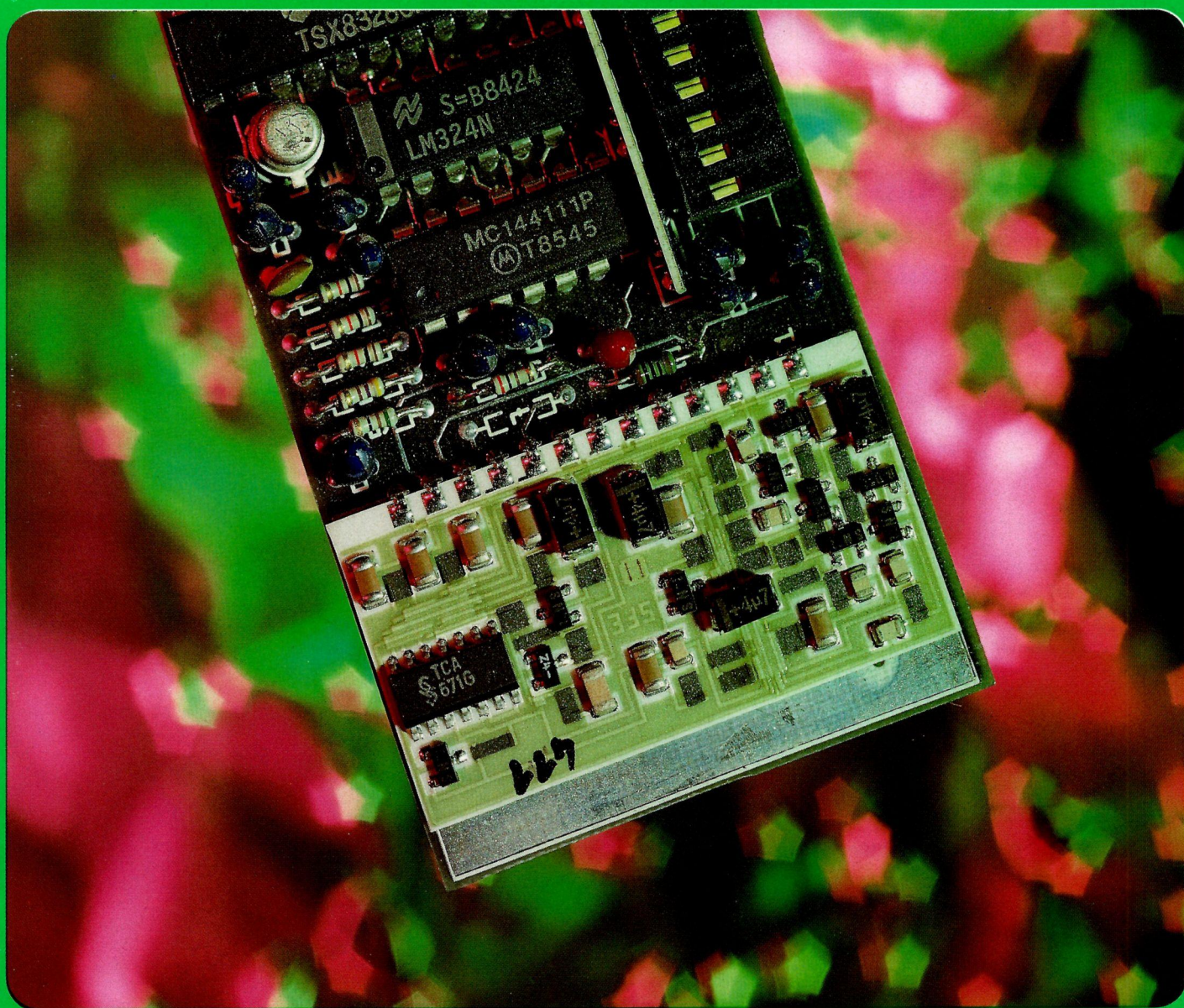


# CERN COURIER

International Journal of High Energy Physics



VOLUME 27



NOVEMBER 1987

# INTRODUCING OUR LATEST DETECTOR DEVELOPMENT TOOL

**Model 2262 Multi-Input, 10-Bit,  
40/80 Megasample/sec  
Waveform Digitizer**

Developed for Jet, Image and Time Projection Chamber (TPC) Systems in High Energy Physics and Heavy Ion experiments, LeCroy's Model 2262 Waveform Digitizer offers precision analysis of both chamber performance and readout electronics.

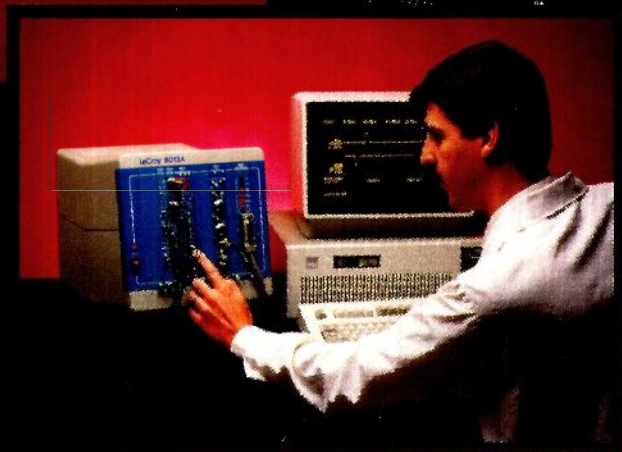
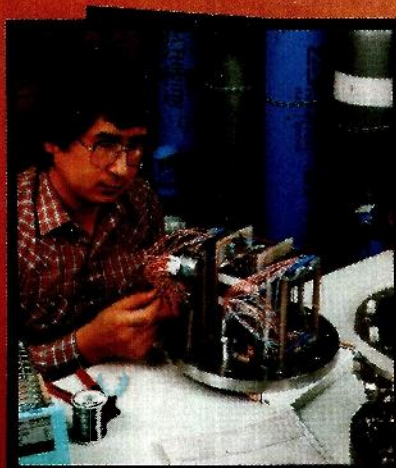
Bi-polar inputs permit simultaneous sampling from sense wires or pads. The DC-coupled 40 MHz analog bandwidth and 10-bit resolution means that the details of the chamber signals will not be lost. Up to four signals at 40 megasamples/sec or two signals at 80 megasamples/sec are captured by a single-width CAMAC (IEEE-583) module. External timebases may also be used.

The Model 2262 is compatible with GPIB (IEEE-488) operation and works with IBM PC™-based software for easy, user-oriented, waveform display and control. Support and accessory modules are available. Contact LeCroy worldwide for more information and detailed specifications.

**LeCROY— for the performance, service and support you can count on today and in the future.**

™IBM PC is a registered trademark of International Business Machines Corporation.  
™CATALYST is a registered trademark of LeCroy Corporation

LeCroy digitizers are being used for detector development in Lawrence Berkeley Laboratory's radial drift detector.



Detector Development Station with HV supply, digitizer, amplifier and time base in bench top mainframe. GPIB connection to an IBM PC AT running CATALYST™ Software.



# LeCroy

700 Chestnut Ridge Road, Chestnut Ridge, NY 10977-6499, USA. Tel: (914) 578-6013  
Route du Nant-d'Avril 101, 1217 Meyrin 1-Geneva, Switzerland. Tel: (022) 82 33 55

Laboratory correspondents:

Argonne National Laboratory, USA  
M. Derrick  
Brookhaven National Laboratory, USA  
N. V. Baggett  
Cornell University, USA  
D. G. Cassel  
Daresbury Laboratory, UK  
V. Suller  
DESY Laboratory, Fed. Rep. of Germany  
P. Waloschek  
Fermi National Accelerator Laboratory, USA  
M. Bodnarczuk  
KfK Karlsruhe, Fed. Rep. of Germany  
M. Kuntze  
GSI Darmstadt, Fed. Rep. of Germany  
G. Siegert  
INFN, Italy  
M. Gigliarelli Fiumi  
Institute of High Energy Physics,  
Beijing, China  
Wang Taijie  
JINR Dubna, USSR  
V. Sandukovsky  
KEK National Laboratory, Japan  
K. Kikuchi  
Lawrence Berkeley Laboratory, USA  
W. Carithers  
Los Alamos National Laboratory, USA  
O. B. van Dyck  
Novosibirsk Institute, USSR  
V. Balakin  
Orsay Laboratory, France  
Anne-Marie Lutz  
Rutherford Appleton Laboratory, UK  
A. D. Rush  
Saclay Laboratory, France  
A. Zylberstejn  
SIN Villigen, Switzerland  
J. F. Crawford  
Stanford Linear Accelerator Center, USA  
W. W. Ash  
Superconducting Super Collider, USA  
Rene Donaldson  
TRIUMF Laboratory, Canada  
M. K. Craddock

Copies are available on request from:

China —  
Dr. Qian Ke-Qin  
Institute of High Energy Physics  
P.O. Box 918, Beijing,  
People's Republic of China  
Federal Republic of Germany —  
Gabriela Martens  
DESY, Notkestr. 85, 2000 Hamburg 52  
Italy —  
INFN, Casella Postale 56  
00044 Frascati  
Roma  
United Kingdom —  
Elizabeth Marsh  
Rutherford Appleton Laboratory,  
Chilton,  
Didcot  
Oxfordshire OX11 0QX  
USA/Canada —  
Margaret Pearson  
Fermilab, P.O. Box 500, Batavia  
Illinois 60510  
General distribution —  
Monika Wilson  
CERN, 1211 Geneva 23, Switzerland

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

Printed by: Presses Centrales S.A.  
1002 Lausanne, Switzerland

Published by:

European Laboratory for Particle Physics  
CERN, 1211 Geneva 23, Switzerland  
Tel. (022) 83 61 11, Telex 419 000  
(CERN COURIER only Tel. (022) 83 41 03)  
USA: Controlled Circulation  
Postage paid at Batavia, Illinois

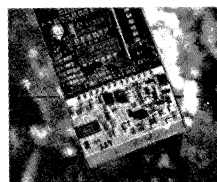
Volume 27  
No. 9  
November  
1987

# CERN COURIER

International Journal of High Energy Physics

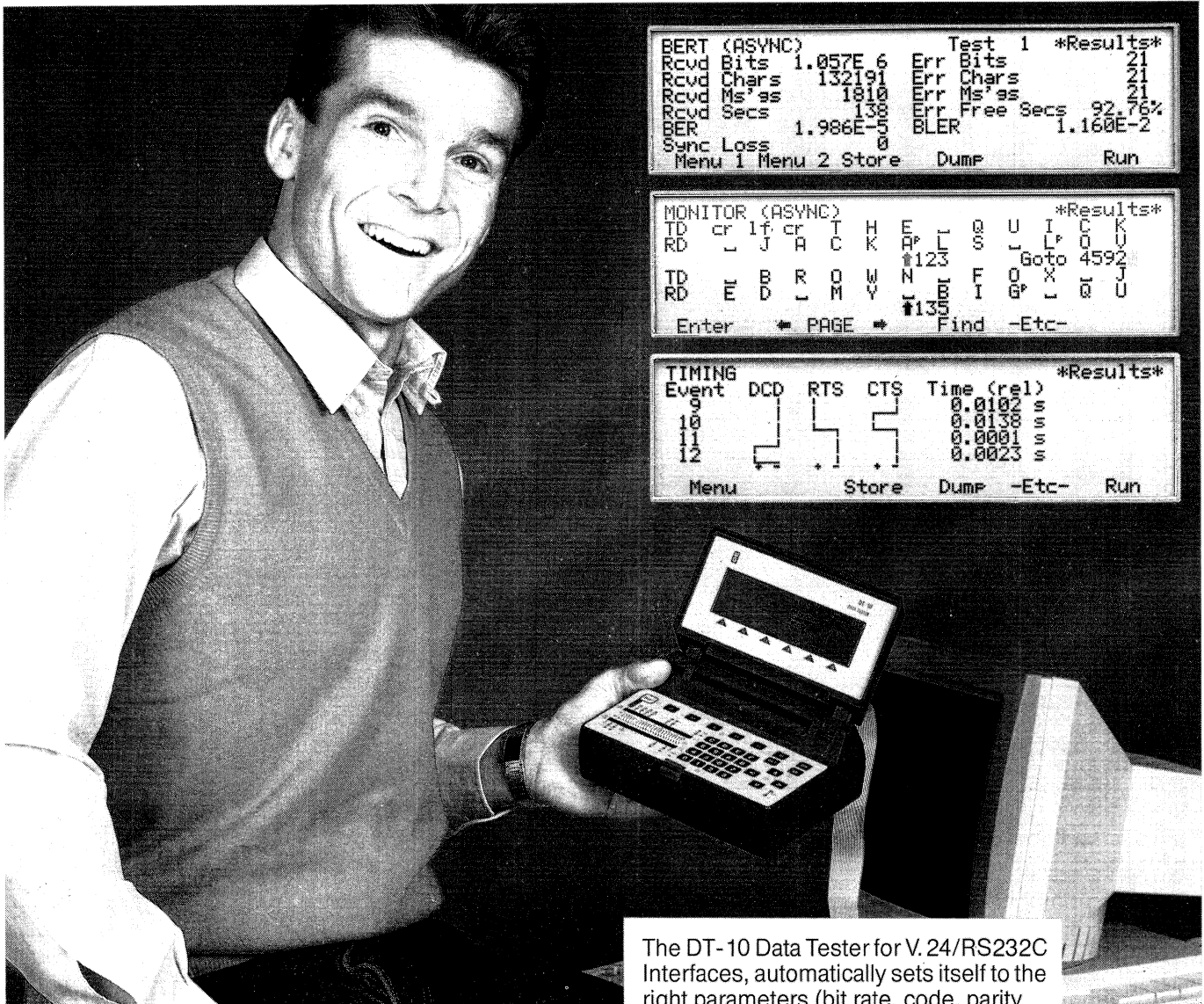
Editors: Gordon Fraser, Brian Southworth, Henri-Luc Felder  
(French edition) / Advertisements: Micheline Falciola / Advisory  
Panel: P. Darriulat (Chairman), H. Bøggild, H. Lengeler,  
A. Martin

1	Pinpointing particles <i>Detection techniques in action</i>
5	A matter of quarks <i>Confidence at international meeting</i>
7	Energy not the only frontier <i>Looking ahead</i>
11	Physics 87 <i>Centenary year</i>
<b>Around the Laboratories</b>	
17	SUPERCOLLIDER: Site proposals <i>States bid to house mammoth machine</i>
17	FERMILAB: Fixed target run begins <i>Exploiting the Tevatron</i>
19	CERN: Crash programme for LEP/Neutral kaons <i>Installation pushes ahead/New clues for CP violation?</i>
23	DESY: TRIUMF for HERA <i>Canadian participation in new electron-proton collider</i>
25	BEIJING: Chinese positrons <i>Progress towards new electron-positron collider</i>
26	GANIL: Channelling heavy ions <i>Steering big particles</i>
29	ELECTRONICS: Surface mount technology gains a foothold <i>New circuits for old</i>
30	SACLAY: PERCOLA in action <i>New computer shows what it can do</i>
33	<b>People and things</b>



Cover photograph:

The changing face of electronics. A thick film hybrid circuit (below) designed at Munich's Max Planck Institute on a board also equipped with normal discrete components. It is part of the Fastbus-based digitizer designed at CERN for the Time Projection Chamber of the ALEPH experiment at CERN's new LEP electron-positron collider. For more electronics developments, see page 29. (CERN Photo X217.9.87 by Gilbert Cachin)



**Data testing –  
the rapid solution:  
connect  
autoconfigure  
read results**

The DT-10 Data Tester for V.24/RS232C Interfaces, automatically sets itself to the right parameters (bit rate, code, parity etc.), it has no problems with printers or terminals. This and menu driven operation using softkeys make it fast. The large display gives you comprehensive results and battery operation makes field work easy. ★ 50 to 20000 bit/s ★ Async/Sync/HDLC ★ Tristate display ★ BERT/BLERT ★ Timing and Distortion Measurements ★ Monitoring ★ DTE/DCE Simulation ★ Echo ★ Dump ★ Polling ★ Storage of Results and 8 Setups. Try the DT-10 yourself.

Wandel & Goltermann (Schweiz) AG, Postf. 254, 3000 Bern 25  
Tel. 031-42 66 44, ttx. 912 350 wgch, Fax 031-42 61 33

- I would like:  
 Your free DT-10 colour brochure  
 A visit from a sales engineer

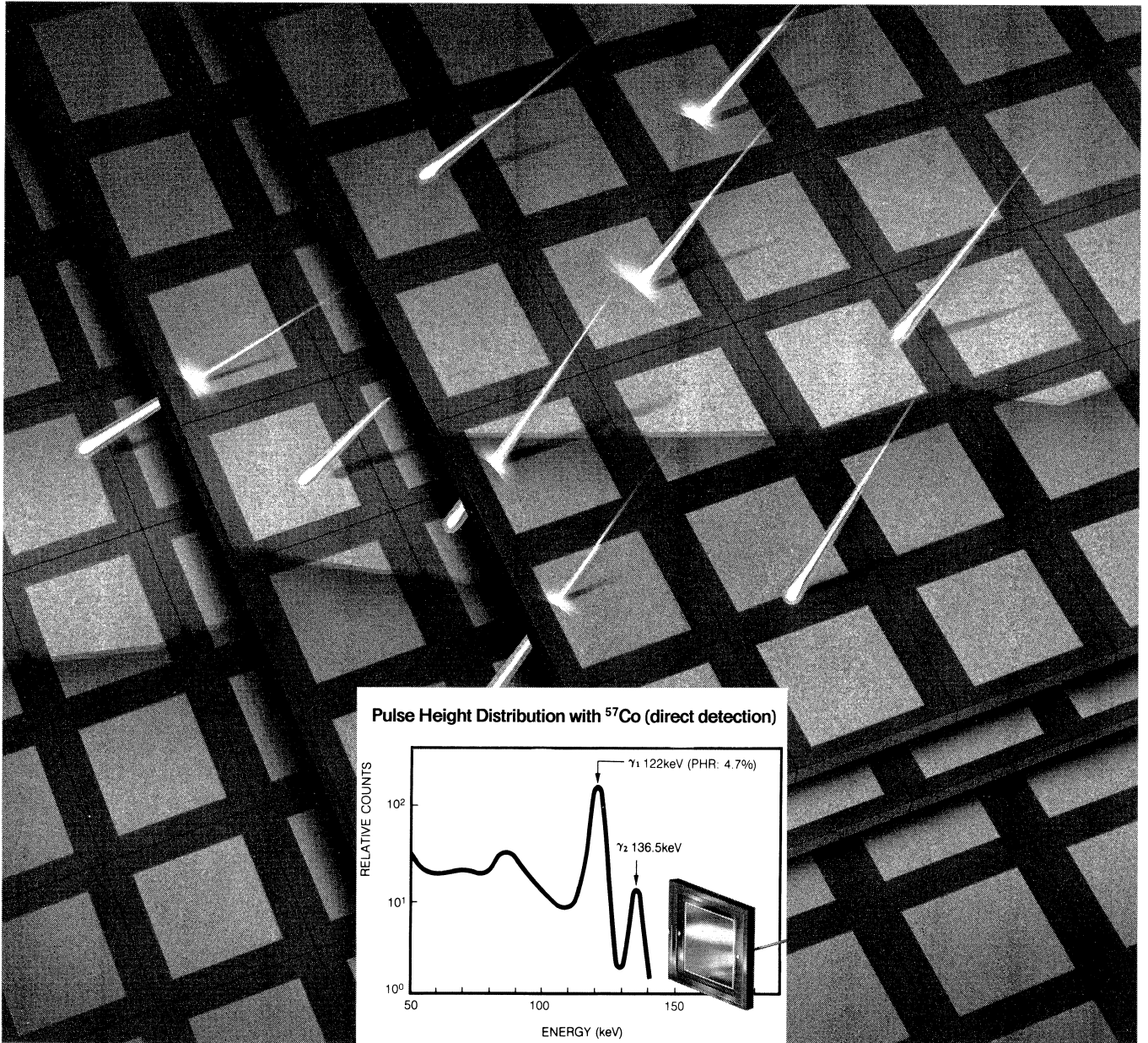
Name .....

Company .....

Street .....

Town .....

Telephone no. ....CH 7390a K



## Now, for the first time, high energy resolution from PIN silicon photodiodes used as nuclear counters

The new S1723 silicon photodiode provides the low junction capacitance and low dark current needed for high speed response and low noise. The UV response is particularly suitable for use with BGO and other scintillation crystals. A sensitive area greater than 100mm<sup>2</sup> is provided in a very compact package.

This new detector is less than 3mm thick compared with 60mm or more for

PMT's. When used with solid-state amplifiers, the S1723 occupies less space at about half the cost of PMT's.

Large-area PIN silicon photodiodes with sensitive areas of 10 x 10mm, 10 x 20mm, 3.4 x 30mm and larger are also available.

Applications for these Hamamatsu photodiodes include scintillation detection in the fields of high energy physics, medical diagnostics and industrial instrumentation.

For Application Information CALL 800-524-0504. In New Jersey Call 201-231-0960

# HAMAMATSU

HAMAMATSU CORPORATION • 360 FOOTHILL ROAD, P. O. BOX 6910, BRIDGEWATER, NJ 08807 • PHONE: 201/231-0960

UNITED KINGDOM: Hakuto International (UK) Ltd. (phone: 0992-769090) • FRANCE: Hamamatsu Photonics France (phone: 46 55 47 58)  
 ITALY: Hesa S. P. A. (phone: (02) 34.92.679) • W. GERMANY: Hamamatsu Photonics Deutschland GmbH (phone: 08152-375-0)  
 SWEDEN, NORWAY, FINLAND, DENMARK: Lambda Electronics AB (phone: 08-620610) • JAPAN: Hamamatsu Photonics K.K.

© 1986 Hamamatsu

# CAMAC ADC's NON LINEARITIES.

# NO LONGER A PROBLEM

WITH SILENA 4K CHANNELS  
8-INPUT CAMAC ADC'S

4418/Q - Pulse Charge Analysis  
4418/V - Pulse Amplitude Analysis  
4418/T - Time Analysis

## which other ADC can meet this performance?

4K Channels - 8 inputs  
in a CAMAC module  
Premium Differential  
Linearity:  $\pm 0.5\%$   
Premium Integral  
Linearity:  $\pm 0.025\%$   
Stability:  $\pm 100 \text{ ppM}/^\circ\text{C}$   
Conversion Time: 4  
 $\mu\text{sec}$  for every valid  
input channel  
ECL Bus  
Extensive use of  
surface mounting  
devices

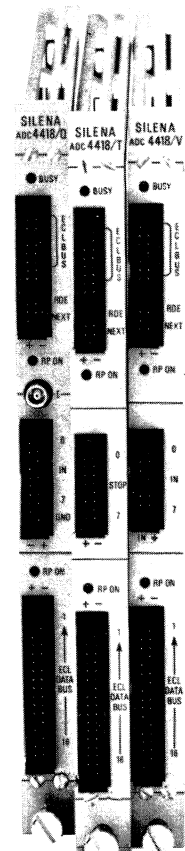


**SILENA**  
SOCIETÀ PER L'ELETTRONICA AVANZATA

**SILENA Spa**  
Via Firenze, 3 -  
20063 CERNUSCO S/N (MI)  
Tel. 02/9233331 (3 linee r.a.)  
Telex 322523 SILENA I  
Telefax 02/9233293

**SILENA WISSENSCHAFTLICHE  
INSTRUMENTE GmbH**  
(Kernphysikalische Meßsysteme)  
Struthweg 1, 6467 Hasselroth 1  
Tel. 06055 / 4021 - Telex 418491 siwi d  
Telefax 049/605582210

**SILENA VERTRIEBSGESELLSCHAFT mbH**  
Grüener Weg 2  
A - 2432 SCHWADORF, Austria  
Tel. 02230 / 3263



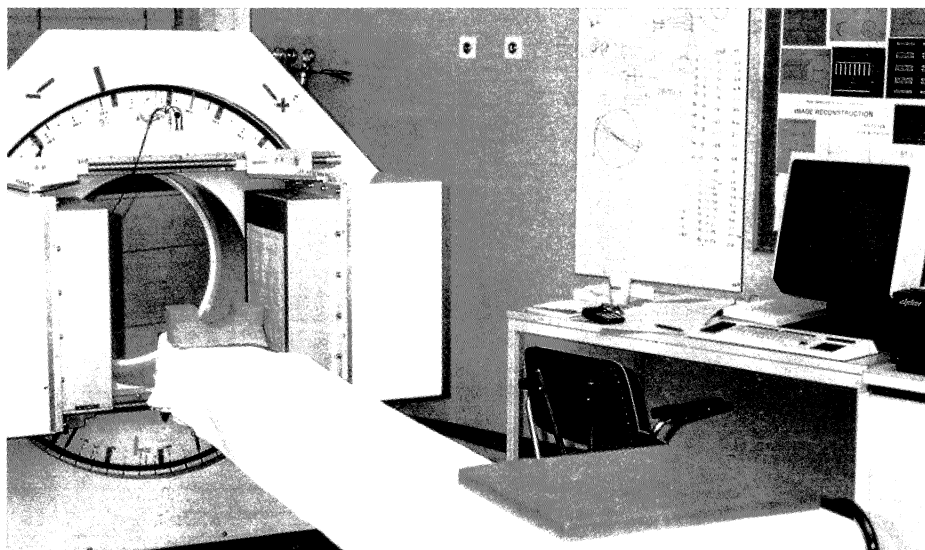
# Pinpointing particles

*Positron Emission Tomography (PET) apparatus at Geneva Cantonal Hospital, showing the diametrically opposed detectors to pick up the gamma rays emerging from positron annihilations.*

The Conference on Position-Sensitive Detectors held at London's University College from 7-11 September highlighted the importance and the growing applications of these precision devices in many branches of science, underlining once again the high spinoff potential for techniques developed inside particle physics.

One particularly fast growing applications field is Positron Emission Tomography – PET – where position sensitive detectors are used to pick up the characteristic gamma rays of positron annihilation. PET scanners are already being used in hospitals particularly to find and study tumours, but their importance in visualizing and measuring the action of drugs is just being realized, according to Terry Jones from the Medical Research Council's Cyclotron Unit at the Hammersmith Hospital in London. Over 80% of the drugs used in the UK can be labelled with suitable tracers. With PET it will be possible to trace any of these drugs to wherever they go in the body. It should even be possible to develop 'magic bullet' drugs which doctors can check in advance on a PET-scanner to make sure they will go only to the parts that need them, with no side-effects anywhere else. The conference was shown some particularly clear pictures of a living thyroid gland, taken by using a positron-emitting iodine tracer with a scanner built by Alan Jeavons of Oxford University.

There was a lively debate at the conference between exponents of the established PET techniques, taken over from nuclear physics, and those who wish to use newer particle physics developments. The old guard seem to be holding their ground. They use very dense



crystal scintillators which send out a flash of light when they are hit by a gamma ray. This light is converted into an electrical signal by photomultiplier tubes. Until recently the tubes have been large and crude, giving a very blurred picture, but that problem is being solved by 'multianode' tubes being developed by large electronics manufacturers such as Hamamatsu in Japan or Philips in Holland and in France.

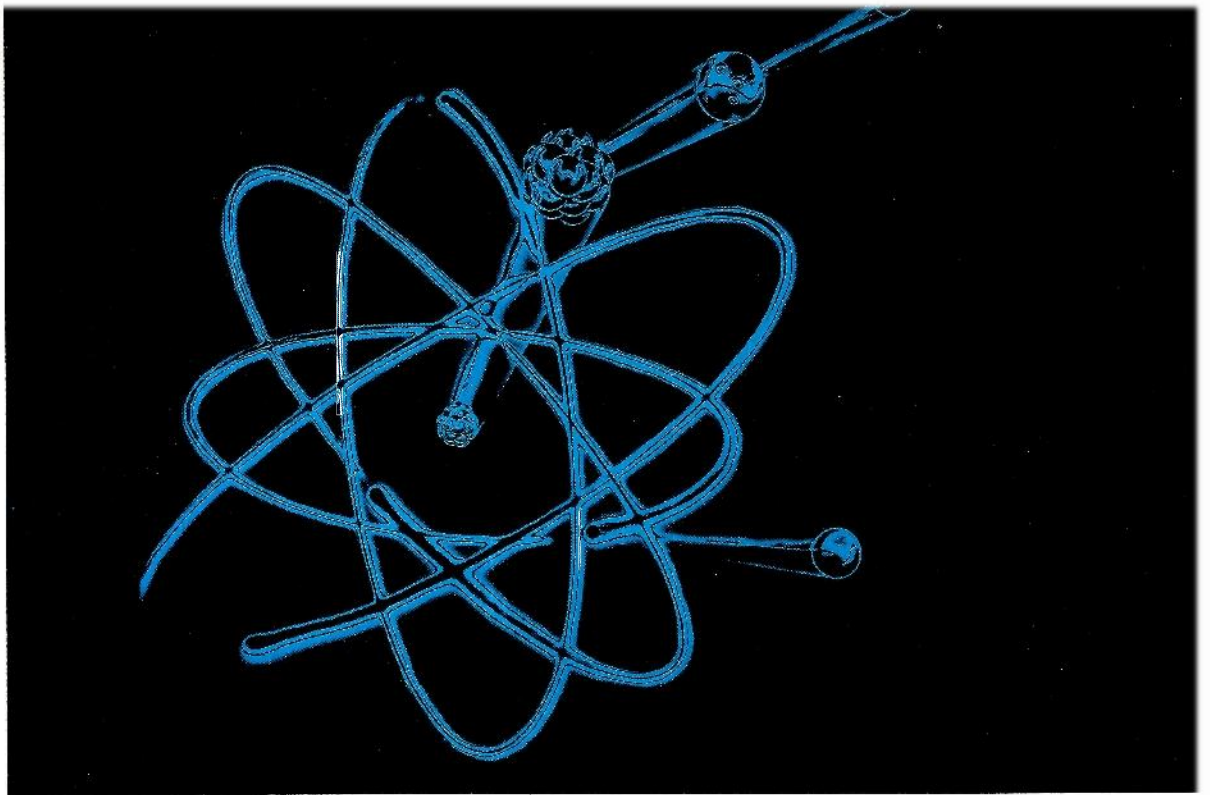
Georges Charpak from CERN is the leader of the rival faction, replacing the photomultiplier tubes with a very precise multiwire proportional chamber (MWPC) using fine high voltage sense wires stretched through a special gas mixture. When incoming radiation releases a few electrons in the gas they cause an 'avalanche' breakdown, like a tiny spark but very localized near a wire, and this gives a pulse of charge ten thousand times bigger than the initial bunch of electrons. The disadvantage of MWPCs at present is that they detect a smaller fraction of the arriving gamma rays than a photomultiplier array, so a patient would need a larger dose of radioactive tracer. But new scintillating crystals

are being found which match better the light-converting gases used in the chambers.

