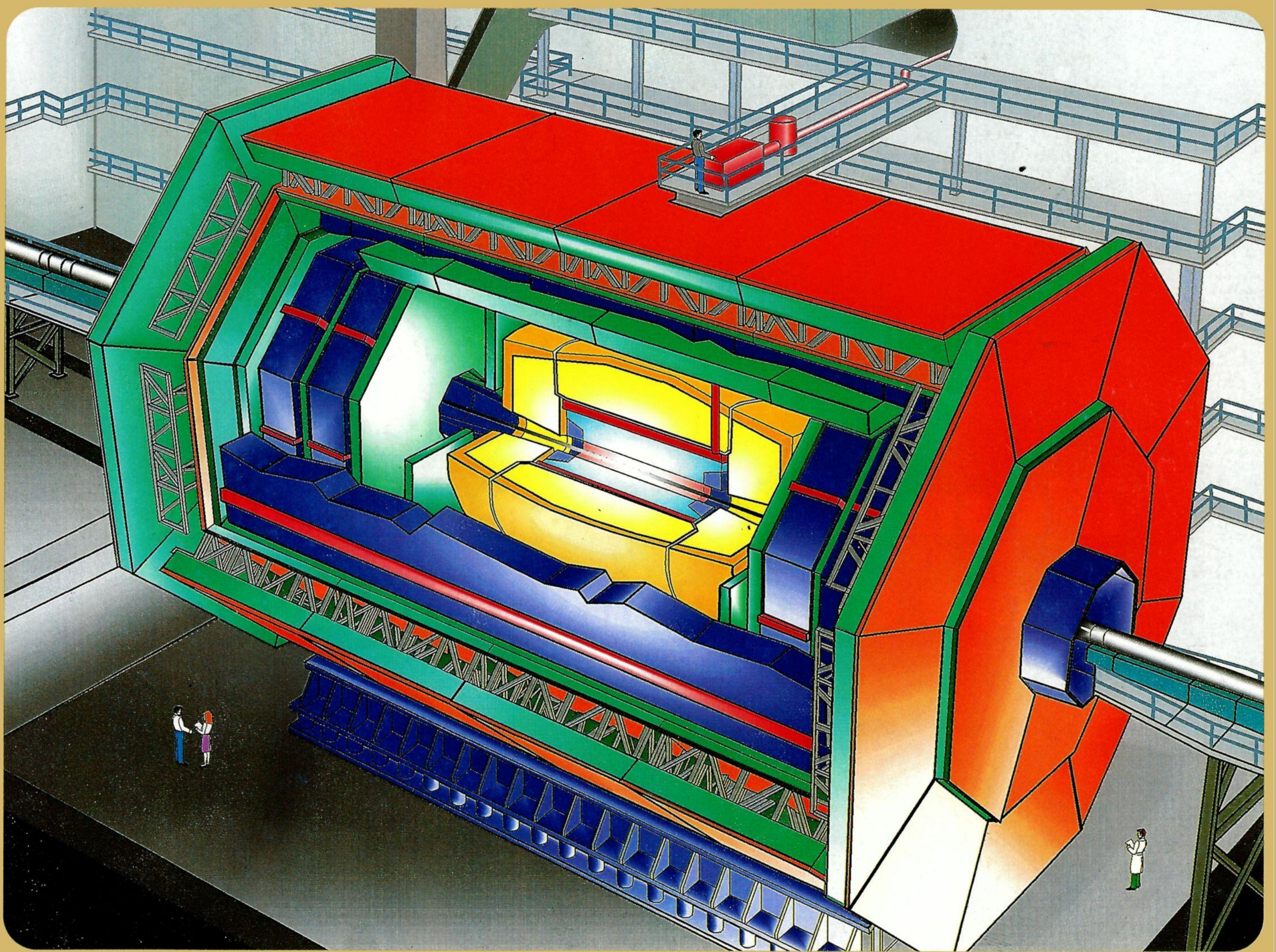
CERN COURIER

International Journal of High Energy Physics



VOLUME 32 **2** MARCH 1992

New micro Pascal : It's smaller and smarter and more calculating than ever.

ALCATEL VACUUM TECHNOLOGY has incorporated a high level of multigauge, multifunctional pressure control technology and electronic measuring capability into a compact frame. Micro PASCAL's 21 mm length and 1.4 kgs hold the microprocessor intelligence and vacuum technology knowhow you need to measure accurately - from atmosphere to ultrahigh vacuum. Micro PASCAL meets the requirements of a large array of demanding industrial applications. It is modular, menu-driven, and easy-to-activate because of its touch panel display.

It is a modern gauge that fits into your environment and make life easier for your workers, by providing constant data logging and uninterrupted information streams on an LCD display screen. Furthermore, its solid construction resists occupational wear and tear ; reduces operating costs. Dedicated to vacuum technology systems everywhere, in laboratories, productions centers and control-processing areas, Micro PASCAL is a great mind and a lot of muscle to have working for you.

Alcatel Vacuum Technology... a partner seeking perfection.

ALCATEL
VACUUM TECHNOLOGY

France : ALCATEL CIT Vacuum Technology Division - Tel : (33) 50.65.77.77- Fax : (33) .50.65.77.89
North America : ALCATEL Vacuum Products Inc. - Tel : (1) - 617.749.8710 - Fax : (1) - 617.749.8660
Germany : ALCATEL Hochvakuumtechnik GmbH - Tel : (49) - 09342.8700 - Fax : (49) - 09342.870.30
United Kingdom : ALCATEL Vacuum Technology Ltd - Tel : (44) - 753.83.04 22 - Fax : (44) - 753.85.12.02
Benelux : ALCATEL NEDERLAND BV Vacuum Technology Benelux -Tel : (31) - 03403.51.360 - Fax : (31) - 03403.51221

AVR INTERNATIONAL COMMUNICATIONS

Advertising enquiries

Europe

Micheline Falciola
Advertising Manager
CERN
CH-1211 Geneva 23, Switzerland
Tel.: +41 (22) 767 4103
Fax: +41 (22) 782 1906

Rest of the world

Yvette M. Perez
Gordon and Breach Science Publishers
Frankford Arsenal, Bldg 110
5301 Tacony Street, Box 330
Philadelphia, PA 19137
Tel.: +1 (215) 537 7262
Fax: +1 (215) 537 0711

Distributed to Member State governments, institutes and laboratories affiliated with CERN, and to their personnel.

General distribution

Jacques Dallemagne
CERN, 1211 Geneva 23, Switzerland

In certain countries, 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

Germany

Gabriela Heessel
DESY, Notkestr. 85, 2000 Hamburg 52

Italy

Mrs. Pieri or Mrs. Montanari
INFN, Casella Postale 56
00044 Frascati, Roma

United Kingdom

Su Lockley
Rutherford Appleton Laboratory,
Chilton, Didcot, Oxfordshire 0X11 0QX

USA/Canada

Cyndi Rathbun (B90904 at FNALVM)
Fermilab, P.O. Box 500, Batavia
Illinois 60510

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: Drukkerij Lannoo nv
8700 Tielt, Belgium

Published by:

European Laboratory for Particle Physics
CERN, 1211 Geneva 23, Switzerland
tel.: +41 (22) 767 61 11,
telex: 419 000 CERN CH,
telefax: +41 (22) 767 65 55

CERN COURIER only:
tel. +41 (22) 767 41 03,
telefax +41 (22) 782 19 06

USA: Controlled Circulation
Postage paid at Batavia, Illinois

Volume 32
No. 2
March 1992

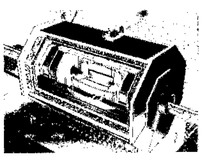
Covering current developments in high energy physics and related fields worldwide

Editor: Gordon Fraser (COURIER at CERNVM)*
French edition: Henri-Luc Felder
Production and Advertisements:
Micheline Falciola (FAL at CERNVM)*

*(Full electronic mail address... at CERNVM.CERN.CH)

1	Nuclear physics looks ahead *Recommendations for Europe*
	Around the Laboratories
4	CERN: Peering into the Pomeron/New CP-violation experiment/ Accelerator School
11	BAKSAN: Solar neutrinos more of a problem *First results from gallium experiment*
13	SUPERCOLLIDER: SDC for SSC *Big detector*
17	BROOKHAVEN: Booster commissioned
18	DESY: HERA polarization Spin oriented electron beams
22	INDIANA: Beam dynamics experiments
22	DUBNA: Member States
24	Bookshelf *Neutrinos and essays*
27	**People and things**

Reader service form, page 32.

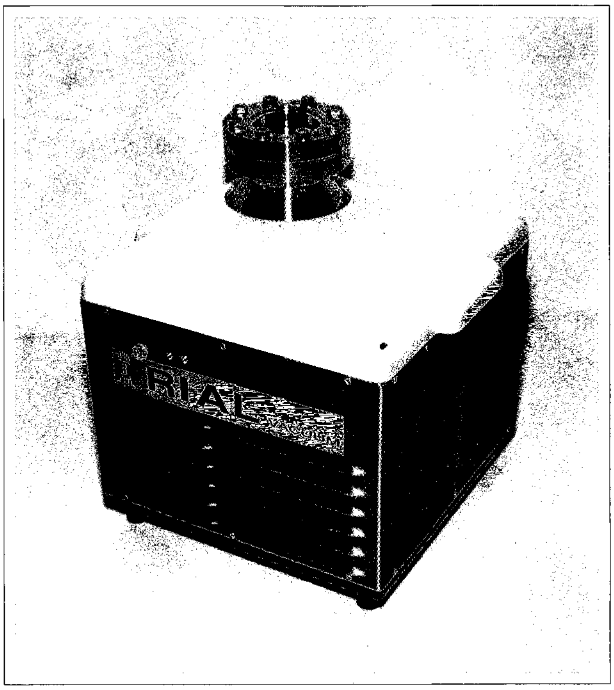


Cover illustration:
artist's impression of the 40 metre-long SDC detector proposed for the SSC Superconducting Suppercollider to be built in Ellis County, Texas (see page 13).

RIAL VACUUM

CLEAN ULTRA HIGH VACUUM IN ONLY A FEW MINUTES

Rial Vacuum presents the first really clean pumping system which starts from atmospheric pressure and goes down to less than 5.10^{-10} mbar with one-switch operation.



Mod. DPS 100/3 - CF63

The system is composed of two pumps:

Mod. ATS 100 Alcatel

This is a hybrid pump composed of: a "turbomolecolar" pump and a "drag" pump with a pumping speed of 100 l/s. This combination provides compression rates of:

10^{11} mbar for N_2
3.10^5 mbar for He
10^4 mbar for H_2

These elevated compression rates permit, besides the attainment of base pressures of $\leq 2.10^{-10}$ mbar, back pumping pressures as high as 40 mbar.
The ceramic ball bearing assembly guarantees more than 14.000 hours operation before the first maintenance.

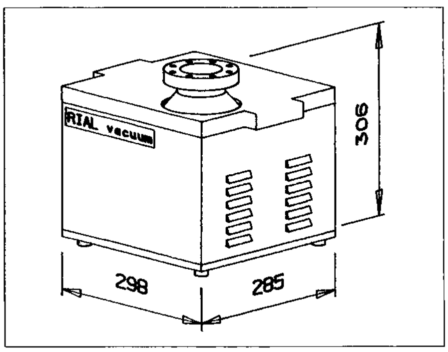
Mod. DRY 3 (New Dry Pump)

This is a completely self-lubricating rotary vane pump, i.e. grease and oil free.
The pumping speed is 3 m^3/h and ultimate pressure is $\leq$ 6 mbar.

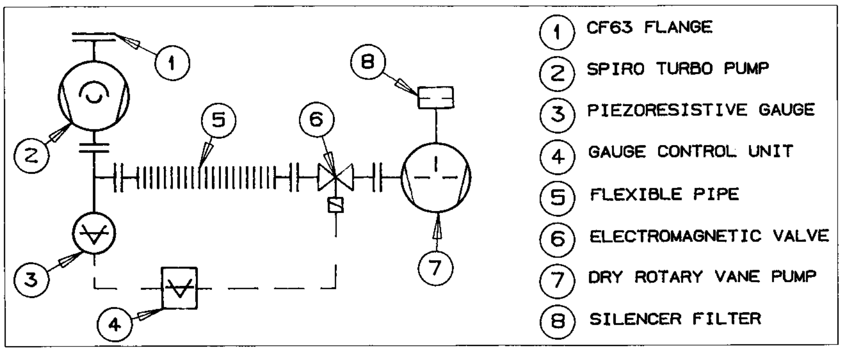
Other features of the system are:

- Extremely compact;
- One-switch operation;
- Air-cooling;
- Mounting in any position;
- CF63 connection flange;
- Power 220V - 50Hz - 0,5 KVA;
- Double over-pressure protection.

