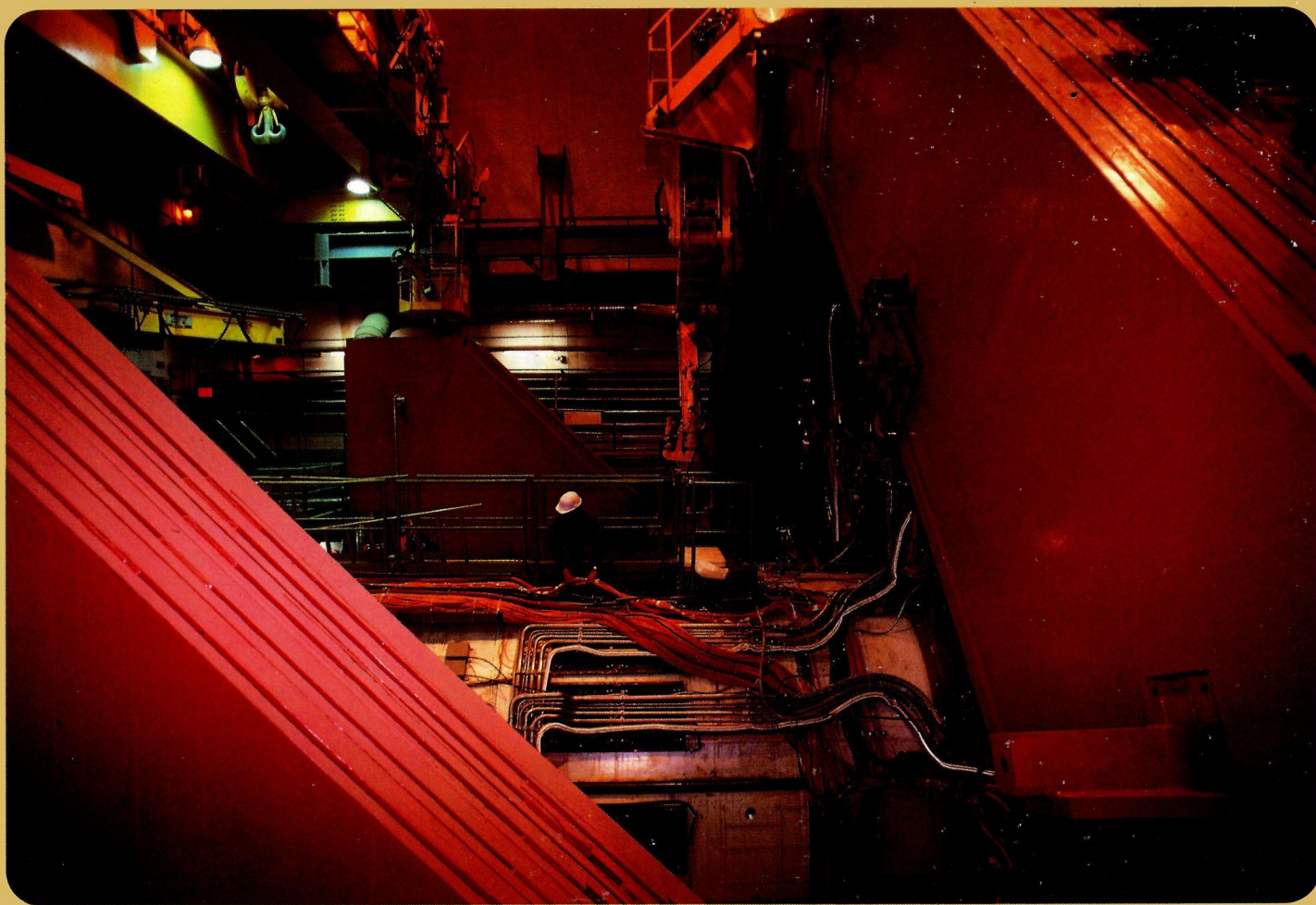


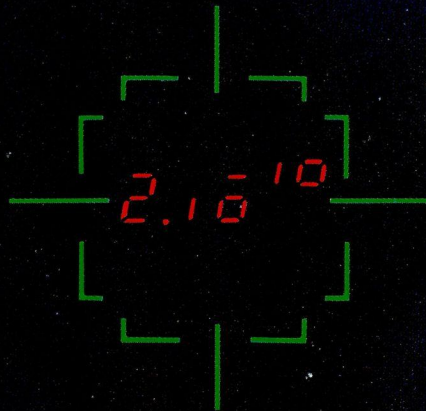
CERN COURIER

International Journal of High Energy Physics



VOLUME 32

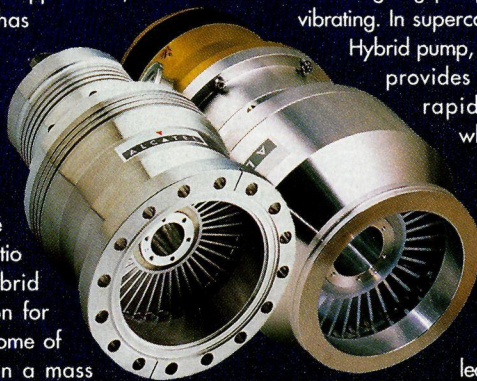
JANUARY/FEBRUARY 1992



Introducing advanced pump technology into a new decade of UHV & UCT applications

In order to extend UHV and UCT capabilities and increase the quality and success of your applications, ALCATEL VACUUM TECHNOLOGY has

combined two major pumping innovations: Our new ATS Hybrid pumps integrate multistaged turbopump and spiral helix molecular drag pump sections, thereby assuring you of excellent high pumping speeds and ultimate vacuum... plus a high-compression ratio for forevacuum tolerance. ATS Hybrid pumps also offer oil-free evacuation for better UCT results. Take a look at some of them! A high-compression ratio in a mass spectrometry application increased the sensitivity of a gas analyser system. In an electron microscope application, ATS pumps



used with a buffer reservoir connected at the exhaust, work without a roughing pump; without forepump polluting or vibrating. In superconductor preevaluations, an ATS

Hybrid pump, used with a membrane forepump provides high-vacuum tolerance and a rapid UHV dry pumping system; which results in decreasing budget problems. At low 27,000 rpm rotational speeds with ceramic ball bearings and in any orientation, ATS Hybrid Pumps will help you succeed in a new decade of pumping technology, which includes surface analysis, leak detection, particle acceleration, space simulation, load lock systems, molecular beam epitaxy.

Alcatel Vacuum Technology... a partner seeking perfection.



France : ALCATEL CIT Vacuum Technology Division - Tel : (33) 1 40 92 30 00 Fax : (33) 1 40 92 04 50
North America : ALCATEL Vacuum Products Inc. - Tel : (1) 617 749 8710 Fax : (1) 617 749 8660
West 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

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

CERN COURIER
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 OX11 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. 1
January/February
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 L3 detector
LEP experiment feature

Around the Laboratories

6 CERN: LEP vintage 1991/SuperLEP
Relative New machine, proposed machine

11 SUPERCOLLIDER: Texas meeting
Progress report

12 DESY: HERA commissioning
New electron-proton machine

13 SPIN PHYSICS: Lasers at work

16 WORKSHOPS: Radiofrequency superconductivity/Ion sources/
Theory flexes its muscles

23 LHC milestone
CERN Council news

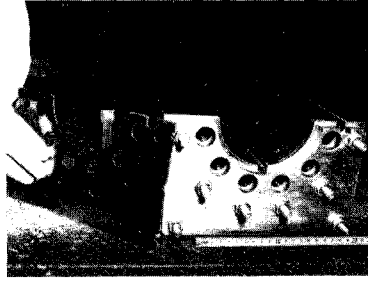
26 People and things

Reader service form, page 20.



Cover photograph:
the L3 experiment at CERN's LEP electron-positron collider
(Photo P.Y. Dhinaut)

Works of art for performance



GF Garçonnet *participated in the HERA project*

supplying stainless steel collars for the accelerator
quadrupoles, cold-rolled sheet iron for the magnetic circuit,
and polymerization tools.

GF Garçonnet

76510 Saint-Nicolas-d'Allermont
Tel. 35 85 90 58 - Telex 180 450 - Fax 35 04 03 56

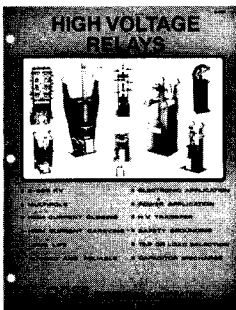
GF Garçonnet

Precision and performance

Paris office - 101, Boulevard Macdonald, 75019 Paris
Tel. 40 04 90 30 - Telex 680 078

2 Circle advertisement number on reader service form

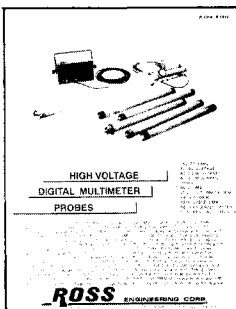
HIGH VOLTAGE RELAYS 1KV TO 300KV



HV Relays of the air insulated type both for low and high current. This series has ratings from 0.001 to 200 amps continuous, 100 to 100,000 amps momentary and capacitor discharge. Peak test voltages from 5 to 300KV. Single or Multi-pole. NO, NC and DT. Auxiliary contacts optional on all types. Latching, extended life, air pressure actuated and also tungsten contacts available for high current closing. Electrical actuators for any AC or DC control voltage.

HV WIDE BAND PROBES 1KV - 300KV

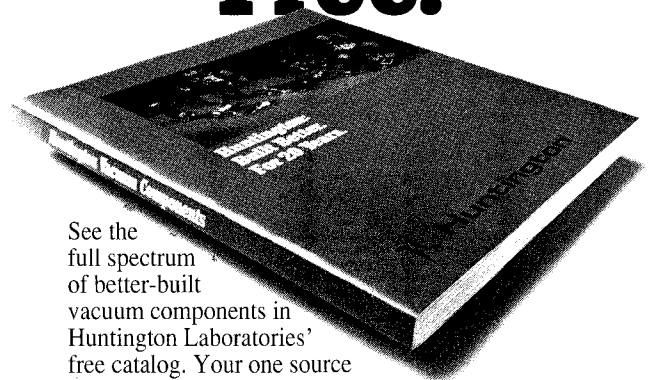
These stable high voltage Probe Systems from Ross Engineering Corporation incorporate 1KV-300KV PK HV wide band DC-10MHz probes and digital meters. With outputs for oscilloscopes and recorders together these two products provide accurate measurement and output for display of voltage, wave or pulse shape. The Ross HV insulated collapsible handles complete the hand-held model VMP Probe system to insure proper personnel clearance according to OSHA recommendations.



Products available from Ross Engineering Corporation include: H.V. RELAYS, H.V. DIVIDERS & PROBES, ANALOG FIBER OPTIC TRANSMISSION SYSTEMS DC TO 10MHz, HIGH CURRENT, H.V. SWITCHES, H.V. ROTARY SWITCHES, H.V. CIRCUIT BREAKERS, H.V. CONTACTORS, H.V. POWER LINE VOLTMETERS, H.V. DIGITAL MULTIMETERS, ADJUSTABLE SPARK GAPS, H.V. SAFETY DEVICES. INDUSTRIAL AND MILITARY APPLICATIONS.
Ross Engineering Corporation. 540 Westchester Dr. Campbell, CA 95008. Ph:(408)377-4621-Fax(408) 377-5182.

3 Circle advertisement number on reader service form

The Better Vacuum Book. Free.



See the full spectrum of better-built vacuum components in Huntington Laboratories' free catalog. Your one source for everything - from valves to manipulators, flanges to feedthroughs, standard and custom chambers. For a free copy, note your application on letterhead to: Huntington Laboratories, 1040 L'Avenida, Mtn. View, CA 94043. Or call: (800) 227-8059. In CA: (415) 964-3323. Fax: 415-964-6153.

