full storage ring.

To save LHC space and cost, the separate magnetic channels for the twin proton beams were proposed for the same iron yoke, mounted in a single cryostat. Achieving 10 Tesla with this special design was a real challenge to the magnet designers, but the new results show that it can be met.

The peak field seen by the superconductor was 10.2 T – a new world record for accelerator magnets – with current at the short sample limit of the cable (the critical current beyond which the magnet ceases to be superconducting).

The magnet was designed and tested at CERN by the LHC magnet development team led by R. Perin and D. Leroy, and manufactured by Jeumont-Schneider in France using niobium-titanium superconducting cables supplied by Alsthom-Intermagnetics.

Last year orders were placed for ten full-size (10 metre-long) LHC dipoles from four suppliers – Ansaldo (Italy), Noell (Germany), a consortium of Elin (Austria) and Holec (Netherlands), and a French consortium formed by GEC Alsthom and Jeumont-Schneider. Some of these dipoles will be delivered next year for tests of an LHC half-cell.

In parallel, other types of magnet continue to be investigated, with future work using models built at CERN as well as those supplied by industry.

Preparing for LHC experiments

While design and development work for CERN's proposed LHC proton collider pushes ahead, physicists from CERN Member States and further afield are actively preparing for experiments at the new machine.

However rather than rushing headlong into major projects, the idea is to profit from ongoing experience and new developments for as long as possible, and avoid prematurely 'freezing' any proposed detector design.

Thus at CERN, some 20 different development projects are underway in a broad programme supervised by the Detector Research and Development Committee specifically established last year to monitor this work. Between them, these projects span the whole spectrum of detector technology, and more are in the pipeline.

In parallel, a detector magnet study group coordinates possible schemes for the enormous magnets such experiments would need. Other groups look at the important general questions of computer-aided detector design and of microelectronics, while an Experimental Requirements Committee covers the interface between the experiments and the machine.

Thinking for LHC experiments has been focused by a series of user meetings. The latest, at CERN in October, was a lead-up to the major meeting to be held in Evian-les-Bains in nearby France from 5-8 March 1992, where 'expressions of interest' to work at LHC will be

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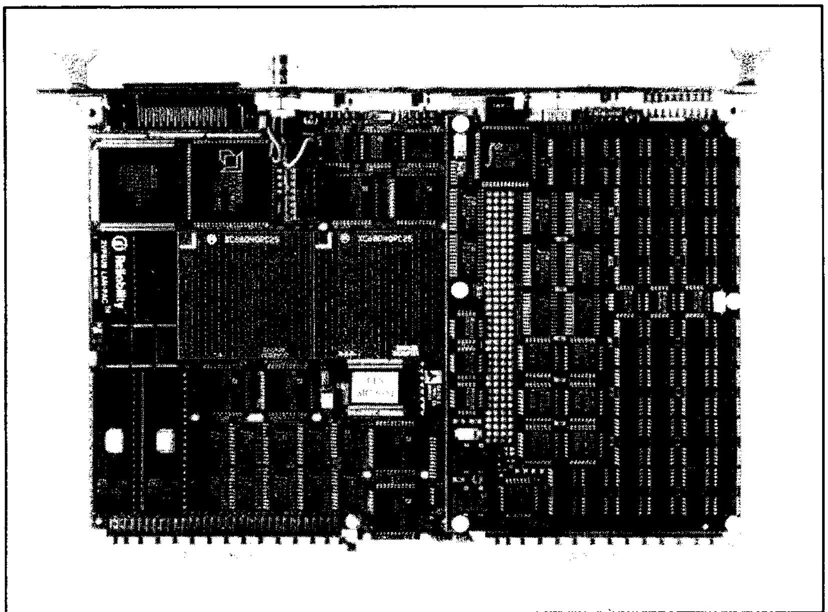

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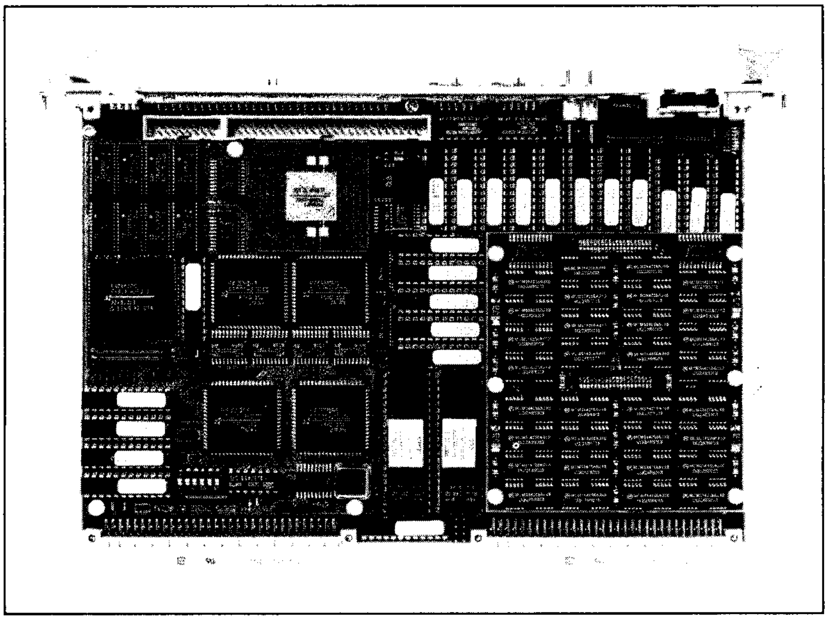

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publicly discussed, setting the stage for the subsequent Letters of Intent, and generally getting the experimental programme rolling.

This year, the traditional December meeting of Council, the Organization's 'Government', is being extended for a special LHC presentation to prepare the way for formal approval of the project at a later date. A special session on 19 December, with extended delegations from CERN Member and Observer States, as well as from other interested nations, will cover LHC's scientific objectives as well as its required technology, cost and timescale, providing a valuable forum for an early exchange of top-level views.

Evian meeting

To prepare the way for the experimental programme at CERN's proposed LHC proton collider, a General Meeting on LHC Physics and Detectors will be held from 5-8 March 1992 in Evian-les-Bains, France, organized jointly by CERN and ECFA (European Committee for Future Accelerators).

The meeting is open to all physicists interested in the LHC physics programme, and will provide a forum for 'Expressions of Interest', stimulate a broad and in-depth discussion of detector concepts, and set the stage for subsequent 'Letters of Intent'.

The success of the meeting depends on a broad participation. To register, please contact LHC92 at CERNVM.CERN.CH as soon as possible.

Getting ready for the new ISOLDE

A new generation of CERN experiments using isotope beams is being prepared. Such experiments began at CERN in 1967, when the ISOLDE on-line isotope separator came on-line at the 600 MeV Synchrocyclotron (SC). When the SC was phased out last year (December 1990, page 8), a programme was already well in hand for a new ISOLDE experimental area, served by beams from the 1 GeV Booster. This machine, although a vital link in CERN's accelerator complex, has never had its own programme of experiments.

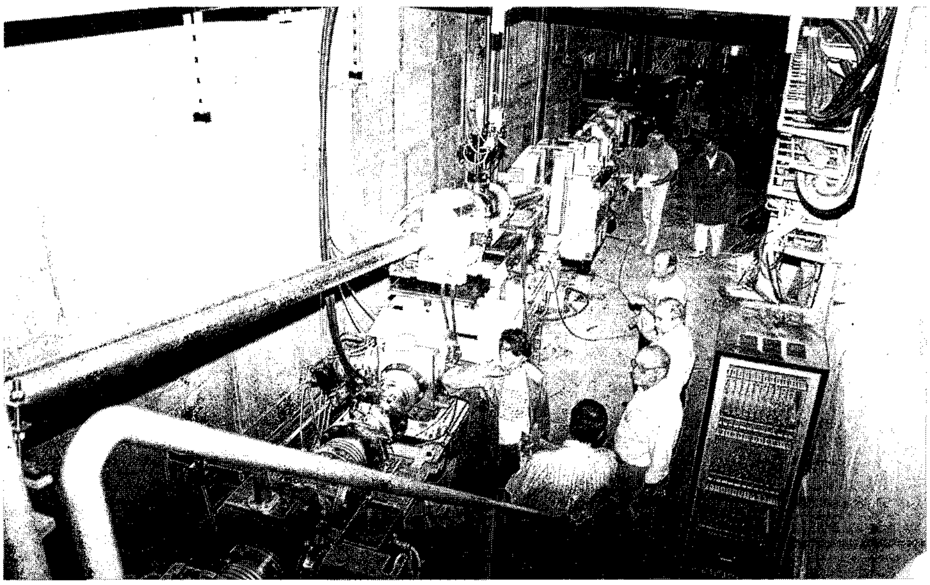
With first Booster protons for the new ISOLDE expected next March, the first series of new ISOLDE experiments has now been approved. The research objectives of this ongoing programme were hammered out at a meeting in Leysin in the Swiss Alps earlier this year.

Five main areas are covered – nuclear ground-state properties, nuclear spectroscopy, astrophysics and fundamental principles, exotic decays, and solid-state physics. Spanning these areas and continuing the ISOLDE scientific tradition are the first six approved experiments:

- measurement of nuclear moments and radii by collinear fast-beam laser spectroscopy;
- investigation of particle-core vibration coupling near the doubly closed tin-132 nucleus using precise magnetic moment measurements with a high resolution ('NICOLE') separator;
- studying the polarization and magnetic moments of mirror nuclei using the 'tilted-foil' technique to induce in-beam polarization;
- a search for axions and massive neutrinos, a highly topical area following recent reports of 17 keV neutrinos (April, page 9);

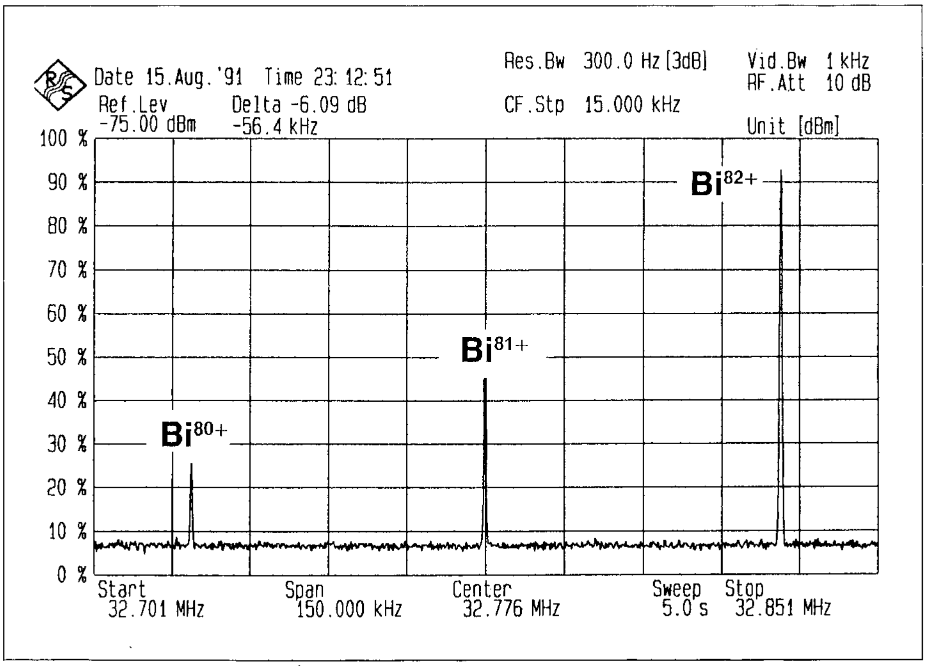
The beamline from CERN's 1 GeV Booster synchrotron has to climb several metres to serve the new ISOLDE on-line isotope separator.

