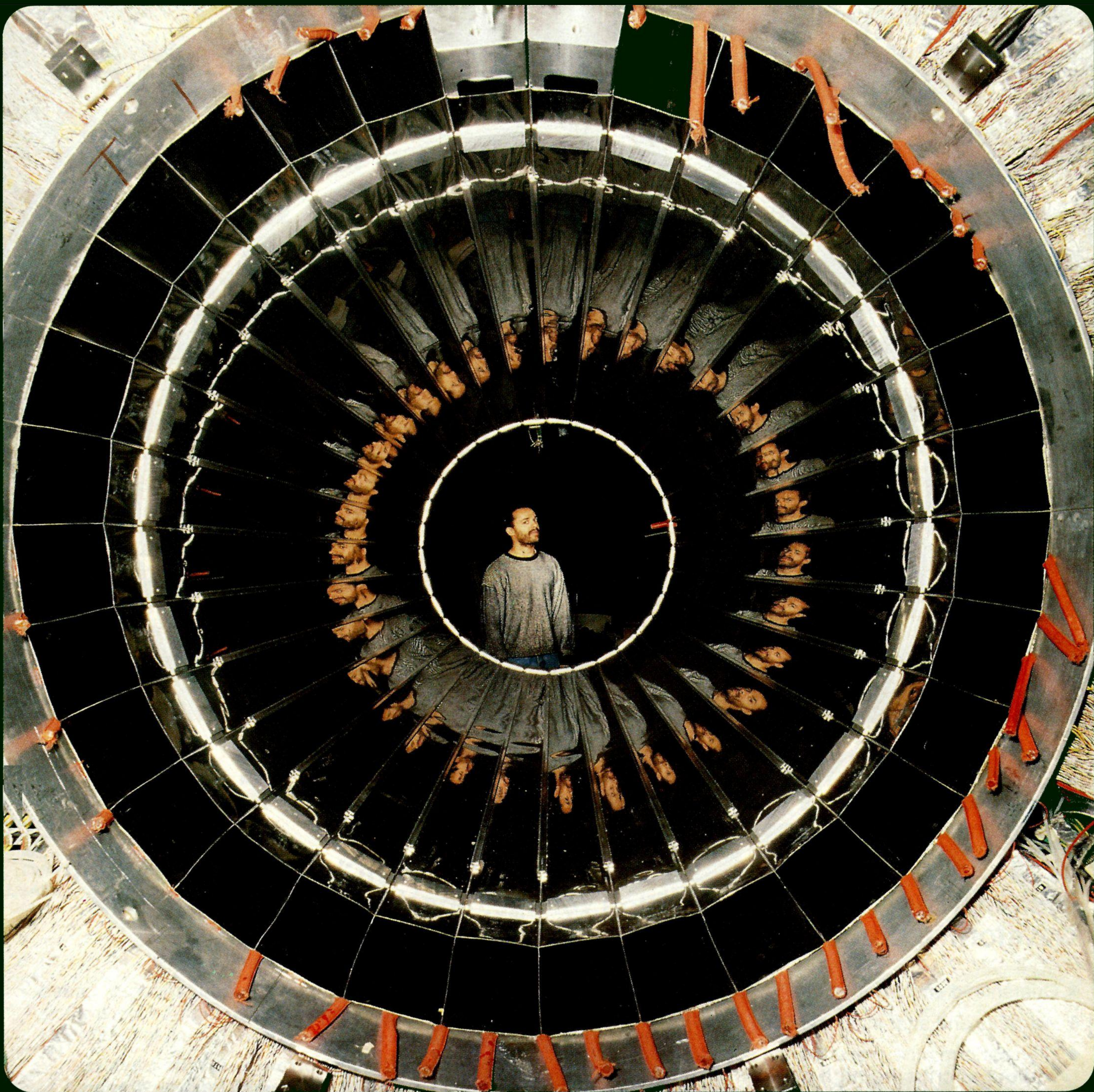
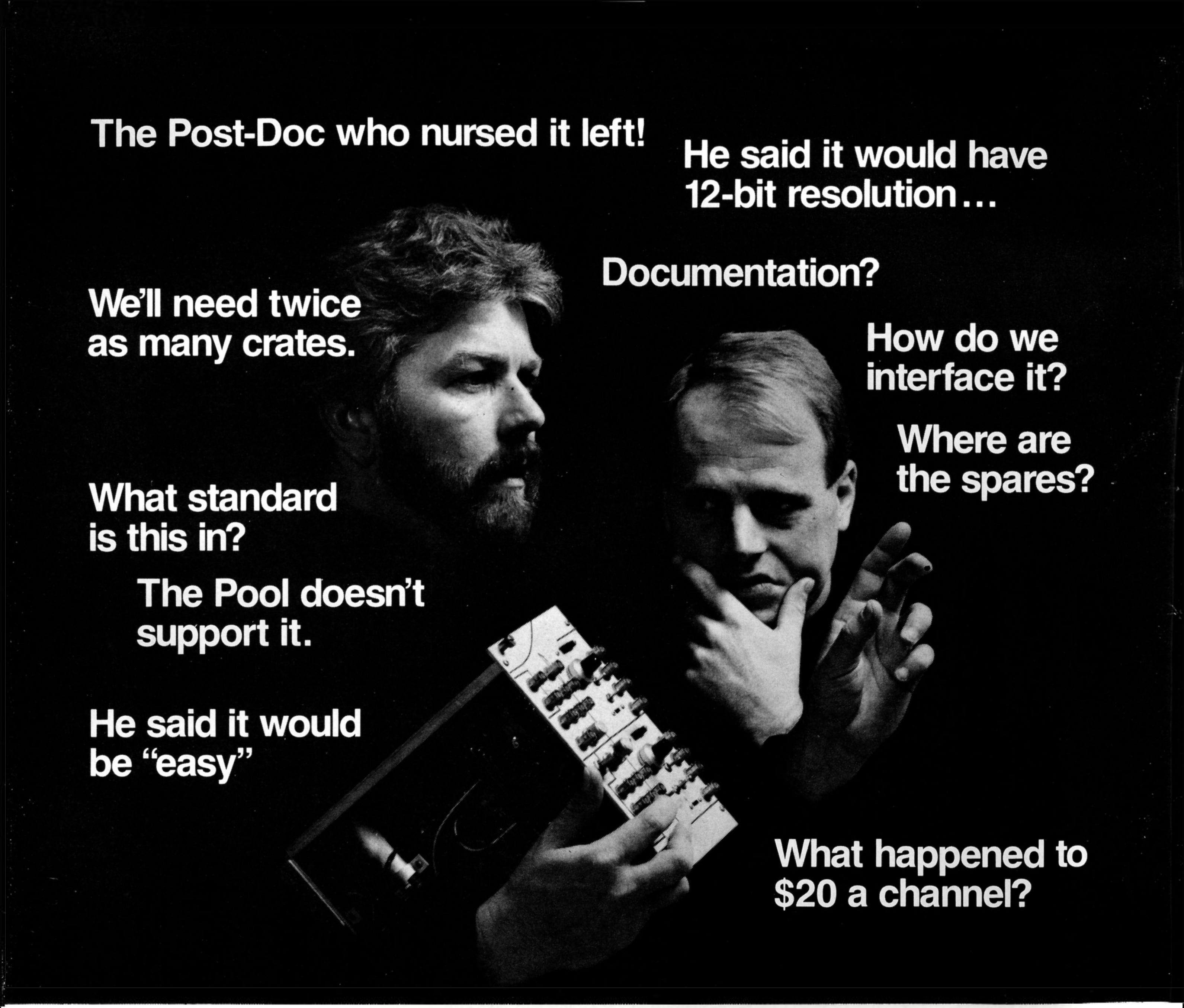
CERN COURIER

International Journal of High Energy Physics

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What standard is this in?
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He said it would be "easy"
What happened to $20 a channel?

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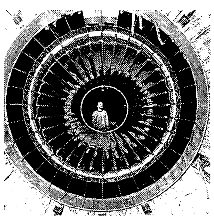
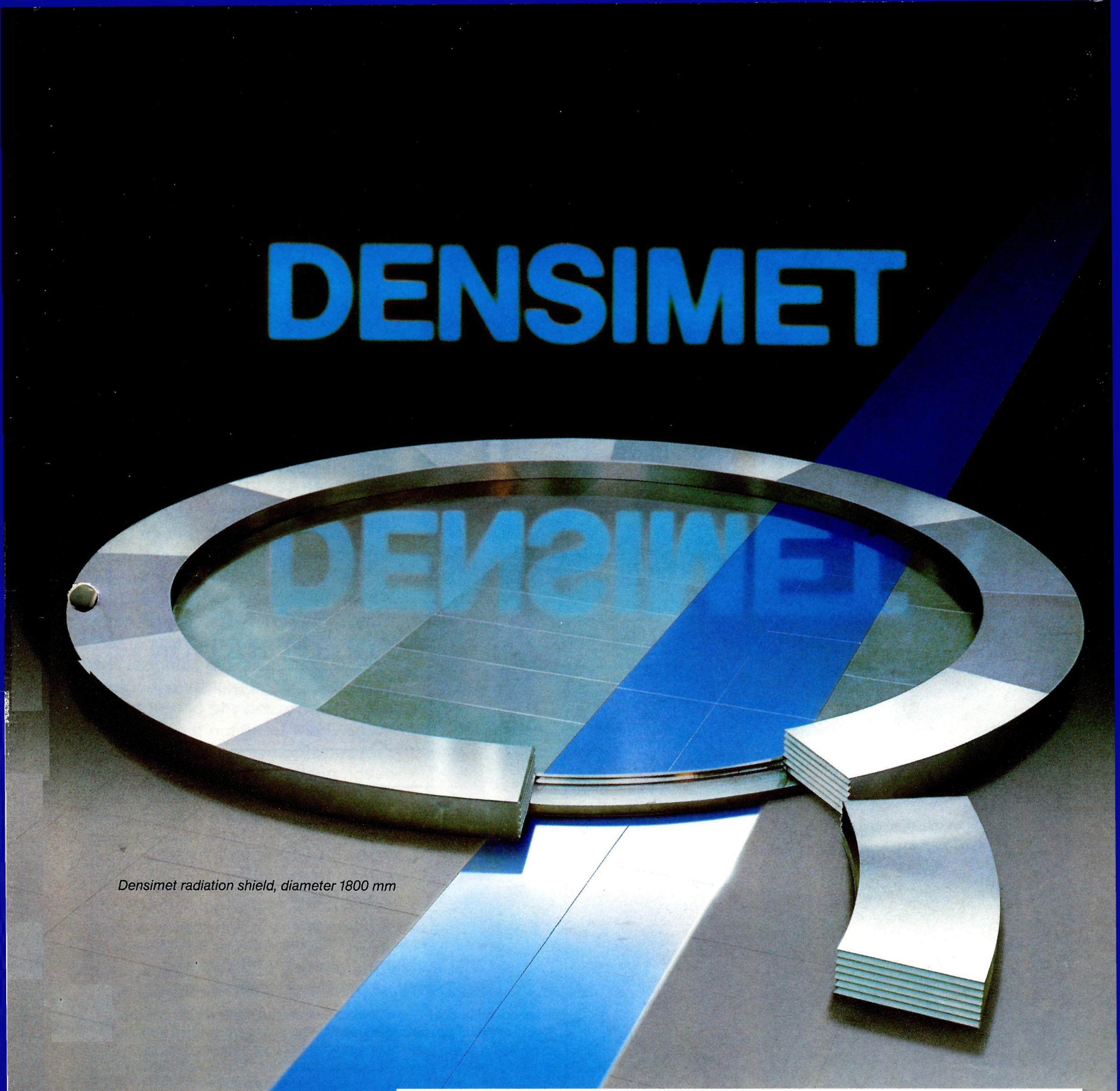


Cover photograph:
The PS195 experiment at CERN's LEAR low energy antiproton ring will extend the study of neutral kaon decays for additional information on the poorly understood phenomenon of CP (combined left-right and particle-antiparticle) symmetry violation (Photo CERN 91.2.89).



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Gran Sasso underground

The external buildings of the new Italian underground Laboratory in the Gran Sasso, near Rome. Data links bring out information from the detectors deep underground.

The first of the big detectors installed in the Italian underground laboratory at Gran Sasso is collecting its first events. The new laboratory is now in impressive shape with two of its three huge halls ready to receive detectors. An interesting experimental programme is lined up and there are already thoughts about future developments.

The Laboratori Nazionale del Gran Sasso, about 150 km from Rome and operated by INFN (Istituto Nazionale di Fisica Nucleare), is a major investment specifically for underground physics.

The construction of the Gran Sasso Laboratory was proposed by Nino Zichichi in 1981 taking advantage of the penetration of the mountain for a motorway. Its realization owed much to the support of Nicola Cabibbo, Zichichi's successor as President of INFN, and the Laboratory is now directed by Enrico Bellotti.

Conditions are particularly clean for 'passive' physics. The mountain provides about 1.4 kilometres of shielding from atmospheric cosmic rays and the surrounding rock is of low natural radioactivity. The three excavated halls are each 100 m long, 20 m high and 18 m across (with the connecting tunnels, some 180 000 cubic metres of rock were excavated). The halls have an inner sheath to protect equipment from the inhospitable 6 degree temperature and 95% humidity.

