# CERN COURIER

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# CERN COURIER

**Covering current developments in high energy physics and related fields worldwide**

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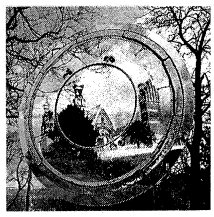
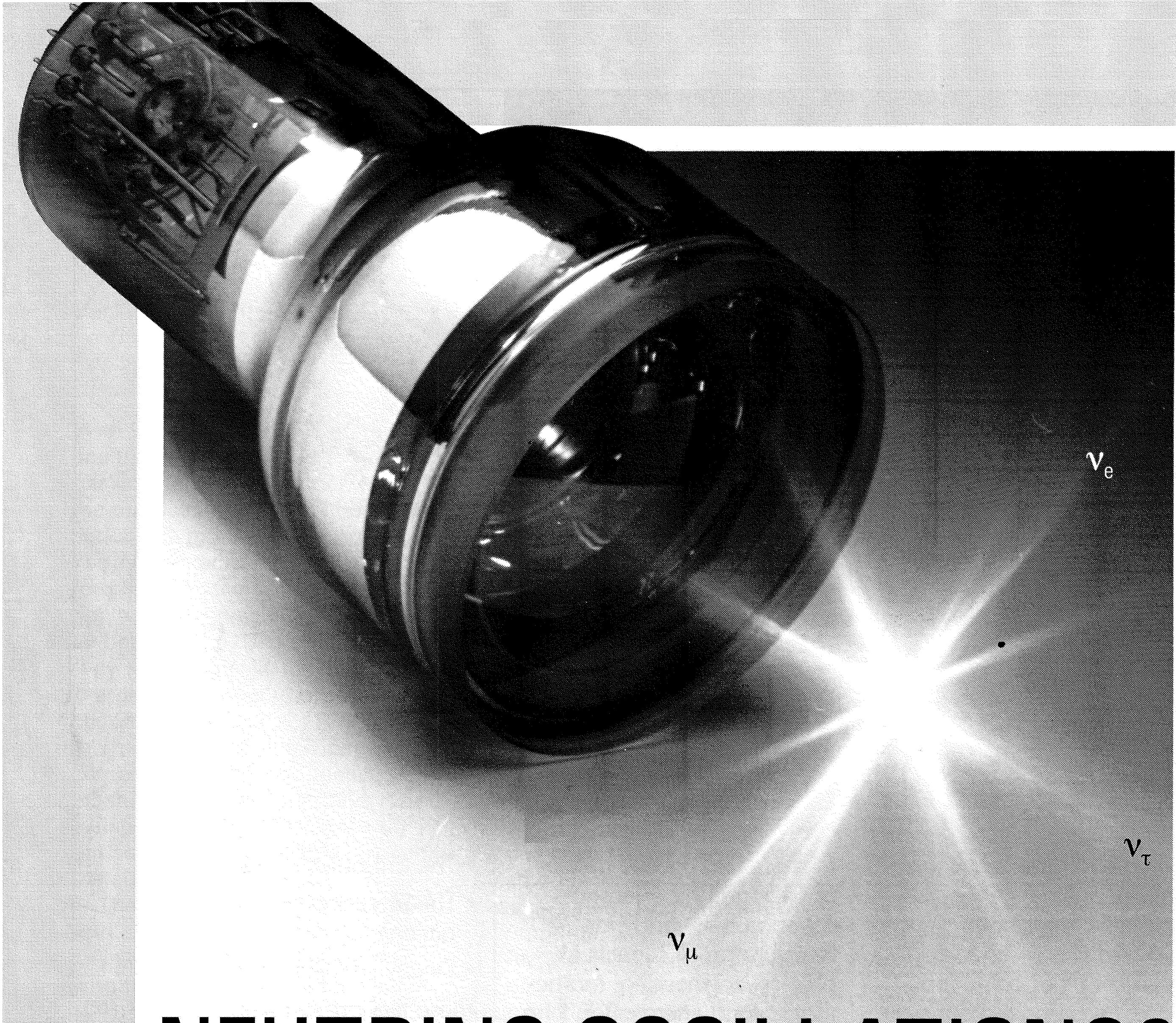


*Cover photograph:*
Darmstadt's Mathildenhöhe reflected in a heavy ion target wheel of the Gesellschaft für Schwerionenforschung (GSI). The wheel rotates at 1666 rpm, synchronized with the Laboratory's UNILAC accelerator.




# NEUTRINO OSCILLATIONS?

## KfK IS LOOKING FOR THEM WITH THE XP3462

| XP3462 |
|---|
| $t_r$ = 3ns, anode pulse rise time for delta-function light pulse |
| $R_E$ = 10%, for $^{57}$Co and a 3″x3″ NaI (Tl) scintillator |
| $S_K$ = 85mA/W (11,5 μA/lmF) |
| G = $10^6$ at 1500V |
| Pulse linearity within 2% up to 100mA |

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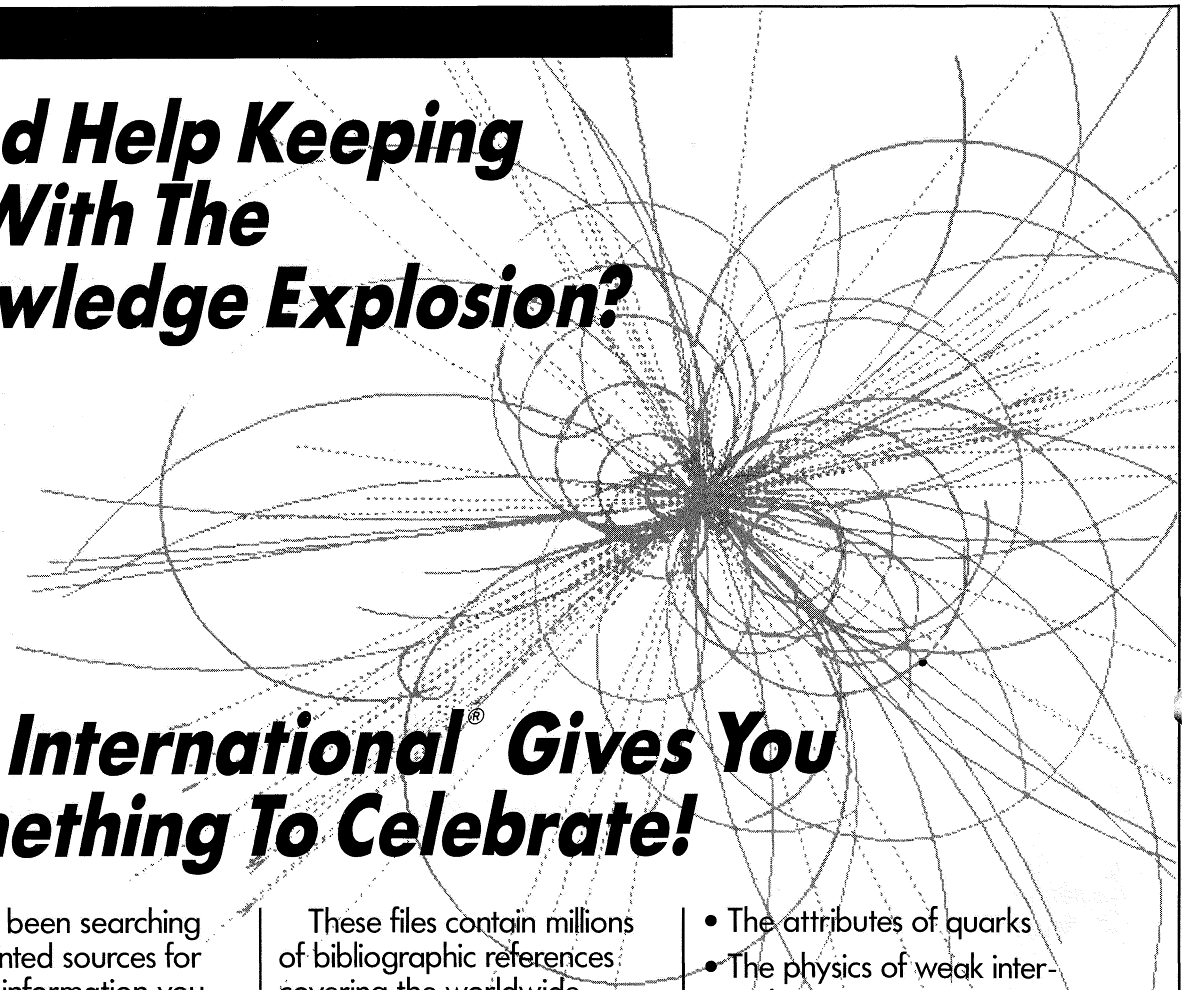
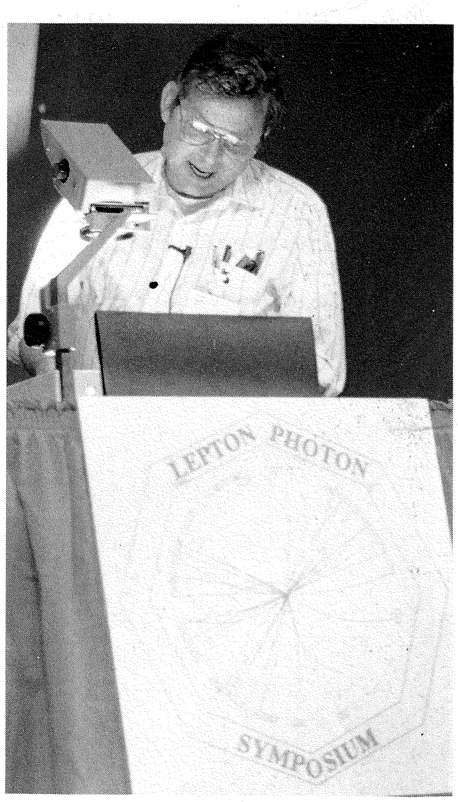


# Stanford Lepton-Photon Symposium

Stanford Lepton-Photon Symposium summarizer Frank Sciulli of Columbia looked forward to an 'era of discovery' in the 1990s.



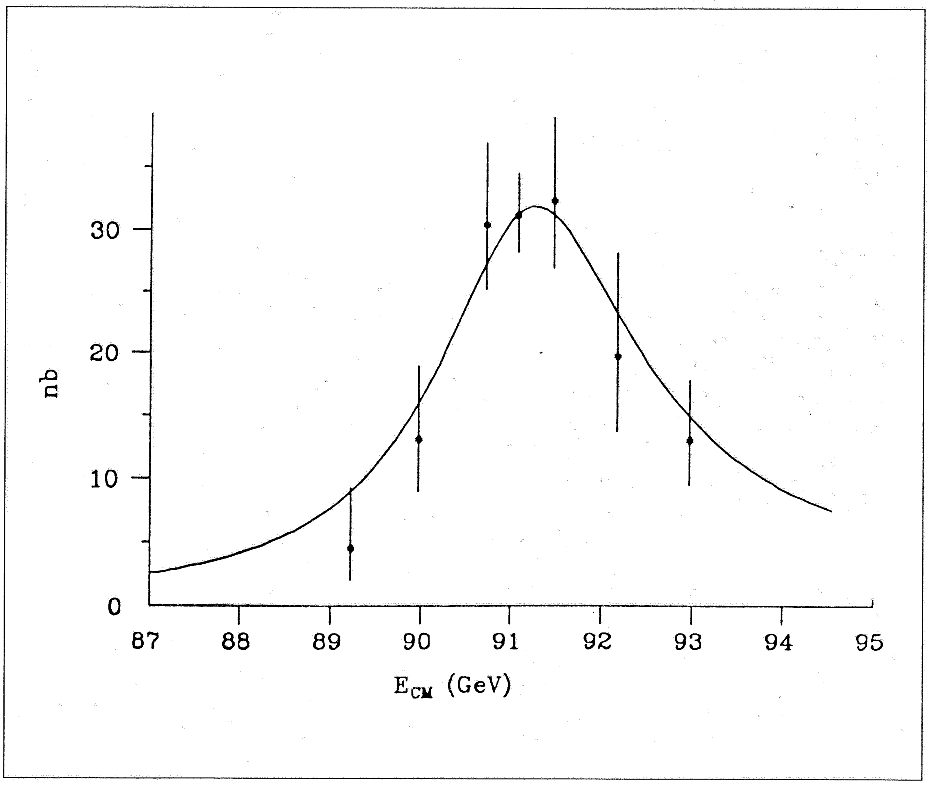

With CERN's new LEP electron-positron collider poised to make its physics debut (September, page 1), the physics at the 14th International Symposium on Lepton and Photon Interactions, held at Stanford from 7-12 August, featured a ripple of new results on the Z and W bosons, the carriers of respectively the electrically neutral and charged components of the weak nuclear force.

These new W and Z results, combined with refined measurements in other sectors, have interesting implications for expected but as yet unseen particles, notably the sixth ('top') quark.

The Mark II detector at Stanford's SLC linear collider has made its initial scan of the Z, the first time this particle has been seen in electron-positron annihilations (September, page 12). By the time of the Stanford meeting, Mark II's sample of 106 Z events had climbed to 233, and Gary Feldman reported a mass centred around 91.17 GeV and a width of 1.95 eV, giving an upper limit for the possible number of different types of neutrino as 4.4 and a value as low as 3 ± 0.9. In other words, there is very little room for more types of neutrino in Nature other than the three currently known – electron-, muon-, and tau-type. However the limit still gives a bit of additional neutrino elbow room and it will take a lot of Zs before a fourth type of neutrino can be ruled out. (The Mark II limit has been subsequently tightened – more news next month.)

Until the arrival of the SLC, all direct W and Z information had come from the big experiments at the proton-antiproton colliders at CERN and Fermilab. (The particles were discovered at the CERN collider in 1983.) Here, the Ws and Zs are fingerprinted through decays producing easily identifiable leptons (electrons and muons). Their decays into strongly interacting particles (hadrons) are difficult to separate from the mainstream proton-antiproton collision products. However these hadronic decays in fact dominate the Mark II Z sample. Alan Weinstein of Caltech showed how this provides a new window on underlying quark mechanisms. Clearly this will be a feature of the physics emerging over the next few months.

The Mark II Z sample shows a bit of scatter among the three lepton channels (electron, muon and tau). For instance 15 tau pairs are seen when only about half this




*A scan of the Z particle, the electrically neutral carrier of the weak nuclear force, as seen by the Mark II detector working at the SLC Stanford Linear Collider. The curve is a 'Standard Model Fit', using five quarks, three charged leptons and three neutrinos.*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number are expected, but this is being played down.