The newest application of PET came from the chemical engineers, tracing particles inside a 'fluidized bed' – like those used in recent coal-fired power stations or in industrial chemical reactors. Fragments of coal, for instance, move around freely in a bed of inert material such as sand which behaves like a liquid because the grains are spaced out by the strong flow of air through a perforated plate underneath. No one had ever been able to follow actual particles in such a bed, but C. R. Bemrose of Birmingham showed a video film of computer images from a PET scanner showing all the details of the path of a particle deep inside the fluidized sand, moving in loops with the flow of material or occasionally getting stuck in a corner where the flow was less active. He used a multiwire proportional chamber scanner, built with the assistance of the Rutherford Appleton Laboratory.

High precision is more important to the engineers than a low dose of radiation, so multiwire propor-

# THOMSON-CSF



## THE FURTHER WE GO, THE FURTHER YOU GO.

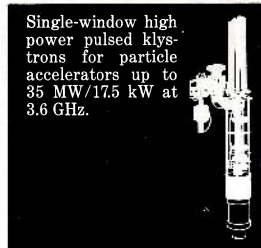
At the cutting edge of scientific research there's a demand for RF and microwave energy that existing technology can't deliver.

At Thomson-CSF we undertake major projects to develop new technology working in close collaboration with our customers.

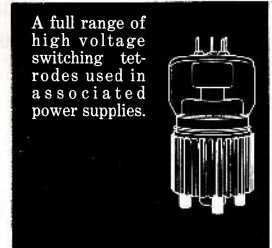
What's vital is that we have the know-how to supply you with the very high power sources you need for particle accelerators and plasma heating.

Know-how acquired in fields such as high-power radars and broadcasting where Thomson-CSF is a leader.

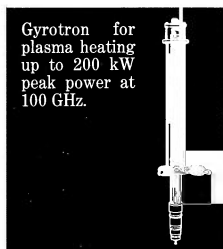
The successes obtained in these areas are due to Thomson-CSF technological innovations such as Pyrobloc® grids and our Hypervapotron® cooling system which guarantee the efficiency, reliability



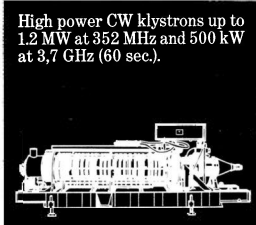
Single-window high power pulsed klystrons for particle accelerators up to 35 MW/17.5 kW at 3.6 GHz.



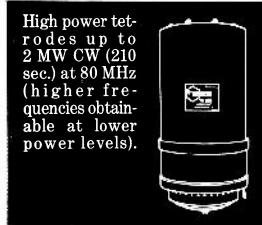
A full range of high voltage switching tetrodes used in associated power supplies.



Gyrotron for plasma heating up to 200 kW peak power at 100 GHz.



High power CW klystrons up to 1.2 MW at 352 MHz and 500 kW at 3.7 GHz (60 sec.).



High power tetrodes up to 2 MW CW (210 sec.) at 80 MHz (higher frequencies obtainable at lower power levels).

and long life of our tubes.

This high performance means important cost savings for the end user.

For special needs - including windows and oversized components capable of handling the required energy - we tailor our products to your requirements.

In radio and television, telecommunications, military and civil aviation, as well as in a wide range of scientific and medical applications, Thomson-CSF know-how gets your systems moving. Fast.

**Our high-energy tubes have been chosen for the world's most important projects.**



**THOMSON-CSF**  
Division Tubes Electroniques  
38, rue Vauthier - BP 305  
F-92102 BOULOGNE-BILLANCOURT CEDEX.  
Tél.: (1) 46 04 81 75. Télex: THOMTUB 200772 F.

**Belgique:** BRUXELLES  
Tel. (32-2) 648 64 85  
Tx 23 113 THBXL B

**Brazil:** SAO PAULO  
Tel. (55-11) 542 47 22  
Tx (011) 24 226 TCSF BR

**Canada:** MONTREAL-QUEBEC  
Tel. (1-514) 288 41 48  
Tx 5 560 248 TESAFI MTL

**Deutschland:** MÜNCHEN  
Tel. (49-89) 78 79 0  
Tx 522 916 CSF D

**España:** MADRID  
Tel. (34-1) 405 16 15  
Tx 46 033 TCCE E

**France:** BOULOGNE-BILLANCOURT  
Tel. (33-1) 46 04 81 75  
Tx THOMTUB 200 772 F

**Italia:** ROMA  
Tel. (39-6) 630 02 48  
Tx 620 683 THOMTE I

**Japan:** TOKYO  
Tel. (81-3) 264 63 46  
Tx 2 324 241 THOSE J

**Sverige:** TYRESÖ  
Tel. (46-91) 742 02 10

**United-Kingdom:** BASINGSTOKE  
Tel. (44-256) 29 155  
Tx 858 865 TESAFI G

**U.S.A.:** DOVER  
Tel. (1-201) 328 1400  
Tx 71099Z 7901

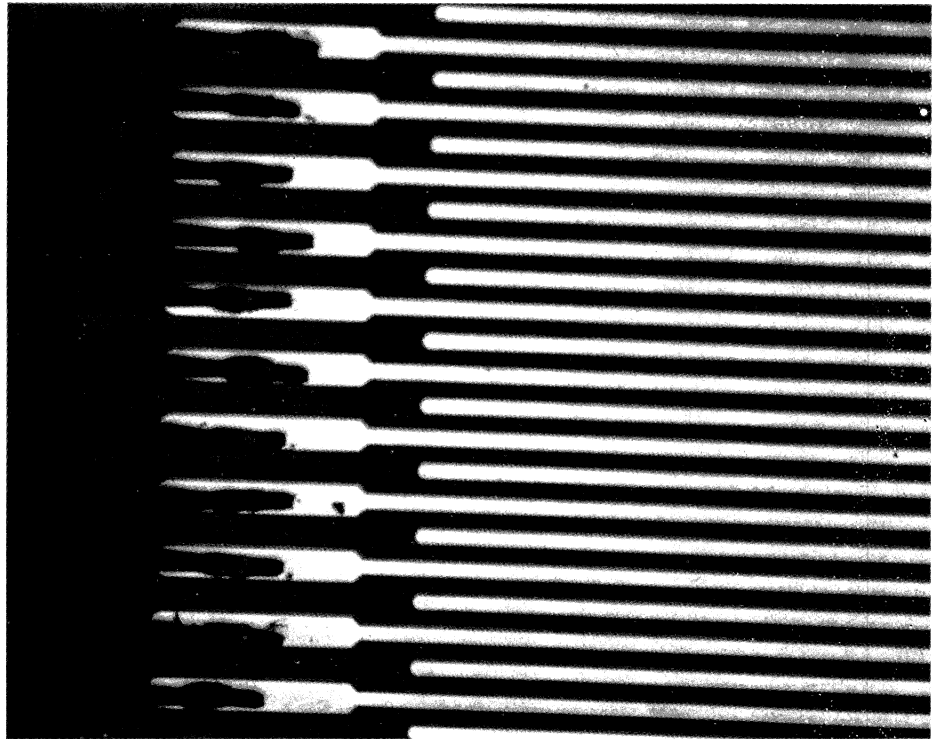


*Silicon strip detector made by Micron Semiconductor (UK) showing the fine wire connections to alternate strips. Used to study the decay of unstable particles, it has a strip spacing of 50 microns.*

tional chambers are the natural choice. They are also being used to follow the motion of oil inside jet engines.

Astronomers want to look at distant objects with every available wavelength of light, not just the visible, and they want to know two things about every photon of light they detect; where did it come from, and what was its energy? For example, at the focus of an X-ray telescope on an orbiting satellite they need a position-sensitive detector connected to a computer which can build up multiple superimposed images of the object in view, each image corresponding to a small range of X-ray energies.

A relative of the multiwire proportional chamber – called a ‘parallel plate avalanche chamber’ – is being used for this, as reported by John Lapington of the Mullard Space Science Laboratory of University College, London. Another related device, used by particle physicists as well as astrophysicists, is the ‘gas scintillation proportional detector’ (GSPD) which picks up the light given out when radiation is detected in a gas-filled chamber. A GSPD can give a precise image for every individual ultra-violet photon that hits it. But much more sensitive devices are now being developed, using arrays of tiny composite crystal detectors at extremely low temperatures. Damian Twerenbold of the European Space Agency described superconducting junctions which send out an electrical pulse proportional to the energy of the X-ray which hits them, and a competing instrument called a bolometer which actually measures minute changes in the temperature of crystals due to the heating effects of single X-rays.



Everyday electronic circuits exploit the movement of electrons through crystals of silicon. But it is possible to make very pure silicon which can be completely ‘depleted’, with all movable free electrons removed. Radiation frees bound electrons from the silicon atoms (ionizing them), giving a detectable signal. This principle is used in TV cameras containing charge-coupled-devices (CCDs). CCDs and other silicon detectors are used by particle physicists, especially in experiments to measure the lifetimes of unstable particles containing the heavy quarks. Such particles only travel a few microns before they decay, but that is just the scale for the patterns on a silicon chip.

There were a number of presentations of a super-CCD, a ‘random-access pixel device’ in which the position and amount of charge of each radiation hit will be read out within a few millionths of a second,

rather than waiting many thousandths of a second (a very long time in electronics) for a TV-style scan through all the thousands of separate sensing points. Sherwood Parker of Berkeley reported on his detailed design which will be laid down on silicon in the next few months. If it works it will be of interest to many more users than just the particle physicists.

Multiwire proportional chambers or scintillators with photomultipliers are proving very useful for neutron diffraction. The ISIS pulsed neutron source at the Rutherford Appleton Laboratory provides beams and detectors for a variety of users, including groups developing the new high temperature superconductors. Slow neutrons do not interact directly with a detector. They have to be captured in an atomic nucleus, such as lithium, which breaks up to release charged particles that are detected by scintillation or ionization in the

detector. P. L. Davidson from ISIS described a lithium-loaded glass scintillator which sends out its signals down lots of separate optical fibres to sets of photomultipliers.

Muscle is one of the most mysterious of biological materials, composed of regular layers of overlapping fibres. A. R. Faruqi of the UK Medical Research Council's Cambridge Laboratory has watched moving muscle simultaneously with a CCD to image the contraction, and with a multiwire chamber to image the changing pattern of X-ray dots, showing the changes in the molecular structure of the fibre layers. Such modern X-ray studies require both sophisticated detection techniques and intense beams of synchrotron radiation, provided by electron storage rings.

Chapak developed his multiwire proportional chambers into another kind of gas-filled detector, the drift chamber, which has proved extremely useful in particle physics. The exact position at which radi-

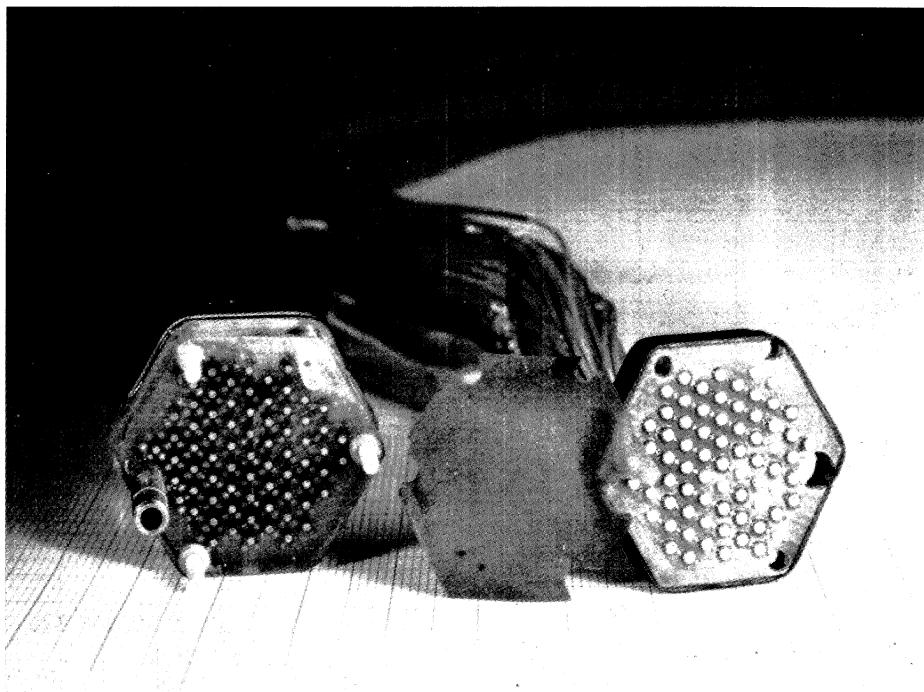
ation interacts with the gas determines how long it takes for the electrons to drift through a uniform electrical field before arriving at the fine wire where they are detected. Fabio Sauli from CERN told the conference about drift chambers being developed for the large electron-positron (LEP) machine which will run at CERN in 1989. In some of them the electrons drift two metres before they reach the wire. This allows a very large detection volume to be covered by a relatively small (and affordable) number of channels of electronics. He also showed pictures of his own compact drift chamber where the track of an ionizing particle can be localized to about twenty microns, comparable with the precision of many silicon detectors.

The drift idea has now been picked up by scientists building both silicon detectors and detectors filled with liquids. In every application it gives improved position resolution and a considerable

reduction in the amount of electronics required. As well as the particle physics possibilities, the conference heard from H. J. P. Kuykens of Delft how a silicon drift chamber might be used to improve the resolution of PET scanners. Liquid drift chambers have good position resolution over a large volume, with a much denser detecting medium than a gas. This is important in detecting neutrinos, which need tons of detector to give a reasonable signal. Liquids also suffer less degradation from intense radiation so they can be used instead of other high-density detectors close to the beam-pipe of an accelerator or storage ring. G. Giorganis and J. Engler from Karlsruhe reported successful experiments on drifting electrons in a cold liquid (liquid argon) or in room temperature organic liquids.

Of the 275 scientists attending the meeting, about 40 per cent were particle physicists, although about 90 per cent of the detectors discussed were developed originally for particle and nuclear physics experiments.

*By David J. Miller*



*The compact drift chamber (its size can be judged by the large centimetre squares on the graph paper) developed by Fabio Sauli and his group at CERN. With more than 60 sense wires, this detector attains twenty-micron precision, comparable to solid state detectors.*

*(Photo CERN X567.1.87)*

# A matter of quarks

Quarks are understood to interact through the 'colour' force, carried by gluons. Under normal conditions these quarks are confined – frozen together in 'colourless' states such as protons, neutrons and other strongly interacting particles. However if the quarks are compressed tightly together and/or are 'heated' by increasing their energy, they should eventually break loose from their colour bonds to form a new kind of matter – the so-called quark-gluon plasma. Although QGP has not yet been synthesized in the Laboratory, it was most likely the stuff of the Universe  $10^{-5}$  second after the Big Bang. Thus the search for this 'new' matter is attracting a growing number of physicists, theorists and experimenters from both the particle physics and nuclear physics fields.

Theorists confidently predict QGP formation in the collisions of heavy nuclei at energies available from present machines, so that a glimpse of these post-Big Bang

## **CERN** *From oxygen to sulphur*

*For several weeks during September and October, the CERN accelerators handled sulphur 32 ions, with the SPS synchrotron boosting them to 200 GeV per nucleon. This set up a new world beam energy record of 6400 GeV (6.4 TeV), doubling the figure set at CERN last year with oxygen 16 ions. With interesting clues emerging from the 1986 data, the first results from the sulphur beams are eagerly awaited.*

conditions might come soon and relatively cheaply.

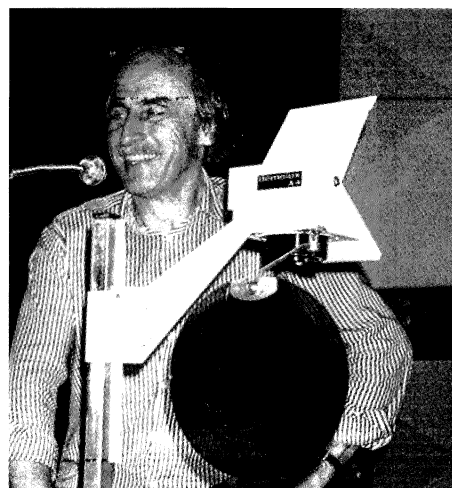
With this in mind, the 1987 Quark Matter Conference, held from 24-28 August at Schloss Nordkirchen, near Dortmund, West Germany, focused on the first results obtained last year with nuclear beams in experiments at CERN and Brookhaven. CERN provided higher energies (oxygen nuclei at 60 and 200 GeV per nucleon) while Brookhaven offered heavier nuclei (silicon at 14.5 GeV per nucleon).

At CERN, four major detectors collected data from the oxygen run last year – the WA 80 'Plastic Ball' study, the NA34/2 HELIOS detector, the NA35 streamer chamber experiment, and the NA38 muon pair spectrometer (see December 1985 issue, page 429). This year's run at CERN used the heavier sulphur nuclei to increase the energy densities, and two more major experiments joined the fray – the NA36 Time Projection Chamber and the WA85 group using the Omega spectrometer. In both runs, smaller experiments using special targets ran in parallel. Complementary results came from two Brookhaven studies (Experiments 802 and 814 – see April issue, page 18).

The first workshop on quark matter physics was held in Bielefeld in 1982. Since then periodic meetings have reflected the increasing enthusiasm and confidence in this new physics venture, but this year was the first time that experimental results were available.

It is not yet possible to say if the quark-gluon plasma has been synthesized under laboratory conditions. Maybe the Brookhaven energy is too low and perhaps the CERN nuclei are too small. Yet there are two intriguing clues. The

*Quark Matter announcement from Reinhard Stock, chairman of the organizing committee at the August meeting at Schloss Nordkirchen, near Dortmund.*



NA38 team reported a suppression of the J/psi resonance in the di-muon spectra from oxygen-uranium collisions producing large transverse energy, while Brookhaven saw five times as many charged pions as kaons. Both these effects had been predicted as indicators of QGP.

Results from the other CERN experiments' 1986 oxygen run can be explained by conventional ordinary nuclear effects. However the 'stopping power' of the incoming nuclei under these conditions is found to be as high as had been hoped, so that a lot of energy (a few GeV) can be compressed inside a nucleon-like volume. This is just what is needed to make QGP, and experimenters are looking forward eagerly to the final analysis of this year's sulphur run.

As well as looking at initial results, the Schloss Nordkirchen meeting looked forward to future projects. Brookhaven has its RHIC Relativistic Heavy Ion Collider plans well advanced, while at CERN attention is turning to the possibility of a dedicated pre-injector providing lead nuclei. US prospects were described by D. Hendrie (Department of Energy), and Pierre Darriulat covered the CERN side.

# More kick for less pounds, francs, yen, deutschmarks pesetas or dollars.

Good news for particle accelerators.

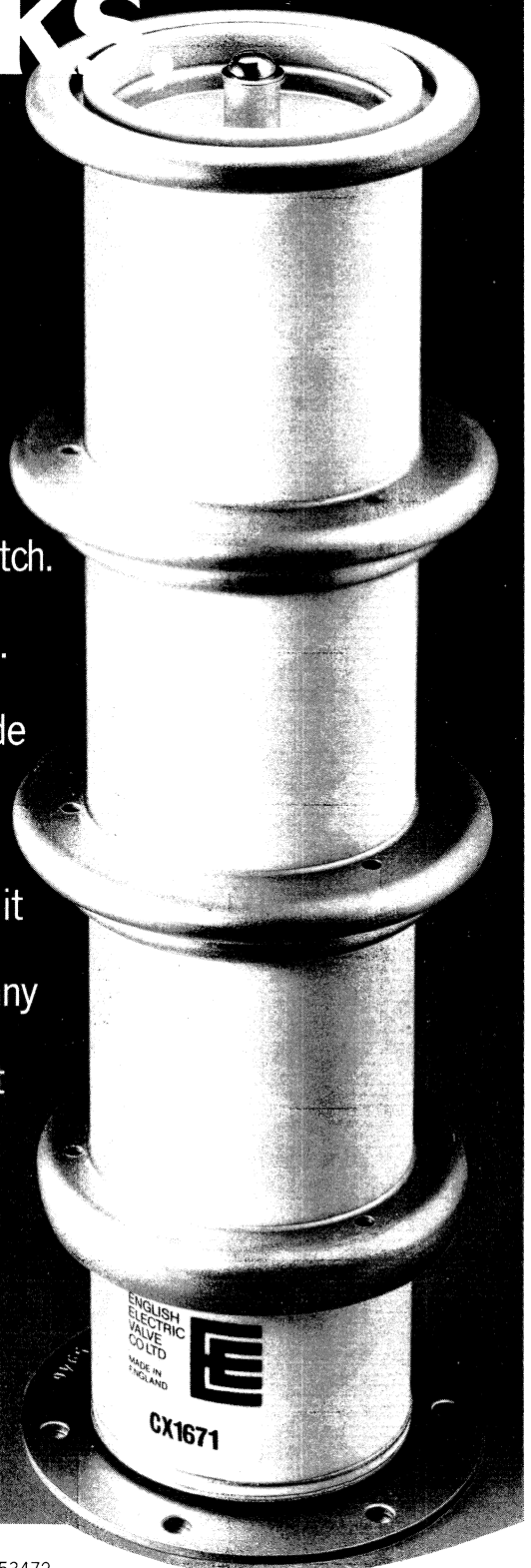
EEV, a world leader in high energy switching thyratrons, has now developed a single cathode multi-gap tube that operates as a bi-directional switch.

Now you can double the power delivered to kicker magnets without substantial rebuilding costs.

This new tube, the CX1671, is a plug-in replacement for the CX1171. Its unique hollow anode design was originally developed by EEV to switch the severe inverse voltages occurring in pulsed gas discharge lasers.

When operating at an anode voltage of 80kV, it has proved capable of switching 2500 amps of reverse current in a 2 microsecond pulse, without any degradation in performance after 10 million pulses.

For further information on this state-of-the-art thyatron, contact EEV today.



## EEV Thyratrons

**UK:**  
EEV, Waterhouse Lane, Chelmsford, Essex CM1 2QU, England. Tel: (0245) 493493. Telex: 99103. Fax: (0245) 353472.

**USA:**  
EEV Inc, 4 Westchester Plaza, Elmsford, NY 10523, Tel: (914) 592 6050. Telex: 6818096. Fax: (914) 682 8922.

**CANADA:**  
EEV Canada Ltd, 67 Westmore Drive, Rexdale, Ontario M9V 3Y6. Tel: (416) 745 9494. Telex: 06 989363. Fax: (416) 745 0618.

Subsidiary of the  
General Electric  
Company plc  
of England **gEC**

The meeting, organized by R. Santo (Munster), H. Satz (Bielefeld / Brookhaven), H. J. Specht (Heidelberg) and R. Stock (Frankfurt, chairman), brought together about 250 physicists. The next conference in the series will be held next September on the US East Coast.

*E. Feinberg (Lebedev Institute, Moscow) sings the praises of the hydrodynamical approach to Quark Matter Conference organizing committee member Hans Specht of Heidelberg*

*(Photos M. Jacob)*



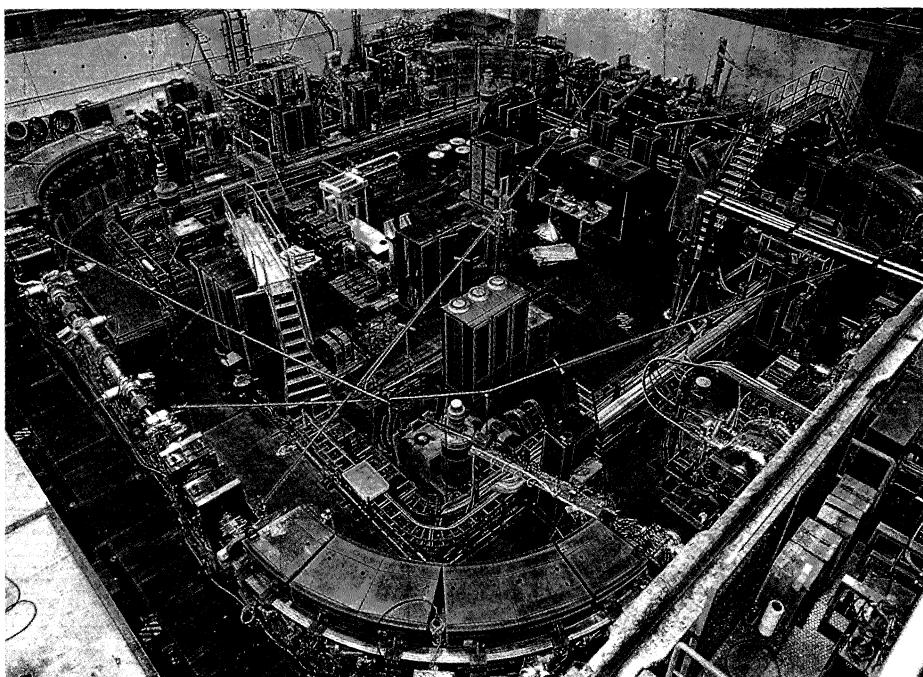
## Energy not the only frontier

*The LEAR Low Energy Antiproton Ring – CERN trump card.*

*(Photo CERN X180.8.87)*

While the push for big new machines to explore high energy frontiers makes the headlines, other avenues for physics progress are still being actively explored. To reflect these efforts, theorists and experimenters from the experiments committees for CERN's two major existing machines – the PS Proton Synchrotron and the SPS Super Proton Synchrotron – joined forces in study groups to look at long term physics perspectives. As one experimenter put it, 'there are frontiers of high complexity and high precision as well as high energy'.

The groups' findings were aired at a special joint open meeting of the two committees at CERN on 31 August and 1 September. Although organized in a CERN con-

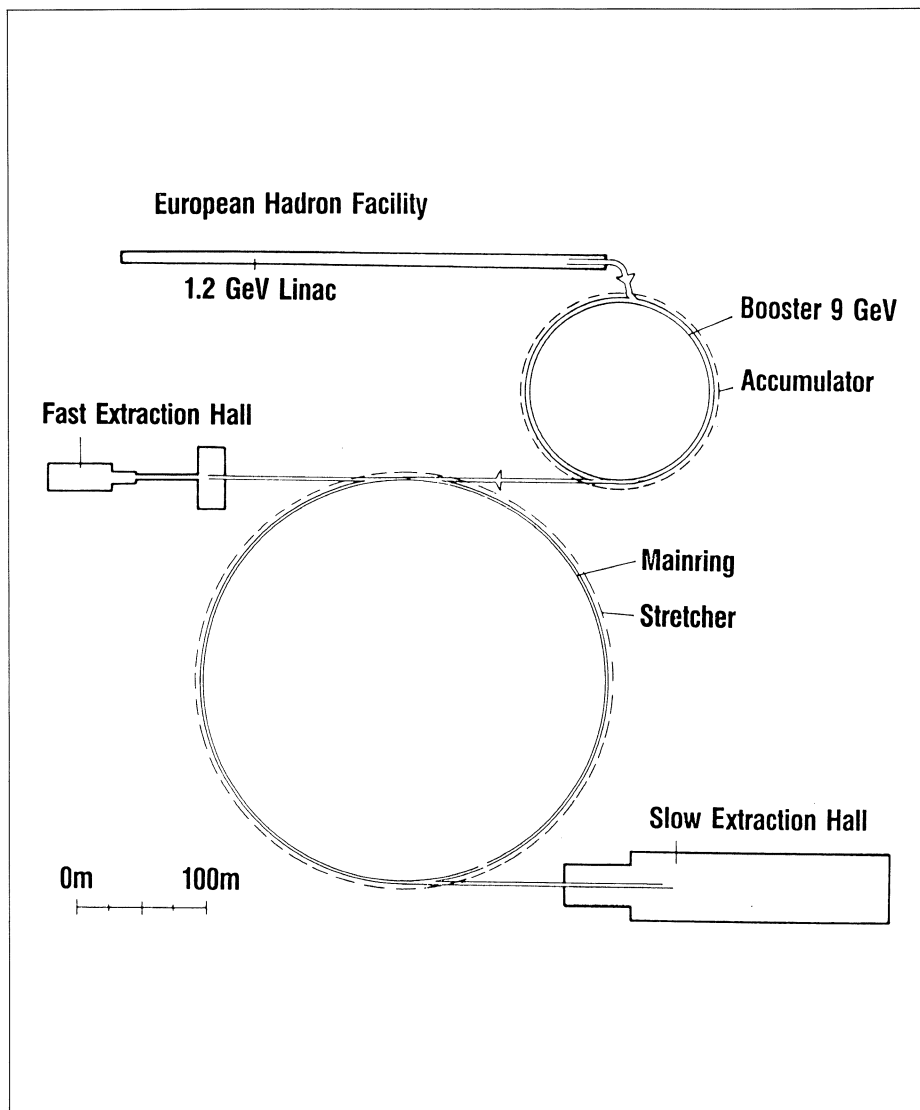


text, the attention was not limited to existing CERN machines and the sessions attracted wide interest from Laboratories further afield with their own preoccupations for the future.