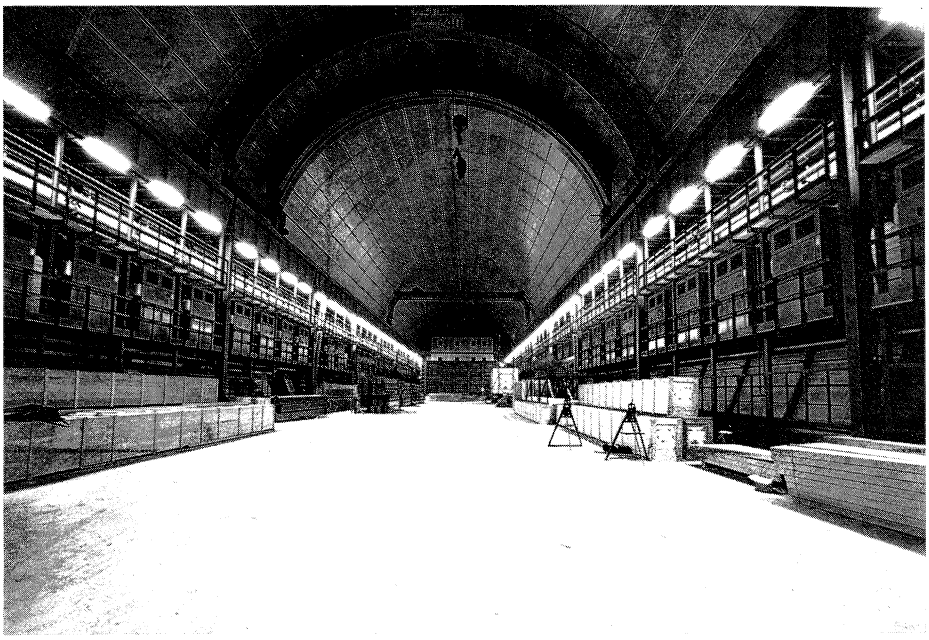
Hall A is divided in two halves. One half houses the Gallex detector to be used by a European/US team for a study of solar neutrinos (May 1987, page 26). It uses the neutrino conversion of a gallium atom to germanium and then applies sophisticated chemistry to sift out the germanium atoms which are counted via their radioactive decays. The anticipated rate of neutrino interaction is below one atom per day and flushing the detector tank every fifteen days means searching for fifteen atoms in thirty tons of gallium chloride.

Installation is on schedule for data-taking to begin early next year. The gallium is on site and the first of the 60,000 litre tanks has just been moved into the hall. (The second tank will be a reserve to receive the gallium in case of accident.)

The other half of Hall A is for LVD (the Large Volume Detector), involving a large collaboration including Italian and Soviet physicists. The framework is in place and the detector elements are being developed at Frascati and Turin as well as in the USA and USSR. The design is similar to the Mont Blanc underground detector but some twenty times larger, with 1800 tons of liquid scintillator and layers of streamer tubes to study neutrino astrophysics.

Hall B is the scene of the first major Gran Sasso data taking. Half of the Macro (Monopole, Astrophysics and Cosmic Ray Observatory) detector, involving an Italian/USA collaboration, has been installed and has been sensitive for several months. This 'catch-all' detector consists of sandwiches of scintillator, streamer tubes and absorber. Three of the six supermodules are now in action; when completed the

One of the three halls at Gran Sasso where detectors are being installed. At the far end are the first units of the Macro detector, eventually to grow to a length of 72 metres.



72-m detector will take up almost the full width of the Hall.

The internal sheath is almost complete for Hall C, assigned to the ambitious Icarus (Imaging Cosmic And Rare Underground Signals) experiment (May 1987, page 29), led by Carlo Rubbia. The detector is still being developed but its first phase is likely to involve some 300 tons of liquid argon. The final version is envisaged as a still larger volume surrounded by a solenoid magnet.

Outside, a series of stations to observe air showers have been tuning up for some time (the EAS-TOP Extensive Air Shower experiment), opening up the interesting possibility of correlating surface and underground observations.

Smaller experiments are taking advantage of the 'quiet' Gran Sasso environment. One has been looking for double-beta decay for the past year and two others are being prepared. A 2440 kg cylindrical aluminium antenna cooled to 0.1 K, sensitive to oscillations of a small fraction the size of an atomic nucleus, will look for oscillations induced by gravity waves.

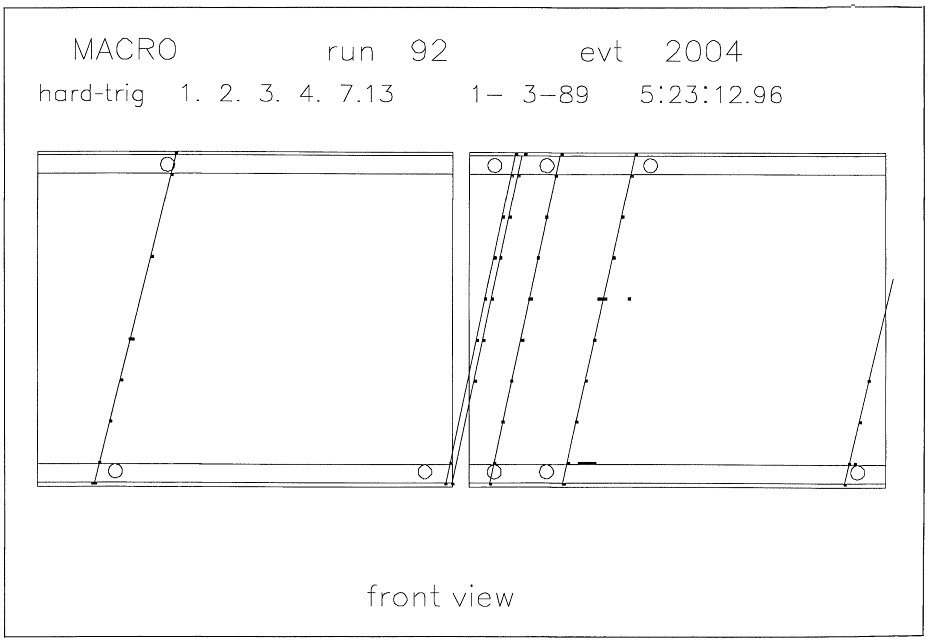
Geophysicists taking advantage of the unique environment have installed a very sensitive interferometer to study rock movements and have other experiments to measure electromagnetic wave and acoustic transmission.

STANFORD
First Z for SLC

The new SLC Stanford Linear Collider made its first Z particle (the electrically neutral carrier of the weak nuclear force) on 11 April. It was clearly seen to decay into back-to-back jets of hadrons in the Mark II detector, with nine charged particle tracks, and about 70 GeV of visible energy in both neutral and charged particles. The total collision energy of the event was 92.2 GeV. More Zs soon followed. The Z was discovered at CERN's proton-antiproton collider in 1983.

The present access to the Laboratory is along one tunnel of the mountain motorway, not yet open to public traffic. When this road is open, reaching the Laboratory will be difficult, and there is a project for a separate access. Two further smaller halls are also foreseen, together with a series of measures to improve the infrastructure, while longer-term plans include improved data communications and additional external buildings.

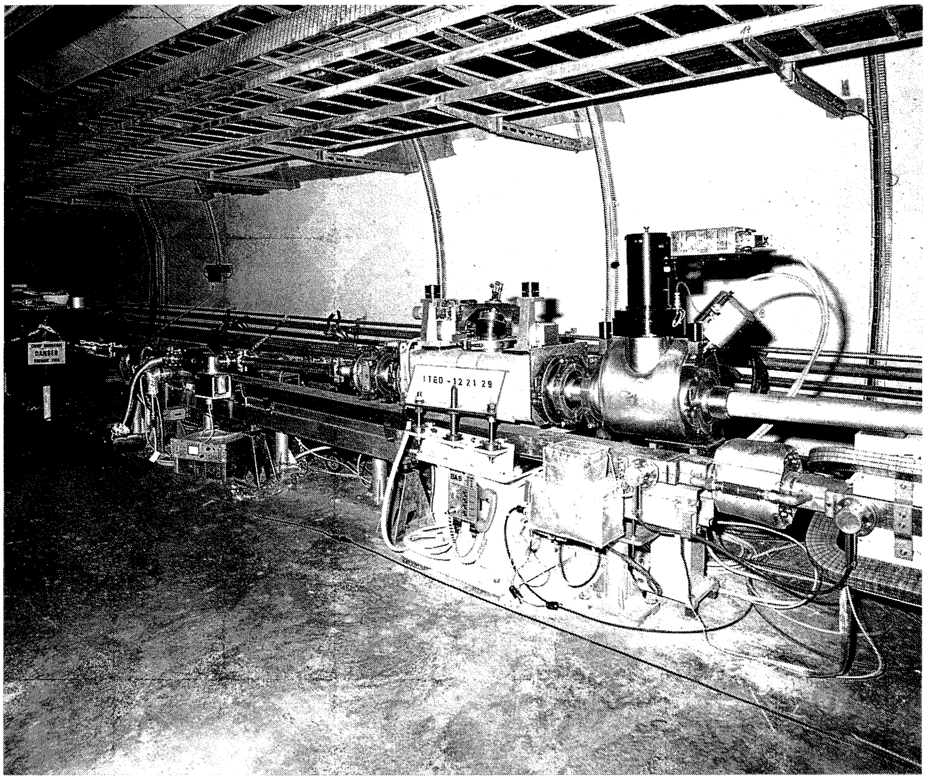
Projective view of a six-muon event as recorded in the first supermodule of the MACRO experiment, the first major detector unit to go live in the new Italian underground Gran Sasso Laboratory. The open circles represent the centre of a hit scintillator box.



Around the Laboratories

CERN's new LEP electron-positron collider will be commissioned in July with the injection line (top) from the SPS feeding in the electrons for the new 27 kilometre ring.

(Photo CERN 228.2.89)



CERN
Final preparations for LEP

With first colliding beams from CERN's new LEP electron-positron storage ring scheduled for this summer, the big push of machine installation is entering its last phase.

In May the final magnets will be placed in the 27 kilometre ring, and the last sectors of high vacuum in the beam pipe commissioned. The arduous programme of installation work goes hand in hand with a meticulous schedule of equipment testing, ensuring that the new machine will be in the best possible shape when the first beams arrive in July.

The carefully orchestrated machine debut is leaving nothing to chance, with commissioning proceeding through a series of prudently interlocked phases. A pilot physics run with 46 GeV beams is scheduled three weeks after initial injection of particles from the SPS injector in July and after the vacuum system has been put through its paces with circulating beams. In a subsequent commissioning phase, the superconducting low-beta quadrupoles will be turned on to squeeze the colliding beams and boost the luminosity (a measure of the collision rate).

The success of the injection test into the first completed octant of LEP last summer provided valuable experience and showed how well careful preparation can pay off.

First port of call on LEP's maiden voyage will be a physics run with 46 GeV electron and positron beams for an initial look at the physics of the Z particle – the electrically neutral carrier of the weak nuclear force, discovered at CERN in 1983.

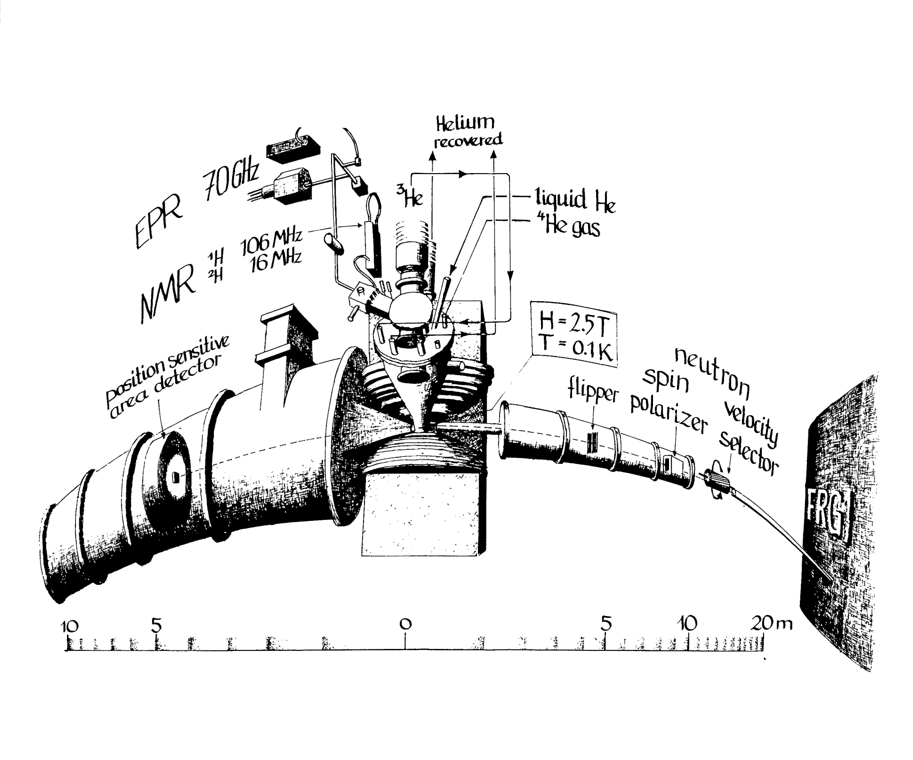
Even at initial luminosities of 2 x 10^{30} $cm^{-2}s^{-1}$ (LEP's design figure is 1.7 x 10^{31}), the four LEP experiments – Aleph, Opal, Delphi and L3 – will have the chance to intercept a few thousand Zs per day. With the total number of Zs clocked up so far at the big proton-antiproton colliders at CERN and Fermilab being only a small fraction of this number, a precision fix on the Z parameters would pay immediate physics dividends.