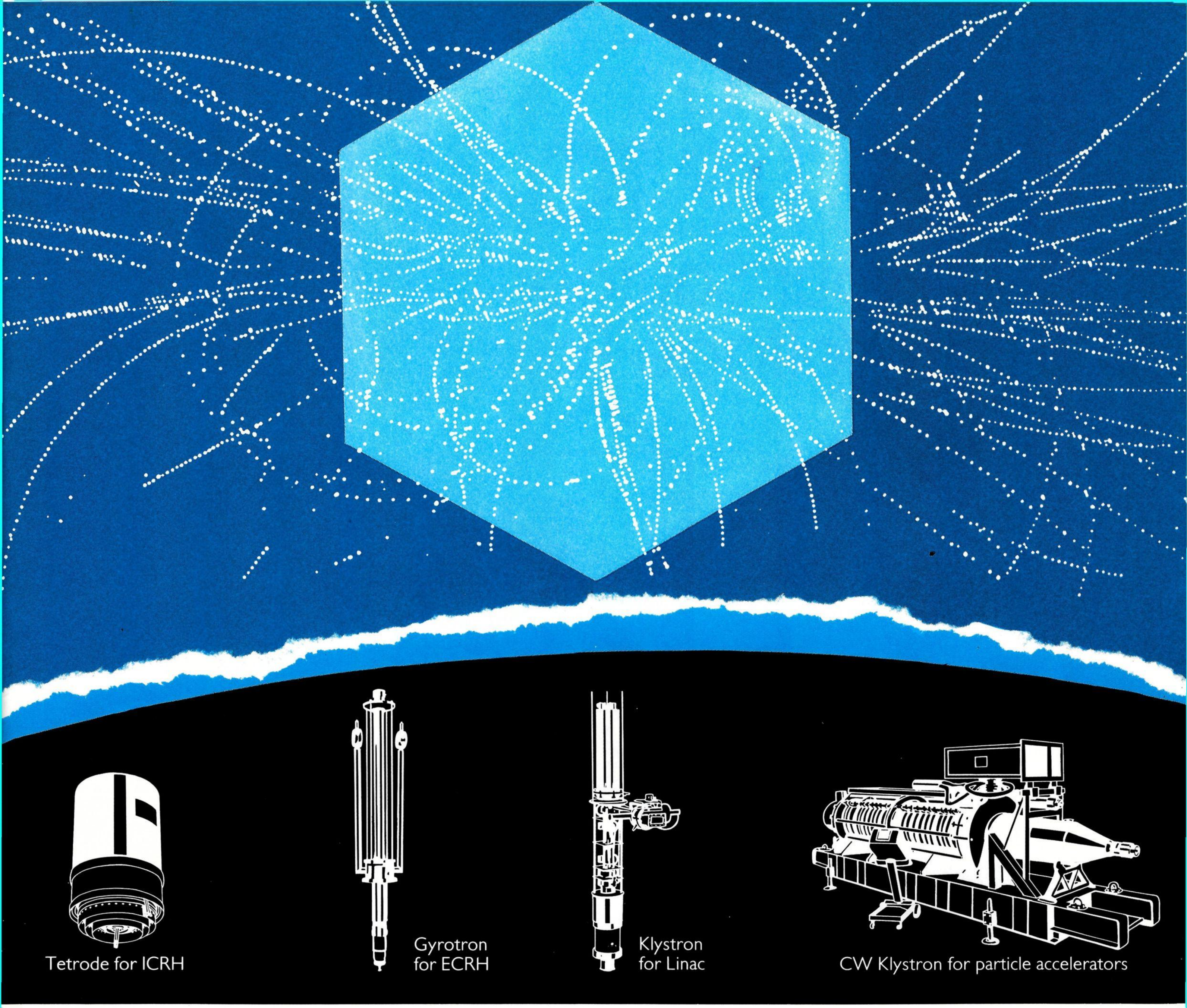
DIMENSION



LAYOUT

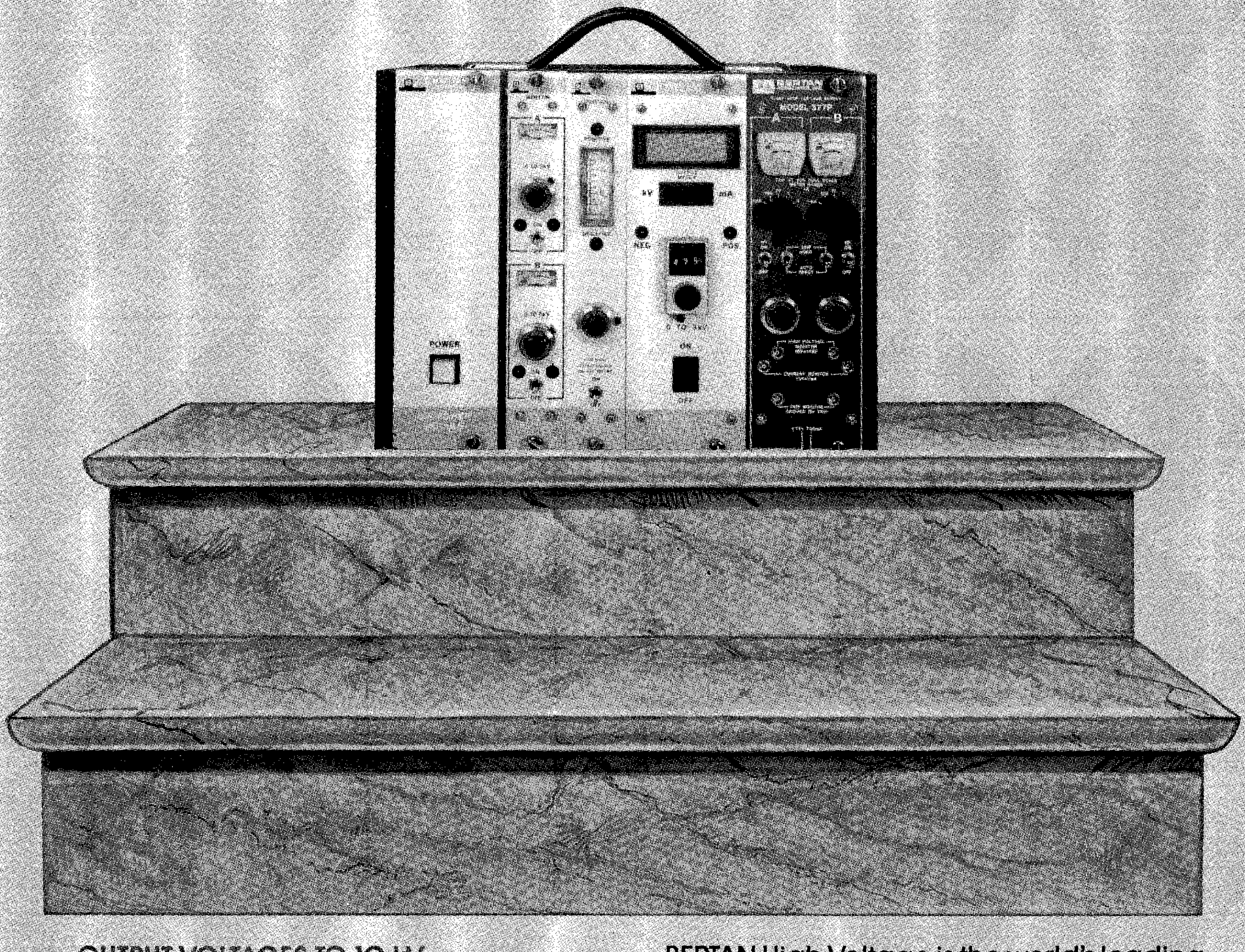


RIAL VACUUM S.p.A. • Via Novara, 6/A • 43100 PARMA - Italia • Tel. +39-521-272120 • Fax +39-521-773268


Tetrode for ICRH
Gyrotron
for ECRH
Klystron
for Linac
CW Klystron for particle accelerators

STEP UP TO BERTAN

Your Source for NIM High Voltage Power Supplies



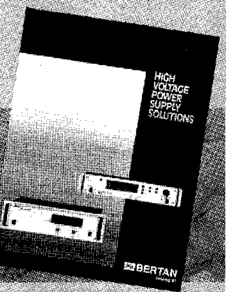
- OUTPUT VOLTAGES TO 10 kV
- OUTPUT CURRENTS TO 3 mA
- MODELS FOR ALL DETECTORS
- SPECIAL MWPC VERSIONS
- SINGLE AND DUAL OUTPUT UNITS
- REVERSIBLE POLARITY
- LOW RIPPLE AND NOISE
- SHORT CIRCUIT AND ARC PROTECTED
- REMOTELY PROGRAMMABLE
- AC AND DC BIN POWERED

BERTAN High Voltage is the world's leading manufacturer of regulated, precision NIM high voltage power supplies and MINI BINs. The excellent stability and low noise featured in our power supplies are just two of the reasons you should specify Bertan in your application. Versatility and quality are others. And our dependability is backed by uncompromising standards and an exclusive 3 year warranty!

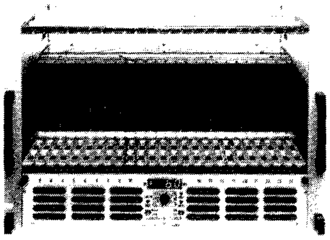
Call us with your high voltage problem. We'll provide the high voltage solution.

BERTAN High Voltage
121 New South Road • Hicksville, NY 11801
516-433-3110 • Fax: 516-935-1766

Send for our new catalog today.

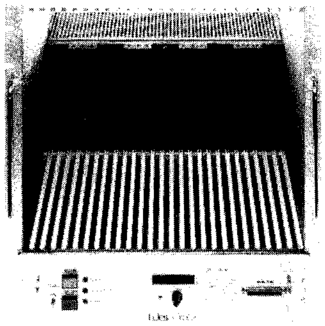


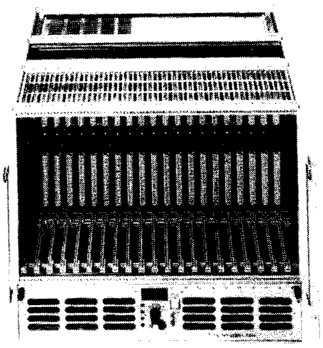
Powered Crates



NIM-Crates
CAMAC Crates
To CERN-Spec. 099a, 500W, linear regulated.
To CERN-Spec. 336, 750W, switch mode regulated.
Tested and accepted by CERN EP

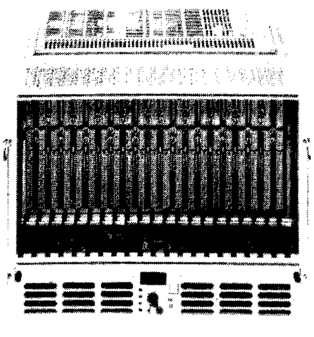
FASTBUS-Crates
To CERN-Spec. F6852, 3.300W, 3-phase input, switch mode regulated. Wes-Crate Power Supplies are distinguished by low noise and ripple. Electro-magnetically shielded.
Tested and accepted by CERN EP





VMEbus-Crates
To CERN-Spec. V-422. Excellent electrical and mechanical performance for institute users.
Tested and accepted by CERN EP

VMEbus-Crates
To CERN-Spec. V-430. Backplane with JAUX connector between J1 and J2.
+ 5V/100A, –5,2V/100A, –2V/50A, ±12V/2A, ±15V/2A.
Tested and accepted by CERN EP



Every CERN-Spec. so far has given rise to a CERN-approved Crate from

Wes-Crates

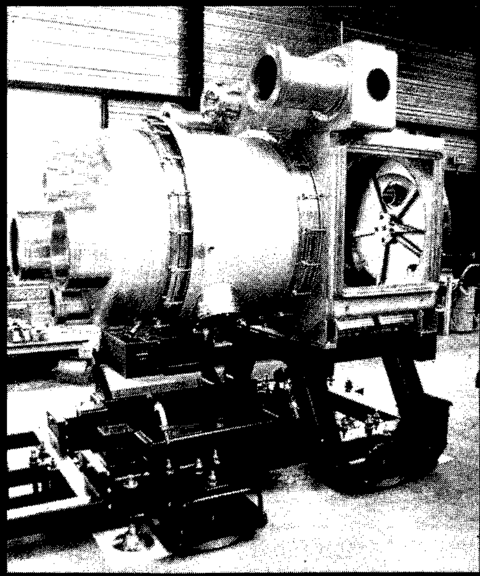
Wes-Crates GmbH
Pattburger Bogen 33
D-2398 Harrislee/Flensburg
Germany

Telefon 0461 / 77 41 77
Telefax 0461 / 77 41 41
Telex 17 461 309

Your contact in Geneva: HiTech Systems SA, Avenue Wendt 16, 1203 Geneva, Tel.: 022 / 44 77 88, Fax: 022 / 45 65 51

26 *Circle advertisement number on reader service form*

MANUFACTURER OF VACUUM VESSELS



SDMS
chaudronnerie blanche

B.P. 4
F . 38160 SAINT-ROMANS
Tél. (33) 76 38 40 13

15a *Circle advertisement number on reader service form*

Weitnauer Trading Company Ltd.

Diplomatic Supply Division

Our Catalogue for the Diplomatic Corps will offer you a wide range of quality products at most competitive prices.

Just ask for the latest edition

Weitnauer Trading Company Ltd.
Diplomatic Supply Division
Petersgasse 36-38
CH-4001 Basel
Tel. 061/ 266 44 44
Fax 061/ 261 77 71
Telex 962 194 WTC ch

Weitnauer Trading Company Ltd.
Show Room
16, Chemin de la Voie-Creuse
CH-1202 Genève
Tel. 022/ 733 54 27
Fax 022/ 740 05 90

47 *Circle advertisement number on reader service form*

Nuclear physics looks ahead

A very wide-ranging report published by the Nuclear Physics European Collaboration Committee (NuPECC) looks at the future of nuclear physics in general, and in Europe in particular. However in view of the increasing interplay between nuclear and particle physics, many of the report's recommendations are of wider interest.

Nuclear physics could once be simply defined as the science of the atomic nucleus, with characteristic features and forces which could not be seen anywhere else. Then the nucleus was the sole stage of the strong interaction. However soon it became clear that the strong interaction has much wider implications, with its role in nuclei shadowing the deeper mechanics of quark interactions and forces.

Called 'Nuclear Physics in Europe: Opportunities and Perspectives', the report reflects this widening of nuclear physics interests as well as underlining NuPECC's role in furthering international research. NuPECC, an Associated Committee of the European Science Foundation, sets out to provide a forum for the discussion of the provision of future facilities and instrumentation, and to advise on the development of nuclear physics.

The report is NuPECC's first step towards fulfilling these goals. It deliberately deals with the scientific aspect alone and does not include a detailed analysis of the present distribution of strength of the community, or of the organization and structures of present-day nuclear physics. This will be the subject of a future study.

In preparing the report, six preparatory groups were set up to assess particular subfields. Each group consisted of five to seven physicists who were not NuPECC members.

Claude Detraz of GANIL, Caen, France, is chairman of the Nuclear Physics European Collaboration Committee (NuPECC), whose report on the future of nuclear physics in Europe is now published.

The groups reported at a week-long workshop held at Ruthin Castle, North Wales, UK, attended by all group members together with some thirty other experts nominated by NuPECC, and all NuPECC members. The Workshop resulted in six reports which form the main part of the report, covering nuclear structure, properties of nuclear and hadronic matter, quark-gluon plasma, nuclear physics with hadron beams, strong interaction physics with electrons, and the nucleus as a laboratory for fundamental interaction.

The detailed recommendations were formulated by NuPECC subsequently, with preliminary drafts being circulated last year.

General Recommendations

Nuclear physics, dealing with systems of strongly interacting particles, is a multifaceted field requiring a wide range of initiatives and facilities. In order to maintain the current vitality of the subject, to exploit the scientific opportunities of the field and to respond to new developments, it is essential to support local initiatives as well as pan-European long-range programmes.

Naturally such local programmes must be regulated by the peer review process and NuPECC considers that international experts should be used whenever possible.

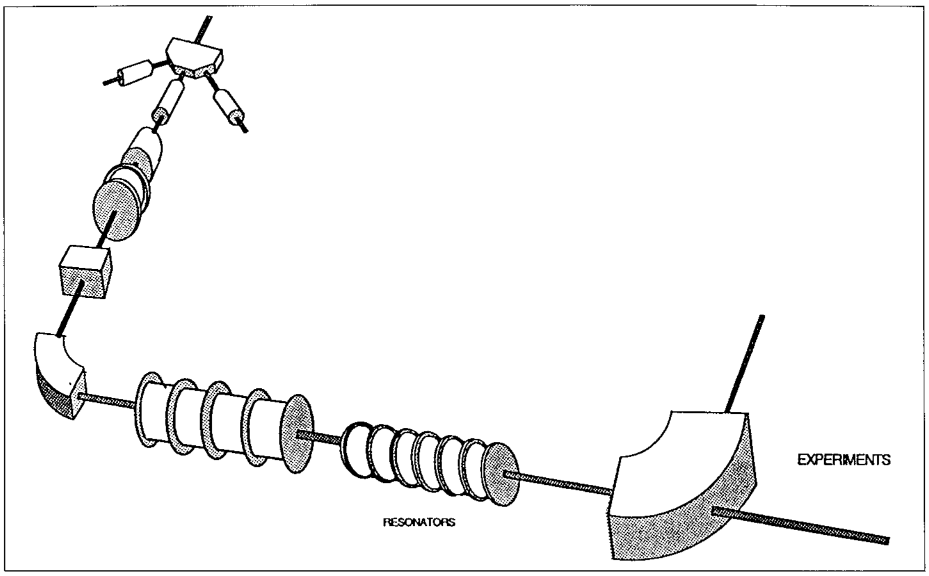
University-based research in nuclear physics is very important and should be strongly encouraged. If large-scale facilities are needed for the experiments, the access to them should be made as attractive as possible by providing the necessary support.

NuPECC recognizes the importance of strong links among nuclear theorists. To this end NuPECC is pushing for a European Nuclear Theory Centre to promote collaboration and interaction. (Analogous to the US centre in Seattle. Several European sites have been proposed.)

Europe has a network of facilities for first-rate research in nuclear and hadronic physics. These should be fully exploited in a European framework, with innovative instrumentation development programmes.

To meet the challenge of the new opportunities outlined in the report, new facilities will be needed. NuPECC considers that initiatives for such research facilities and programmes should be coordinated in a European framework.

Possible scheme for ion post-acceleration at CERN's ISOLDE on-line isotope separator, with, successively, a radiofrequency quadrupole, accelerating tanks and single resonators arranged in two sections linked by a 90-degree bend.



Nuclear structure

Many of the properties of quantum states of nuclei at low excitations are now well known. Although the nuclear many-body problem is not solved on a fundamental level, many properties can be accounted for by models of differing degrees of sophistication.

The search for anticipated new phenomena will require the study of states where the excitation energy or the quantum numbers of spin or isospin take extreme values.

To achieve these objectives it is recommended that a broad European collaboration should prepare a proposal to spell out the physics case and design goals for the Euroball project (a gamma ray detector, currently under study, based on a cluster of germanium crystals). The optimum solution to achieve the physics goals should be searched for by upgrading the present multi-detector gamma ray arrays.

Also vigorous research programmes complemented by intensity upgrades should be pursued with the radioactive beams available at existing facilities. The new techniques required to exploit cooled beams should be fully developed. A European study group to evaluate the scientific prospects and technical realization of beams produced by the two-accelerator method (ions produced by a primary beam and then post-accelerated) should be set up.

This method is already used to produce radioactive beams of a fraction of a keV per nucleon at on-line isotope separators, such as ISOLDE at CERN. Higher energies, a few MeV per nucleon, are available at Louvain, Belgium. Post-acceleration techniques can be readily developed to study new reactions, particularly those of interest to astrophysicists.

Hadronic Matter

The understanding of bulk hadronic matter is a central issue in nuclear physics. It includes the derivation of its equation of state, the study of phase transitions and the properties of hadrons in the nuclear medium. Adequate beams are available in Europe for a wide range of energies up to 2 GeV per nucleon for a first-rate research programme in this field. This programme should be developed to the full, which implies major developments of experimental equipment with an emphasis on the detection of electroweakly-interacting particles.

At higher energies, in the field of hadronic matter at high baryon density, a European study group should be set up to report on the physics case and to consider the technical feasibility of a heavy ion collider with luminosities beyond those which eventually will be provided by the SPS heavy ion scheme at CERN.

The search for the quark-gluon plasma represents a new scientific challenge: it should lead to an understanding of the transition from hadronic to quark-gluon degrees of freedom in ensembles of strongly interacting particles. Full use should be made of the lead beams available soon at the CERN SPS. For the future, new perspectives would be offered by heavy ion beams at CERN's proposed LHC collider.

Properties of Hadrons

Specific information on hadrons, their quark structure and their internal dynamics, can be obtained by studying their properties in an extended (nuclear) medium. Such research programmes are very promising.

Existing facilities providing light hadronic probes should be fully exploited and advantage should be taken of the new opportunities offered by the KAON 'factory' project proposed for the Canadian TRIUMF

Laboratory in Vancouver, and the proposed SuperLEAR ring at CERN (January/February, page 7).

Studies using high energy electron probes will be very important in opening up access to this new physics. Optimum use should be made of existing continuous electron machines for the study of the properties of hadrons in nuclei.

The investigation of quark dynamics in nuclei should be started with exploratory experiments at existing high energy storage rings.

NuPECC recommends that a major initiative be launched now to develop a proposal for a European continuous-wave electron accelerator in the 15 GeV region. This would be a unique facility in the fundamental study of quark properties in extended matter. NuPECC proposes that a European project group be set up on a broad scientific basis to: identify the key experiments to be performed with such an accelerator; to determine the initial energy and propose an optimum design for the accelerator; and to establish the instrumentation required to carry out the initial experimental programme.

Low energy studies of fundamental interactions

An important aspect of nuclear physics is the investigation at low energies of fundamental interaction symmetries and particle properties. The broad range of this field includes: precision experiments in atomic and nuclear physics; the use of intense beams of neutrinos, muons and cold neutrons; the study of extraterrestrial neutrinos; and the search for rare events at large underground facilities.

NuPECC recommends that steps be taken to ensure that access to adequate beams of such particles is available within Europe and to facilitate the coordination, on a European scale, of large underground experiments.

NuPECC, which is chaired by Claude Detraz of GANIL, Caen, France, is prepared to contribute whatever assistance will be needed for the implementation of the recommendations in its report.