(Photo CERN AC 47.9.91)

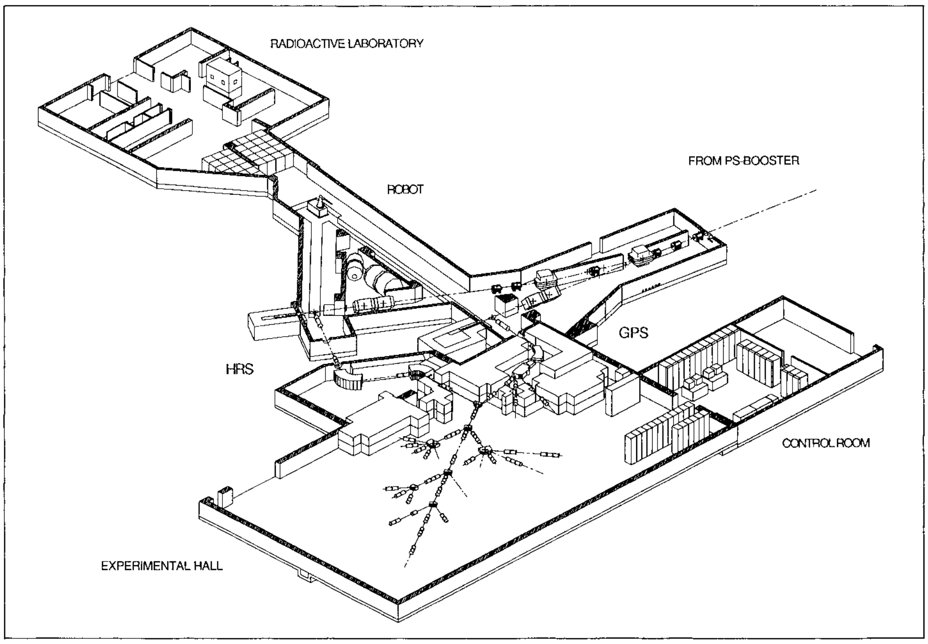


– fabrication of implanted sodium-22 targets for experiments of vital interest to cosmochemists, gamma-ray astronomers and astrophysicists;
high accuracy mass measurements using a Penning trap mass spectrometer.

Other experiment proposals are still in the pipeline, while another card up the new ISOLDE's sleeve will be the acceleration of exotic nuclear beams, a topic of increasing interest.



▲ *Different ion charge states stored simultaneously in the ESR ring at the GSI Darmstadt heavy ion Laboratory. Right, the coasting bismuth-82 beam, with the 81 and 80 charge states produced by capture of electrons in the beam cooling process.*



▼ *Layout of beamlines at CERN's new ISOLDE on-line isotope separator, to be fed by protons from the 1 GeV Booster. First beams are expected next year.*

DARMSTADT
Heavy ion progress

Since its inauguration in March 1990, the SIS/ESR complex at the GSI Darmstadt heavy ion Laboratory has made considerable progress. In the SIS synchrotron for example, beams of neon, argon, krypton, xenon, gold, bismuth and uranium ions have been accelerated up to 2 GeV per nucleon.

Usually the SIS has been operated in a time-shared mode with high energy (1-2 GeV per nucleon) ion beams with slow resonance extraction for target experiments being handled at the same time as acceleration to a few hundred MeV per nucleon with fast extraction to feed the ESR storage ring. These modes could be combined on a pulse-to-pulse basis, so that with ESR filling usually needing only about a hundred pulses every hour, most of the SIS capacity was available for target station experiments.

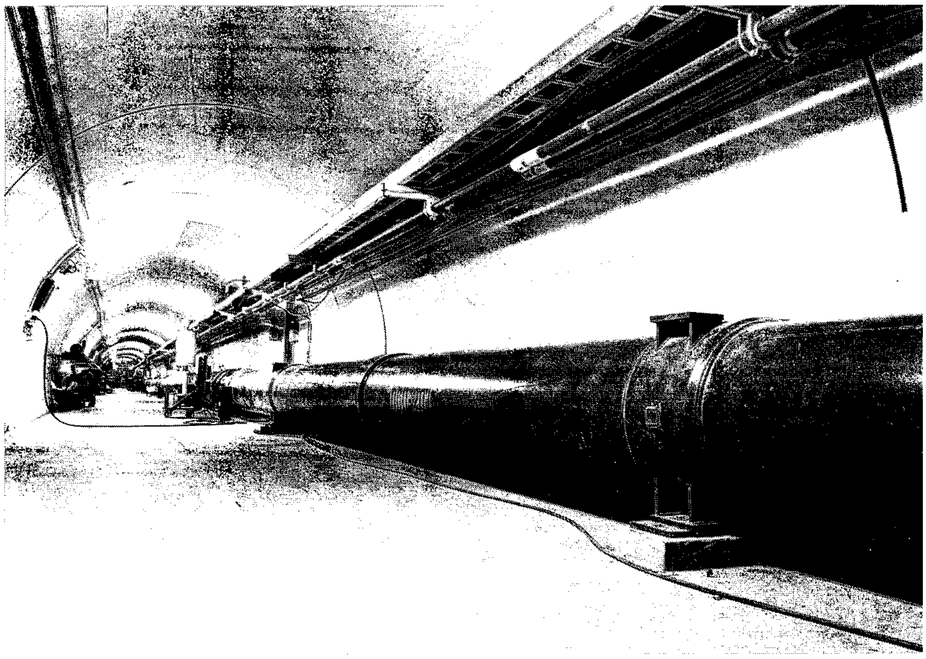
Intensities after slow extraction range from $3x10^6$ ions per spill for heavy ions, and up to $5x10^9$ for neon. These levels are mainly limited by the currents available from the Unilac injector linac, between 2 microamps for bismuth-67 and 500 microamps for neon-10. Although many target experiments used quite long spills (up to four seconds), intensity fluctuations were below ten per cent. Typical beam diameters at the target stations were 5mm.

Commissioning of the ESR storage ring began in March 1990. So far, the following ion beams have been accumulated and cooled at energies between 90 and 250 MeV per nucleon – 10^9 neon-10, $5x10^8$ argon-18, $8x10^7$ krypton-36, and recently $4x10^6$ bismuth-82. The ion content will be boosted in the near future with higher injection currents from the Unilac and improved transmission between the different accelerators.

The electron cooling of heavy ion beams works very well, with beam lifetimes between ten hours for neon-10 and 20 minutes for bismuth-82. This performance is mainly limited by radiative capture of cooling electrons (REC), which increases as the square of the ionic charge. In comparison, losses due to interactions with residual gas are negligible. For very small numbers of particles, the momentum spreads were very low – $6x10^{-7}$ for bismuth-82.

Different ion beams can be stored simultaneously in the ESR. For example cooled bismuth-82 can be held at the same time as the lower 81 and 80 charge states produced sequentially by REC in the electron cooler. The resultant measurements open up mass spectrometry of radioactive nuclei in the ESR.

At Fermilab, a string of five superconducting dipoles, each 17 metres long and 40 mm in aperture, has been tested for the Superconducting Supercollider (SSC) to be built in Ellis County, Texas. Next year tests at the SSC site will begin using an improved design with 50 mm aperture.



First results from experiments with cold ESR ion beams include the hyperfine structure spectroscopy of hydrogen-like bismuth-82 ions and the investigation of laser-induced capture of free cooler electrons. With the internal gas jet target now in operation, the first low energy target recoil spectra have been obtained for 150 MeV/nucleon neon-10 beams on hydrogen and nitrogen.

FERMILAB
Testing dipoles for the Supercollider

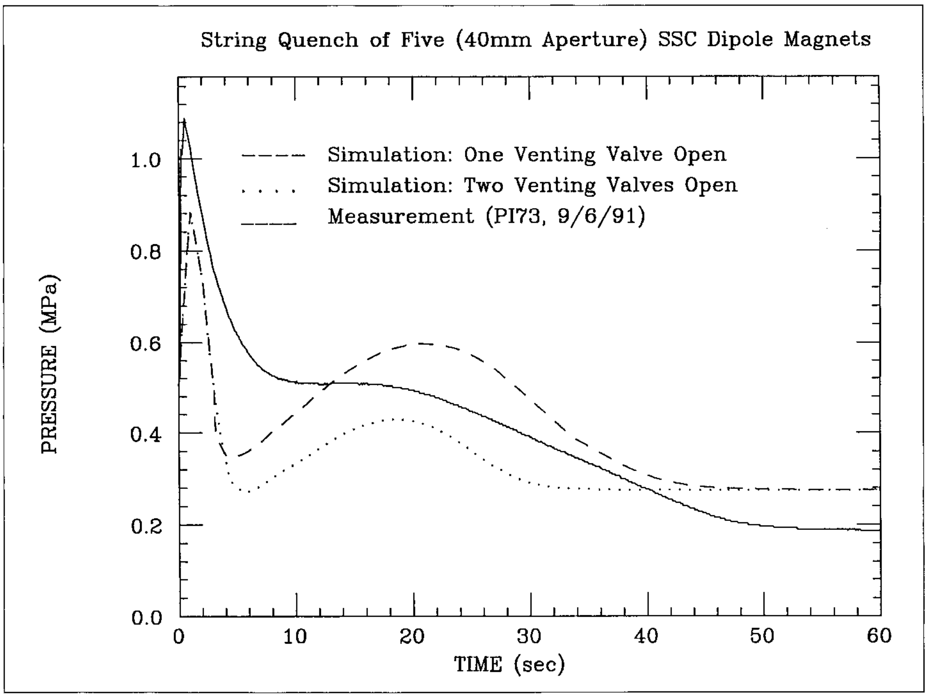
As reported last month (page 13), a string of five superconducting dipole magnets, each 17 metres long, for the Superconducting Supercollider (SSC) in Ellis County, Texas, has been successfully power tested at Fermilab.

The test, using the earlier design of 40-mm aperture magnets, marks an important step forward in for SSC magnet development, demonstrating performance under serial powering conditions anticipated for collider operation. A similar string test is being readied for the coming year on-site at the SSC, where collider magnets with an improved design, including a 50-mm aperture, will be evaluated.

The effort that culminated in the string test at Fermilab was the result of a joint project involving a number of US national laboratories. The 40-mm magnets, each weighing 10 tons, were jointly designed by the Central Design Group at the Lawrence Berkeley Laboratory (LBL), Fermilab and Brookhaven, who also fabricated the five magnet cold masses. Four of these cold masses were cryostatted at Fermilab, and one at Brookhaven.

At Fermilab, accelerator staff and technicians began work on the string test facility in 1986, installing a control station and a satellite refrigerator plant. This was similar to those used for Fermilab's Teva-

The SSC magnets are equipped with circuits on the magnet coils to allow the magnet energy to be distributed safely during magnet quenches. Quenches were induced in the five-magnet string to study the generated pressures, voltages and temperatures. Shown here (full curve) are the results of pressures observed during a 6550 A quench in the centre of the string. The other curves are calculations, showing that the initial peak producing a pressure near 1.1 MPa is due to the expansion of dense helium in the magnet coils as their normal zones form. The later rise is due to the expansion of the dense cold helium gas as heat transfers from the magnet iron yoke and assembly.



tron, the world's first high energy physics cryogenic accelerator.

Work on the installation of the SSC magnets began in 1990. The team was coordinated by Fermilab physicist Al McInturff, while SSC physicist John Weisend acted as his deputy throughout the installation and data tests. Installation and modification of the cryogenic, vacuum, electrical and instrumentation systems, as well as the operation of the cryogenic refrigerator and data collection during the power tests, was a joint Fermilab/SSC effort.

The string test at Fermilab involved modifying and serially connecting the five dipoles cryogenically and electrically, then cooling the magnets to superconducting temperatures between 3.8 and 4.35 K before ramping the current through the string to the required 6600 A level.

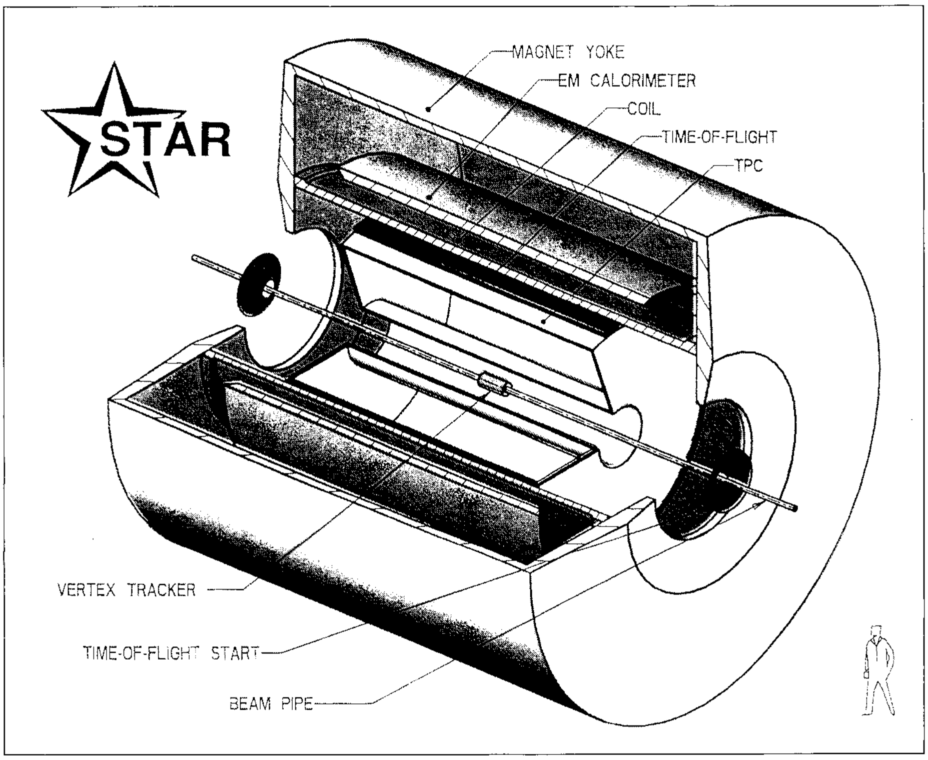
All the systems needed for safe collider operation were also successfully tested. Quenches, induced in the string during the power tests, tested the circuits that protect the magnets, and the behaviour was generally found to be within anticipated or manageable limits.