The physics aim for this year is to tune the machine to the Z production energy and sit there for as long as possible, with precision energy calibration to give maximum physics insight.

After beam currents of one milliamp during this year's run, next year should see the current tripled, with the machine attaining its design luminosity. The LEP team has put a lot of work into improving the machine's potential by looking closely at possible adverse beam-beam effects and instabilities. Beam currents of over a milliamp for each of the four colliding bunches are not excluded, eventually doubling the design luminosity.

On the energy front, LEP's 128 conventional radiofrequency acceleration cavities should be complemented by the end of this year by the first superconducting cavities, offering additional beam energy. The exact path to the higher LEP energies needed to produced pairs of W particles (the electrically charged carriers of the weak force) will be plotted in detail in the coming months.

Schematic of the polarized neutron technique for studying macromolecules. The particles enter from the reactor, right. The microwave power saturates paramagnetic compounds and the nuclear magnetic resonance monitors target polarization in a target set-up previously used in particle physics experiments. The scattered neutrons are picked up by a position sensitive area detector (left).



various proteins and ribonucleic acids.

Extensive tests on an albumin with a molecular weight of 68,000 gave promising results, demonstrating the power of the spin contrast variation method. However to reveal the fine details of molecular structure, a more intense beam of polarized neutrons is needed. A new cold source is being installed at the GKSS reactor, while a new dilution refrigerator will be able to cool targets down to 40 degrees millikelvin and boost polarization levels. In this target all helium-3 has been eliminated – in previous experiments its strong absorption of neutrons limited the accuracy of the results.

The technique is also being investigated at the Saclay and KEK Laboratories in France and Japan respectively.

Polarized neutrons probe organic molecules

The expertise in spin-oriented (polarized) targets developed in particle physics experiments is proving useful in the study of complex organic molecules, supplementing input from more conventional techniques such as X-ray diffraction. For example after lining up the spins of the target particles, neutron scattering has probed the protein structure of ribosomes (December 1988, page 17).

Additional information can come from using polarized neutron beams as well as polarized targets. Several years ago Anatole Abragam, chairman of the CERN Review Committee which published its final report in 1987, was one of the physicists who drew attention to this approach.

Meanwhile particle physicists had developed polarized targets using special organic materials (alcohols and diols) to achieve high hydrogen content. New paramagnetic organometallic compounds had been synthesized with deuterons in place of protons to improve the polarization levels, and to minimize thermal effects improved dilution refrigerators provided temperatures just a few tenths of a degree above absolute zero.

In a new series of experiments at the GKSS Research Centre in Geesthacht, West Germany, a GKSS/Munich/Chicago/CERN team looked at the scattering of spin-oriented neutrons (polarized by total reflection from the magnetized surfaces using a set of 'supermirrors') using polarized targets of

Plasma lens development

Beams of high energy charged particles are focused by magnetic fields such as those given by magnetic quadrupole lenses, or by devices producing azimuthal fields, such as a magnetic horn, or a 'wire' lens – a cylindrical conductor carrying an axial current.

Another possibility is to use the azimuthal magnetic field created by a column of current-carrying plasma, potentially superior to conventional focusing devices because of its high field gradient and transparency to a particle beam.

The first such plasma lens was designed and installed at Brookhaven's Alternating Gradient Synchrotron in 1965, and briefly succeeded in focusing a beam of sec-

Discharge tube for experiments at CERN looking at possibilities for focusing particles using the magnetic fields in a column of current-carrying plasma.

(Photo CERN 599.12.85)

ondary particles. The reasons for its failure were not well understood and for a long time the idea lay dormant as the fusion community concentrated on tokamaks.

The upgrading of CERN's Antiproton Accumulator Complex, with the addition of the Antiproton Collector ring, has boosted CERN's antiproton supply, calling for additional focusing power. Attention has centred on a plasma column 40 mm in diameter and 30 cm long, carrying a current of 400 kA using hollow electrodes.

Investigations so far have looked at a wide range of parameters – gas type, gas pressure, charging voltages, currents – in parallel with extensive computations to estimate the conditions in a real lens. Ongoing work requires a new pulse generator compatible with the plasma dynamics requirements and with the target area constraints.

With the objective of installing an operational lens in CERN's Antiproton Accumulator Complex, the programme is benefiting from a collaboration with the University of Erlangen-Nürnberg, with a grant from the West German Ministry of Research and Technology and additional resources from CERN.

Supergondolas and superbouchons

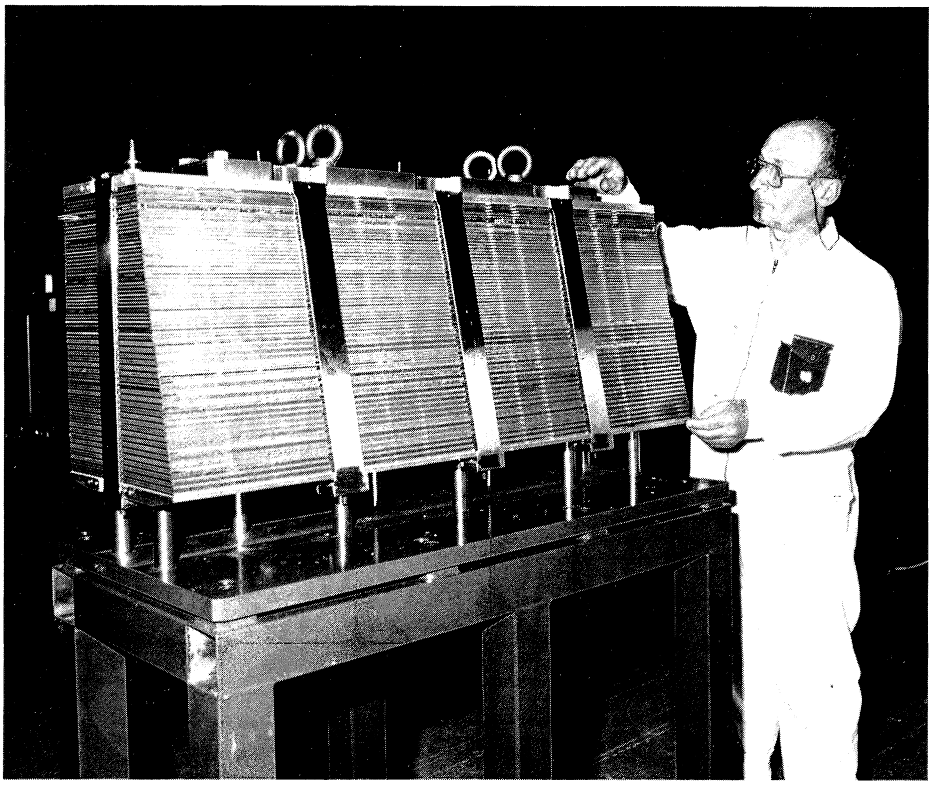
Making their debut at the big UA1 detector at CERN's proton-antiproton collider during the latest run are modules of a new calorimeter ('supergondolas' and 'superbouchons') using a revolutionary detection method which could well go on to become one of the standard techniques of tomorrow.

To take advantage of the increased proton-antiproton collision rates provided by CERN's new Antiproton Accumulator Complex, UA1's calorimetry (measuring the deposition of energy) was completely redesigned to improve the precision of mass measurements and the detection of 'jets' – the narrow sprays of particles given off when the quarks hidden deep inside the colliding particles clash together.

With no room in the already-crowded detector for cryogenics, the bold decision was taken to go for a completely new kind of material, picking up ionization at room temperature. After investigating several alternatives, the choice was TMP, tetramethylpentane, an or-

One module of the ten new 'supergondolas' for the UA1 experiment at CERN's proton-antiproton collider. It contains 38 2-mm layers and 24 5-mm layers of depleted uranium absorber interspersed with 62 boxes of containing TMP, an organic liquid which can contain free electrons at room temperature. Each supergondola contains 16 such modules. This revolutionary new method of calorimetry (measurement of energy deposition) could go on to become a standard technique in the detectors of tomorrow.

(Photo CERN 224.6.88)



ganic liquid which can contain free electrons. UA1's upgrade called for 13,000 litres of TMP, the largest quantity ever used so far.

Particle showers are created in sheets of depleted uranium, 300 tons in all. The increased neutron yield in the uranium ensures more equal responses from strongly interacting particles and electrons ('compensation'), improving also the hadronic energy resolution.

The TMP is contained in 34,000 3 mm-thick stainless steel boxes fitted with all the necessary electrodes, high voltage feedthroughs, filling pipes, etc. and manufactured by industry. The 40 cm-deep supermodules are built up using alternate layers of uranium and TMP boxes. In the electromagnetic section a position detector is inserted with horizontal and vertical strip electrodes to localize the shower.

To function properly, the TMP must be perfectly clean, free of all impurities which would otherwise capture signal electrons. Before assembly, all box components are ultrasonically cleaned in hot deionized water and then baked out under vacuum at 900°. The boxes are laser welded and after initial stacking are rinsed with hot ultrapure water, dried with pure argon, baked out at 300° under vacuum and then filled with pure TMP, previously cleaned using silica gel and molecular filters.

The perfection of all these techniques is the result of a heroic effort. In tests last year, the first complete modules gave excellent results, in particular giving the same results for electrons and positrons. This is promising for the new physics runs, and perhaps points to a new path for experimental physics.

MORIOND
Fifth force fervour

Was Newton right in thinking that the pull of gravity on a body is governed by its inertial mass? If he was, then all bodies have the same free fall acceleration, as Galileo tried to check in his classic but not very accurate experiments at the leaning tower of Pisa.

This equivalence of inertial and gravitational mass went on to become a basic principle in Einstein's general theory of relativity, and so is a cornerstone in our understanding of the Universe.

Successive experiments have checked this out to a precision of one part per billion under certain conditions. However several years ago some physicists began to think along different lines when a reanalysis of Eötvös' classic 1922 experiments found tiny systematic effects, hinting at a possible tiny matter-dependent repulsive force acting against gravity.

As matter is characterized by its nuclear composition, such an effect has implications for protons and neutrons. Perhaps there is a fifth force at work, supplementing the well known mechanisms of gravity, electromagnetism and the strong and weak nuclear forces. However while ingenious theorists can dream up a framework for such a force, it is not a vital part of ongoing physics ideas.

New experiments looking for non-Newtonian gravity were covered in the Moriond workshop 'Tests of Fundamental Laws of Physics', held recently in Les Arcs in the French Alps. The studies fall into two categories – those looking for composition-dependent forces and those searching for terrestrial deviations from the classical gravi-

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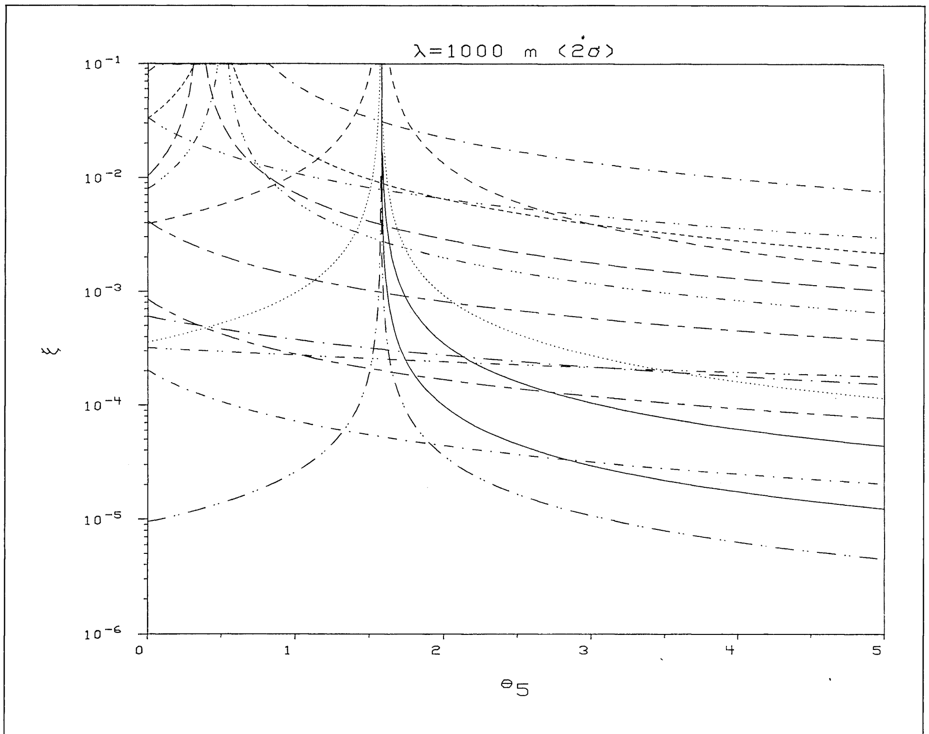
No room any more for a fifth force? Strength of an additional composition-dependent force (vertical axis) plotted against the mixing parameter relating this force to neutron and proton numbers. Unlike before (April 1988, page 11), there is now no region where positive and negative results are compatible. The lowest curve is from a lead-copper beam balance measurement by C. Speake and T. Quinn at the Bureau International des Poids et Mesures, Sèvres, near Paris.



tational pull which decreases as the square of the separation. (Deviations from this inverse square law are well known in extraterrestrial physics and are understood from general relativity.)