Copies of the report are available from Gabriele-Elisabeth Koerner at the NuPECC scientific secretariat, c/o Physikdepartment E12 der Technischen Universität München, D-8046 Garching, fax (+49 89) 32 09 22 97.

Around the Laboratories

CERN
Peering into the Pomeron

Jets – narrow clusters of particles produced in violent collisions – provide a very effective window on the elusive interactions of the quarks and gluons hidden deep inside strongly interacting particles.

Predictions of jet production in proton-antiproton collisions depend on knowing the detailed inner structure of the proton, obtained from deep-inelastic lepton-proton interactions. Such predictions agree well with measurements by the big experiments at the CERN and Fermilab proton-antiproton colliders.

However there is very little sensitivity to that 'soft' part of the proton structure carrying only a small fraction of the total momentum (called small x in the trade).

In 1984 Gunnar Ingelman and Peter Schlein suggested getting at this soft structure by looking for jets in those collision events where a proton stays close to the beam direction, carrying off 90% or more of the beam momentum.

Such jets would be produced by the scattering of the proton on the soft 'remainder' of the antiproton, or vice versa. Such interactions have traditionally been called diffraction and are interpreted in terms of the exchange of a complex, and little understood, entity called a Pomeron.

(The same mechanism also dominates elastic scattering, where particles just bounce off each other. It was the Russian theorist Isaak Pomeranchuk who deduced powerful theorems about this scattering.)

Thus jet production would involve a Pomeron radiated by the leading proton. It was pointed out that the observation of jets in these collisions would show that the Pomeron itself has a deeper quark/gluon structure.

The UA8 experiment at CERN's proton-antiproton collider set out to search for jet production in diffraction. UA8 was a marriage between the large UA2 detector and special 'Roman pot' spectrometers to look for

Technopolis Thoiry

Geneva Moves With The Times

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

An International Role

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

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

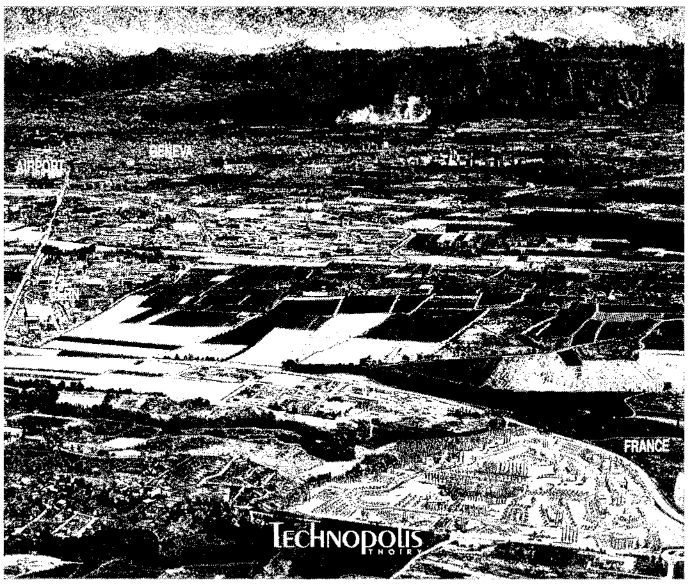
The Technopole Interface

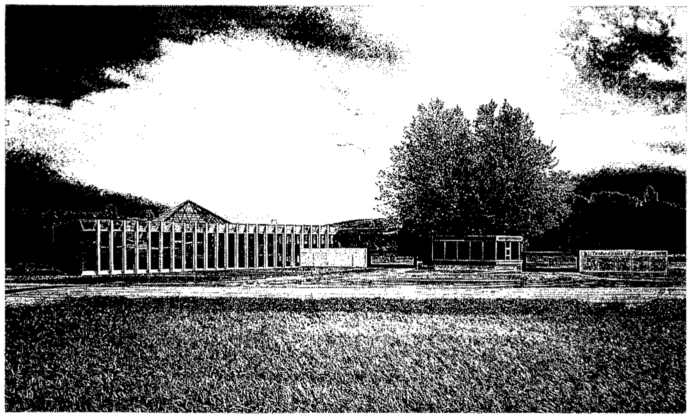
Geneva continues to adapt its role as we move towards the 21st Century. Science parks represent one development and there are now about 300 in the industrialized world. In offering a homogeneous blend of activities and facilities, they generally aim to enhance synergies in an increasingly competitive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

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

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

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





The Opus One building at Technopolis Thoiry.

Focussing on Applied Physics

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

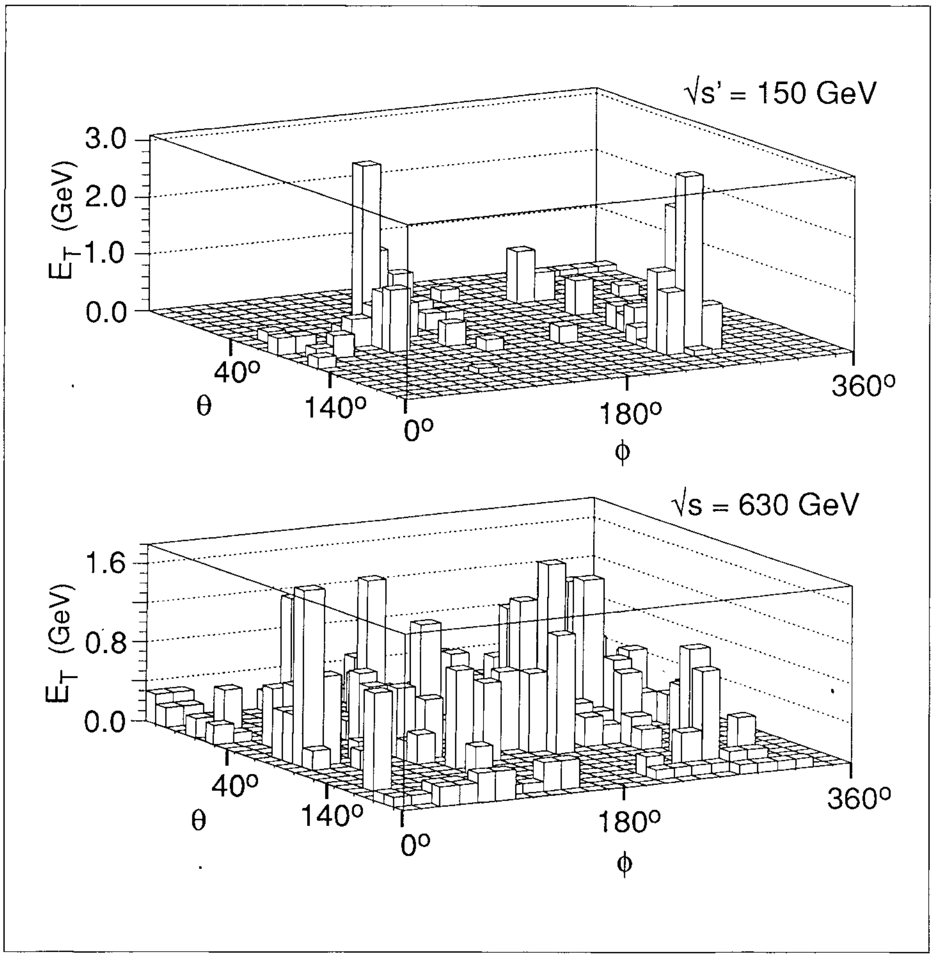
Technopolis aims to allow industry and institutes to participate in, and contribute to, the rich scientific and technical environment by serving as a closeknit interactive base for specialist organizations. In addition to enjoying a convenient window on CERN's extensive sub-contracted requirements, they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

A Superb Environment

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

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

Top: Clear signals for low energy jets in the UA2 calorimeter used in the UA8 experiment at CERN's proton-antiproton collider, where the proton (or antiproton) flies off carrying 95 per cent of the momentum, while the antiproton (or proton) 'collides' with the residual soft ('Pomeron') structure.
Bottom: Without triggering on the fast forward particles, the jets are almost indistinguishable from the background.



protons or antiprotons close to the beam direction.

A state-of-the-art data-driven trigger processor calculated the proton momentum in real time from the wire chamber 'hits' and a signal passed to the UA2 control room to be combined with the conventional UA2 triggers. In this way the UA8 group was able to use the UA2 calorimeter to see and study jets associated with a leading proton or antiproton. If one particle carries away a lot of momentum, there is less available for the interaction, and the UA2 calorimeter sees a 'quieter' event.

The figure shows the 'unwrapped' calorimeter signals for two events, each with two jets having transverse energy above 8 GeV. The lower plot, from UA2, is for a routine proton-antiproton collision at 630 GeV, and the background is so pervasive that the jets cannot be easily picked out.

However the upper plot, for a typical event where a recoil proton carries off 94 per cent of the available energy, is remarkably different. Here the 'collision energy' between the antiproton and the Pomeron is 150 GeV. The calorimeter is much quieter and the jets are very clear. They are also azimuthally back-to-back, clear evidence for hard scattering constituents inside the Pomeron.

The Pomeron behaviour seen by UA8 suggests that it contains only two hard scattering constituents. This and the jet production rate agree with predictions by A. Donnachie and P. Landshoff, who predict the Pomeron to be made up of quarks and antiquarks.

However similar measurements at the new HERA electron-proton collider at DESY, where small x proton kinematics will really be opened up, will help decide whether the Pomeron contains gluons or quarks, or both.

New CP-violation experiment

In 1964, Val Fitch and Jim Cronin's team at Brookhaven discovered something new in neutral kaon decays. Called CP-violation, this effect is now an integral part of today's particle physics dogma, and could be related to deep questions of cosmology, particularly why the Universe, governed by equations symmetric between matter and antimatter, appears to have almost no antimatter in it.

Without CP violation, the neutral kaon comes in two immutable varieties – a short-lived version decaying into a pair of pions, and a long-lived one normally decaying into three particles. Fitch and Cronin discovered that a fraction of a per cent of these neutral kaons decayed the wrong way. This tarnished the hitherto golden rule that all particle interactions should be symmetric under a combined (CP) operation of charge conjugation (C) – switching particles to antiparticles – and parity (P) – full reflection in three-dimensional space. Despite heroic efforts over the past 27 years, theorists have not been able to find any definitive clue to the origin of this subtle effect.

However CP-violation can be contained in, but not explained by, today's Standard Model of interactions between six types of quark.

In addition to the classical CP-violation due to asymmetry in the way the two neutral kaons mix, CP-violation can also occur in the decays of neutral kaons into a pair of pions.

This 'direct' CP violation is measured by a parameter related to the 'ratio of ratios' – the relative decay rates of short- and long-lived neutral kaons into neutral and charged pion pairs. In the last few years two major experiments, NA31 at CERN and E731 at Fermilab, have attempted to fix this parameter, using different techniques.

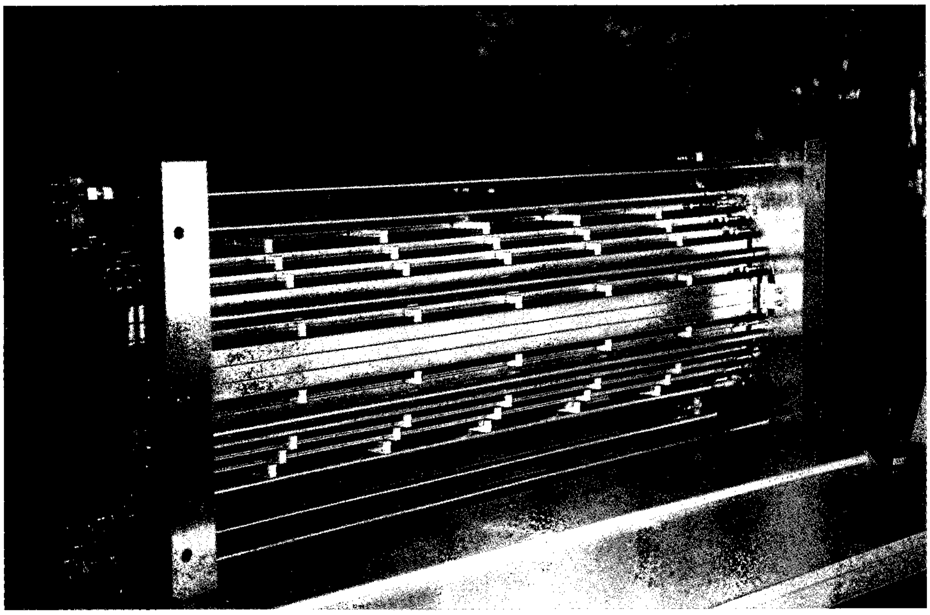
After each amassing several million neutral kaon decays, the results from the two experiments do not necessarily disagree, but the agreement could be better.

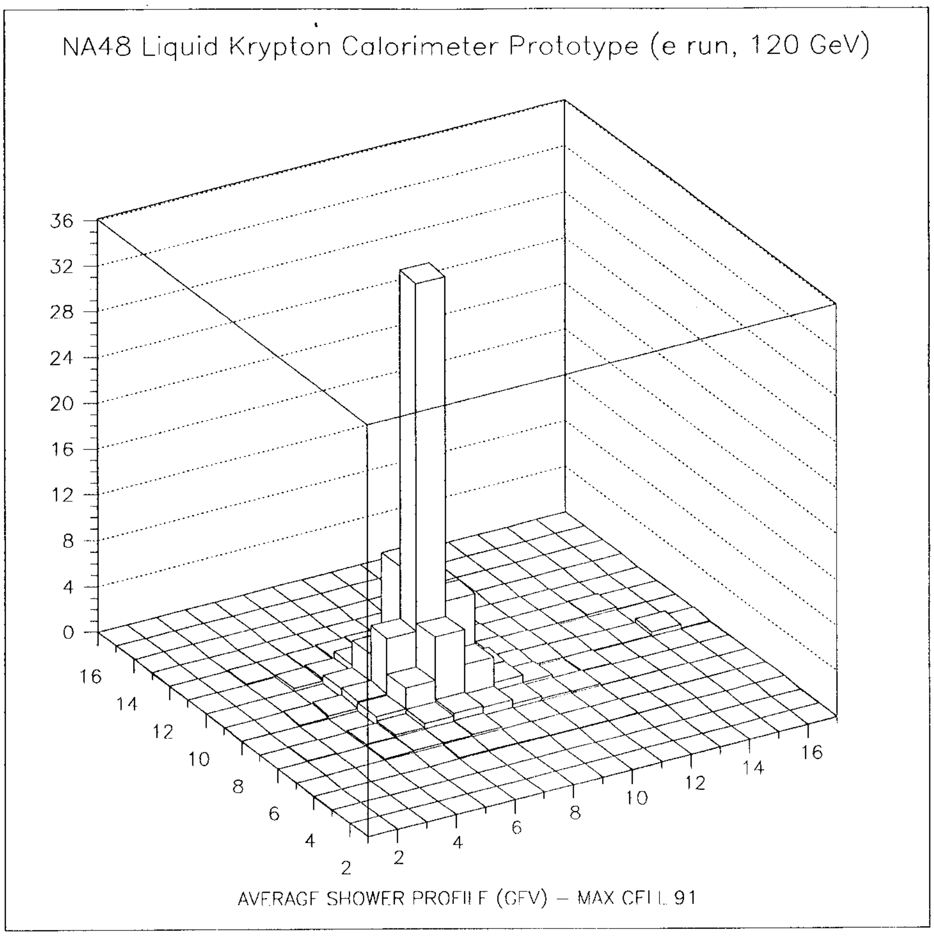
The new experiment (NA48, a Cagliari/Cambridge/ CERN/Dubna/ Edinburgh/Mainz/Perugia/ Pisa/ Saclay/Siegen/Turin collaboration) continues the basic approach of its predecessor, comparing charged and neutral pion pair decays from distinct long-lived and short-lived kaon beams entering a common decay region inside a long vacuum tube. The improvement will be to record the decays from the two different beams at the same time and from the same portion of the detector, reducing possible sources of error.

To achieve this, the primary proton beam is first used to produce the long-lived kaon beam, the remaining charged particles being swept away by a magnet. A small fraction of the remaining primary beam is then bent back into the kaon line to produce a collinear short-lived kaon beam. This bending will be done using a bent crystal (May 1990, page 5).

A new electromagnetic calorimeter

Immersed in liquid krypton, this prototype electromagnetic calorimeter for a new CP-violation experiment at CERN gave excellent results (below, cell size 2 × 2 cm).






We Go to Great Lengths...
...Producing Your Plastic Scintillating Fibers.
• Blue scintillating fibers
• Green scintillating fibers
• Rad-hard fibers
• Ribbons and arrays
• Large cross-sections
• Custom formulations
Our tradition of advancing scintillation technology assures fiber properties which let you make the measurements you need.
Contact us today for our latest technical and pricing information.
BICRON
Bicron Corporation
12345 Kinsman Road
Newbury, Ohio 44065-9677
Telephone: (216) 564-2251
Telefax: (216) 564-8047
Telex: 980474 BICRON NWBY
European Office
Markstraat 27A, P.O. Box 271
2410 AG Bodegraven, The Netherlands
Telephone: 1726-14243
Telefax: 1726-14316
Telex: 39772 BICIN NL
Nippon Bicron
Room No. 805 1-8, 1-Chome
Shinyokohama, Kohoku-Ku
Yokohama 222 Japan
Telephone: 045 (474) 5786
Telefax: 045 (474) 5787

will be used to pick up the neutral kaon decays. To handle the million resulting photons per second with good energy resolution and to pinpoint them to within less than a millimetre and within one nanosecond needs special attention. The initial proposal was to use liquid xenon, but attention soon turned to the cheaper liquid krypton.

The experiment will also employ a new magnetic spectrometer. The trigger rate will be twenty times that of its predecessor, requiring a three-stage approach and advanced 'pipelining' in the data handling.