Introducing the proceedings, CERN Director General Herwig Schopper emphasized CERN's tradition of a rich and varied research programme catering for a large user community. Alone, the four big experiments being built for CERN's new LEP electron-positron collider, scheduled to switch on in 1989, do not continue this tradition. Schopper also drew attention to interim recommendations of the CERN Review Committee chaired by Anatole Abragam – 'every effort should be made to keep this variety (of programme) ... for maintenance of the Laboratory's prestige and creativity'.

One CERN trump card is the LEAR low energy antiproton ring. For some six years, CERN was the only place in the world where antiprotons were on tap. Fermilab has now followed suit, but the US Laboratory has not yet embarked on a low energy antiproton programme, preferring for the meantime to concentrate on the high energy sector.

Lucien Montanet covered the possibilities for low energy antiprotons at CERN in the 1990s. The continued exploration of fundamental symmetries was seen as one major objective, including precision measurements of antiproton properties and the study of neutral kaons to probe deeper into the mysteries of CP violation (the almost but not quite exact symmetry of particle-antiparticle and left-right permutation). While the neutral kaons are still the only offenders, the effect could be looked for elsewhere, for example in lambda ba-



*The proposed European Hadron Facility – aiming to put Europe on the high intensity map.*

ryons and their antiparticles.

Spin can still be the joker in the particle physics pack, and Montanet suggested a systematic attack, using polarized targets and possibly beams. Elsewhere, the search for new particle states frequently provides additional insights into the underlying forces, and here LEAR could continue to make important contributions, whether in a gently upgraded form, or with a new superconducting 'SUPERLEAR' ring.

Important progress was made with CERN's Intersecting Storage

Rings machine in the last few months of its life, using a gas jet target and a tuned antiproton beam to home in on states difficult to isolate using the conventional approach of colliding electron and positron beams. This could be adopted for LEAR.

The idea of using LEAR to supply trapped antiprotons or even neutral antimatter remains as fascinating as ever.

Away from LEAR, lower energy antiprotons (about 45 GeV instead of the hundreds of GeV normally used) could be stored in the SPS

ring for use with the UA6 gas jet target equipment to explore higher energy spectroscopy.

F. Bradamante enthusiastically extolled the virtues of the proposed European Hadron Facility (EHF – see July/August 1986 issue, page 13). This high intensity (microamp) 30 GeV proton machine could bring the requisite physics power to bear on a wide range of questions. Bradamante underlined the need for physics research with high intensity beams of kaons, neutrinos, etc. While the US and Japan have well-developed plans in this area, 'Europe has nothing' he emphasized. A 'green field' version of EHF has been costed at 867 million deutschmarks, less if it exploited some existing Laboratory infrastructure.

CERN's traditional staple diet has been protons from the PS. However the advent of the LEP electron-positron collider called for a sophisticated supply of electrons and positrons. Mike Albrow pointed out the potential of the new EPA electron-positron accumulator for physics.

Additional flexibility could also come from the SPS, and Harry Atherton outlined what additional beams, not necessarily at the highest possible energies, could do.

John Garvey and Guido Altarelli looked at proton-antiproton colliding beam physics with the increased antiproton levels from CERN's new ACOL Antiproton Collector. While Fermilab's Tevatron has walked off with the energy prize, CERN's additional antiprotons, together with the major upgrades for the big UA1 and UA2 detectors, could pay dividends and keep the CERN collider in the physics front line for several years more yet.

The implications of spectroscopy

for strong interaction physics were looked into by Frank Close, who wanted to know where the 'glue' is. Gluons are understood to carry the forces between quarks, but so far there has been little indication of particles with constituent gluons instead of, or as well as, quarks. Close outlined a possible strategy to search for all the missing states, and concluded with comparative ratings of different schemes for spectroscopy progress.

Hans-Jürgen Pirner took up the question of lepton physics, with implications mainly for the SPS, pointing out that the lepton sector of today's Standard Model of particle physics is the least well known. Neutrino parameters in particular are difficult to pin down, and a high intensity beam would be useful.

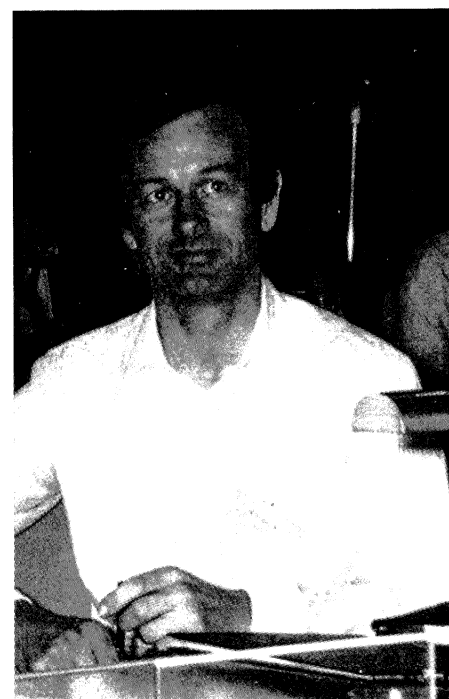
The search for unusual decays is an area where research investment could provide good value for money. A. Buras (theory) and C. Guyot (experimental setups) provided an interesting counterpoint of theoretical ideas and experimental scenarios. Searches could be mounted for decays forbidden according to conventional ideas, while the study of rare decays test special physics areas. CP violation again came under close examination, where new examples could be looked for.

Finally G. London and R. Stock looked at what had been learned from the brief but highly successful runs last year at CERN using high energy beams of oxygen nuclei. (These promising results were covered in detail at the recent 'Quark Matter' conference at Schloss Nordkirchen near Dortmund in West Germany – see report on page 5). This year's run used sulphur nuclei, twice as heavy, while for the future the exper-

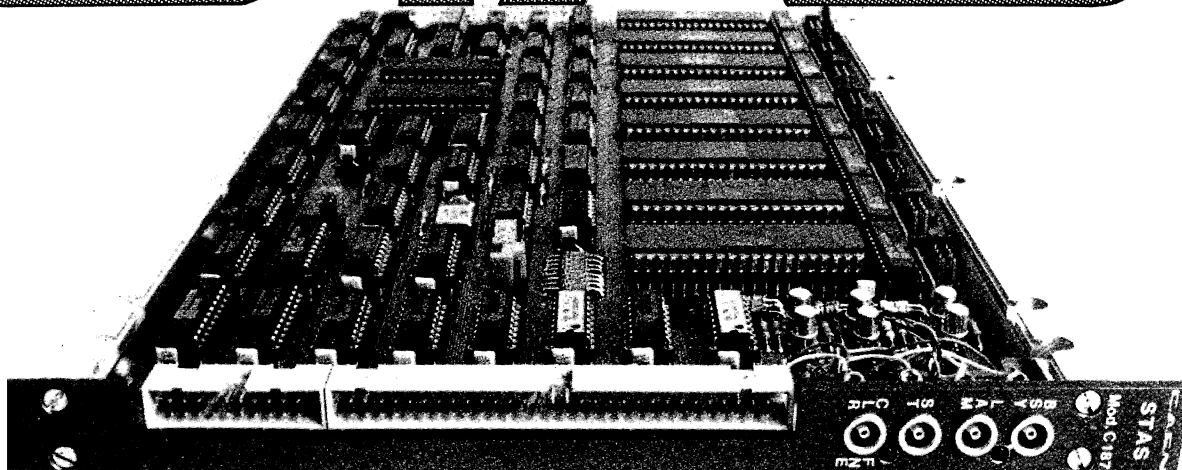
imenters rub their hands at the thought of what beams of lead nuclei could do.

Not all of the ideas mentioned at the meeting will see the light of day, but it is clear that there is a lot of work to do away from high energy frontiers. The continued exploration of CP violation, still poorly understood 23 years after its discovery, the ongoing search for new particle states, and precision measurements of known phenomena were recurring themes in many of the presentations.

Frank Close – looking for glue.



# STAS



at last .....

an EFFICIENT , ECONOMIC , STRAIGHTFORWARD

# STREAMER TUBE DATA ACQUISITION SYSTEM

THE C187 IS A ONE-UNIT WIDE CAMAC MODULE FEATURING:

- 8 TOTALLY INDEPENDENT , SIMULTANEOUS ACQUISITION CHANNELS
- ADJUSTABLE ACQUISITION CHAIN LENGTH ( SHIFT REGISTER ) FROM 32 TO 1024 BITS
- AUTOMATIC CLUSTER IDENTIFICATION AND DEFINITION
- MULTIEVENT OPERATION SUPPORTED BY 512 x 16 BIT FIFO
- LONG DISTANCE OPERATION THROUGH SY190 REPEATER-DISTRIBUTOR BOARD POWERING THE STREAMER DETECTION CARDS



# Physics 87

*The title page of Newton's Principia, published 300 years ago.*

87 seems an auspicious cycle for physics. This year has seen the first neutrino observation of a supernova and the development of a new class of superconductors which carry large currents at relatively high temperatures. It is also the centennial of several major events in the history of physics which have shaped our present understanding of the universe.

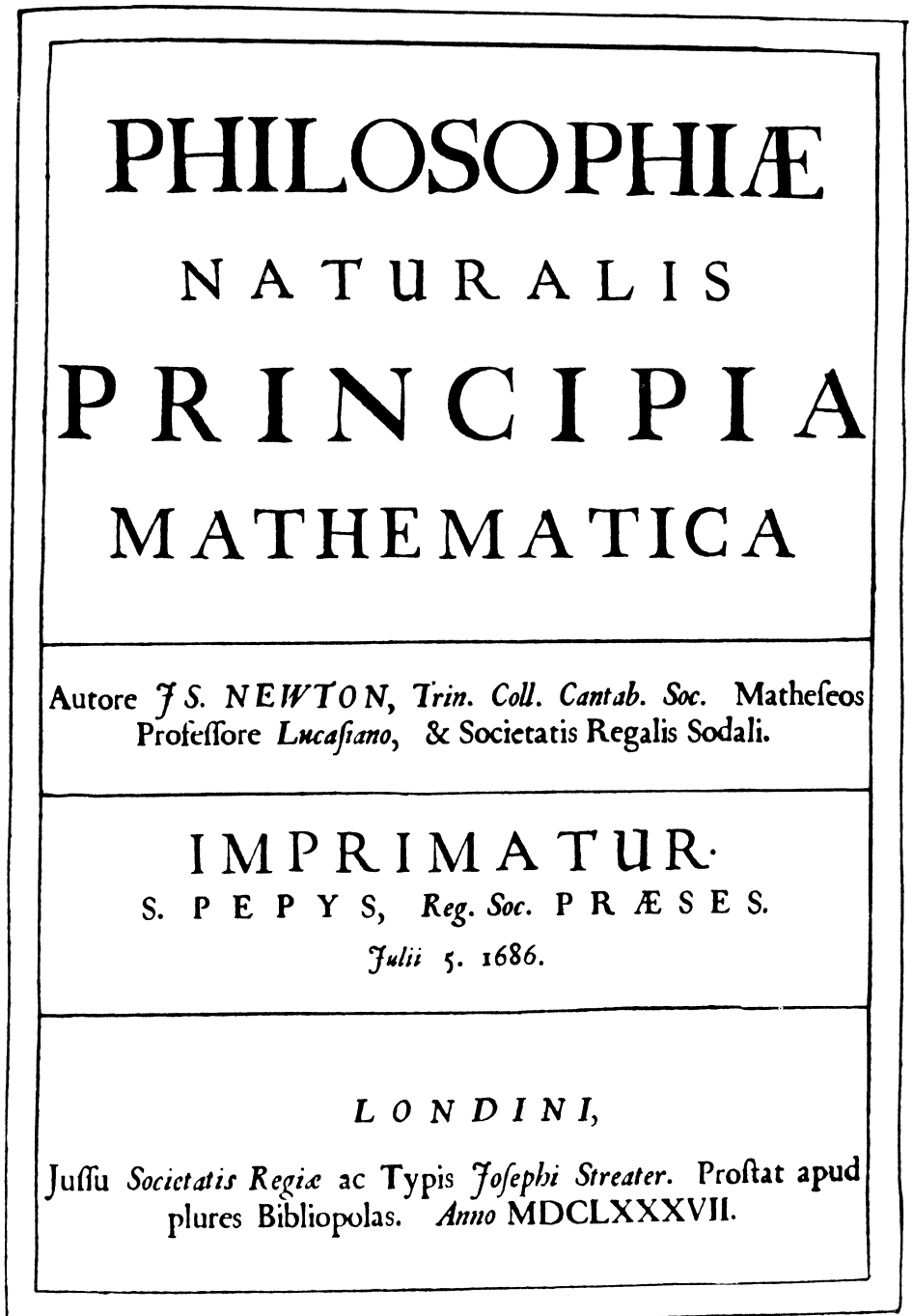
In 1687, Edmond Halley as Secretary of the Royal Society in London wrote to Isaac Newton in Cambridge to confirm that the latter's *Philosophiae Naturalis Principia Mathematica* was finally ready for publication.

In view of the Royal Society's lack of funds at the time, Halley had undertaken to publish the book at his own expense.

'Honoured Sr, I have at length brought your Book to an end, and hope it will please you. The last errata came just in time to be inserted. I will present from you the books you desire to the R. Society, Mr Boyle, Mr Pagit, Mr Flamsteed and if there be any elce in town that you design to gratifie that way; and I have sent you to bestow on your friends in the University 20 Copies, which I entreat you to accept.'

Two hundred years later, in Cleveland, Ohio, Albert Michelson and Edward Morley failed to detect any effect on the velocity of light due to the movement of its source, a puzzling null result which had to wait 18 years for an explanation by Einstein's revolutionary Special Theory of Relativity.

Also in 1887, Heinrich Hertz, then working in Karlsruhe, was especially busy discovering the electromagnetic radiation suggested twenty years earlier by Maxwell's equations. Not content with this single breakthrough, he



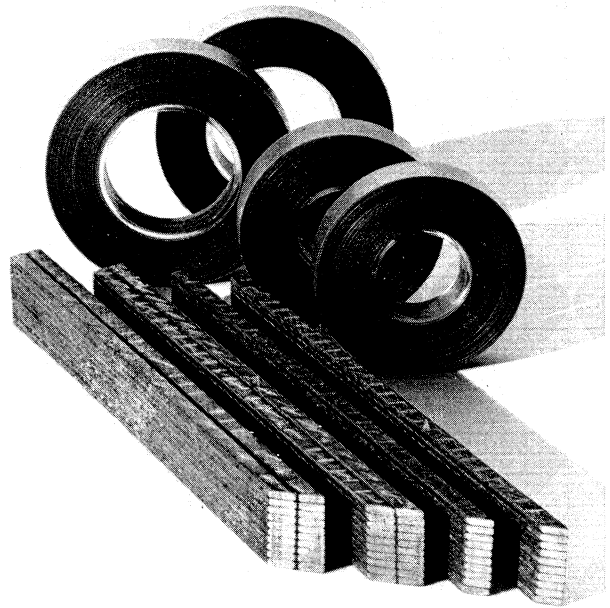
saw for the first time the photoelectric effect. For the explanation of this initial example of light waves behaving like particles, the world also had to wait until 1905 and the genius of Einstein.

Three centuries after the publi-

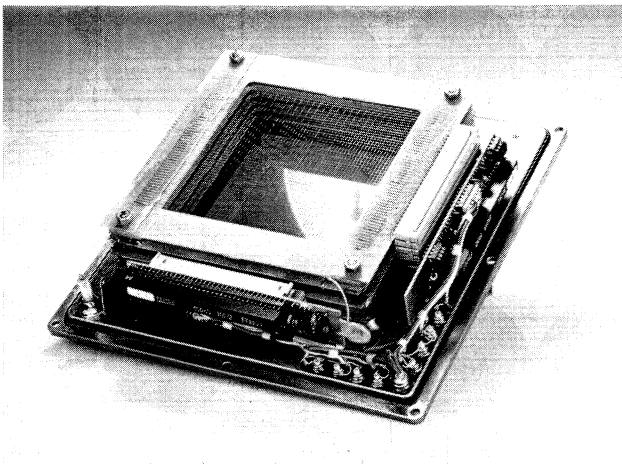
cation of Newton's masterpiece, Stephen Hawking and Werner Israel assembled a group of the world's foremost researchers in cosmology, relativity and particle physics for a commemorative meeting '300 years of Gravitation'

## Insulating Materials with High Radiation Resistance

The Swiss Insulating Works together with CERN carried out detailed tests about the radiation resistance of numerous high voltage insulating materials. The results published in the "CERN Publication 85-02 of the Technical Inspection and Safety Commission" prove the usability of selected insulation under working conditions with high radiation. A radiation dose of  $5 \times 10^7$  Gy affects only very little the break down voltage of our conductor insulating tape Grade 366.16 which consists of samicapor, glass fabric and silicone resin. Our high voltage insulating material for motors and other electrical apparatus behaves similarly good: Samica-therm consisting of samicapaper, glass fabric and epoxyresin withstands a dose of  $1 \times 10^8$  Gy and retains at the same time 50% of its original flexural strength.



## Your reliable partner for electrotechnical insulation problems



The chambers in VETRONITE G-10 are manufactured and machined by Swiss Insulating Works.

### Your specialist in base materials for printed circuit boards

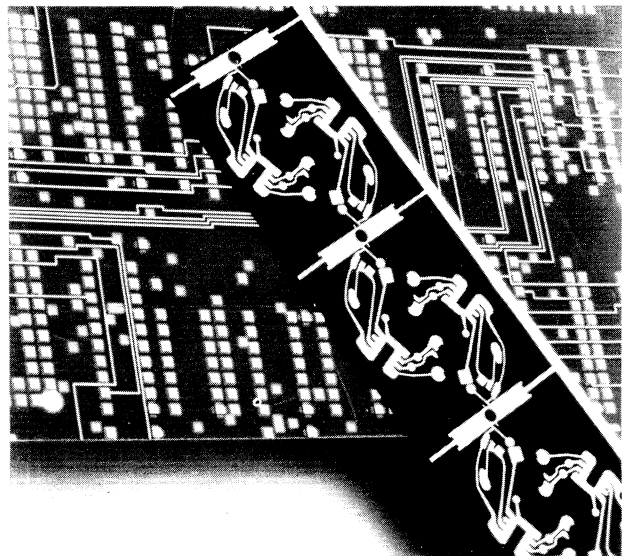
- Base material for FR-4
- Multilayer
- Multiwire<sup>®</sup>
- Base material for CC-4 Additive Process<sup>®</sup>
- Flexible Copper Clad Laminates with modified epoxy adhesive (a Sheldahl product)
- Base materials for microelectronics  
(<sup>®</sup> Trade Mark of PCK-Technology)

**The Swiss Insulating Works Ltd**  
CH-4226 Breitenbach/Switzerland  
Tel. 061/80 21 21 Telex 62 479  
Fax 061/80 20 78

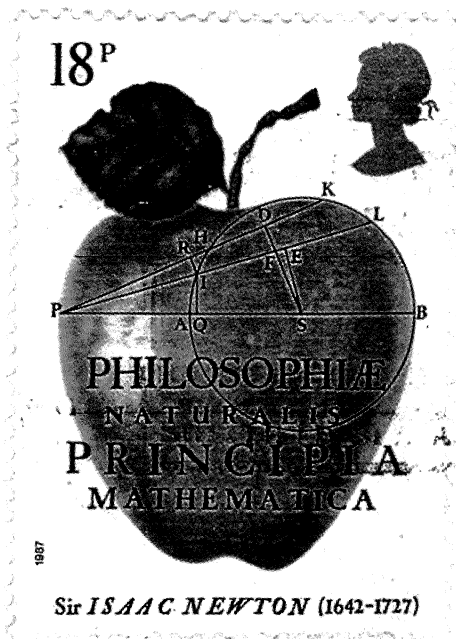
Our manufacturing programme includes also Varnishes and Resins for the manufacture of electrical machines and for the electronic equipments with excellent dielectric and protective properties.

# ISOLA

We also obtained excellent results with our Laminates Epoxy Glass Cloth VETRONITE G-10 and VETRONITE G-11 as well as with Epoxy Glass Mat DELMAT. Radiation Doses of  $10^7$  Gy for example lead not to a substantial loss of the mechanical properties.



UK postage stamp commemorating this year's tercentenary of the publication of Isaac Newton's 'Principia'.



in Cambridge earlier this year. In addition, Trinity College, Newton's home from 1661 to 1696, organized its own tribute, as did the Royal Society.

The papers presented at the Gravity 300 meeting have been published as a commemorative volume\*. Introducing the subject, Stephen Hawking claimed Newton's *Principia* to be 'probably the most important single work ever published in the physical sciences', and went on to explain how Newton was motivated by Halley to make clear how the elliptical orbits of the planets were due to an inverse square type force directed towards the sun, a result Newton had in fact worked out some years earlier but had not published.

In the *Principia*, Newton introduced the ideas of absolute time and absolute space, controversial concepts which nevertheless held fast until the advent of Einsteinian relativity more than two centuries later. In the book, Newton did not introduce his idea of 'fluxions' — a form of differential calculus he

developed to handle forces varying in magnitude and direction — preferring the historically acceptable geometrical approach, and leaving the door to calculus open for Leibniz.

In the preface to the first edition of *Principia*, Newton remarked 'I wish we could derive the rest of the phenomena of Nature by the same kind of reasoning for mechanical principles, for I am induced by many reasons to suspect that they may all depend on certain forces'. This hope has not been fulfilled, but, as Stephen Weinberg concludes in the book, 'we are working on it, very much in the Newtonian tradition: the formulation of increasingly comprehensive quantitative laws. From this high viewpoint, all that has happened since 1687 is a gloss on the *Principia*'.

The 1987a supernova came as a fitting monument to the tercentenary, underlining the importance of the classical theory and at the same time pointing to the future. Gravitation reflects both the sedate beauty of a classical theory and the turmoil of modern research, as exemplified by the contributions to the book.

---

#### *Upsetting the ether*

---

The Michelson-Morley experiment was one of the big upsets of physics, undermining the considerable confidence that had built up in the ideas of the day and setting the scene for modern physics and the special theory of relativity almost twenty years later.

When the two American experimenters planned their epic study, electromagnetic radiation such as light was believed to travel through some invisible 'ether' that filled all

space. If so, radiation from a moving body should travel faster than radiation from a static source. To test this idea, Michelson and Morley built a superbly tuned instrument designed to compare the velocity of light moving in the same direction as the Earth with the velocity perpendicular to the Earth's motion.

After repeated attempts, they found no such evidence for the long-awaited ether. According to their precision experiment, the velocity of light looked to be independent of the velocity of its source. Working independently, Hendrik Lorentz in the Netherlands and George Fitzgerald in Ireland concluded that the paths travelled by the two perpendicular light beams had to depend on velocity. This empirical result was eventually set in context by Einstein, who showed that Newton's absolute benchmarks of space and time were only valid for everyday phenomena, and had to be rethought on the grander scale.

In 1907, Michelson became the first American to receive a Nobel Prize for scientific achievement, but to his death in 1931 remained a staunch opponent of quantum physics and relativity.

In Cleveland, Ohio, where the experiment took place, thirteen of the city's cultural and educational institutions joined in a city-wide six-month celebration entitled 'Light, Space and Time', encompassing the sciences, arts and humanities. Case Western Reserve University, where Michelson and Morley were based, played a leading role, with major symposia on

---

\* *300 years of Gravitation*, edited by Stephen Hawking and Werner Israel, published by Cambridge University Press.

physics history and modern perspectives held during October.

---

### *Hertzian waves*

---

A pupil of Helmholtz, Heinrich Hertz made his initial mark on physics by justifying Maxwell's equations on theoretical grounds. With so much evidence building up to support the idea of electromagnetic radiation, he turned his attention to its detection. Using the apparatus still on view at the Deutsches Museum in Munich, he found that sparks across a gap in a rectangular wire frame could produce sparks in a similar but unconnected circuit. The distance between the transmitting and receiving circuits was gradually increased from 1.5

metres to right across the room.

After this initial discovery, Hertz went on to demonstrate that the radiation could be reflected and refracted like all other waves.

His patient investigations also found that illumination somehow facilitated sparking across a gap in a secondary coil. After carefully adjusting the gap so that no spark was seen in the dark, the spark came back when the lights were on. This was the first evidence for the photoelectric effect – the production of ions by light.

To commemorate Hertz' historic advances, the University of Karlsruhe is organizing a series of lectures culminating in a centenary ceremony on 5 December. A special exhibition will be held early next year. Other Hertz events have

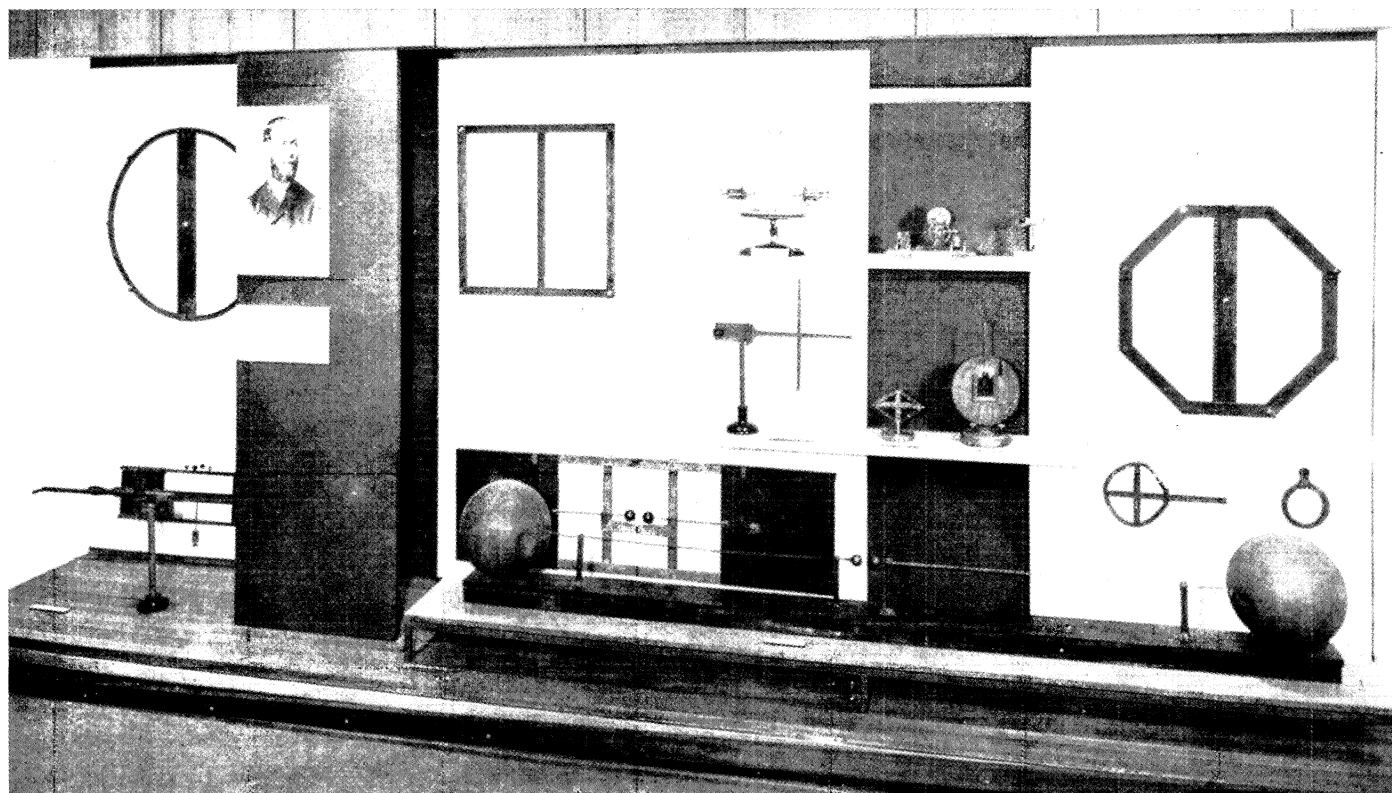
been organized in Hamburg, his birthplace, and at the Hertz Institute in Berlin.