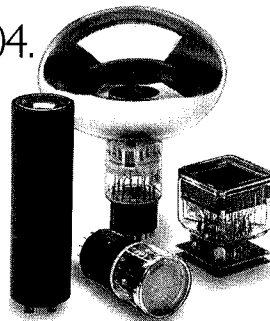
 **Huntington**
Better-Built Vacuum Components

35 Circle advertisement number on reader service form



**THE FINEST MATERIALS
MEAN NOTHING WITHOUT THE TALENT
TO PUT THEM TOGETHER.**

Wise fishermen know that flies that catch trophies take two things. Fine materials and expert craftsmanship. ■ We believe it takes the same things to build a Hamamatsu PMT. That's why we too begin with the finest materials available. Like special glass made to strict Hamamatsu specifications for clarity and uniformity. And pure nickel for lower noise and dark current. ■ Each tube is carefully hand-crafted under Class 1000 clean-room conditions. This reduces the chance of contamination that can affect performance or shorten tube life. Photocathode material is then applied in a painstaking process using advanced vacuum technology. Finally, every PMT is tested to assure unparalleled accuracy. ■ So when you need the highest quality PMTs available, call on the people who put them together like no one else in the world. Hamamatsu. ■ For assistance, call 1-800-524-0504.



HAMAMATSU

HAMAMATSU CORPORATION ■ 360 FOOTHILL ROAD, P.O. BOX 6910, BRIDGEWATER, NJ 08807

4 Circle advertisement number on reader service form



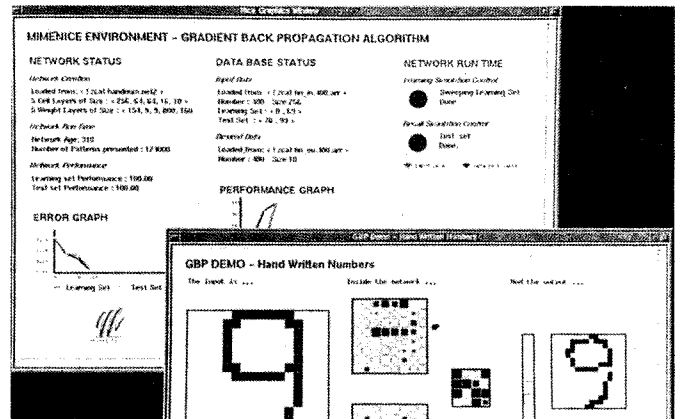
MIMETICS
THE NEURAL COMPANY

Image processing
Signal processing
Pattern recognition
Process control
Optical character recognition

Neural Networks simulators :

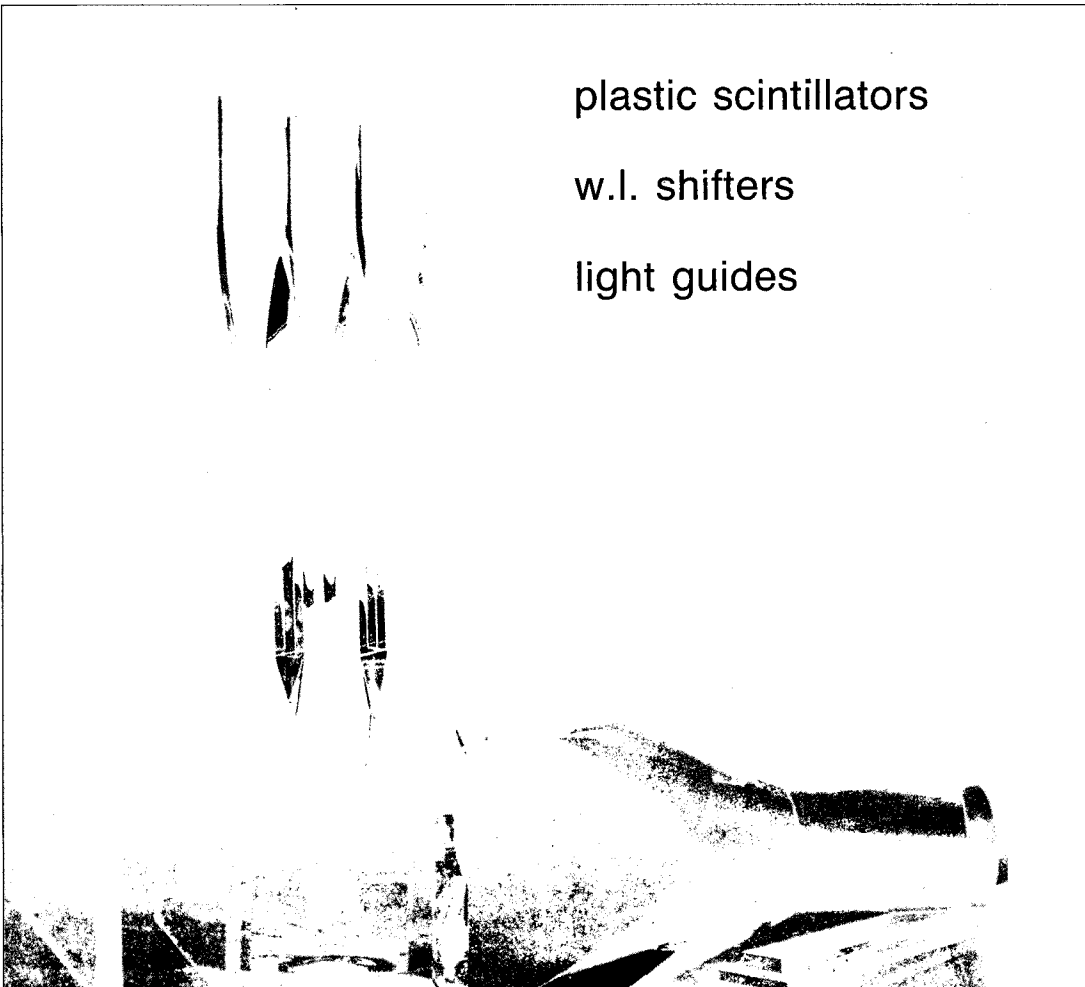
MIMENICE is a user-friendly simulator of Artificial Neural Networks, available on Sun and IBM workstations; it includes a graphic library, a Neural Networks algorithms library, and an interpreter, allowing the user to define his own applications .

MIMEDENS is our second generation environment; it includes all the MimeNice features and a graphic application-builder which allows to design new architectures by simply clicking the mouse. **MIMEDENS** works on workstations and can be easily ported onto supercomputers and "neuro-computers".



MIMETICS
5 Centrale Parc - Avenue Sully Prud'homme
92 298 Châtenay Malabry - France
Tel: 33-1-40 91 09 90 Fax: 33-1-40 91 90 55

41 Circle advertisement number on reader service form

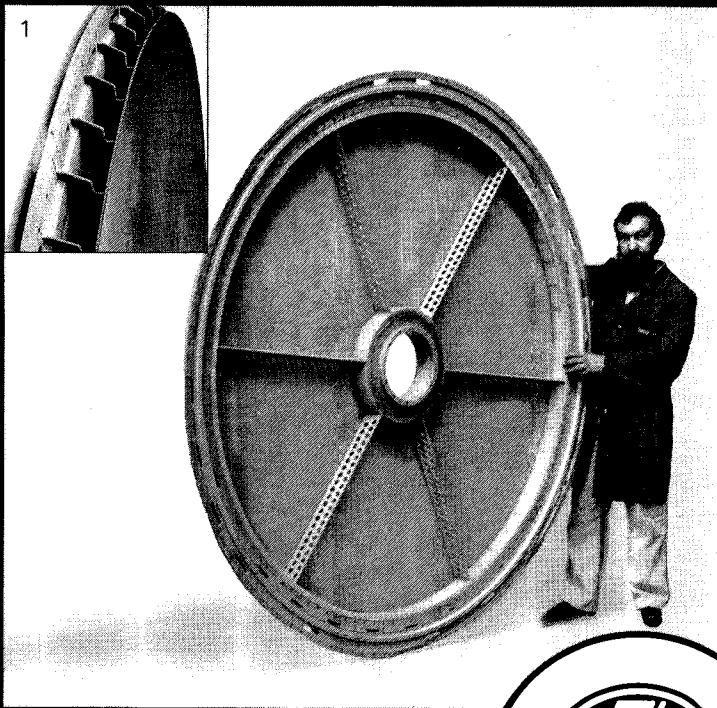


plastic scintillators
w.l. shifters
light guides

pol. hi. tech.® s.r.l.

S. p. Turanense ; Km 44,400 ; 67061 Carsoli (AQ) - Italie
Tél. (0863) 99 77 98/99 56 03 - Fax (0863) 99 58 68

40 Circle advertisement number on reader service form

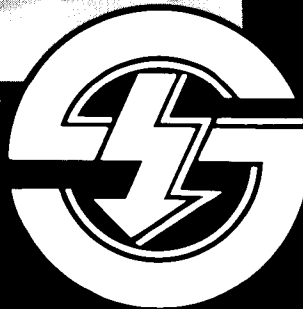


Rear panel of one of the four concially arranged TRD wire chambers

This project was commissioned by the University of Bonn, designed and completely produced together with the University and installed at DESY Hamburg.

All components were produced by the glass fibre compression process, the outer surfaces were copperplated and the components were bonded and machined so that they were ready to install.

1) The superimposed detail in the top picture shows a complicated construction in conjunction with high precision.



Stesalit AG Kunststoffwerk

CH-4234 Zullwil SO
Tel. 061 / 80 06 01 Fax 061 / 80 06 04

25 Circle advertisement number on reader service form



HIGH CAPACITY STORAGE SOLUTIONS HIGH ENERGY PHYSICS APPLICATIONS



HIGH CAPACITY HARD DRIVES

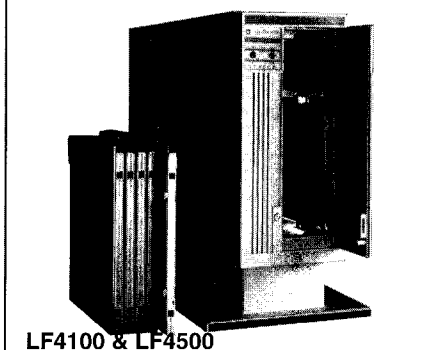
NEW FOR DSSI



SEAGATE WREN & ELITE

VALUE-ADDED SOLUTIONS FOR:
SCSI, DSSI, IPI-2, ESDI

SMALL FOOTPRINT JUKE BOXES



LF4100 & LF4500

• UP TO 28 GB OF DESKTOP ARCHIVAL STORAGE FEATURING WORM DISK AND LMSI'S RAPID CHANGER

8MM & ERASABLE OPTICAL

EXABYTE 8500



SONY-PANASONIC-PIONEER

• 5 GB TAPE BACK-UP FOR SCSI & PERTEC
• 650 MB-1 GB ERASABLE OPTICAL
• WE STOCK ALL OPTICAL DISKS

• OEM-APPROVED PERIPHERALS • VALUE-ADDED SOLUTIONS •
DEC™ • SILICON GRAPHICS™ • SUN™ • HP/APOLLO™ • NeXT™

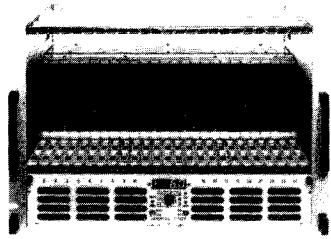
PH 612 829 0300 US
FAX 612 829 0988 US

RORKE DATA
Technology Park II
9700 West 76th Street
Eden Prairie, MN 55344

Toll Free in the US:
1 800 328 8147

36 Circle advertisement number on reader service form

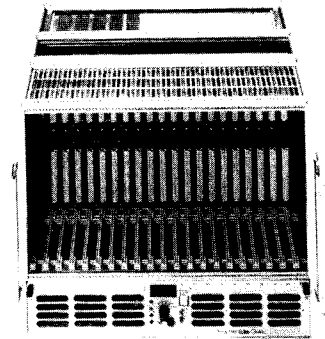
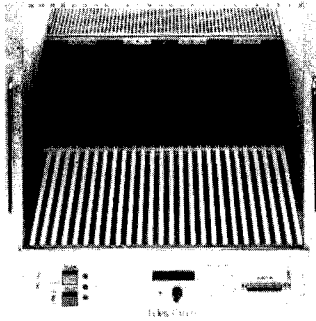
Powered Crates