A prototype calorimeter containing 170 litres of liquid krypton read out through copper-cladded kapton foil stretched along the beam direction has now been successfully tested in an electron beam, giving the required spatial and energy resolutions. The experiment would need seven cubic metres of liquid krypton.

In another test, a bent crystal transmitted enough protons (a half per mil of the primary beam) to be used for production of short-lived kaons. Prototypes have also been built of the large drift chambers for the magnetic spectrometer.

The new experiment plans to start taking data in 1994.

Accelerator School

The CERN Accelerator School (CAS), set up in 1983, aims to make good the lack of university courses in accelerator physics, and to train the staff needed to plan, construct and man new machines.

Kjell Johnsen, the first leader of the school (1983-5) set high standards, maintained by his successor Phil Bryant. So far the School has organized twenty courses and workshops and finds the demand as strong as ever. Phil Bryant now moves over to the LHC project at CERN and hands the CAS baton to E.J.N. ('Ted') Wilson.

E.J.N. ('Ted') Wilson becomes Head of the CERN Accelerator School.

The first CAS course in 1992, on Magnetic Measurement and Alignment, will be held in Montreux from 16-20 March. Although this specialized course is the first time CAS has set out to teach magnets, it is seen as having broad appeal, since almost everyone in the accelerator world has to build a magnet sometime.

This will be followed by a two week General Course in Jyväskylä, Finland, from 7-18 September, the first in a two-year cycle of Accelerator Physics courses.

Finally there will be a joint US-CERN Course on Factories with Electron-Positron Rings in the 'Frontiers of Particle Beams' series. This will be in Benalmadena (Spain) from 29 October to 4 November.

Further information and application forms from Mrs S. von Wartburg, CERN Accelerator School, 1211 Geneva 23, Switzerland, bitnet CASUS at CERNVM.CERN.CH.

BAKSAN Solar neutrinos more of a problem

Initial results from the SAGE detector, operated by a Russian-US collaboration in the Baksan underground Laboratory in the Caucasus, still find a dearth of solar neutrinos – the 'solar neutrino problem'.

All experiments monitoring the neutrino flux from the Sun have seen considerably less than the expected level. This has serious implications for our understanding of neutrinos and of what goes on deep inside the Sun. However the first detectors to measure this flux were only sensitive to a minority of solar neutrinos.

To cover a wider spectrum, new detectors were built, including SAGE (June 1990, page 16). This uses 30 tons of gallium, the neutrinos being detected through conversions of gallium nuclei into germanium, and is sensitive to the more copious neutrinos from the fundamental proton-proton fusion reaction providing most of the Sun's fuel.

After going live in 1990, the detector was found to be contaminated with germanium produced by cosmic rays while the gallium was waiting to be installed underground.

By the beginning of last year, these germanium backgrounds were no

longer a problem, and the detector started counting solar particles. Last summer SAGE had no comment to make, being busy digesting five months of data.

However careful analysis, including consistency checks on the estimated efficiency of the germanium extraction process, reveals a smaller signal than expected. Standard solar model calculations predict about 132 'Solar Neutrino Units'. The minimum expected rate in a gallium experiment, assuming only that the Sun is presently generating nuclear energy at the same rate it radiates, is 79 of these units. SAGE most likely sees much less than this level.

Thus for the first time, the solar neutrino problem extends to all, rather than a small fraction, of the Sun's particles. It implies than the solar neutrinos are doing something else on their way from the Sun's interior to the Earth.

SUPERCOLLIDER SDC for SSC

On a scale to match the 87-kilometre Superconducting Supercollider (SSC) planned for Ellis County, Texas, the Solenoidal Detector Collaboration (SDC) is designing a large general-purpose detector to pursue a broad range of physics goals.

The detector is to be optimized for high transverse momentum physics (where the proton constituents collide violently) and will have diverse capabilities, making it a premier exploratory tool in the SSC energy and luminosity regime. The design draws heavily on the CDF experience at Fermilab's proton-antiproton collider and strives for excellent performance in central tracking, calorimetry, and muon systems.

The SDC is a group of about 100 institutions, involving more than 700 physicists and engineers, in over a dozen countries around the world. Already involved are the United States, Japan, member countries of the Commonwealth of Independent States, France, Italy, The United Kingdom, Canada, China, Bulgaria, Czechoslovakia, Romania, Israel, and Brazil. In December 1990, the SSC Laboratory approved the SDC to proceed with the preparation of a Technical Proposal, to be submitted by 1 April this year.

The major goal of the SDC is to exploit the outstanding physics opportunities opened up by the 20-fold energy and 1000-fold luminosity increases to be provided by the SSC collider with its 20 TeV proton beams.

The Standard Model and its extensions provide useful guidance to help ensure a good match between detector capabilities and SSC opportunities. Simulated searches for Higgs, top quark decay, higher-mass gauge bosons, new spectroscopies such as supersymmetry, and compositeness effects have provided important benchmarks to apply to the SDC detector design to make sure that all these phenomena would be convincingly detectable.

However the real goal is the discovery of new phenomena, not necessarily suggested by present theoretical directions, with sufficient multiple capability within the detector to establish, rather than merely suggest, their existence. This is all the more demanding since interesting signals will most likely occur very seldom in a vast ocean of background.

The name 'solenoidal detector' refers to the substantial cylindrical volume, concentric with the beam, surrounded by a solenoid coil and filled with tracking detectors. This system, immersed in a 2 Tesla magnetic field, is capable of measuring precisely the momenta of charged particles emitted from the interaction, within an angular acceptance extending from 10 to 170 degrees relative to the beam.

Outside the solenoid and tracking volume is a hermetic calorimeter, covering the angular range from 6 to 174 degrees, with fine-sampling electromagnetic sections and coarser hadronic compartments. Inside the electromagnetic section is a special high-spatial-resolution detector to provide improved position precision of electromagnetic showers.

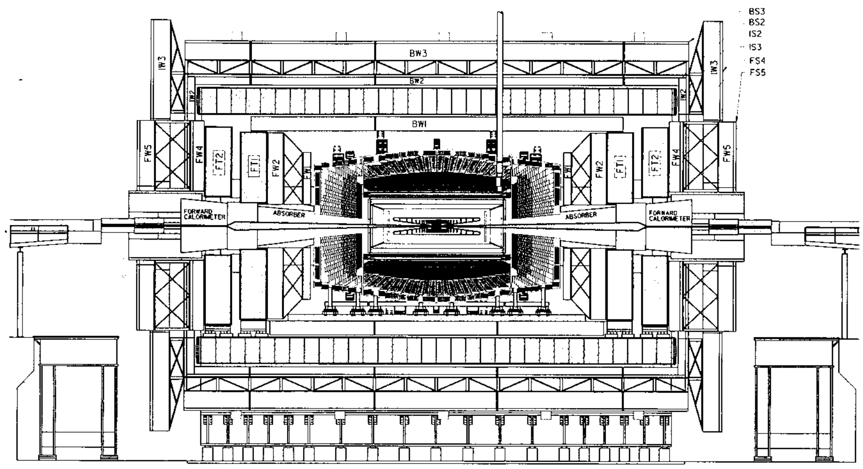
It is a major SDC goal to have excellent electron identification, and to measure with high precision the energies of isolated electrons and photons. To avoid degradation of these measurements, the solenoid coil has been carefully designed for minimum thickness.

Outside the calorimeter is an extensive muon system, including magnetized iron toroids, tracking chambers and scintillation/Cherenkov counters, to provide muon identification, triggering, and in combination with the inner tracker mentioned above, excellent momentum resolution.

Finally, to 'observe' energetic neutral, non-interacting particles (like neutrinos) through apparent transverse momentum non-conservation (missing momentum), and which are otherwise invisible, there are forward calorimeters covering the very small angles between 6 and 0.5 degrees.

The tracking system consists of inner and outer sections. The inner section is an ambitious double-sided silicon-strip system, whose 17 square metres of silicon dwarf all existing

The 87-kilometre SSC Superconducting Supercollider to be built in Ellis County, Texas, needs detectors to match. 40 metres long along the direction of the 20 TeV colliding proton beams and 24 metres across, the mighty SDC detector is designed to catch whatever may happen. The dark lines near the collision point show the silicon inner tracker. BW, IW, FW denote muon tracking chambers, BS, IS, FS muon scintillators.



silicon-strip tracking detectors. Pattern recognition, even within very complex events, partial momentum information, and detection of heavy quark decays, are its goals. One challenge is to maintain alignment and stability tolerances at the few micron level while simultaneously removing heat produced by several kilowatts of electronics power.

For the outer section, several technologies are still under consideration, including gas/wire, gas-microstrip, and scintillating fibres. The more conservative gas/wire system would take the form of multiple layers of 4mm diameter 'straws' with wires running down their axes, these axes being parallel or near-parallel to the beam.

The gas microstrip detectors, pioneered in Europe at Pisa and at NIKHEF, Amsterdam, may prove particularly applicable to the difficult 'intermediate angle' region (from about 26 down to 10 degrees). Scintillating fibres (about 1 mm in diameter) have the advantages of high speed and superb granularity. Their proposed readout is a fast and efficient solid-state device, the Visible Light Photon Counter (VLPC), developed by the Rockwell Corporation. The final technology choices will depend on the outcome of continuing R&D and engineering design efforts.

The central calorimetry technology chosen by the SDC consists of scintillating tiles with 1 mm wavelength-shifting fibres placed in grooves in the tiles. The signal photons are transported by the fibres to the phototubes, and the resulting dead space can be made very small. The absorbers are thin lead for the electromagnetic compartments and thicker iron for the hadronic sections.

An elaborate calibration system is being developed to monitor performance and provide correction capability for potential radiation damage. There is an extensive international programme, using electron beam facilities in China, France, and Japan, to study how the performance of electromagnetic calorimeters of the tile-fibre design depends on radiation exposure and other parameters.

The muon system consists of magnetized iron toroids, and enormous areas of tracking chambers and scintillation counters with the option of Cherenkov counters in the forward direction. A number of different tracking chamber designs are under development in different Laboratories, and a specific design choice will be made soon.

To read out these detector subsystems, electronics systems including front-end electronics, a three-level trigger system, the data acquisition system, and the control system are all under active development, and making good progress. Needless to say, the 100 MHz event rate at design luminosity, (and higher rates if the luminosity is upgraded) provide daunting challenges.

All subsystems are planned to be fully functional at the SSC design luminosity of 10^{33} per sq cm per s. The detector will be capable, with somewhat reduced functionality or modest upgrades, of attacking specialized physics issues which require higher luminosity. It is part of the design criteria that the detector components be able to survive operation at luminosities of 5 – 10 times design for long periods, and that there be sufficient monitoring capability to allow correction for effects of radiation damage.

The SDC detector will, according to present plans, be installed underground at Intersection Region 8 on

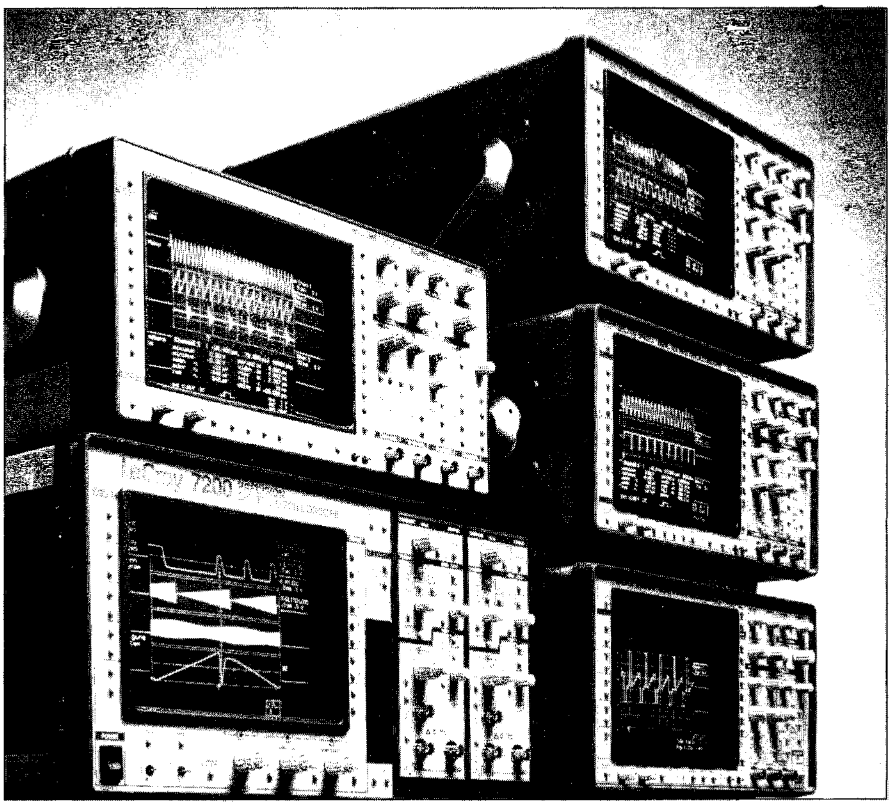
21a *Circle advertisement number on reader service form*

25a *Circle advertisement number on reader service form*

LeCroy Pioneers
New Digital Scope Technology
To Enhance Your Productivity
In The 90's

The technology and spirit of innovation that have made LeCroy the world leader in physics instrumentation for more than 25 years, have been yielding time-saving and performance breakthroughs in digital scopes since 1985.

LeCroy scopes are truly "easy to use"... they give you that familiar "analog feel" plus the accuracy, display & processing options of a digital instrument... without the complexity of layered menus and confusing operation.



The best values in scopes today -

From the pioneer of the modern oscilloscope

Best displays in the business...
Large and bright, no overlap of text and signal, multiple grids, simultaneous viewing of traces and their expansions.

Powerful processing...
- Multiple simultaneous cursors
- Waveform statistics — trends and histograms
- Built-in automatic calibration
- Spectrum analysis with fast FFT
- Pass-fail decision making
- More pulse parameters

Long memories...
Allow higher usable bandwidth at lower time ranges. You don't miss the fine detail.

Mass storage...
High speed *memory cards,* hard and floppy discs, PC compatibility.

TV trigger, X-Y display...
And lots more.

In Switzerland: Geneva: (22) 719. 2228, Lenzburg: (64) 519.181
FAX: (22) 719. 2230, or (64) 519.192

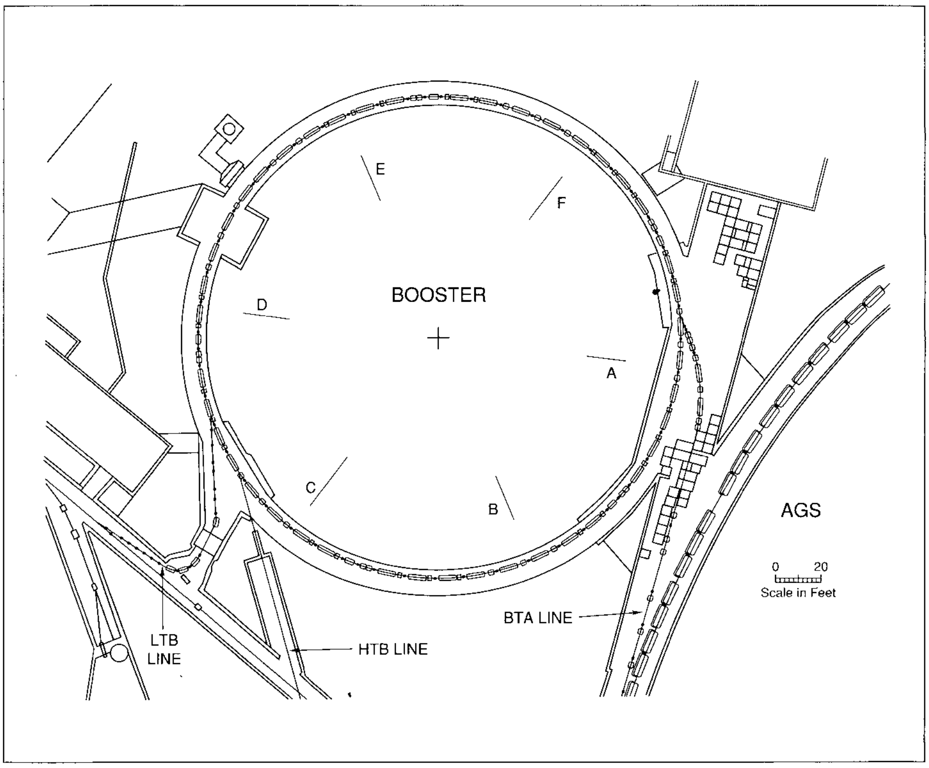
In the U.S.A.: Phone: 1-800-5-LeCroy, FAX: (914) 578-5991

LeCroy
The Digital Scope Specialists

the East Campus of the SSC Laboratory. As far as possible, subsystems will be assembled above ground and lowered into the hall through shafts. According to detailed month-by-month computer-aided design simulations, installation and initial checkout will take about three years. It is the SDC's aim to have its detector ready for physics operation when the SSC turns on.

The design, and the estimated cost and schedule, will be critically reviewed in the six months following the Technical Proposal submission date of 1 April. The SDC hopes to start component construction by the end of this year. The fabrication of the detector will require a major investment of effort from the international high energy physics community over the coming decade, but the physics rewards should more than compensate this great effort.

The new Brookhaven Booster and its three transfer lines: the Linac-to-Booster injection line (LTB); the Tandem-to-Booster heavy ion injection line (HTB); and the extraction line (BTA) feeding the Alternating Gradient Synchrotron.