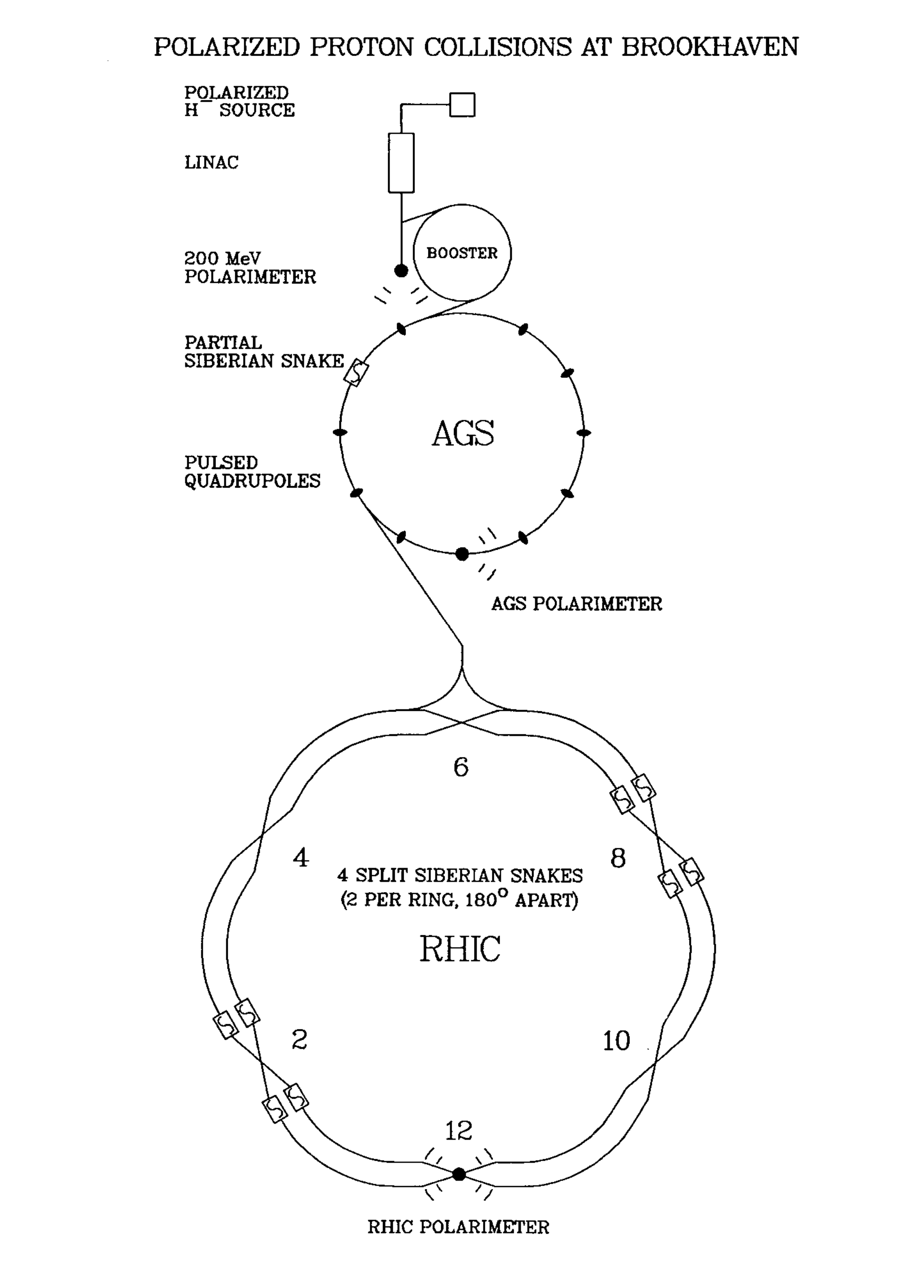
The SSC engineers and technicians who took part in the test are from the group that will install and operate the string test in Texas next year using industrially-produced 50-mm aperture magnets, the first of the 8,600 15-metre magnets to be installed in the 87 kilometre SSC tunnel.

BROOKHAVEN
Spin rotator to boost polarization

The Alternating Gradient Synchrotron (AGS) at Brookhaven holds the world record energy for spin polar-

In line for construction at Brookhaven's new RHIC collider is the STAR experiment based on a time projection chamber (November, page 17).





The spin polarization of proton beams will be preserved up to 25 GeV in the Brookhaven Alternating Gradient Synchrotron with a 'Partial Siberian Snake' and fast pulsed quadrupoles. Two full Siberian Snakes in each of the two RHIC rings will allow collisions of 250 GeV polarized proton beams.

ized proton beams at 22 GeV. However this required a complicated two-week commissioning effort to overcome 39 imperfection depolarizing resonances and six intrinsic depolarizing resonances.

Imperfection depolarizing resonances are caused by magnet misalignment. They were overcome using 94 correction magnets distributed around the accelerator, each resonance being treated separately. Since the tiny misalignments of the magnets also change with time, this tortuous tuning procedure had to be repeated each time the AGS was set up to run with polarized proton beams.

A strong resonance will completely flip the spin of all protons and thus not cause any depolarization. Rather than correcting the magnetic field imperfections, Thomas Roser of Brookhaven proposed introducing a 9-degree spin rotator into the AGS to make all imperfection resonances stronger. Since the spin rotator overpowers the field imperfections due to magnet misalignment, the lengthy tuning procedure can be avoided. This change should also make it possible to take polarized protons to 25 GeV or higher, while improving operational reliability.

The use of local spin rotators in accelerators to avoid depolarization was first proposed around 1974 by Y. Derbenev and A. Kondratenko of Novosibirsk. Their 180 degree spin rotator is best suited for energies higher than 50 GeV, where the resonances are much stronger. For high energies, the spin rotator is a sequence of vertical and horizontal bending magnets to make the beam to wiggle – hence the name 'Siberian Snake'. This concept has been tested successfully at low energy in the Cooler Ring at the Indiana University Cyclotron Facility (January/February 1990, page 20).

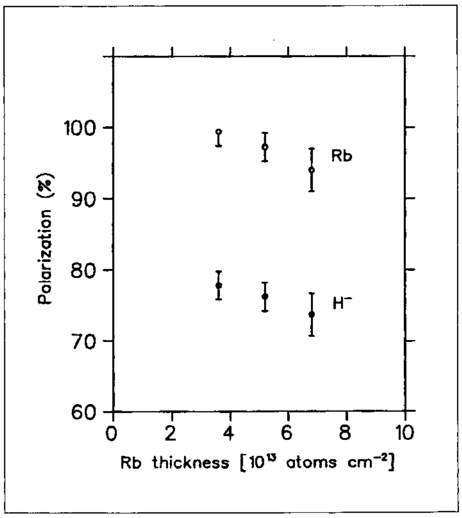
A test of the 9-degree spin rotator, aptly called 'Partial Siberian Snake', has recently been approved for the AGS and will be carried out by an Argonne/Brookhaven/Fermilab/KEK (Japan)/TRIUMF collaboration. The spin rotation will be provided by a conventional ramped solenoid reaching 4.7 T-m at 25 GeV.

The six intrinsic depolarizing resonances are caused by the combined action of the vertical betatron oscillation and the focusing quadrupoles. Depolarization was avoided by crashing through these resonances with ten pulsed quadrupoles. This should also be possible using the Partial Siberian Snake.

The AGS snake should also open up polarized proton collisions in the Relativistic Heavy Ion Collider (RHIC), now under construction nearby. The exciting and unique possibilities of colliding 250 GeV polarized protons have recently led to the formation of the 'RHIC Spin Collaboration' of Argonne/Brookhaven/IHEP (Serpukhov)/Indiana/KEK/Kyoto/Marseille/MIT/Penn State/Trieste/Genova/Padova/UCLA).

Polarized proton collisions should provide detailed information on the spin of constituent quarks and gluons, allow for detailed tests of the underlying theory, and offer a sensitive new approach to looking for new physics.

Transferring electronic polarization to nuclei. Rubidium electronic polarization and nuclear polarization of negative hydrogen ions measured at 300 keV, plotted as functions of rubidium thickness, for a proton energy of 2.49 keV in the source and a laser power of 8 W, showing the efficiency of the heavy alkali for this work.



TRIUMF
Record proton polarization

At the Canadian TRIUMF Laboratory in Vancouver, modifications to the optically-pumped polarized negative hydrogen ion source completed this summer have resulted in a large increase in the proton polarization to a record 78%, and an order-of-magnitude improvement in long-term polarization stability.

The changes involved replacing the sodium vapour in the optical pumping cell by rubidium, and the high-power dye lasers by solid-state titanium sapphire lasers. The best polarization from the sodium-based system had been 61% for a 10 microamp dc beam, of which 5 microamps could be accepted by the TRIUMF cyclotron for acceleration and subsequent extraction.

The new system achieves a polarization of about 75% at similar currents. Two depolarizing resonances at 300 and 470 MeV reduce the polarization by approximately 3% at the highest extracted energies.The source now meets the requirements of several approved TRIUMF experiments and is being used in routine operation.

The source exploits the pickup of a polarized electron by a fast proton passing through alkali vapour itself polarized by optical pumping. The electron polarization is then transferred to the nucleus (via the hyperfine interaction) as the resulting neutral hydrogen atom traverses a region where the axial magnetic field is reversed.

Finally the nuclear-polarized atom picks up another electron in an ionizer cell containing unpolarized sodium vapour, and the resulting negative hydrogen ion is accelerated to 300 keV and transported to the TRIUMF cyclotron.

This type of source, based on optical pumping of sodium, was first proposed in detail by L.W. Anderson at Wisconsin in 1979.

The ideal rubidium target is 100% polarized and dense enough to overwhelm unpolarized background (from charge exchange with residual hydrogen gas). The rubidium polarization depends on the balance between the optical pumping rate and depolarization due to wall collisions. The former depends on the photon flux – rubidium pumped with 9 W of laser light at 795 nm is twice as effective as sodium pumped with 6 W at 590 nm. The depolarization rate is halved with the slower heavy rubidium atoms.

In addition, the absorption region of rubidium is about 50% broader than in sodium. Beside giving a better match to the laser profile, this also reduces depolarization by radiation trapping – the repeated emission and absorption of fluorescence photons within the vapour.

As expected, the new system allows relatively thick rubidium targets to be highly polarized. However it was a surprise that the maximum beam polarization was achieved for a relatively thin target (3.6×10^{13} atoms per sq cm, a typical operating thickness for the highly polarized sodium system).

Development of the TRIUMF d.c. source began in 1983, following the first successful construction of a pulsed source using flashlamp-pumped dye lasers at the Japanese KEK Laboratory. At Moscow's Institute for Nuclear Research (INR) another pulsed source, based on very similar principles, has this year been converted to rubidium and pulsed titanium sapphire lasers. A group at LAMPF (Los Alamos) has constructed a 10% duty cycle source using continuous titanium sapphire lasers to pump potassium vapour.

The TRIUMF group has collaborated with and been assisted by all these groups, particularly by KEK early on and more recently by INR. The TRIUMF d.c. source currently produces the highest polarization of any optically-pumped source, despite the very high laser powers available in the pulsed sources.

SACLAY
Restructuring

In a major restructuring exercise at the French Saclay Laboratory, particle physics, astrophysics and nuclear physics, together with their respective technical support services, have been merged into a single department, to be known as DAPNIA – Department of Astrophysics, Particle Physics, Nuclear Physics and Associated Instrumentation.