G. F.

---

*The apparatus used by Heinrich Hertz at Karlsruhe in 1887 to discover electromagnetic waves.*

*(Photo Deutsches Museum)*



# From the specialist in high-density fast-NIM instrumentation

## FTA 810

### Octal Fast Amplifier

- < 1 ns risetime
- - 5 V output into 50  $\Omega$
- < 20  $\mu$ V equiv input noise
- gain up to 200

## CO 4010

### Quad 4-fold Logic Unit

- Coin/anticoin/off settings
- overlap and updating outputs
- fast-NIM and TTL outputs
- LED indicator
- gate input

## DV 8000

### Octal Variable Logic Delay

- adjustable delay 10-50 ns
- 15 ns pulse-pair resolution
- 3 outputs/channel
- fast-NIM logic signals
- < 10 ps/ $^{\circ}$ C drift

## RD 2000

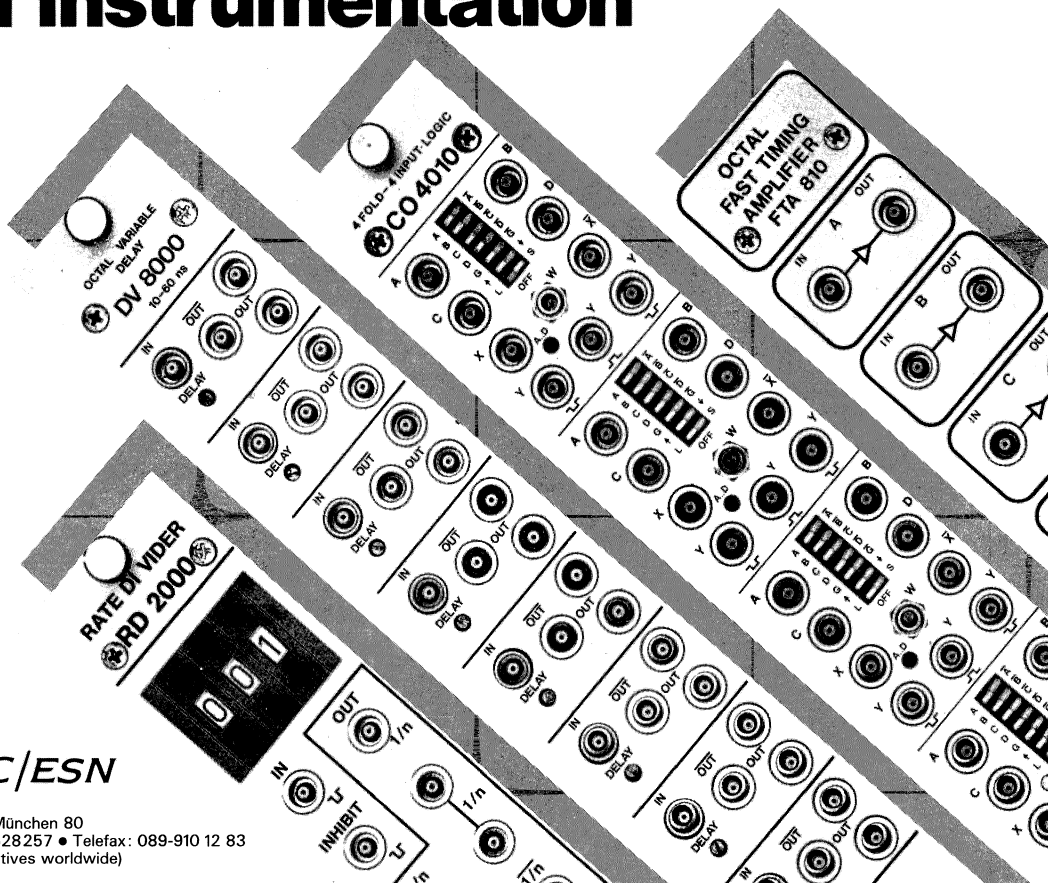
### Dual Rate Divider

- Dividing from 1000:1 to 1:1
- 40 MHz maximum rate
- propagation delay independent of ratio
- inhibit input
- 6 outputs/channel
- fast-NIM logic signals

For more information:

 **EG&G ORTEC/ESN**

Hohenlindener Strasse 12 • D-8000 München 80  
Telephone: 089/92 692-0 • Telex: 528257 • Telefax: 089-910 12 83  
(Distributed by EG+G Ortec representatives worldwide)



# CE TEC

AG für moderne  
Technologie

## YOUR PARTNER FOR VACUUM VALVES

We manufacture and supply a large range of vacuum valves and special components for

- **chemical**
- **medical**
- **nuclear**
- **metallurgical**
- **process engineering**
- **cryogenic**
- **vacuum**
- **scientific research**

and other applications.

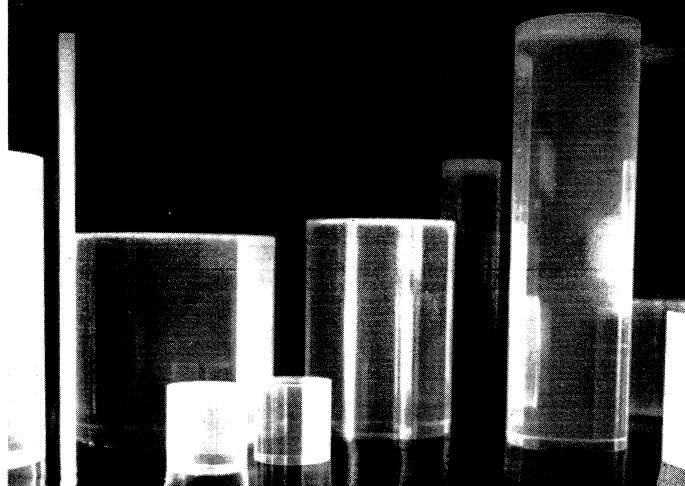
We are not the oldest and not the largest company in the field of component-manufacturers, but we create modern technology in connection with highest quality and reliable function during a long service-life.

## WE TRY HARDER.

Call us for more information.

CH-9468 SAX (Schweiz) Postfach 41  
Tel. 085-7 5070, Telefax 085-7 5086  
Telex 855 194 cetc ch

# SCINTILLATORS



We have the expertise and the know-how for high-quality plastic scintillators.

High light output, excellent transmission and fast speed are the main features of our plastic scintillators. We manufacture all sizes to customers specifications. Rods, sheets, blocks and light guides with polished or coated surfaces will be manufactured within close tolerances.

Lithium-glass-scintillators are available in special shapes and sizes from powders for HPLC and flow cells, discs for neutron measurements etc. Various types from low background to very high efficiency are available.

**ZINSSER  
ANALYTIC** (UK) Ltd.

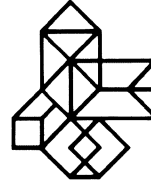
Howarth Road, Stafferton Way, Maidenhead, Berks. SL6 1AP  
Telephone 06 28/2 45 70 · Telex 849 462

M & K

CERAMIC / METAL SEALS FOR HIGH TECHNOLOGY

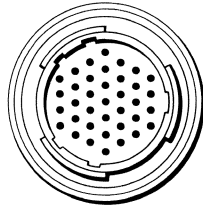
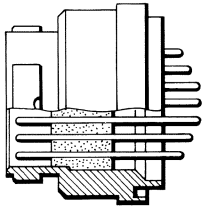
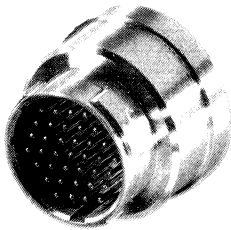
# QUARTEX

19, rue Poliveau 75005 Paris Tél. (1) 43.31.95.15 Télex 206679 F Téléfax (1) 43.31.82.66



## INSTRUMENTATION FEEDTHROUGHS • VACUUM TIGHT FEEDTHROUGHS

### QUARTEX TMJ FEEDTHROUGH SERIE



#### Electrical datas :

Voltage rating : 600 V  
Breakdown voltage (20°C)  $\geq$  2000 V  
Current rating : 1A

#### Environmental temperature range :

Cryogeny to 500°C

#### Mechanical datas :

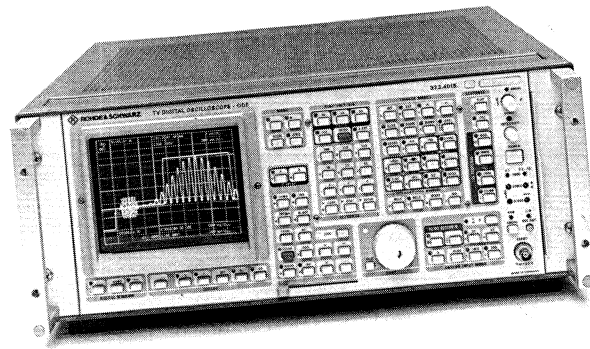
Construction : Stainless-steel 304 L Body  
Kovar pins (Gold plated)  
Ceramic : 97% purity  
Helium leak tight  $< 10^{-9}$  atm/cm<sup>3</sup>/S<sup>-1</sup>  
4 types available : 12 - 17 - 27 - 37 pins  
Compatible connector : JAEGER miniature serie

## Oscilloscope TV digital ODF

Par son traitement digitalisé du signal, l'oscilloscope TV ODF est très peu influencé par les tensions parasites et donne une évaluation précise du signal dans la bande de 0 à 10 MHz.

Une grande précision de mesure est obtenue grâce aux 1024 échelons digitaux (convertisseur A/D à 10 bit); la représentation de signaux uniques ou de lignes test s'obtient sans scintillement (fréquence de répétition de 50 Hz).

Le micro-processeur interne de 16 bit permet de raccourcir la durée d'évaluation et le confort d'utilisation.



**ROHDE & SCHWARZ**



**ROSCHI**  
Télécommunication SA

CH-3063 Ittigen, Case postale  
Téléphone 031 58 90 11  
Télex 911 759

Représentation  
générale et service  
pour la Suisse

# Around the Laboratories

36 sites in 25 states are under consideration for the proposed 84 kilometre US SSC Superconducting Supercollider ring to handle 20 TeV proton beams.

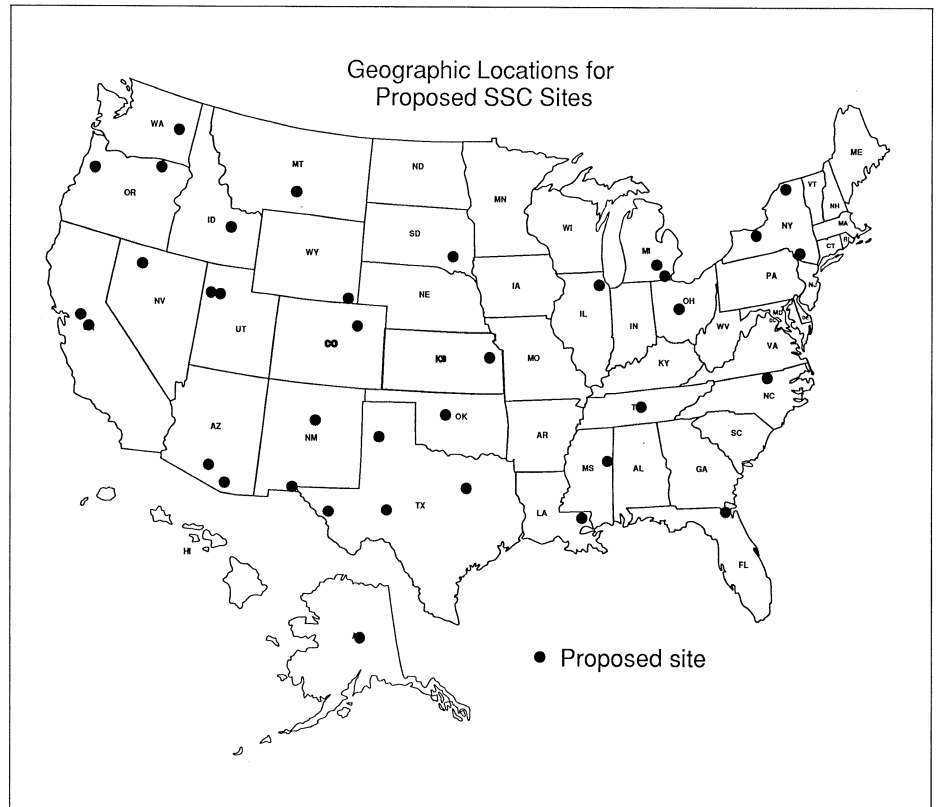
## SUPERCOLLIDER Site proposals

In response to the 1 April invitation for site proposals for the proposed US Superconducting Supercollider (SSC), the Department of Energy (DOE) received 43 proposals from 25 states by the deadline of 14.00 hrs on 2 September. About 26 000 separate items (volumes, attachments, appendices, and maps), and 13 tons of proposals were processed and distributed.

On 18 September, the DOE completed screening and forwarded 36 proposals to the SSC Site Selection Committee of the National Academy of Sciences and the National Academy of Engineering. These sites in 25 states met all of the DOE's basic qualification criteria – the land, located entirely in the US, should be made available at no cost to the federal government, and should accommodate the proposed layout of the project. Certain minimum utilities are required, and of course no known unacceptable environmental effects should result.

In the Academy committees' evaluation, primary emphasis will be placed on technical criteria – geology and tunnelling, regional resources, environment, setting, regional conditions, and the availability of utilities. Cost considerations are also significant. The committees' report to the DOE will include the unranked list of the best qualified sites, but the size of the short list has not been predetermined.

Additional geological and environmental information may be requested of finalists and confirmatory investigations will be conducted by DOE. Detailed staff ana-



lyses and environmental information will be presented to the DOE Site Selection Energy System Acquisition Advisory Board (ESAAB) as input into the decision process. Based on the Academy committees' evaluation, this additional information, the ESAAB findings, and other input as appropriate, the Secretary may designate the preferred site as early as July 1988.

Preparation of an Environmental Impact Statement (EIS) for the SSC has begun, in accordance with the National Environmental Policy Act process. This will include an opportunity for public comment, preparation of a Final EIS and a Record of Decision (ROD). Environmental impacts of constructing and operating the SSC, including those relating to public health and safety will be addressed in the EIS. The issuance of the ROD based on the final EIS will be the last step of the

site selection process.

In January 1989, the Secretary of Energy will announce the final site selection following completion of the National Environmental Policy Act process. Preliminary and Final Safety Analyses will be prepared during the design and construction phases of the project.

## FERMILAB Fixed target run begins

Fermilab began a 800 GeV fixed target physics run this summer with almost a full complement of 16 experiments and 15 beamlines. (The only exception was a new polarized beam which will be commissioned at the end of the current running period.)

*The beamlines fanning out from Fermilab's Tevatron ring.*

During the previous 800 GeV fixed target run, experiments were serviced by existing beamlines upgraded to transport 800 GeV beam as none of the major new Tevatron facilities were ready.

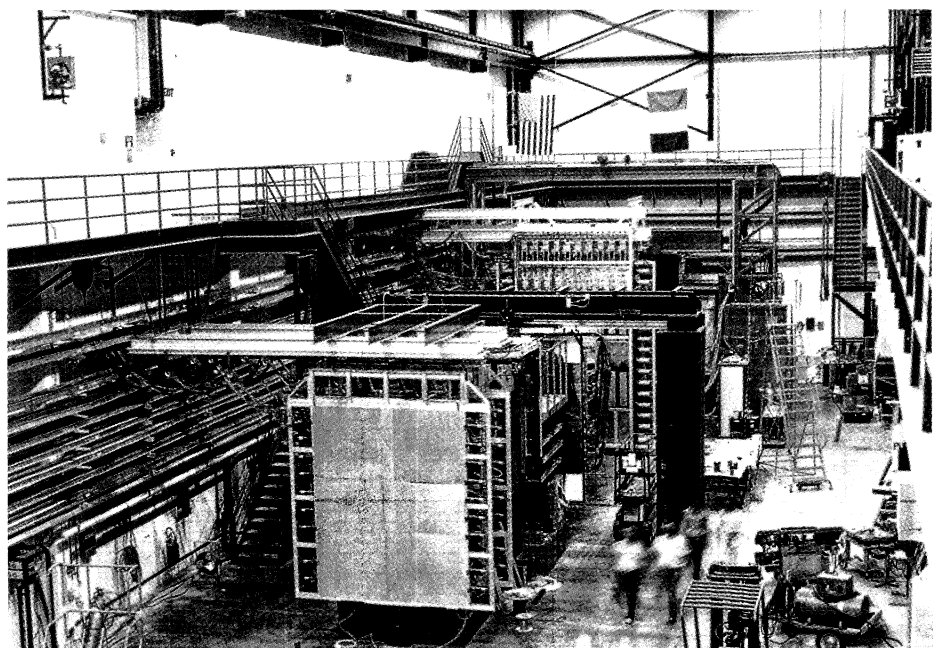
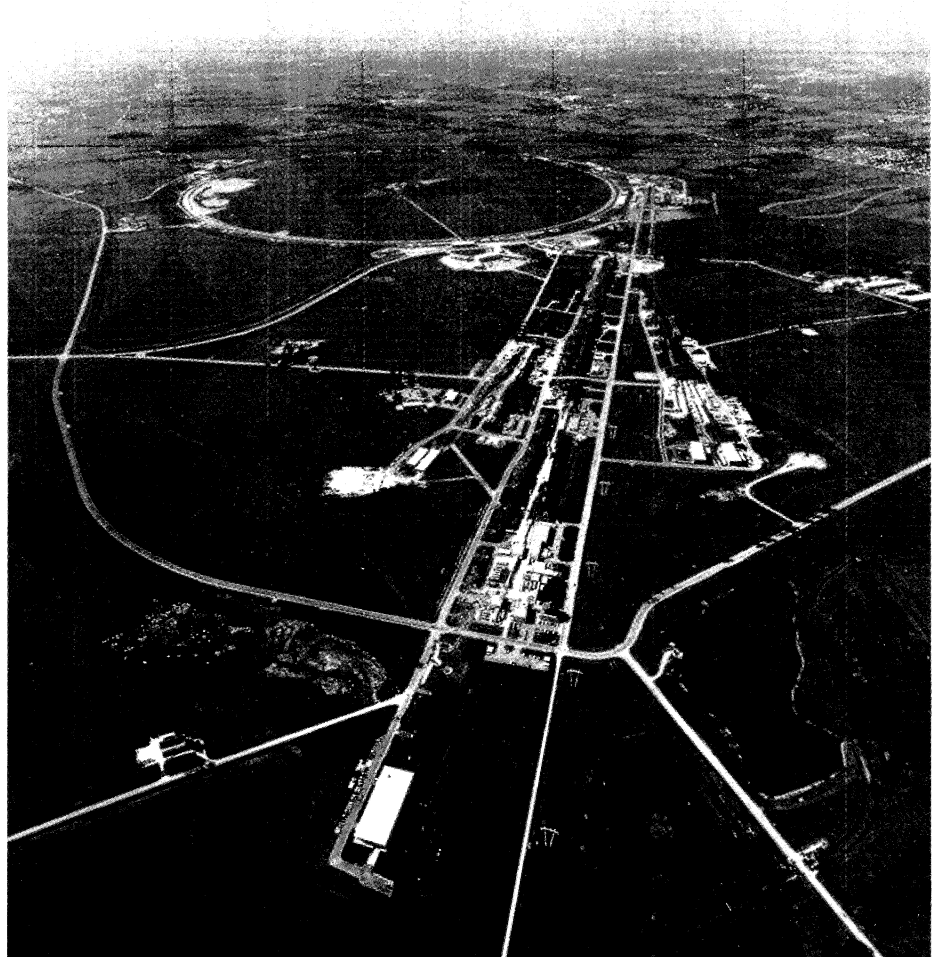
Two highlights of this present run are the increased efficiency of the Tevatron and the commissioning and data taking of three big fixed target beamlines and detectors in the new Muon, Wideband, and Meson West Areas.

During the first nine weeks of running, the accelerator surpassed the peak intensity record from the previous run, reaching more than  $1.7 \times 10^{13}$  protons per pulse. Compared with the start-up of the previous run, twice as many protons per week have been accelerated this time, with the highest accumulated weekly proton intensity reaching  $1.06 \times 10^{17}$ . In addition, a record 127 hours of beam was reached during one week.

One of the three new beams leads to the Muon Experimental Hall and Experiment 665, studying muon interactions at energies of up to 750 GeV in a variety of targets, looking at the hadrons recoiling from violent muon collisions in hydrogen and heavy nuclei, and measuring the quark content (structure functions) of these targets. It involves a collaboration Argonne, California (San Diego), Fermilab, Freiburg, Harvard, Illinois (Chicago), Poland, Maryland, MIT, the Max Planck Institute (Munich), Washington, Wuppertal and Yale.

The second new major experiment is E687 in the Wideband Beam, looking at the photoproduction of charm and beauty, especially photo-excited states containing

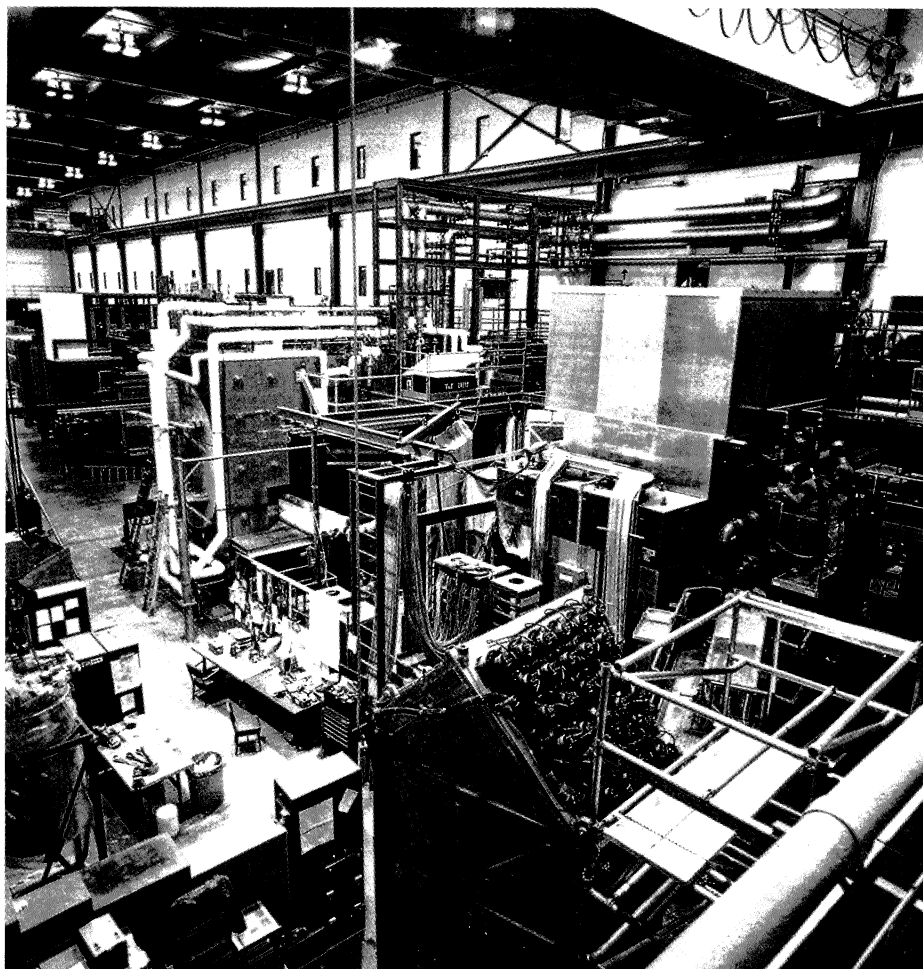
*Experiment 687 in the Tevatron Wideband Beam looking at the photoproduction of states containing heavy quarks includes a large Italian contingent.*





Fermilab Experiment 665 studies muon interactions at up to 750 GeV and among other things will measure the quark content of different nuclear targets.

(Photos Fermilab)



charmed quarks, charmed D mesons and lambda-C baryons, J/psi and psi prime, and heavier states containing bottom quarks. The collaboration includes Colorado, Fermilab, Illinois, INFN Frascati and Milan, the University of Milan, Northwestern and Notre Dame.

The third new experiment is E706 in the Meson West Beamline, studying the gluon content of hadrons by analyzing the direct photons from collisions of pions, kaons, and protons with a variety of targets. It uses a very large liquid argon calorimeter. Housed in the same experimental hall and running simultaneously is experiment E672, whose special interest is the particles produced in asso-

ciation with J/psi and high mass muon pairs. E706 involves physicists from Delhi, Fermilab, Michigan State, Minnesota, Northeastern, Pennsylvania State, Pittsburgh, Rajasthan and Rochester, while E672 covers Arizona, California Institute of Technology, Fermilab, Florida State, George Mason, Illinois at Chicago, Indiana, Serpukhov, Maryland, Michigan and Rutgers.

With the upgraded beamlines and detectors and with the three new large experiments, Fermilab's investment in the Tevatron is up and running and users are already reaping the rewards with lots of data at high energy. After the inaugural physics run of the Tevatron

proton-antiproton collider (see May issue, page 18), the full fixed-target programme got underway with physicists optimistic of new results. It is scheduled to run until the middle of December, when the big CDF detector will take over for five months of proton-antiproton collisions.

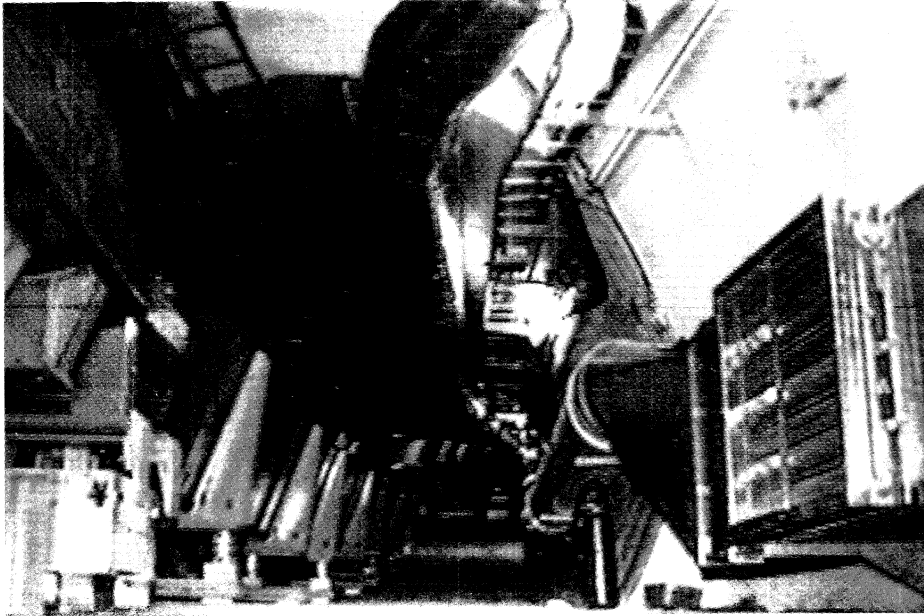
## CERN Crash programme for LEP

To push work on the LEP electron-positron collider forward as quickly as possible, the installation team has embarked on a crash programme to fit out the first 2.8 kilometre octant of the 27 kilometre ring. The aim is to have the necessary equipment for beam handling and control in position and working so that a positron beam from the SPS can be injected into this sector of the LEP ring next July, slamming into a beam dump at the far end.

This challenging goal will provide valuable working experience of major LEP components and enable subsequent installation work in the remainder of the ring to be optimized.

As the crash programme was getting under way in September, the SPS Super 'Proton' Synchrotron pointed the way by accelerating its first beam of positrons to 12 GeV, the highest positron energy possible with the existing SPS radiofrequency accelerating system. New radiofrequency equipment will soon be added to take the SPS positrons (and electrons) up to 20 GeV ready for injection into the LEP main ring.

LEP's electrons and positrons are supplied at 500 MeV by the

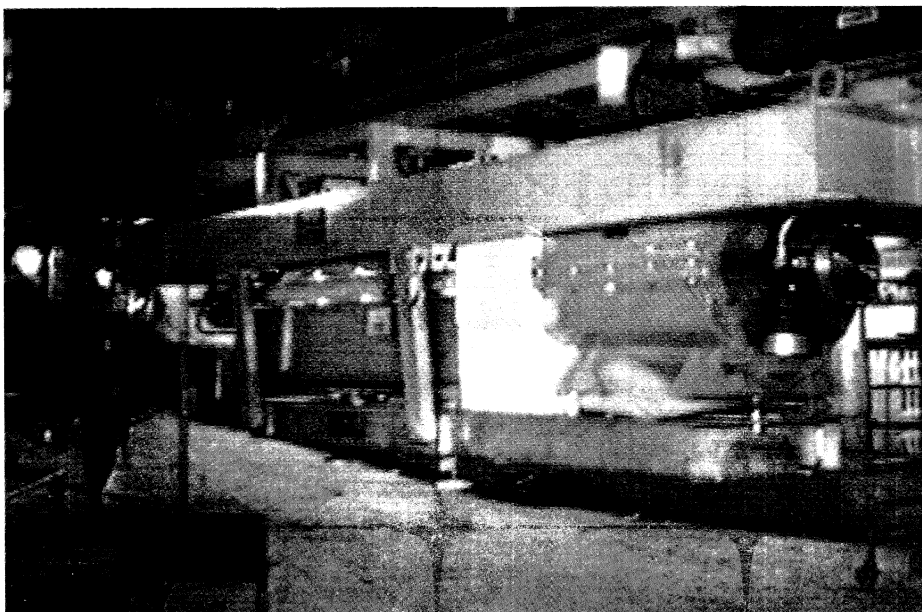


▲ First magnets and equipment for the LEP electron-positron collider installed in the 27 kilometre tunnel.

(Photo CERN 257.9.87)

▼ Transporting equipment for the LEP ring by the tunnel monorail.

(Photo CERN 256.9.87)



new LPI LEP Pre-Injector (see September issue, page 33) and taken on to 3.5 GeV by the PS 'Proton' Synchrotron.

Meanwhile the initial trickle of completed LEP components is building up to a steady flow, and the sophisticated installation techniques (see July/August issue, page 1) are getting into their stride.

Civil engineering work on the remainder of the tunnel nears completion. All the signs are that the first LEP beams are less than two years away and on schedule.

## Neutral kaons

Until 1964, CP symmetry was sacrosanct – physics was unchanged whenever particles and antiparticles and left and right were interchanged simultaneously. Then a historic experiment at Brookhaven by J. W. Cronin and V. L. Fitch took a closer look at neutral kaons. These come in two varieties – a short-lived kind which likes to decay into two pions, and a long-lived one preferring to go to three pions. The Brookhaven experiment found that about one long-lived kaon in every five hundred managed to decay into two pions, revealing the neutral kaons' scant regard for CP, and physicists have searched hard ever since for further clues to this mystery.