**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

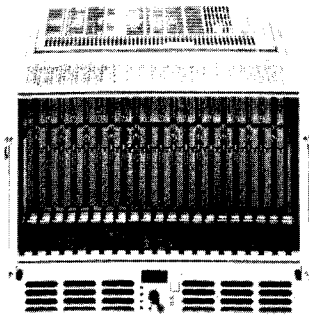
To CERN-Spec. F6852,
3.300W, 3-phase input,
switch mode regulated.
Wes-Crate Power Supplies
are distinguished by low
noise and ripple. Electro-
magnetically shielded.
**Tested and accepted
by CERN EP**



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

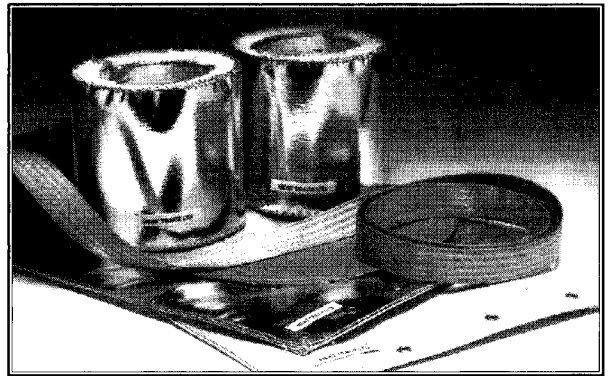
Wes-Crates GmbH
Pattburger Bogen 33
D-2398 Harsislee/Flensburg
Germany

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

FOR BAKE OUT OF HIGH VACUUM EQUIPMENT and Other High Temperature Applications Up To 450°C



Heating Jackets, Mats, Blankets and Tapes with a full
range of Electronic Control and Monitoring Equipment
from

HEAT TRACE

HEAT TRACE LIMITED, Tracer House, Cromwell Road, Bredbury, Stockport, SK6 2RF, England
Tel: 061-430 8333 Telex: 667045 Facsimile: 061-430 8654
HEAT TRACE GmbH, Im Hohlweg 42, 6231 Sulzbach/Frankfurt, Germany - West
Tel: 06196-72122 Facsimile: 06196-72385 BTX: 06196-721220001
HEAT TRACE (USA) INC., PO Box 641, Belle Mead, New Jersey 08502, USA
Tel: (201)874 6762 Facsimile: (201) 874 7679

29 Circle advertisement number on reader service form



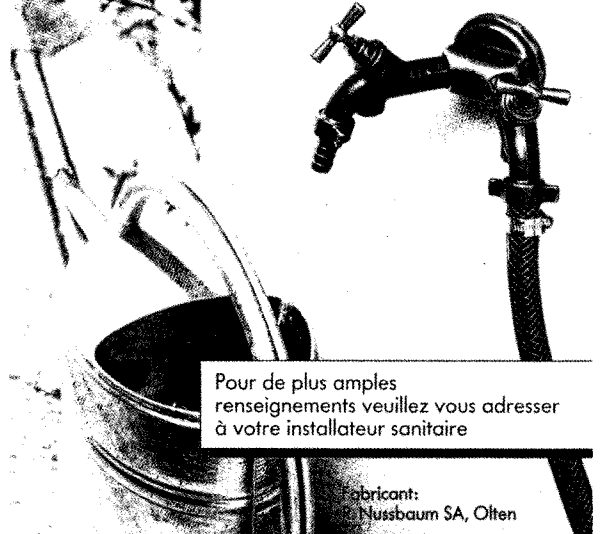
NUSSBAUM^{RM}

L'installation idéale
pour la distribution d'eau au jardin

AQUA-DUO

Double robinets de jardin

- commande: à potence ou à clé sortante
 - raccordement 1/2" ou 3/4"
 - exécution en laiton bruni
- * spécialement conçu pour montage
sur installation existante



Pour de plus amples
renseignements veuillez vous adresser
à votre installateur sanitaire

abricant:
Nussbaum SA, Olten

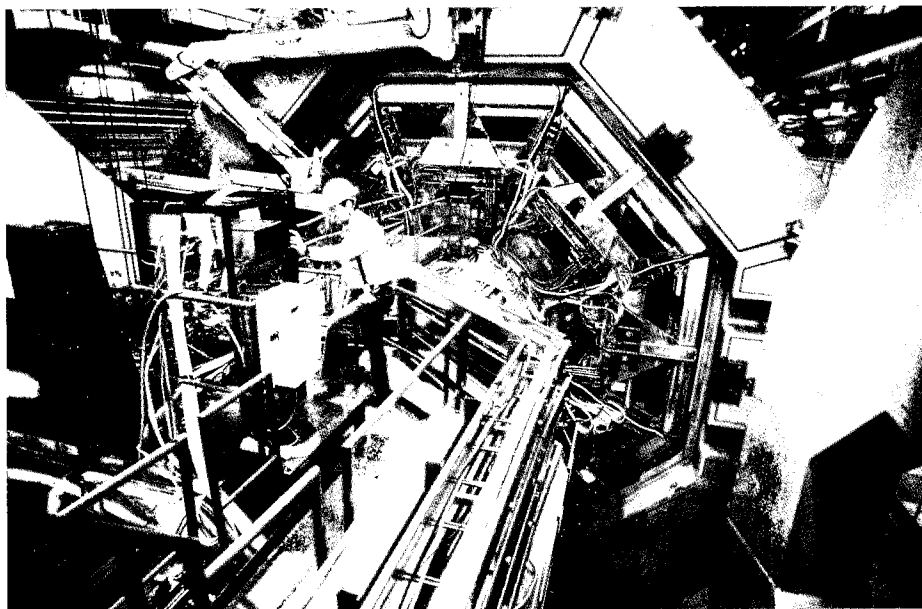
27 Circle advertisement number on reader service form

L3 detector

The L3 detector at CERN's LEP electron-positron ring – blazing a trail in worldwide physics collaboration.

(Photo P. Dhinaut)

This is the final article in the CERN Courier series marking a decade of the four big experiments – Aleph, Delphi, L3 and Opal – at CERN's LEP electron-positron collider. Data-taking started soon after LEP became operational in July 1989, followed by substantial runs in 1990 and 1991. Because of the long lead times involved in today's major physics undertakings, preparations for these four experiments got underway in the early 1980s. For Aleph, see January/February 1991, page 1; Delphi, November 1990, page 1. Opal's decade was covered in the June 1991 issue, page 4.



Eleven years ago, with design work for CERN's proposed 27-kilometre LEP ring well advanced, physicists started to think seriously about the big experiments to monitor LEP's electron-positron collisions. In June 1981, the alpine resort of Villars was the setting for the traditional ECFA (European Committee for Future Accelerators) major user community meeting to put the case for the new machine and study the physics possibilities.

That year Sam Ting's Mark-J experiment at the PETRA electron-positron ring at DESY, Hamburg, was well into its research programme, and the 1976 co-Nobel prizewinner was looking to the future. The electron-positron route could be continued at CERN's LEP ring, but there was another route, for protons, elsewhere. The idea for L3 was born when Ting visited Hans Hofer and his colleagues at the Swiss Federal

Technical Institute (ETH) in Zurich in April 1981.

The Mark-J collaboration included Aachen (III) in Germany, MIT in the US, NIKHEF from Amsterdam, JEN in Madrid and the Beijing Institute of High Energy Physics. (Mark-J was the first western scientific project in which Chinese physicists participated following the 1977 cultural revolution.) As well as ETH, Antonino Zichichi's group, with valuable experience in studying lepton pairs, was eager to join any new Ting venture.

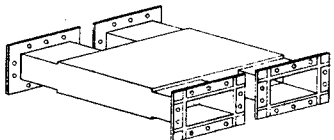
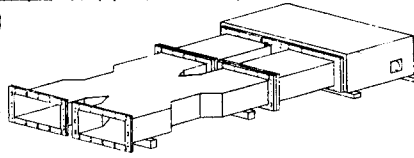
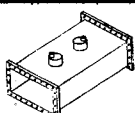
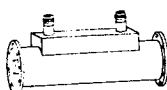

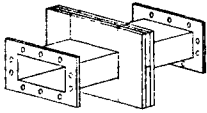
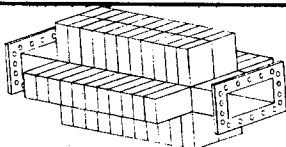
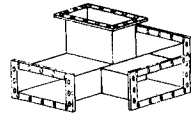
What came to be known as L3 (it was the third Letter of Intent to be submitted for approval in 1982) looked very different to the other LEP detector plans. While these concentrated primarily on the hadron (strongly interacting) and lepton (weakly interacting) products of the electron-positron collisions, Ting's plan was to construct a detector to emphasize the leptons and photons produced in electron-positron annihilation, looking deep inside the electroweak mechanism to see what makes it work.

As well as being large, L3 is also a truly world collaboration, the first major physics team to span Europe, the US, USSR, the People's Republic of China, and Asian countries.

Despite its \$150 million pricetag, funding for the detector was never a major problem, with the USA, the Soviet Union and the Eurasian countries each contributing about a third of the total cost. However Ting says that setting up the worldwide team, for example with Soviet and Chinese scientists working alongside each other – a rarity in those days, took a lot of patient preparation.

Once outlined, the initial L3 design, with a large magnet enclosing a modular detector aimed at precision measurements of photon, electron and muon momenta, did not change very much. The need for an outer magnet to provide the required momentum measurement precision meant that the detector had to be big. Unlike the other LEP detectors, constructed on the push-pull principle with a 'garage' position away from the circulating beams, L3 had to be built in situ. As in effect it formed part

HIGH-POWER AND SUPER-HIGH POWER WAVEGUIDE AND COAX NETWORKS

	
BROAD BAND SUPER-HIGH POWER, HIGH VACUUM HYBRIDS	PHASE SHIFTER/ IMPEDANCE MATCHERS
	
WAVEGUIDE DIRECTIONAL INSTRUMENTATION COUPLERS	COAXIAL LINE DIRECTIONAL INSTRUMENTATION COUPLERS
	
COAX D.C. BREAKS	WAVEGUIDE D.C. BREAKS
	
HIGH POWER ABSORPTIVE FILTERS	MAGIC TEES

NOW THERE'S A HIGH POWER RF WAVEGUIDE AND COAX COMPONENTS COMPANY WITH THE KNOW-HOW TO DELIVER COMPLETE SOLUTIONS...

- COAXIAL LINE
- WAVEGUIDE WR-90 – WR-2300
- HYBRIDS
- PHASE SHIFTERS
- IMPEDANCE MATCHERS
- DIRECTIONAL INSTRUMENTATION COUPLERS
- HIGH-ORDER MODE FILTERS
- D.C. BREAKS
- ULTRA-HIGH VACUUM NETWORKS
- TEES
- POWER DIVIDERS
- PRECISION MICROPROCESSOR-BASED RF INSTRUMENTATION AND CONTROL SYSTEMS

-RFT RF TECHNOLOGIES CORPORATION →

238 GODDARD ROAD
LEWISTON, ME 04240

TEL: (207) 777-7778
FAX: (207) 777-7784

6 Circle advertisement number on reader service form

PHYSICS FROM OXFORD... QED!

Niels Bohr's Times

In Physics, Philosophy, and Polity
Abraham Pais

Niels Bohr's life spanned a time of revolutionary change in science and its impact on society. Pais describes the state of physics before Bohr and considers his legacy, both theoretical and practical. But more than this, he captures the essence of Bohr, the intensely private family man.

0-19-852049-2, 582 pp., illus., Clarendon Press, October 1991 £ 25.00

Theories of Everything

The Quest for Ultimate Explanation
John D. Barrow

Many scientists now believe that we are close to discovering a 'Theory of Everything', a formula which will contain all that can be known about the universe. In this fascinating and very readable book, John Barrow asks whether this Theory of Everything is within our grasp, and whether it can really tell us Everything.