Four composition-dependent experiments were discussed. Riley Newman reported on a study by an Irvine group using a balance to compare the acceleration of lead and copper to that of lead. Measurements and systematics were completed with the experimenters blind to the results during 260 hours to eliminate any subjective bias. A null result emerged.

A positive result reported last year by the Washington group ('the Index experiment') was taken up by Paul Boynton. A further year's work has revealed several systematic effects but does not modify the original result. Upgraded equipment has improved sensitivity by an order of magnitude, and new measurements should soon be complete.

Pier Bizzeti covered the Florence/INFN 'Vallombrosa Experiment' which floats a 10-cm nylon ball on a stratified solution of potassium bromide. After many systematic and auxiliary studies, no fifth force effects are seen.

Eric Adelberger and Chris Stubbs presented results from the Washington 'Eöt-Wash' project. Significant apparatus improvements have led to a 25-fold increase in sensitivity over the 1987 results. They use a four-mass beryllium-copper or beryllium-aluminium torsion balance rotating relative to a hill or a lead source, and new data clearly precludes a composition-dependent effect of the strength originally suggested. They have also been able to test the equivalence of gravitational and inertial mass for the Earth's gravity to a level of less than 3×10^{-11}, reaching the same sensitivity as previous measurements which compared objects falling towards the sun, but extending the validity of the limit.

A possible resolution of the apparent discrepancies between different results has been proposed by Goldman, Nieto and Hughs using a two component model inspired by quantum gravity. However the Eöt-Wash Experiment showed that with the ranges which might be inferred from geophysical experiments, this model is not compatible with the resultant composition-dependent couplings.

With new composition-dependent experiments not confirming earlier positive results, the composition-independent experimental situation is not yet resolved either. Don Eckhardt summarized the status of the Air Force Geophysics Lab tower experiment which last year hinted at a small deviation from Newtonian inverse-square gravitation. The technique is to measure gravity on the ground surrounding the tower, extrapolate the gravitational field up the tower and compare with measured values. During the past year scrutiny has uncovered some biases in the ground survey which decreased the discrepancy. Additional measurements are needed at another tower.

Such an experiment, by a Colorado team, was discussed by Tim Niebauer and Clyde Speake. Efforts began last August on a 300 metre tower with studies of how vibrations could affect the gravimeter measurements. The conclusion was that under appropriate weather conditions, the measurements are unaffected. Preliminary data taken above 100 metres was in reasonable agreement with the Newtonian prediction. However final conclusions await more ground measurements in the immediate vicinity of the tower to take care of

the enormous sensitivity to even slight local gravity anomalies.

An experiment by a Lawrence Livermore team using a 465 metre tower at the Nevada Test Site was described by Paul Kasameyer and Jim Thomas. A ground survey of 280 measurements made within 2.6 km of the tower was combined with 60,000 measurements from a gravity data base of the Western United States maintained by the U.S. Geological Survey. A preliminary analysis was consistent with Newtonian theory.

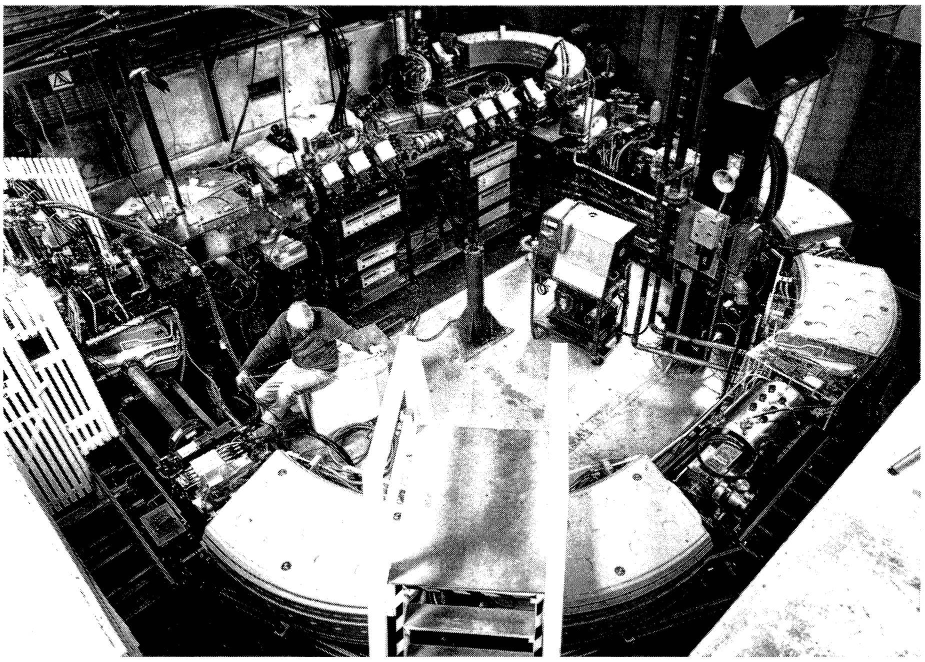
Mike Gorman and Richard Hughes presented a composition-independent study by a collaboration working in Greenland. Instead of going up a tower, they went down a 1700 metre borehole into the ice cap, comparing the extrapolation of surface gravity with underground measurements. Their comparison is perturbed by effects from the ice-rock interface and the calculated ice density shows almost a 4% deviation from the inverse-square law. However they cannot rule out the effect being due to gravitational anomalies in the rock substrata, and are seriously considering moving to a better location in Antarctica.

Plans for new 'fifth force' experiments include measurements of the free fall of electrons and positrons as well as protons and antiprotons. Theoretical presentations looked at the open possibilities and their implications.

Summarizing, Frank Calaprice of Princeton could point to the progress over the past year with 'many beautiful experiments'. The remaining 'serious discrepancies' are being examined by ongoing experiments.

Workshop report from Orrin Fackler and Marshall Mugge

Now completed at Fermilab is the 250 MeV proton synchrotron for the Loma Linda Medical Center in California. After tests at Fermilab it will be shipped to Loma Linda this summer.



FERMILAB
Medical machine takes shape

The proton synchrotron being built at Fermilab for the Loma Linda University Medical Center, California, has been completed. Beam has been accelerated to the maximum design energy of 250 MeV and extracted. Commissioning studies are underway and will last until July, when the accelerator will be dismantled and shipped to Loma Linda for installation.

The use of protons for cancer therapy was first suggested by Robert Wilson in a famous paper published in 1946. The great advantage of protons or other heavy charged particles is the localization of dose because the particle dumps most of its energy at the end of its trajectory (the Bragg peak). The cyclotron Wilson built at Harvard has been used for this type of therapy for several years.

Treatment has also been available at the Lawrence Berkeley Laboratory, using first the 184-inch cyclotron and later the Bevalac, and at laboratories in Sweden, the USSR, Japan, Switzerland, and Canada, and has recently begun in South Africa. However all this work has made use of accelerators built for research and subsequently adapted for therapy.

The rapid development in the last few years of new imaging methods has made it possible to locate a tumour with high precision, complementing the dose localization possible with protons.

In April, 1986, Loma Linda and Fermilab agreed that Fermilab would design and build a synchrotron with a maximum energy of 250 MeV to be used specifically for therapy. Fermilab personnel have also contributed to the design of the remainder of the Loma Linda facility. Science Applications International Corporation was chosen as an industrial partner.

DO detector progress

Fermilab's 1988-9 proton-antiproton collider run has been a great technical success, and to capitalize on the physics potential (so far mainly exploited by the big CDF detector) Fermilab is pushing to bring the DO Detector into full operation for the next collider run in winter 1990.

Based on early experience with the big UA1 and UA2 detectors at CERN's proton-antiproton collider, the DO design was built around optimal lepton identification, good measurement of transverse energy balance to pick up otherwise invisible particles, and full coverage of narrow sprays of secondary particles ('jets') with fine segmentation and excellent energy resolution.

To gain space for lepton identification, and since at high energy calorimetric energy resolution is good, DO has no central magnetic field. This results in a compact calorimeter (inner active radius 84 cm) and makes space for lots of muon identification on the outside of the detector.

Calorimetry is DO's speciality. Liquid argon was chosen to give a stable active medium with excellent radiation resistance and fine segmentation. The primary absorber is uranium to help equalize electromagnetic and hadronic energy response (compensation).

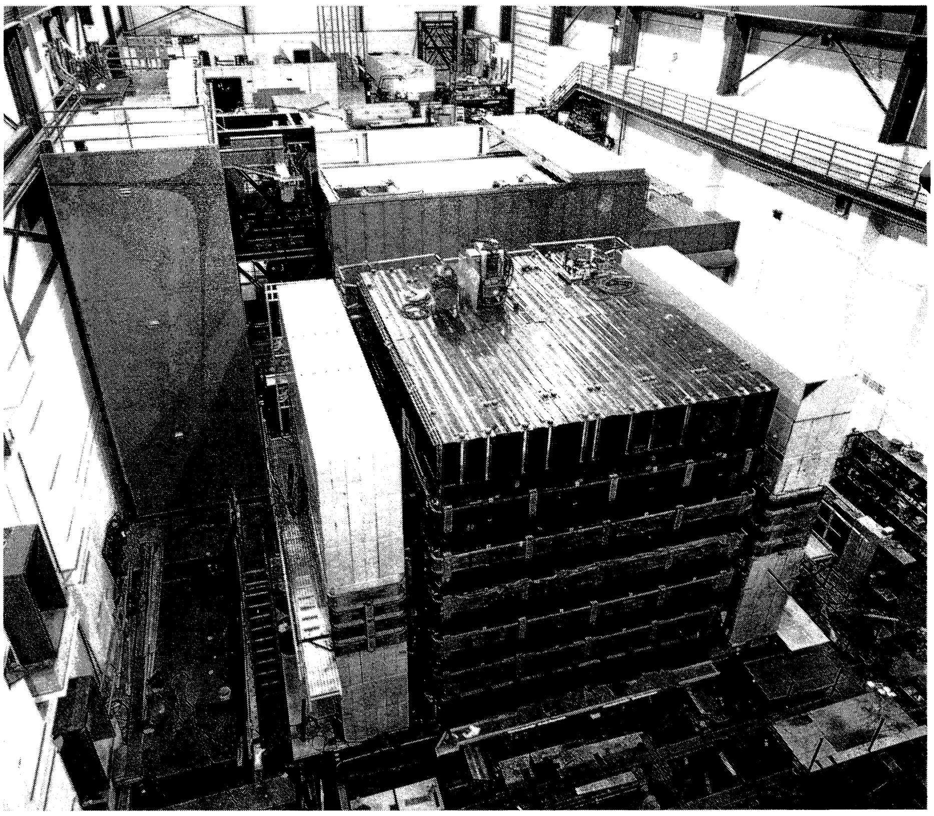
Approximately square readout pads are arranged into projective towers pointing to the luminous region, with optimal granularity to give accurate position resolution for electrons and photons (tests show better than 2 mm photon resolution) and electron/hadron differentiation (500:1 hadron rejection has been measured for the calorimeter alone). The hadronic sections of the calorimeters are further subdivided, giving excellent energy resolution. Electron identification is further assisted by transition radiation detection.

Because both tracking and calorimetry are so compact, the muon identification system can be correspondingly larger, using three large magnetized toroids and two smaller toroids for small angles. The thickness of absorber means that remnants of hadron showers provide little background for muons. With muon trajectories having typically 10 points before and after the magnetic bend, measurements of high transverse momentum particles are possible, opening the door to heavy quark studies.

Much of the work of building the DO detector is now finished, including TRD, central drift chamber, central calorimeter modules, muon chambers, and muon toroids. By the summer, vertex and forward/backward drift chambers as well as the first set of end calorimeter modules should be complete. Substantial testing of detectors and systems has already led to useful modifications.

Installation of detectors and electronics is now underway and trials of the full system have begun, with signals taken through digitization and triggers to the data acquisition system using DO standard on-line software. Elements of both the muon chamber system and the central drift chamber are in their approximately final locations and the first collisions in the DO interaction region have been observed.

A view of the completed toroids for the DO detector at Fermilab's proton-antiproton collider. DO should begin physics next year.