Five years ago, a CERN / Dortmund / Edinburgh / Mainz / Orsay / Pisa / Siegen collaboration began building an imaginative detector to compare the decays of long-lived and short-lived kaons into electrically charged or neutral pairs of pions.

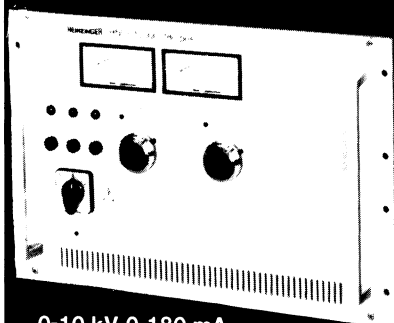
The idea was to record the two-pion decays of both kinds of kaons in the same detector simultaneously. Long-lived kaons travel further before disintegrating than do their short-lived counterparts. So while the experiment produces its long-lived kaons from the incident high energy beam at a target 250 metres upstream of the detectors, the target producing short-lived kaons is closer to the detectors and mounted on rails inside

# High Tech from HEINZINGER

West - Germany

Examples of our products:

Capacitor charging units  
Accuracy up to  $1 \times 10^{-4}$



0-10 kV 0-180 mA



High voltage-system DVM up to 132 kV  
Accuracy  $1 \times 10^{-4}$  (PTB-approved)

Special products are our strong point

# HEINZINGER

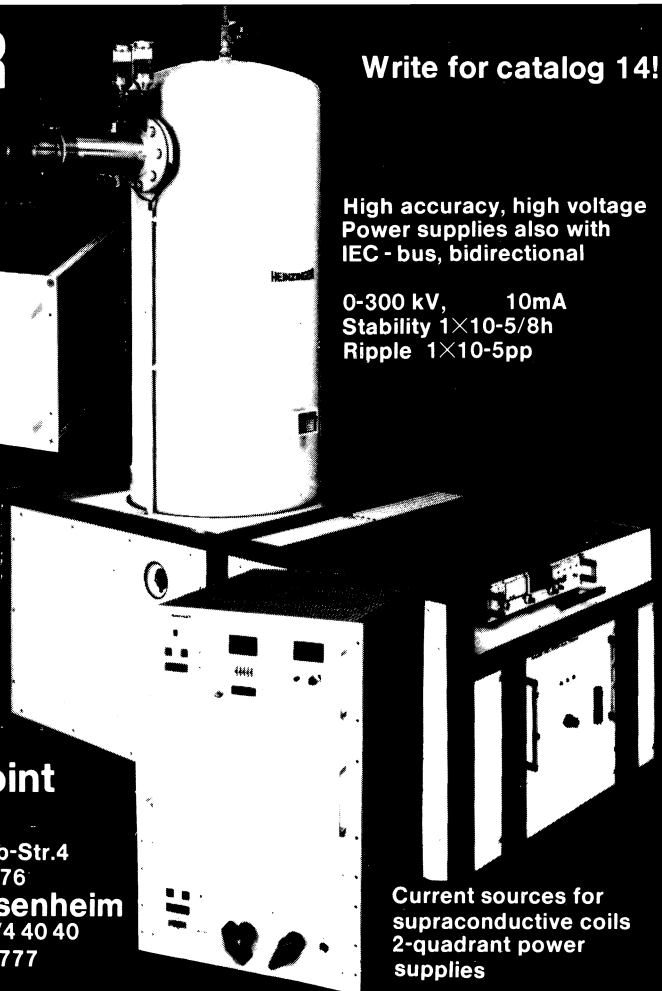
electronic GmbH

Anton-Jakob-Str.4  
Postfach 1076  
8200 Rosenheim  
Tel.: 0 80 31/4 40 40  
Telex: 0525 777

Write for catalog 14!

High accuracy, high voltage  
Power supplies also with  
IEC - bus, bidirectional

0-300 kV, 10mA  
Stability  $1 \times 10^{-5}/8h$   
Ripple  $1 \times 10^{-5}pp$



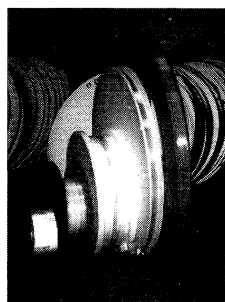
Current sources for  
superconductive coils  
2-quadrant power  
supplies

## SCINTILLATING PLASTIC OPTICAL FIBERS



### OPTECTRON

LEADING  
MANUFACTURER  
IN THE WORLD



OPTECTRON'S SCINTILLATING Plastic Optical Fibers (*developed under CEA Licence*) are present in all large nuclear Equipment: in calorimetry, tracking... etc. Thanks to a stabilized fabrication and excellent results obtained, thousands of kilometers of Scintillating Plastic Optical Fibers have already been realised for applications in different programs such as: UA2, DELPHI-SAT, NA 38, CLEO II, experiments at Brookhaven, Berkeley... etc.



For your needs in Fluorescent or Transparent Plastic Optical Fibers **OPTECTRON'S** products are also available.

**OPTECTRON** Z.A. Courtabœuf, Bâtiment Evolic B 1  
Avenue de la Baltique - BP 535 - F 91946 LES ULIS  
Tél.: (1) 69 28 15 20 - Télex: 603635 OPECT

**PI** Physik  
Instrumente

## F-200 LWL precision positioner

LWL positioner for  
coupling single  
and multi-mode  
fibres

- High-precision pre-adjustment
- Piezoelectric fine adjustment
- Stereo microscope observation
- Ergonomic design
- 12 or 220 V operating voltage



Contact us for documentation or advice.

**POLYSCIENCE AG**

Bleichstrasse 8  
CH-6300 ZUG  
Tel. 042/22 15 33



**REICHENBERGER AG**  
 Reuss-Strasse 9  
**CH-6038 GISIKON**  
 Telefon 041/91 02 22  
 Telex 868 288 RAG CH  
 Telefax 041/91 35 65



BRAND- UND WASSERSCHADENSANIERUNG  
 REMISE EN ETAT APRES INCENDIE OU AUTRES PHENOMENES  
 RIPRISTINO DI BENI DANNEGIATI DOPO INCENDIO O ALTRI FENOMENI  
 RECONDITIONING PROPERTY DAMAGED BY FIRE



BRANDSCHUTZ  
 PROTECTION INCENDIE  
 PROTEZIONE INCENDIO  
 FIRE PROTECTION



ASBESTENTFERNUNG  
 ELIMINATION D'AMIANTE  
 ELIMINAZIONE D'AMIANTO  
 ASBESTOS REMOVAL



PROFESSIONELLE DEKONTAMINATION  
 DECONTAMINATION PROFESSIONNELLE  
 DECONTAMINAZIONE PROFESSIONALE  
 PROFESSIONAL DECONTAMINATION



INDUSTRIEWARTUNG  
 ENTRETIEN D'INSTALLATIONS INDUSTRIELLES  
 MANTENIMENTO DI INSTALLAZIONI INDUSTRIALI  
 INDUSTRIAL MAINTENANCE



CHEMISCHE PRODUKTE  
 PRODUITS CHIMIQUES  
 PRODOTTI CHIMICI  
 CHEMICAL PRODUCTS

REICHENBERGER AG  
 Filiale Basel  
 Gartenstrasse 63  
**CH-4052 BASEL**  
 Telefon 061/23 17 71  
 Telefax 061/23 18 13

REICHENBERGER AG  
 Filiale Zürich  
 Gasometerstrasse 9  
**CH-8005 ZÜRICH**  
 Telefon 01/42 74 05

REICHENBERGER AG  
 Filiale Sargans  
 Rheinstrasse 1132  
**CH-7320 SARGANS**  
 Telefon 085/2 64 44

REICHENBERGER SA  
 Succursale de Nyon  
 Rte du Stand 43  
**CH-1260 NYON**  
 Telefon 022/62 22 55  
 Telefax 022/61 74 44

RAG-BELGIUM N.V.  
 Kapucinessenstraat 19  
**B-2000 ANTWERPEN**  
 Telefon 03/231 26 52+  
 03/231 64 23  
 Telex 72 887 RAGBEL B

RAG-REICHENBERGER  
 Brand- und Wasserschaden-  
 sanierungsgesellschaft m.b.H.  
 Quellenstrasse 185  
**A-1100 WIEN**  
 Tel. 0222/627 28 80+  
 627 20 73  
 Teletex (61) 3221382=  
 RAGWIEN

RAG in FRANKREICH  
 vertreten durch  
 COUTHEILLAS SA  
 185, Av. du Général Leclerc  
 F-94700 MAISONS ALFORT  
 Telefon 1/43 75 52 45  
 Telex 262 163 COUTHEI F

RAG in DEUTSCHLAND  
 vertreten durch  
 ELEC-SAN  
 Brandschutz-Sanierung GmbH  
 Kolping-Ring 12  
**D-8024 OBERHACHING**  
 Telefon 089/613 48 93+94  
 Telex 521 34 68 MEMO D

RAG in GROSSBRITANNIEN  
 vertreten durch  
 MERRYHILL CONTRACTING LTD.  
 Tanners Lane, East Wellow  
**GB-ROMSEY/HAMPSHIRE SO51 6DP**  
 Telefon 0794/51 58 48  
 Telefax 0794/52 43 86

## CAPTEURS

et appareils pour la mesure de :

- Accélérations (0 - 1 / 0 - 100 000 g.)
- Angles
- Champs magnétiques
- Contraintes (jauges)
- DÉBITS (air)
- DÉPLACEMENTS  
(LVDT / pot. / sans contact)
- ÉPAISSEURS
- FORCES ( $\pm 10$  g à 0 - 1000 ton)
- HUMIDITÉ
- INCLINAISONS
- MOMENTS DE TORSIONS
- PRESSIONS (0 - 0,5 mbar à 0 - 7000 bar)
- TEMPÉRATURES
- VITESSES linéaires
- VIBRATIONS

et aussi

Datalogger

Terminals RS 232

Interface Modules mV - V - mA - A - Temp. - Imp ... /  
 RS 232

**RIKENTA AG**

Motorenstrasse 21, 8005 Zurich  
 Tél. 01/44 29 90, Télex 823 015

**ANECHNIKA**

**METAL BELLOWS**  
 Pumpen mit  
 Edelstahl-Faltenbälgen

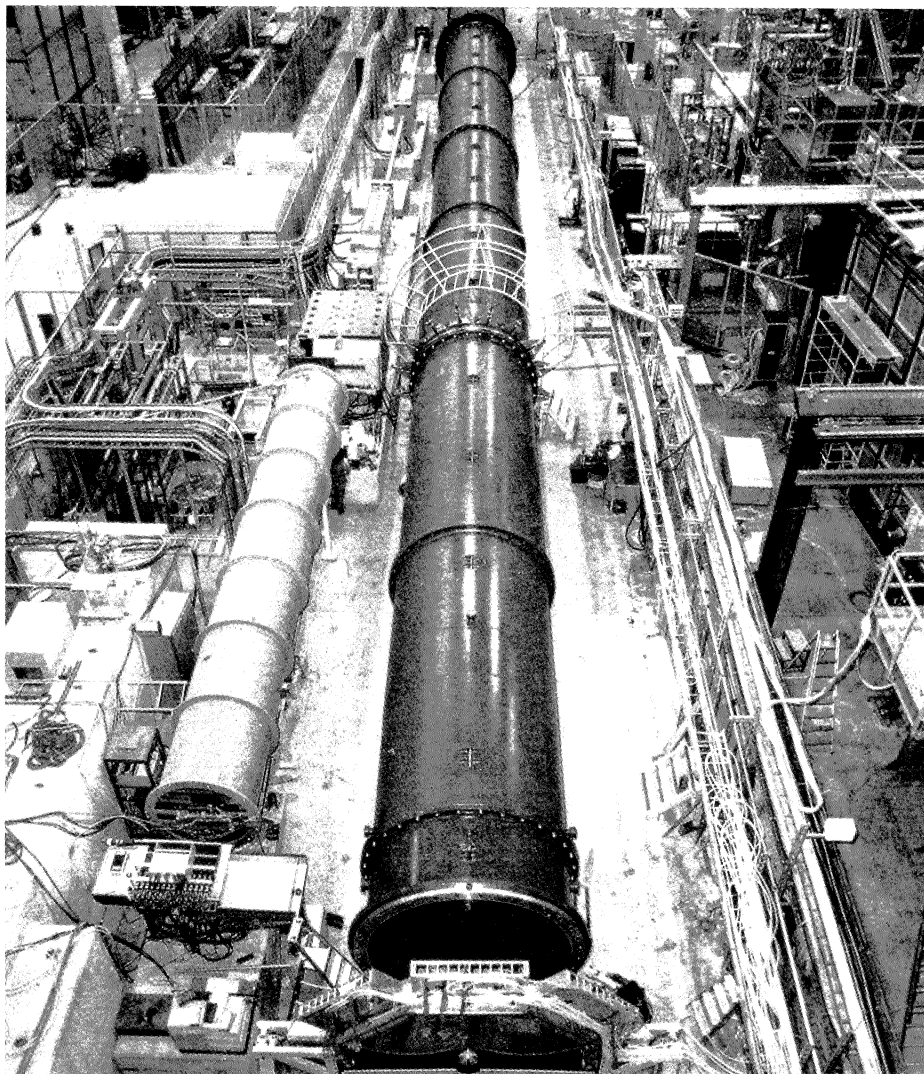
Für anspruchsvolle Applikationen:

- minimale Leckrate
- hohe Standzeiten
- wartungsfrei
- korrosionsfest
- inert
- beheizbar

**ANECHNIKA Analytische Geräte GmbH**  
 Nobelstraße 3 · D-7505 Ettlingen  
 Telefon (07243) 14061 · Telex 782990 ante d

The 110 metre vacuum chamber of the CERN / Dortmund / Edinburgh / Mainz / Orsay / Pisa / Siegen experiment studying neutral kaons.

(Photo CERN 288.6.84)



a 110 metre-long vacuum chamber. In this way the experiment is able to watch the 'arrival' of the short-lived kaons.

Preliminary results emerging from the analysis of the painstakingly amassed data – two hundred thousand decays of long-lived kaons into neutral pion pairs, and a million into charged pion pairs, together with three million short-lived kaon decays – show something very interesting.

The relative decay rates of the long- and short-lived kaons into neutral and into charged pion pairs are not the same – the difference

being a few per cent. This preliminary result, if confirmed, would rule out certain candidate mechanisms for CP violation, the most important single advance for this kind of physics in the 24 years since Fitch and Cronin's experiment.

A spinoff from this precision study is the first sighting of short-lived kaons decaying into pairs of photons. With the neutral pion pairs copiously produced by these kaons themselves giving lots of photons, the direct decay into photon pairs was always masked.

## DESY TRIUMF for HERA

Canada is making important contributions to the construction of the electron-proton collider HERA in Hamburg. Components worth nearly 9 million Canadian dollars are provided for the preacceleration of protons, according to an agreement just signed between the German DESY Laboratory and the Institute of Particle Physics (IPP) of Canada.

Atomic Energy of Canada Limited (AECL) will provide the 50 MHz radiofrequency acceleration system for protons of both the modified PETRA ring and the superconducting HERA proton ring.

The 80 metre beam transport system between the new Linac III (for negative hydrogen ions) and the 300 metre circumference proton synchrotron DESY III was designed and built by the Canadian TRIUMF Laboratory in Vancouver, and has already been delivered to DESY. It consists of 2 dipole magnets, 15 quadrupoles (plus 3 spare units) and 7 double steering dipoles, including mechanical supports and adjustment devices.

In addition, most parts of the vacuum system (flanges, bellows etc.) have been supplied. They are now being welded to vacuum pipes at DESY and will be installed soon. Also the full beam diagnostic system has been built by TRIUMF.

Linac III will provide negative hydrogen ions at 50 MeV, which reach the synchrotron through the TRIUMF transport line. In a special bypass provided by the Institute of Physics I of the University of Hamburg consisting of four kicker magnets and an electron-stripping foil, the negative hydrogen ions

# TECHNIQUES DU VIDE

*Holweck : question de principe!*

## MDP-5010

**pompe moléculaire** : le complément idéal de votre système de pompage. Une pompe propre, rapide, compacte, robuste et une barrière contre la rétrodiffusion d'hydrocarbures.

Consultez-nous.

### ALCATEL-CIT

Division Vide et Mécanique

55, rue Edgar Quinet, 92240 MALAKOFF

Tél. : (1) 40 92 30 00 - Telex : 632033 F

Fax : (1) 40 92 04 50



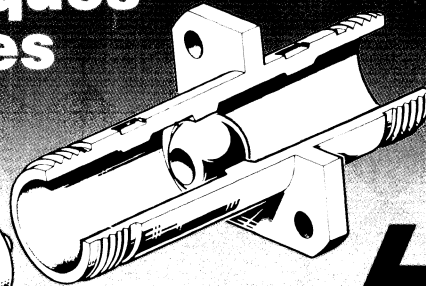
CIGIE

**Alcatel**

ECHOPRESS

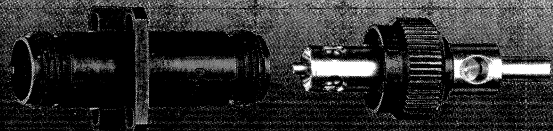
## Nouveau

### Connecteurs pour fibres optiques monomodes



**LEMO**

- Système d'alignement et de réglage OPTABALL.
- Compatibles avec les séries VFO et DF de la société Radiall.
- Disponibles dans les modèles fiches, embases, raccord et atténuateurs fixes ou variables.



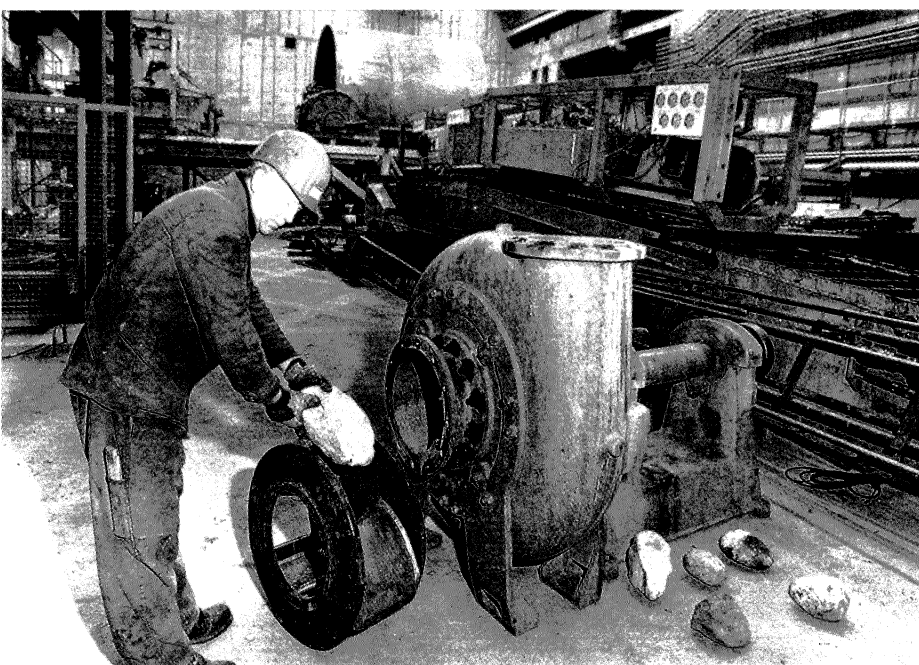
**LEMO SA**

P.O. Box 316 · Route de Lausanne · CH-1110 Morges · Téléphone: (021) 711341 · Telex: 458122



▲ Beamline equipment (left) provided by the Canadian TRIUMF Laboratory to link DESY's Linac III with the DESY III proton synchrotron (centre), being shown by DESY-TRIUMF collaboration coordinator Lutz Crigee (left). On the right is the operational DESY II electron/positron synchrotron.

▼ The glory that was HERAKLES. With the 6.3 km tunnel excavated for the electron-proton collider at the DESY Laboratory in Hamburg, the HERAKLES tunnelling machine is dismantled. In the foreground is the pump and some of the stones it managed to push out, suspended in a clay-mud mixture.



will be converted into protons and guided into a synchrotron orbit.

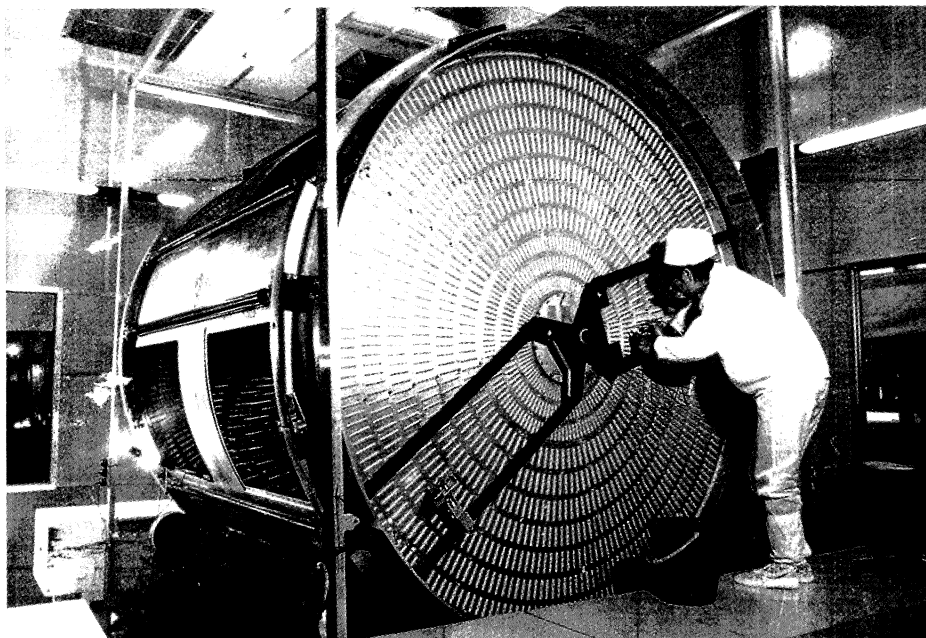
Injection (with the kicker magnets on) takes place during 30 microseconds, corresponding to ten revolutions in the synchrotron. The bypass kickers are then turned off and the circulating protons, conveniently bunched, are accelerated to 7 GeV and injected into the 2.3 km long PETRA ring. In PETRA the protons will be further accelerated to 40 GeV and sent to the superconducting HERA proton ring, where they will finally reach 820 GeV. The proton beam will collide head-on with the 30 GeV electron (or positron) beam of the HERA electron ring in two interaction regions – Halls North and South. These will be the homes of the H1 and ZEUS experiments respectively.

While installation work in the HERA tunnel forges ahead, the big superconducting magnet test hall at DESY has started operation, cooling down one of the nine-metre prototype magnets already available. These magnets were designed, developed and wound at DESY and provided with cryostats by Brown Boveri of Mannheim.

In November the first industrially produced magnet is expected to arrive from the Italian Ansaldo-LMI-Zanon consortium. The Italian Istituto Nazionale di Fisica Nucleare is providing half of HERA's 420 dipoles, while the second half will be produced by Brown Boveri according to the same design.

## BEIJING Chinese positrons

Recent landmark in the development work for the new Beijing Electron-Positron Collider (BEPC)



*Assembly of the main drift chamber for the BES detector to be installed at the BEPC electron-positron collider now under construction at Beijing.*

was the production of the first positron beam in China. BEPC is designed to take electron and positron beams to between 2.2 and 2.8 GeV in a storage ring fed by a linac supplying 1.4 GeV beams.

The input end of the linac has now produced 99 MeV positrons using eight accelerating stations powered by four klystrons. The first five stations take an electron beam to 150 MeV to bombard a positron production target, and the final three stations take care of the positively charged beam. Without the production target, the electron beam alone can be taken to 250 MeV.

The other design goals for the positron source have been attained. The positron production rate is 2 per cent of the electron

yield per GeV, the beam current (2.5 mA) has exceeded the 1.5 mA design figure, and the beam radius is good at less than 2.5 mm.

Meanwhile wire stringing for the main drift chamber of the BES magnetic detector was completed in the summer. BES will be installed at one of the BEPC interaction regions. As well as the main drift chamber, it will consist of a central drift chamber, a system of time-of-flight counters, an electromagnetic shower counter, muon identifier and conventional magnet (see June issue, page 5).

The BES main drift chamber designed for better than 200 micron precision, consists of ten concentric cylindrical layers with an inner radius of 155 mm, outer radius 1150 mm and active length 2200

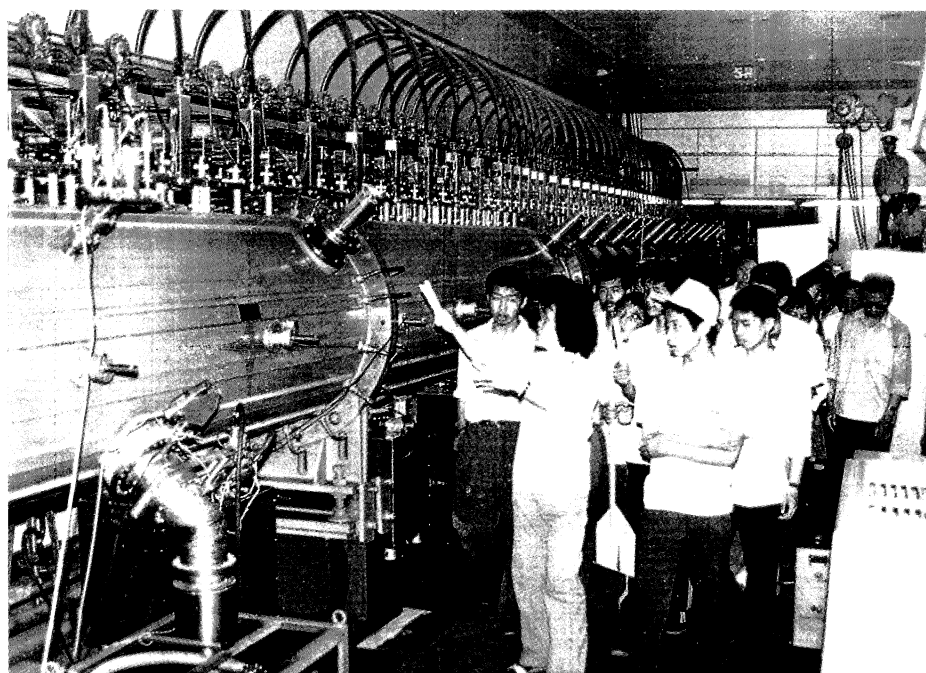
mm. Each layer will measure energy loss to help with particle identification. A government aerospace factory in Guizhou, in the south-west of the country, supplied the frame of the chamber and stringing of the total of 19 380 wires (2808 sense wires) began in January.

## GANIL Channelling heavy ions

A fast charged particle entering disordered matter (a gas, liquid or amorphous solid) is slowed down by a random succession of collisions. But when the projectile is injected into a single crystal, in a direction close to that of a crystal axis, its penetration is no longer random but is channelled by atomic rows or planes that behave like safety barriers on a highway, keeping the projectiles on course and preventing them from penetrating atomic nuclei in the target.

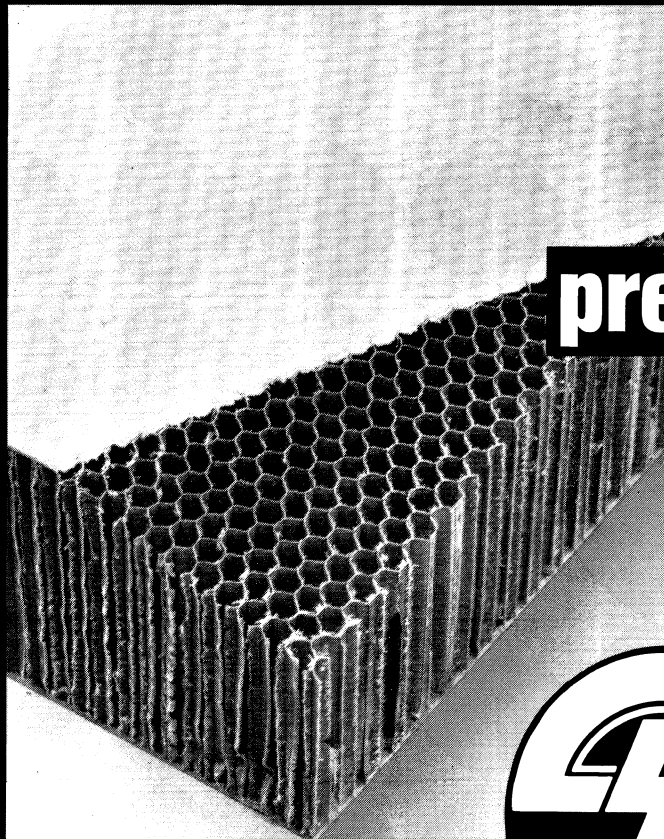
This channelling phenomenon has been known for more than 20 years for electrons and light ions but has not hitherto been explored with highly charged heavy ions. To do so, the right beams had to be available and it had to be possible to align beams and crystals to a few thousandths of a degree.