0-19-853928-2, 234 pp., illus., Clarendon Press, April 1991 £ 14.95

TO ORDER: These books can be ordered from your usual supplier. Customers in the UK and Europe can also order from OUP Distribution Services, Saxon Way West, Corby, Northants, NN18 9ES (add £ 1.75 P & P). Credit card holders can order by phone (0536) 744964; or fax (0536) 746337.

OXFORD UNIVERSITY PRESS

7 Circle advertisement number on reader service form

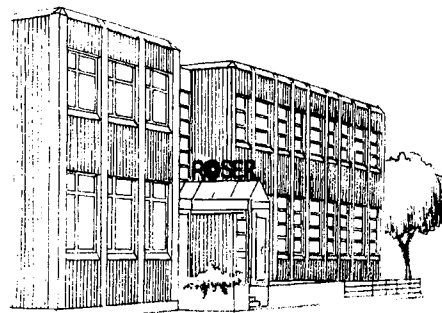
ROSER

ERNST ROSER AG

Feinmechanik und Apparatebau
Ziegelackerstrasse 9A, CH-3027 Bern 27
Telefon 031 56 76 76 Telefax 031 56 76 00
neue Tf-Nr. ab 28.3.92: 992 76 76
neue Fax-Nr. ab 28.3.92: 992 76 00

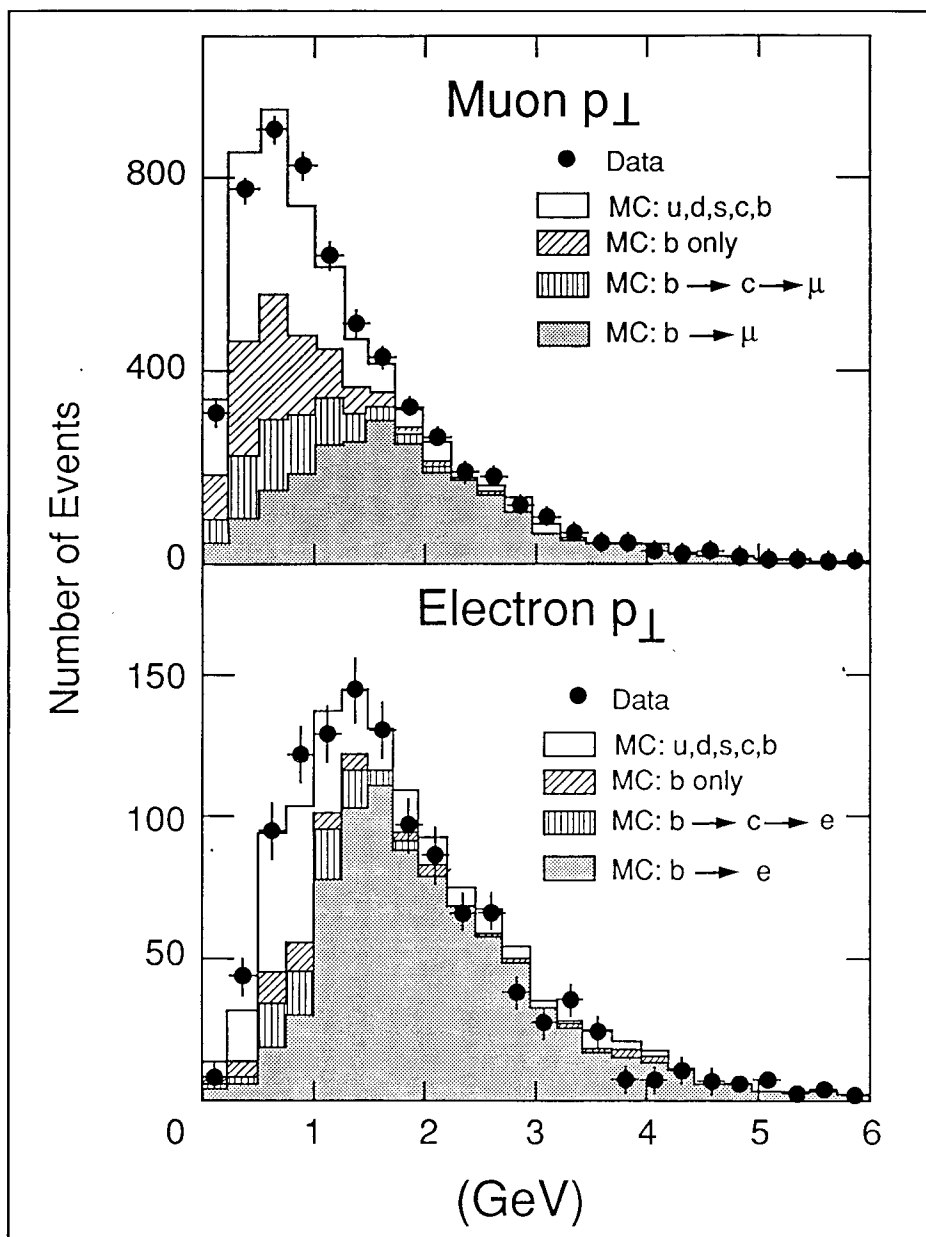
**Unsere Stärke
liegt in der Vielseitigkeit**

- Elektronik
- Feinmechanik
- Produktentwicklung
- Apparateschlosserei
- Servicestelle für Messapparate



8 Circle advertisement number on reader service form

B particle physics is one of L3's emerging specialities. Cutting off muon and electron transverse momentum below 2 GeV gives a clean sample.



of LEP's infrastructure, L3 had to be ready and operational on LEP Day One. This was a powerful driving force in L3 installation.

Another novel L3 feature is the use of bismuth germanium oxide (BGO) for the electromagnetic calorimeter. Twelve tons of this material are used in the complete detector, which drove the material's market price down

from \$18 to \$5 per cubic centimetre. The BGO raw material was supplied by the Soviet Union, but crystal production was in the capable hands of the Shanghai Institute of Ceramics.

Responsibility for the 8000-ton magnet, 15.6 metres high, 13.6 long and providing a central field of 0.5 T, and the large experimental area was

shared by the big guns of the collaboration – CERN, ETH Zurich, ITEP Moscow and MIT.

Inside the magnet are the muon large muon chambers (NIKHEF Amsterdam/Madrid/ETH Zurich/Harvard/Naples/Leningrad/ MIT/Northeastern) to give resolution of one per cent or better at the Z mass working point. Under Ulrich Becker of MIT, research and development work for this major detector component went through many iterations – it took two years to produce the first octant for the ultra-precise muon central barrel spectrometer – before an optimal design emerged and production could begin. Precision laser monitoring systems were specially developed to ensure accurate octant alignment.

Inside the muon chambers, the hadron calorimeter (Aachen/ Florence/ITEP Moscow/Michigan/Rome/Bombay/ETH-EIR Zurich) with copper and Soviet uranium absorbers was assembled at the Swiss Federal Institute for Nuclear Research (EIR). Here too extensive initial R and D work paid dividends.

Inside the hadron calorimeter, the BGO electromagnetic calorimeter (including a luminosity monitor) is also delegated to a highly international team (Aachen/Annecy/ Beijing/Budapest/Caltech/Carnegie-Mellon/ CERN/Geneva/Hofei/ Lausanne/ Lyon/Madrid/Munich/Moscow/ NIKHEF/Princeton/Rome). In place for the 1991 run are the endcaps, making the original L3 design finally complete.

The 'Time Expansion Chamber' vertex chamber currently at the heart of the detector was built by a European team (Aachen/Zeuthen-Berlin/ Zurich) after considerable prototype development at Aachen, Geneva and ETH Zurich.

L3's Governing Board – the Execu-

L3's Higgs candidate – explained as a Z decaying into a Higgs and a pair of muons (top left), the Higgs subsequently giving the particles, including a lone muon (right), corresponding to a beauty (b) quark-antiquark pair.

tive Committee – includes key delegates from the collaborating research centres with vital responsibility for subdetector units. Other groups represented on the Committee look after physics goals, detector improvements, assembly and parameters, the magnet and the experimental area, on- and off-line data analysis, triggering, and instrumentation R and D. The sessions are open to all L3 collaborators.

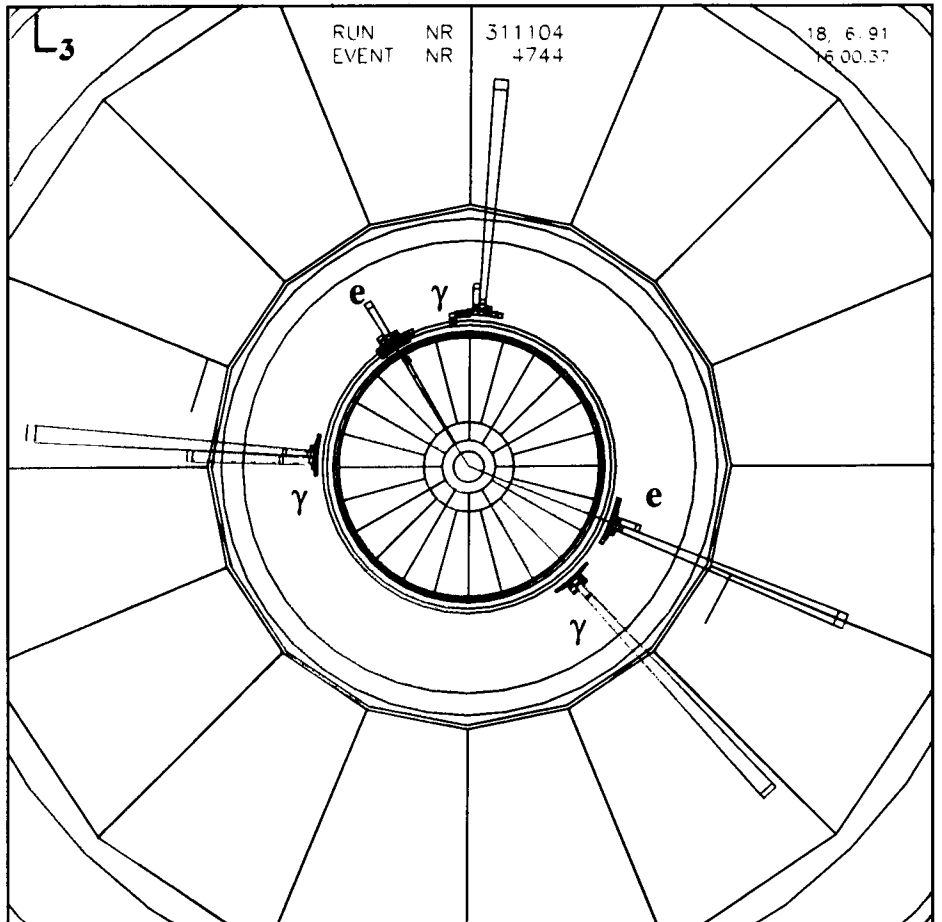
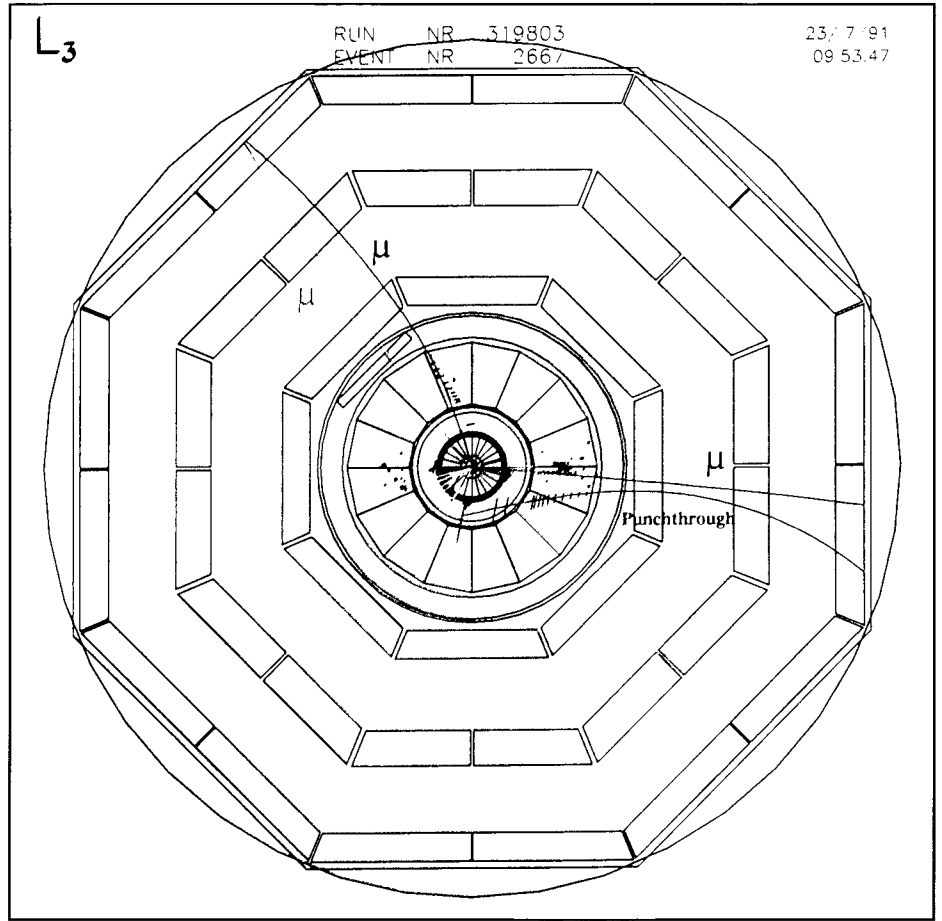
Special L3 roles are played by Hans Hofer of ETH Zurich with overall responsibility for coordination and finance (L3 has its own Finance Committee) and Frederic Eppling of MIT in administration and communications. At CERN, François Wittgenstein led the magnet team, while Alain Hervé and Mike Harris looked after engineering support.