The new arrangement will ensure the interdependence of phy-

sics and its technical back-up while constituting a high-quality fundamental research team with a totally open and flexible approach covering the physics of the cosmogenesis over the entire spectrum of wavelengths, energies and reaction rates.

With the associated technical and engineering skills that the various physics disciplines can muster, good management should be easier, a boost should be given to R&D, and Saclay's contacts with the national and international scientific community should be further expanded.

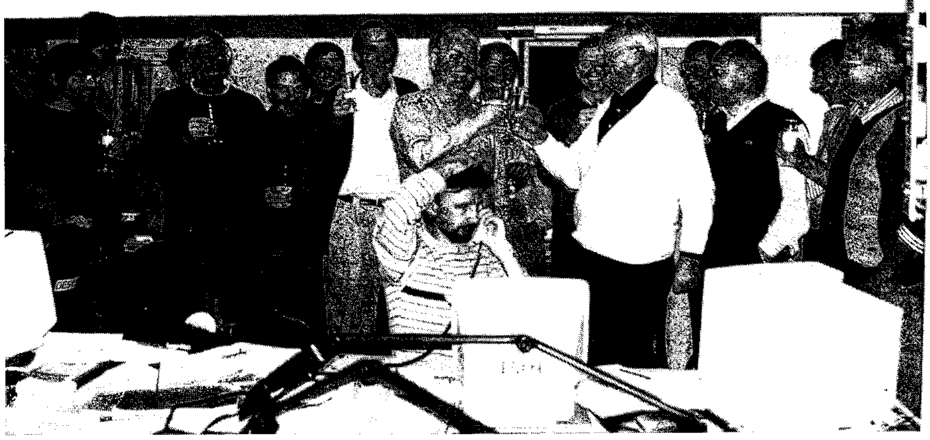
As there are more than 950 staff in the new department, the merger will mean the introduction of new management tools. A *Laboratory Council* will assist the Head of the Department in laying down general guidelines and in work planning. An *Executive Committee* will coordinate progress.

All physics and instrumentation sections will have an individual *Scientific and Technical Council* for developing its own scientific programme and ensuring its execution.

As with all the other Atomic Energy Commission units, from now on the department will be subject to periodic evaluation by a *Scientific Council* of eminent outsiders.

Electron-proton champagne glass collision in the control room between Bjorn Wiik (left, proton ring) and Gus Voss (electron ring) to celebrate the first electron-proton collisions in the new HERA machine at DESY, Hamburg, on 19 October (November, page 20).

(Photo Petra Harms)



DESY
Technology transfer on show

As well as exploring the unknown, fundamental physics research, with its continual demands for special conditions and precision measurements, makes special demands on frontier technology. One of the most prolific areas of this technology transfer, superconductivity and cryogenics, was highlighted by a recent exhibition at DESY organized by the International Cryogenic Engineering Committee.

With Fermilab's 6.2 kilometre Tevatron superconducting ring in action since 1983, with the HERA 6.3 kilometre superconducting ring at DESY just coming into operation, with much bigger proton rings on the drawing board, with many Laboratories increasingly turning to cryogenic radiofrequency cavities to accelerate electrons, and with many other applications areas too, interplay between high energy physics in particular and cryogenics is growing.

The DESY event attracted 230 delegates from ten countries, including some 35 exhibitors. In the parallel oral presentations, Gerhard Horlitz of DESY and Jorg Schmid

A view of the cryogenics exhibition at DESY, which attracted some 35 suppliers.

(Photo P. Waloschek)

Hans Quack (left) of Sulzer and Gerhard Horlitz of DESY were the organizers of the recent 'Technology Transfer in Cryogenics' event at DESY which highlighted the increasing interplay between fundamental physics and cryogenics industry.

(Photo Petra Harms)

of CERN underlined this importance of cryogenics for particle physics with illustrations of the work at their respective Laboratories.

CERN's industrial liaison officer Oscar Barbalat encouraged representatives from smaller companies to seek contacts with major Laboratories. Over the two days of the event, many suppliers also took the platform.

The event was organized by Gerhard Horlitz and by Hans Quack of Sulzer, the company which supplied the three large helium refrigerators for HERA. The next Conference in the series will be in Kiev in June 1992.

GRAN SASSO Enriched germanium in action

Two large crystals of carefully enriched germanium, one weighing 1 kilogram and the other 2.9 kilograms, and worth many millions of dollars, are being carefully monitored in the Italian Gran Sasso Laboratory in the continuing search for neutrinoless double beta decay.

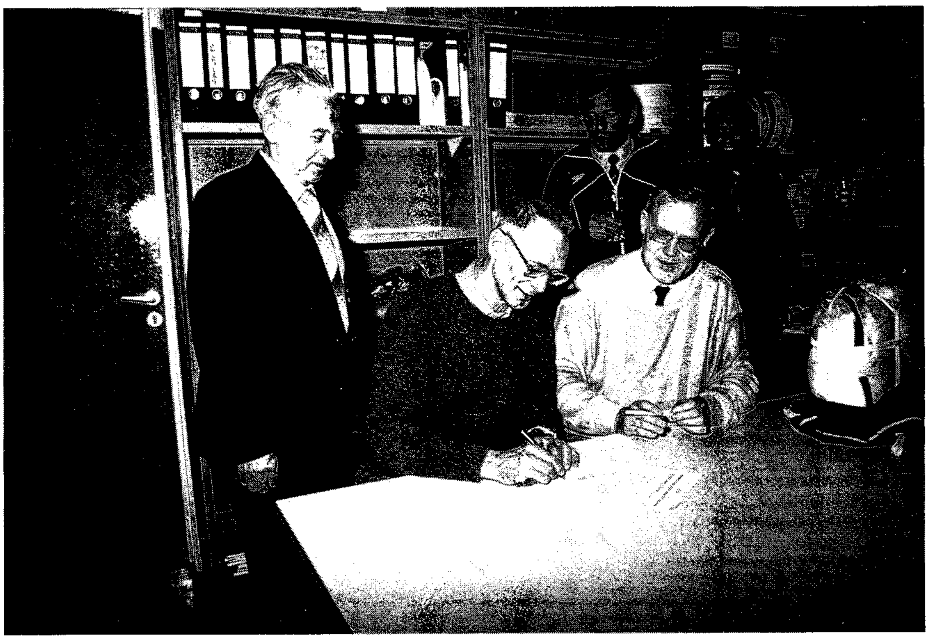
In ordinary beta decay, a nuclear neutron decays into a proton, releasing an electron and an antineutrino. The resulting nucleus, lighter but containing an extra proton, is one rung higher in the Periodic Table than its parent.

In double beta decay, the parent and daughter nuclei are two rungs apart, but the transition, involving two interlinked weak interactions, is very difficult. The tell-tale double electron signal was finally seen by an Irvine group in 1987 in the decay of selenium-82 into krypton-82, with a half-life of about 10^{20} years.

This decay is accompanied by two invisible (anti)neutrinos which carry away surplus energy. But another kind of double beta decay might also be possible, where the two neutrinos swallow each other up and are not released.

For this to happen, the normal selection rules governing beta decay and other weak interactions

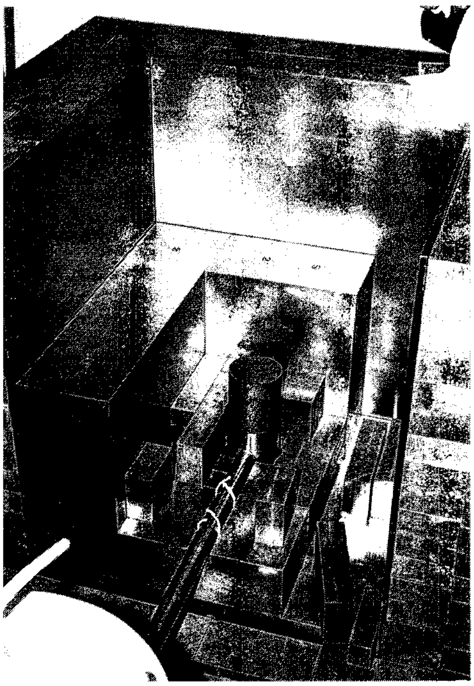
Signing the agreement for the transfer of the world's largest sample of high purity germanium-76 (86 per cent) from Moscow's Kurchatov Institute for a Heidelberg/Moscow experiment in the Italian underground Gran Sasso Laboratory are (seated) the two collaboration spokesmen – S.T. Belyaev of Moscow (left) and H.V. Klapdor-Kleingrothaus of Heidelberg. Looking on (left to right) are V.I. Lebedev, A. Balish, I. Kondratenko and A. Müller.



would have to be abandoned. The ieutrino would also have to behave n a special way – rather than being ι conventional 'Dirac' particle with ın antiparticle counterpart carrying ɔpposite quantum numbers, it would have to be a 'Majorana' par-:icle, with no distinct antiparticle ınd with only its spin direction dif-'erentiating between electron and ɔositron processes.

However important new physics ιas come by looking hard for rare ɔrocesses which violate estab-ished weak interaction symmetries - parity in beta decay, CP violation 'or neutral kaons – while the neutri-ıo, whose very existence was a surprise in itself, has never stopped surprising physicists. So the hunt joes on.

Germanium-76 is a potential double beta decay candidate, and ɔeing an electron detector itself, is deally suited to these studies. The sotope occurs naturally at the level ɔf 7.8 per cent, and germanium de-:ectors, using natural and enriched samples, have established that neutrinoless double beta decay for this isotope, if it happens at all, has a half-life longer than 10^{24} years.



A Heidelberg/Moscow collaboration now has the world's largest sample of high purity (86 per cent) germanium-76. The 17 kilograms of metal supplied by Moscow's Kurchatov Institute correspond to 14.5 kg of the rare isotope. Further refining and preparation of the final crystals and detectors was carried out in the USA and Western Europe.

An initial 1 kilogram sample, monitored in the Gran Sasso Laboratory over 251 days, shows no characteristic two-electron spike. However several other beta decay processes show up clearly, demonstrating the clean conditions in the underground Laboratory, shielded from cosmic ray background by 1.4 kilometres of rock. The background rate is particularly low in the region where the neutrinoless double beta decay would occur.

A larger (2.9 kilogram) sample was placed in position in September, and all the enriched germanium should be in use by the end of next year.

The Heidelberg/Moscow experiment complements the Gallex and SAGE neutrino experiments now underway, the former in a neighbouring Gran Sasso cavern, the latter in the USSR.

The continued absence of neutrinoless beta decay can be used to deduce limits on the mass of the (electron-type) neutrino. These put the neutrino lighter than 2 electronvolts, a tenfold improvement on mass limits from direct measurements (less than 9.3 electronvolts).

A 1 kilogram detector of high purity (86 per cent) germanium-76 used in the Italian Gran Sasso Laboratory by a Heidelberg/Moscow collaboration has provided limits on neutrinoless double beta decay. With more than 10 kilograms eventually available in the enriched form – the world's largest sample of germanium-76 – the experiment will bring new precision to bear on this hunt.

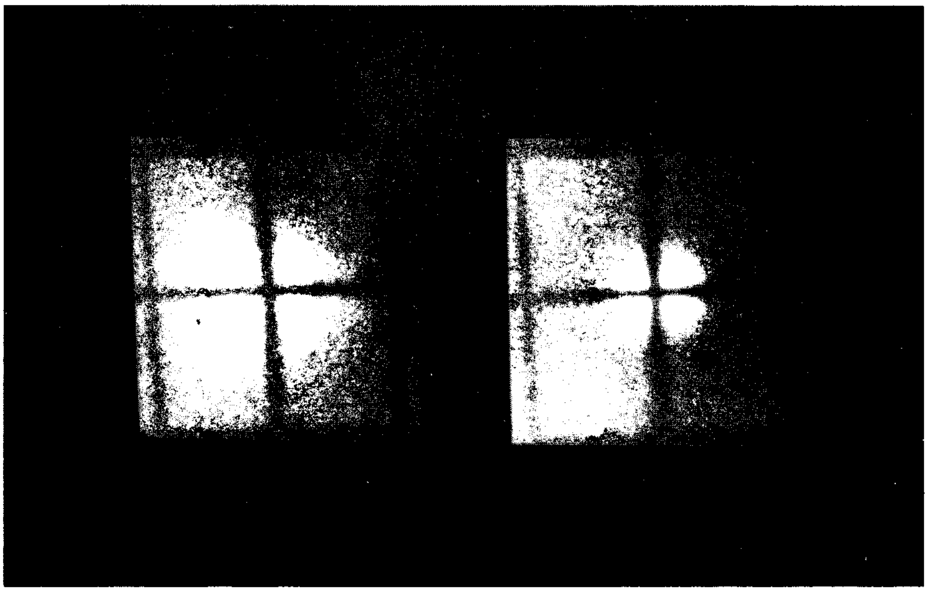
The electron-neutrino mass may well turn out to be zero, but some physicists point out that the limits deduced from neutrinoless double beta decay searches are assumption-dependent. If neutrinoless double beta decay were to be seen, this would certainly imply a non-zero neutrino mass, and the particle would have to be Majorana-type.