With big data samples from their recent lengthy runs (September, page 13), improved Z measurements came from the UA2 (Anthony Weidberg, CERN) and CDF (Myron Campbell, Chicago) experiments at CERN and Fermilab respectively. With 132 decays into muon pairs and 64 into electrons, the latter had already reported a Z mass of 90.9 ± 0.3 GeV. At Stanford, UA2 gave a Z mass of 90.5 ± 0.5 from an 85-event sample. These values complement the new fix from SLC.

However these proton-antiproton collider experiments also home in on the W, the electrically charged partner of the Z, produced in pairs in particle-antiparticle annihilations. Although the W is slightly lighter than the Z, W pairs are out of reach of SLC and LEP, at least for the time being. New W mass values announced at Stanford were 80.0 ± 0.4 from 1185 UA2 events and 80.2 ± 0.2 from CDF events with electrons. Results from the CDF muon sample should follow soon.

Until LEP's energy is boosted, proton-antiproton studies have a monopoly on the W, and new measurements will provide a useful complement to the new Z information.

With just three types of neutrino looking increasingly probable, an underlying physics picture of six types of quark grouped pairwise into three 'generations' continues to sell well. Particles containing five types of quark are known, and experiments at the TRISTAN electron-positron collider at the Japanese KEK Laboratory (Akihiro Maki, KEK), although not seeing the sixth ('top') quark at collision energies exceeding 60 GeV, suggest that the fifth ('beauty'-b) quark behaves like one of a pair.

Once thought to be just round the corner, the top quark stubbornly refuses to come out into the open. Strict limits from CDF (Pekka Sinervo, Pennsylvania) put it above 80 GeV, however consistency arguments using the new Z mass values together with data from precision studies of neutrino scattering (results reported by Jaap Panman of CERN) and other electroweak input now suggest that the top quark could be considerably heavier than 100 GeV. 'This is depressing news if it is taken seriously', commented Conference summarizer Frank Sciulli of Columbia, intimating that some calculations and predictions might need to be overhauled to take account of a heavyweight quark.

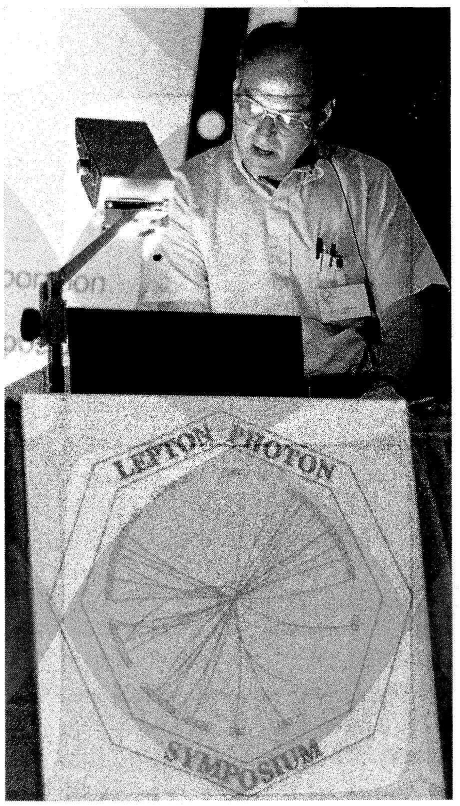
Hadron production levels at TRISTAN show a slight surge around 60 GeV, and this had once been a talking point. Thoughts of an early top have now been dispelled, even though the surge is still there.

However the top quark is being squeezed from all sides. Guido Altarelli of CERN explained how an upper limit of around 200 GeV for the missing quark comes from taking account of the subtle radiative corrections to electroweak effects. Combined with precision electroweak measurements, this cramps the space remaining for the top quark.

*Lepton sector*

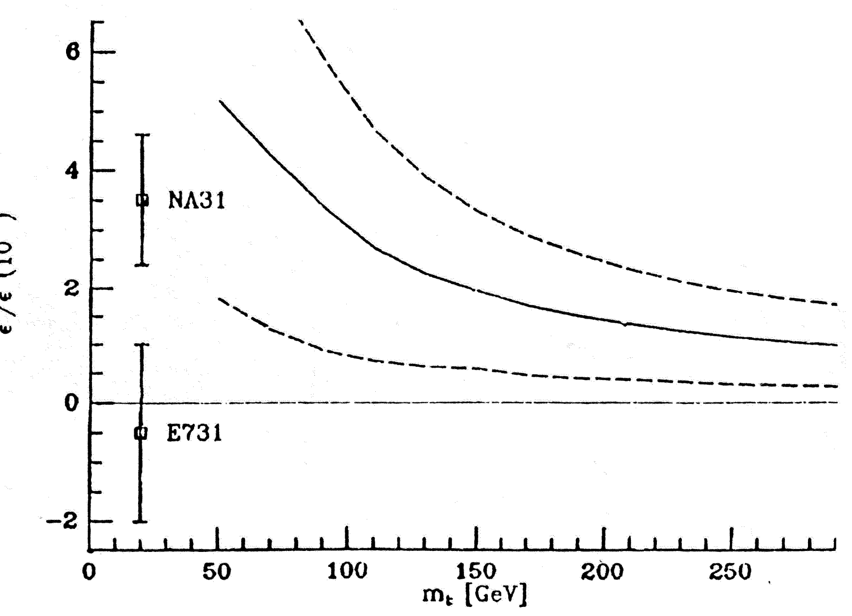
At Stanford, lepton (weakly interacting particle) properties were covered by Marty Perl of SLAC, who had news of fresh limits on the mass of the electron-type neutrino from experiments at Los Alamos (less than 13.4 electron volts) and from Tokyo's Institute for Nuclear Study (less than 11 eV). According to some observers, these new numbers must be approaching the absolute limit with which the neutrino mass can be measured directly.

*A good fix on the Z particle by the Mark II detector at Stanford's SLC linear collider was reported by Gary Feldman.*




There are still not enough neutrinos seen coming from the sun (the 'solar neutrino problem'). This long-standing enigma had shown signs last year of resolving itself, with bursts of activity reported from new solar neutrino measurements at both the Japanese Kamiokande underground detector and from the classic study led by Ray Davies of Brookhaven (October 1988, page 2). However this year the Kamiokande neutrino levels tie in with the previous enigmatic levels. Further solar neutrino information will come from a new generation of experiments being prepared using special detector materials.

A talking point. CP violation parameter (vertical axis) as measured by the NA31 experiment at CERN and the E731 experiment at Fermilab (preliminary result only), compared with the theoretically expected value, which depends on the mass of the so-far unseen sixth ('top') quark.




Singly-charged particle decay modes of the heavy tau lepton are not seen quite as frequently as expected, but Perl speculated as to how this 'Gilman anomaly' might be fixed up. In looking to build up an accurate picture of the tau, Perl underlined the need for a tau/charm factory to mass produce this rare particle (July/August, page 29).

*Hadron sector*

Twenty-five years after the discovery of the subtle violation in neutral kaon decays of the combined 'CP' symmetry of particle-antiparticle switching and left-right reversal, the origin of this effect remains a mystery, and new measurements of additional CP-violation parameters are needed to provide fresh insights.

Last year, the NA31 experiment at CERN reported a new slant on CP violation (July/August 1988, page 7), with the decays of short-lived and long-lived neutral kaons into charged and neutral pion pairs showing a small but significant bias. This result was reiterated at Stanford by Daniel Fournier of Orsay, however the E731 study at Fermilab, reported by Bruce Winstein of Chicago, sees a much smaller effect in a preliminary sample of 20 per cent of the data collected in a recent long run. The data should be completely analysed next year. In the meantime NA31 is also analysing new data and is busy collecting even more with CERN's SPS proton synchrotron running for fixed-target experiments in parallel with feeding electrons and positrons to LEP. Summarizer Sciulli was unfazed by the apparent disagreement, but pointed out the implications for the mass of the top quark.

In inter-quark transformations, ARGUS at the DORIS ring at the German DESY Laboratory in Hamburg (Michael Danilov, Moscow) and CLEO at Cornell's CESR ring (David Kreinick) could both report that in analysis of B meson decays (containing the b quark) around the broad (4S) upsilon resonance, the level of transformations of b quark to light ('up') quarks was about ten per cent that of beauty to charm. This is the level needed to accommodate CP violation in a six-quark picture. Several years ago an initial ARGUS measurement had seen an anomalously large effect.

Like the neutral kaons, the neu-

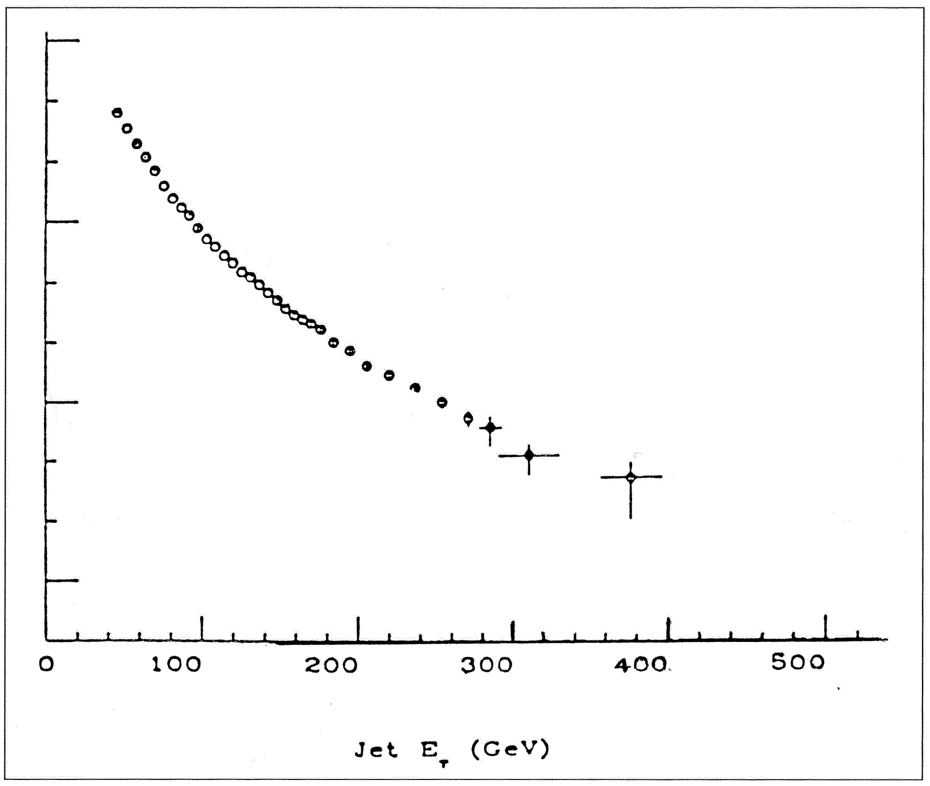
## Stanford Symposium

*In keeping with the tradition of the Lepton-Photon Symposia, the Stanford meeting included only plenary sessions, making for simpler coverage but with a single speaker on each topic there is an ever-present risk of overindulgent subjectivity.*

*In addition to a solid scientific content and good participation, the imagination of the Stanford organizers resulted in a number of innovations, including TV retransmission of talks to a nearby room with lots of desk space and a zoom lens making overcrowded transparencies easier to follow. A boon for avid notetakers.*

*The Symposium dinner in the Monterey Aquarium is beyond the scope of this report, but was an experience few delegates will forget.*

Confined sprays ('jets') of hadrons at the CDF detector working at the Fermilab Tevatron proton-antiproton collider extend out to transverse energies of 400 GeV.




tral B mesons are expected to mix, and ARGUS and CLEO see compatible signals for B mesons containing the light 'down' quark. The UA1 experiment at CERN's proton-antiproton collider homes in on B mixing by comparing levels of like- and unlike-sign charged muon pairs. At these energies, B mesons containing strange quarks can also be intercepted, and with a lot more data now available, Karsten Eggert (CERN) reviewed the evidence for B mixing in the strange-quark sector.

Last year, the analysis of quark interactions had been confused by differences in the quark structure of protons (structure functions) as measured in different experiments at CERN using muon beams and a hydrogen target. This year, a re-analysis at Stanford (SLAC) of existing data from electron beam experiments has helped to resolve the confusion. According to Joel Feltesse of Saclay, the structure function measurements from different experiments are now compatible, and looked a few years into the future to new structure function measurements at the HERA electron-proton collider now nearing completion at DESY, opening up new kinematical areas.

Another structure function result, initiated by spin-dependent investigations by the European Muon Collaboration, throws new light on how the spin of the proton is carried by its constituent quarks (June 1988, page 9), with apparently little spin being carried by the valence quarks. Graham Ross of Oxford looked into this problem, but did not think that it implied the immediate downfall of quark-gluon field theory (quantum chromodynamics – QCD).

Impressive evidence for QCD is now contained in the spectra of sharply-defined showers ('jets') of produced hadrons, which for the CDF experiment extend out to 450 GeV of transverse momentum.

## *New machines*

Had his talk been scheduled just a few days later, Friedrich Dydak of CERN would have been able to illustrate his LEP progress report with some examples of LEP Zs (September, page 1). Mass production of Zs at LEP should get underway later this year.

News of initial operation of another electron-positron collider came from Ye Minghan of Beijing. The 240-metre BEPC ring at the Chinese Institute of High Energy Physics is well on its way to attaining its intended collision rate, having exceeded luminosities of $10^{30}$ per sq cm per s, and Ye was optimistic that $10^{31}$ could be surpassed. The BES detector has started work in the ring, and although initial magnetic interference between the ring and the detector reduced the available electron-positron collision rate, 50,000 J/psi particles have been reconstructed.

Looking to the electron-positron collider future, Gustav-A. Voss of DESY reminded the audience of ongoing plans tabled for LEP and SLC. While LEP will push for increased energy using superconducting radiofrequency cavities and increased collision rates using beam separators, SLC's plan includes increasing the rate from 60 to 120 Hz and boosting the number of bunches handled. This could increase luminosity tenfold over the present 1.6 x $10^{28}$ figure. Polarized beams also figure high on the agenda. Longer term investments in rebuilding the damping rings and the final focus could push the lumi-

## Conferencing

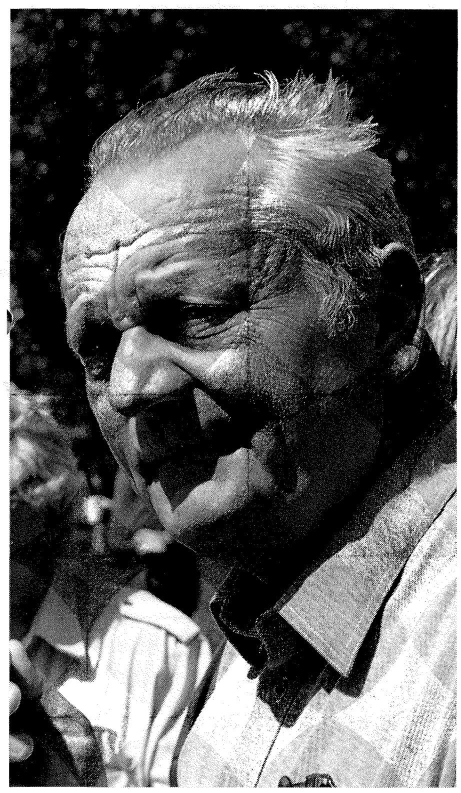
*Traditionally, the biennial (even-year) international 'Rochester' particle physics meetings alternate in odd-number years with the Lepton-Photon Symposia, another IUPAP line, and the international 'Europhysics' meeting organized by the European Physical Society.*

*This year saw the Lepton-Photon Symposium held in Stanford from 6-13 August back-to-back with the Europhysics meeting in Madrid from 6-13 September (a report on the Madrid meeting will feature in a forthcoming issue). This double heading means that physicists have a choice of venue, but has led to some conflict of interests and a good deal of repetition.*

*Next year's Rochester meeting will be held in Singapore from 2-8 August (details page 29), but as an experiment, 1991 will feature a single major meeting, to be held in Geneva from 23 July to 1 August. In contrast with the Lepton-Photon Symposium tradition of plenary talks only, this meeting will also include parallel sessions.*

*Gustav-A. Voss of DESY – 'most depressed' by the support for the R and D effort for new machine ideas.*

*(Photos Harvey Lynch)*



nosity towards $10^{30}$.