The collaboration was boosted in the mid-80s with the advent of the World Laboratory. Under Antonino Zichichi, this project aims to capitalize on the science and technology base of the major industrialized nations to promote projects in developing countries. A World Laboratory contingent is now the largest single institute team in L3, sharing responsibility for much of the experiment's data analysis hardware and software.

In this way young scientists from developing countries get valuable experience in front-rank high technology, providing a strong springboard for future careers and a catalyst for technology sharing.

During L3 installation, cabling turned out to be a tough task, but monthly meetings under Lars Leistam sorted this out. Such a widespread collaboration also

An interesting Z decay from L3, giving an electron-positron pair and three high energy gamma rays.



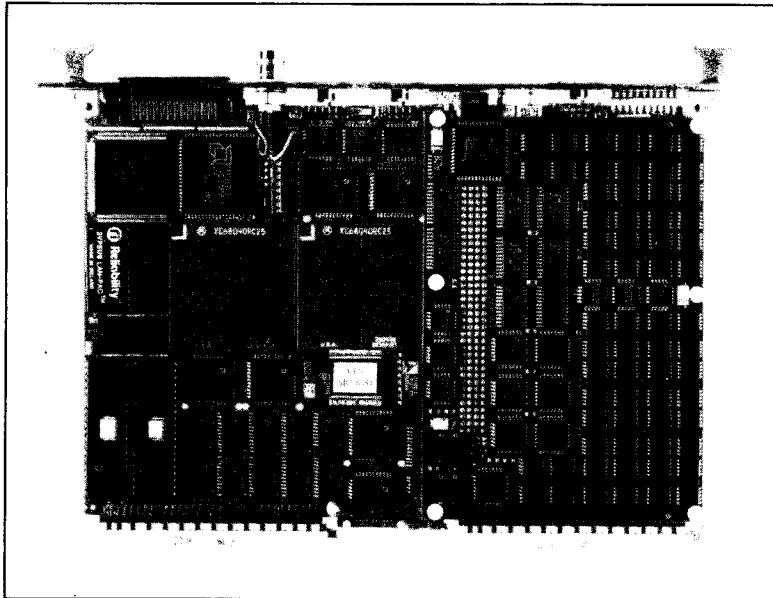
CES PRESENTS:

The best of both CISC & RISC worlds, with the best for each world :
Real-Time UNIX®, just to fit in with your needs !



where data flow is critical...

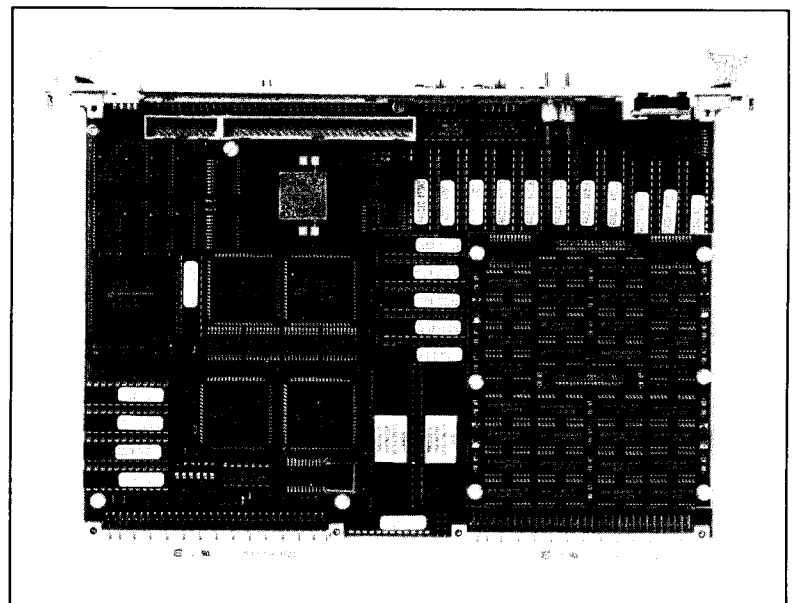
68040 CISC, FIC 8234



- Dual 68040 processor 25 MHz or 33 MHz.
- Up to 128 Mbytes System Memory.
- Up to 1 Mbyte of EPROM.
- Eight 16-bit timers and Real-Time Clock.
- High-Speed Block Mover Logic.
- Real * 40 Mbytes/s Block Mover in D32
* 80 Mbytes/s Block Mover in D64
- Multiprocessing message passing through eight 32-bit FIFOs and two Mailbox Interrupts.
- Local Bus Extension connector.
- 8 Kbytes EEPROM.
- Direct Cheapernet (79C900) with a private buffer.
- Two RS-232C serial ports.
- 53C710 32-bit SCSI Scripts Processor.
- Fast SCSI-2 (10 Mbytes/s).
- 66 Mbytes/sec (@ 33 MHz) 32-bit Host bus DMA.
- VME/VSB Master/Slave Interface.
- VME Interrupt Handler & Requester (SIC 6351).
- VSB Slave Write Broadcast Mode supported.
- OS9 and Lynx OS supported.

...where massive calculation is required

R3000 RISC, RAID 8235



- MIPS R3000 RISC processor 24 / 48 MHz.
- MIPS R3010 Floating Point Unit.
- 32/128 Kbytes Data & Instruction Caches.
- 8/32 Mbytes System Memory DRAM.
- 8 Kbytes NVRAM.
- Sixteen 16-bit Timers & one Real Time Clock.
- Four 32-bit FIFOs of 255 words each.
- High Speed DMAC (WE 32204).
- 42000 Dhrystone & 7 Mflops SP Linpack.
- Block mode Quad Word Transfer over local, VME and VSB busses.
- SCSI, Ethernet and two RS-232 Interfaces.
- VME Master / Slave Interface.
- VSB Master / Slave Interface.
- Complete Interrupt handling.
- Virtual Interrupts & Message passing.
- General Purpose front panel connector.
- TC/IX and VRTX32 supported.

For these and our other VME, CAMAC and FASTBUS modules, contact us :

Headquarters: CES Geneva, Switzerland Tel: (022) 792 57 45 Fax: (022) 792 57 48
CES.F France Tel: (33) 50 31 55 00 Fax: (33) 50 31 55 10
CES.D Germany Tel: (6055) 4023 Fax: (6055) 82 210

CES Creative Electronic Systems SA 70, Route du Pont-Butin Case Postale 107
CH-1213 PETIT-LANCY 1 SWITZERLAND



Around the Laboratories

needed a special effort in data communications. Richard Mount of Caltech looked after the international computer network.

L3 has its own dedicated computer for data analysis. Provided by US Department of Energy funds, it currently uses an advanced IBM 3090-200J processor.

Despite its size and complexity, the detector worked very well when LEP provided its first beams in the summer of 1989. A few dead sectors in the vertex chamber were soon replaced.

Sam Ting sees the three data taking seasons so far as only the beginning of a long career for L3. With the current data samples there is little to choose between the four detectors, he explains. However specific design objectives should come into their own in the next few years, when the experiments have each a few million Z decays under their belts. He highlights the first L3 results on B physics (particles containing the fifth 'beauty', or 'b', quark) as a pointer to L3's future capabilities. These results include branching ratios for semi-leptonic b quark decays, the affinity of the Z particle for b quarks, the mixing parameter of the neutral B mesons, and the lifetime of B particles.

Also for the future, L3 is installing forward-backward muon chambers to extend muon coverage down to 22 degree angles. This will be particularly important for running at higher LEP energies to study the physics of W particle pairs. L3 will also be fitted with a microvertex detector inside the Time Expansion Chamber and immediately around a new narrow beam pipe, to improve tracking for very short-lived particles.

Despite the complexity of the detector and the size of the experimental collaboration, L3's results are

presented publicly in a refreshingly clean and easy-to-assimilate form. 'Physics comes from transmission of simple ideas,' explains Ting. 'You don't have to go into too many details.'

CERN LEP vintage 1991

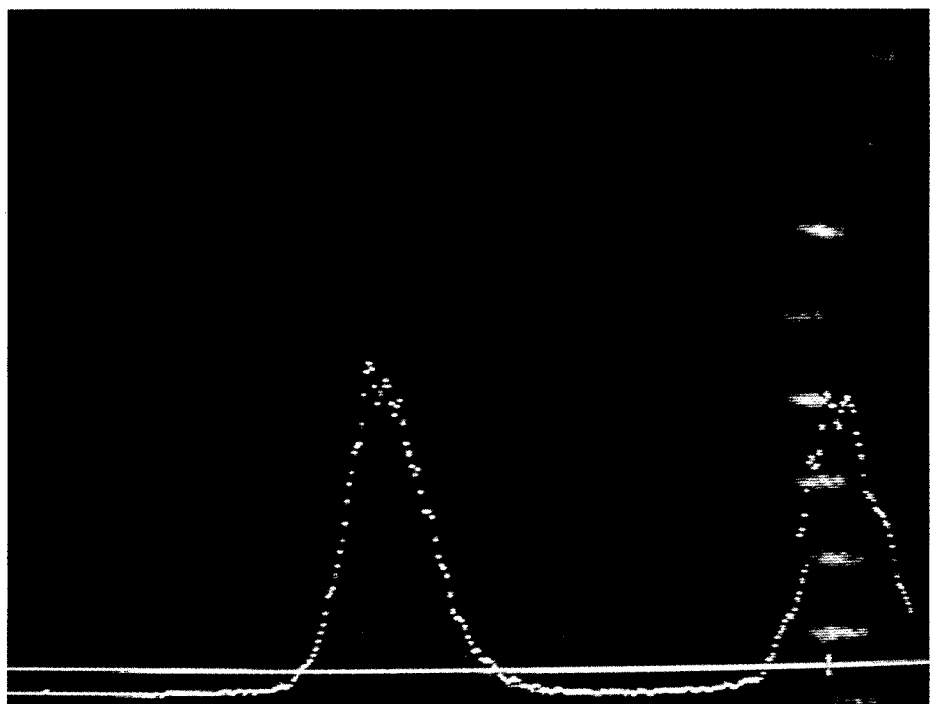
When CERN's 27-kilometre LEP electron-positron collider finished its 1991 run in mid-November, the four big experiments – Aleph, Delphi, L3 and Opal – had each amassed about 300,000 Z particles over eight months. This was about twice the figure for the 1990 run, so that the total number of Zs seen by the four detectors since experiments got underway in August 1989 now exceeds two million.