CENTRAL EUROPE
Austron

For many of the countries of Central and Eastern Europe access to international research centres such as CERN, the European Space Agency (ESA), the Institut Laue-Langevin (ILL) or to national centres such as the Rutherford Appleton Laboratory in the UK or DESY in Germany, is hindered by the absence of intermediate research institutions.

Since mid-1990 this question has been studied by an 'Austron' Study Group set up under the auspices of the Austrian Academy of Sciences and which cooperates with the so-called 'Pentagonal' initiative of Austria, Czechoslovakia, Hungary, Italy and Yugoslavia to promote cooperation in the area, with which Poland is now associated.

This autumn CERN hosted a meeting of the Study Group which is now specifically investigating the possibility of establishing an international research centre in Central Europe, probably in Eastern Austria, close to the borders of Czechoslovakia, Hungary, Italy, Poland, Focusing a proton test beam at CERN by the magnetic field of a current-carrying plasma – the beam spot seen on a luminescent screen with (right) and without the lens switched on.



and Yugoslavia. This concept of a regional centre of excellence has already aroused considerable interest among the research community of this historically linked area of Europe.

With the idea of a tau-charm factory for Spain currently gaining momentum (July/August, page 13), and with a phi factory being built in Frascati, Italy (September 1990, page 43), another regional accelerator for pure particle physics is seen as having reduced appeal. Austron thinking therefore currently concentrates on a powerful spallation neutron source based on either a state-of-the-art 1.6 GeV rapid cycling synchrotron or a more ambitious high energy option of a 5 GeV synchrotron, with a 120 MeV linac in a first stage to be upgraded subsequently to 400 MeV to provide more power on the target. Such a spallation source would cater for a wide scientific community – materials scientists, life scientists and medical researchers as well as nuclear and medium energy physicists. The beams would also be very useful for detector research and development, an area where Austria has strong traditions.

As well as supporting this Austron science, an associated computer centre, with appropriate links to neighbouring countries and integrated into the European and international networks, would provide additional research scope.

BEAM DYNAMICS
Plasma lenses

Several Laboratories are investigating the possibilities of 'plasma lenses' for focusing particle beams, and progress was highlighted in a recent meeting at CERN.

High energy particle beams are focused by magnetic fields, usually from quadrupoles, magnetic 'horns', or 'wire lenses' with a cylindrical conductor. Another possibility is to exploit the magnetic field of a column of current-carrying plasma, with its potential advantages of power and of transparency to the beam.

At CERN, such a lens, developed for the antiproton source (May 1989, page 7) has given promising antiproton yields despite not having been optimized. Reliability is also good - the lens survived 20,000 pulses at 56 kJ per shot.

At the GSI Darmstadt heavy ion Laboratory, ion beam focusing tests in the context of the fusion confinement programme (using high energy ion beams to drive a fusion reactor) have shown how beam intensity can be increased by a factor of a thousand, beyond the reach of ordinary quadrupole lenses. However still stronger lenses are required, and the GSI team is being augmented by specialists from Erlangen who have also participated in the CERN work.

At Erlangen, stable discharges have given field gradients of up to 250 tesla/m, while work at Naples concentrates on measuring the magnetic fields inside the plasma columns at high current.

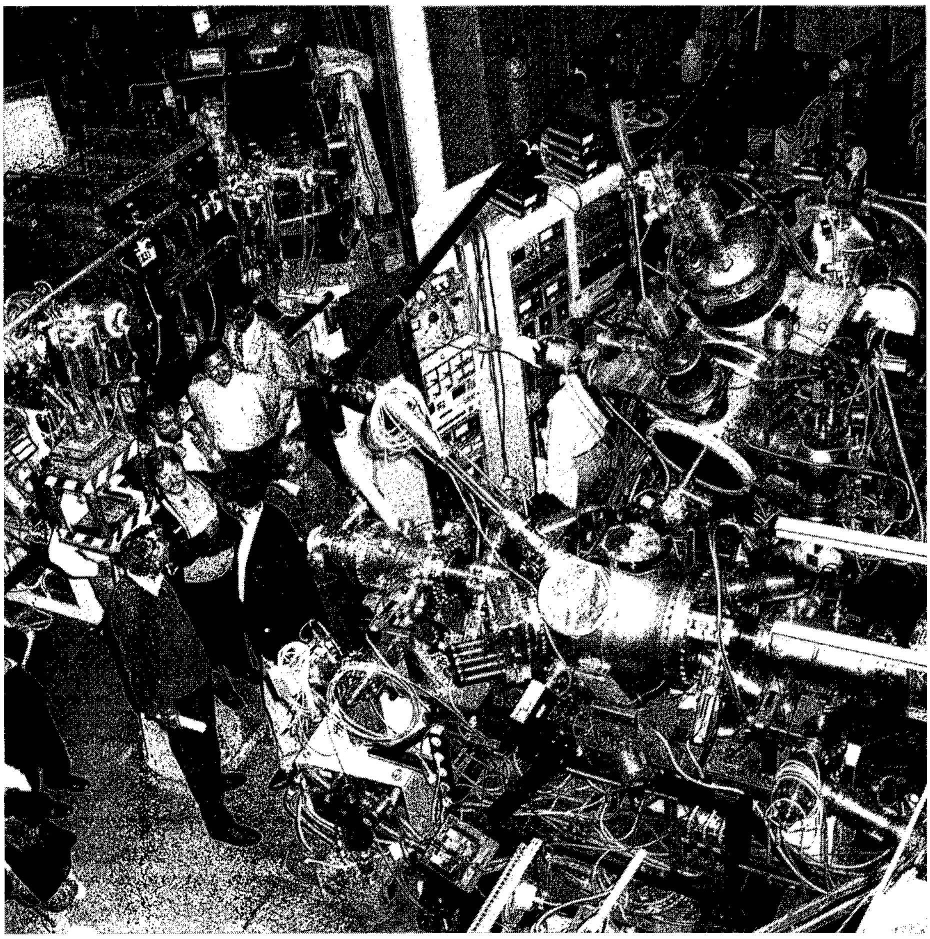
For the future, CERN's antiproton requirements are not demanding, and the antiproton lens is scheduled for final tests next year. However these lenses could also be used to condition other beams, particularly neutrinos (November, page 7), and this option is being watched closely.

At GSI, the goal is to develop more powerful devices for use in the SIS heavy ion synchrotron, attaining beam spots a few hundred microns (a hairsbreadth) across.

For the planned US Superconducting Supercollider (SSC) in Ellis County, Texas, plasma lenses are one option for the pressing problem of dumping the 20 TeV proton beams.

Elsewhere, plasma lenses could also be useful in concentrating positrons for high intensity electron-positron linear colliders.

Participants at a recent workshop on polarized gas targets for storage rings, held at Heidelberg, inspecting the FILTEX internal target apparatus. The TSR storage ring can be seen in the background.



WORKSHOP Polarized targets

Spin experiments in high energy physics have often yielded surprises. The 1988 'Spin Crisis' measurements at CERN, which suggested that the proton spin is not simply the sum of the component quark spins, and the strong spin asymmetries seen in proton scattering at Brookhaven (September 1990, page 34) are good examples.

More and better data, and possibly more surprises, could follow from new techniques using internal targets in storage rings and colliders, as discussed at a recent workshop in Heidelberg.

Currently available target densities, used with intense stored beams of electrons or protons, promise competitive luminosities (collision rates). In contrast to the solid polarized targets used with external beams, internal (gas) targets are pure and highly polarized, while the spin direction can be switched rapidly, opening up the next generation of high-precision spin experiments.

Entitled 'Polarized Gas Targets for Storage Rings' the September Heidelberg workshop began with a survey of experiments, both proposed and running, using polarized internal targets at various rings – TSR at Heidelberg, the Indiana IUCF cooler ring, LEAR at CERN, medium energy electron rings at Novosibirsk, Bates (MIT) and NIKHEF (Amsterdam), and large machines – HERA at DESY, LEP at CERN and UNK at Serpukhov.

Much attention focused on methods to produce a polarized gas of hydrogen, deuterium or helium-3. The quest for high target density has resulted in a strong effort – highlights at the workshop were new results from the laser-driven source developed at Argonne, the rapid progress on the ultracold source obtained by teams at Michigan and Dubna, and the record intensity produced by the 'conventional' FILTEX atomic beam source developed by a Heidelberg/Marburg/Munich team. Target densities up to 10^{13} per sq cm for free beams and 10^{14} for storage cell targets are anticipated.

The machine session looked at the interaction between the storage ring and the internal target. Encouraging results were reported from the VEPP-3 (Novosibirsk) and IUCF (Indiana) rings and from an external-beam experiment at Heidelberg's Max Planck Institute, raising confidence in the storage cell technique required to obtain high density. The remarkable achievement at Indiana of a stored polarized proton beam interacting with an (unpolarized) target paves the way for two-spin measurements.

Other topics were on-line target polarimeters, design criteria for internal targets and – in the final panel discussion – the future of this new technique. Experience with the UA6 experiment at CERN showed that internal targets and collider rings can coexist, and more examples of colliders supplemented by polarized internal target experiments can be expected. This could bring new physics without a big investment.

The meeting, sponsored by the University of Michigan and the Max Planck Institute, was organized by Erhard Steffens (who also compiled this report). The proceedings will be published as an MPI Heidelberg Internal Report.

Looking for new physics

The problem with the Standard Model of particle physics is that while it is very successful, its predictive power has run out of steam.

A major objective now is to look beyond this Model - the twin picture of particle physics in terms of the electroweak unification of electromagnetism and the weak force on one hand and the quantum chromodynamics theory of inter-quark forces on the other – to find out why it works so well.

Thus the implications of recent accelerator and underground experiments came under scrutiny at a recent International Workshop on Electroweak Physics Beyond the Standard Model held in Valencia, Spain.

Supersymmetry is the most popular way to extend the electroweak sector for a deeper understanding. At Valencia, this was reviewed by Graham Ross (Oxford) and by Luis Ibanez (CERN). Ross argued that the minimal supersymmetric unified models are remarkably consistent with precision low energy and LEP data (April, page 3).

This consistency underlines the need to search for signs of supersymmetry, where LEP has already contributed in several ways. One is the search for supersymmetric Higgs bosons, a subject discussed by Spanish theorist M. Quiros, who stressed the importance of including radiative corrections in the experimental analyses.

There was also an interesting presentation by Portuguese theorist Jorge Romao on the rare decays expected in supersymmetric models where the conventional supersymmetry quantum number (R parity) is not conserved (spontaneously violated) so that even the lightest supersymmetric particle, stable under R parity conservation, becomes unstable.

Such processes could provide novel signatures at LEP and/or at a tau factory (July/August, page 13), and the underlying physics could help in understanding the long-standing deficit of observed solar neutrinos.

In the neutrino sector, the claims and counter-claims for a 17 keV particle (April, page 9) were reexamined, but no conclusions can yet be drawn. The solar neutrino session was enlivened by new results from the American Germanium Experiment (SAGE), given by Tom Bowles of Los Alamos. He presented a series of measurements carried out this year with 50 tons of gallium. Taken at face value, these results support the classic deficiency of solar particles seen by the Kamiokande and Homestake detectors.

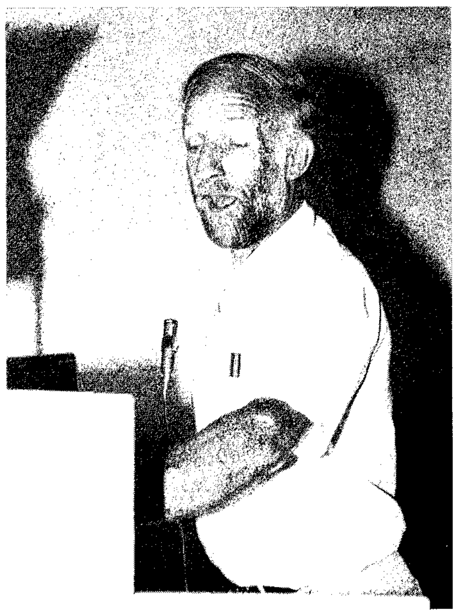
The implications of solar neutrino results were explored by specialists John Bahcall of Princeton and Alexei Smirnov of Moscow (currently at Valencia). Taking the 17 keV neutrino seriously, organizer Jose Valle showed how it could be reconciled with the solar neutrino observations. The outcome should be testable in the next generation of solar neutrino experiments and laboratory searches for neutrino conversions.