BROOKHAVEN Booster commissioned

The construction and first commissioning phase of the Booster synchrotron to inject into Brookhaven's veteran Alternating Gradient Synchrotron (AGS) were completed last year. Scheduled to come into operation this year, the new Booster will extend the research capabilities AGS, and with its ability to accelerate partially stripped heavy ions will play an essential role in the chain of accelerators serving the Relativistic Heavy Ion Collider (RHIC).

The polyvalent Booster will increase AGS proton intensity by a factor of four, will serve as an accumulator for polarized proton beams, and will accelerate heavy ions up to gold for injection into the AGS, and ultimately RHIC.

Construction of the $30 million Booster ring was completed last April, and the next few months of the AGS run were used for Booster commissioning in parallel with routine AGS operations. The commissioning process was a novel experience for many since each step was monitored by the US Department of Energy. Each new step could be taken only after the previous one had been evaluated, the impact of the new step reviewed, and personnel had been thoroughly trained in the appropriate procedures. The result was a remarkably efficient and trouble-free commissioning.

The Booster is fed with 200 MeV protons from the Linac through the Linac-to-Booster (LTB) transfer line. These are then accelerated to 1.5 GeV in 63 msec, and four pulses injected into the AGS at 7.5 Hz through the Booster-to-AGS (BTA) line. In early 1992, heavy ions from the Tandem Van de Graaff will be injected into the Booster through the HITL-to-Booster (HTB) line (see figure).

The Booster is a separated function synchrotron of 24 focusing/defocusing (FODO) cells. With a circumference of 202 metres, it contains 36 2.4-metre dipoles and 48 0.5-metre quadrupoles. The radiofrequency system has been implemented with state-of-the-art direct digital synthesizer technology, making it easy to switch between high intensity proton beams or low intensity heavy ion beams.

The main magnet power supply must also be flexible, achieved through complete computer setting of a multi-phase thyristor control system. The design vacuum goal is in the low 10^{-11} Torr range, ambitious for a small ring full of specialized equipment, and the Booster team were pleased that the average commissioning vacuum was in the high 10^{-11} range.

There were five major commissioning goals: to transport 200 MeV protons from the Linac to the Booster; to inject protons into the Booster; to circulate and capture beam in the Booster; to accelerate beam to 1.2 GeV, effectively the full proton energy; and to extract beam from the Booster.

These goals were all readily achieved – the beam seemed to stay forever in the ring and positive action by the operators was usually necessary to get rid of it. Acceleration to full energy was celebrated with champagne hand-carried from California by the Associate Director.

With everything running as it should, detached observers were heard to remark that it was a very dull machine. For those responsible, it was hardly dull. Success was marked by a great feeling of relief since all systems, including instrumentation and controls, had to perform to high standards on a tight schedule.

The Booster is a rapid cycling machine with an Inconel vacuum chamber. The large eddy currents produced in this chamber generate a large rate-dependent sextupole field which could greatly affect performance (chromaticity), but for a passive correction system (proposed and designed by Gordon Danby). This uses a set of sextupole coils mounted on each vacuum chamber and driven by windings around the magnet pole.

Intensities varied from 10^{10} protons (comparable to the expected heavy ion beam levels) to a maximum of 10^{12} protons. The next major goal will be to increase proton intensity in the Booster to 5×10^{12}. With the heavy ion beamline from the Tandem to the Booster completed and tested, heavy ion commissioning of the Booster will begin shortly.

By Ed Bleser

DESY HERA polarization

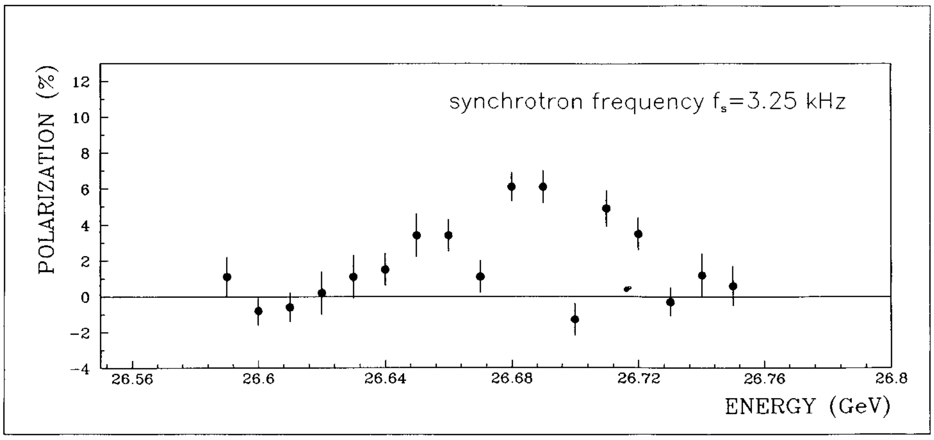


Figure 1. Electron polarization in the HERA ring at DESY, Hamburg. The polarization is maximal around 26.66 GeV, the value for half-integer spin tune. The narrow dips are due to synchrotron side-band resonances. The polarization is expected to vanish if the values for integer spin tune at 26.44 and 26.88 GeV are approached.

The new HERA electron-proton collider at DESY in Hamburg achieved the first luminosity for electron-proton collisions on 19 October last year (January/February, page 12). Only one month later, on 20 November, HERA passed another important milestone with the observation of transverse electron polarization.

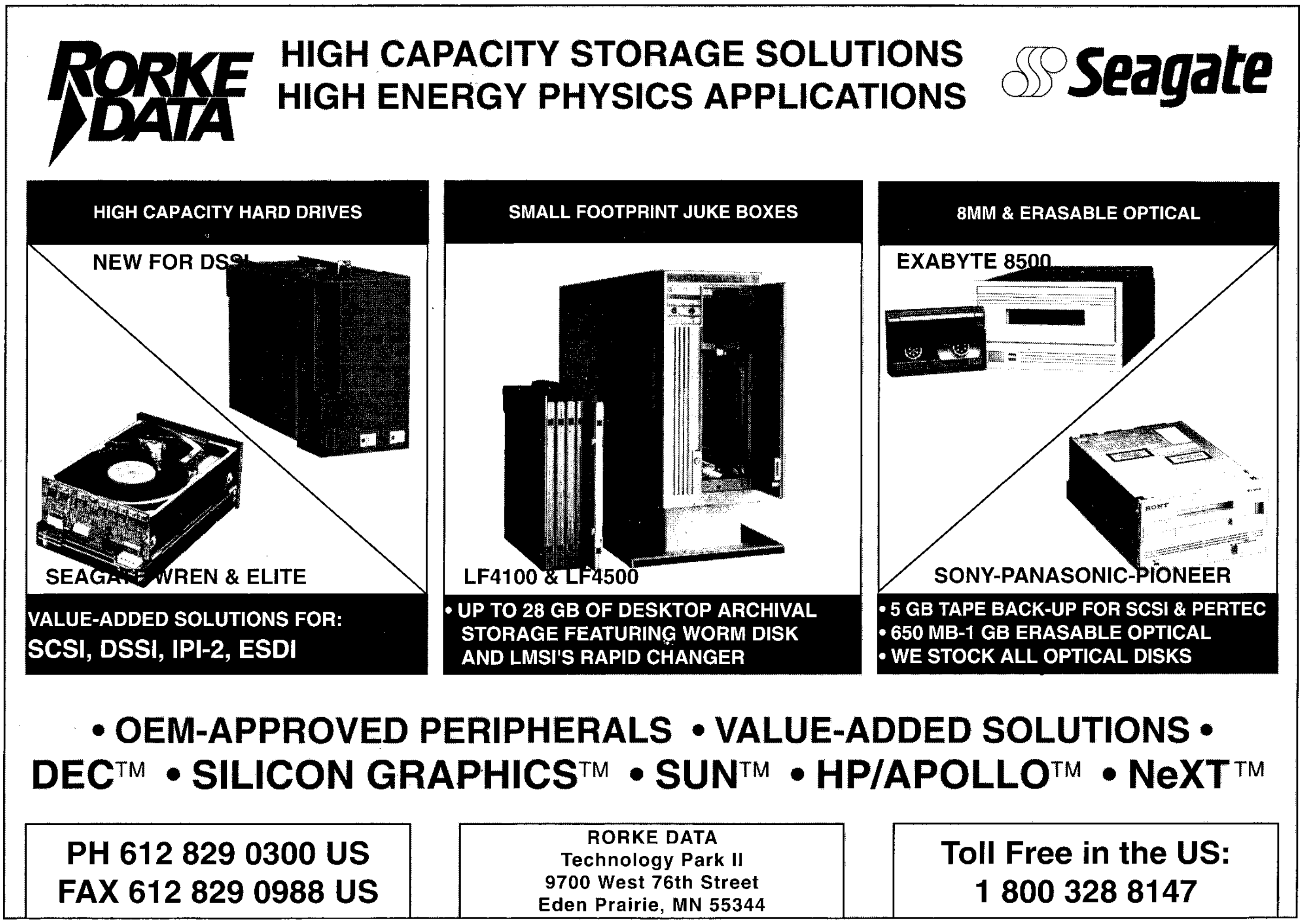
This is a further step in the long tradition of experimental and theoretical study of electron polarization at DESY, where polarization was observed at PETRA and DORIS in the early eighties.

From the outset, spin polarization has been part of the HERA design, and space has been left to install spin rotators. The initial polarization measurements were the result of a close collaboration between members of the DESY machine group and from two experiments – HERMES (MPI-Heidelberg, TRIUMF, Argonne, Caltech, MIT) and ZEUS (DESY, Hamburg and Wisconsin).

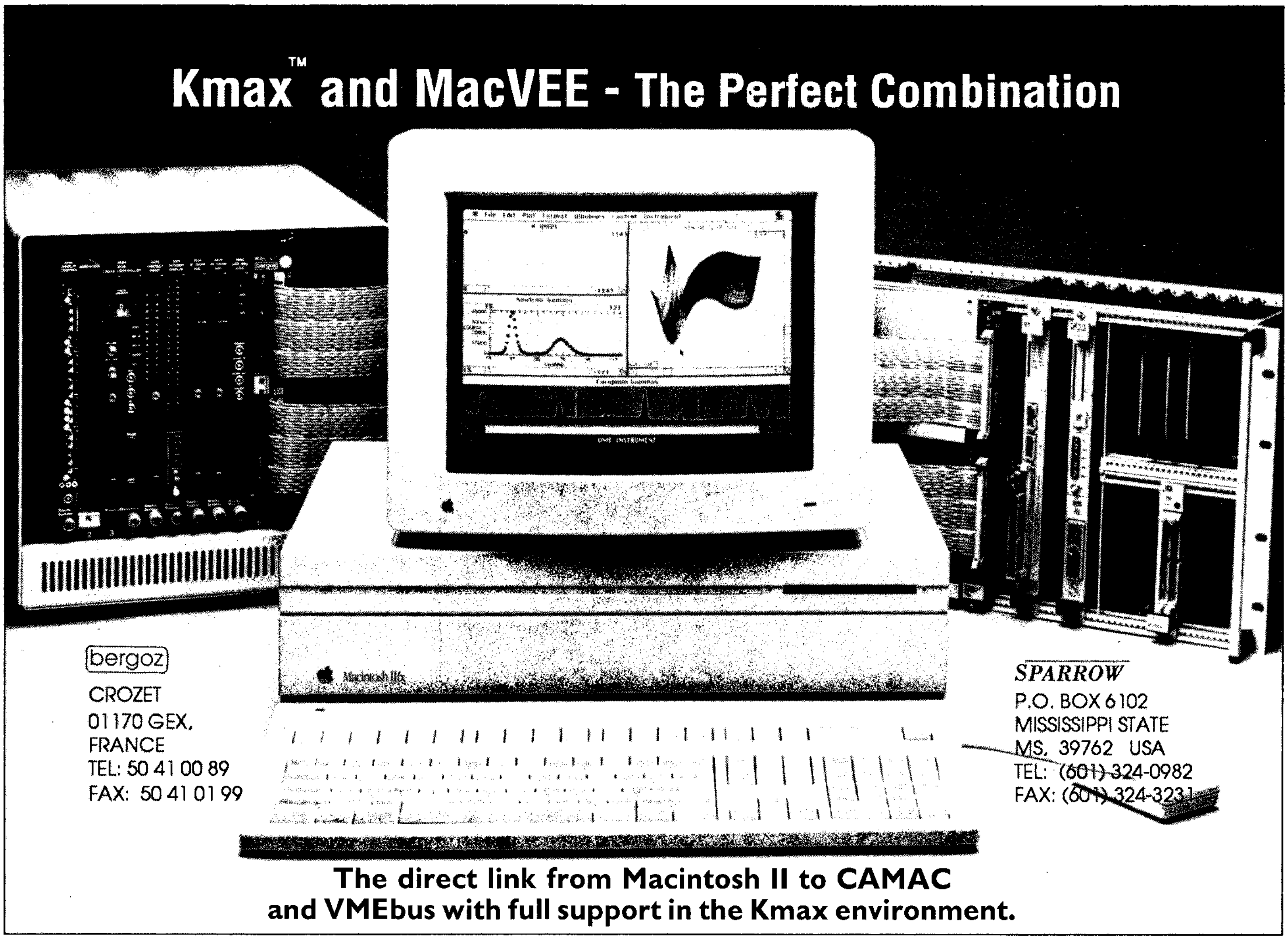
Due to their charge and spin, electrons behave as small gyroscopes precessing in the magnetic field of the accelerator. When ultra-relativistic electrons are held on their circular orbits by the guiding fields, they emit synchrotron radiation, which causes the spin axes of the electrons to line up opposite to the direction of the field. This process, the Sokolov-Ternov effect, gives a maximum theoretical polarization of 92.4%.

The time to reach this polarization value depends on the electron energy and the radius of the machine – at 26.66 GeV, where the measurements have been performed, it is about 40 minutes. In practice, depolarization effects due to orbital oscillations of the electrons can result in a much lower equilibrium polarization, which is reached in a correspondingly shorter time. At energies where the orbital and the spin motion resonate together, the polarization tends to disappear.

The art of obtaining a high polarization in storage rings consists of minimizing the depolarization by precise alignment of the machine

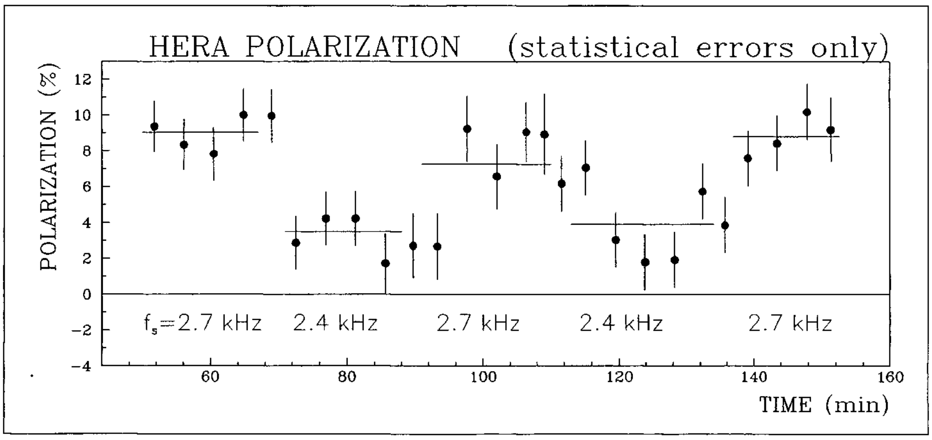


36 *Circle advertisement number on reader service form*



16 *Circle advertisement number on reader service form*

Figure 2. Electron polarization at 26.67 GeV. By varying the HERA accelerating voltage between 102 MV and 90 MV the synchrotron frequency changes from 2.7 to 2.4 kHz, and the polarization from 8% to 4%.



elements and suitable choice of beam energy, optics and orbit. Given the large number of parameters involved, a lot of systematic work is still required before polarized electrons can be used for high energy physics experiments.

Electron polarization results are shown in Figure 1, with a maximum here of about 6.5%. There are clear dips corresponding to so-called synchrotron side-band resonances. The polarization is expected to vanish when approaching the integer spin tunes at 26.44 and 26.88 GeV and to peak around 26.66 GeV, the value for half-integer spin tune.

Figure 2 shows how in another run the polarization could be reproducibly switched between about 8% and 4% by stepping in and out of a synchrotron side-band resonance, achieved by varying the total accelerating voltage from 102 MV to 90 MV, thus changing the synchrotron frequency from 2.7 to 2.4 kHz.

The polarization is measured (Figure 3) by the (Compton) scattering of circularly polarized photons off HERA electrons. An argon-ion laser provides a continuous 10 Watt beam of 2.41 eV photons. Lenses and mirrors transport the laser beam 190 m to the interaction point. A Pockels cell switches the photon polarization with a frequency of 90 Hz. Energy and vertical position of the back-scattered Compton photons are measured in a tungsten-scintillator calorimeter 65 m from the interaction point.

If the electrons are vertically polarized, the Compton photons will show an up-down asymmetry proportional to the electron polarization, which changes sign when switching between right and left circular laser photons. This asymmetry shifts the centre of gravity of the vertical position of the Compton photons at the calorimeter by a fraction of a hairsbreadth.

As 10^6 events are required to achieve a 1% measurement accuracy, the calorimeter and data acquisition system have been built to cope with event rates up to 10^5 Hz. This is achieved with the read-out card of the ZEUS calorimeter, which incorporates four ADCs (12-bit, 1 MHz) to digitize the signals from the calorimeter, and a Motorola 56001 DSP (Digital Signal Processor), which directly accumulates multidimensional histograms – for example photon energy versus vertical position from different laser polarization states and from bremsstrahlung photons.