1991 started on an optimistic note. Lessons had been learned, and a healthy crop of Zs was expected. In addition, LEP would continue to scan around the Z energy to see how behaviour changes across the resonance.

After the experience of the 1990

A specially developed streak camera at CERN's LEP electron-positron collider can give top (left) and lateral views of the circulating particle bunches. In this photograph, the development of the bunches (each a few centimetres long, about a millimetre high and a few millimetres across) in successive (bottom to top) turns around the 27-kilometre ring shows delicate oscillations. This camera has proved invaluable in understanding the complex behaviour of the LEP beams.

(Photo CERN CO 36.11.91/3)



run, simulation studies had suggested how troublesome beam-beam effects could be sidestepped using a new optimal working point (horizontal and vertical tuning). This worked, and together with some magnet realignment, gave luminosities of some 7×10^{30} per sq cm per s, compared with a best of 5×10^{30} in the previous year.

Among other things, beam-beam effects had meant that the experiments saw less than the predicted luminosity. In addition, the four experiments, spaced symmetrically around the ring, had each seen a different luminosity. In 1991, they enjoyed equal and predictable shares of electrons and positrons.

The next tentative advance came when new measurements showed that the (low-beta) focussing quadrupoles were not squeezing the colliding beams as tightly as was thought. The collision rate is very dependent on this final beam compression, and rectifying the error quickly took the luminosity to 10^{31} . With the Z score climbing fast, confidence was high.

However this fresh optimism was short-lived. The new conditions brought in their wake high backgrounds and radiation problems in the experiments. The new settings had to be abandoned, and the peak luminosity took a step back.

The experiments log their data while stable beams collide, a good beam coast lasting about eight or nine hours, sometimes more. Before the next one, the depleted beams have to be dumped and the ring refilled with fresh particles. Ramping the beams from the 20 GeV at which they are injected from the SPS towards 45 GeV takes the best part of an hour, and the final grooming of the beams before physics conditions are 'declared' normally takes another

hour. However these figures are very variable, and coast turnaround time has been as short as one hour.

Accumulated experience and know-how continually improve overall machine efficiency (the ratio of collision coast time to total time available for physics). One particular 1991 improvement (which also reduced residual beam-beam effects) was a combined ramp and squeeze procedure to simultaneously accelerate the LEP particles and focus them at the collision points. Over the year, the average efficiency was about 44 per cent, but attained 70 per cent at times.

Running during the height of the summer was dogged by a series of equipment failures. Also taking their toll were power supply instabilities due to thunderstorms, and skill shortages with key personnel enjoying well-earned vacations.

This down-time underlined the importance of comprehensive monitoring and diagnostics. The LEP control room can now follow a lot more behaviour on-line and anticipate trouble.

At the beginning of October a major vacuum leak was found in the beam tube inside the Delphi experiment, where the aluminium lining had become detached from the outer carbon fibre reinforcement. After heroic efforts, a sleeve was fitted to get physics underway again for the remainder of the run and minimize downtime.

After three operational seasons, the LEP team still acknowledge that their machine is tricky. Unforeseen wrinkles need careful investigation, but smoothing out one quickly reveals another somewhere else. The latest LEP obstacle to appear is unwanted sidebands of main resonances attacking the positron beam.

Interleaved with the physics, as

always, was machine development time. As well as exploring new machine optics for improved running, the main 1991 goals were beam polarization (leading to an improved energy calibration – November, page 10), testing superconducting radiofrequency units which will take the LEP collision energy towards 200 GeV, and preparing the way for the 'pretzel' scheme – running with eight, rather than four – bunches per beam.

The 1992 LEP run begins in April.

SuperLEARative

With CERN's SPS ring now only occasionally serving as a proton-antiproton collider, the LEAR low energy antiproton ring at CERN is the main client for CERN's antiproton supply system.

LEAR has attacked a wide range of physics problems since its commissioning in 1983, and the experimental programme is continuing, notably with three major second generation studies – Crystal Barrel, Obelix and Jetset – while the CP-LEAR experiment is also poised to make important new contributions. However it is becoming increasingly clear that continued progress needs antiproton energies beyond the 2 GeV currently available.

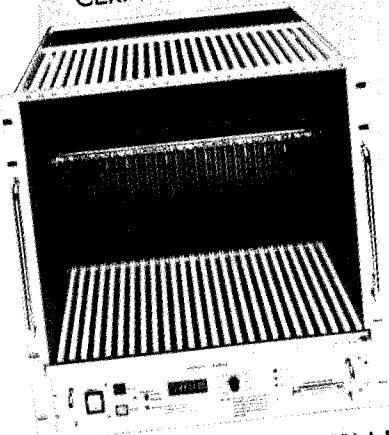
With the Quantum Chromodynamics field theory of inter-quark forces in good shape, the gluons which carry this force should also show up as particles ('glueballs'), or combine with quarks to form hybrid particles. Initial evidence for glueballs has been seen (July/August 1989, page 21), but further study is needed to clinch the assignment.

Quarks could form complex 'molecular' states as well as just baryons

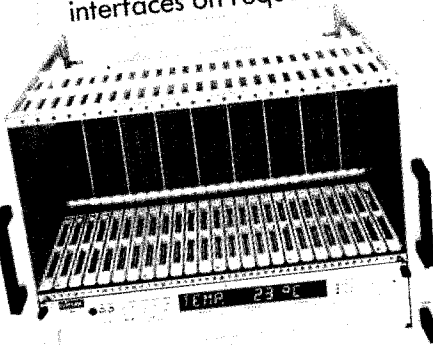
WIENER CRATES



VME-VXI modular 1250 W, microprocessor monitoring, IEC-CAENET interfaces CERN-DESY-specs.



FASTBUS approved to CERN-F6852 modular 3 kW, optional up to 4 kW, interfaces on request



CAMAC-NIM according to CERN-specs. 200 - 500 W in linear, up to 1,4 kW in switching technology

High Reliability
High Quality



Hans Wiener GmbH + Co., Müllersbaum 18-20
W-5093 Burscheid (Hilgen), Tel. 0 2174/678-0
Fax 67 85 55, Telex 8 515 523 wiew d

10 Circle advertisement number on reader service form

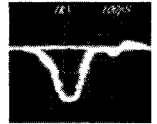
Kentech Instruments Ltd.

FAST, HIGH-VOLTAGE PULSE GENERATORS

We manufacture a wide range of very fast, high voltage pulse generators using advanced avalanche and VMOS technology. Our amplitude capability extends to 10kV with an 80ps risetime. We have built special high repetition rate pulsers to provide kV outputs at frequencies in excess of 20kHz. A range of output pulse shaping techniques allows us to generate camera gate pulses and radar drive signals. Our pulsers have been used in high speed camera systems, laser pulse chopping, radar, time of flight mass spectroscopy, EMP simulation and cable characterisation. If you have a pulser requirement please contact us. Our pulsers can be configured to suit most loads and many can drive short or open circuits without damage. We can build transformers to match the pulsers into low impedance loads such as micro-channel plates. We make many special pulser systems and are always happy to discuss an unusual requirement.



Typical pulser capable of 2kV into 50Ω with 100ps fwhm



HIGH-VOLTAGE PULSER SUMMARY

Pulser	Amplitude*	T _{rise} / Pulse Width	PRF	Jitter	Features
APG1	>100V	150ps/150ps	10kHz	10ps	S/D/R/A
ASG1	>200V	100ps/8ns step	1kHz	10ps	St/D/R/A
MPS	>1.5kV	0.5ns/10ns decay	100Hz	10ps	P
SPSV	>1kV	0.6ns/1,2,4,8,12ns	100Hz	10ps	S/V
CPS	>2kV	150ps/1ns decay	1kHz	20ps	P
CPSS	>1.4kV	200ps/0.2-2ns fixed	1kHz	20ps	S
CPSS/MC	>1kV p-p	200ps/1-6ns FW	1kHz	20ps	M
VMP1	>4kV	2ns/8ns	5kHz	10ps	S/D
HQPS	>4kV	90ps/5ns decay	100Hz	20ps	P/D/R/A
HMPS	>4kV	120ps/5ns decay	100Hz	20ps	P/D/R/A
HVS	>2kV	100ps/0.1-2ns	1kHz	10ps	S/D/R/A

P - fast rise, exp. fall; S - nominal square pulse; St - step; M - quasi monocycle; D - internal delay option; R - internal rate option; A - auxiliary low level trigger outputs (for sampling pretrigger etc); V - variable pulse length

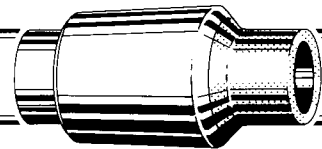
* Voltages into 50Ω

Kentech Instruments Ltd., Unit 9, Hall Farm Workshops, South Moreton, Didcot, Oxon, England.
International Tel: +44 235 510 748 Fax: +44 235 510 722

11 Circle advertisement number on reader service form

THE VENET CLERJOUNIE TRANSITION JUNCTIONS CEA SYSTEM FOR CRYOGENIC, VACUUM, NUCLEAR AND SPACE APPLICATIONS

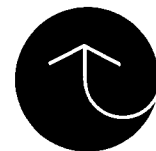
ALUMINUM ALLOY



STAINLESS STEEL

THEY HAVE THE SAME MECHANICAL CHARACTERISTICS AS THE ALUMINUM TUBE AND CAN ALSO BE FABRICATED TO ANY MATERIAL SPECIFICATIONS

TOTALLY RELIABLE BIMETALIC TRANSITION JUNCTIONS FOR TUBULAR ASSEMBLIES UP TO Ø 600 MM (24")
10⁻⁹ atm. cm³, S⁻¹
10 MPa
0 to 573 K *
UNDER RADIATION