The meeting concluded by looking at the physics which will be opened up by increased energy at CERN's LEP electron-positron collider, by CERN's proposed LHC proton collider, and by the Tau-Charm Factory now being discussed in Spain.

The Valencia meeting was organized by Instituto de Fisica Corpuscular (IFIC) and sponsored by Universidad Internacional Menendez Pelayo (UIMP-Valencia) and other Spanish agencies.

From Jose. W.F. Valle

Graham Ross of Oxford – looking beyond the Standard Model



Electron-positron colliders: looking at future physics

With research and development work underway throughout the world towards high energy electron-positron linear colliders (April, page 10), interest turns to the new physics these machines would open up.

The first International Workshop on Physics and Experiments with Linear Colliders was held recently in Saariselkä in Finnish Lapland – some 300 kilometres north of the Arctic Circle. The consensus was that a compelling programme of physics would be opened up by colliders reaching 300-500 GeV, the major topics being precision

Technopolis Thoiry

Geneva Moves With The Times

Geneva has been closely linked to science from the time it hosted crucial discussions on links between such diverse phenomena as light, chemical reactions and magnetism. Indeed, the city became the home of one of Europe's first major experimental facilities — a giant electrochemical pile designed to test Ampere's theories. This was built by de Saussure two decades after a visit by Volta to demonstrate a more famous, but much smaller, pile on his way to impress Napoleon.

An International Role

Geneva's role in providing a testbed for unified theories of matter continues to this day at CERN where the LEP collider probes nature at the 10^{-18} metre scale by colliding electrons and positrons circulating inside a high vacuum beam pipe buried up to 100 metres below the Swiss and French countryside in a 27 kilometre circular tunnel.

CERN was conceived by scientists and politicians in the late-1940's as a step on the road to post-war reconciliation *via* a major collaboration on the neutral ground of pure research in a region with a long history of internationalism. With a staff of 3000 and a budget of some 900 million Swiss francs to provide facilities for scientists from 300 institutes, CERN welcomes 6200 visitors each year.

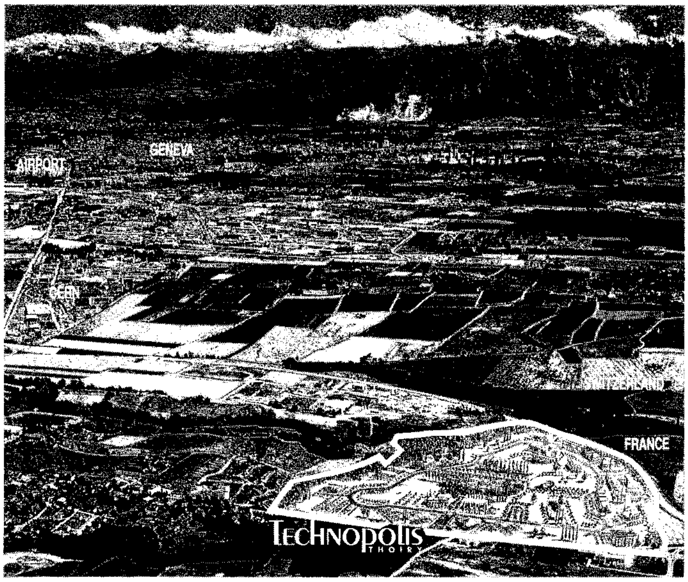
The Technopole Interface

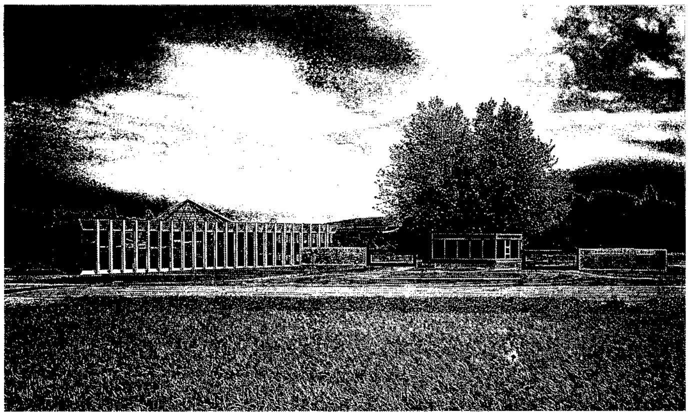
Geneva continues to adapt its role as we move towards the 21st Century. Science parks represent one development and there are now about 300 in the industrialized world. In offering a homogeneous blend of activities and facilities, they generally aim to enhance synergies in an increasingly competitive world.

Unique among the science park concept is the Technopole approach where an outer circle of commercial, governmental and institutional interests come together to promote an inner core of activities providing interfaces between science, technology, new businesses, and higher education. Each Technopolis thus comprises a homogeneous blend of facilities and ancilliary services.

The Geneva region's Technopolis is situated just across the Franco-Swiss border from the main CERN campus. The 27 hectare green field site on the outskirts of the village of Thoiry is therefore ideally located to interface with the international physics community. Being only five kilometres by road from Geneva's international airport and main line station is an invaluable advantage.

Looking across the main CERN campus to Geneva from Technopolis Thoiry, outlined as an artist's image.





The Opus One building at Technopolis Thoiry.

Focussing on Applied Physics

LHC, CERN's next major collider, proposed for the LEP tunnel, follows on from past achievements in calling for state-of-the-art superconducting magnets, advanced materials, sophisticated vacuum and cryogenic systems, high power electronics, and a wide range of computer-based facilities to serve all aspects of the machine — from resource management to the imaging of particle collisions in its mega-detectors.

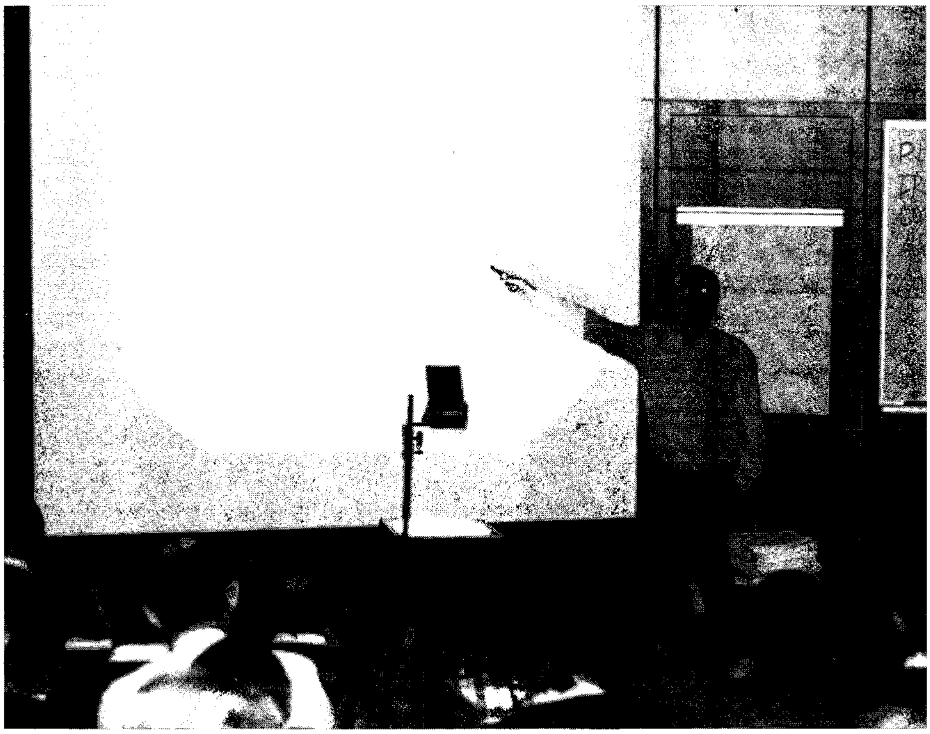
Technopolis aims to allow industry and institutes to participate in, and contribute to, the rich scientific and technical environment by serving as a closeknit interactive base for specialist organizations. In addition to enjoying a convenient window on CERN's extensive sub-contracted requirements, they will be able to arrange collaboration on a formal basis. Technopolis is also working to establish an Institute to provide an interface in applied physics between teaching and research staffs, postgraduates and high calibre technicians coming from industry and R. and D. centres.

A Superb Environment

Robert Hinterberger, Director of a Technopolis Thoiry based computer software company, plaçes great importance on the "perfect working environment". This will continue to be preserved in a balanced development comprising space reserved for accomodation, technical and commercial companies, the technological institute, small scale R. and D. units, and hotels and conference services.

By the same token, while Mr. Benier, the Mayor of Thoiry, is "obviously interested in promoting employment opportunities" he is "also concerned that we preserve the quality of our local environment". Hence recent agreements for a national park in the Jura mountains behind Thoiry, consolidation of road access from Switzerland through to the French motorway system, a cultural centre, a second international school, and the imminent construction of a major world-class shopping centre.

At the recent electron-positron linear collider physics workshop in Saariselkä in Finland, Bjorn Wiik of DESY addressed the three big questions for such a machine – do we need it?, do we know how to build it?, and how do we get it?



top quark physics, the physics of gauge (W and Z) bosons, hunting for Higgs particles, and new particle searches.

It looks as though the long awaited sixth ('top') quark will be heavier than the W and Z boson carriers of the weak force. Understanding the role of the top quark is an important goal, and analysis techniques and machine parameters were discussed and developed.

Scanning the threshold of top quark production will fix the mass to better than 500 MeV. This will help understand the spectrum of quark masses, and, combined with high precision measurements from CERN's LEP and the precision measurements of the W mass from the Fermilab Tevatron and from increasing the LEP energy, will constrain the mass of the Higgs particle to about 20 per cent. Detailed studies of the top quark, including its electroweak interactions and decay properties, will be possible.

Another new sector would be the physics of W and Z boson interactions. The static magnetic dipole and electric quadrupole moments of the charged W bosons could be measured more accurately than at LEP and at hadron colliders.

The study of W-W scattering will require TeV collision energies and very high luminosities, and will be left for a future generation collider.

In the search for (scalar) Higgs particles no loophole must be left. Data samples well below the performance expectations of various machine designs will be sufficient to illuminate even the most complex Higgs spectra. As with LEP, these studies are limited only by the energy of the machine – masses up to about 70% of the total energy are accessible.

Recent calculations increase the upper limit on Higgs masses that can be tolerated by the Minimal Supersymmetric Standard Model. These limits exceed the grasp of increased LEP energy, but are well within the reach of the next linear collider. A supersymmetry working group has concluded that a linear collider with a collision energy of 500 GeV is guaranteed either to find at least one Higgs (and most probably three neutral states and the charged states), or the Minimal Supersymmetric Standard Model will be ruled out. These new states generally appear with intermediate masses and investigation at hadron colliders is difficult.

Historically electron-positron colliders have been ideal hunting grounds for new particles, and a wide variety of goals and strategies were presented at the workshop, covering such exotica as heavy Majorana neutrinos and new vector bosons as well the more familiar predictions of supersymmetry.

On the machine side, control and measurement of the beam energy profile and of the beamstrahl spectra created during the beam-beam interaction was considered to be important for much of the discussed physics programme.

Experience with the SLC Stanford Linear Collider has shown that the detectors are an integral part of the machine, and control of backgrounds is a challenge for accelerator physicists and particle physicists alike.