With polarization values of about 8% the build-up time is only four minutes, too short to be measured accurately with the 5 out of 200 electron bunches stored in HERA

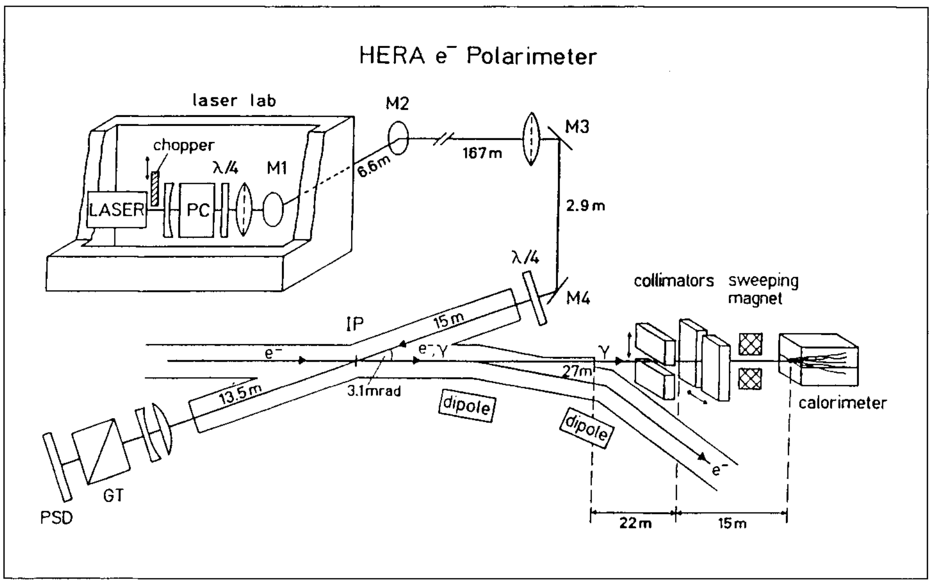


Figure 3. Schematic view of the HERA polarimeter. The elements along the laser beam are: lenses, a Pockels cell (PC) to switch the laser polarization, optical plates to change linearly polarized light into circularly polarized light and vice versa, mirrors (M), the interaction point (IP) with the electron beam, Glan-Thompson (GT) prisms to analyse, together with the position sensitive photodiodes (PSD) the position and polarization behind the interaction point.

CES INTRODUCES:

The Intelligent I/O Solution for Physics: the RIO/MIO Families

Your first level reduction made simple:
- cheap
- fast (your I/O available within 1 month)
- safe (tested with the FIC, VIC, RAID, ... environment)

CES offers design help for your application in any CES environment from simulation to layout and production.

In brief, the RIO/MIO families introduce a **revolutionary and versatile concept** in a single VME slot, offering the perfect combination of:

- huge local processing power
- a bullet-proof VME back-end
- direct software development under Real-Time UNIX

This association of features provides the key to **rapid and successful development** of specific I/O functions at the **minimum cost.**

Many I/O interfaces have already been designed, covering the principal requirements in many application fields (serial lines: **RS 232, RS 422, RS 485, Ethernet, GPIB**; acquisition tools: **ADC / DAC**; high speed link: **HIPPI**; ...).

Debugging tools

Software: CES provides an EPROM-resident software debugging tool supplied with one RS 232 serial line on a small piggy-back. When connected to a CES Real-Time UNIX Workstation it supports remote symbolic debugging.

Hardware: HP 16500A probe. CES has designed an optional piggy-back board which connects the HP 16500A logic analyser probes directly to the I/O interface bus.

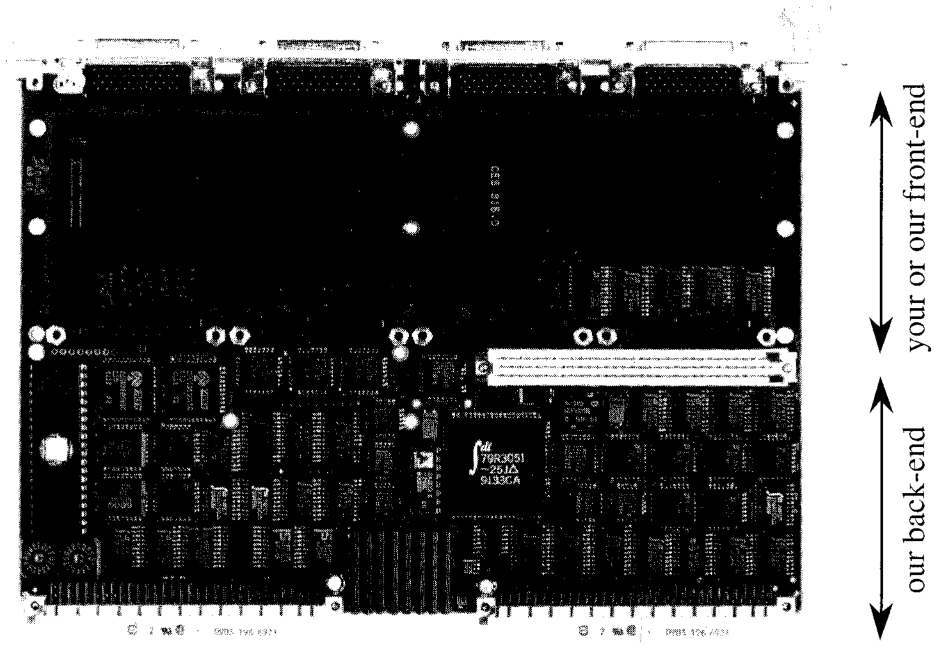
Software support

Application software can be compiled on any R3000 workstation (DEC 5000, Silicon Graphics, ...) and is optimized on the CES Real-Time UNIX **RAID workstations**. Down-line loading is either performed through RS 232 or through VME backplane (RAID workstation only).

BIOS library: access to the RIO/MIO resources.

VME library: procedures for VME access and IRQ generation.

Features:
- R3051 RISC Controller (25 MHz, 20 mips)
- 4 / 16 Mbytes of system DRAM
- 128, 256 or 512 Kbytes of EPROM
- 8 Kbytes of EEPROM
- 6 Timers & CSR
- Versatile Interrupt control
- Remote RESET register
- FIFO based message passing
- VME Slave Port (A32)
- VME Master Port with fast Block-Mover capability (20 Mbytes/s)
- 4-level VME Interrupt
- 96-pin DIN I/O-Bus connector
- Up to 4 piggy back interfaces, or
- One large 6U interface
- 20 to 100 Mbytes/s I/O bus bandwidth
- Complete software tools

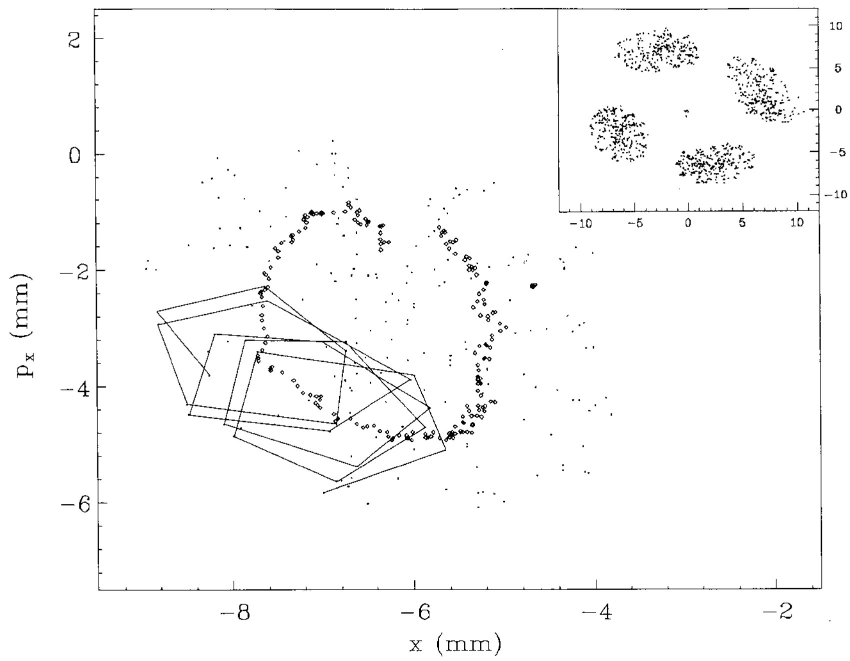


For any additional information about those products or our complete VME, CAMAC and FASTBUS line, do not hesitate to contact us.

CES Geneva, Switzerland Tel: +41-22 792 57 45 Fax: +41-22 792 57 48
CES.F France Tel: +33 50 31 55 00 Fax: +33 50 31 55 10
CES.D Germany Tel: +49 60 55 4023 Fax: +49 60 55 82 210
CES Creative Electronic Systems SA, 70 Route du Pont-Butin, P.O. Box 107
CH-1213 PETIT-LANCY 1 SWITZERLAND

Therefore this method, normally used to calibrate polarimeters, could not be employed. At present the measured polarization value has a systematic scale uncertainty of about 50%, which should be decreased fivefold by further analysis.

During the fall six machine shifts were dedicated as prime time to the polarization measurement. For 80% of this time data was taken, demonstrating the excellent performance of HERA and the polarimeter. More polarization studies are expected this year. Exceeding 50% polarization will be the signal to install the spin rotators to rotate the polarization vector of the electrons into the beam direction and open up new physics opportunities.



Experiments at Indiana University last year looked at the detailed effects of multipole magnetic fields on protons in a synchrotron. The plot shows one of the resulting 'islands' in the plot of transverse particle momentum against position. (The inset, top right, shows the full plot, with four such islands.) The solid line shows the complicated evolution of transverse (betatron) oscillations, but by taking a moving average, the trend of the particle motion (large data points) can be seen more clearly.

INDIANA
Beam dynamics experiments

Beam dynamics experiments at the Indiana University Cooler Facility (IUCF) are helping to trace complicated non-linear effects in proton machines and could go on to pay important dividends in the detailed design of big new high energy proton storage rings.

The 87-metre circumference IUCF is one of the new generation of compact machines using electron cooling to obtain extremely well-behaved proton beams with a narrow momentum spread, ideal for such precision dynamics studies.

In previous work, particle tracking in proton beams was complicated by the complex internal motion of the particles. The other alternative is computer simulation, but these complicated calculations can keep even big supercomputers busy for several days!

In an ongoing experiment, specialists from Indiana, the Superconducting Supercollider (SSC), Fermilab and Brookhaven reconstructed the detailed tracking of the particles in the IUCF and inferred the effects of higher order (sextupole, octupole,...) magnetic fields.

The cooled beam bunches were given a sudden sideways kick and the resulting transverse (betatron) oscillations tracked turn by turn. The resulting multipole fields distort the classic elliptical envelope of transverse particle momentum plotted against transverse position, with resonance 'islands' being formed.

Last year's IUCF experiments traced the movement of several different such resonances and their effects on particle motion. Ongoing goals are to follow the protons in both transverse directions rather than just one, while more data storage will enable the protons to be tracked for longer, up to 128,000 turns.

From the new knowledge of particle motion around non-linear resonances, new correction schemes can be explored. The results can also be compared with the computer simulation studies.

DUBNA
Member States

The political upheaval in what was the Soviet Union was reflected in an Extraordinary Plenipotentiaries Committee of Joint Institute for Nuclear Research (JINR) Member States, held in Dubna, near Moscow, on 10-13 December, with representatives of eleven sovereign republics of the former Soviet State taking part.

The main event of the meeting came when three sovereign republics – Byelorussia, Russia and Ukraine – became full and equal members of JINR. The Russian

Bookshelf

delegate from the Ministry of Science, Higher School and Technical Policy, B.Saltykov, pledged that, as host country, Russia will undertake all the corresponding obligations.

The delegations from Armenia, Azerbaijan, Georgia, Kazakhstan, Latvia, Lithuania, Moldavia and Uzbekhistan said their governments would take an active part in JINR activities and in the very near future would be ready to join the International Organization.

Director D. Kiss presented the Annual Report and reported on a new agreement signed between JINR and the German Ministry of Research and Technology. Vice-director A. Sissakian described the establishment of the Dubna International Centre for Development of Science and Technologies (Technopolis – Dubna).

The problems of JINR finance in 1991 and planned figures for 1992 were also discussed as well as ideas for developing the Laboratory and its science. The Proceedings of the meeting were adopted and signed by the representatives of the thirteen Member States.

Klaus Winter – neutrino physics

Some excellent books arrived on the CERN Courier desk last month, notably Klaus Winter's new tome on the neutrino, a 'must' for all enthusiasts of this enigmatic particle, and a collection of essays from Lev Okun, whose mind continually climbs above the clouds which fog lesser intellects.

A Winter's tale

'Though I am satisfied, and need no more
Than what I know, yet shall the oracle
Give rest to the minds of others such as he
Whose ignorant credulity will not
Come up to the truth.'

Leonides, King of Sicily, in 'The Winter's Tale', Act II, Scene 1, by William Shakespeare (1611).

It is over 60 years since Wolfgang Pauli sent his famous letter to the 'Radioactive Ladies and Gentlemen' gathered in Tübingen for a physics meeting. Unable to attend because of prior commitments, Pauli sent his excuses accompanied by the prediction of a new particle to explain missing energy in beta decay.

Pauli called this new particle the neutron, and predicted it would pass easily through matter. Two years later, James Chadwick in Rutherford's Cambridge Laboratory discovered heavy electrically neutral nuclear particles released when light elements are bombarded with alpha particles. He called these neutrons, and Pauli, whose particle had not yet been discovered, lost his place in the nomenclature queue.

Enrico Fermi came to the light particle's rescue, calling it the diminutive neutrino, and putting its theory in order. In 1956 the neutrino was finally seen in an experiment led by Clyde Cowan and Fred Reines at the Savannah River reactor.

Ever since, apart from a brief period in the early 60s when physicists were obsessed with strongly interacting particles, the neutrino has remained in the physics headlines, never far from the big discoveries.

The availability of high energy neutrino beams, the use of neutrinos as a fine probe of nucleon structure, and most recently, the advent of neutrino astronomy, have given new impetus to this physics. Born as part of nuclear physics, neutrino studies went on to make important contributions to particle physics, and most recently to astrophysics too, reflecting the growing interplay between particle physics, astrophysics and cosmology.

Paradoxically these new developments have still not been able to unveil many of the neutrino's innermost secrets.

This scientific saga is traced in a new book, 'Neutrino physics', edited by Klaus Winter of CERN and published by Cambridge University Press (Monographs on Particle Physics, Nuclear Physics and Cosmology, ISBN 0-521-36452-3). It is a collection of both reprinted and specially written contributions signposting the history and physics interest of this enigmatic particle.

The first chapter is devoted to neutrino history, and leads off with a 1957 Pauli paper, written just after Reines and Cowan first detected free neutrinos, and published in the book for the first time in English. The chapter also includes original reports (retypeset) on early neutrino discoveries – that of the neutrino itself; the 1962 observation by Leon Lederman, Mel Schwartz and Jack Steinberger of two distinct kinds of neutrino; and the 1973 sighting at CERN of neutral

Lev Okun – deep insight

currents in neutrino interactions in the big Gargamelle bubble chamber.

The neutral current discovery highlighted the vital role of the neutrino in weak interactions, opening the door to a deeper understanding of this physics. The culmination was the 1983 discovery at CERN of the W and Z carriers of the weak force. This evolution of weak interaction physics is traced in a separate chapter.

Other chapters cover the intrinsic properties of the neutrinos themselves – an area where many question marks still have to be resolved, the interaction of neutrinos with matter, and the results of using high energy neutrino beams to probe the deep inner structure of the nucleon – an endeavour which assumes all the basic properties of the neutrino are understood.

The final chapter deals with the role of neutrinos in astrophysics and cosmology, with contributions on solar and supernova emitted particles.

Building on a wealth of historical archive material, Editor Klaus Winter has done a good job in seeking out good authors, and the result is a valuable volume for researchers in the subject. Its appeal would have been increased by some introductory material sketching and connecting the relative importance of the landmark discoveries, and by brief synopses of the chapters themselves.

In the Cambridge University Press pipeline is another, very different, book – 'Spaceship Neutrino', by particle physics specialist writer Christine Sutton, scheduled for publication later this year.

The Relations of Particles

Stimulating reading is 'The Relations of Particles' by Lev Okun of Moscow, a collection of memorable reviews, talks and papers over a ten-year period, published by World Scientific (ISBN 981 02 0453 1 hardback, 981 02 0454 X, paperback).

Although he has no major discoveries to his credit, Okun is a widely admired physicist whose opinions and powers of synopsis are often solicited at major international meetings. He is also a prolific writer on science, at many different levels. He entered research through a back door, initially having a job in a publishing office, but his penetrating insight came to the attention of Isaak Pomeranchuk.

Many of the thoughtful papers in this latest book were drawn from introductory or concluding addresses at major international meetings on particle physics, accelerators or cosmic rays. Although some of the data and ideas in the papers have become obsolete, the clarity of thought behind them has not.

The book concludes with three articles on the concept of mass, a subject where Okun has carried out a long and often lonely crusade to preach the Truth about mass and to harass the relativistic infidels. These papers have appeared elsewhere, creating much debate and controversy.

One of Okun's most memorable talks includes an audience poll on the meaning of mass. He writes on the blackboard four variants of Einstein's famous equation relating mass and energy – $E_0=mc^2$, $E=mc^2$, $E_0=m_0c^2$ and $E=m_0c^2$ – and asks physicists which one best follows the ideas of relativity. Many people do not know, as, unlike Okun, they have rarely thought deeply about these matters. By buying the book, physicists will at least know which one they should vote for.