GANIL, the French heavy ion machine at Caen, has the right conditions for generating heavy ion beams with their electrons eliminated, i.e. either fully stripped or almost so, and with good emittance (low angular dispersion). The highly charged ions such as xenon result from stripping electrons with



*The Institute of High Energy Physics in Beijing attracted some 5000 curious visitors when its doors were open to the public for two days this summer.*





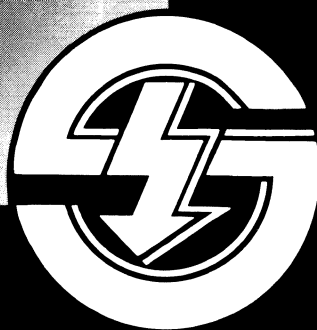
# Sandwich prefab elements

Well-founded informations give you a personal lead in any project management. Take for example

of all types with various material combinations.

Please request detailed information. Mr H. Mauch will be glad to advise you personally.

We offer a range that is based on 30 years' experience and know how through successful collaboration with field specialists.



## Stesalit AG Kunststoffwerk

CH-4249 Zullwil SO Fax 061/80 06 04  
Telefon 061/80 06 01 Telex 963182

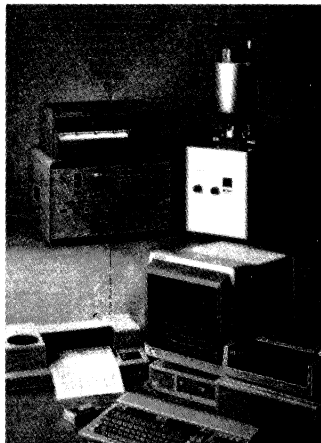
We provide easily built-in safety in Know-how.



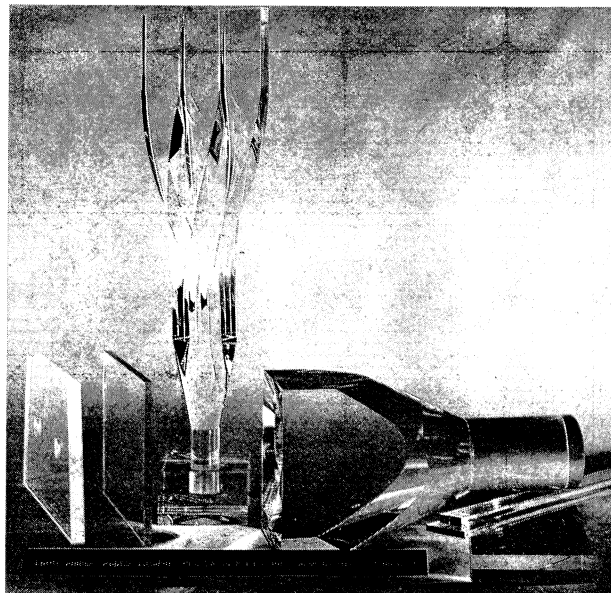
## THERMAL ANALYSIS

Netzsch Gerätebau GmbH is a world wide leading company, offering a complete **Thermal Analysis Laboratory** with fully automatic data acquisition and computer evaluation:

- Simultaneous TG/DTG-DTA  
-160 ... 2400° C
- DSC/TG-DSC  
-160 ... 1400° C
- $c_p$ -measurements  
25 ... 1400° C
- Dilatometer/TMA  
-160 ... 2000° C
- STA/Mass Spectrometry  
25 ... 2000° C
- Thermo Micro Balance  
25 ... 1500° C



Netzsch Gerätebau GmbH ● D-8672 Selb ●  
Wittelsbacherstr. 42 ● P.O. Box 1460 ●  
Telex: 643 510 ●  
Phone: W.-Germany (09287) 881-0 ● FRG



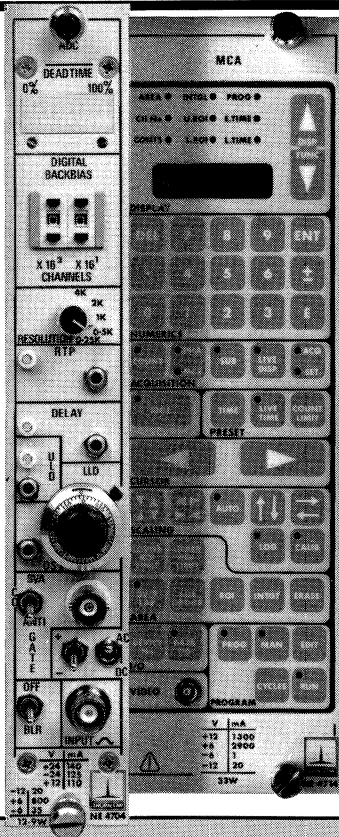
## POLIVAR S.p.A.

Via Trieste 10/12 P.O. Box 111  
00040-POMEZIA (Roma)  
Tel. 06/912 1061 Telex 611 227 PLVI

### Product line

Cast acrylic sheets, bars, blocks, scintillators,  
light guides

# THE NEW 4K NIM ADC



NE4704 is specially designed to complement our comprehensive range of MCA systems –

- Single width NIM unit
- Peak Detection/Rise Time Protection/Sample Modes
- Built-in Base Line Restorer
- L.L.D./U.L.D. Front Panel Controls
- S.C.A. Output
- Digital Back Bias
- P.U.R. Interface

Get your Information Pack on the New 4704 and our complete range of MCA Systems – NOW!

## Nuclear Enterprises Limited

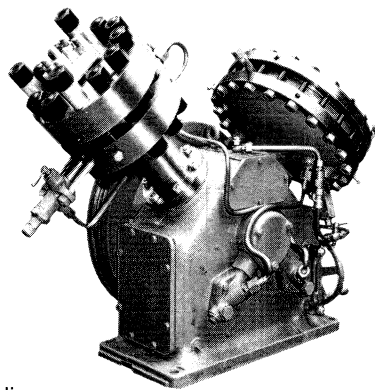
Sighthill, Edinburgh, Scotland EH11 4BY  
Telephone: 031-453 5560 Fax: 031-453 5560 Ext 234 Telex: 848475

In the USA: Nuclear Enterprises America, 23 Madison Road, Fairfield, NJ 07006  
Telephone: 201 575 5586 Fax: 201 575 8717 Telex: 221236



# Nuclear Enterprises

## Burton Corblin Membrankompressoren sind problemlos



Das hermetische System verdichtet ölfrei alle Gase bis 2500 bar und hält die Gase und Umwelt rein.

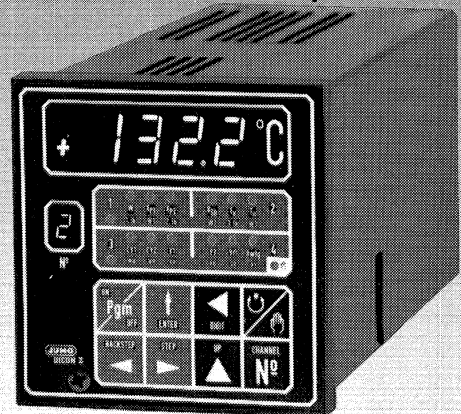
Lieferbar in vielen Bauarten und Leistungsstufen, vom Laborgerät bis zum 100 kW-Kompressor – auch als Trockenläufer mit Membran-Endstufe und als Komplettseinheit. Sie entsprechen allen Abnahmevorschriften.

## HERBERT OTT AG

Missionsstrasse 22, Postfach, CH-4003 Basel  
Telefon 061 / 25 98 00, Telex 964 562 (hoc)

# JUMO<sup>9721</sup> DICON Z

Régulateur multicanaux à microprocesseur pour l'industrie et la commande de processus



- 1 à 4 circuits de régulation.
- Utilisable comme régulateur à 2 ou 3 points, resp. par paliers à 3 points.
- Linéarisation pour les thermomètres à résistance et les thermocouples usuels; enregistrée en mémoire EPROM.
- Précision de régulation élevée;  $\leq 0,2\%$  au moyen de circuits d'entrée à auto-étalonnage.
- Comparateurs de limites incorporés; jusqu'à 8 sorties binaires ou à relais.
- Interfaces V24, resp. RS232C ou TTY.
- Alimentation stabilisée à découpage et à auto-surveillance (circuit « Watchdog »).

**JUMO** MESS- UND REGELTECHNIK<sup>®</sup>

JUMO MESS- & REGELTECHNIK AG · Seestrasse 67 · CH-8712 Stäfa · 01/928 21 41  
Bureau Suisse romande · CH-2203 Rochefort-Neuchâtel · 038 / 45 13 63

a thin foil. They then have to be sorted so that the desired charge state can be conveyed to the crystalline sample. This is done by the specially designed magnetic spectrometer LISE (Lignes d'Ions Super Epluchés).

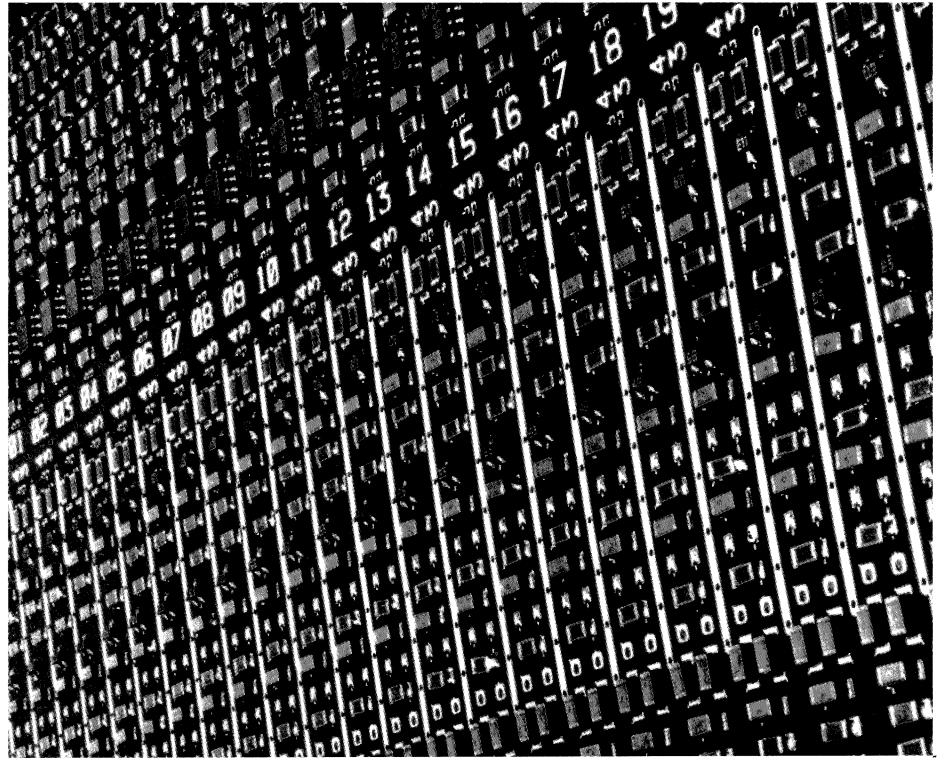
Physicists from Bordeaux, Lyon, Paris, Caen and Strasbourg recently exploited the high quality of secondary ion beams of  $Xe^{54+}$  (xenon atoms stripped of all electrons),  $Xe^{53+}$  (atoms with only one electron, termed 'hydrogen-like') or  $Xe^{52+}$  ('helium-like' atoms) to study how they are channelled in silicon monocrystals. They were able to show that the channelled ions were much less likely than unchannelled ions to capture an electron. For channelled ions, the usual collision method of capture cannot occur and only radiative capture (the inverse of the photoelectric effect) can take place. With still more refined measurements based on coincident X-ray emission it should be possible to demonstrate the effect of the spacing of atoms aligned in rows on all these phenomena and thus acquire a better grasp of the basic mechanisms underlying channelling.

---

## ELECTRONICS

### Surface mount technology gains a foothold

Traditionally, printed circuits with leaded components and hybrid circuits have been the backbone of electronic circuit construction for high energy physics. More recently semi-custom and custom integrated circuit designs have become more widespread, while SMT (surface mount technology)



is increasingly being used by electronics design engineers as another option.

A surface mount circuit differs from a conventional leaded component board in that components are attached to the substrate without the aid of holes or feed-through mechanical hardware. Generally, the components are miniaturized and attached to both sides of the substrate.

The hybrid circuits used for many years in a wide variety of applications usually use surface mount circuits assembled on alumina substrates and with screened and fired resistors, while surface mount circuits prefer FR-4 substrates with chip resistors.

Many industries are implementing surface mount technology designs to improve their products. Compared to leaded printed wire boards, surface mount circuits are generally 40% to 60% smaller, perform better due to their lower

inductance and capacitance, and can be less expensive, depending on choice of components.

In most cases surface mount does not compete with custom or semi-custom IC designs because these designs aim for extreme size reduction. The advantage of surface mount is primarily lower cost for lower quantity production runs and shorter turnaround time for construction of prototype and production quantities.

While hybrids and surface mount circuits have about the same circuit density, the latter have a couple of advantages. Considerably larger circuits can be fabricated in surface mount because the substrate material is not as fragile as with hybrids. Circuits can be prototyped considerably faster. Also, a circuit can be prototyped in-house with surface mount on FR-4 and then later fabricated on alumina substrate.

To understand the advantages

and problems associated with this technology, engineers and scientists at physics laboratories have been exploring a variety of applications, driven mainly by a need for more compact electronics for large experiments.

Surface mount is not expensive. For a modest outlay and in a small space, prototype surface mount circuits can be assembled and surface mount and hybrid circuits repaired, as is done in CERN's Research Divisions.

At CERN, most applications concentrate on thick film hybrids – recent examples include FASTBUS cable segment drivers, and preamplifiers and shaping arrays for the central detectors being built for the LEP electron-positron collider. At Fermilab, both analog and digital surface mount circuit boards ranging from thumbnail to album size have been designed and installed. Examples include several different detector preamplifier boards, a FADC differential line receiver, memories, a front-end input latch and readout shift register board, and multichannel ASD (amplifier shaper discriminator) boards.

When ASDs were manufactured, they were the largest known surface mount board. Assembly was a challenge because of the boards' size and density. However automated equipment rose to the challenge.

As experiments and accelerators grow in complexity and size, the need for smaller, improved circuits will continue to drive future electronic designs. While it is certainly true that custom ICs and hybrid circuits will play important roles, surface mount has taken a foothold in particle physics and can be expected to take on added significance in the future.

*The Percola computer, the brainchild of H. J. Herrmann. The design, assembly and programming of the machine are the work of J.-M. Normand (right), who worked as project leader with M. Hajjar (left), who is writing his thesis.*



## SACLAY PERCOLA in action

Developed by the Institute of Fundamental Research of the French Commissariat à l'énergie atomique (CEA) in collaboration with the Elementary Particle Electronics and Computer Department at the Centre d'études nucléaires in Saclay, where it was built, the new Percola computer is a dedicated device for performing lengthy numerical simulations in statistical mechanics for disordered systems of the percolation type.

The percolation concept allows systems composed of large numbers of possibly interconnected objects to be described statistically. In such a system the number of objects and interconnections govern whether communication over long distances is feasible or not. Between the two categories, there is a precise transition threshold, termed the percolation threshold. The project that the computer is engaged on at present is intended to improve by one order

of magnitude the true values of critical indices characteristic of the behaviour of electrical conductivity at the percolation threshold in a system of random resistors.

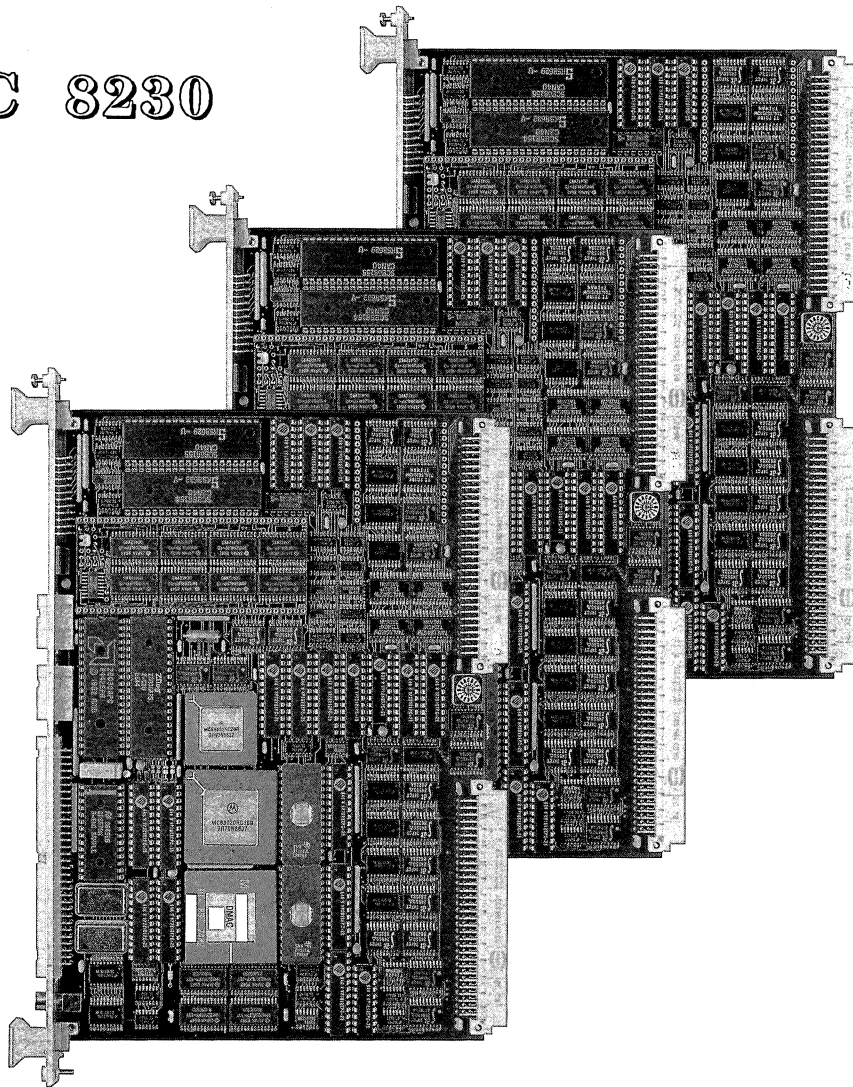
The building of the machine began in January 1985 and it has been in service since May of this year. It is 10 per cent faster than the Cray XMP supercomputer, for at least one class of problems with the same 64 bit floating point precision, for the modest overall cost of less than a million French francs (170 000 dollars).

Although best suited to one particular algorithm, the Percola has all the characteristics of a completely programmable 64-bit floating point computer, and has a potential for future use on other problems. Its architecture is of the pipeline type with internal parallel operation resulting from the fact that its component parts are independent. It can operate either in scalar or in pipeline modes, and its top calculation speed in pipeline mode is 25 Megaflops.

*By J.-M. Normand*

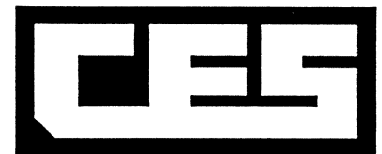
# The Right Stuff in VME

FIC 8230



## Just three facts:

- \* in sheer speed nothing gets close.
- \* runs PSOS/PRISM multiprocessor software over VME interconnect (VMV/VIC), and OS9.
- \* Ex-stock from C.E.S.



**CREATIVE ELECTRONIC SYSTEMS**

For these and our other VME and CAMAC modules, contact us for your nearest distributor.

Headquarters: CES Geneva, Switzerland  
CES-D Germany

Tel: (022) 925 745

Tel: (6055) 4023

Fax: (022) 925 748

Fax: (6055) 82210

Tlx: 421 320

Tlx: 418 4914

North America: CES-USA  
BYTECH Vancouver (BC)  
KSC Lockport (IL)  
I.M. SYSTEMS Tempe (AZ)

Tel: (408) 727-3360

Tel: (604) 980-4131

Tel: (815) 838-0005

Tel: (602) 948-1495

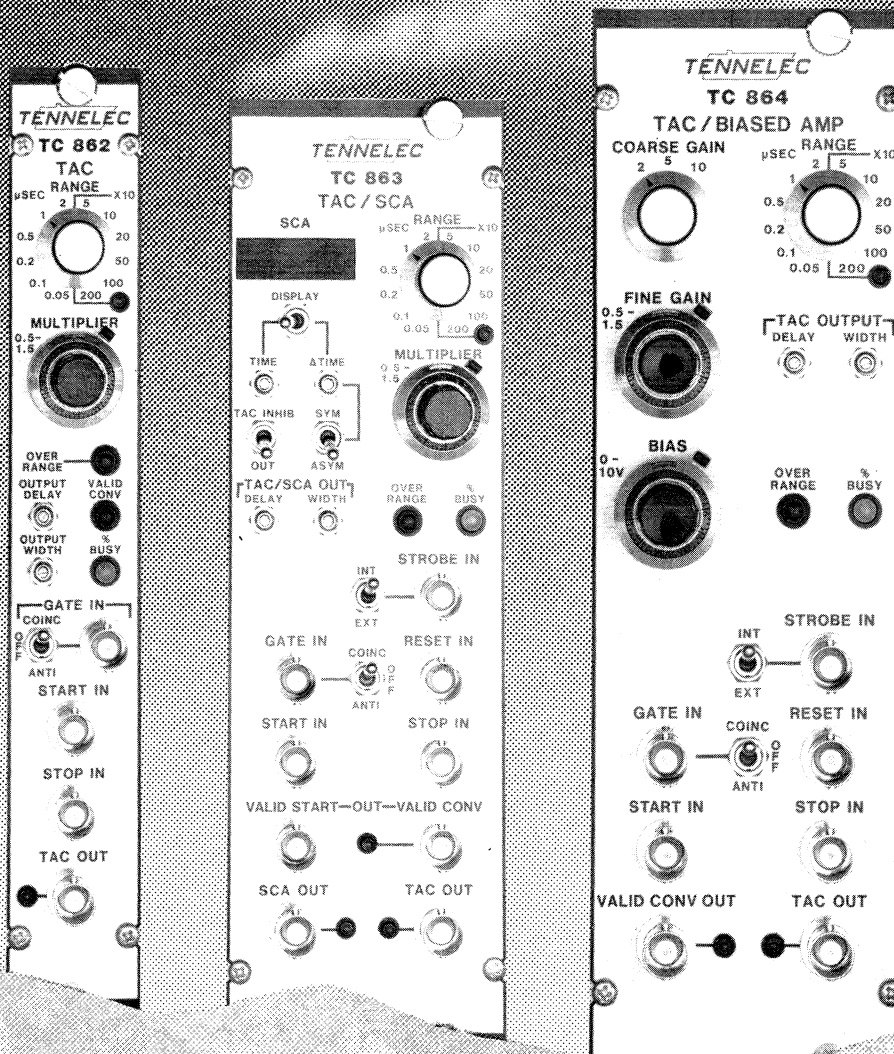
Fax: (604) 879-1133

Fax: (815) 838-4424

Fax: (602) 991-7846

CES Creative Electronic Systems SA 70, Route du Pont-Butin Case Postale 107 CH-1213 Petit-Lancy 1 GENEVA SWITZERLAND

# PEAK PERFORMANCE



## In Time-To- AMPLITUDE- CONVERTERS

new innovations  
from

**TENNELEC**

All three of our NEW Time-to-Amplitude-Converters (TACs) share certain family characteristics. Some of them are:

- **Continuously variable time ranges.**
- **Usable ranges** from 5 ns to 3 ms!
- **Time resolution**  $\leq 0.01\%$  of full scale + 5 ps FWHM.
- **Differential non-linearity**  $\leq \pm 1\%$  from 5 ns (or 2% of full scale, whichever is greater) to 100% of full scale.
- **Ultra-fast ECL input comparator** — the same as used in the industry-standard TC 454 Quad Constant Fraction Discriminator.

- **Adjustable output delay and width** from 0.25-25  $\mu\text{s}$  and 1-10  $\mu\text{s}$  respectively.

- **LED indicators** provide positive visual feedback for experimental set up and verify correct system operation.

To learn more about the individual modules in our Tennelec family, why not write or call us today? Or contact one of our many representatives worldwide. We'll provide you with complete data and prices.

Call us today and your timing will never be better!

TENNELEC, INC.  
601 Oak Ridge Turnpike, P.O. Box 2560  
Oak Ridge, Tennessee 37831-2560 USA  
Telephone (615) 483-8405  
TWX 810-572-1018 FAX (615) 483-5891

**TENNELEC**

TENNELEC, GmbH  
Münchner Strasse 50, D-8025 Unterhaching  
West Germany  
Telefon: 089/6115060 Telex: 5215959 FRIE D

CALL TOLL FREE 800-255-1978

# People and things

Retiring ECFA Chairman Jean Sacton of Brussels (left), seen here with CERN's LEP Project Director Emilio Picasso.

(Photo CERN 274.12.85)

---

## On people

---

Walter Hoogland, Director of the Dutch national NIKHEF Laboratory in Amsterdam, becomes Chairman of the European Committee for Future Accelerators (ECFA) from 1 January 1988, succeeding Jean Sacton of Brussels.

During his term of office, unexpectedly prolonged last year, Jean Sacton has consolidated ECFA as a forum for all sections of the European particle physics community and has done a great deal to ensure that the European voice is heard on the world stage.

A retirement milestone was passed earlier this year by Gordon Munday. After playing a vital role in coordinating the beams supplied by CERN's Proton Synchrotron (PS) with the vagaries of physics requirements, he went on to become Leader of the PS Division from 1973 to 1981, overseeing the evolution of the PS from a proton accelerator in its own right to a beam factory for other machines. In recent years he has put in much unstinting work as Chairman of CERN's Staff Policy Group and as Deputy to Technical Director Giorgio Brianti.

---

## Moves at Fermilab

---

William A. Bardeen has become Head of Fermilab's Theoretical Physics Department, succeeding Chris Quigg who recently moved to the Central Design Group of the proposed US Superconducting Super Collider (SSC) as Deputy Director for Operations.

Jeffrey Appel becomes the Head of Fermilab's Computing Department,



ment, succeeding Hugh Montgomery who moves to the Research Facilities Department and becomes spokesman of experiment E665 in the Tevatron muon beam. Jack Pfister continues as Associate Head of the Computing Department, with primary responsibility for central computing.

▼ The 1987 JINR-CERN School of Physics, held at Varna, Bulgaria, in September was the tenth in the series organized by the Joint Institute for Nuclear Research (JINR, Dubna, USSR) and CERN. Seen here, left to right, at the School are CERN Director General Herwig Schopper, P. K. Markov of Bulgaria's Institute of Nuclear Energy and Nuclear Research, and Ch. Christov, Academician of the Bulgarian Academy of Sciences.



# SCIENTISTS/ ENGINEERS/ COMPUTER PROFESSIONALS

Brookhaven National Laboratory, one of the nation's leading R & D facilities, has a number of challenging opportunities within our National Synchrotron Light Source Department. The NSLS provides synchrotron radiation to a large multi-disciplinary user community. In order to provide the next generation of solid state devices, the XLS Program has been initiated to supply the synchrotron radiation of 10 Å wavelength peak to serve as a source for X-ray micro-lithography. Two additional storage rings, one with room temperature dipoles, the other with superconducting dipoles, plus a full-energy injector linear accelerator are contemplated. These synchrotrons are designed to serve as models for future machines to be built by U.S. industry. The following are brief descriptions of available positions:

## Accelerator Physicists

Accelerator Physicists with experience in the design, construction and operation of particle accelerators, in particular electron storage rings for high energy physics experiments or synchrotron radiation production. Individuals are expected to have capacity for independent work and for coordinating teamwork.

## Electrical Engineers

Requires BS/MS in electrical engineering with a minimum of 5 years' design and development experience. Numerous positions exist requiring knowledge in one of the following areas: high power radiofrequency systems, analogue and digital feedback circuitry, computer control systems, or highly regulated dc power sources.

## Mechanical Engineers

Requires MS in mechanical engineering or equivalent with 5 years' experience. Candidate should have sound knowledge of engineering principles, experience in mechanical design, heat transfer and CAD helpful. Responsibilities will include design/construction/operation of mechanical components and systems for the NSLS storage rings and beam lines.

## Programmer Analysts

Requires MS or Ph.D. with experience in UNIX™, "C", Ethernet TCP/IP network communications. Experience with real-time control and data acquisition very desirable. Will work on an "accelerator expert emulator" control system for the XLS which can automatically operate and troubleshoot the injector and synchrotron with minimal human intervention.

Brookhaven is located on a campus-like 5,000-acre site on eastern Long Island, New York. Our comprehensive benefits package includes medical, dental and retirement plans, relocation allowances, and 24 days' annual vacation. If you would like to be considered for one of these exciting opportunities, please forward your resume, responding to AD #NSLS, including salary history and requirements, to: Nancy L. Sobrito, Brookhaven National Laboratory, Associated Universities, Inc., Personnel-Bldg. 185, Upton, NY 11973, U.S.A.

Equal Opportunity Employer m/f.  
UNIX™ AT&T Bell Laboratories

 **BROOKHAVEN  
NATIONAL LABORATORY**  
ASSOCIATED UNIVERSITIES INC.

# Research Scientists

## Continuous Electron Beam Accelerator Facility (CEBAF)

Located in Newport News, Virginia, CEBAF will be a 4 GeV high-intensity, continuous wave electron accelerator utilizing superconducting RF technology. Its scientific goal is to study the structure of the nuclear many-body system, its quark substructure, and the strong and electroweak interactions governing the behavior of this fundamental form of matter.

A range of full-time positions is open in the Research Division for scientists who can contribute both to the development of state-of-the-art tools for a new generation of physics experiments and to the long range scientific effort. Significant areas of research during the construction phase will include design of high resolution and large acceptance spectrometers, design of instrumentation for experimental equipment and halls, and development of the physics program.