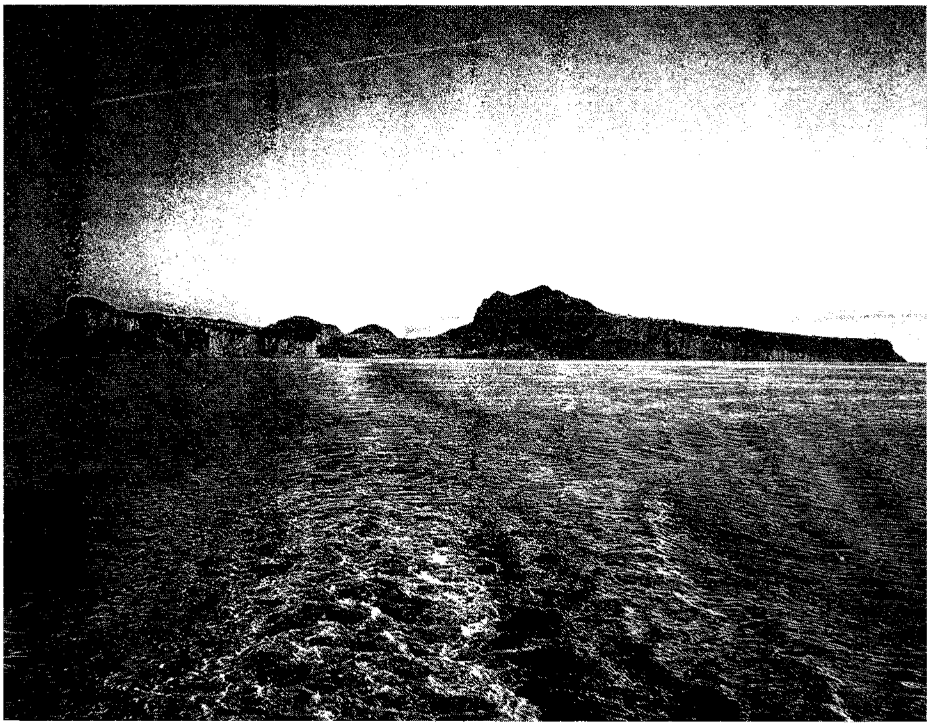
Problems in beam collimation and detector shielding are being attacked by a growing number of accelerator and particle physicists, especially the calculation of backgrounds produced in the interactions of small intense beams.

The peripheral photon flux accompanying electron beams grows with energy and can lead to electromagnetic and hadronic backgrounds if the luminosity produced by the collider within the resolving time of the detector becomes too large. This ultimately will constrain machine designs to favour higher repetition rates and lower luminosities per bunch crossing.

The physics opened up by such a collider will probe the most puzzling problems of today's Standard Model and its proposed extensions. As summary speaker Bjorn Wiik of DESY concluded - 'the physics programme of a 300 – 500 GeV electron-positron collider with luminosity of ten inverse femtobarns per year has unique features, and is complementary to that of the hadron colliders LHC and SSC'.

The machine will demand international collaboration. As Burt Richter emphasized in his introductory talk – 'the world high energy physics community must begin to lay the foundation with governments for broad international effort to push this research frontier forward'.

The meeting, jointly sponsored by the International Committee on Future Accelerators (ICFA), DESY and CERN, and organized by the Finnish Institute for High Energy Physics (SEFT), was attended by 150 physicists from laboratories and universities in Europe, Russia, Japan and America. The next workshop in the series will be held on the balmy shores of Hawaii in the Spring of 1993.



The island of Capri – scene of the second International Conference on Calorimetry in High Energy Physics, held from 14 –18 October.

(Photo Mimmo Jodice)

DETECTORS
Calorimeters at Capri

The second International Conference on Calorimetry in High Energy Physics, held from 14 –18 October on the island of Capri, included a workshop dedicated to the important problem of calorimetry for experiments at future big proton colliders – the LHC at CERN and the Superconducting Supercollider (SSC) in the USA.

The high energy and luminosity of those machines, together with the short bunch crossing interval, is a real challenge for any detector and in particular for calorimeters. Moreover the large number of readout channels strongly constrains the cost of the detectors.

The Conference began with a series of review talks on general issues – performance limitations, physics requirements, experience with existing large systems, large scale engineering, radiation damage calculations, readout electronics, simulation studies, and applications in non-accelerator physics.

Subsequent parallel sessions covered physics requirements on calorimetry, scintillation calorimeters, ionization calorimeters, homogeneous calorimeters, electronics, radiation hardness and performance of large systems, summarized on the final day by the parallel session conveners.

The picture which emerged shows a large range of ongoing R&D covering almost all calorimeter technologies and often involving experimental setups on the scale of small experiments.

Interesting results were presented on the different options for LHC and SSC detectors – scintillating fibres and tiles, ionization calorimeters (mostly liquid argon) and crystals (for very accurate energy measurements). Important issues on radiation hardness, fast readout electronics and actual realization of complex systems were also examined.

The session on physics requirements established a direct link between the physics motivation of the future experiments and the choice of specific calorimetric detectors. Concluding the conference, Klaus Pretzl of Berne stressed the

People and things

enormous progress achieved in recent years in understanding and developing calorimetric techniques.

The large number of ongoing projects and the encouraging progress in this field, mainly under the pressure to define the experimental programme at the LHC and the SSC, led to the decision to continue the series of Conferences on an annual basis (the first meeting was held last year at Fermilab). Applications are open to host the future meetings.

The Capri meeting was organized by A.Ereditato (Napoli), P.Jenni (CERN), V.Palladino (Napoli) and A.Para (Fermilab) with the support of the Italian INFN and University of Napoli. Some 120 participants attended.

Thermal detectors: Initial results

Thermal detectors are widely regarded as being likely to contribute to new precision physics, and many groups in Europe, USA and Japan are presently developing examples such as superheated superconducting grains, superconducting tunnel junctions and bolometers (September 1988, page 23).

Especially popular is the latter, using as detector a pure diamagnetic and dielectric crystal. Its heat capacity at low temperature (proportional to the cube of the ratio between operating and Debye temperatures) can become so small that even the tiny amount of energy left by a particle causes a rise of temperature measurable by a suitable thermistor.

The technical development of these detectors has been impressive over the last years and an experiment using this technique has contributed new limits on neutrinoless double beta decay (see page 14), in this case tellurium-130 going to xenon-130. The experiment, by a Milan team (University and INFN) led by Ettore Fiorini, began in August in the Italian Gran Sasso underground Laboratory.

The detector/source is a 35 gram crystal of tellurium oxide operating at about 20 millikelvin in a dilution refrigerator specially made with previously tested low radioactivity materials.

No sign of neutrinoless double beta decay has been found with a lower limit for the halflife of more than 3×10^{20} years after only 500 hours of effective running time, extending the previous limit by almost two orders of magnitude.

Italy's President Francesco Cossiga visited CERN on 25 October. At the Delphi underground experimental area at LEP were (left to right) Delphi spokesman Ugo Amaldi, CERN Council President Sir William Mitchell, President Cossiga, and CERN Director General Carlo Rubbia.

(Photo CERN HI 43.10.91/13)

On people

William Happer, formerly at Princeton, has become Director of the Office of Energy Research in the US Department of Energy, the government department funding most of the US particle physics programme. He takes over from Deputy Director James F. Decker, who had been Acting Director. Dr. Happer also becomes Science and Technology Adviser to Energy Secretary James D. Watkins.

Emilio Picasso of CERN receives one of this year's prestigious Italgas Prizes for Research and Innovation awarded to European Community scientists. As Director of CERN's 27-kilometre LEP ring construction project, his work was of 'historical importance', the citation reads.

Robert Cahn becomes Director of the Physics Division at the Lawrence Berkeley Laboratory, enabling Piermaria Oddone to act full time as the Laboratory's Deputy Director.

Yakir Aharonov of the Universities of Tel Aviv and South Carolina (Columbia) and David Bohm of London (Birkbeck) share the Elliott Cresson Medal of Philadelphia's Franklin Institute for their 1956 prediction of the quantum mechanical effect which now bears their names.

Trieste centre awards

This year's Dirac Medals awarded by the International Centre for Theoretical Physics (ICTP), Trieste, have been awarded to Jeffrey Goldstone (MIT) for 'his fundamental clarification of the phenomenon of spontaneous symmetry violation in relativistic field theory', and to Stanley Mandelstam (Berkeley) for his analytic formulation of scattering amplitudes and for his seminal work on the quantization of string theories.

Earlier this year, Sidney Coleman of Harvard received from ICTP Director Abdus Salam the Dirac Medal he was awarded in 1990 (when the other recipient was L.D. Faddeev of Moscow). At the same ceremony, a special ICTP Medal was awarded to Claudio Villi in recognition of his contribution to the development of scientific activities at the Trieste institutes. From 1970-75 he was President of the Italian INFN, and from 1977 has been President of the Consortium for Physics of the University of Trieste.

Berkeley/Oakland Fire

The blaze which swept through the Berkeley/Oakland hills to the east of San Francisco Bay on 20 October went on to devastate 2,000 homes. 24 people lost their lives.

The nearby Lawrence Berkeley Laboratory was never in danger, but 50 Lab employees lost their homes.

More muons for ISIS

The pulsed muon facility at the UK Rutherford Appleton Laboratory's ISIS neutron source is to be substantially upgraded under the European Commission's Large Installations Plan. The existing ISIS muon beamline and spectrometer, built four years ago, will be split into three. Construction should be complete by Spring 1993, and will be followed by a two-and-a-half year EC-sponsored scientific programme.

This new boost for ISIS muons follows an upgrade covered by an agreement drawn up last year with the Japanese Institute for Physical and Chemical Research (RIKEN), Tokyo.

CERN-Australia cooperation

On 1 November at CERN, Australian Ambassador to Switzerland John Brook and CERN Director General Carlo Rubbia signed a cooperation agreement which provides a framework for Australia and CERN to develop reciprocal scientific and technical cooperation. Australian specialists will be able to participate in CERN research projects, and the Australian government has also expressed its interest in participating in future major CERN programmes, such as the LHC collider.

Australia thus joins Brazil, Bulgaria, Chile, Czechoslovakia, Hungary, India, Israel, Romania and the Soviet Union in the list of countries having signed a cooperation agreement with CERN. An agreement has also been signed with the Chinese Academy of Sciences.

Distinguished theoretician Daniele Amati is leaving CERN after a long career in the Theory Division to become Director of Trieste's International School for Advanced Studies (Italian acronym SISSA).

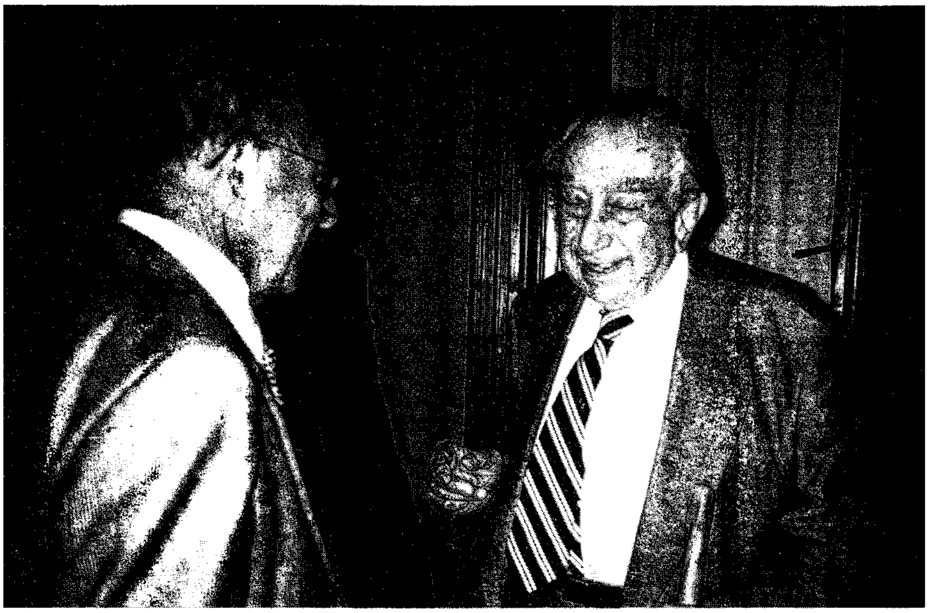
Meetings

Cyclotrons '92, the 13th International Conference on Cyclotrons and their Applications, will be held in Vancouver, Canada, from 6-10 July, sponsored by IUPAP and hosted by TRIUMF. Further information from Maureen Iqbal, Cyclotrons '92, TRIUMF, 4004 Wesbrook Mall, Vancouver, BC, Canada, V6T 2A3. Fax (604) 222-1074. E-Mail (Bitnet) CYC92 at TRIUMFCL ; (Internet) CYC92 at ERICH:TRIUMF.CA ; (Hepnet) 45387::CYC92 or ERICH::CYC92

From 26 May – 4 June next year a Summer School on Quantitative QCD Phenomenology is being organized by the CTEQ Collaboration (Coordinated Theoretical/Experimental Project on Quantitative QCD Phenomenology and Tests of the Standard Model). Further information from C.M. Sazama, Fermilab, P.O.Box 500, Batavia, IL 60510, USA, Fax 708-840-3867, e-mail SAZAMA at FNAL

The subject of the 1992 Gordon Research Conference, to be held from 13-17 July next year at Proctor Academy, Andover, New Hampshire, is 'Particle Physics in the 90s'. Further information from C.M. Sazama, Fermilab, P.O.Box 500, Batavia, IL 60510, USA, Fax 708-840-3867, e-mail SAZAMA at FNAL

The 1992 (17th) Meeting of the Division of Particles and Fields of the American Physical Society (Particles and Fields 92) will be held at Fermilab from 10-14 November. Further information from C.M. Sazama, Fermilab, P.O.Box 500, Batavia, IL 60510, USA, Fax 708-840-3867, e-mail SAZAMA at FNAL



▲ Together in Budapest for the centenary of the Eotvos Society (Hungarian Physical Society) on 18-19 October were distinguished expatriate Hungarian physicists Val Telegdi (left) and Edward Teller.