Also from Cambridge

Cambridge University Press have published a new edition of The Ideas of Particle Physics, by G.D. Coughlan and J.E. Dodd (hardback ISBN 0 521 38506 7, paperback 0 521 38677 2). This is aimed primarily at those with a physics background who want to go deeper than the popular books. New chapters cover quantum gravity, superunification, the relation between particle physics and cosmology, and superstrings. The book recommends CERN Courier as good reading for the non-specialist. Thankyou, authors.

Going deeper into the subject is Elementary Particles by Ian Hughes. Aimed at undergraduates, this book now appears in its third edition (hardback ISBN 0 521 40402 9, paperback 0 521 40739 7), suitably updated with material on the Big Bang, dark matter, 1987 supernova, etc.

Another useful Cambridge book is a Practical Guide to Data Analysis for Physical Science Students by Louis Lyons (hardback ISBN 0 521 41415 6, paperback 0 521 42463 1), aiming to assist undergraduates in their laboratory work, and published in a handy pocket format. It concentrates on data analysis and error estimation, and is not meant to be a textbook on statistics.

People and things

On people

The January list of nominations to the French Légion d'honneur included distinguished CERN theorist André Martin, and, as a foreign member, Emilio Picasso, former Leader of CERN's Experimental Physics Division and Director of LEP project throughout its construction phase.

David W.G.S. Leith is Associate Director of SLAC's Research Division, taking over from Charles Prescott.

Texas magnets

Peter McIntyre of Texas A & M becomes Director of the Texas Accelerator Center (TAC) at the Houston Advanced Research Center (HARC), succeeding Russ Huson.

With Carlo Rubbia and David Cline, McIntyre was one of the authors of the famous 1976 paper which first suggested using colliding proton-antiproton beams to search for the W and Z carriers of the weak force.

Huson came to Texas A & M from Fermilab in 1983 and became TAC's first Director, when R and D for the proposed Superconducting Supercollider (SSC) was the main goal. Huson and McIntyre led the push to set up TAC in the HARC framework, providing valuable impetus for the successful bid to locate the SSC in Texas.

Recently, the range of TAC's interests has extended to cover maglev trains and self-shielded high-field superconducting magnets ('Huson magnets') for magnetic resonance applications in medicine and materials research. A recent HARC seminar looked at the possibility of setting up a regional NMR research centre in the Houston area.

American Physical Society

SLAC Director Burton Richter has been elected Vice-President of the American Physical Society. The APS custom is that next year Richter becomes President-elect, and in turn President in 1994. This year's APS President is Ernest M. Henley of the University of Washington.

UK Institute of Physics awards

The UK Institute of Physics awards for 1992 include several for achievements in particle physics.

Nicolas Ellis of Birmingham receives the Charles Vernon Boys Prize for his work in the UA1 proton-antiproton experiment at CERN, particularly for his study of heavy quark production.

Peter F. Smith of the Rutherford Appleton Laboratory receives the Duddell Award for his work in the development of new filamentary superconducting composites ('Rutherford cable') which opened up new magnet applications.

Erwin Gabathuler of Liverpool and Terry Sloan of Lancaster share the Rutherford Award for their leadership in the big European Muon Collaboration experiment which began at CERN in the late 1970s and led to the discovery of the 'EMC Effect' – the dependence of nucleon quark structure on the surrounding nuclear environment.

The Maxwell Medal and Prize goes to Neil Turok of London's Imperial College for his work on cosmic strings, a possible connection between elementary particle physics and the large-scale structure of the Universe.

SSC management changes

At the Superconducting Supercollider (SSC) Laboratory in Ellis County, Texas, John Rees takes over as Project Manager from Paul Reardon. Rees came to SSC from the Stanford Linear Accelerator Center (SLAC), where he was Associate Director. In the late 1970s he was Director of the PEP storage ring project, and more recently in charge of construction of the Stanford Linear Collider.

SSC Accelerator Design and Operations Division (ADOD) Head Don Edwards retired in December, and ADOD has now moved the Project Management Office under John Rees.

Meanwhile the first industrially-built SSC dipole has been successfully tested at Fermilab, built by General Dynamics staff using Fermilab facilities. Previous successful tests (December 1991, page 6) were on magnets assembled by US Labs.

Pierre Lehmann 1926-1992

Pierre Lehmann, distinguished French experimentalist and Vice-President of CERN Council, died on 26 January, aged 65. Director of the Institut National de Physique Nucléaire et de Physique des Particules (IN2P3), he played a leading role in basic physics research in France and in French participation in international projects.

His initial major contributions to particle physics came in the early 1960s at the Orsay linear accelerator, using inelastic electron scattering to study the proton and neutron form factors. His first contact with CERN came in the late 1960s, with studies on the backward scattering of pions and kaons. During this time he looked after Orsay's contributions to counter experiments at CERN.

In 1972 he became first Chairman of the Experiments Committee for the SPS synchrotron, then under construction, so shaping and ensuring the success of the machine's future experimental programme.

As Deputy Director at Orsay, he temporarily took over the running of the linear accelerator Laboratory with the death of André Lagarrigue in 1975, and later that year became Elementary Physics Department Head at Saclay.

He was a member of CERN's Scientific Policy Committee from 1975 to 1981, and in 1986 became French delegate to CERN Council. In 1987 he was elected Council Vice-President. From 1983-88 he was also a member of the DESY Scientific Committee. Last year he became Chevalier of the French Légion d'Honneur.

Pierre Lehmann 1926–1992

Frank M. Pipkin 1925-1992

Harvard lost one of its most respected and versatile physicists with the death of Frank M. Pipkin on January 5, after a short illness. With very broad interests, he worked in the 'big science' of experimental particle physics at major accelerator centres, while his large Harvard student group maintained a major in-house programme of table-top experiments in atomic physics, lasers and atomic and molecular beams.

An infantryman in World War II, he was awarded the Purple Heart and the Bronze Star Medal for valour. He came to Harvard in 1954 as a Junior Fellow and joined the faculty in 1957. He was active in the planning, construction and operation of the Cambridge Electron Accelerator in the 60s and early 70s. He also worked at Fermilab and most recently at Cornell. From 1985-88 he was Chairman of Harvard's Physics Department.

He was a gifted mentor and many of his more than fifty students have gone on to make their mark in atomic and experimental particle physics.

Gösta Funke 1906-1991

Gösta Funke died in December, aged 85. He spent the main part of his very active life in the advancement of scientific research and on furthering the understanding of the importance of this research. After teaching mathematics and physics at Stockholm University from 1937 to 1944, he worked for the Swedish Natural Science Research Council and the Council of Atomic Research.

He played an important role in international research, in particular pushing for improved links between his country and France. He was a national delegate to NORDITA, CERN and ESO (European Southern Observatory), being Chairman of the Councils of the latter two organizations in 1967-9 and 1966-8 respectively. At CERN, he was also Chairman of the Finance Committee from 1961-3.

Meetings

An international workshop on techniques to study cosmic rays at very high energy will be held in Paris from 22-24 April, organized by IN2P3 in Paris. As well as reviewing the current situation, the meeting will look at possible new large projects. Specialists from other fields are encouraged to attend and bring new ideas. Further information from Sylvie Brelaud-Theis, fax (+33) 1 44274638, e-mail easparis at frcpn11.in2p3.fr

The 4th San Miniato Topical Seminar, to take place from 1-5 June in San Miniato (Pisa), Tuscany, will be on 'The Standard Model and just beyond'. The meeting is organized jointly by F. Hussain of ICTP, F.-L. Navarria of Bologna (vaxbo::kaos, kaos at bo.infn.it), P.G. Pelfer of Florence (vaxfi::flavour91, flavour91 at fi.infn.it) and G. Smadja of Lyon and Saclay. The seminar will focus on precise electroweak and QCD tests, heavy flavour physics with emphasis on mixing, and searches for new particles.

Following the first meeting in Stockholm in 1990, the second conference on Low Energy Antiproton Physics (LEAP 92) will be held in Courmayeur, in Italy's Aosta Valley, from 14-19 September. As well as covering latest results and future perspectives (SuperLEAR – January/

Director for the Accelerator and Fusion Research Division

The Lawrence Berkeley Laboratory invites applications for the position of Director of the Accelerator and Fusion Research Division. The Director is responsible for a varied program of research in accelerator physics and related technologies (high-luminosity colliders, two-beam accelerators, beams for heavy-ion fusion and magnetically confined fusion, free-electron lasers, and superconducting magnets) under general direction of the Associate Laboratory Director for Operations. In addition, the Division Director has overall responsibility for the construction and operation of the Advanced Light Source and the operation and improvement of the Bevalac heavy-ion accelerator facility. As a Division Director of the Laboratory, this person also participates in formulating the research policy and long-term direction of the Laboratory as a whole.

This position requires a Ph.D or equivalent in physics or engineering, combined with a distinguished record of technical management of major accelerator, detector, or fusion-energy programs. The successful candidate would be a scientific leader with strong management background, including excellent scientific judgment, strong administrative skills, creativity in decision making and problem solving, and human resource management.

The closing date for the submission of applications is May 15, 1992.

Please submit two copies of resume, salary history, and the names and addresses of three references to: Dr. Edward Lofgren, Chairman, AFRD Search Committee, Box A/7113, c/o Employment Office, 90/1042, Lawrence Berkeley Laboratory, One Cyclotron Road, Berkeley, CA 94720. An equal opportunity employer. M/F/H/V.

LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
U.S. Department of Energy

MIT

PRINCIPAL RESEARCH SCIENTIST

The MIT Laboratory for Nuclear Science invites applications for an immediately available Principal Research Scientist to assume a major role in the L3 experiment. Responsibilities will include: leading the trigger and data acquisition activities of the L3 experiment at CERN which is based on Fastbus and controlled by a large VAX cluster; initiating and performing upgrades of the electronics and of the on-line computing facility; developing on-line and data analysis software and coordinating the data taking of the experiment.

Applicants are required to have a Ph.D. in experimental particle physics followed by a minimum of five years' experience in the field, and a demonstrated ability to generate and develop concepts independently, to do independent research, and to plan and execute large projects. Experience in trigger, data acquisition, and analysis in a large high energy physics experiment essential. This should include experience in detector and readout technology, on-line and off-line software at the systems, applications and programming levels, as well as a solid background in e^+e^- physics. The successful candidate is expected to be able to work in a French speaking environment and is required to reside permanently at CERN, Geneva, Switzerland.

Please send curriculum vitae including a list of publications and a minimum of four letters of reference to: ***Mr. Richard Adams, Laboratory for Nuclear Science, MIT 26-505, 77 Massachusetts Ave., Cambridge, MA 02139-4307.***

MIT is an Affirmative Action/Equal Opportunity Employer and encourages applications from women and minorities.

Massachusetts Institute of Technology

UNIVERSITY COLLEGE LONDON

Department of Physics and Astronomy
Gower Street, London, WC1E 6BT
Telephone 071 380 7149

LECTURER IN EXPERIMENTAL HIGH ENERGY PARTICLE PHYSICS

Applications are required by **3 April 1992** for appointment to the above position in October 1992.

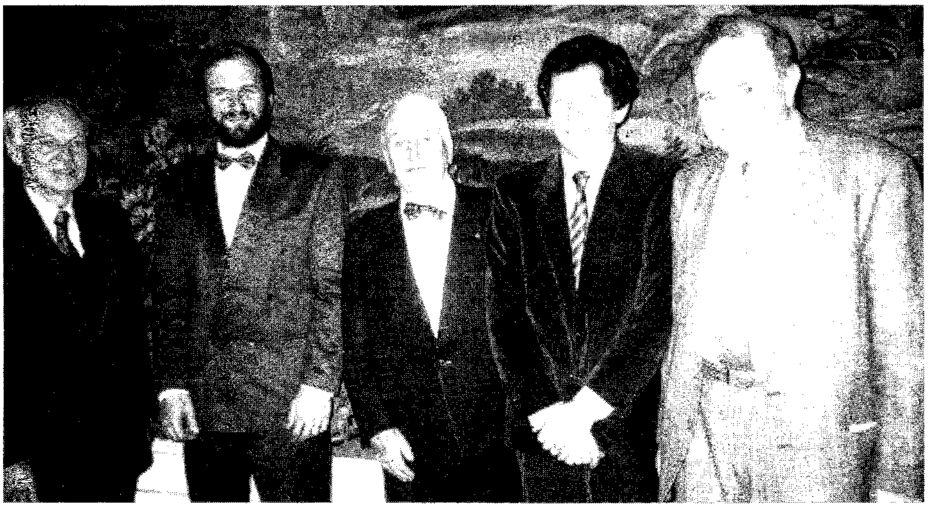
The HEPP group is a collaborator in the OPAL experiment at CERN and in the ZEUS experiment at DESY. In addition the group is actively pursuing a programme of physics studies and detector R&D with a view to participation in experiments at the next generation of colliders.

The successful applicant will be young (probably less than 35) and will be expected to have an established track record in research, or to have shown potential to become an independent and leading researcher in the field. Although participation in one of the group's present experiments is assumed, the expectation is that strong involvement in activities directed to the future development of the group will be a high priority.

Evidence of competence in teaching will be a significant factor in the appointment. Shortlisted candidates may be invited to make a presentation to demonstrate teaching ability.

Letters of application, accompanied by a full CV including a statement of research interests, and the name and addresses of 3 referees, should be sent to Prof F W Bullock at the above address. Further details can be obtained on request.

Every other year the Academie de Lyon honours two young particle or nuclear physics with the Prix Thibaud. This year LEP was honoured, with Alain Blondel (second from left) of the Aleph experiment and Guy Wormser (second from right) of Delphi. They are seen here with Academy members (left to right) A. Sarazin, M. Jacob (father of CERN theorist Maurice and grandfather of award-winning actress Irène), and C. Ruhla.



February, page 7), the meeting will also mark the 40th anniversary of the first low energy antiproton results, presented at the 1962 Geneva international conference. Further information from Silvia Giromini (fax +39 6 9403-243) or Donatella Pierluigi (fax + 39 6 9403-559) at Frascati, decnet VAXLNF::LEAP92 or bitnet LEAP92 at IRMLNF or from Sue McCreadie at CERN (fax +41 22 782-9415), bitnet MCC at CERNVM.

The Second Annual Conference on Electronics for Future Colliders will be held from 19-21 May at Lecroy Corp. headquarters, Chestnut Ridge, New York. Further information from George Blanar, LeCroy Corp, 700 Chestnut Ridge Road, Chestnut Ridge, NY 10977-6499, fax (914) 578-5984.

1992 CERN School of Computing

This year's CERN School of Computing (the 15th) will be held from 30 August-12 September in L'Aquila, Italy, organized in collaboration with and under the sponsorship of the Italian INFN and the Scuola Superiore G. Reiss Romoli. Open to postgraduate students and researchers with a few years experience, it will cover four main themes – distributed and parallel computing, modelling and simulation, techniques for experiment design, and architectures for future data-acquisition systems. The number of participants will be limited to 80, mostly from CERN Member States or from Laboratories closely associated with CERN. Further information from Mrs Ingrid Barnett, CERN, CN Division, 1211 Geneva 23, Switzerland, fax (+41 22) 767 7155, phone (+41 22) 767 3090, e-mail barnett at cernvm.cern.ch

Computing in High Energy Physics 1992

The Computing in High Energy Physics (CHEP) series of conferences aims to bring together active physicists and computing specialists to review progress in all aspects of computing in high energy physics, and to plan for the future. The next in the series – CHEP92 – will be organized jointly by the Annecy Particle Physics Laboratory (LAPP) and CERN, and will be held Annecy, France, from 21-25 September.

The meeting will concentrate on on-line and off-line computing issues important at the present and future high-luminosity colliders. Contributed papers will be presented in parallel sessions. Prospective authors should submit a 100 word abstract and a 500 word summary before 31 March by electronic mail (INTERNET) to CHEP92 at cernvm.cern.ch or mail 2 copies to: CHEP92, c/o Mme Christiane Le Marec, LAPP, BP 110, Chemin de Bellevue, 74941 Annecy-le-Vieux Cedex, France, fax: (+33) 50 27 94 95.

With the HERA electron-proton collider at the DESY Hamburg Laboratory now a reality, the HERA Machine Committee had its final meeting late last year. Left to right – Paul Reardon, Bjorn Wiik, Lyn Evans, Helen Edwards, Warren Funk, Ferdinand Willeke, Karl-Heinz Althoff, Burton Richter, Cornelis Daum, Ulrike Buechler (Secretary), David Gray, Kurt Huebner, Kjell Johnsen, Daniel Boussard, Sergio Tazzari, Jacques Perot, Ady Seidman, Volker Soergel.

(Photo Petra Harms)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE

The National Synchrotron Light Source Department (NSLS) has a position open for a scientist with an advanced degree and a background in experimental particle accelerator physics. Principal activities will be directed to the operation and enhancement of existing NSLS storage rings, and will include the study of beam intensity limiting effects, orbit stabilization and the development of the related hardware. Additional activity will involve the design, construction and commissioning of a compact, superconducting storage ring dedicated to X-ray lithography.

Candidates should submit a curriculum vitae and the names of three references to: Dr. S. Krinsky, National Synchrotron Light Source Department, Building 725B, Brookhaven National Laboratory, Associated Universities, Inc., Upton, L.I., NY 11973. Equal opportunity employer M/F/H/V.