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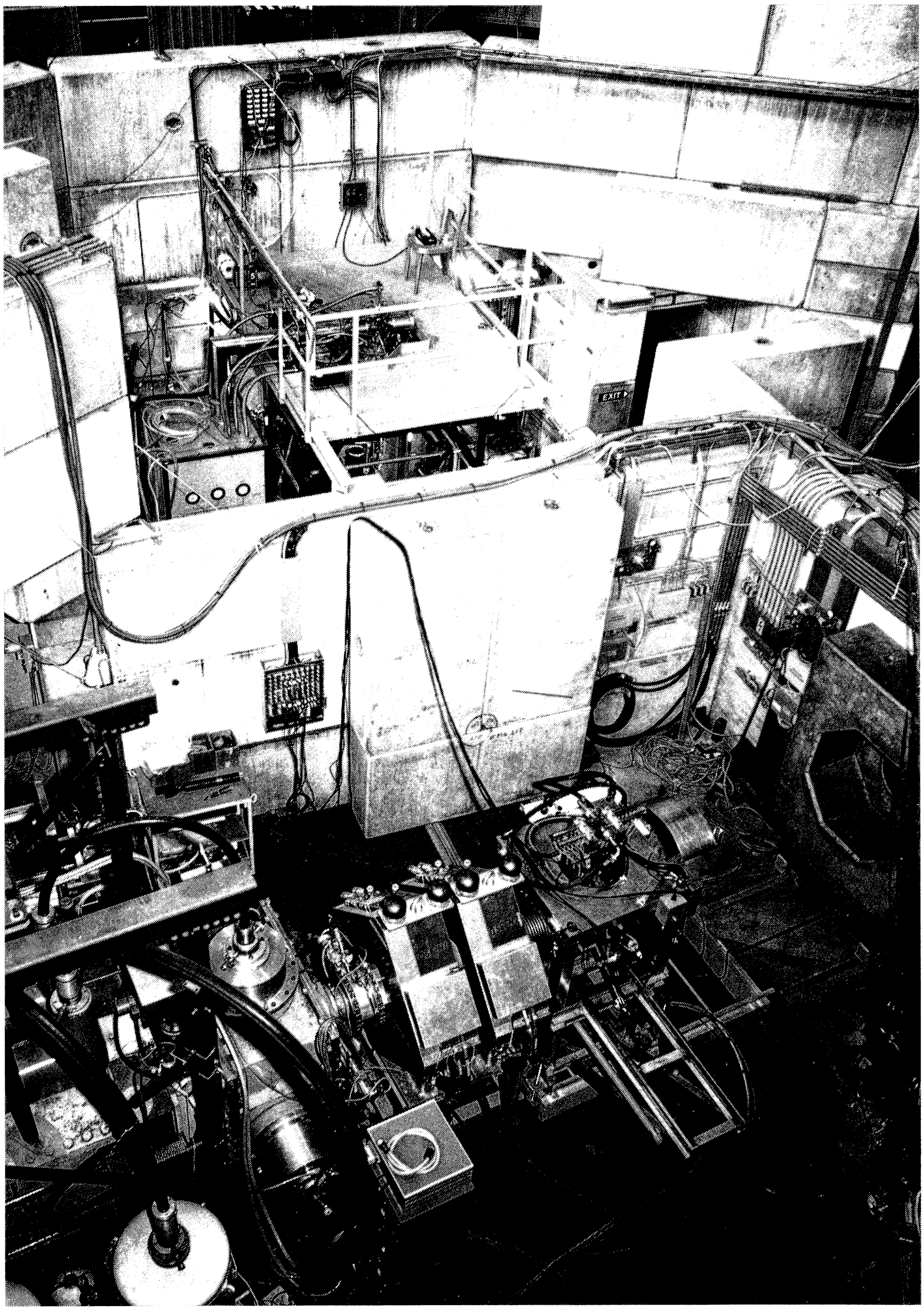
Muon spin rotation station at the Swiss Paul Scherrer Institute's 600 MeV cyclotron, with (foreground) the muon spin rotation equipment and (rear) cryogenics.



PSI
Swiss-made particles

What were formerly called the Eidgenössisches Institut für Reaktorforschung (EIR – Swiss Federal Institute for Reactor Research) and the Schweizerisches Institut für Nuklearforschung (SIN – Swiss Institute for Nuclear Research) on opposite banks of the River Aare have now been formally amalgamated as a single national Laboratory, the Paul Scherrer Institut (PSI – March 1988 issue, page 29).

Apart from participation in experiments at other research centres, notably the L3 detector nearing completion at CERN's new LEP electron-positron collider and at CERN's LEAR Low Energy Antiproton Ring, PSI particle physics activity centres on the Institute's 600 MeV cyclotron.

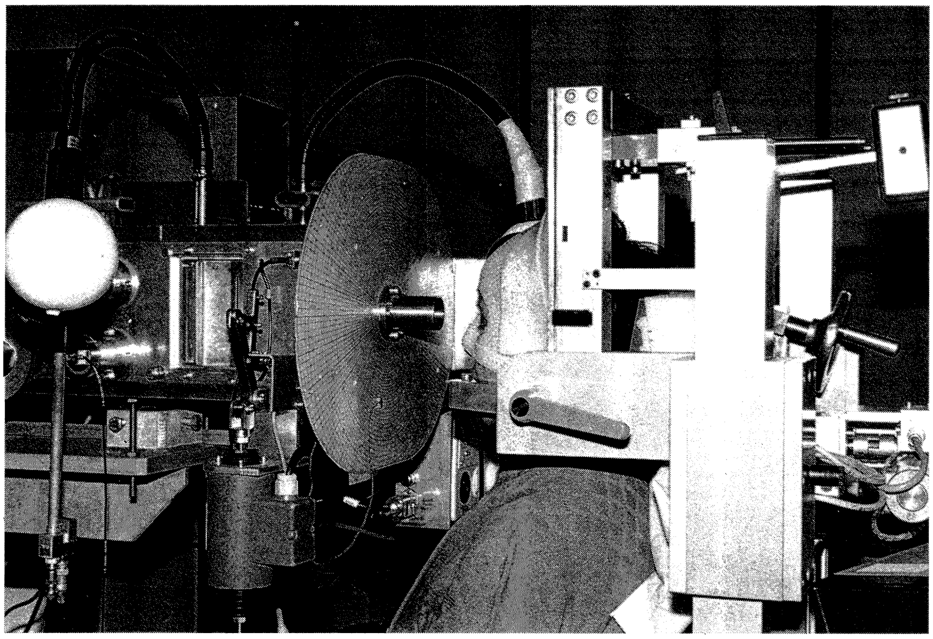
With proton currents already attaining 250 microamps, increasing to 700 next year, and with further improvements promising up to 1.5 milliamps by 1993, PSI is one of the world's three 'meson factories' (along with Los Alamos and TRIUMF, Vancouver). Such high proton currents could also open the door for a proposed spallation neutron source.

Much groundwork has also been done for a proposed B-meson factory, a new electron-positron collider supplying beams up to 7 GeV (July/August 1987, page 21). High collision rates, with luminosities of 10^{33} cm^{-2} s^{-1}, or even higher, would ensure lots of physics with B-particles (containing the fifth 'beauty' quark).

International interest in this machine is assured, and if the green light is given, about a third of the funding would come from outside Switzerland (mainly from West Germany, which has a tradition of collaboration at the Institute). A recent workshop in Paris looked at the emerging plans for the detectors to exploit this ambitious machine. One interesting possibility is 'asymmetric' collisions, with unequal electron and positron beam energies to improve the kinematics for intercepting short-lived secondary particles.

With the current PSI beams, the new SINDRUM II detector (PSI/Zurich/Aachen/Saclay/Swierk (Poland)/Tbilisi (USSR) collaboration) is

Irradiating an eye tumour with 72 MeV protons at the Paul Scherrer Institute. Several hundred cases have been treated since 1984.



continuing the tradition set by its predecessor in pushing out the limits for 'forbidden' decays prohibited by the selection rules of today's Standard Model physics.

Ruling out such forbidden decays to less than one in a million million ordinary decays greatly increases confidence in the underlying physics and provides an additional physics frontier, complementing the push for higher collision energies. Using improved techniques, SINDRUM II hopes to push some limits out to less than one decay in a hundred million million.

Muon spin rotation is now an established tool for materials science, and applications at PSI have included studies of new superconducting materials for IBM's Rüschlikon Research Laboratory.

Also making use of PSI beams is PIREX, a collaboration with Lausanne, looking at radiation resistance in the context of a Euratom study of materials for use in future fusion machines.

Since 1980, over 400 cancer patients have been treated with secondary pion beams from the 600 MeV cyclotron, a special 'Piotron' irradiation device having been developed to concentrate the beams. 72 MeV protons from the PSI injector are used to treat superficial tumours, particularly for melanomas of the eye. Plans for irradiation using 200 MeV protons are well advanced, with special techniques having been developed to optimize the proton dose for maximum effect.

BROOKHAVEN
Switched power

Hosted by Brookhaven's Center for Accelerator Physics, a recent workshop on switched power techniques attracted a group of specialists to Shelter Island, New York, location of several important physics meetings, including the famous 1947 sessions which helped mould modern quantum electrodynamics.

The current interest in switched power stemmed from a series of papers by W. Willis of CERN, starting in 1984. The idea is for stored electrical energy to be suddenly switched onto a transmission line, producing a very short (about 10 ps) electromagnetic pulse in a region traversed by a particle beam.

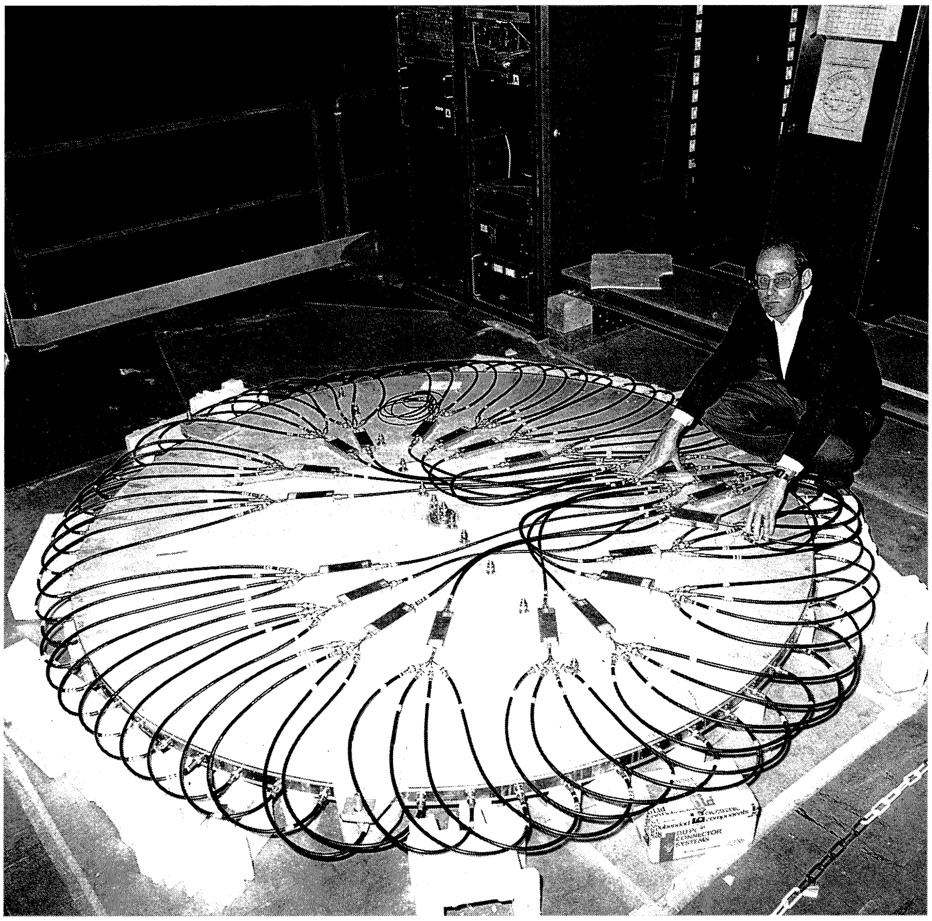
Because the pulse is so short, there is no time for breakdown to set in, and so it may be possible to obtain much larger fields (of the order of 1 GV/m) than with conventional techniques. These high fields might be used, for example, for high brightness electron sources, high gradient accelerating sections, or quadrupoles.

The crucial component is the switch to transfer power to the transmission line, and there are currently four ideas on the market. In the vacuum photodiode method a wire (either of an easily ionizable material or photosensitively coated) is charged to many kilovolts. A short laser pulse then leads to a discharge in a short gap to the wall of the transmission line. This technique is being investigated by T. Srinivasan-Rao and J. Fischer at Brookhaven and by M. Boussoukaya at Orsay. The US group has concentrated on readily electron-emitting metals and has obtained current densities of over 60 kA per square cm. Boussoukaya has studied field-enhanced photoemitters such as needles and microetched silicon wafers.

In the solid state switching method the high voltage is separated from the transmission line by a small piece of semiconductor such as silicon or gallium arsenide. A short laser pulse closes the switch by generating electron-hole pairs in the semiconductor. A series of experiments are already underway by W. Donaldson and E.

Looking at switched power possibilities. This scale model radial transformer built at CERN showed how pulses from the outer rim can give a compressed electric field towards the centre.

(Photo CERN X246.2.87)



lincke at the University of Rochester.

F. Villa at the Stanford Linear Accelerator Center (SLAC) has proposed using high pressure gases as the switch, with a short laser pulse initiating the discharge.

The fourth method is an interesting attempt to create the short pulse directly by Fourier synthesis – adding together the outputs of around ten suitably phased frequency generators to produce a resultant short pulse in a cavity. It is being studied by H. Haseroth and F. Caspers at CERN, with a trial experiment now underway at Wuppertal.