Voss was sceptical of ideas for an additional ring, for electrons and positrons, in the 84-kilometre tunnel to be built in Texas for the US Superconducting Supercollider (SSC) proton-proton machine. Although benefiting from a prebuilt tunnel, such an electron-positron collider would cost a lot of money, calling for its own distributed superconducting acceleration system, and would yield only a modest markup on the energy available from LEP. However a separate electron ring might be worth looking at to provide the SSC with an electron-proton option, commented Voss.

Looking further ahead, Voss drew attention to the difficulties in opening up a new electron energy domain. 'All the exotic ideas of the past 20 years have evaporated', he declared, and admitted to feeling 'most depressed' by the lack of current research and development effort, apparently limited more by funding than by ideas.

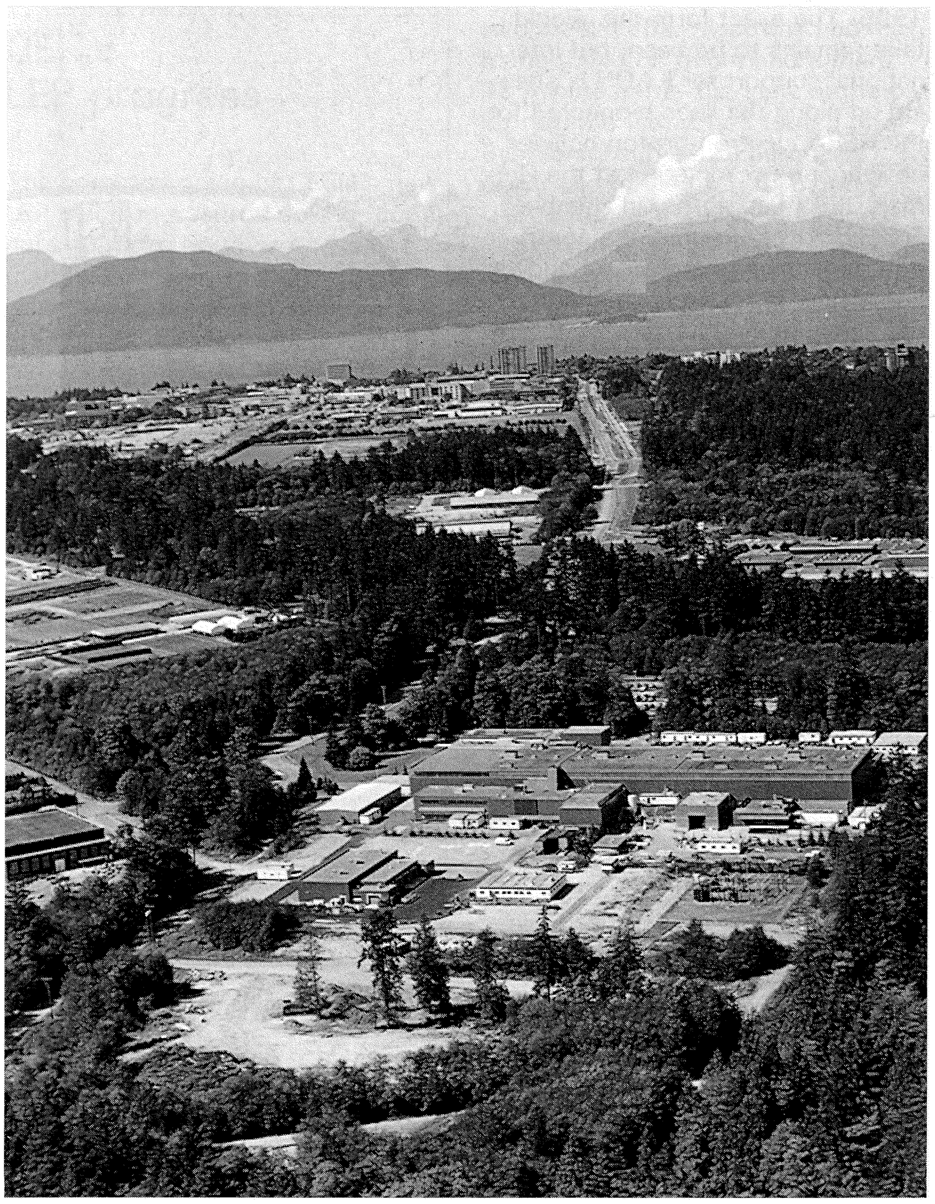
Concluding his summary, Sciulli hoped that the final decade of the century would reveal the limitations behind today's Standard Model. Omnipotent yet stuffed full of unknowns that have to be plugged in from experiment, the Standard Model can only be the crust of something deeper. With the traditional mix of particle physics 'competition, collaboration and cameraderie', and with many new machines in the pipeline, Sciulli looked forward to an 'era of discovery'.

*Of fish and physicists on Cannery Row – the Stanford Symposium programme included a memorable evening at the Monterey Aquarium*

*(Photo Harvey Lynch)*

# A boost for KAON

Aerial view of the Canadian TRIUMF Laboratory in Vancouver.



Earlier this year, a report by a specially-formed subcommittee of the US Nuclear Science Advisory Committee gave an important boost to the proposal to build a high intensity particle beam 'factory' at the Canadian TRIUMF Laboratory in Vancouver.

Last year, TRIUMF received a total of 11 million Canadian dollars (September 1988, page 1) from the federal government in Ottawa and from the regional British Columbia administration for a Project Development Study, with a final report expected towards the end of this year. The hope is to have the green light sometime next year. Estimated cost is 571 million Canadian dollars.

In line with current thinking on particle factories to explore a new high precision physics frontier, KAON aims to provide a high intensity (100 microamp) continuous beam of 30 GeV protons for a wide range of secondary beams – hence the acronym KAON (Kaons, Antiprotons, Other particles, Neutrinos).

Using the existing TRIUMF 500 MeV cyclotron as injector, KAON's special requirements for high intensity beams call for particles passing through a series of five rings, alternately d.c. storage rings and fast cycling synchrotrons.

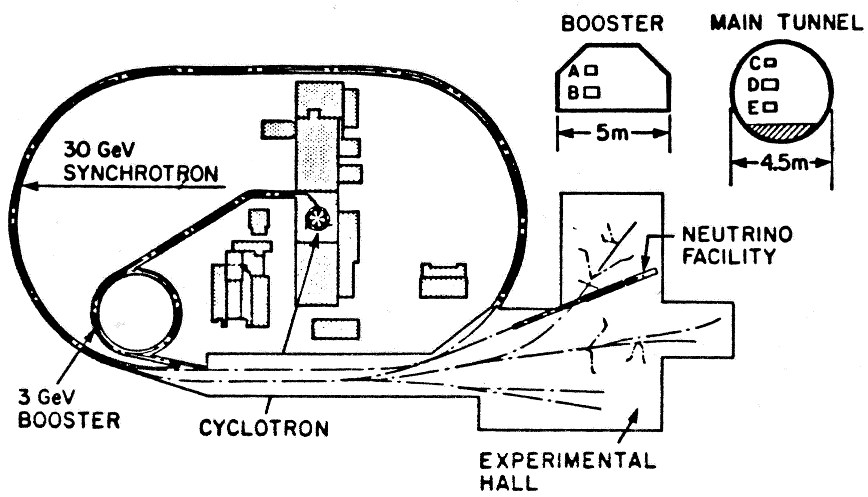
In parallel with the KAON pilot study, high energy physics contacts in the context of the seven-nation 'summit' group encouraged Canada to seek international interest and commitment to the project. The national delegation made the rounds of the capitals last year, one result being the formation of the special US subcommittee, chaired by Herman Feshbach of MIT.

As well as looking at KAON, the Feshbach subcommittee also looked at other plans for similar physics opportunities at Brookhaven and at Los Alamos. The report said 'the design of the KAON facility was judged ...... to be conservative. There appear to be no major design problems which would seriously impede construction .... The facility would certainly "provide the needed experimental capability in this area of hadronic physics". The TRIUMF Laboratory would need to augment its staff ....'.

The report also underlined KAON's complementarity to other US nuclear physics projects – the CEBAF electron accelerator under construction at Newport News, Virginia, and the projected RHIC heavy ion collider for the vacant tunnel at Brookhaven.

The proposed US contribution is 75 million US dollars over the five-year construction period ending in

A possible layout of the KAON particle factory project at TRIUMF in Vancouver. The 214-metre circumference Accumulator and Booster rings and the 1070-metre circumference Collector, Driver and Extender rings would be housed in two tunnels.




1995. The exact form this would take remains to be seen, but international support for KAON is shaping up along the lines pioneered for the HERA electron-proton collider now nearing completion at the German DESY Laboratory in Hamburg. For HERA, partner nations contributed machine components and know-how in return for a share in the scientific programme.

TRIUMF Director Erich Vogt explains that the parallels between KAON and HERA run deeper, with local authorities – British Columbia and Hamburg respectively – playing an important role.

As well as the strong positive reaction from the US, other nations are keen to help KAON get off the ground. Canada was one of the first nations to offer assistance for HERA, and the West Germans could repay the courtesy. Support is not seen as being limited to the seven-nation group and initial contacts have also been made further afield.

The plan is for a third of KAON investment to come from outside Canada, however this would not be reflected in the experimental programme, with two-thirds of the scientists coming from abroad. In the meantime the project is being strongly pushed both by prospective international partners and by the regional British Columbia government, which would provide construction funds.

To help mould the pattern of the scientific programme and to stimulate interest, a series of KAON physics workshops was arranged with venues so far in Canada, Japan, and West Germany. The final meeting (on intense hadron sources and antiproton physics) is in Turin, Italy, in October.

Already this effort has generated widespread user interest and has influenced the ongoing design work for the experimental halls, adding requirements for additional beamlines.

The exacting demands for a particle factory require the existing cyclotron to be supplemented by five rings, labelled A-E, in two tunnels, with the B and D rings running continuous acceleration cycles.

The first of two 214-metre rings is the Accumulator, five times the size of the cyclotron, to take 440 MeV protons obtained by stripping the cyclotron's negative hydrogen ions and stack them over 20 millisecond periods ready for injection into the Booster, a 50 Hz rapid cycling synchrotron taking protons to 3 GeV. Next comes the Collector, the first of three 1070 metre rings, to take five successive Booster pulses and arrange them for the 10 Hz rapid cycling Driver, where the energy is taken to the required 30 GeV level. Finally the Extender stretcher ring optimizes the beam for slow extraction.

The KAON radiofrequency system has to supply 3MW of beam power with a frequency change as the energy rises from 440 MeV to 30 GeV. By breaking the acceleration into two stages, 440 MeV to 3 GeV in the Booster and the remainder in the Driver, most of the frequency swing happens in the Booster while most of the power is supplied by the Driver. In this way two major radiofrequency tasks are separated.

The existing TRIUMF cyclotron works with negative hydrogen ions, stripped for extraction. For KAON, these ions would need to be extracted before stripping, and the small emittance beam 'painted' over the much larger acceptance of the Accumulator. Negative hydrogen ion extraction from the cyclotron demands some deft radiofrequency manoeuvers, and this work is well in hand.

An initial plan saw five circular

# Around the Laboratories

rings, with the largest encircling the present TRIUMF site, but subsequent work showed that improved performance would result if the larger rings were racetrack-shaped. To avoid these rings passing too close to existing buildings, the site could expand across the street.

As part of the preconstruction studies, design teams have looked at some of the demanding problems to be solved, including beam dynamics, magnet design, power supplies, beam kickers, radiofrequency systems, vacuum, etc.

Meanwhile the existing cyclotron continues to provide beams for a wide range of experiments. New ion sources will extend the range of studies possible. Proton-rich isotopes for medical use are manufactured both at the main cyclotron and a smaller dedicated machine. A second such machine is being assembled to boost capacity.

## CERN
## LEP progress

The commissioning of CERN's new LEP electron-positron collider continues to make good progress. As mentioned briefly in the previous issue, by mid-August confidence in the new 27-kilometre ring warranted going for a pilot physics run to give the four big experiments – L3, Aleph, Opal and Delphi – their first taste of collision physics and explore the impressive capabilities of their detection systems.

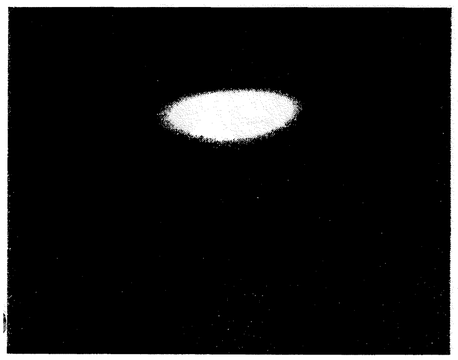
Late in the evening of Sunday 13 August, only one month after a lone positron beam had circulated for the first time in the ring, just two weeks after electrons had made their LEP debut and a mere 16 minutes after the start of the pilot run, the first Z had turned up. By midnight three Zs had been seen, and more soon followed.

The run, with collision luminosities of the order of $5 \times 10^{28}$ per sq cm per s, encountered some technical problems. With 51 Zs in the bag, the run was terminated on 18 August after some 16 hours of physics operation and attention returned to the job of getting Europe's big ring in tip-top shape. One goal is to eliminate some troublesome coupling between vertical and horizontal beam motion. Meticulous machine studies and careful vacuum conditioning continued with the goal of optimizing LEP's

*The LEP control room. Seated is Albert Hofmann, who, with Steve Myers, is jointly responsible for commissioning CERN's big new machine.*

*(Photo CERN 61.8.89)*

A 45 GeV beam in CERN's new LEP electron-positron collider, as seen by a synchrotron light monitor.