Applicants should submit a curriculum vitae, a list of publications, and three professional references to: **Employment Manager, CEBAF, 12070 Jefferson Avenue, Newport News, VA 23606.**

# CEBAF

An equal opportunity employer M/F/H/V

# APS

## 7-GeV Advanced Photon Source

Argonne National Laboratory plans to construct a 7-GeV Advanced Photon Source, a high-brilliance synchrotron x-ray facility strongly endorsed by national research advisory groups and favorably reviewed by the Department of Energy. Preconstruction R&D and the conceptual design are at an advanced stage. We seek a number of talented R&D scientists.

- **PHYSICISTS**
  - Accelerator design & construction
  - insertion device design
  - synchrotron beamline design
  - x-ray optics.
- **MECHANICAL ENGINEERS**
  - high vacuum systems
  - accelerator and storage ring design
- **ELECTRICAL ENGINEERS**
  - RF power supplies and magnet design
  - accelerator computer control systems
- **CIVIL ENGINEERS**
  - design/construction of research laboratory and accelerator facilities
- **MANAGEMENT/PROJECT ENGINEERS**
  - Management systems
  - Quality control

Candidates both experienced and entry-level should submit resume, detailing relevant experience to:

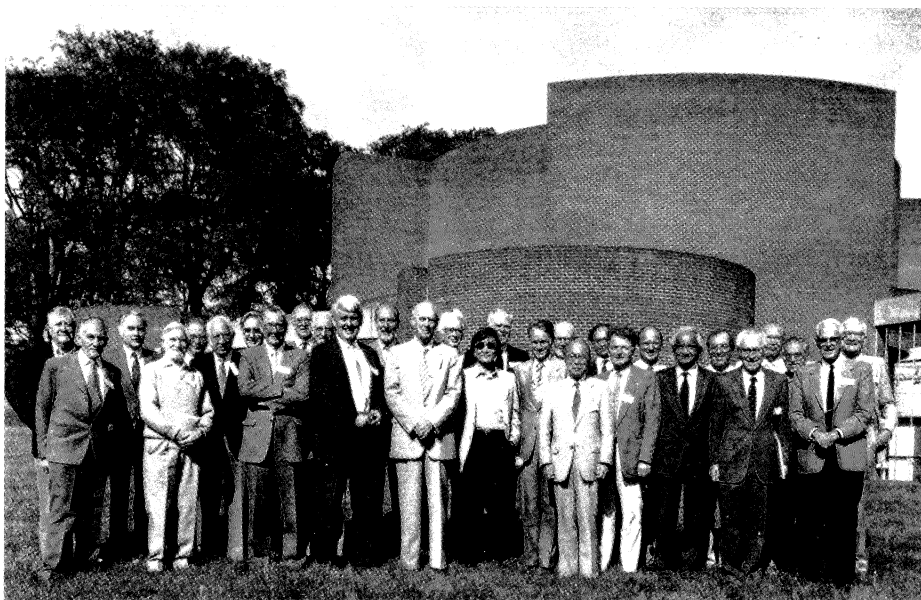


**Mr. R.A. Johns, Appointment Officer**  
Box D-APS-88  
Argonne National Laboratory  
9700 S. Cass Avenue  
Argonne, Illinois 60439

Equal opportunity employer



Participants at the 'Interactions and Structures in Nuclei' meeting held at the University of Sussex, UK, in September to mark the 65th birthday of Denys Wilkinson.



## Interactions and Structures in Nuclei

From 7-9 September distinguished physicists from many parts of the world assembled at the University of Sussex in the UK to honour Sir Denys Wilkinson on his 65th birthday. The stimulating and enjoyable meeting also coincided with his retirement as Vice-Chancellor of the University or, as he put it, his 'emergence from retirement' from physics! (In fact his contributions to nuclear physics have continued unabated during his 11 vice-chancellorian years.)

The programme reflected his broad interests over 40 years in many aspects of nuclear and particle physics, astrophysics and cosmology, and there was also frequent mention of his expertise in the field of bird navigation. The talks covered nuclear models (J. P. Elliott), heavy ion radioactivity (G. A. Jones), electromagnetic properties of nuclei (A. Arima, A. Richter),

mesonic and quark effects (M. Rho, A. Faessler), weak interactions (J. Deutsch, E. Warburton, F. Boehm), elementary particles, cosmology and astrophysics (T. Kibble, J. Barrow, M. Goldhaber, W. Fowler), experimental developments (E. W. Vogt, G. Charpak) and symmetries (E. Henley). After-dinner talks in a lighter vein were given by Fay Ajzenberg-Selove on Denys Wilkinson's involvement with the light nuclei and by Ken Allen and Dave Alburger on his contributions to physics in Cambridge, Oxford and Brookhaven.

At the end of the conference Denys Wilkinson discussed some recent developments in nuclear physics, particularly the question as to whether a quark description for the nucleus is needed.

From Roger Blin-Stoyle

---

## 1988 CERN School of Physics

---

The 1988 CERN School of Physics will be organized jointly by the Nuclear Research Centre 'Demokritos', Athens and CERN. Its basic aim is to teach various aspects of high energy physics, but especially theoretical physics, to young experimental physicists, mainly from the Member States of CERN.

It will be held in Lefkada, Greece, from 18 September to 1 October 1988. Further information from the Organizing Secretary, Miss S. M. Tracy, CERN School of Physics, CERN, 1211 Geneva 23, Switzerland.

---

## Asian superstrings

---

The first and highly successful Asia-Pacific Workshop on High Energy Physics, devoted to Superstrings, Anomalies and Field Theory, was held in Singapore this summer and brought together 60 participants from 12 countries. The opening address was given by Zhou Guangzhao, President of the Chinese Academia Sinica. Invited pedagogical lectures were intended to introduce new subjects from first principles. Talks in this category were: A. P. Balachandran (Wess-Zumino Terms and Quantum Symmetries), C. Itzykson (Conformal and Modular Invariance in 2-dimensional Field Theory) and R. Jackiw (Update on Anomalous Theories). The remaining invited talks covered research results. The second Asia-Pacific Workshop, this time on Collider Physics, is tentatively scheduled for summer 1989 in the People's Republic of China.

# KERNFORSCHUNGSANLAGE JÜLICH

Für das HÖCHSTLEISTUNGSRECHENZENTRUM suchen wir den/die

## ASSISTENTEN/IN DES WISSENSCHAFTLICHEN RATES

– Kennziffer 122/87 –

Die Grossforschungseinrichtungen DESY, GMO und KFA haben zu Beginn des Jahres ein Höchstleistungsrechenzentrum (HLRZ) gegründet, das in Jülich angesiedelt und mit den jeweils leistungsfähigsten Grossrechnern ausgestattet sein wird. Seine Rechnerkapazitäten werden Wissenschaftlern aus Hochschulen, Forschungsinstituten und Wirtschaft zugänglich sein.

Die Verantwortung für das Zentrum und seine wissenschaftliche Ausrichtung wird ein unabhängiger Wissenschaftlicher Rat (WR) wahrnehmen, der sich aus Vertretern von Hochschulen, Forschungsinstituten und Wirtschaft des In- und Auslandes zusammensetzt.

*Aufgabengebiet:* Der/die Assistent/in dieses Wissenschaftlichen Rates soll vielfältige Aufgaben bei Aufbau und Betrieb des Zentrums wahrnehmen:

- Unterstützung des Vorsitzenden des WR in allen Angelegenheiten des Zentrums,
- Vorbereitung der Entscheidungen des WR,
- wissenschaftliche und administrative Betreuung der Forschungsgruppen,
- Koordination des HLRZ mit KFA, GMO und DESY.

*Anforderungen:* Promotion in einem mathematisch-naturwissenschaftlichen oder ingenieurwissenschaftlichen Fach, Erfahrungen in der computergestützten Forschung, breite naturwissenschaftlich/technische Bildung, Interesse an Aufgaben des wissenschaftlichen Managements.

Arbeitsplatz wird das Sekretariat des WR sein mit Sitz innerhalb der KFA Jülich. Die Vergütung erfolgt nach den Bestimmungen des Bundesangestelltentarifvertrages (BAT).

Bitte richten Sie Ihre ausführliche Bewerbung mit den üblichen Unterlagen an den

Vorsitzenden des Wissenschaftlichen Rates des HLRZ

Prof. Dr. H. Rollnik c/o

KERNFORSCHUNGSANLAGE JÜLICH GmbH

Personal- und Verwaltungsabteilung – Personalentwicklung –

Postfach 1913, 5170 Jülich



## UNIVERSITY OF HOUSTON

### RESEARCH IN ACCELERATOR PHYSICS (Theory)

#### Post Doctoral Research Associate

An opening exists at the University of Houston for a Post Doctoral Research Associate. Recent Ph.D.'s (0-3 years or equivalent experience) in high energy, nuclear or plasma physics with strong background in computer usage are encouraged to apply.

The work will be in nonlinear beam dynamics, beam-beam interaction in storage rings, high-intensity linacs and other theoretical problems in accelerator physics.

This person will initially work at the Texas Accelerator Center (30 miles north of Houston) with other physicists and engineers from the University of Houston, Texas A & M University, Rice University and University of Texas, Austin.

Applicants should send curriculum vitae with names of three references to:

**Sho Ohnuma,  
Physics Department,  
University of Houston,  
University Park,  
4800 Calhoun Road,  
Houston, TX 77004.**

*The University of Houston is an Equal Opportunity / Affirmative Action Employer.*

## VANDERBILT UNIVERSITY

### Director

#### Free Electron Laser Center for Biomedical and Materials Research

Vanderbilt University invites applications for the position of Director, Free Electron Laser Center for Biomedical and Materials Research. The Center is a broadly based interdisciplinary collaboration including researchers from physics, molecular biology, the clinical and biomedical sciences, and materials science. The Center is funded for the construction of a broadly tunable, ultra-short-pulse FEL, and for research on thermal and non-thermal interactions of laser light with matter.

The Director will be expected to lead the construction, operation and future development of the free-electron laser; to carry on a vigorous program of research either in FEL physics / engineering or in the scientific fields represented in the Center's program; to develop long-range external funding for the operation of the FEL Center; and to fulfill appropriate academic duties of teaching, supervision of graduate students and university service. The appointment is a regular faculty position with rank, salary and home department all to be determined by the experience and interest of the successful candidate.

The selection criteria to be applied in evaluating candidates include: overall scientific excellence; experience in the construction, operation and development of free-electron lasers, storage ring radiation sources, large laser systems, or accelerators; demonstrated ability to attract significant funding for research; and demonstrated ability to manage major experimental research projects.

The deadline for applications is January 15, 1988; the University desires to fill the position no later than the fall semester, 1988. Interested persons should send a curriculum vitae, including the names of at least four references, to:

**Professor Norman H. Tolk, Chair  
FEL Director Search Committee  
Department of Physics and Astronomy  
Vanderbilt University, Nashville, TN 37235  
(615) 322-6438**

*Vanderbilt University is an equal opportunity, affirmative action employer*



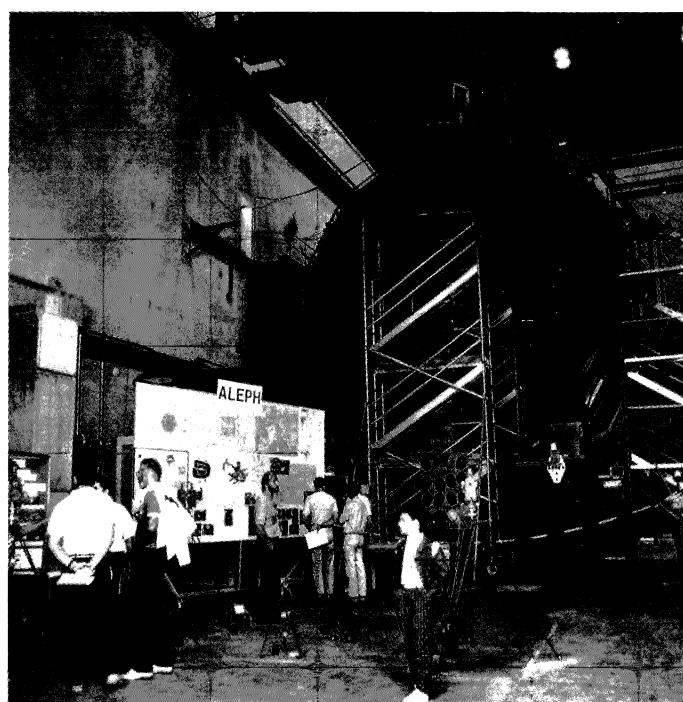
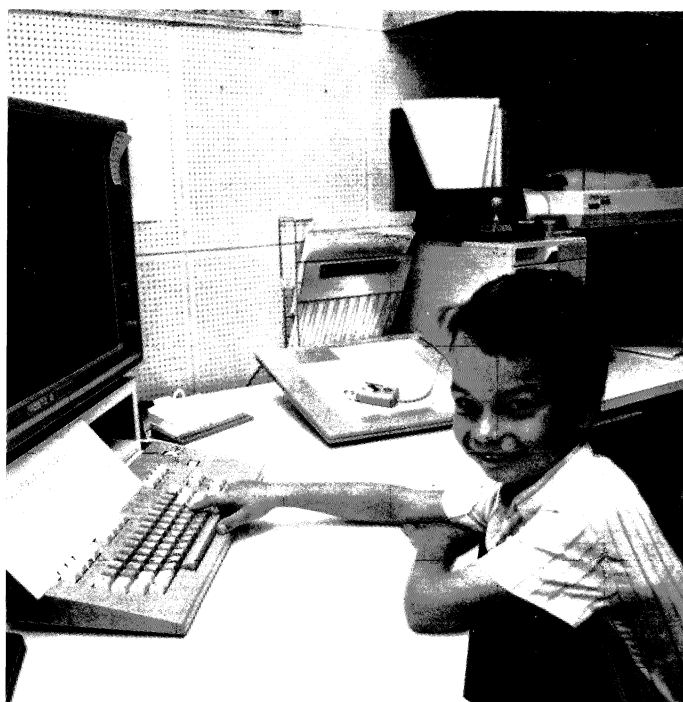
## Electronic Mail

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

*COURIER@CERNVM*

---

*CERN's Open Day in September was a great success. Among other things, visitors could ride the monorail for the new LEP electron-positron collider (left), try their hand at computing, or be dwarfed by the magnet assembly for the ALEPH experiment at LEP.*



## Faculty Positions

# Experimental High Energy Physics Space Physics Experimental Nuclear Physics

The University of Kansas invites applications for three tenure-track positions at the Assistant or Associate Professor level in the Department of Physics and Astronomy. Individuals having strong research interests, experience, and capabilities in the experimental areas of particle, nuclear, and space physics are sought.

Two positions are tenable in fall, 1988 and one in fall, 1989. Consideration of applicants will begin on January 15, 1988 and continue until these positions have been filled.

Requirements are: PhD in physics and demonstrated research achievement in one of the specified areas. Duties include the conduct and supervision of research as well as graduate and undergraduate teaching. The particle physics group is currently involved in the ARGUS collaboration at DESY as well as research at Fermilab, and is supported by the NSF. The space physics program is currently involved in NASA flight projects for Voyager, Galileo, and Ulysses as well as solar terrestrial research funded by the NSF. The nuclear physics program is currently involved in heavy-ion accelerator physics and is funded by the DOE. Salary range is from \$32,000 to \$45,000 for the 9-month academic year; starting salary and rank depend on qualifications and experience.

Applications should be sent to:

**Professor J.P. Davidson,  
Chairman  
Department of Physics and Astronomy,  
University of Kansas,  
Lawrence, Kansas, 66045.**

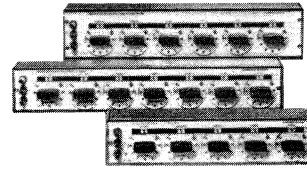
and should include a curriculum vitae, a statement of professional plans and the names of three references.

*The University of Kansas is an Affirmative Action/Equal Opportunity Employer. Applications are encouraged from all qualified people regardless of race, religion, color, sex, disability, veteran status, national origin, age or ancestry.*

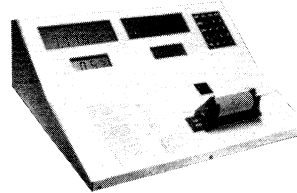
QUALITY FROM

DANBRIDGE  
DENMARK

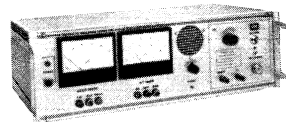
If reliability is important to you...



Decade Resistors  
Decade Attenuators  
Decade Capacitors  
Decade Inductor



Component Testers



Automatic CLR Bridges

Non-destructive  
High Voltage  
Insulation Testers

**DANBRIDGE A/S, Denmark, has specialized in high quality component test equipment and R-C-L decade boxes since 1949.**

Please ask for detailed documentation or call for technical information! We are the exclusive Swiss representative/distributor for DANBRIDGE.

Elektronische Instrumente für die Mess-, Registrier- und Datentechnik

**ERPATEC AG**

8965 Berikon, Tel. 057/33 87 87, Tx. 828 020 erpa ch, Telefax 057/33 00 15

*In the Electron Tubes Departments of our "RF Systems and Components" Division we manufacture and develop the key components for the advanced equipment to be used in the communications technology, the medical engineering (radiotherapy) and the power engineering of the next millennium. In order to meet the high demands of the expanding market for these products, we are seeking two qualified creative persons who would like to participate in this important development.*

*We require a*

## **RF Engineer or Physicist**

*for each of the following posts:*

### **Project leader for the development of linear accelerators for radiotherapy**

*To a large extent you will be independently responsible for the:*

- calculation
- design and
- testing

*associated with the development of the components for a new generation of linear accelerators. An important part of this work will be building up and being in charge of a micro-wave laboratory. Assistance is available from specialists in medical engineering and electron tube technology.*

**We expect** a university education in physics or electrical engineering (specialised in micro-wave engineering) with several years experience in the RF engineering field, preferably with RF accelerators.

### **Project leader for the development of high-power micro-wave transmitter tubes**

*In cooperation with the Swiss Federal Institute of Technology in Lausanne we are working on the development of gyrotrons and gyroklystrons for ECRH respectively LHH, that is for methods of heating plasma for nuclear fusion.*

*In this connection your duties would be*

- leading a team of specialists for calculation, design and manufacture,
- participating in experiments and prototype testing in close cooperation with the scientists of the Swiss Federal Institute of Technology in Lausanne,
- presentation of our activities and following the worldwide activities of others at conferences.

**We expect** a university education in physics or electrical engineering. Sound knowledge in the fields of electron beam generation and RF technology is desirable. The ability to work in a team

*is essential. The successful candidate must be prepared to travel frequently within Switzerland and have a good working knowledge of German and English.*

**We offer** the advantages of working in a large multi-national company with good professional prospects and opportunities.

**Location** Baden, Switzerland.

*For an initial contact or more information please contact Mr. Liver at the personal department PN-A or call 056 29 25 28 (ref. no. 233).*

**BBC**  
BROWN BOVERI

BBC Brown Boveri AG  
CH-Turgi / Schweiz

# SF6 HIGH VOLTAGE D.C. GENERATOR\*

## PERFORMANCE REQUIRED-OBTAINED

### 1 - Voltage regulation mode

- a) Adjustment of output voltage  
continuous from 0,2 to 160 kV  
- from less than 0,1 to 180 kV  
accuracy better than  $\pm 100$  V  
- better than  $\pm 50$  V
- b) Response time constant  
less than 50 ms for a step  
of +16 kV (10%)  
- less than 15 ms
- c) Line regulation  
better than  $\pm 2 \times 10^{-4}$  for a  
 $\pm 10\%$  variation of mains voltage  
- better than  $\pm 1 \times 10^{-4}$
- d) Voltage ripple less than  
100 V peak-to-peak at 50% load  
- less than 80 V peak-to-peak-
- e) Temperature coefficient  
less than  $1 \times 10^{-4}/^{\circ}\text{C}$   
- less than  $1 \times 10^{-4}/^{\circ}\text{C}$

### 2 - Current regulation mode

- a) Continuous adjustment of output  
current, in three ranges:
  - 1 - 0 to 0,2 mA, accuracy  $\pm 2 \mu\text{A}$   
- less than  $\pm 1,5 \mu\text{A}$
  - 2 - 0 to 2 mA, accuracy  $\pm 5 \mu\text{A}$   
- less than  $\pm 3 \mu\text{A}$
  - 3 - 0 to 15 mA, accuracy  $\pm 50 \mu\text{A}$   
- less than  $\pm 20 \mu\text{A}$
- d) Current stability  
Drift less than  $\pm 1 \times 10^{-2}$  after 8 h  
from 10% to 100% of nominal current  
- less than  $\pm 0,5 \times 10^{-2}$



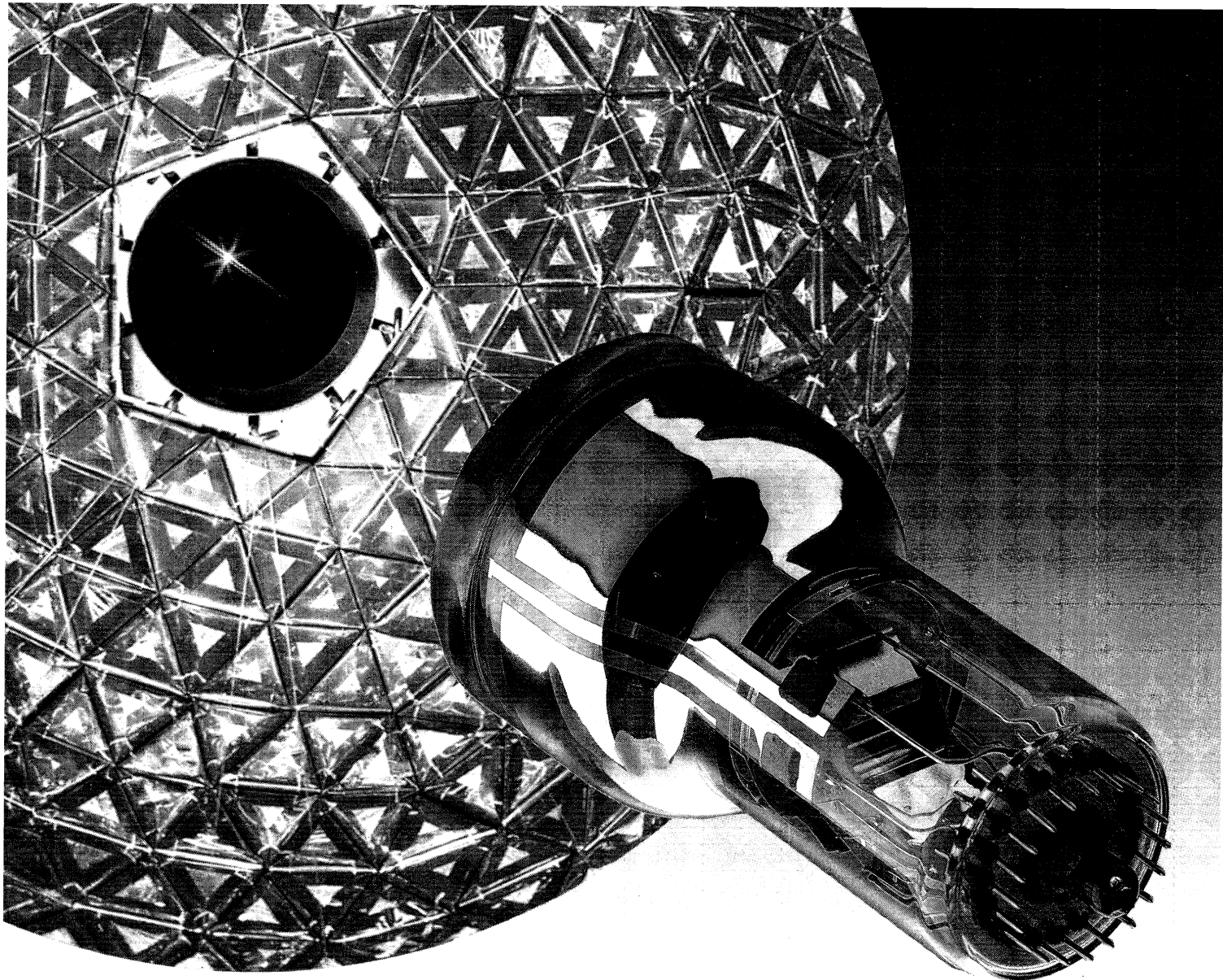
\* 39 UNITS ORDERED BY CERN FOR LEP EXPERIMENT

# PASSONI & VILLA

IMPULSE GENERATORS • D.C. STATIC GENERATORS  
TEST TRANSFORMERS • RESONANT TEST SYSTEMS  
STANDARD CAPACITORS • DIVIDERS, SHUNTS AND MEASURING EQUIPMENT  
BUSHINGS UP TO 1200 kV • CAPACITIVE VOLTAGE TRANSFORMERS  
POWER FACTOR CAPACITORS • GRADING CAPACITORS  
CAPACITORS FOR SPECIAL APPLICATIONS

**PASSONI & VILLA**  
**EXPERTS IN HIGH VOLTAGE**

V.le Suzzani, 229 - 20162 Milano (Italy)  
Tel. (02) 6421451 (r.a.) - 6473821 (r.a.)  
Telex 330420 PASVIL I - Telefax (02) 6423422 - Telegr. PASVILLA MILANO



# CRYSTAL BALLS?

## XP3462!

The unique answer to crystal ball requirements. Developed for KfK's neutrino experiment, the XP3462 offers a combination of rise time and energy resolution unequalled by other 3" PMTs.

$t_r$  = 3 ns, anode pulse rise time for delta-function light pulse  
 $R_E$  = 10% for  $^{57}\text{Co}$  and 3" x 3" NaI (Tl) scintillator  
 $G$  =  $10^6$  at 1500 V  
 Pulse linearity within 2% up to 100 mA.

*Plastic ball photo courtesy of LBL/GSI*

## We've set the standard for over 20 years

Philips Electronic Components and Materials Division, 5600 MD Eindhoven, The Netherlands. Telex 35000 phtc nl  
 In the U.S.A.: Amperex Electronics Corporation, Hicksville NY 11802, (516) 931-6200

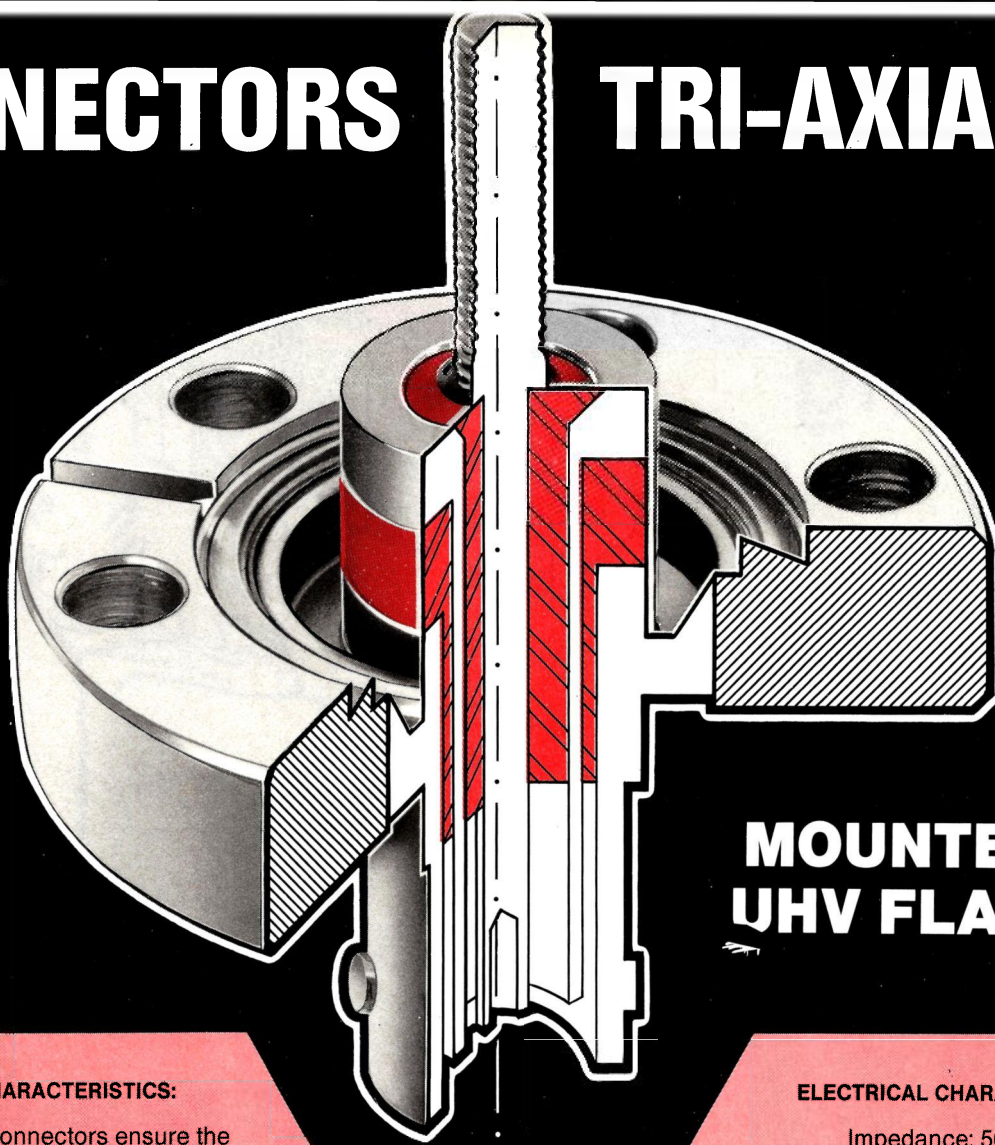


Electronic  
 components  
 and materials

# PHILIPS

# CONNECTORS

# TRI-AXIAL BNC



**MOUNTED ON  
UHV FLANGES**

#### GENERAL CHARACTERISTICS:

These connectors ensure the electrical continuity of:

- The central connector,
- The first shield to ground,
  - The second shield (insulated from the first) joined to the body of the connector.