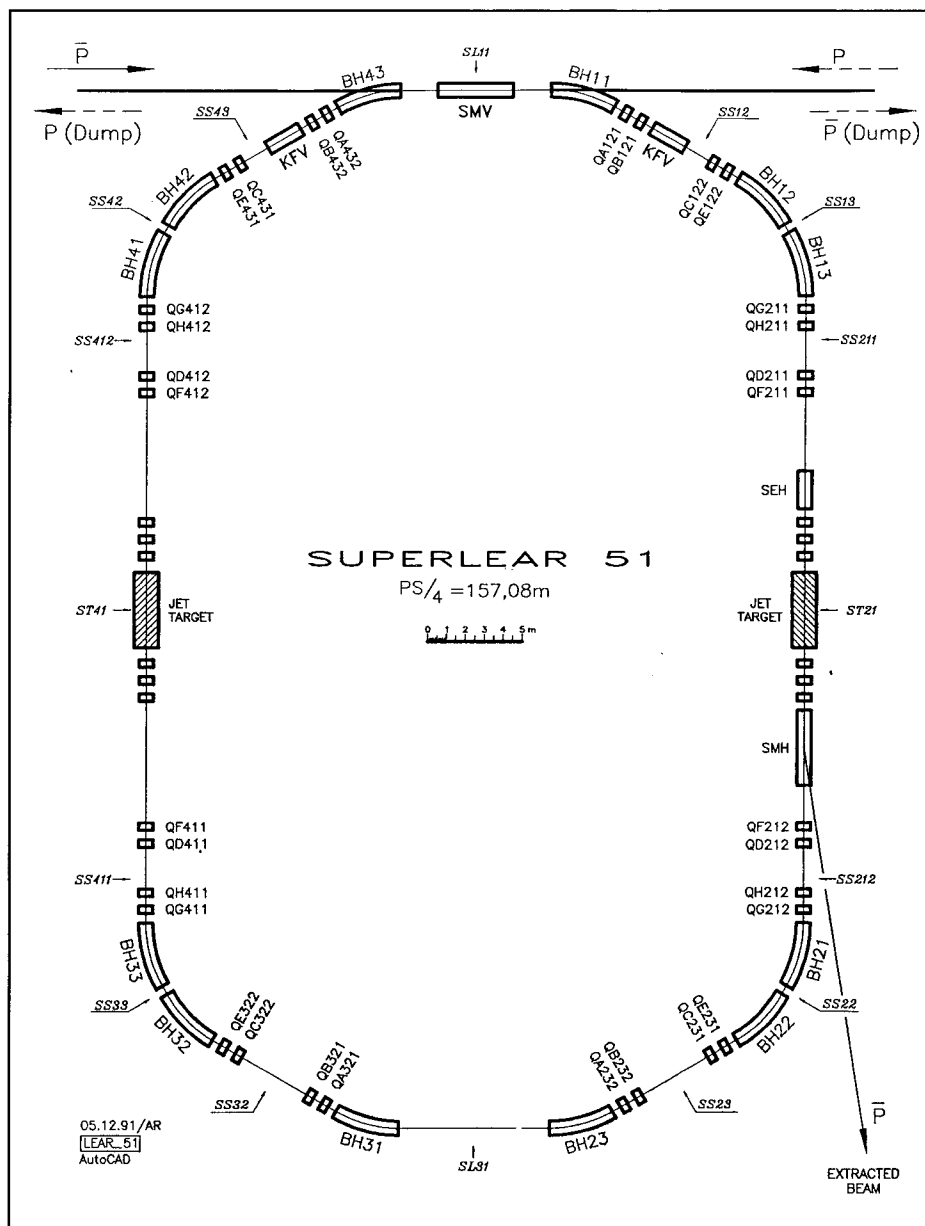


* COMMISSARIAT A L'ENERGIE ATOMIQUE

CALL OR WRITE FOR DOCUMENTATION
THEVENET CLERJOUNIE - DEPARTEMENT JONCTIONS TC
CONTACT: M. ARMAND PINET, CONSULTING ENGINEER
22, AVENUE FRANKLIN-ROOSEVELT - 69517 VAULX-EN-VELIN
CEDEX FRANCE - TELEPHONE: (7) 849.54.64 - TELEX 380 544 F

12 Circle advertisement number on reader service form

A 157-metre circumference ring of superconducting magnets envisaged for the SuperLEAR antiproton scheme at CERN.



(composed of three quarks) and mesons (quark-antiquark pairs). The particle spectrum invites further explanation, while evidence for gluon interactions (known at high energy) could be found at lower energies, and particularly in proton-antiproton annihilation.

To supply the higher energies needed to exploit this physics, plans

have been prepared for a new SuperLEAR storage ring using superconducting magnets. Antiprotons would be injected into the PS synchrotron at 3.5 GeV (as at present), for acceleration or deceleration prior to injection into SuperLEAR. Operation of this modest 157 metre-circumference ring could be interleaved with major PS

functions (LEP, heavy ions, LHC).

As well as examining the physics aims in detail, a workshop with 120 participants in Zurich from 9-12 October also looked at the machine possibilities. Several options have been prepared, with different arrangements of gas jet targets and extracted beams.

Three high priority SuperLEAR physics objectives were identified at Zurich – spectroscopy of particles containing the fourth ('charm') quark, light quark spectroscopy in the 2-3 GeV mass range, and the production of hyperon pairs.

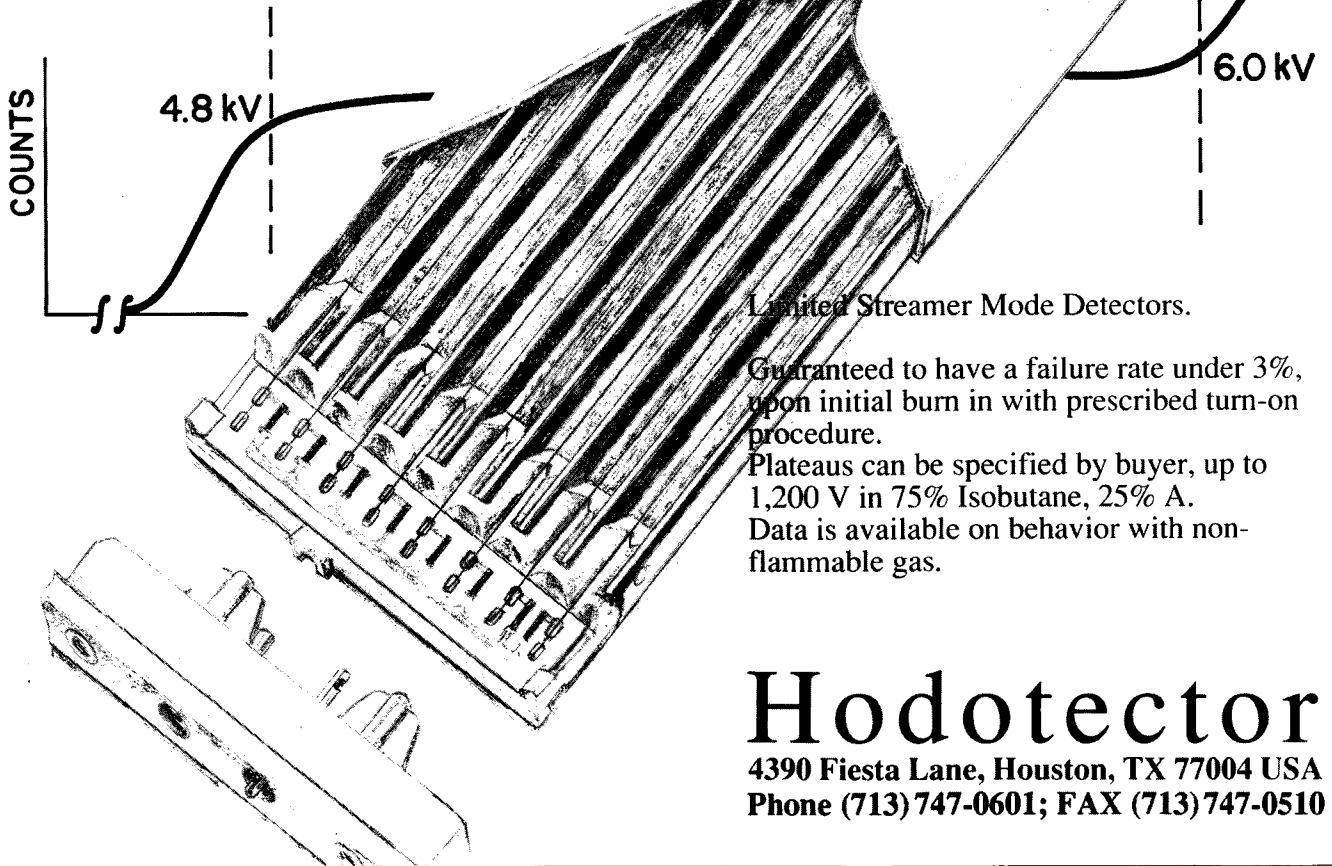
'Charmonium' states (composed of a bound charmed quark and antiquark) are a good laboratory for studying the details quark forces. A wider range of these states is accessible through proton-antiproton annihilation than through the electron-positron route (for example at a tau-charm factory).

In contrast to light quarks, where states cluster and overlap, the charmonium spectrum is well spaced out. With the potential of the interquark force well known, the spectrum is also predictable, so that 'exotic' additional particles would soon show up.

In the light quark sector, the basic quark-antiquark states are well charted. However many additional levels are expected carrying radial and angular momentum (just as in atomic spectroscopy). To explore this potentially rich spectrum, where the component quarks are wider apart than usual, needs higher proton-antiproton energies.

If a decision is taken next year, SuperLEAR could be running for physics in 1996. The configuration of jet targets and extracted beams would have to be carefully matched with the physics objectives, and the Zurich meeting helped the selection

"Burn in" with wider plateaus



Limited Streamer Mode Detectors.

Guaranteed to have a failure rate under 3%, upon initial burn in with prescribed turn-on procedure.

Plateaus can be specified by buyer, up to 1,200 V in 75% Isobutane, 25% A. Data is available on behavior with non-flammable gas.

Hodotector

4390 Fiesta Lane, Houston, TX 77004 USA
Phone (713) 747-0601; FAX (713) 747-0510

13 Circle advertisement number on reader service form

**EXB-8500. 5 GB.
4 times faster
30 times less restrictive!**



It backs up 5 GB in 3 and a half hours. It is 4 times faster than the traditional tapes and will save you 30 manual interventions.

8, route des Avouillons
CH-1196 Gland (VD)
Phone 022/64 47 47/48/49
Fax 022/648 127
Telex 419 654 erb ch

*Rimacor, your
Backup adviser.*

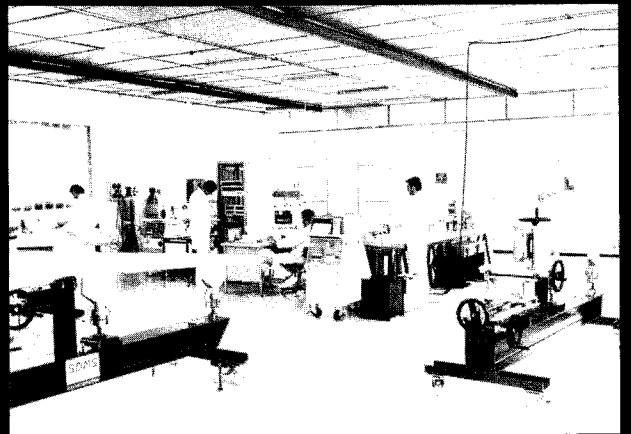
Dielsdorferstrasse 9
8173 Neerach (ZH)
Phone 01/858 06 58/59/61
Fax 01/858 08 25



EXABYTE OFFICIAL REPRESENTATIVE

14 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

15 Circle advertisement number on reader service form

Construction at the Ellis County, Texas, site of the Superconducting Supercollider (SSC). Right is the football-pitch size Magnet Development Laboratory (MDL), and at lower left the Accelerator String Test System (ASST, some 200 metres long, and now complete). Under construction alongside are the refrigeration buildings. Nearby, work for the first magnet delivery shaft has now also begun.

of likely scenarios.

Two working groups on the conceptual design of possible detectors have been set up, one for extracted beams and external targets, headed by Lucien Montanet (e-mail montanet at cernvm.cern.ch) and the other, on internal target possibilities, headed by Claude Amsler (e-mail amsler at cernvm.cern.ch).

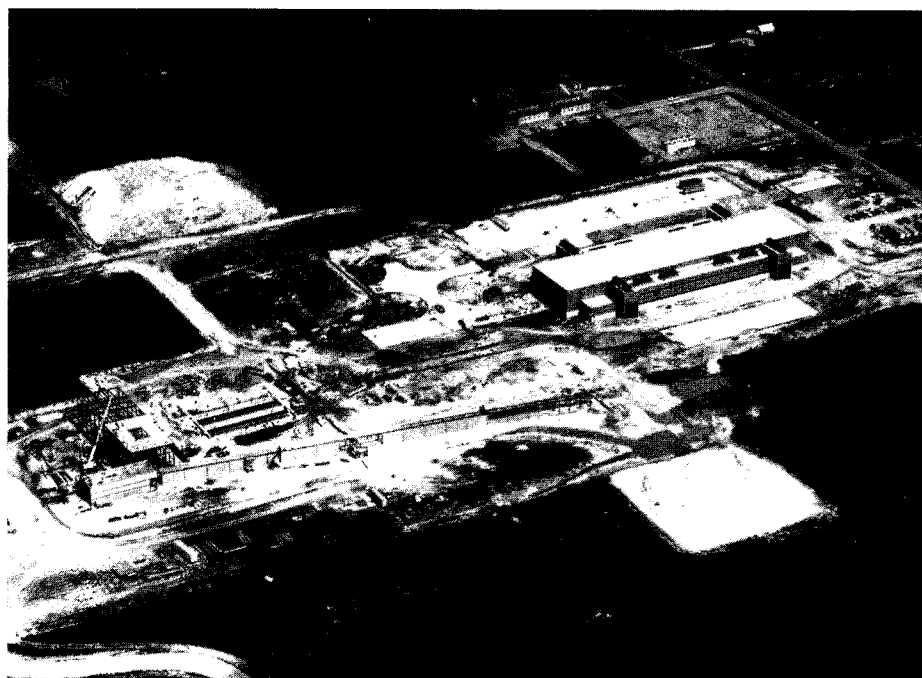
SUPERCOLLIDER Texas meeting

With preparations pushing forward for the Superconducting Supercollider (SSC) to be built in Ellis County, Texas, there was a full agenda at the third SSC fall conference, held in Corpus Christi, Texas, from 14-17 October.