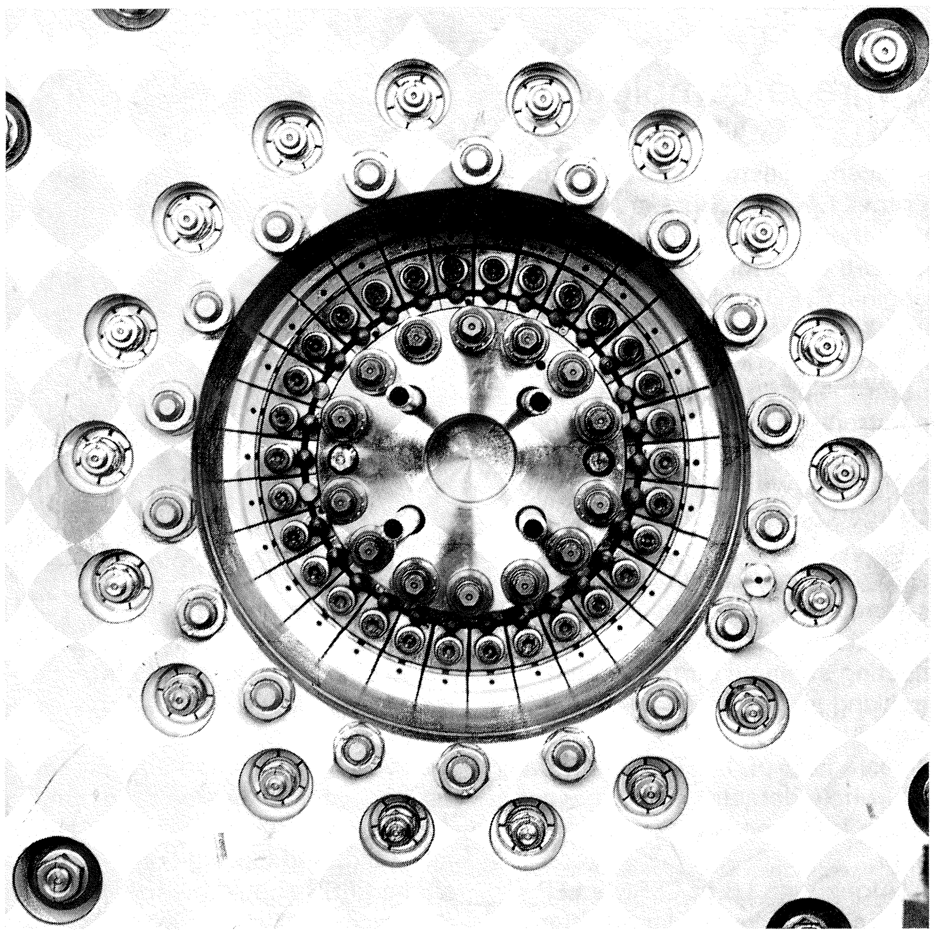


myriad of components and systems.

Next physics operation began mid-September.

## Lithium lens

Centre, the steel pressure vessel containing a lithium antiproton lens, mounted concentrically inside a current pulse transformer, built for CERN at the Novosibirsk (USSR) Institute for Nuclear Physics. In tests, the lens enabled a record number of antiprotons from a single pulse of CERN's PS proton synchrotron to be injected into the Antiproton Collector ring.



In the context of CERN's push to boost antiproton production, a record $10^8$ antiprotons from a single pulse of the PS proton synchrotron have been injected into CERN's antiproton collector ring during the first beam test of a 36mm-diameter lithium lens.

The lens is a short (15 cm) cylindrical column of lithium metal with a constant current density along its axis, giving an azimuthal magnetic field which focuses particles transversely. A short focal length (about 10cm) is needed to collect antiprotons produced at small angles.

Lithium is chosen to minimize nuclear interaction losses of antiprotons. A gaseous plasma would be even better and such lenses are being investigated.

The particles have a momentum of 3.5 GeV, implying magnetic gradients of 5T/cm and currents of 1 million amperes!

The lithium is loaded into a water-cooled steel pressure vessel and the whole assembly mounted in a concentric current pulse transformer built at the Novosibirsk (USSR) Institute for Nuclear Physics for CERN. Because of eddy currents it takes several hundreds of microseconds for the current and field to penetrate inside the lithium column.

Peak pulse current was 1.1 MA with a time to peak value of 1 ms. The system is designed to operate up to 1.3 MA. During the pulse, magnetic and thermal pressures exceeding 1000 bars result in 30-40 ton thrusts on the end-flanges of the pressure vessel. During preliminary testing a flange became distorted, and the design was altered before beam tests.

In a series of developments initiated at Novosibirsk (May 1988, page 11), this latest lithium lens design, with its increased diameter and current, is essential for the collection of particles produced at large angles. Smaller lens diameter and current would suffice for a point source, but for a maximum of antiprotons captured in the Collector ring, the target must be about 6cm long and there are mechanical constraints on the target-lens spacing.

The tests promise even higher antiproton stacking rates in the near future. The eventual improvement in antiproton yield is estimated at 40%, a good return on the investment.

# CORNELL
## Upgrade complete

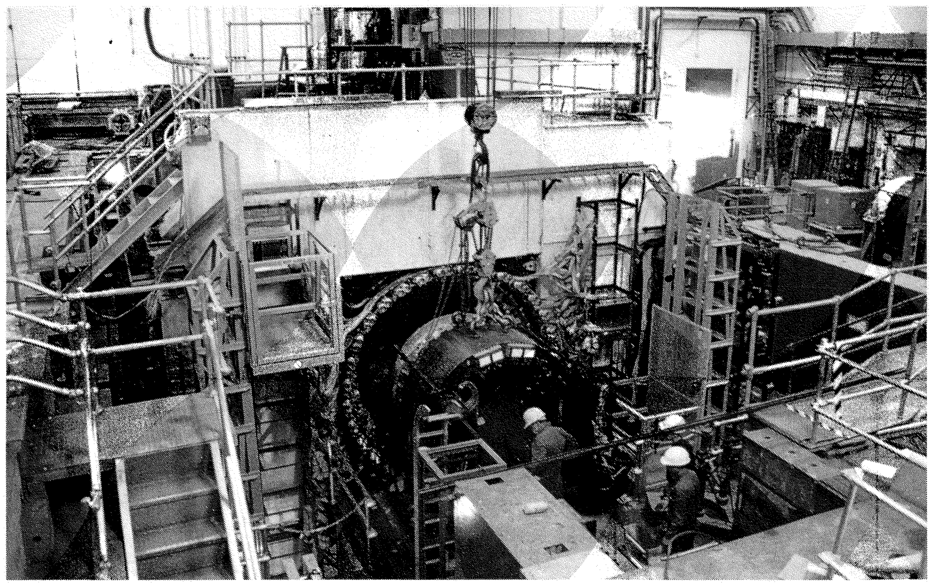
A recent milestone at CESR – the Cornell Electron Storage Ring – was the completion of the new CLEO-II detector, replacing the original CLEO dating from operation in 1979.

Like its predecessor and most other major detectors at electron-positron colliders, the new apparatus is based on a solenoid magnetic field, with drift chambers for charged particle tracking. The special new feature is a high resolution electromagnetic calorimeter consisting of 7800 blocks of scintillating cesium iodide. The superconducting solenoid surrounds the tracking chambers and the calorimeter at a radius of 1.5 m and provides a field of 1.5 Tesla. Enclosing the whole detector is the magnet return iron, serving also as a muon filter.

Along with L3 at CERN's LEP electron-positron collider and the Crystal Barrel at CERN's LEAR low energy antiproton ring, CLEO-II is one of a new generation of magnetic detectors exploiting the advantages of crystal calorimetry.

The CLEO collaboration includes physicists from Albany, Carnegie-Mellon, Florida, Harvard, Kansas, Maryland, Minnesota, Ohio State, Oklahoma, Purdue, Rochester, Syracuse, and Vanderbilt, as well as from Cornell.

The installation of CLEO-II has been the major focus of CESR activity since June 1988, when the machine last ran. During the shutdown numerous improvements have been made to the CESR machine to increase reliability and performance and the number of beamlines for parasitic synchrotron X-ray research doubled.



*Installation of the new CLEO-II detector at the Cornell Electron Storage Ring (CESR).*

CLEO-II was complete except for some cabling in June, and attention then turned to final reassembly of the CESR interaction region components – focusing quadrupoles, separators, vacuum system, etc. On 6 August circulating beam was reestablished, and barring major mishaps CESR should be soon operating again at its record peak luminosity level of $10^{32}$ per sq cm per s.

The first run for physics will search for new spectroscopic levels in transitions from the 3S upsilon state. Besides being the tune-up run for CLEO-II, this will be curtains for the Columbia-Stony-Brook (CUSB) detector in the other interaction region.

With CUSB retired, CESR will become a single-interaction-region collider. In this new 'CESR-plus' configuration, an increase in the number of stored bunches and in the beam current per bunch could yield a fivefold improvement in luminosity.

In the past year the prospects of measuring subtle physics effects (CP violation) in B meson decays has inspired many physicists around the world to think seriously about a 'B-factory' to provide the 100 million B decays that are probably required for physics to show up (see also page 25).

One option is an electron-positron collider running in the required energy range with a luminosity perhaps 100 times higher than the present CESR limit. This has prompted the accelerator physics group at Cornell to look beyond the CESR-plus upgrade to consider the feasibility of such a new collider in the present CESR tunnel. The kinematic benefits of unequal electron and positron energies is one option under study.

The Cornell group is engaged in intensive research to see whether such high luminosities are possible and what the design implications might be. One of the first experiments to be made in CESR within the next few months is a test of colliding round, rather than flat, beams. Computer simulations carried out at Cornell indicate that round beams could pay luminosity dividends.

# FASTBUS
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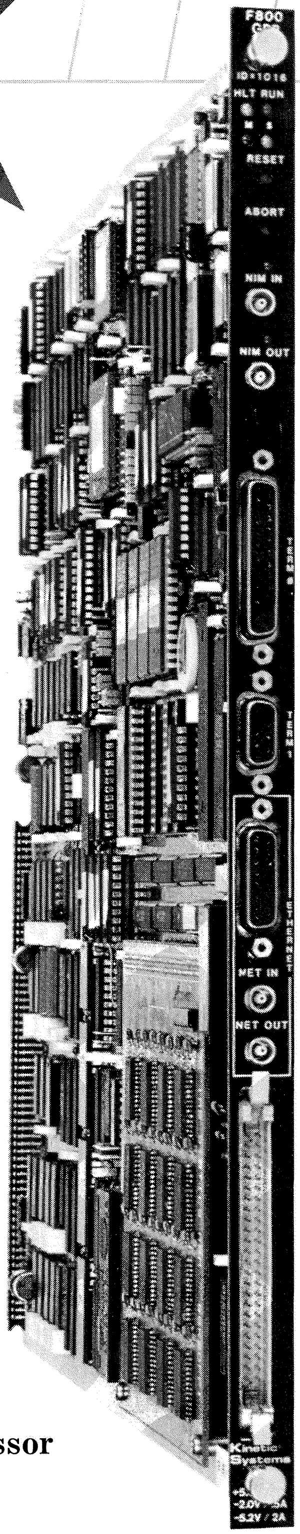


## A new general purpose processor with realtime processing power

The new **F800** module is a general purpose processor (GPP) which serves as a primary host in small FASTBUS systems using an OS-9, realtime, UNIX-like operating system. As your FASTBUS system grows, any number of F800s may be installed for additional processing power.

This module contains a high-speed Motorola 68020 microprocessor and a 68881 floating point coprocessor with a full 32-bit data path. Providing the 68020 signals at the auxiliary connector for future expansion purposes permits the F800 to be easily interfaced to such other devices as bulk memory and graphic controllers as well as other buses. A front-panel SCSI (Small Computer System Interface) bus permits this module to boot up from a variety of disk and tape drives and to be used in data logging and file storage. Up to eight SCSI devices are permitted on this port (including itself).

The F800 GPP offers full FASTBUS Master/Slave capability. It provides block transfer rates of up to 20 megabytes per second as a slave device and up to 6 megabytes/second as a master. As a slave, this GPP supports geographic addressing as well as random and block transfer data cycles. Service requests and user interrupts are also supported.

Other features of the F800 include a one-megabyte static memory, provided on a daughter card. This memory is upgradable to 16 bytes of dynamic RAM and is accessible from both FASTBUS and the microprocessor. Dual RS-232 serial ports, located on the front panel, provide multiuser support or a simple link to the host processor. Baud rate is programmable from 300-38.4K Baud. Added flexibility on the RS-232 ports is provided by a 25-pin and a 9-pin connector.

F800 processors can be networked from a front-panel, P.C. board-selectable, Ethernet and Cheapernet port. The Ethernet port uses a standard, front-panel, 15-pin D-connector, and the Cheapernet requires LEMO type connectors.

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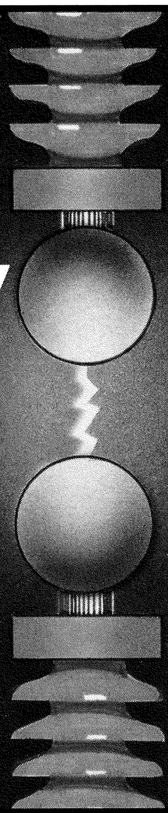

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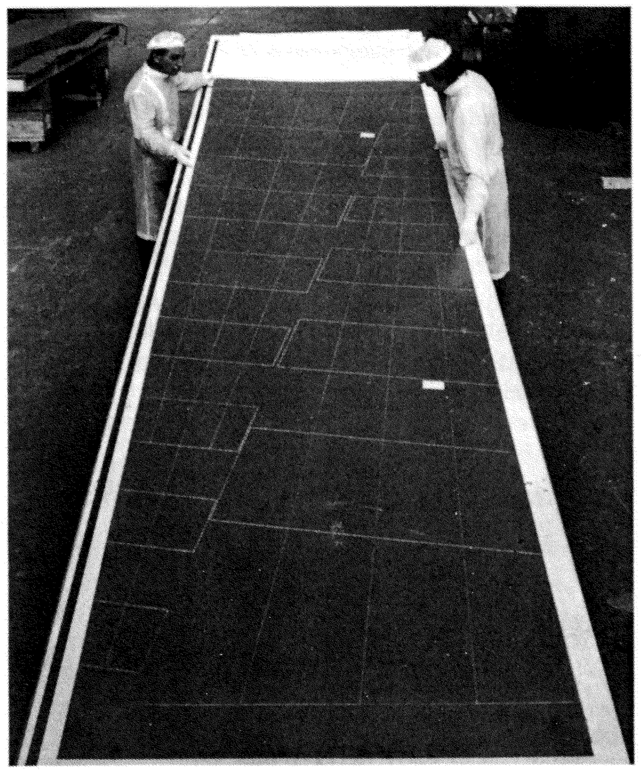
# Giant Read-Out Boards?