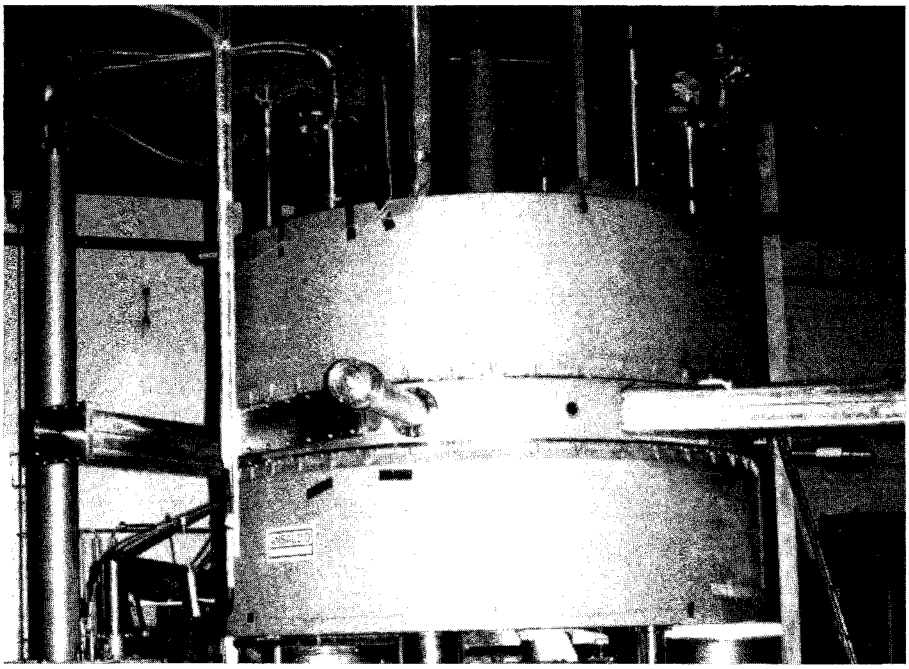
BROOKHAVEN NATIONAL LABORATORY ASSOCIATED UNIVERSITIES, INC.

Research Associate or Postdoctoral Position in experimental particle physics Université de Montréal

Applications are invited for a Research Associate or a Post-doctoral Position in Experimental Particle Physics for participation in the OPAL collaboration at LEP. The primary responsibility of the successful candidate will be the maintenance and development of the data acquisition system hardware and software of the Z chambers, one of the subdetectors of OPAL. She/he will also be expected to contribute to the data analysis and work closely with graduate students. The position requires a permanent presence at CERN.
Candidates should send their resumé and three letters of references by April 15, 1992 to :

Jean-Pierre Martin
Laboratoire de physique nucléaire
Université de Montréal
C.P. 6128, succursale A
Montréal (Québec), Canada H3C 3J7

e-mail : JP MARTIN@LPS.umontreal.ca
Telefax (514) 343-6215; phone (514) 343-7340



The superconducting magnets of the AGOR cyclotron, a French/Dutch project which eventually will be operated at the Dutch KVI Laboratory, Groningen, seen here after initial assembly at the French Orsay Laboratory.

Laboratory correspondents

Argonne National Laboratory, (USA)
M. Derrick

Brookhaven, National Laboratory, (USA)
P. Yamin

CEBAF Laboratory, (USA)
S. Corneliussen

CERN, Geneva, (Switzerland)
G. Fraser

Cornell University, (USA)
D. G. Cassel

DESY Laboratory, (Germany)
P. Waloschek

Fermi National Accelerator Laboratory, (USA)
M. Bodnarczuk

GSI Darmstadt, (Germany)
G. Siegert

INFN, (Italy)
A. Pascolini

IHEP, Beijing, (China)
Qi Nading

JINR Dubna, (USSR)
B. Starchenko

KEK National Laboratory, (Japan)
S. Iwata

Lawrence Berkeley Laboratory, (USA)
B. Feinberg

Los Alamos National Laboratory, (USA)
O. B. van Dyck

NIKHEF Laboratory, (Netherlands)
F. Erné

Novosibirsk, Institute, (USSR)
V. Balakin

Orsay Laboratory, (France)
Anne-Marie Lutz

PSI Laboratory, (Switzerland)
J. F. Crawford

Rutherford Appleton Laboratory, (UK)
Jacky Hutchinson

Saclay Laboratory, (France)
Elisabeth Locci

IHEP, Serpukhov, (USSR)
Yu. Ryabov

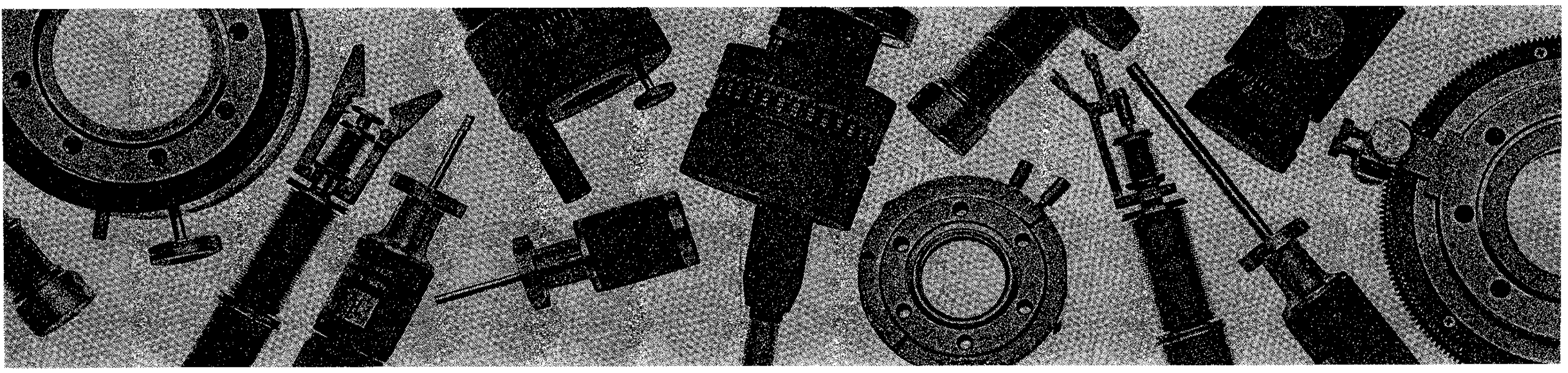
Stanford Linear Accelerator Center, (USA)
M. Riordan

Superconducting Super Collider, (USA)
N. V. Baggett

TRIUMF Laboratory, (Canada)
M. K. Craddock

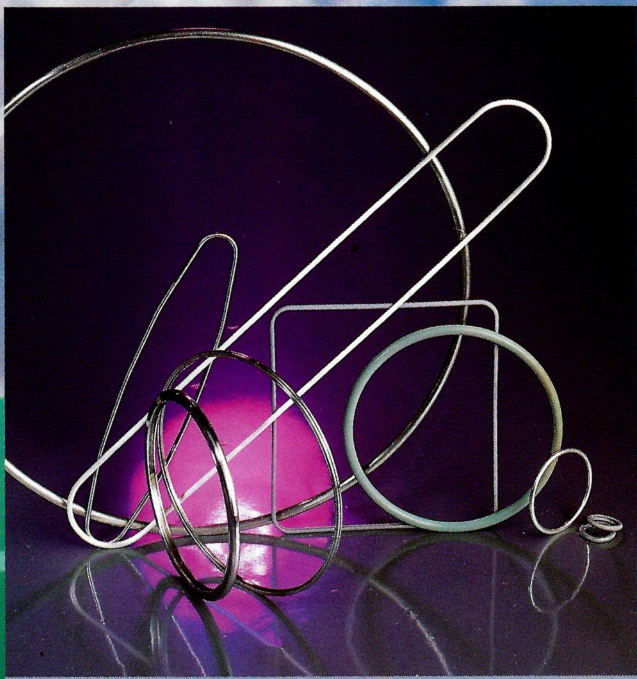
AGOR milestone

Late last year, the four main coils of the AGOR superconducting cyclotron were cooled. AGOR is a Dutch/French compact cyclotron to accelerate both light and heavy ions (protons up to 200 MeV and fully stripped heavy ions up to 95 MeV per nucleon). After construction and assembly at Orsay, AGOR will be moved to KVI Groningen in 1993 to replace the existing cyclotron.



CEFILAC® ETANCHEITE

HIGH PERFORMANCE SEALING



The seal of choice for extreme environment:

- ▶ 10^{-13} Pa. $m^3.s^{-1}$
- ▶ 850 °F
- ▶ 1.6 °K
- ▶ radioactivity
- ▶ ....

HELICOFLEX® △

The low-load spring-energized metal seal which exceeds elastomer O-ring performance.
More than 20,000 seals around the world in ultra-vacuum applications:

- – AGS / BROOKHAVEN (USA)
- – LINEAR ACCELERATOR / STANFORD (USA)
- – LEP-SPS / CERN/GENEVA (SWITZERLAND)
- – TRISTAN / KEP (JAPAN)
- – HERA / DESY (GERMANY)

Another product from

LE CARBONE - LORRAINE
CEFILAC DEPARTMENT

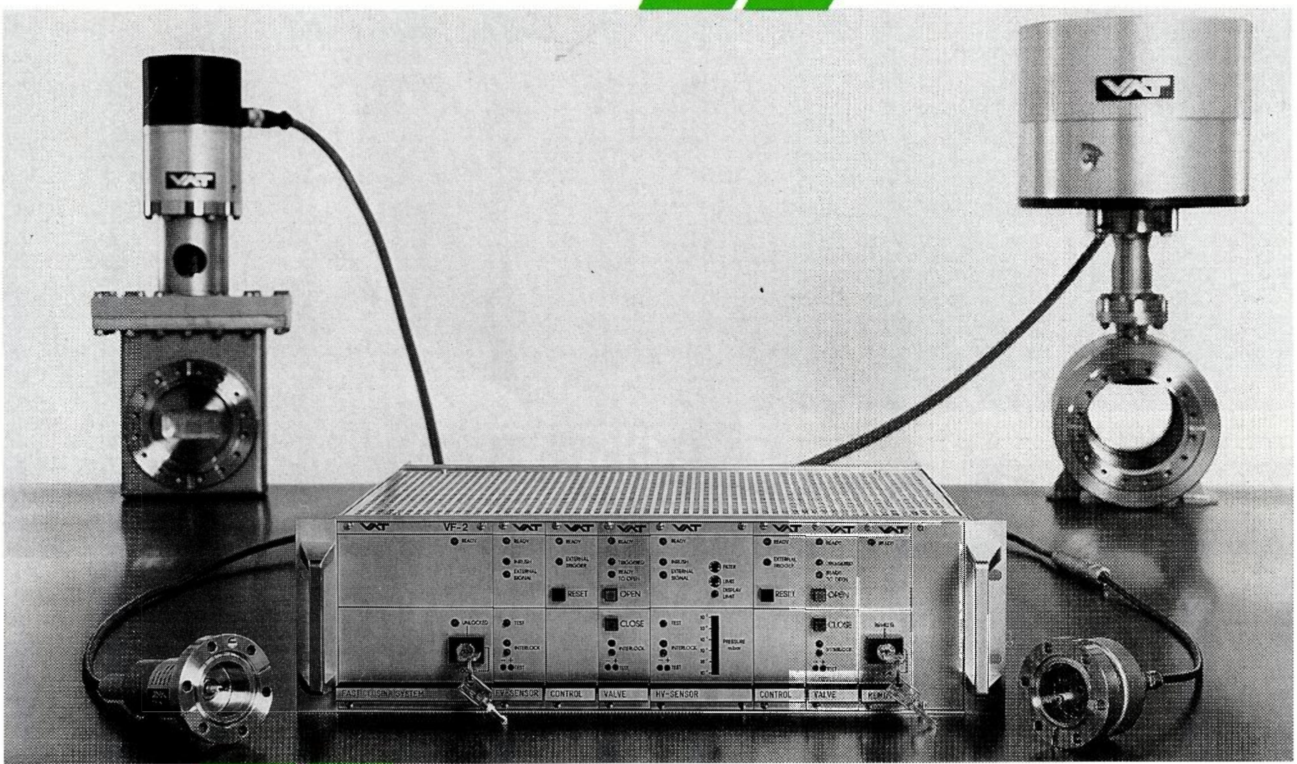
A PECHINEY COMPANY

IN EUROPE, CONTACT:
CEFILAC ÉTANCHÉITÉ
90, rue de la Roche du Geai
42029 SAINT-ÉTIENNE CEDEX 1 - FRANCE
Tél. (33) 77 25 22 77 - Fax (33) 77 57 37 18 14

IN NORTH AMERICA, CONTACT:
HELICOFLEX COMPANY
PO Box 9889 COLUMBIA
SOUTH CAROLINA 29290
Tél. (1) (803) 783 1880 - Fax (1) (803) 783-4279

VAT Fast Closing Valves and Shutters protect your Vacuum System

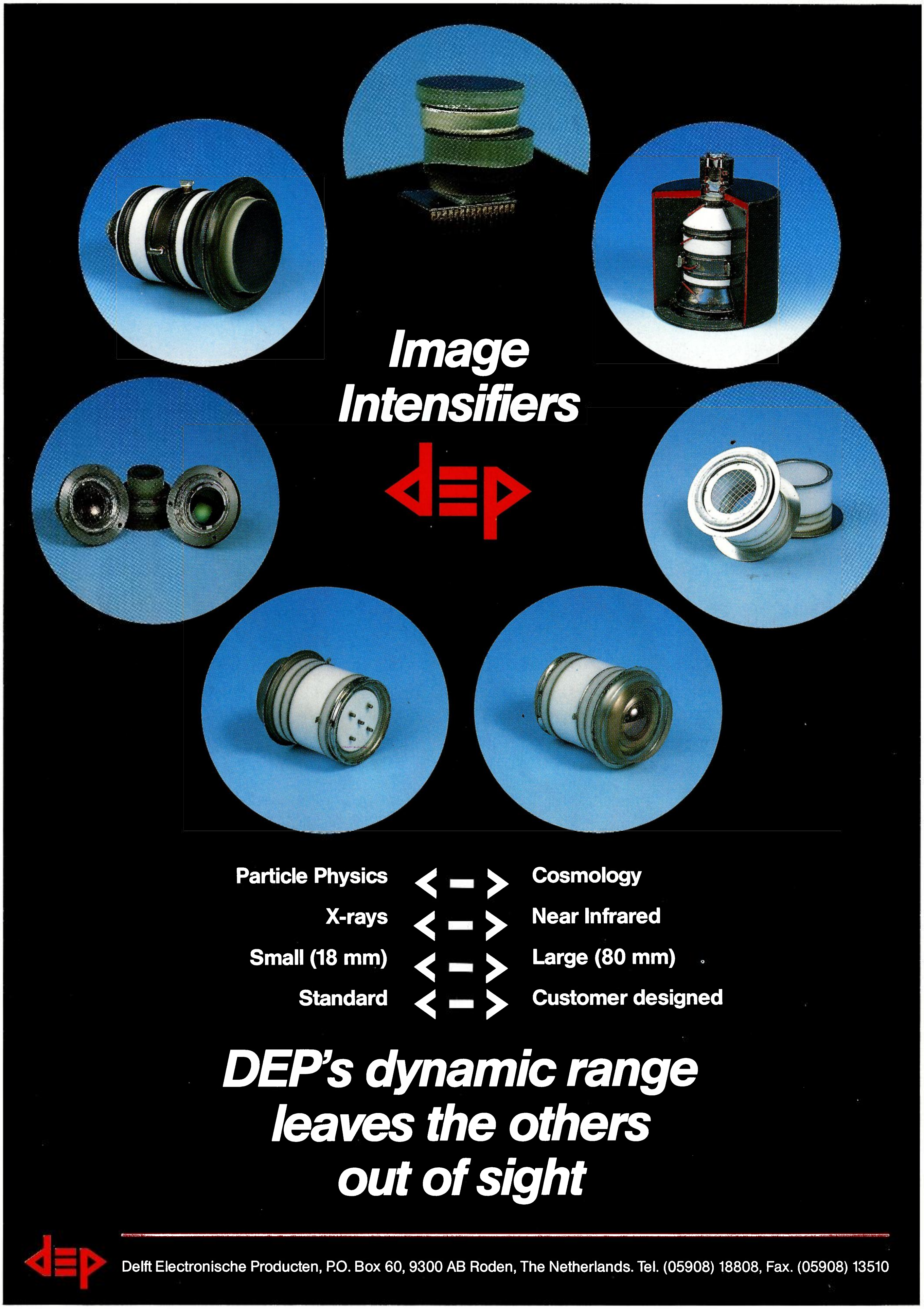
very **fast** and **tight**



VAT offers a complete solution:
A matched choice of sensors, control units, fast closing valves, and shutters.

Ask for the VAT catalogue **Vacuum Valves 90** for more detailed information.

VAT Vakuumventile AG
CH-9469 Haag, Switzerland
Tel (085) 7 01 61
Tlx 855 162 vat ch
Fax (085) 7 48 30



62 *Circle advertisement number on reader service form*

SCIFI TRACKERS?

XP1704

$24 a channel* and no cooling

Ninety-six channels at a time, and with less than 5% crosstalk. Taking PMT spatial resolution to new heights, the XP1700 family combines 64 or 96 ten-stage foil multipliers with long-life CuBe dynodes in one compact tube. Matched channel gains and transit times produce an exquisite signal-mosaic. And input-fibre multiplexing can reduce the cost of tracking low-occupancy events.

* for 10^6 channels

The XP1700 family for affordable fibre readout - without cooling

type	channels	window	photo-cathode	$sk_e(\lambda)$ at 400 nm (mA/W)	gain at 1150 V	linearity <2% (mA)	t_r (ns)	cross-talk (%)	output channels
XP1702	64	glass	bialkali	65	10^6	10	5	5^+	segmented last dynode of 2.54 mm square pads
XP1704	96								
XP1722	64	fibre-optic		60					
XP1724	96								

potted types available
$^+$scanned by a 50 μm light spot

Philips Photonics
F-19106 Brive, France
Tel. +33 55 863757
Fax.+33 55 863773

Still setting the standard

Philips Photonics

PHILIPS

PHILIPS