Much attention centred on radial transmission lines, with a pulse at the outer radius of a disc structure giving an increased electric field as the pulse is compressed inwards. Additional gain could come from tapering the line along the beam direction (the common axis of the discs). F. Villa has proposed a clever method of close packing using twisted, tapered lines.

R. Palmer (Brookhaven/SLAC) proposed an initial application of switched power for a high brightness electron gun incorporating a photocathode, and using a 3 MV/m accelerating voltage, 2 mm gap, 10 ps accelerating pulse, and 100 fs electron pulse.

At the workshop, working groups looked into the switching methods to produce the pulse, the matching of the initial power supply circuitry to the transmission line, the design of the radiofrequency cavity and photocathode, and the production of a suitable short laser pulse.

Calculations showed the possibility of developing an electron gun up to a hundred times brighter than the design value of the radiofrequency gun now under test at Brookhaven's Accelerator Test Facility (April 1987, page 21). If this can be achieved, switched power may have an important role to play in future accelerator construction.

STANFORD
Internal targets

Of burgeoning interest to many nuclear and particle physicists is a storage ring technique for fixed target experiments. It hinges on the use of gas-jet targets, shooting a narrow stream of atoms (hydrogen, helium, argon, xenon, ...) through a circulating beam of electrons or protons.

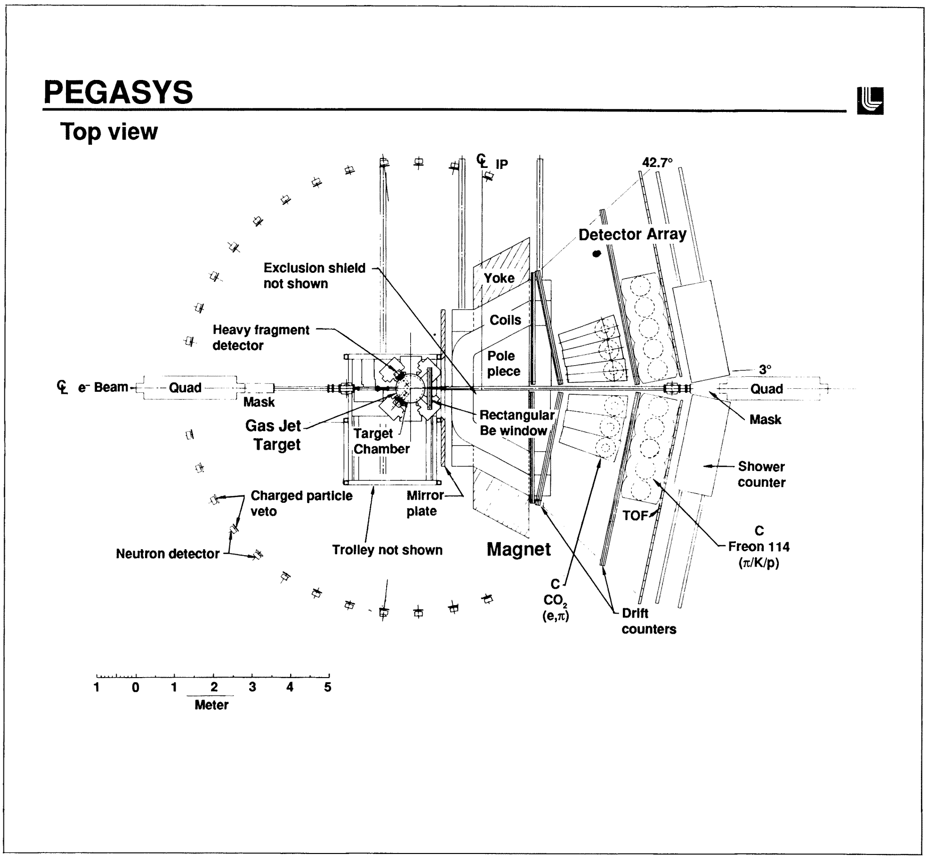
Pioneered at CERN and the Soviet Novosibirsk Laboratory, more such 'internal targets' are being built or contemplated for storage rings in Europe, the Soviet Union, and the United States.

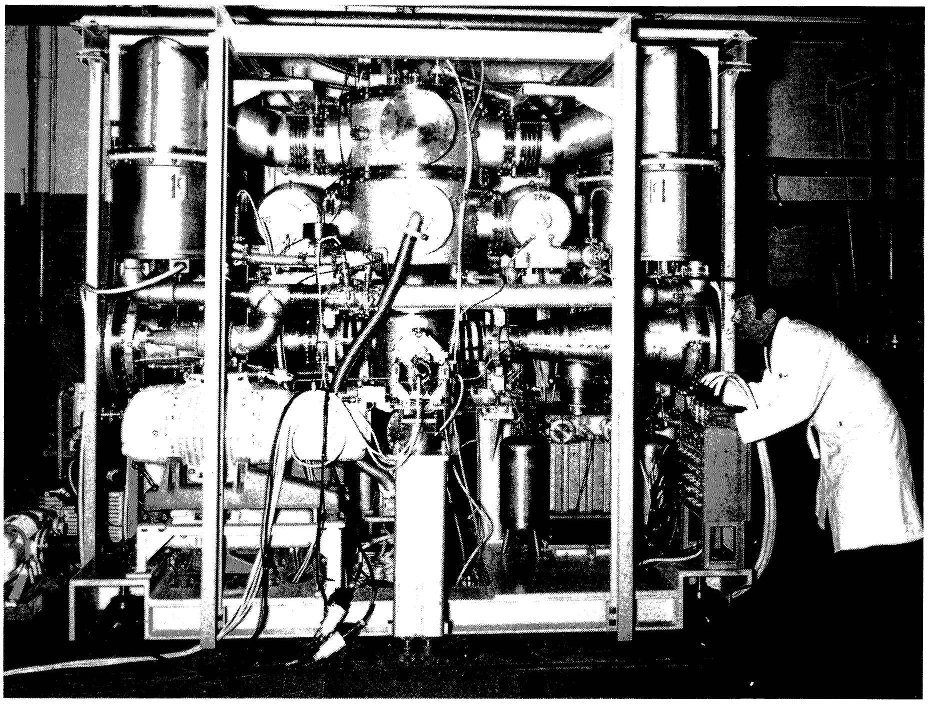
From 9-12 January, physicists from around the world met at the Stanford Linear Accelerator Center (SLAC) to discuss prospects and problems in this expanding field. Opening with a discussion of the physics possibilities at electron storage rings with internal targets, Stan Brodsky of SLAC noted that electroproduction continues to be the definitive path to explore the quark and gluon structure of nucleons (structure functions).

Recent surprising revelations by the European Muon Collaboration (EMC) at CERN, reviewed by Frank

Above, schematic of the PEGASYS internal target proposed for Stanford's PEP electron ring. Below, a gas jet internal target developed for beams stored in CERN's SPS ring.

(Photo CERN 347.12.82)





Close of Tennessee, suggest that the proton spin might not be due merely to the spin of the quarks (June 1988, page 9). Some theorists propose that the gluons are responsible, while others point to orbital motion of the quarks. Whatever the case, electron scattering from polarized targets should help provide some answers.

The subsequent 'hadronization' of a quark violently struck in deep inelastic scattering was another subject of strong interest. By studying the hadrons produced when leptons scatter from different nuclei, noted Andreas Bialas of Cracow, physicists can gain added insight into this poorly understood process. So far most of these experiments have used beams of muons and neutrinos at CERN and Fermilab. However the intense electron levels available from storage rings would open up the hadronization process in greater detail.

Providing high average currents that appear almost continuous to a particle detector, the circulating electron bunches in a storage ring are far better suited for detecting several secondaries in coincidence than are the short pulses extracted from most electron accelerators. A large-acceptance detector could analyse most of the spray of particles and nuclear fragments produced in electron-nucleus collisions.

Karl Van Bibber of Livermore described the PEGASYS internal target scheme proposed for SLAC's PEP storage ring. The PEGASYS collaboration aims to study both the fate of the struck quark as it hadronizes and the response of a nucleus to the sudden removal of one of its quarks.

Another advantage is that slow particles and heavy nuclear fragments are not absorbed in a 'thin'

People and things

internal target and can thus reach detectors. A whole new class of nuclear structure measurements therefore becomes possible, using heavy fragment 'tags' at low energy storage rings. Stan Kowalski outlined the 1 GeV electron stretcher ring and internal target facility under construction at the MIT-Bates accelerator, and Kees de Jager revealed similar plans for NIKHEF in Amsterdam.

Other potential internal-target dividends include polarized nuclear targets. The recent EMC surprises in muon scattering from polarized protons have whetted theorists' appetites for similar measurements on the neutron, requiring targets of polarized deuterium or helium-3.

Richard Milner of MIT discussed recent work on a novel polarized target of optically pumped helium-3 atoms and described a proposal to measure the quark spin structure of nucleons in the HERA electron-proton collider being built at the German DESY Laboratory in Hamburg.

Several other speakers, among them Louis Dick of CERN, described the wide range of plans to use internal targets in circulating proton or antiproton beams. Martin Perl of SLAC showed how PEGASYS might even be used to search for new particles.

Providing useful insights into the range of new experiments possible with internal targets, the Topical Conference on Electronuclear Physics with Internal Targets drew large contingents from CERN and MIT; Caltech, Fermilab, Frascati, Livermore and Novosibirsk were also well represented. The Conference was organized and chaired by Ray Arnold of American University, Coordinator of the NPAS (Nuclear Physics At SLAC) programme.

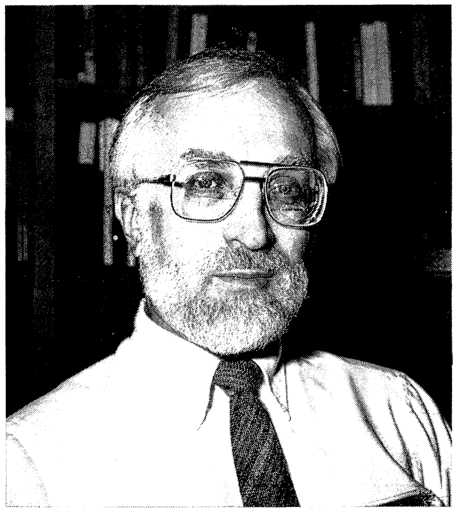
From Michael Riordan

On people

*The Alexandre Joannides Prize, a major award of the French Academy of Sciences, goes this year to **Raymond Stora** , research director at the French Centre National de la Recherche Scientifique working at LAPP (Annecy) and CERN, for his work in the renormalization of non-Abelian gauge theories, where with his students A. Rouet and C. Becci, he developed the BRS formulation, a cornerstone of modern quantum field theory. In other areas, his contributions to particle theory have been both profound and wide-ranging.*

*The 1989 J.J. Sakurai Prize for Theoretical Particle Physics goes to Italian theoretician **Nicola Cabibbo** for his 'outstanding contribution to elucidating the structure of the hadronic weak neutral current'. In 1963, Cabibbo supplied a framework to describe the weak decays of particles carrying strange quarks, a vital step towards the current picture of three interrelated 'families' of leptons and quarks.*

***Stan Schriber** takes over from Bob Jameson as Head of Los Alamos National Laboratory's Accelerator Technology Division.*



Stan Schriber is the new Head of Los Alamos National Laboratory's Accelerator Technology Division.

New Berkeley Director

Charles Vernon Shank, 45, currently Director of the Electronics Research Laboratory at AT and T Bell Laboratories in Holmdel, New Jersey, becomes Director of the Lawrence Berkeley Laboratory from 1 September, succeeding David A. Shirley, who will return to chemistry.

German Awards

Among the awards for this year by the Deutsche Physikalische Gesellschaft is its highest annual accolade, the Max Planck Medal, to Bruno Zumino of Berkeley, and the Robert Wichard Pohl Prize to Wolfgang Paul.

A member of CERN's Theory Division from 1969 to 1982 and for several years its Leader, Zumino is well known for his fundamental contributions to the field theory of elementary particles, characterized by deep insight and mathematical and logical rigour. In 1974 came his pioneer work with Julius Wess which led to the formulation of supersymmetry.

Wolfgang Paul, who celebrated his 75th birthday last year, has made numerous contributions to atomic and nuclear physics, including ingenious systems to handle electrically neutral particles, and was a driving force behind the Bonn electron synchrotron. At CERN from 1964-67, he was first joint Head of Nuclear Physics Division, then Director of Physics I Department. He was Chairman of CERN's Scientific Policy Committee from 1975-77.

Fermilab Director Leon Lederman (right) with V. Vranic of the Ruder Boskovic Institute, Zagreb, at the recent European Physical Society Seminar on International Research Facilities, held in Zagreb.

(Photo Maurice Jacob)

Nishikawa steps down

On 31 March, Tetsuji Nishikawa retired as Director-General of the Japanese National Laboratory for High Energy Physics (KEK). During his twelve-year term of office KEK has developed from modest beginnings into a prestige Laboratory reflecting Japan's status in the world.

Established in the new Tsukuba 'science city' in 1971, KEK's progress has been marked by the commissioning of the 12 GeV proton synchrotron in 1976, the Photon Factory with its dedicated 2.5 GeV Synchrotron Light Source and the Booster in 1982, and the site-wide TRISTAN electron-positron collider in 1986. First as Director of the Accelerator Department and then as Director-General, Nishikawa has led these ambitious projects as both an outstanding accelerator specialist and as a physicist with broad scientific interests.