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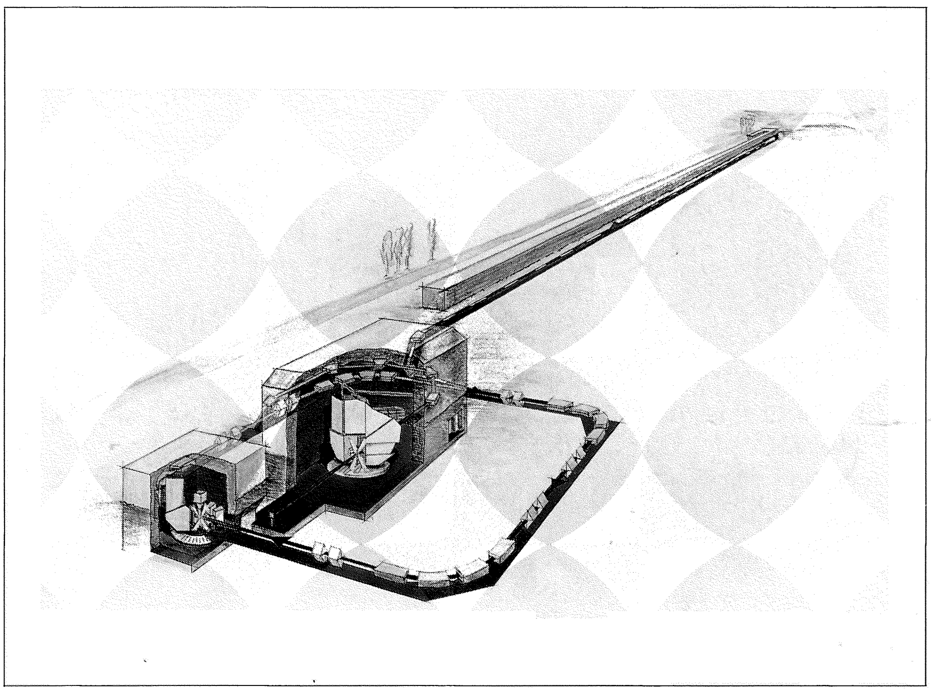
Schematic of NIKHEF's existing linac and new stretcher ring (foreground), with the existing and new (smaller) experimental halls.



## NIKHEF
## New stretcher ring for electron linac

July 14 was the official start date for construction of the Amsterdam Pulse Stretcher (AmPS) ring, an extension of the medium energy electron accelerator (MEA) of the nuclear physics section of the Dutch National Institute for Nuclear Physics and High Energy Physics (NIKHEF).

As well as increasing the duty cycle of the machine to almost 100 per cent, its maximum energy will be increased from the present 500 MeV to about 800 MeV. Construction is expected to be complete in 1992.

The present facility has profited from two high resolution spectrometers, and number of good electron scattering experiments with a range of nuclei have yielded detailed charge and magnetic current distributions in nuclei and differences between neighbouring nuclei.

By requiring coincidence between the scattered electron and a knock-on proton, another series of experiments provide accurate momentum distributions of protons in nuclei, revealing striking deviations from the independent particle shell model.

The coincidence experiments have also studied the behaviour of nucleons in the nuclear medium, confirming the observation in electron scattering experiments that in the quasi-elastic region, dominated by single emerging nucleons, the ratio of longitudinal to transverse nuclear structure functions is smaller than the ratio for free nucleons. Several explanations have been offered – swollen nucleons, meson exchange current contributions, correlations in the nuclear wave function and final state interactions.

The need for more kinematical flexibility and for triple coincidence measurements to learn more about two-nucleon correlations have been the motivation behind the new extension. New detectors, specifically for neutron work, are being developed.

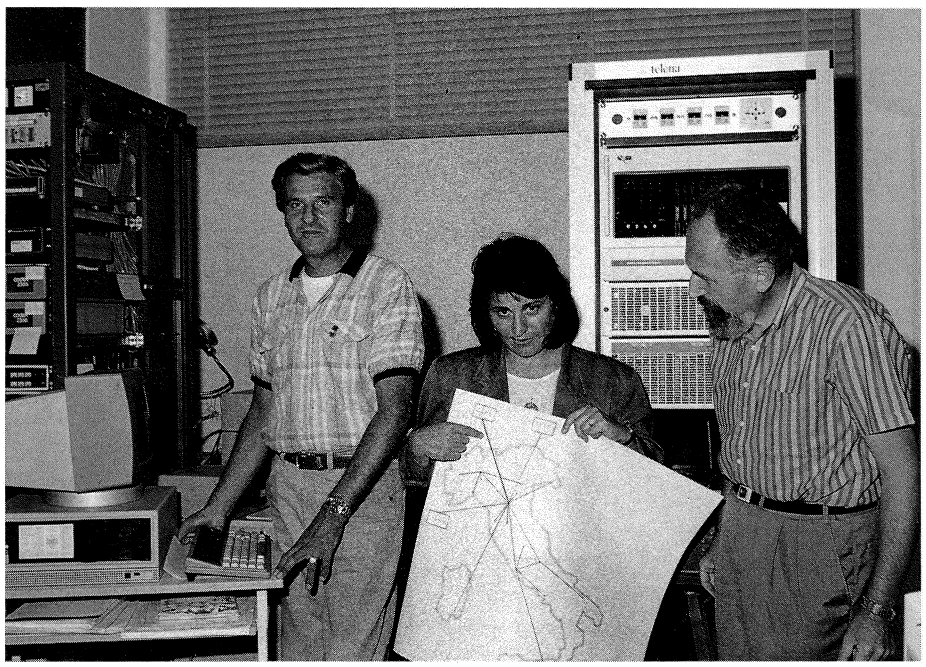
The stretcher ring also opens the exciting possibility of internal target experiments with very light nuclei and experiments with polarized (spin-oriented) electrons on polarized targets. A new experimental hall will house an electron spectrometer and a series of detectors using a gas jet target in the stored electron beam.

Experimenters will profit from the very high beam currents (200 mA) and the high duty factor, allowing very dilute targets and the detection of low energy recoil products to tag the final state, of particular importance for final states with neutral particles. With its stretcher ring complete, NIKHEF, together with MIT/Bates and MAMI-B (Mainz), will be at the forefront of medium energy electronuclear physics.

## COMMUNICATIONS
## High speed data link INFN-CERN

A newly-installed 2 Mbit/second data link from Bologna (INFN-CNAF) to CERN is the first 2 Mbit/s line arriving at CERN, and the very first international line of such speed in the international HEPnet High Energy Physics data communications network. Hopefully it will soon be followed by many others. (A feature article on HEPnet follows next month.)

This link extends the links connecting INFN-CNAF, the main node of the Italian HEP network INFNET, to the CERN computer networks, *At the Bologna end of the new INFN 2Mbit/s data link to CERN – left to right Massimo Cinque, Antonia Ghiselli and Umberto Zanotti.*



and will replace the slower analog links used for the last six years. This latest achievement complements the investments made in the past six years by INFN and the funding Ministry of University and Scientific Research of Italy (MURS), and will constitute an essential part of the backbone of the GARR, the Italian research network, now being developed. Through the INFN-CNAF centre at Bologna, the line is also connected by a high speed link (also 2 Mbit/second) to the Italian computing centre CINECA and to other national centres such as CI-LEA.

Operational tests of the 2 Mbit Bologna-CERN line started on July 26 with a DECNET connection between a pair of advanced DEC routers installed by INFN (in collaboration with CERN) at the two ends. When fully operational, the line will carry, as well as DECNET, the protocols SNA, TC/IP and X.25, and will give every opportunity to Italian physicists to access their home computers when at CERN, and the CERN experimental setups, documentation and databases when at home, and to bring LEP data into Italian computing centres, thus decreasing pressure on CERN's computing centre.

Although the line was planned for October, at the beginning of June INFN and CERN were informed by the PTT agencies concerned that the line would be delivered in July. This challenge was immediately accepted by the technicians and engineers of both institutions who, in less than seven weeks, and thanks to a well-organized synchronization of effort, succeeded in getting the first data packets through on July 26, allowing Italian scientists to fully exploit CERN's new LEP electron-positron collider right from the start.

# BROOKHAVEN Booster progress

With conventional construction nearing completion and magnet production well underway, the Booster synchrotron at Brookhaven is beginning to take shape.

Scheduled for completion in 1991, the Booster will extend the research capabilities of the Alternating Gradient Synchrotron (AGS), and with its ability to accelerate partially stripped heavy ions, will play an essential role in the chain of accelerators feeding the proposed Relativistic Heavy Ion Collider (RHIC).

The Booster is a rapid cycling synchrotron. By increasing the AGS injection energy, it will

- increase proton intensity in the AGS fourfold (to 6 x $10^{13}$ particles/pulse) to satisfy the demand for more beam and bigger data samples;
- increase polarized proton intensity in the AGS by a factor of 20 (to $10^{12}$ particles/pulse) for multi-target operation;
- allow acceleration in the AGS of heavy ions with mass up to 200 (gold) and beyond for both AGS physics and eventually for injection into RHIC.

The Booster ring, made up of twenty-four FODO cells, has a circumference of 201.78 m, a quarter that of the AGS, and will be equipped with 48 conventional quadrupoles and 36 dipoles, with twelve straight sections. The radiofrequency harmonic number of 3 and the low injection energy of the heavier ions present a wide frequency range, 178 kHz – 4.2 MHz, covered by amplifiers operating in three different bands.

Three modes of operation are

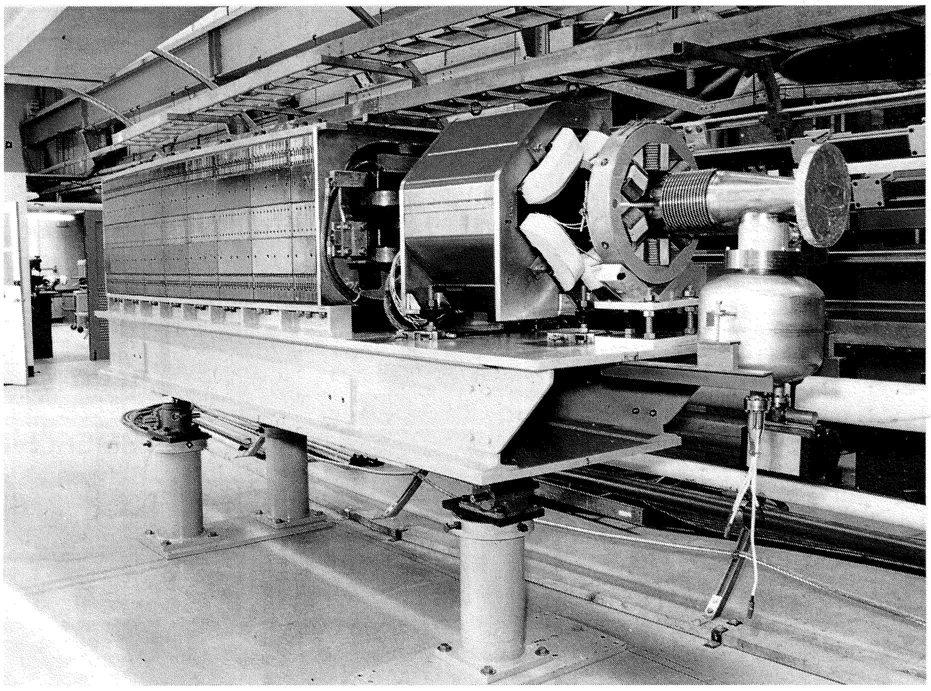
foreseen. When operating for protons, the Booster will inject four pulses of particles at a repetition rate of 7.5 Hz into the AGS. Each booster pulse will consist of three bunches of $5 \times 10^{12}$ protons, thus increasing the number of particles per pulse in the AGS to $6 \times 10^{13}$. Initially, protons will be extracted from the Booster at 1.5 GeV; however, since the magnetic elements of the Booster and the transfer line must also accommodate the much stiffer heavy ion beams, protons could also be taken up to 2.5 GeV.

For heavy ions, the dipole magnetic field at extraction is greater than for protons – 1.27 T for partially stripped gold ions versus 0.546 T for protons, for example – and the acceleration time is slower. Only one pulse will be injected into the AGS ring per AGS cycle.

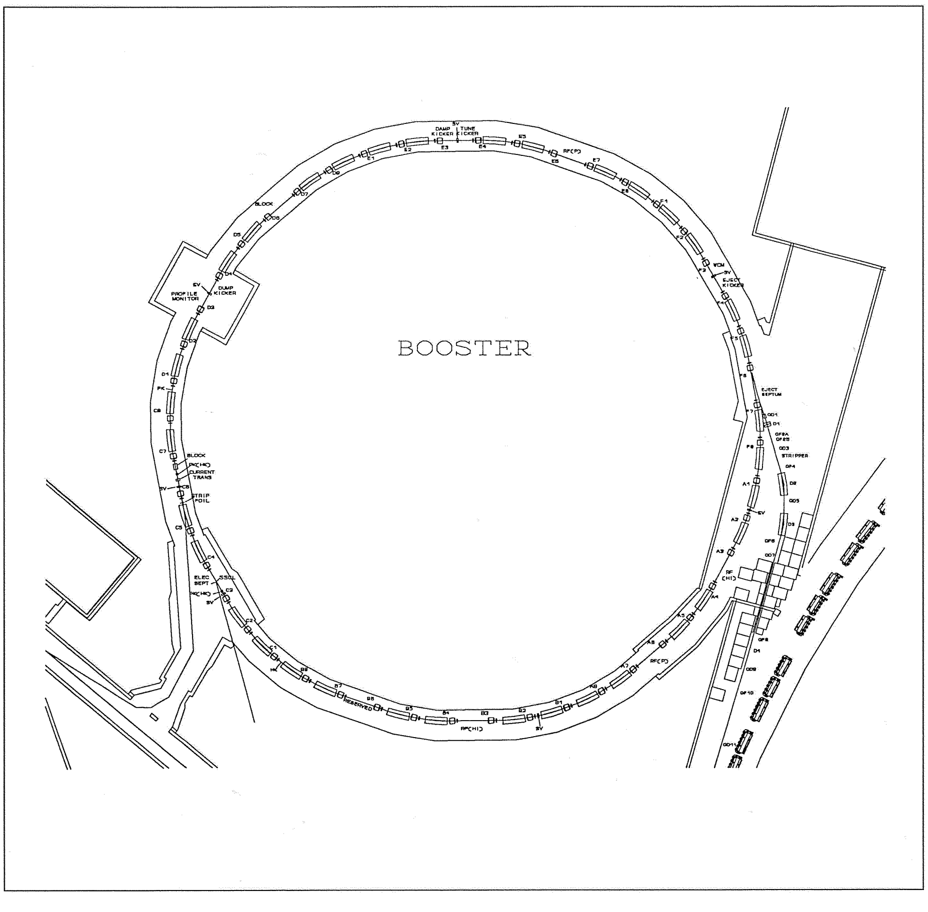
For polarized protons, the Booster will act as an accumulator-accelerator, with injection into the Booster taking 20-30 linac pulses.