A glass moulding insulates them from each other.

#### ELECTRICAL CHARACTERISTICS:

Impedance: 50  $\Omega$

Working frequency: 10 GHz<sub>3</sub>

Test voltage:

- Between connector and inner shield: 1 500 V.DC.
- Between the first and second shield: 2 500 V.DC.

Working temperature

(when not connected):

— 55° to + 350 °C.

**Insulation between  
conductor and inner shield**

**10<sup>12</sup>  $\Omega$  at 1 000 V.DC**

Coupling is by bayonet.

Proofing > 1.10<sup>-9</sup> Atm.cm<sup>3</sup>/s

**GLASS-METAL WELDING/ALUMINA-METAL BRAZING/GLASSWARE**

 **VERELEC**

Zone d'activités de la Plaine Haute  
17 à 21, rue des Entrepreneurs  
91560 CROSNE - FRANCE  
Tél. : 16 (1) 69 83 89 00 (5 lignes groupées)  
Télex : 603 862 F

NUCLEAR • MILITARY • VACUUM • HIGH VACUUM • HIGH PRESSURE • LASERS

CRYOGENY • AIR AND SPACE • ASTRONOMY • ALTERNATIVE ENERGY

Are high-density  
NIMs  
leaving  
you  
powerless?



**BLACK MAX™**

Rescues you  
with twice\*  
the power!

Ask about the  
**BLACK MAX™** Power Supply.  
Contact your sales representative,  
or in the USA, call the HOTLINE,

**800-251-9750**

\* DC power:

**12 amps at  $\pm 6$  volts**

4 amps at  $\pm 12$  volts

2 amps at  $\pm 24$  volts



**EG&G ORTEC**

100 Midland Road, Oak Ridge, TN 37831-0895 U.S.A.  
Telephone: (615) 482-4411 Telex: 499-3119 EGG OKRE UI



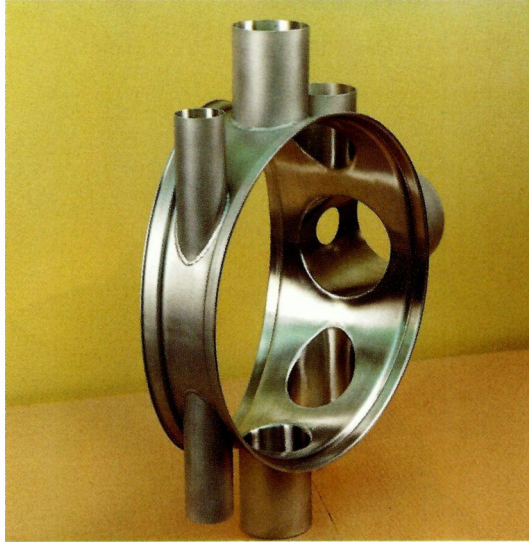
**Special Equipment for Vacuum  
and Physics Research**



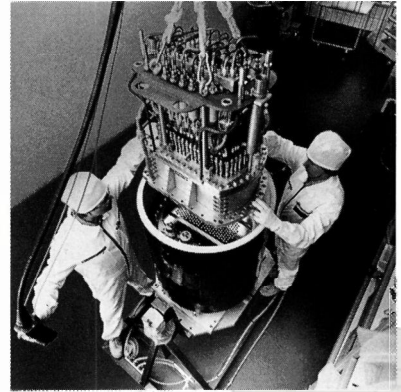
# Nuclear fusion

- Neutral gas injectors for plasma heating
- Gas inlet systems
- Antenna vacuum systems
- Probe manipulators and transfer systems for plasma diagnostics
- Detection systems for soft X-rays
- Vacuum vessels for plasma confinement
- Crystal spectrometers

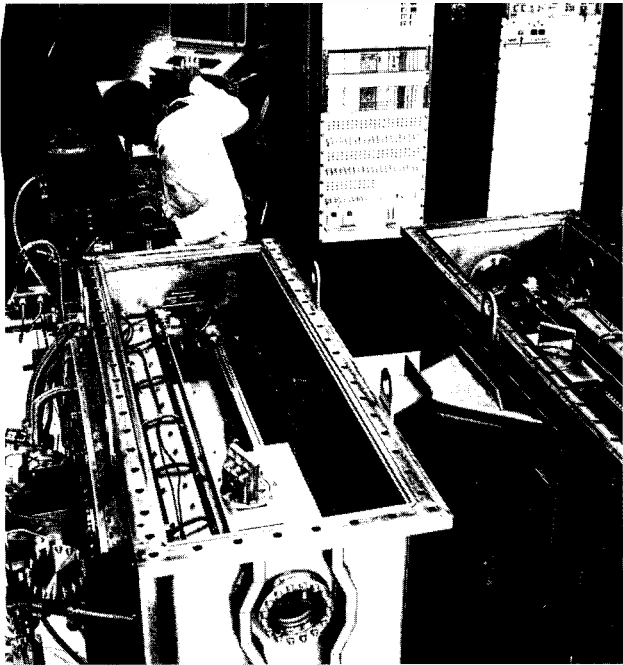
Flange section for the toroidal vacuum vessel of the COM-PASS tokamak. A total of 26 segments of different shapes, made of austenitic stainless steel, are welded together to form a torus with an major diameter of 1114 mm.



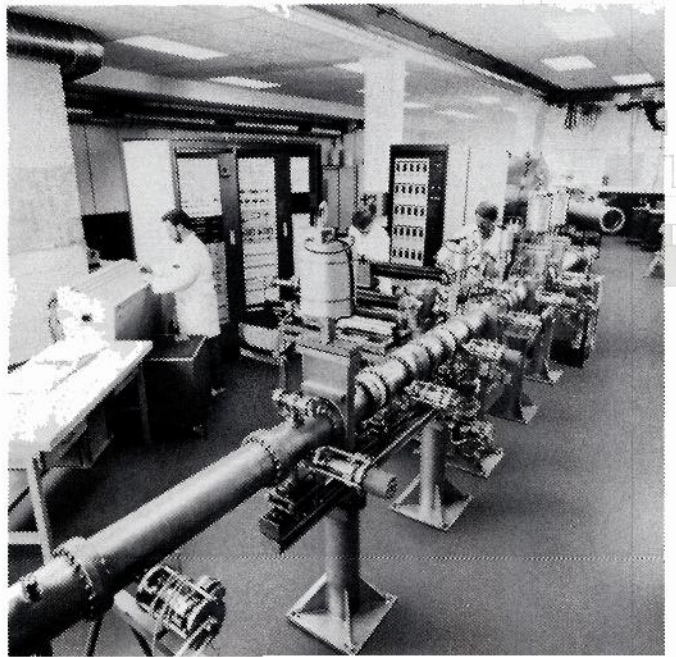
P.I.N.I. (Plug In Neutral Injector). The ion source generates a hydrogen ion beam of up to 80 A which, after neutralization, is used for neutral gas injection heating in nuclear fusion experiments.



Surface analysis of probes from nuclear fusion experiments by atomic and nuclear spectroscopy. In a compact UHV multichamber system probes are transferred to the analysis stations by precision driving and indexing systems.



Double crystal spectrometer for the detection of plasma impurities in nuclear fusion experiments. The characteristic X-radiation can be analyzed over a broad spectral range with a repetition rate of about 1 Hz, due to simultaneous rotation and translation of the two crystals.



# BALZERS

Please contact me

Please let me have your verbal/written advice on the following problem

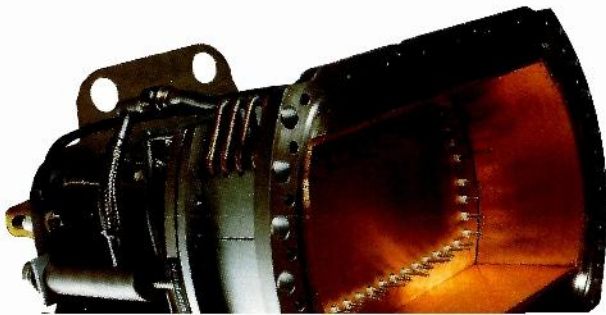
---

---

---

---

Please enter your address overleaf



# BALZERS

Please contact me

Please let me have your verbal/written advice on the following problem

---

---

---

---

Please enter your address overleaf



## You are looking for

- a qualified partner from concept design phase to completion
- the solution of a problem in the field of complex UHV systems for technical/scientific applications
- optimum design of your project with maximum cost benefit

## We offer

- well-founded scientific and technical knowledge as a result of our cooperation with universities and research centres, as well as continuous education and training throughout the company.
- continuous cooperation with our customers in the field of research and development
- experience from many years of worldwide activity in all applications of vacuum technology

## You will find

- us a reliable partner for the professional handling of your projects, from the design phase to the final acceptance at the place of installation
- below some examples of our activities in the fields of nuclear fusion, generation and use of synchrotron radiation, as well as accelerators and storage rings.

Please send these cards in an envelope!



[Grid for Name]

Name

[Grid for Title/Mail Stop]

Title/Mail Stop

[Grid for Company]

Company

[Grid for Street]

Street

[Grid for City/State/Zip]

City/State/Zip

[Grid for Telephone]

Telephone

from:

[Grid for Name]

Name

[Grid for Title/Mail Stop]

Title/Mail Stop

[Grid for Company]

Company

[Grid for Street]

Street

[Grid for City/State/Zip]

City/State/Zip

[Grid for Telephone]

Telephone

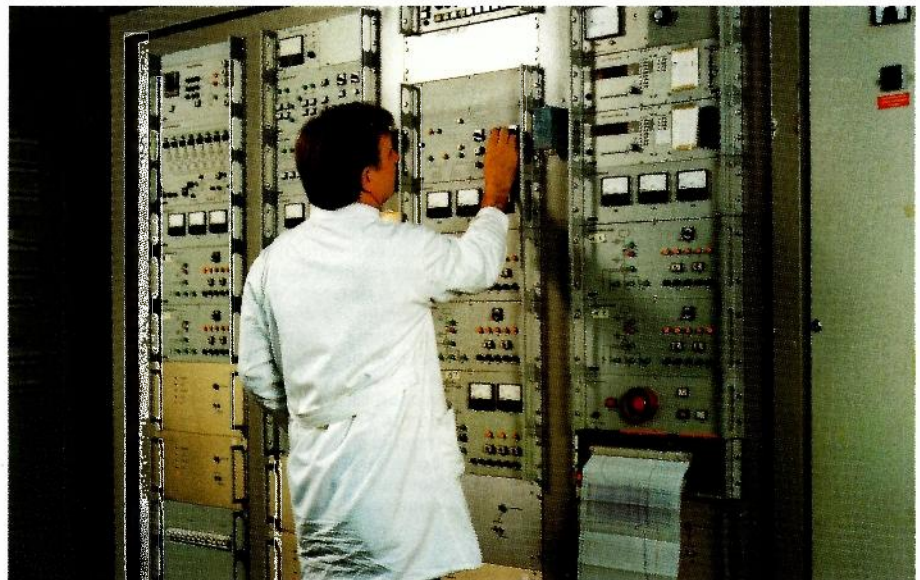
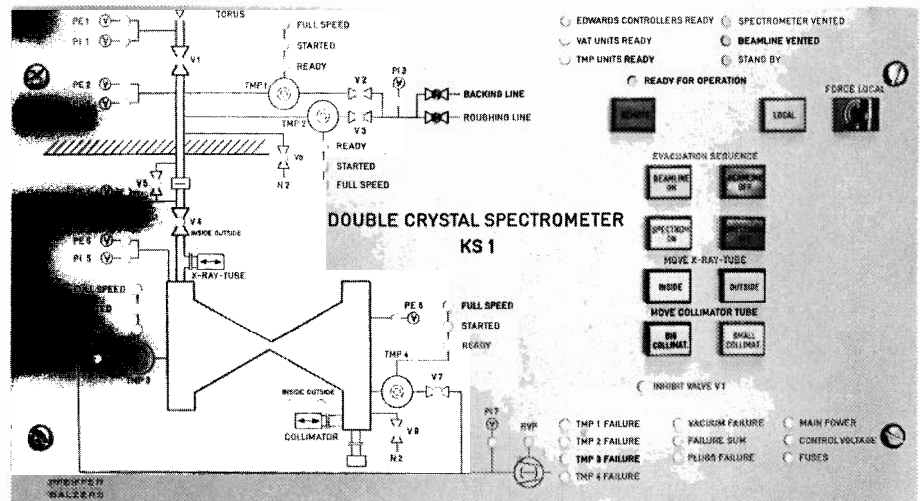
om:

**Arthur Pfeiffer**  
**Vakuumtechnik Wetzlar GmbH**  
Abt. GWE  
Postfach 1280  
**D-6334 Asslar**

# Process controls



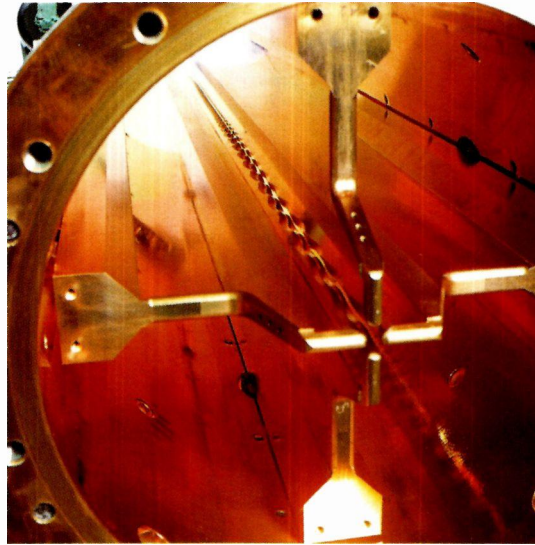
The combination of vacuum sequences with predefined process cycles is provided by programmable logic controllers (PLC). Controllers with integrated processors are used for complex control and positioning tasks, such as correcting the motion sequence of a crystal spectrometer with all necessary correction calculations and the interface to a main computer. These controllers represent intelligent subsystems which can be combined with other control systems via standard interfaces.



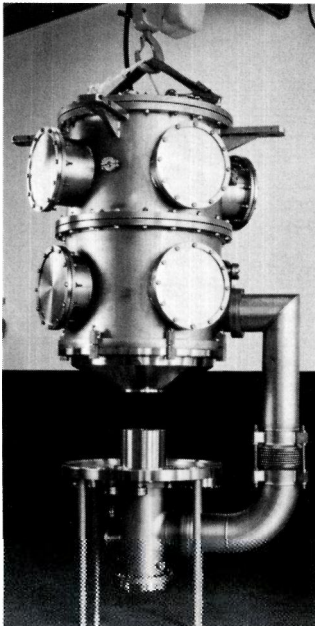
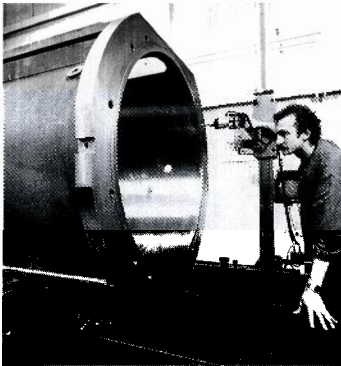
## Accelerators and storage rings

- Cryostat systems for superconducting cavities
- RF quadrupole accelerators
- Alvarez structure as a linear accelerator for protons
- UHV dipole and quadrupole chambers for beam steering and beam diagnostics
- Electrostatic septum chambers
- Gas jet targets for scattering experiments

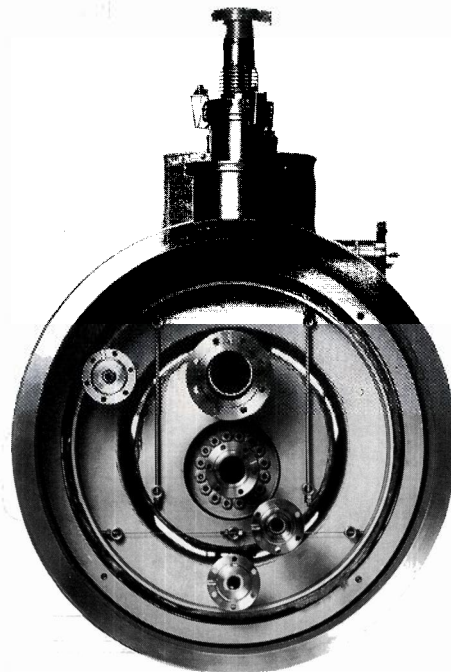
RFQ linear accelerator. The accelerator structure of this Radio Frequency Quadrupole consists of 4 vanes with wavelike pole tip design. These vanes are manufactured on CNC machines with an accuracy of  $\pm 3$  microns.



Dimensional inspection of an approx. 3,5m long module of an Alvarez structure on an X-Y-Z measuring machine. Ten of these modules form the three resonator tanks of the proton linear accelerator for HERA at DESY.



Gas jet target for the CELSIUS storage ring in Uppsala. A hydrogen cluster beam with a target thickness of up to  $10^{14}$  atoms/cm<sup>2</sup> can be produced using a two stage cooling system for the nozzle and skimmer together with three differential pumping stages. A special cryo pump is used as the beam dump. The equipment is shown without scattering chamber and without vacuum pumps.



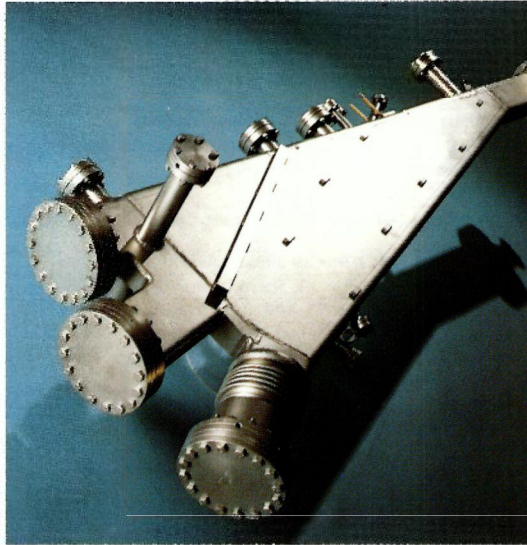
View into a 1,8 K cryostat for a superconducting electron-recyclotron accelerator. Superfluid helium is used for cooling. The heat dissipation of a cryostat module housing a 20-cell cavity resonator

is less than 3 watts: (The schematic diagram is shown in the background).

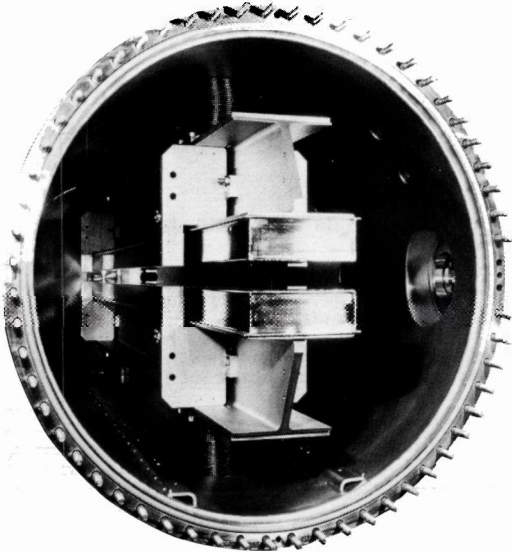
# Synchrotron radiation

- Normal incidence monochromators with integrated grating change mechanisms
- Toroidal grating monochromators for different wavelength ranges
- Irradiation plant for X-ray lithography
- Wiggler/Undulator with encapsulated permanent magnets in ultrahigh vacuum

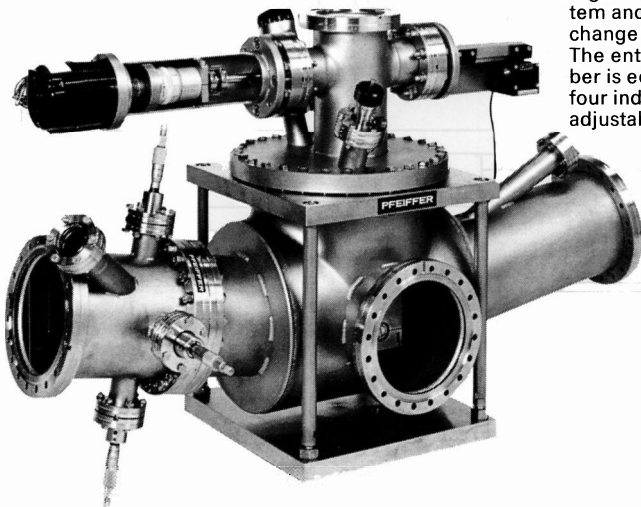
Dipole chamber for Synchrotron radiation at the BESSY I storage ring



Wigglers/Undulators are used on modern synchrotron radiation sources to increase the photon flux. Inherent is high precision, both of mechanics and of the control system, as well as UHV compatibility, which is needed for storage rings.

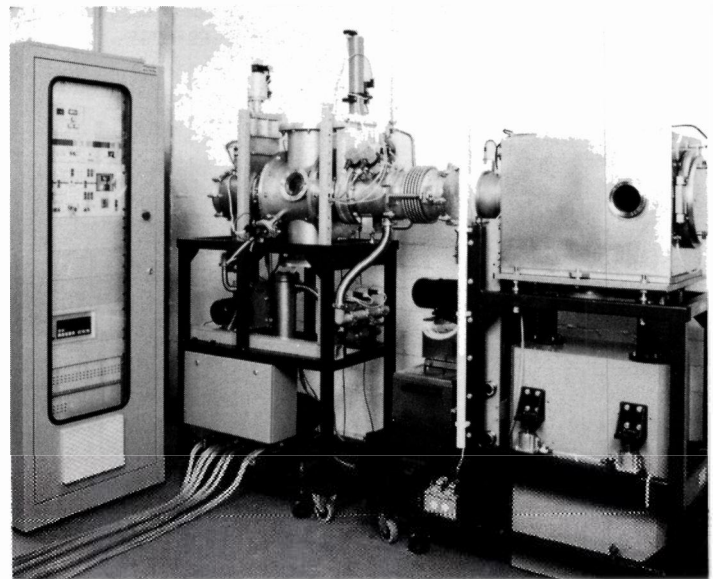


Toroidal grating monochromator with integrated drive system and grating change mechanism. The entrance chamber is equipped with four independently adjustable slit blades.



Irradiation plant for X-ray lithographic production of microstructures. In addition to mechanical accuracy, the required repositioning

accuracy of the mask is obtained by controlling the temperature inside the chamber to an accuracy of 0,1°C.



## Sales and Service Companies

	Addresses	Telephone	Telex
Belgium/Luxembourg	Balzers, Excelsiorlaan 7, B-1930 Zaventem	(02) 720 48 38	25 145
BRD	Balzers Hochvakuum GmbH, Siemensstrasse 11, D-6200 Wiesbaden-Nordenstadt	(06122) 7060	41 82 531
France	Balzers S.A., 47, rue d'Arthelon, F-92190 Meudon	(1) 45 34 75 44	26 08 64
Great Britain	Balzers High Vacuum Limited, Northbridge Road, Berkhamsted/Herts, HP4 1EN	(04427) 2181	82 209
Italia	Balzers S.p.A., Tecnica dell'Alto Vuoto, Via Favretto 13, I-20146 Milano	(02) 42 29 241	33 22 42
Nederland	Balzers, Savannahweg 49, NL-3542 AW Utrecht	(030) 44 25 45	47 389
Österreich	Balzers Hochvakuum Ges.m.b.H., Bischof-Faber-Platz 14, A-1180 Wien	(0222) 47 23 66	114 676
Sverige/Danmark	Nordiska Balzers AB, Lilla Verkstadsgaten 2, Box 10272, S-434 01 Kungälv	(0300) 14045	21 229
Schweiz/Suisse	Balzers Hochvakuum AG, Stampfenbachstrasse 48, Postfach 186, CH-8035 Zürich	(01) 363 32 66	52 278
U.S.A. & Canada	Balzers, 8 Sagamore Park Road, Hudson, NH 03051	(603) 889-6888	710 228 7431

## Representatives

Argentina	ARO S.A., Casilla de Correo 4890, 1000 Buenos Aires	33-3572	17 268
Australia	C. Berney & Co. Pty. Ltd., Balzers High Vacuum Equipment, 8th Floor, 159 Kent Street, Sydney, N.S.W. 2000	27 61 53	72 330
Brasil	Micronal S.A., Rua João Rodrigues Machado, 25, Santo Amaro, 04707 São Paulo-SP	241-3011	112 3817
Chile	Bermat S.A., Lota 2250, Casilla 9781, Correo 1, Santiago de Chile	231 88 77	340 341
Colombia	Arotec Colombiana S.A., Carrera 15 No. 38-23, Apartado Aéreo 050862 (P.O.Box), Bogota D. E.	2 455 970	42142
España	REGO Y Cia S.A., San Romualdo 26, E-28037 Madrid	(01) 204 5340	23140
Hellas	Dr. C.J. Vamvacas, P.O. Box 3115, GR-10210 Athens	67 23 405	2142 90
India	Toshniwal Bros. (HYD) Pvt. Ltd., 4th Floor, Moghul Court, Deccan Towers Basheerbagh, Hyderabad 500 001	23 7114	155-6618
Israel	Eastronics Ltd., 11 Rozanis Street, P.O. Box 39 300, Tel Aviv 61 392	47 51 51	33-638
Japan	Hakuto Co. Ltd., Balzers Division, P.O. Box 25, Tokyo Central 100-91	34 12 611	22 912
Mexico	Maquinaria y Accesorios S.A., Cincinnati 81-402, 03720 Mexico-DF	563 56 56	017-74 217
Norge	Instruments & Systems AS, P.O. Box 53, Leirdal, N-1008 Oslo 10	(02) 32 00 85	77 660
Peru	Ing. Erich Brammertz S.C.R.L., Avenida José Pardo 182, Oficina 905, Apartado 180, PE-18-0173 Miraflores	45 81 78	25 739
Portugal	Cassel, Indústrias Electrónicas e Mecânicas, S.A.R.L., Apartado 1100, P-1002 Lisboa Codex	97 65 51	12702
Republic of Korea	Keehwa Enterprise Corp., 44-27 Yeowido-Dong, Yeongdungpo-Ku, P.O. Box 8719, Seoul	783-7396/8	28183
Rep. of South Africa	Balzers Division, Labotec (Pty.) Ltd., 51 D Richard Road, Industria North, P.O. Box 43161, Industria 2042	(673) 4140	9-45 1117
Singapore	Balzers Representative Office, 200 Cantonment Road, Unit 06-06 Southpoint, Singapore 0208	225 52 36	42 744
Suomi	Instrumentarium Elektroniikka, P.O. Box 64, SF-02631 Espoo 63	52 81	12 44 26
Taiwan	Heli-Ocean International Co. Ltd., Balzers Optical and Components Division, Rm. 3, 13th Floor, No. 432, Section 1, Keelung Road, Taipei	(02) 709-1193	25 939
	Ever-Island Corporation, Balzers Electronics Division, 3F.-3, No. 171, Section 2 Chan An E. Road, Taipei	(02) 77 12 214	13 343
Venezuela	Secotec S.A., Apartado 3452, Caracas 1010-A	573 02 70	21 652

## Product lines

### Components for the production, measurement, and regulation of medium, high and ultra high vacuum

Rotary vane vacuum, roots vacuum, oil diffusion, turbomolecular sublimation, and cryo pumps; line construction elements, feed-throughs, and valves with standard KF, ISO, and CF flanges; total and partial pressure measurement and regulation instruments, vacuum monitors, leak detection devices

### Mass spectrometer systems

for the analysis of gases, liquids and solids as well as for process monitoring

### Plants for vacuum metallurgy

Melting and casting plants; precision casting plants; heat treatment plants, inductively heated; heat treatment furnaces, resistance heated with metal and graphite elements; special plants

### Vacuum systems for thin film technology

Evaporation and sputtering systems for optical coatings, for microelectronics and semiconductor technology, for metal coating plastic, for surface treatments; evaporation materials, evaporation sources, and sputtering targets

### Thin film products

Laser coatings and components, infrared coatings, interference filters, antireflection coatings, color filters and color separation filters, components for light-heat separation, electrically conductive transparent coatings, replicated optics, etc.

### Ophthalmic lens coatings

Coated substrates for the production of chrome masks and hybrid circuits; resistor chips

Wear-resistant and corrosion-proof decorative coatings

### Preparation systems and accessories for electron microscopy

Evaporation and sputtering systems, freeze-etching and ion etching systems, auxiliary equipment and laboratory utensils

### Special systems – Special processes – Large scale experimental systems for physics

Space simulation chambers, automatic leak detection devices, components for acceleration and storage rings, separation nozzle test systems for isotope separation systems, etc.

### Project engineering

Design, planning, and construction of complete turn-key production sites for manufacturing thin film products and vacuum components, with full production and quality guarantees

# BALZERS

Balzers Aktiengesellschaft  
FL-9496 Balzers  
Fürstentum Liechtenstein  
Tel (075) 4 41 11  
Telex 889 788 bva fl  
Telefax (075) 4 44 13

Arthur Pfeiffer  
Vakuumtechnik Wetzlar GmbH  
Postfach 1280  
D-6334 Asslar  
Tel (06441) 802-0  
Telex 48 38 69  
Fax (06441) 802-202

Balzers  
8 Sagamore Park Road  
Hudson, NH 03051  
Tel (603) 889-6888  
TWX 710 228 7431

Products of A. Pfeiffer GmbH, Asslar  
Specifications subject to change without notice