His keen international awareness has opened KEK to research teams from abroad, and has furthered the US/Japan cooperation scheme in high energy physics, the UK/Japan cooperation in neutron scattering, and 'summit' working groups.

The new KEK Director General is Hirotaka Sugawara.

Centre, the CERN auditorium was packed on 31 March to hear Martin Fleischmann (Southampton) who with fellow electrochemist Stanley Pons of Utah has seen effects in modest experiments suggesting that nuclear reactions such as fusion are being induced.

(Photo CERN 489.3.89)

▶ Probir Roy of the Tata Institute of Fundamental Research, Bombay, India, receives the 1988 Shanti Swarup Bhatnagar Award from Indian Prime Minister Rajiv Gandhi.

THE COMMISSION OF THE EUROPEAN COMMUNITIES

is carrying out a selection procedure with a view to drawing up a reserve list from which to appoint staff in grade A3 for implementing the

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Closing date: requests for application forms must be made in writing not later than 15.5.89 (postmark) to the following address: C.E.C., Secretariat for Selection Committees Research, SDME R2 / 82, rue Montoyer 75, B-1040 Brussels (tel.: 02 / 235.56.60).

These application forms, duly completed and signed, must reach the above address not later than 6.6.1989.

Eligibility: candidates must ensure that: □ the above deadlines are met; □ their application form is legible, complete and signed; □ copies of certificates and other documents specified in the application form are attached; □ the other conditions set out above are satisfied, failing which they will be disqualified.

The Commission is an equal opportunities employer.

ACCELERATOR SCIENTISTS AND ENGINEERS

Argonne National Laboratory will be entering the construction phase of its 7-GeV Advanced Photon Source (APS) Project. The APS is a state-of-the-art synchrotron x-ray source optimized to produce insertion-device radiation. APS accelerator facilities comprise a 7-GeV low-emittance positron storage ring 1100 m in circumference, a 7-GeV synchrotron, a 450-MeV positron accumulator ring, a 450-MeV positron linac, and a 200-MeV electron linac. The challenges of building the facility offer great potential for professional growth for scientists and engineers in the following areas:

ACCELERATOR SCIENTISTS

Several positions at various appointment levels are available for candidate with experience and interest in accelerator design, including computer simulation of beam dynamics, calculation of coupling impedance and collective effects, particle tracking simulation, lattice design, vacuum and surface physics, beam diagnostics, and magnetics and magnet design. Appointment level will depend on the candidate's experience. Entry-level or postdoctoral positions will be available.

ELECTRICAL ENGINEERS

Two senior positions are available, requiring an advanced engineering degree and at least ten years' experience in design and construction of large particle accelerators. Work experience in accelerator-type magnets and/or power supplies is highly desirable. We also have several positions requiring BSEE and a minimum of five years' experience in the following areas:
• Design and power electronics • Multi-kilowatt power supplies • Low-level fast electronics • Beam diagnostics.

MECHANICAL ENGINEERS

A senior-level position is available, requiring an advanced ME degree at least ten years' experience in mechanical engineering aspects, such as ultra-high vacuum and structural design, of the design and construction of large particle accelerators. We also have several openings requiring a BSME and a minimum of five years' experience in the following areas:
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CERN Accelerator School

CERN's Accelerator School and Uppsala University, Sweden, are jointly organizing a course on Advanced Accelerator Physics, to be held in Uppsala from 18-29 September. Students should have a basic knowledge of accelerators, and the course is designed to highlight the problems of small rings. Further information from Mrs. S. von Wartburg, CERN Accelerator School, LEP Division, CERN, 1211 Geneva 23, Switzerland. Next year, CERN's Accelerator School is organizing a course on Power Converters for Particle Accelerators, from 26-30 March in Montreux, Switzerland. Further information from the above address or by e-mail from caspower at cernvm.cern.ch.

Ernst Michaelis

Ernst Michaelis died on 17 March. Although not one of CERN's real pioneers, he arrived at the new Laboratory in 1957 just in time for the first beam at the new 600 MeV Synchro-Cyclotron (SC). Going on to become SC Division Leader, his dynamic leadership resulted in the successful SC improvement programme of the mid-1970s. Until his retirement in the early 1980s, he spent his last few years at CERN in experimental physics, and continued an active physics career in Oxford after he left Geneva.

CERN's phone number

CERN's general telephone number has changed from Geneva 83 61 11 to Geneva 767 61 11. For direct dialling, use 767 followed by the four-digit internal number. Thus the CERN Courier's new number is Geneva 767 41 03. (The international dialling code for Geneva ends with 4122.)

World Laboratory

The new World Laboratory headquarters in Lausanne, Switzerland, were formally opened on 7 March. On 5-6 May its General Assembly and Scientific Committee reviewed major changing projects.

Germany at CERN

Under the auspices of the Federal Ministry for Research and Technology
(Building 60)

23.05.-25.05.1989

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- Development and manufacturing of complete systems
- Material technology:
- • Surface physics. Powder metallurgy.
- • Surface and thin film analytics. Coating technology. Ceramics development
- Energy technology:
- • Systems technology. Thermodynamics
- • Aerodynamics. Thermal analysis Cryotechnology. 3D Navier. Stokes equation solution which is precise with respect to time
- Manufacture:
- • Manufacture of complex mech./electron. systems. Fibre composite components E.B. welding. Simulation and manipulation systems. Structures for highly dynamic motions. Complex strength calculation. Gas ultra-centrifuge
- Further activities:
- • Electronics. Environmental technology
- • Information and communications technology. Transport technology. Space Technology

Products exhibited:
- Cavity CFK technology
- Coating technology. Surface analysis

Dräger

Drägerwerk AG

Postfach 1339
D-2400 Lübeck 1
Federal Republic of Germany

Telephone: FRG - (451) 882-0
Telefax: FRG - (451) 882-2080
Telex: 26807-0 dwl d

Contact person at the stand and in the enterprise:
ellwig Bauer

Dräger (Schweiz) AG

Letzigraben 134 A
CH-8047 Zürich
Telephone: 01/4915400

Main production lines:

Breathing Protection
Compressed Gas Technology
Filter Technology
Gas Detection
Medical Technology
Diving Technology

Exhibited products:

Gas detection tubes and sampling devices. Electronic gas measuring devices. Escape mask, Filters, Self rescuers Compressed Air Breathing Apparatus.

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fug

F.u.G. Elektronik GmbH

Florianstrasse 2
D-8200 Rosenheim

Telephone: (0 80 31) 8 10 93
Telefax: (0 80 31) 8 10 99
Telex: 5 25 712

Contact persons at the stand:
G. Giebichenstein, E. Fritz, F. Weber

Contact persons in the enterprise:
G. Giebichenstein, E. Fritz, Rosenheim
F. Weber, Zürich

Representative (CH):

Elektronik-Ingenieurbüro
Fritz Weber, Dipl.-Ing. ETH
Großplatzstr. 24
CH-8122 Pfaffhausen-Zürich

Telephone: (01) 825 1844
Telex: 826 224

Production line:

General purpose DC power supplies from 7 W to 35 kW, more than 200 standard types
High-voltage DC power supplies up to 150 kV
High-current DC power supplies up to 10000 A
All power supplies are possible with IEEE-Bus-Interface

Special power supplies for:
- supra conductive magnets
- capacitor charging
- photo-multipliers
- micro-wave tubes
- ion sources

Power supplies to customer's specifications

Products exhibited:

High-voltage DC power supplies, various models, up to 35 kV
High-voltage cassettes up to 35 kV
General purposes DC power supplies up to 2,8 kW

HEINZINGER electronic

HEINZINGER electronic GmbH

Anton-Jakob-Strasse 4
D-8200 Rosenheim
Telephone: (0 80 31) 44 04-0
Telefax: 440 444
Telex: 525 777 hemes d

Contact person at the stand and in the enterprise:

Dipl.-Ing. Hugo Führling

Production line:

High precision power supplies
- Highest stability with thyristor preregulation and transistor linear controller, up to 500 V
- Only thyristor controller, with L/C-filter, up to 500 V
- Bipolar supplies, four-quadrant operation
- Special supplies for the operation of superconductive coils
  Special supplies for operating discharge lamps with
- high-precision control
- Electronic load
- High voltage supplies, off-line switch-mode, up to 500 kV
- Capacitor charging unit
- AC bench power supplies, up to 6000 V
- High voltage DVM, up to 32/65/131 kV
- IEC-Bus IEEE 488

Products exhibited:

High and low voltage power supplies
High voltage DVM
Laboratory power supplies

Heraeus QUARZSCHMELZE

Heraeus Quarzschmelze GmbH

Product Division POL ★ Quartzglass for Optics & Lamps

Product Division PLW ★ Quartzglass for Optical Fibers

Quarzstraße
D-6450 Hanau - 1
Telephone: (0)6181 - 367338 (POL), Mr. R. Sellner
Telephone: (0)6181 - 367342 (PLW), Mr. M. Kiehl
Telefax: (0)6181 - 39420
Telex: 4 184 854

Contact persons at the stand:

R. Kunz (WISAG), Dr. Englisch (POL)
Dr. Klein (PLW)

Swiss Affiliate

WISAG

Wissenschaftliche Apparaturen und Industrieanlagen AG
Oerlikonerstrasse 88
8057 Zürich
Telephone: (01) 311 40 40, Mr. R. Kunz
Telex: 823218
Telefax (01) 311 56 36

Main Product Lines:

Various grades of fused quartz and synthetic fused silica with optical transmission ranging from about 180 nm to 4 um.

Main product lines are:
- cut, ground or polished blanks (plates, disks, windows, lenses, prisms, mirrors, rods)
- Fluosil® preforms for optical fibres
- mirrors, ultra-lightweight-mirrors
- doped quartzglass with modified optical transmission
- tubes, ampoules, other special parts manufactured to customers drawings and specifications

French Affiliate

Heraeus S.A.

Z.A. Courtabœuf, B.P. 18
91941 Les Ulis Cédex
Telephone: 0033 - 1 6907 6500, Mr. R. Durand
Telex: 042 600 037
Telefax: 0033 - 1 6928 1245

- crucibles, flasks, dishes, beakers, quartzglass wool, and other laboratory equipment
- quartzglass for semiconductor applications, diffusion tubes, ampoules, jigs, expitaxy bell jars
- Rotosil®, opaque fused silica tubes, columns, crucibles, bell jars
- infrared radiators, water distilling apparatusses
- Wickbold combustion apparatus

Exhibited products:

Ingots, plates, windows, cubes,
prisms, corner prism,
optical fibre preforms,
optical fibres

At the same stand:

Heraeus WITTMANN

HERAEUS-WITTMANN GmbH

Englerstraße 11
D-6900 Heidelberg
Telephone: (06221) 30 43-0
Telefax: (06221) 30 43 43
Telex: 461 823

Contact persons at the stand and in the enterprise:

Mssrs. Lohse/Theise (Tel. 06221/3043-2927)

Swiss representation:

WISAG AG

Oerlikonerstraße 88
CH-8057 Zürich
Telephone: (1) 311 40 40
Telefax: (1) 311 56 36
Telex: 823 218

Contact person:

Hans-Jürg Schawalder

Products exhibited:

- Heated parts for vacuum technology and standard products

Production line:

Advising, planning and manufacturing of heating systems for vacuum parts:
- Recipients
- Vacuum gate valves
- Pumps
- Vacuum chambers
- Cavities

Standard production line of Heraeus-Wittmann
- Heating tapes up to 900°C
- Heating elements up to 1000°C
- Regulators and Controllers

LEYBOLD

LEYBOLD AG Hanau

Wilhelm-Rohn-Strasse 25
D-6450 Hanau
Telephone: (06181) 34-0
Telefax: (06181) 34-1690
Telex: 415 206-0 lhh d

Contact persons at the exhibition:

Mr. Müller, LEYBOLD AG Köln
Mr. Fischer, LEYBOLD S.A. Lausanne

LEYBOLD S.A.

Rue de Bassenges 13
1024 Ecublens/Lausanne
Telephone: (021) 691 8414
Telefax: (021) 691 6273

LEYBOLD AG Köln

Bonner Straße 498
D-5000 Köln 51
Telephone: (0221) 347-0
Telefax: (0221) 347-1250
Telex: 888 481-0 lh d

Affiliated companies in Switzerland:

LEYBOLD AG

Oerlikoner Strasse 88
8057 Zürich
Telephone: (01) 311 5757
Telefax: (01)312 5083
Telex: 823 212

Production line:

Vacuum process engineering
Measuring and Analytical technology
Vacuum Technology

Products exhibited:

Turbomolecular Pumps
Cryopump
Vacuum Valve
Vacuum Gauges
UHV Components

Linn High Therm

Linn High Term GmbH

Heinrich-Hertz-Platz 1
D-8459 Hirschbach/Eschenfelden
Telephone: (09665) 1721-25
Telefax: (09665) 1720
Telex: 63902

Contact person at the stand:

Roland Waitz

Contact person in the enterprise:

G. Schlegl

Representative in Switzerland

Häberli Härtetechnik AG

Tscharnerstraße 39
CH-3000 Bern 14

Production line:

Laboratory furnaces up to 1150°C with 100% fibre insulation.
High temperature furnaces up to 1800°C, gastight and vacuum; working under air up to 2100°C.
Induction remelt furnaces for sample preparation of metallic materials under air, protective gas atmosphere or vacuum for emission, X-Ray, AAS, ICP or RFA.
Induction fusion furnaces for sample preparation of oxidic materials.
High frequency semiconductor generators for any kind of inductive heating.
ICP sources 27.12 MHz and 40 MHz.
Tube furnaces with different heating zones (up to 22).
Induction casting system for Titanium.
Meltspin and powder granulation systems.
Image furnaces and special furnaces on customer's request.