Each mode of operation has special requirements, including the pace-charge tune shift due to the ıtense proton beams, the eddy current effects produced in the beam chamber by rapid cycling, and an ultra-high vacuum beam pipe to prevent electron exchange between residual gas molecules and the partially stripped, yet electron rich, heavy ions.

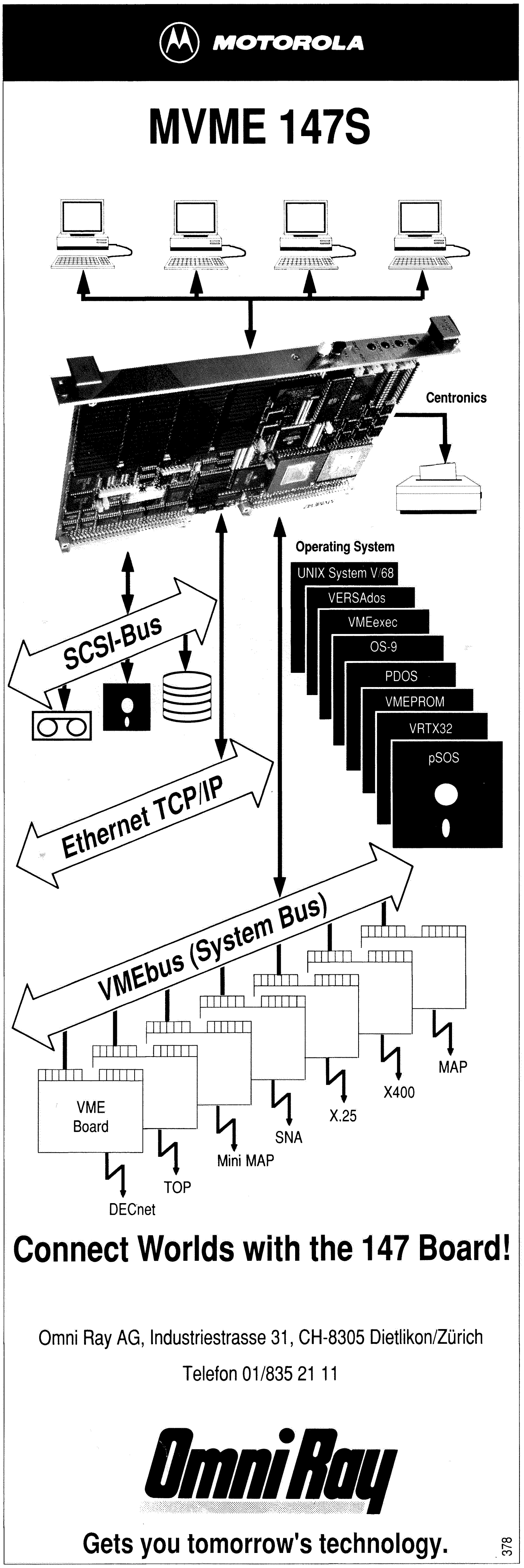
Although the Booster became a construction project in October 1986, major funding is concentrated in the period 1988 – 1991. Conventional construction is now 90% complete; main magnet power supplies have been specified and ordered; radiofrequency amplifiers and beam pipe assemblies con-



*A half-cell of Brookhaven's new Booster, showing one dipole, one quadrupole and one sextupole. Magnetic correctors will be installed over the bellows (at right).*




*The Brookhaven Booster will link the 200 MeV linac (left) and the Alternating Gradient Synchrotron (right).*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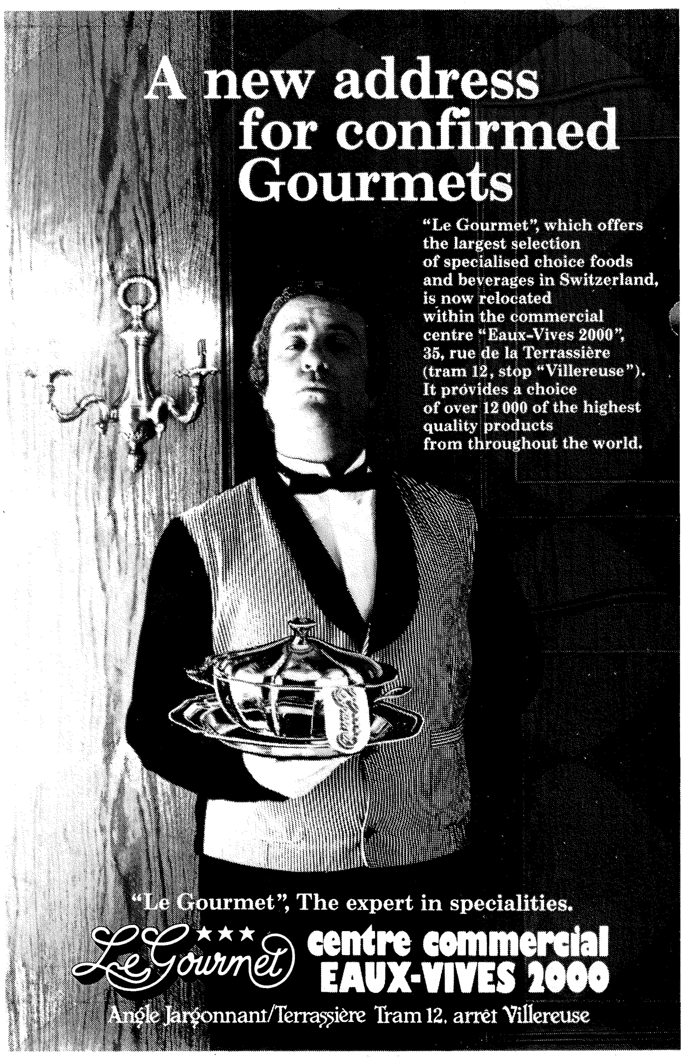
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***** Late news: On 16 September the electron ring for the HERA electron-proton collider at DESY reached its design energy of 26.4 GeV.**

structed and under test; most of the linac-Booster injection line components completed ready for installation; and dipole laminations assembled into blocks, with both dipole and quadrupole magnets being produced as the coil assemblies become available. Measurements on the initial dipoles have confirmed the magnet design and measurements on a prototype quadrupole are underway. Installation of completed half-cells is imminent.

# DESY* DORIS at 16

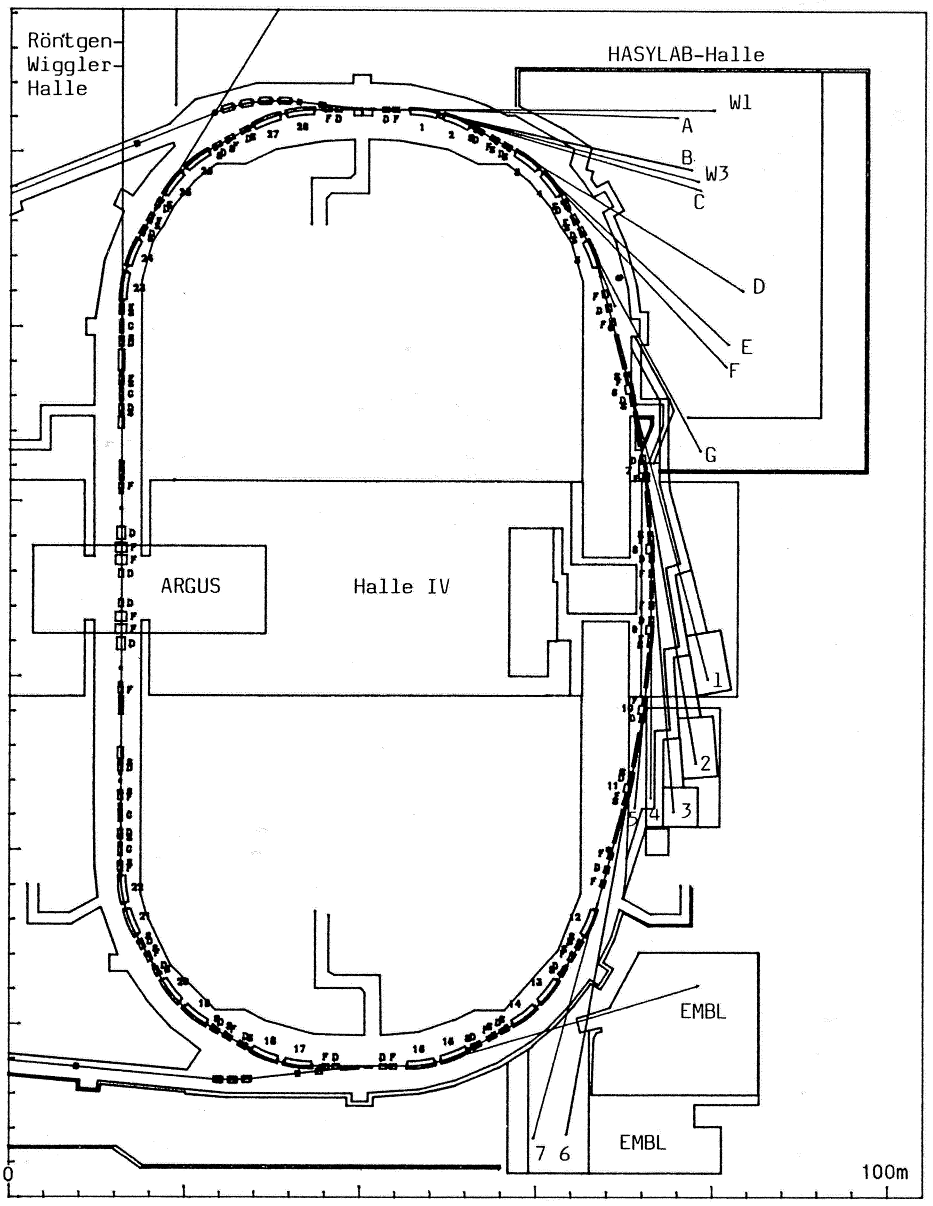
Despite its advanced age of 16 years, the DORIS electron-positron collider at the German DESY Laboratory in Hamburg attained a new best performance earlier this year. The luminosity (a measure of the collision rate) reached 1880 inverse nanobarns per 24 hours following a series of improvements, mostly carried out last year. Since then DORIS has provided continuous beams for high energy physics and for synchrotron radiation studies.

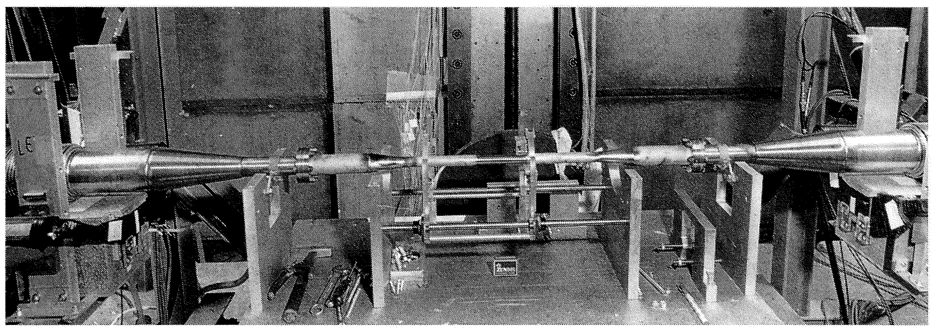
(This performance has been exceeded elsewhere, notably at Cornell's CESR ring – June 1988, page 13.)

The DORIS ring (about 300 m in circumference) started operation in December 1973 as a double ring optimized for 3.5 GeV beams. It was subsequently modified and improved, and in 1977 was converted into a single ring and the energy increased to 5.1 GeV.

A mini-beta beam squeezer was installed in 1982 and the energy boosted to 5.6 GeV. This machine

*Proposed layout of the modified (DORIS III) electron-positron storage ring at the German DESY Laboratory in Hamburg. A new bypass (right) will house six new wiggler magnets to produce additional synchrotron radiation beams.*



*Tests with narrow beam-pipes (only a few centimetres across) are being carried out at DORIS II for the ARGUS experiment.*

is now called DORIS-II and is used mainly to produce B mesons (containing the 'beauty' quark) for the ARGUS international collaboration and to provide synchrotron radiation to 24 main ports for 'HASYLAB', the HAmburg SYnchrotron-Radiation LABoratory.

The beam energy is usually around 5.3 GeV for particle physics (colliding beams with one bunch each) and around 3.7 GeV for HASYLAB (single beam, multibunch operation).

In 1988 additional improvements helped increase stored currents and make for smoother running. The number of radiofrequency accelerating cavities (each with five cells) was increased from 10 to 11 and the power output of the transmitters was raised from 1.0 MW to 1.2 MW. Two damping antennas were added to each cavity to decouple higher modes. The beam current monitor had to be replaced as the old one showed vacuum leaks due to overheating by stored currents. The electrostatic beam separators (used earlier at injection) had to be removed for the same reasons, but were no longer needed anyway, due to the high injection rates achieved.

Following these modifications, several synchrotron radiation absorbers could be eliminated and the structure of the inner surface of the vacuum pipe simplified.

Since 1982 it has been possible to inject particles at the running energy and 'top up' the circulating bunches with fresh particles from the DESY II synchrotron without any time-consuming energy ramping. Injection now takes typically two minutes.

The total particle current reaches now up to 45 mA per beam (in two-beam single-bunch operation at 5.3 GeV) with a beam lifetime of about an hour. With a single beam and with four bunches at 3.7 GeV, the current reaches 100 mA with a lifetime of about three hours.

In 1988 the ARGUS experiment was able to collect 67 events per picobarn at the broad (4S) upsilon resonance and during the course of this year expects to obtain even more. By the summer, DORIS II had provided 100 inverse picobarns of collisions.

July saw testing of a narrow vacuum pipe, only 37 mm across in the interaction region, with a central part (16 cm long) made of beryllium. The goal is for the ARGUS detectors to get as close as possible to the collisions and to minimize particle losses in the beam pipe. Initial results are very encouraging and even smaller pipes will be tested.

Next year the straight section opposite ARGUS previously occupied by the Crystal Ball experiment will be bypassed to add six new wiggler magnets with beamlines for synchrotron radiation. The machine will then be called DORIS III.