Theory up in smoke. Rather than profit from the long hot summer, CERN's Theory Division perversely insists on arranging its picnic to coincide with the onset of autumn wind and rain. Sensibly clad picnickers enjoy the warmth, as well as the produce, of the barbeque.

(Photo Guillermo Zemba)

Going up and up

The 100.57 metre-high staircase of LEP pit 6 (which houses the Opal experiment) was climbed a hundred times on 31 October by Francois Siohan, 50, who translates from English much of the material for the French edition of the CERN Courier.

His total time of just under eight hours for the vertical ten-kilometre climb must be some kind of record, making the Opal staircase one of the fastest vertical tracks in the world. (The total exploit, including time spent going down in the elevator, took more than ten hours).

The previous month, Siohan cycled fourteen times up and down the nearby Jura mountains, taking just under 11 hours to climb the same distance (total time just over 14 hours including descents). Thus the LEP stairs are a more efficient way of climbing, but he finds the view from the Jura much better.

Beauty baryon in UA1 muon data

As this issue was going to press, the UA1 collaboration at CERN's proton-antiproton collider, which finished taking data last year, announced evidence for baryon (heavy proton-like particle) containing the fifth ('beauty') quark.

High energy proton-antiproton collisions are a prolific source of such particles. In 1986 the big UA1 experiment reported evidence for neutral B meson mixing, however seeing individual particles was difficult because of the clutter of the collisions. That the particle has only now been seen in data taken several years ago reflects the difficulty of extracting a clear signal.

In an analysis of a sizable chunk of 1988-89 UA1 muon data, when the detector ran without an electromagnetic calorimeter, the group looked for a neutral baryon containing a beauty quark (a lambda-b particle) through its decay into a J/psi and an ordinary lambda baryon (containing a strange quark).

The J/psis are identified through oppositely-charged muon pairs, while the lambdas are found through their decays into a proton and a negative pion. 16 ± 5 candidate lambda-bs are found with a mass of $5640 \pm 50 \pm 30$ MeV.

Interest in b-quark physics is growing because of the sizable signals expected in the next generation of proton colliders – the US Superconducting Supercollider (SSC) and the LHC in CERN's LEP tunnel.

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TRIUMF Laboratory, (Canada)
M. K. Craddock

On 8 November, Bjorn Wiik of DESY gave the traditional John Adams Memorial Lecture at CERN. He delivered a status report on the HERA electron-proton collider now being commissioned at DESY, Hamburg. Following first collisions between 12 GeV electrons and 480 GeV protons (November, page 20), the electron energy has been increased towards the design level of 30 GeV.

TRIESTE
Funding crisis

As the CERN Courier went to press, the International Centre for Theoretical Physics (ICTP) in Trieste was going through a painful funding crisis.

Set up in 1964 by Abdus Salam under the auspices of UNESCO and the International Atomic Energy Agency, ICTP has in recent years been mainly funded through the generosity of the Italian Government.

While awaiting confirmation of similarly generous long-term Italian support to last until the end of 1998, the rollover of the interim funding ran into difficulties. An altruistic and timely interest-free loan from the Islamic Republic of Iran will help tide things over.

ICTP is a focus for scientists from developing countries, and has established itself as a major world research centre in its own right. At the beginning of November, a Trieste plea for support drew overwhelming response from scientists and ICTP admirers throughout the world.

Hopefully the interim funding hiatus will be speedily resolved.

On 11 November an agreement was signed establishing the Institut für Hochenergiephysik, Zeuthen (formerly East Berlin) as a formal part of the DESY Laboratory in Hamburg from 1 January 1992. Signing the agreement were (left to right) – Leon Hajen, Senator for Science and Research in the regional Hamburg administration; Federal Research Minister Heinz Riesenhuber; and Hinrich Enderlein, Minister for Science, Research and Culture in the regional Brandenburg administration.

DESY finance has always been split between the Federal government (90%) and Hamburg (10%). The pattern continues with the two regional administrations contributing ten per cent of the budgets of the respective research centres, henceforth under an overall DESY umbrella (October, page 13).

(Photo DESY)

SSC Laboratory

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The Experimental Particle Physics Group of the University of Glasgow has a vacancy for a Research Assistant to work on the ZEUS experiment, now being installed at the DESY HERA electron-proton collider. The Glasgow ZEUS group has been working in a number of areas : we have constructed transition radiation detector modules for electron identification, and are working on the use of these and of information from the tracking detectors for physics analyses. The group is also active in HERA Physics studies.

For the first year, the post is funded by the European Community, and is intended for nationals for European Community countries outside the United Kingdom. There will be an opportunity for extension for up to an additional three years. The superannuable post is on the Research 1A scale. The salary will be in the range £12690 to £ 15481 per year, depending on age and qualifications. Applicants will probably have or expect soon to receive a PhD in experimental particle physics or a related field. A starting date in late 1991 or early 1992 is desired.

For further information, please write to

Prof. D.H. Saxon
Department of Physics & Astronomy
University of Glasgow
Glasgow G12 8QQ
Scotland

Tel. : +44-41-330-4673 Fax : +44-41-334-9029
Computer mail : SAXON@UK.AC.GLA.PH.I1

Applications should be sent to the same address, enclosing a curriculum vitae and list of publications, together with the names and addresses of two referees.

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Bewerbungen mit Lebenslauf, akademischen Zeugnissen und zwei Gutachten sind zu richten an den Sprecher des Kollegs :

Prof. Dr. H. Kolanoski
Institut für Physik
Universität Dortmund
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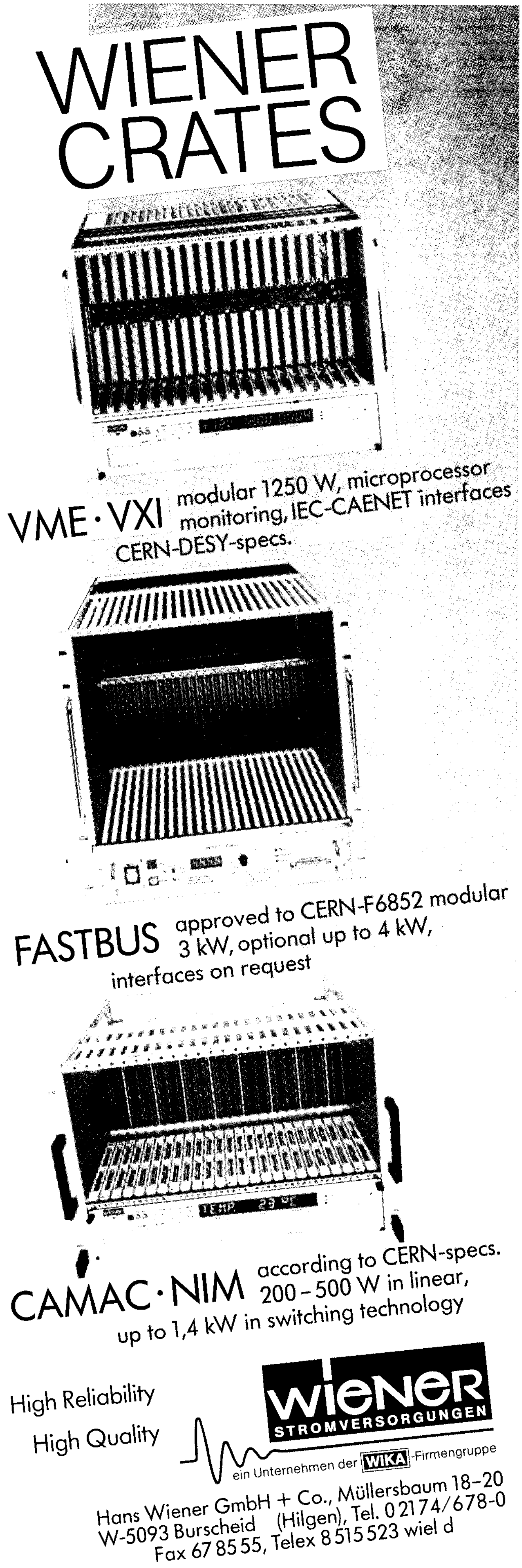

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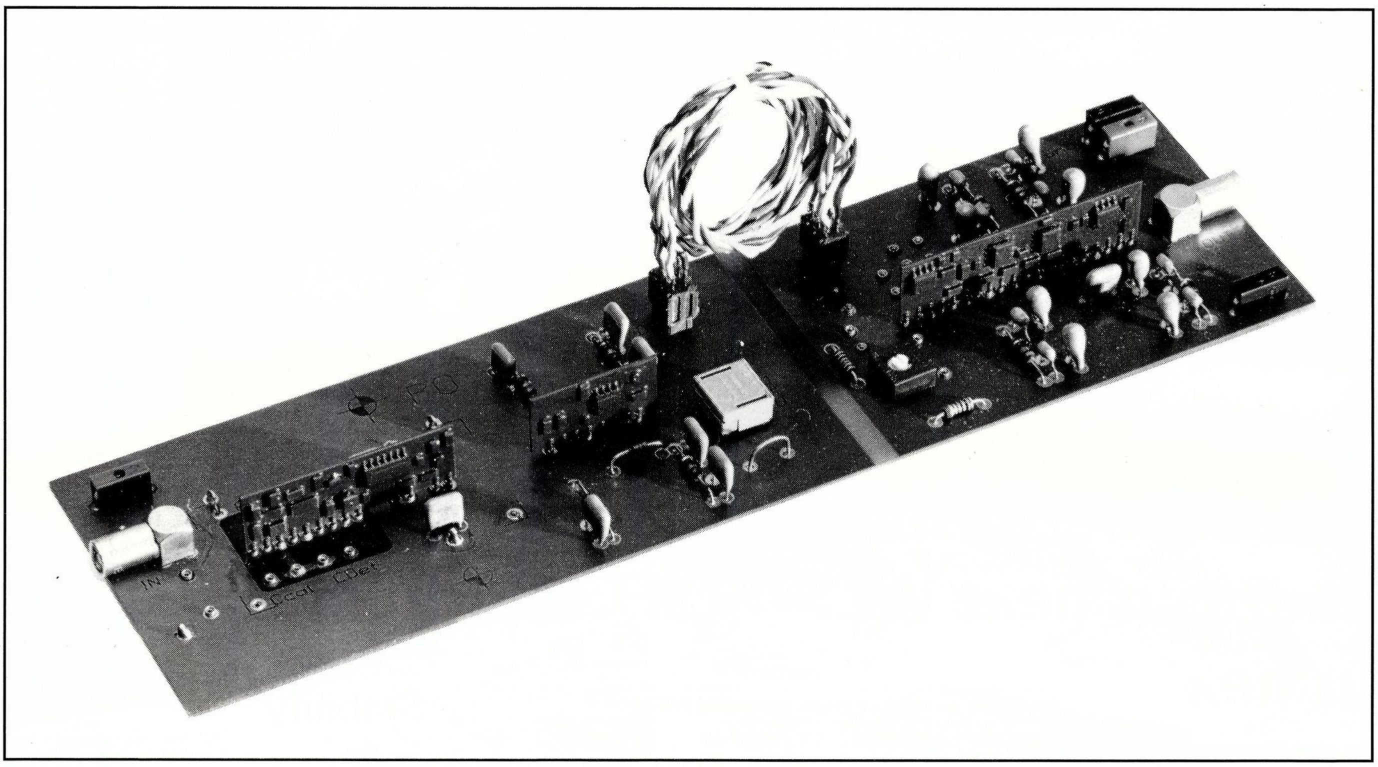

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