Products exhibited:

HF-Generator HTG 1000/1,3 kW
HF-Remelt-Furnace Inductherm 3,3 μP Vac
Laboratory Furnace VMK

MERCK

E. Merck

Frankfurter Straße 250
D-6100 Darmstadt
Telephone: (06151) 72-0
Telefax: (06151) 72-33 68
Telex: 4 19 328-0 em d

Contact person at the stand:

Dr. Knöchel

Contact persons at the enterprise:

Mr. Strupp and Mr. Bauer

Main production lines:

- Special reagents and ready-to-use preparations in application-oriented purity
- Sorbents, HPLC columns and ready-to-use TLC plates
- Ready-to-use analytical test kits for the mobile analytics in the field
- Pure substances and ready-to-use mixtures
- Enzymes, nucleic acids and speciality reagents for biochemical research, analysis and molecular biology
- Chemicals for Crystal growing
- Evaporation Chemicals
- Process Chemicals
- Monocrystals – Optics and Scintillators

Products exhibited:

- Monocrystals – Optics and Scintillators
- Chemicals for Crystal growing
- Liquid crystals

NTG

NTG Neue Technologien GmbH u. Co. KG

Im Steinigen Graben 12-14
D-6460 Gelnhausen-Hailer
Telephone: (0 60 51) 60 03-0
Telefax: (0 60 51) 60 03-55
Telex: 4 184 320 ntg d
Teletex: 60 51 19 14

Contact person at the stand and in the enterprise:
W. Pick, Tel. 0 60 51/60 03 30

Production line:
- Nuclear Technics
- Nuclear Power Plant Service
- Nuclear Power Plant Equipment
- Tritium Technology
- Nuclear Medicine
- Beamline systems
- Cryo Technology
- Laser Optical Chambers
- Astro Physics
- Bio Technics
- Surface Coating Plants
- Vacuum Furnaces for Heat Treatment
- Vacuum Induction Furnaces
- Sintering Furnaces
- Measuring Devices
- Plant Installation

Products exhibited:
- Various
  Beamline - Diagnostic elements
- VIDEOFILM Vacuum components
  and Hightech-Products

PFEIFFER
Ein Unternehmen der Gruppe
BALZERS

BALZERS

Arthur Pfeiffer Vakuumtechnick Wetzlar GmbH

Postfach 1280
D-6334 Asslar
Telephone: (06441) 802-0
Telefax: (06441) 802-202
Telex: 483 859

Contact persons at the stand:
K. Abbel (Pfeiffer)
Dr. G. Prüfer (Pfeiffer)
H. Pilet (Balzers-Gland)
Telephone: (022) 64 30 65
Telefax: (022) 64 36 52

Balzers Hochvakuum AG

Postfach 186
CH-8035 Zürich
Telephone: (01) 363 32 66
Telefax: (01) 362 46 23
Telex: 817 005

Manufacturing program specially for the nuclear technology
- Pumps and pumping units (cryo-, titanium-sublimation and turbomolecular)
- Measuring instruments for medium, high and ultra-high vacuum as well as helium leak detectors (standard versions and on customer's specification including radiation resistant vacuum measuring equipment)
- Quadrupole mass spectrometer for measuring the partial pressure and residual gas analysis
- Ultra-high vacuum systems for coating of e.g. supracontacting layers
- Vacuum installation for UF_6.
- UHV unit for metallurgic testing
- Components for accelerators and storage rings as e.g
- Alvarez-structure as 50 MeV H-linear accelerator
- 760 keV – radio-frequency-quadrupole-accelerator
- Special chamber of a central tracking detector for a H1-experiment
- Gas jet target for a celsius storage ring
- Electrostratic septum chamber for a celsius storage ring
- 1,8 k cryostat for a superconducting electron recyclotron

PLANSEE

Metallwerk Plansee GmbH

Siebenbürgstrasse 23
D-8923 Lechbruck
Telephone: (0 88 62) 86 11
Telex: 5 97 47 plan d

Contact persons at the stand:
Edgard Bachmann, Ernst Barwa,
Rudolf Klemencic, Erich Kny

Contact person in the enterprise:
Rudolf Klemencic
Tel. (0043 56 72) 70 26 64

Production line:
* Composite materials:
- tungsten/copper
- tungsten/silver
- tungsten/carbide/copper
- chromium copper
- heavy metals (tungsten/nickel/iron/copper (DENSIMET), machined heavy metal parts as radiation shields)
- tungsten bonded to copper
- metal ceramics

* Sintered polyimide (SINTIMID)
  Shaped parts as material in high gamma radiation environment, high vacuum and low as well as high temperature use
* Refractory metals:
- molybdenum
- tungsten
- tantalum
- niobium

Products exhibited:
Heavy metals, Mo30Co foils and sintered polyimide

DR. B. STRUCK

Dr. Bernd Struck

Bäckerbarg 6
D-2000 Tangstedt

Telephone: (04109) 55-0
Telefax: (04109) 5533
Telex: 2 180 715 tegs

Contact persons at the stand:

Dr. Bernd Struck, Dipl.-Ing. Ronald Ölschläger, Dipl.-Ing. Volker Wöbber

Contact person in the enterprise:

Dr. Bernd Struck/Dipl.-Ing. Ronald Ölschläger

Production line:

CAMAC products
NIM products
FASTBUS products
Physical Trigger Systems
Track processors
VME products
Microprocessor developments Z 80, 68000, 68020
Bloodgasanalyser, gradientoven, animal feeding processors.
Oceanographic research - IEEE 488 products relative navigationsystems
Military developments

Products exhibited:

FASTBUS products, Crate, CI, SI, GMP, CHI, SFDM
VME-products, Crate, VIP, VSB, FASTLOGIC

VACUUMSCHMELZE

VACUUMSCHMELZE GmbH

Grüner Weg 37
D-6450 Hanau 1

Telephone: (0 61 81) 362-1
Telefax: (0 61 81) 36 26 45
Telex: 4 184 863

Contact person at the stand:

Reinhard Dietrich

Contact persons in the enterprise:

Reinhard Both, Tel. 06181/362-289
Reinhard Dietrich, Tel. 06181/362-634

Agency:

Matthées AG

Peter-Merian-Str. 22a
CH-4002 Basel

Telephone: (061) 22 20 77
Telefax: (061) 22 84 58
Telex: 96 27 70

Production line:

- Inductive Components
- Soft magnetic cores and parts
- Magnetic shielding
- Magnetically shielded rooms
- Soft magnetic semi-finished products
- Amorphous materials
- Sub assemblies and magnet-systems
- High grade permanent magnet alloys
- High field superconductors
- Mineral insulated electrical conductors
- Thermostat metals
- Expansion and glass/ceramic to metal sealing alloys
- Age hardenable spring materials
- Sensor

Products exhibited:

Samples of superconductors for some different projects

Wandel & Goltermann

Electronic Measurement Technology

Head Office:

Wandel & Goltermann GmbH & Co.

Electronic Measurement Technology
Postfach 12 62
D-7412 Eningen u.A.

Telephone: (07121) 860
Telefax: (07121) 884 04
Telex: 7 29 833 wug d

Contact person at the stand and in the enterprise:

D. Fuchs

Representative in Switzerland:

Wandel & Goltermann (Schweiz) AG

Postfach 254
Spitalackerstraße 51
CH-3000 Bern 25

Telephone: (031) 42 66 44
Telefax: (031) 42 61 33
Telex: 912 350 wg ch

Main production line:

Audio and LF Measurement Technology
Spectrum and Network Analysis
Measurement Technology for Digital Communications and PCM Systems
Data and Protocol Analysis
Data Network Diagnostics
Distortion Measurement Technology
Fiber Optics Measurement Technology
Test and Monitoring Systems

Exhibited products:

Spectrum and Network Analyzer
Data Analyzer for ISDN
Bit Error Measuring Set
Jitter Meter
Fiber Optics Source and Power Level Meter

WES-Crates Kristensen

Wes-Crates GmbH

Pattburger Bogen 33
D-2398 Harrislee

Telephone: (0461) 75 202
Teletex: (2627) 46 13 09 = Kristen
Telefax: (0461) 75 075
Telex: 17 461 309

Contact persons at the stand and in the enterprise:

Jørgen L. Kristensen, Kay Peters

Production line:

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

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

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

NIM
- Crates
Power Supplies, Linear and Switch Mode
Fan Units

Crates and Power supplies in Custom Design.

Products exhibited:

CAMAC – Crate with Switch Power Supply, Dataway and Fan Unit
FASTBUS – Crate with Switch Power Supply, Backplane and Fan Unit
VME – Crate with Power Supply Backplane and Fan Unit

At the same stand:

INTEGRAL

INTEGRAL Technologie GmbH

P.O. Box 1910
D-2390 Flensburg

Telephone: (0461) 999 333
Telefax: (0461) 999 399
Telex: 17 461 340
Teletex: 461 340 tg flens

Contact person at the stand and in the enterprise:

Joachim Paul

Product line:

Energy Technology
- Refrigeration Engineering
- Refrigeration Plants
- Waste Heat Power Stations (ORC-Plants)
- Chillers using Water Vapour instead of Refrigerants such as CFCs or Ammonia
- Ice-Machines for pumpable (soft), Slurry-Ice used for Ice-Banks, Hydraulic Cooling Systems, and Air/Space-Conditioning

Water-Treatment Plants with Low Energy Consumption
- Volume-Reduction of Liquid (Water) by Vacuum Distillation
- Concentration of Liquids (Water) with Suspended or Dissolved Solids
- Systems to Prepare large Quantities of Desalinated Water for Boilers and other Industrial Processes

Products for Energy technology:
- High-Performance, Small Size Heat Exchangers with Low Pressure-Drop and High Operating Pressure and Temperature
- Boiler/Steam - Leak Detector
- PLC-Control Systems for Plants and Machinery

Production of Machine-Parts, Structures and Systems

Products exhibited:
- Heat Exchanger of High Performance, Small Size and for High Pressure and Temperature

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WIENER STROMVERSORGUNGEN
ein Unternehmen der WIKA-Firmengruppe

Hans Wiener GmbH + Co.

Müllsersbaum 18
D-5093 Burscheid 2 (Hilgen)

Telephone: (0 21 74) 20 34-36
Telefax: (0 21 74) 6 31 30
Telex: 8 515 523 wiel d

Contact persons at the stand:

M. Plein, Tel.: s.a.
U. Vogt: Tel. 00 41 22/61 53 52

Contact persons in the enterprise:

M. Plein

Product range:

NIM-CAMAC-FASTBUS power supplies and crates
VME-MULTIBUS power supplies and crates
EUROPA type power supplies
Switch mode supplies
from 60 W to 12 kW
DC/AC converters
UPS and high voltage power supplies

Products exhibited:

1000 W VME crate with + 5V, -5V, 2V, -2V & +/-12 V outputs
4 kW FASTBUS power supply
1000 W CAMAC power supply
NIM & CAMAC crates featuring microprocessor controlled fan trays with CAENET interface
EUROPA type power supply

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

PFEIFFER

Pfeiffer has experience in the vacuum technology for almost a century. Pfeiffer is part of the Balzers Group, with over 3600 employees, which is itself a member of the Oerlikon Bührle organisation in Zürich.

Manufacturing program specially for the nuclear technnology

- Pumps and pummping units (cryo-, titanium-sublimation and turbomolecular)
- Measuring instruments for medium, high and ultra-high vacuum as well as helium leak detectors (standard versions and on customer's specification including radiation resistant vacuum measuring equipment)
- Quadrupole mass spectrometer for measuring the partial pressure and residual gas analysis
- Ultra-high vacuum systems for coating of e.g. supracontacting layers
- Vacuum installation for UF_6
- UHV unit for metallurgic testing
- Components for accelerators and storage rings as e.g.
- **Alvarez-structure as 50 MeV H^- linear accelerator**
- **750 keV – radio-frequency-quadrupole-accelerator**
- **Special chamber of a central tracking detector for a H1-experiment**
- **Gas jet target for a celsius storage ring**
- **Electrostratic septum chamber for a celsius storage ring**
- **1.8 k cryostat for a superconducting electron recyclotron**

Meet us at the special CERN exhibition and the lecture on the occasion of
30 years experience of turbomolecular-pumps
(23th to 25th of May 1989
from 09.00 – 17.30)
and on Wednesday 24th of May
at 11.00 at the Council Chamber,
Bldg 503, 1st floor

BALZERS

Balzers Hochvakuum AG
Stampfenbachstrasse 48
Postfach 186
CH-8035 Zürich
Tel (01) 363 32 66
Telex 817 005
Telefax (01) 362 46 23

Arthur Pfeiffer
Vakuumtechnik Wetzlar GmbH
Postfach 1280
D-6334 Asslar
Tel (0 64 41) 802-0
Telex 483 859
Telefax (0 64 41) 802-202