*From Horst Nesemann*

## FERMILAB
## Working with industry

*Walter LeCroy, founder and President of LeCroy Electronics speaking at the recent Fermilab Industrial Affiliates Meeting, where he examined the history of data acquisition for high energy physics from the corporate perspective.*

Highlighting the increasing interplay between high energy physics and industry, this year's annual meeting of Fermilab's Industrial Affiliates featured two roundtable discussions on new technology related to high energy physics.

The first covered applications of accelerators both in research and industry, ranging from the giant machines at major Laboratories like Fermilab to the compact devices used in medicine.

Speakers and their topics included Tsahi Gozani of SAIC and explosive detection in baggage; former Argonne director Al Crewe and high resolution electron microscopes; Gwyn Williams of Brookhaven and the growing role of synchrotron radiation; Frank Cole and medical accelerators; Craig Noonan and industrial applications; Mahler Wilson and tritium production with powerful linacs; Tom Cahill of UC/Davis and archaeological dating with accelerators.

The second roundtable covered new initiatives for computers and electronics for science, and included experts from industry and from scientific laboratories.

The Fermilab Industrial Affiliates organization (now numbering 40 institutions) was established in 1980 by then Director Leon Lederman to improve university-industry research communications and to foster technology transfer from Fermilab.

# WORKSHOP
# Looking to mass-produce beauty

Physicists' attention is increasingly turning to the possibilities of 'particle factories' to explore the high intensity frontier and complement the traditional push for high energy (July/August, page 26).

A workshop held at the Château de Blois, France, from June 21 – July 1 looked at requirements and physics prospects for factories to manufacture B mesons (containing the fifth 'beauty' quark). Under organizing committee chairmen D. Cline and A. Fridman, the basic goal was to assess the prospects for achieving the necessary high collision rate (luminosity of $10^{34}$ per sq cm per s) with a B factory to produce more than a thousand million pairs of neutral B mesons per year to search for violation of CP symmetry (combined left/right and particle/antiparticle reversal), seen so far only in the neutral kaon sector, together with other physics aims and related detector constraints.

The machine discussions covered different approaches – linear-linear colliders, linear-circular (symmetric and asymmetric) and fixed target hadron machines. Thinking is turning towards asymmetric colliding beams to produce B pairs for CP violation studies, with the promise of a gain factor of 4.6 over symmetric (equal energy) colliding beams.

The meeting started with a review of B physics, including recent results from Cornell, DESY, UA1 at CERN and CDF at Fermilab. One highlight was a report by the CLEO group at Cornell's CESR electron-positron collider that transitions of beauty (b) to 'up' (u) quarks are beginning to show up (see page 4). Other speakers looked at implications of the production of B meson pairs at both proton-proton and proton-antiproton colliders.

Ideas were aired for prospective B factories at Cornell, Stanford (SLAC), Novosibirsk, Southern California, PSI (Switzerland – July/August, page 27) and Frascati as well as exploiting CERN's new LEP ring.

B physics will also be possible at the new US Superconducting Supercollider (SSC) project, using either a low intensity extracted 20 TeV (20,000 GeV) beam or the proton-proton collisions. In the first case the only real problem is to extract a modest beam, and various ideas, such as a crystal channeling device, were discussed. In the second case the main problem is to live with the extremely large backgrounds in high luminosity proton-proton colliders.

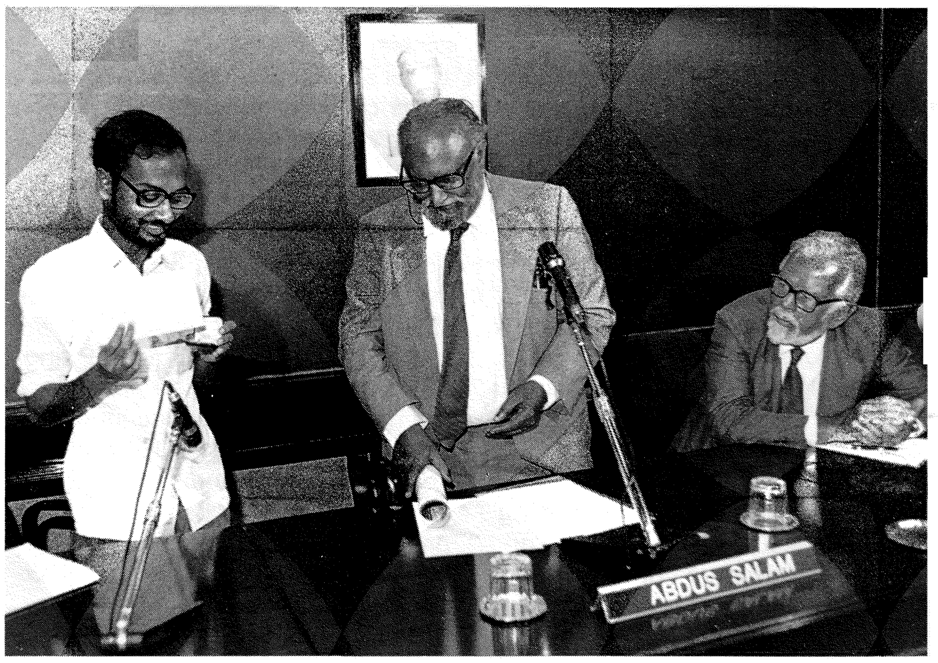
The major objective of the workshop was to assess the prospects for an electron-positron collider reaching a luminosity of $10^{34}$, a hundred times higher than the present world record of the CESR machine at Cornell. For circular colliders this means storing a beam of several amps, rather than the conventional hundreds of milliamps. For linear-linear and linear-circular colliders, the problem lies in the positron levels needed.

It was clear that extensive R & D is required before such high luminosity linear colliders can leave the drawing board, however much of this R & D would also be useful for higher energy linear machines. The asymmetric circular colliders fared better but would have to live up to their expected large luminosity increases. Accelerator physicists were optimistic that a solution providing the required luminosity could be found eventually.

Another conclusion was that although the hadron collider option lagged behind that the electron-positron collider solution, it showed great promise, especially using extracted proton beams of several TeV.

*From David Cline*

# People and things




Ashoke Sen (left) receives the Yukawa Prize of the International Centre for Theoretical Physics (ICTP), Trieste, from ICTP Director Abdus Salam. Right is Paolo Budinich, of Trieste's International School of Advanced Studies.

## Finland lines up for CERN

*The Finnish Government has decided to begin negotiations for Finland to become a CERN Member State in a few years. Finland would then become CERN's fifteenth Member State (the others being Austria, Belgium, Denmark, the Federal Republic of Germany, France, Greece, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom).*

## On people

*While in Australia recently for top-level discussions exploring the possibilities for consolidating CERN's international collaboration, CERN Director General Carlo Rubbia was awarded the Silver Dirac Medal for the Advancement of Theoretical Physics of the University of New South Wales, at the same time giving the University's Public Dirac Lecture. The title was 'Hunting the Higgs Particle'.*

*Abdus Salam, Founder and Director of the International Centre for Theoretical Physics, Trieste, becomes an honorary British Knight Commander, OBE.*

*Daniel Denegri of Saclay has been awarded the Joliot-Curie Prize of the Société Française de Physique for his contributions to the UA1 experiment at CERN's proton-antiproton collider.*

*Louis Fayard of Orsay and the UA2 experiment at CERN's proton-antiproton collider receives the IBM prize of the Société Française de Physique.*

*Michael Green of London's Queen Mary College and John Schwarz of Caltech receive this year's Dirac Medals of the International Centre for Theoretical Physics (ICTP), Trieste, for their basic contributions to superstring theory, while a special ICTP Prize this year in honour of the late Hideki Yukawa went to Ashoke Sen, of the Tata Institute for Fundamental Research, Bombay, India, for his special contributions to string and superstring theory. At the ICTP ceremony announcing the awards (held on 8 August, birthday of the late Paul Dirac), ICTP medals were also presented to S. Coloni, Member of the Italian Parliament, and M. Rosetti, Member of the European Parliament, in appeciation of their work for the progress of science at Trieste.*

## Georges Charpak 65

*Detector virtuoso Georges Charpak formally retired from CERN at the end of August. With his inventive genius and strong leadership, his group pioneered the multiwire proportional chamber and drift chamber in the late 60s, and went on to develop many ingenious applications of particle physics detection techniques in other fields.*

*A memorable event at CERN in October will be a special 'Charpakfest', where eminent speakers will chart his distinguished career and include their own tributes.*

*At the Europhysics International Conference on High Energy Physics in Madrid in September, Charpak received the first High Energy and Particle Physics Prize of the European Physical Society, an award which will henceforth be attributed every two years.*

## New High Energy Physics Director at Argonne

*In July, Thomas Kirk took over from Thomas Fields as Director of the High Energy Physics Division of*

An event at the Joint Institute for Nuclear Research (JINR), Dubna, near Moscow, in August marked the 80th birthday of former JINR Director N.N. Bogolyubov (centre), who now holds the title of Honorary Director of JINR. Among those paying tribute to this figurehead of Soviet science were A.A. Logunov, Vice-President of the Soviet Academy of Sciences (right), and JINR Director D. Kiss (left).

(Photo Yu. Tumanova)

Argonne National Laboratory.

Previously Acting Head of the superconducting magnet effort in the Central Design Group of the US Superconducting Supercollider (SSC), Kirk has also held a number of important positions at Fermilab, including Head of the Physics Department and Project Manager for the Tevatron II Fixed Target Project.

Argonne's physics programme includes collaboration in the CDF experiment at the Fermilab Tevatron collider, continuing studies of hadron polarization effects, and underground experiments in the Soudan mine. There is also the construction of a 150 MeV electron linac to continue the successful wakefield studies carried out on an existing 20 MeV machine, and of the barrel calorimeter for the ZEUS detector at the HERA proton-electron collider at the German DESY Laboratory. Major ongoing plans centre on Argonne's role in the SSC experiments.

## Meetings

The 25th IUPAP International ('Rochester') Conference on High Energy Physics will be held from 2-8 August 1990 in Singapore, hosted by the South East Asia Theoretical Physics Association and the National University of Singapore. Further information from Prof. K.K. Phua, c/o Dept. of Physics, National University of Singapore, Kent Ridge, Singapore 0511, bitnet PHYCONF at NUSVM.

The second European Particle Accelerator Conference will be held from 12-16 June 1990 in Nice, France, under the auspices of the European Physical Society and the European Committee for Future Accelerators. Further information from the Local Organizing Committee, (Chairman P. Mandrillon, Secretary F. Fein) Centre Antoine-Lacassagne, 26 Voie Romaine, 06054 Nice, Cedex, France.

A 'Dalitz Conference' will be held in Oxford on 5-6 July 1990 to mark Dick Dalitz's (formal) retirement. Speakers will include Abraham Gal, Gerson Goldhaber, Maurice Jacob, T.D. Lee, Yoichiro Nambu and Val Telegdi. Further details and registration forms from – Dalitz Conference, Department of Theoretical Physics, 1 Keble Road, Oxford OX1 3NP, UK, or via bitnet from LLEWELLYN at UK.AC.OX.PH.V1 or LLEWELLYN at V1.PH.OX.AC.UK.

From 14-25 June 1990 an Advanced Study Institute on Techniques and Concepts of High Energy Physics will be held at St. Croix, US Virgin Islands, sponsored by the NATO Advanced Institutes Programme, the US Department of Energy and the US National Science Foundation, Fermilab and the University of Rochester. Further information from – C. Jones, Dept. of Physics and Astronomy, University of Rochester, Rochester, NY 14627, USA.

The successful Lake Louise Winter Institute organized by the University of Alberta, Edmonton, Alberta, Canada, continues with themes of The Standard Model and Beyond from 18-24 February next year and The Factory Era in February 1991. Further information from the Winter Institute Secretary, Dept. of Physics, University of Alberta, Edmonton, Canada T6G 2J1.

'Trends in Physics' – the eighth General Conference of the European Physical Society – will be held from 4-8 September 1990 in Amsterdam and will cover a wide range of physics subjects. Further information from the Conference Secretariat, RAI Organistie Bureau bv, Europaplein 12, 1078 GZ Amsterdam, Netherlands.

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- SOUDAN 2 experiment on proton decay (Minnesota)
- SNO experiment on solar neutrinos (Sudbury, Ontario)
- Development of cryogenic particle detectors

The Research Officer is expected to have a few years postdoctoral experience and be prepared to accept major responsibilities in experiments overseas. The appointment is for 3 years, renewable for a further 2 years, on the University Lecturer Scale (£10,458 to £21,852). There are possibilities for some paid college teaching.

The Research Associate posts are postdoctoral positions on the Research Support Grade 1A Scale (£10,458 to £16,665), with appointments again for an initial period of 3 years renewable for a further 2 years. In both cases, starting salaries will be according to age and experience.

Applicants should state whether they are interested in one or other (or both) the above posts, and send a cv with statement of research interests and the names and addresses of two referees, to:

**Mr. A. Jones, General Administrator,
Department of Nuclear Physics, Keble Road,
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Candidates with zero to three years from Ph.D. with a background in either nuclear or high-energy physics or nuclear chemistry are encouraged to apply. These appointments will be for a term of one year with the possibility of renewal for up to three years. **Candidates are encourged to apply by January 31, 1990.**

Applicants are requested to submit a curriculum vitae, list of publications, and arrange for three letters of recommendation (Specify Job #B/5452) to be sent to: Janis M. Dairiki, Assistant Director Nuclear Science Division, Lawrence Berkeley Laboratory, Employment Office, Bldg. 90/1042, 1 Cyclotron Road, Berkeley, CA 94720.

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## Cryogenic ion source

*A cryogenic electron beam ion source (CRYEBIS) came into operation earlier this year at the J.R. Macdonald Laboratory of the University of Kansas and went on to supply fully stripped argon ions for physics experiments. The Laboratory studies atomic interactions using a range of ion energies.*

## Accelerator Conference

*The International Conference on High Energy Accelerators was held in Tsukuba, Japan, in August, hosted by the Japanese KEK Laboratory. A full report will feature in the next issue.*

## ICFA meets in Japan

*The International Committee for Future Accelerators (ICFA) meeting at the Japanese KEK Laboratory on 18 August reviewed the work of the four ICFA panels set up in 1984 and which have substantially increased their activities in recent years (September 1988, page 14).*

*Following the success of the earlier Instrumentation Schools held at the International Centre for Theoretical Physics (ICTP) in Trieste, the Panel for Instrumentation Innovation and Development will hold its next school (the third) in Rio de Janiero in July 1990, in line with ICFA's policy of promoting high energy physics in developing countries. The following School, in June 1991, will again be held in Trieste. The Instrumentation Bulletin now has a circulation of some 2,500 and is distributed from four regional centres. The latest issue is No. 7.*

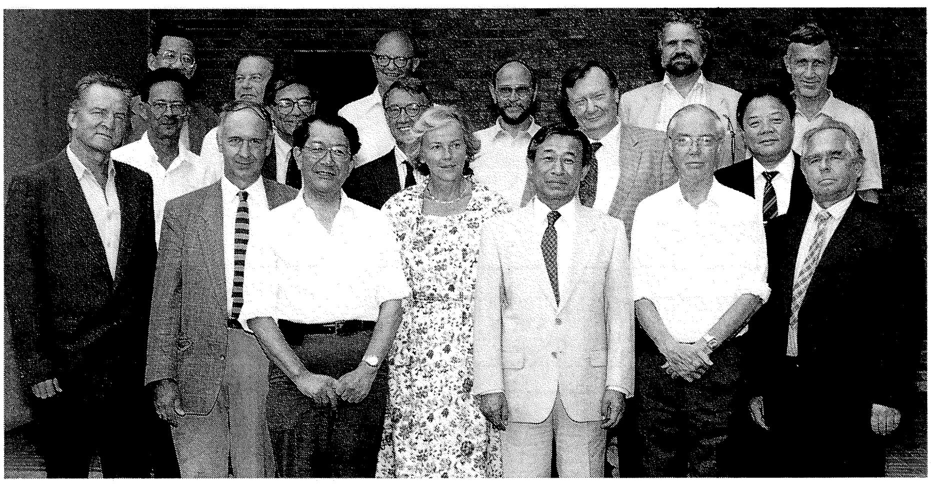
*The Beam Dynamics Panel publishes a Newsletter with a circulation of around a thousand: the latest issue is No. 4. Forthcoming Workshops organized by this Panel will be on 'Collective Effects of Short Bunches', to be held at KEK Japan next September or October, and on 'Operations Simulation' in the US in 1991.*

*The Panel of New Accelerator Schemes will hold a Workshop on 'High Current Cathodes' next June on Bandor Island, France, immediately after the European Particle Accelerator Conference in Nice (see page 29). For 1991 there are plans to hold a joint Workshop with the Beam Dynamics Panel on 'Beam-Beam Effects in Linear Colliders'.*

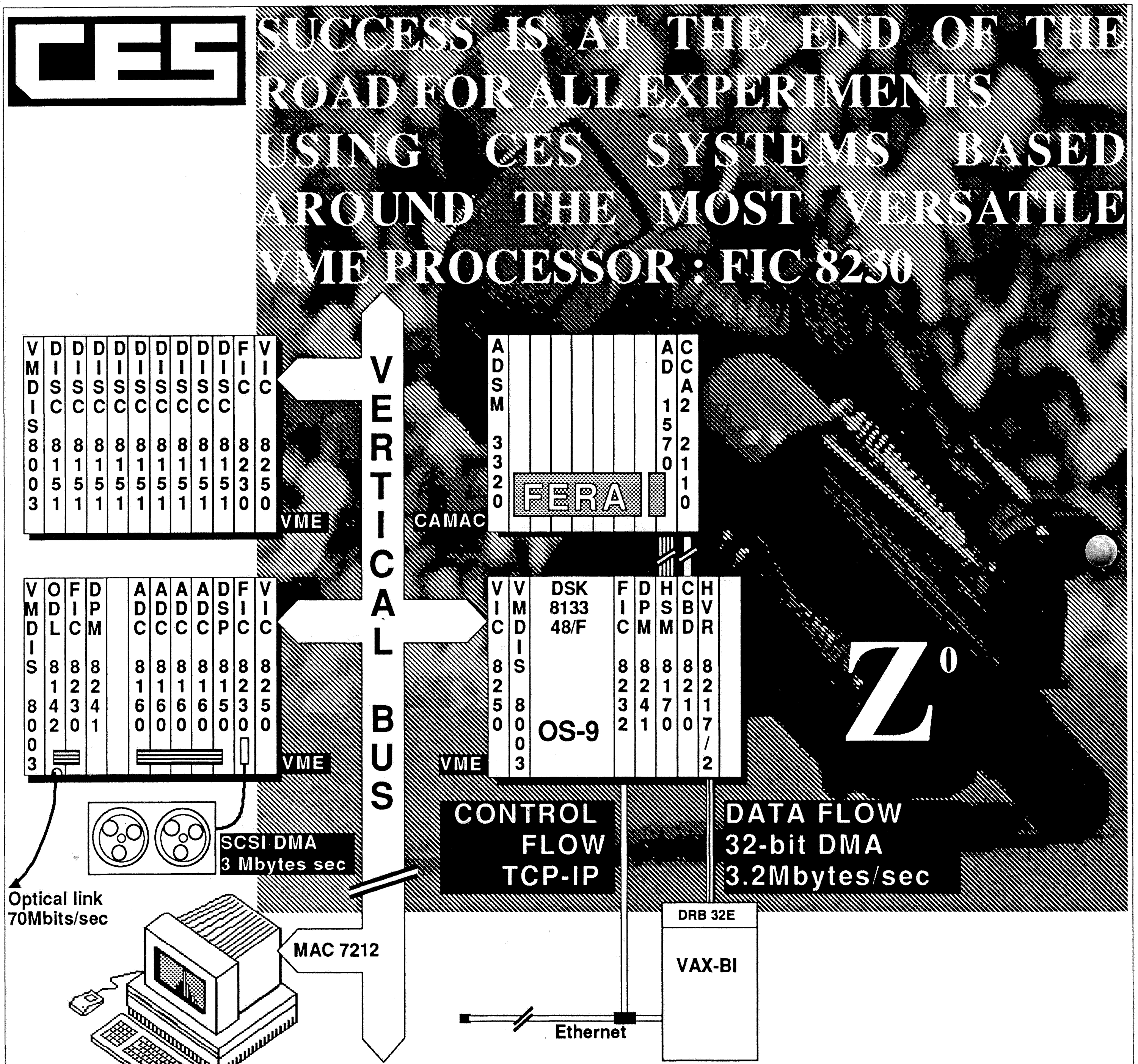
*The Panel of Superconducting Magnets and Cryogenics has been working on an ICFA standard for superconducting wire and cable for accelerator magnets. It is hoped to finalize this within the next year for forwarding to the appropriate Standards Bureaux in the major countries concerned.*

*As well as reviewing the work of its panels, ICFA also discussed the programme for the next ICFA Seminar on Perspectives in High Energy Physics to be held at the Institute of High Energy Physics, Serpukhov, USSR, next October. The previous seminar was held in Brookhaven (December 1987, page 1).*

*Finally ICFA unanimously decided to propose to the Particles and Fields Commission of the International Union of Pure and Applied Physics (IUPAP) that Academician A.N. Skrinsky, Director of the Novosibirsk Nuclear Physics Laboratory and who last year succeeded M.A. Markov as Secretary of the nuclear physics branch of the Soviet Academy of Sciences, should be appointed as ICFA's next Chairman for three years from 1 January, succeeding Yoshio Yamaguchi, who retires from the Committee after serving as a member since its inception in August 1977.*



*Delegates at the recent ICFA (International Committee for Future Accelerators) meeting at the Japanese KEK Laboratory – left to right, E. Myae (Serpukhov), R. Palmer (SLAC/Brookhaven), S. Fang (Beijing), V. Soergel (front, DESY), D. Kiss (Dubna), G. Trilling (Berkeley), S. Ozaki (KEK), K. Strauch (Harvard), L. Pondrom (Wisconsin), Helga Schmal (secretary, CERN), E. Keil (CERN), Y. Yamaguchi (chairman, Tokai), C. Rubbia (CERN), T. Ekelof (Uppsala), W.O. Lock (secretary, CERN), H. Hirabayashi (KEK), A. Skrinsky (Novosibirsk), Yu. Ado (Serpukhov).*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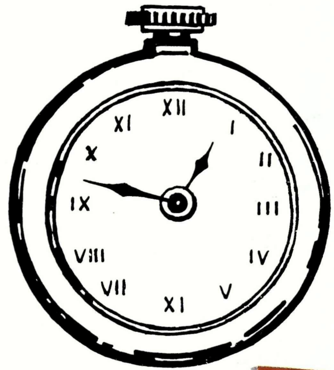
# It's about TIME . . .

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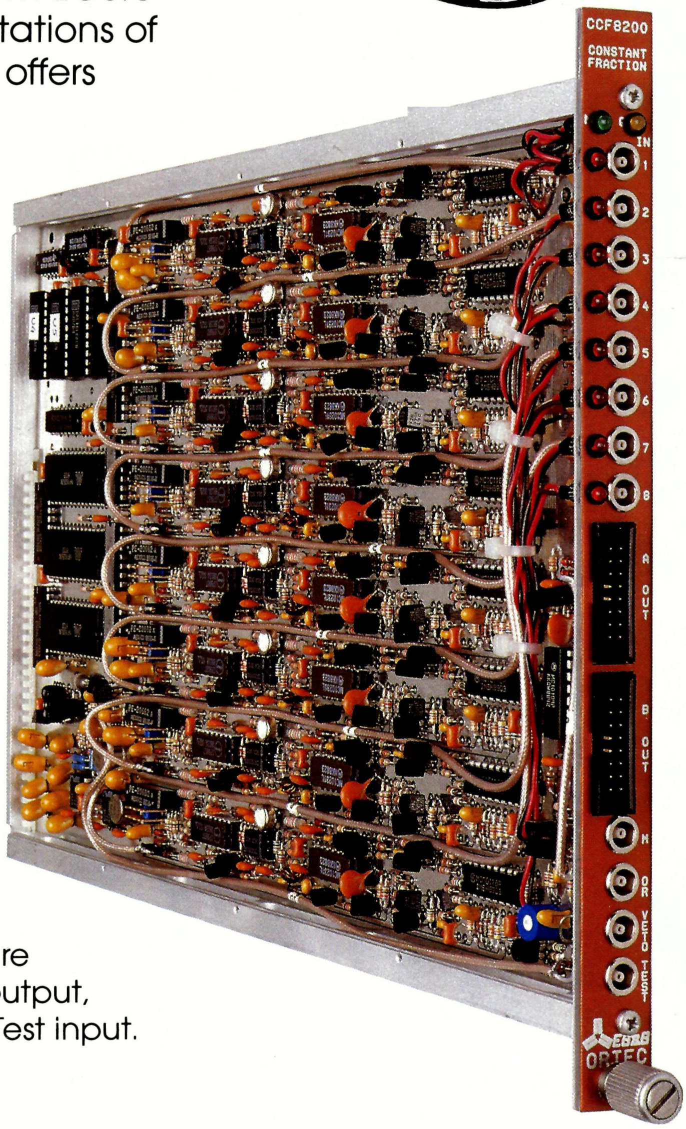


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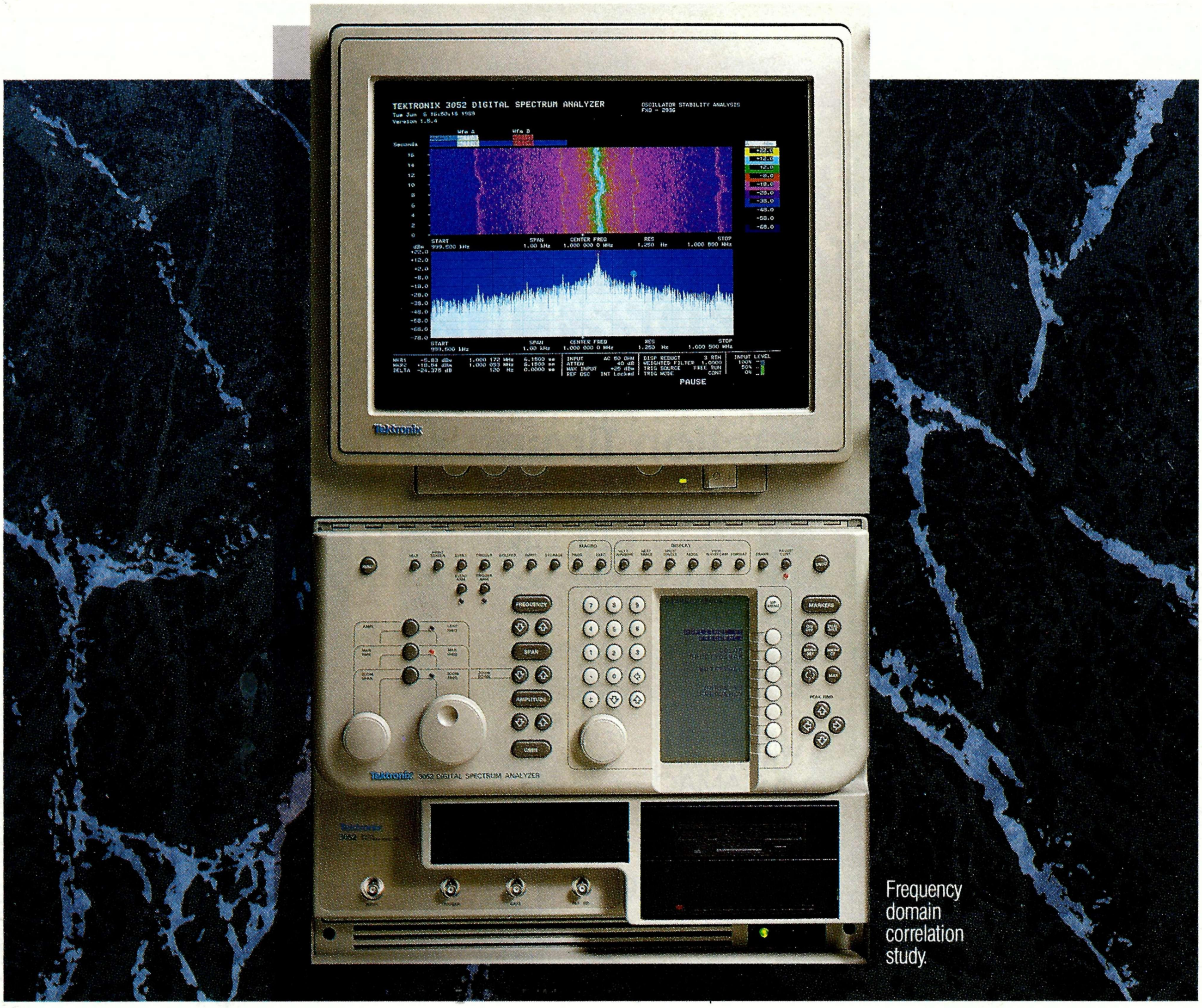


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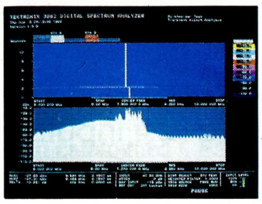

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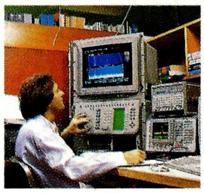

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