Participants heard that civil construction is progressing at the N15 area, with staff and equipment already moving into the Magnet Development Laboratory. The Accelerator System String Test (ASST) building was completed in October, and installation of refrigeration equipment has now begun. The ASST will be used for system testing of a string of full-length 50-mm collider dipole magnets, now being assembled by industry using facilities at Fermilab and Brookhaven.

On the machine side, the design of the accelerator complex continues to be refined, with the low-, medium- and high energy boosters better optimized. Soviet accelerator physicists working at the SSC Laboratory have contributed to this work.

An SSC site development plan, drawn up by the architectural and engineering contractor, covers technical facilities and lays out buildings, roads, utilities and other



services for the east and west complexes. A zoning plan for Ellis County is being prepared by an independent contractor. The first campus building contracts are expected to be awarded by the end of the year, and 'pioneers' should start moving onto the campus during 1994.

On the experimental side, the first major proposal – the Solenoidal Detector Collaboration (SDC) – has selected scintillating tiles with wavelength-shifting fibre readout for its central calorimeter. The tracking radius has been fixed at 1.7m, while the number of layers of silicon and other trackers has been reduced to lower costs and reduce thickness of material near the interaction point.

The second major detector candidate – the Gammas, Electrons and Muons (GEM) collaboration – involved 300 physicists from nine countries as of October, and was growing rapidly. Detector technology options were being selected – for the electromagnetic calorimeter, barium fluoride and an accordion geometry liquid argon or krypton were being

studied. The magnet is planned as a large (17m diameter × 30m long) unshielded superconducting solenoid.

A full day of the Corpus Christi meeting was devoted to detector research and development, with talks on calorimetry, tracking, electronics, muon systems, and computing.

Meanwhile magnets are being built at the SSC Laboratory, and the first SSCL-built magnet has been assembled and successfully tested. This short 50-mm-aperture dipole went to 'short sample' (the superconductor current limit, about 7500 amperes at 4.35 K) on the first quench when testing began at Fermilab in October, and has continued to perform consistently.

The first prototype 'spool piece' has been sent to Fermilab as part of the 40-mm magnet test programme (December 1991, page 6). Each half-cell of the collider lattice will include a spool piece to provide the interface between the magnets and the outside world of electrical power, liquid helium, and control systems. A spool

piece contains superconductors and hence must operate at liquid helium temperatures like the dipoles and quadrupoles.

The first magnet delivery shaft is under construction. T.L. James and Co, of Kenner, Louisiana, have begun excavation of a 60 by 30 foot elliptical shaft, 250 feet deep. Two 75-foot-long horizontal tunnels leading from the base of the shaft will be provided to serve as 'starter' tunnels for excavating the main tunnel. Using the shaft and stub tunnels, a subsequent subcontractor will lower and assemble a tunnel boring machine and drive the first section of tunnel northward for 2.7 miles. The shaft, to be completed by mid-1992, will later be used for delivering magnets to the tunnel; its 60-foot dimension will allow them to be lowered in a horizontal position.

Meanwhile the first two full length 50 mm collider dipoles have been tested successfully at Fermilab and Brookhaven. Both went well above the design current of 6500 amperes and performed well. These are the first of a series of dipoles being built at the two Laboratories to transfer the magnet technology to industry. General Dynamics will now build seven dipoles at Fermilab, and Westinghouse will build five at Brookhaven. Of these first dozen industrially assembled magnets, five will be used in the string test next fall at the SSC Laboratory.

Potentially troublesome persistent currents in the superconducting magnets of the proton ring for the HERA electron-proton collider at DESY, Hamburg, are constantly monitored by these two superconducting reference magnets switched into the main magnet circuit. Although the effects are quite strong, they are sufficiently reproducible that field errors can be corrected.

Photo P. Waloschek

DESY HERA commissioning

The commissioning of the world's first electron-proton collider – the 6.3 kilometre HERA ring at the DESY Laboratory in Hamburg – last year was the result of more than a decade of careful planning, design and construction.

Although 1991 will be remembered as HERA commissioning year, trials began back in August 1988 when 7 GeV electrons were injected into the electron ring. Just three days later, electrons were being held for 20 minutes.

This initial success was followed by a six-week study which confirmed that the electron machine behaved as expected. Commissioning continued eleven months later, and by the end of September the following year, the electron energy had climbed to 27.5 GeV, limited at the time by the radiofrequency power available from the 84 conventional accelerating

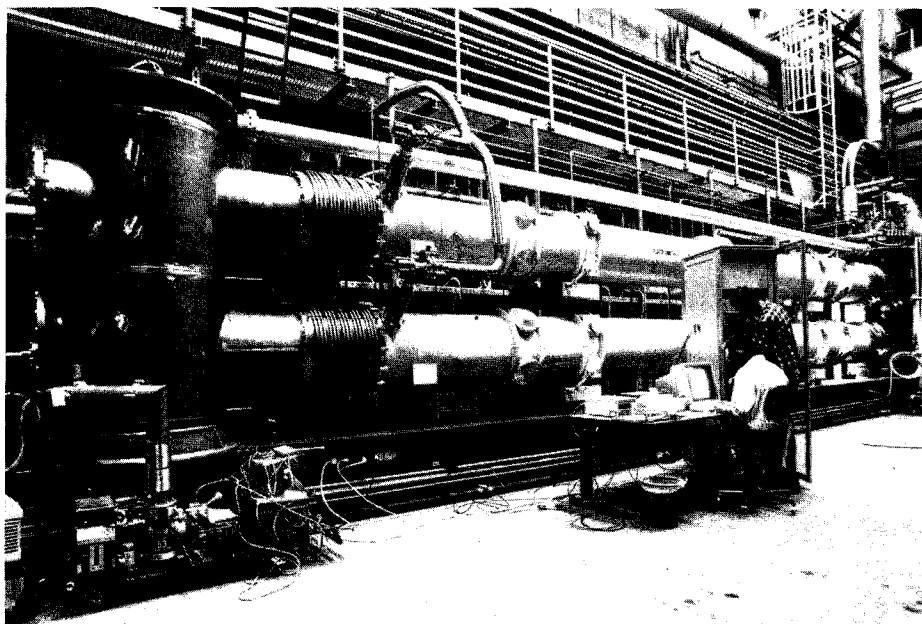
cavities. Beam optics and multibunch injection were well understood and completely under control. The maximum single bunch electron current of 2.5mA achieved so far is almost a factor of ten above the design value.

A powerful bunch-to-bunch damper system is needed to control the instabilities which develop if the design intensity is stored in 200 bunches. Such a damper system implemented in the downstream PETRA ring enabled design intensity to be reached in this machine. The same system was then built for HERA where its damping capability has been successfully demonstrated.

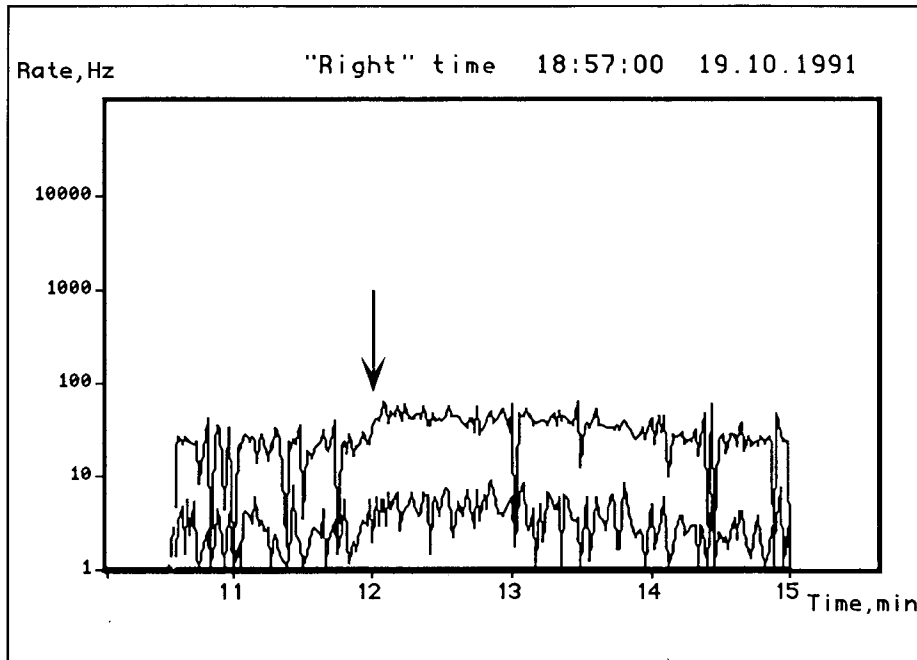
With the installation of 12 superconducting four-cell cavities the ring is now fully equipped with r.f. power, and last July HERA-e reached its design energy of 30 GeV.

A laser polarimeter to measure transverse spin polarization was tested last summer, and on 20 November, an 8 per cent transverse spin polarization was picked up.

For the proton ring, equipped with superconducting magnets and completed in September 1990 for



A blip on the H1 experiment's luminosity monitor on 19 October showed that electrons and protons had begun colliding in HERA.



initial cooldown, prior measurements of field quality and extensive performance tests on each major component promised a smooth commissioning. After hardware trials in early spring 1991, commissioning with 40 GeV protons started last April.

A major concern at proton injection is the strong field errors due to 'persistent' eddy currents in the superconductors. Despite their name, these currents decay, producing further complications.

For the April run no acceleration was planned, and persistent current problems could therefore be avoided by a special magnet excitation cycle. Despite a low injection rate, stored beam was achieved in a few days. After a few technical problems, proton beam lifetimes of about 30 minutes were being obtained by the end of April.

HERA-p commissioning continued in August with the superconducting magnets powered up to 1000 A and persistent current field errors at full strength. After careful adjustment of

the correction circuits and optimization of beam parameters, proton lifetimes of more than three hours were achieved at 40 GeV.

The persistent currents are constantly monitored in HERA by two superconducting reference magnets switched into the main magnet circuit. Although the effects are quite strong compared to the tolerances, they turned out to be sufficiently reproducible, and field errors can be corrected so that injection is possible without significant degradation of the proton beam behaviour (emittances).

This reproducibility and transparency of the persistent currents opened the door to energy ramping in the proton ring, and on 8 October, the beam reached 480 GeV with good intensity. The preaccelerators deliver about 2.5×10^{10} protons per bunch which can be accelerated without losses up to the maximum intensity. The beam emittances are close to the design values. So far, ten proton bunches at a time have been accelerated.

With each ring delivering, the next step was to run them in parallel. On 19 October, a proton bunch of 10^{10} protons was accelerated to 480 GeV. 12 GeV electrons were then injected into the electron ring, and the beams adjusted at the North interaction point using beam position monitors. Luminosity (collisions) was immediately picked up by detection of bremsstrahlung photons.

Progress continued in November with electrons taken to 26.5 GeV prior to collisions. To ensure good collision conditions over about ten hours, electron and proton beam sizes at the collision points are matched. The maximum luminosity for single bunch collisions is 0.7×10^{28} per sq cm per s. No problems have been detected when the number of colliding electron and proton bunches is each increased to ten.

These achievements promise a successful start to the HERA operations on 9 March. Soon after, the big ZEUS and H1 detectors will be ready to log their first data.

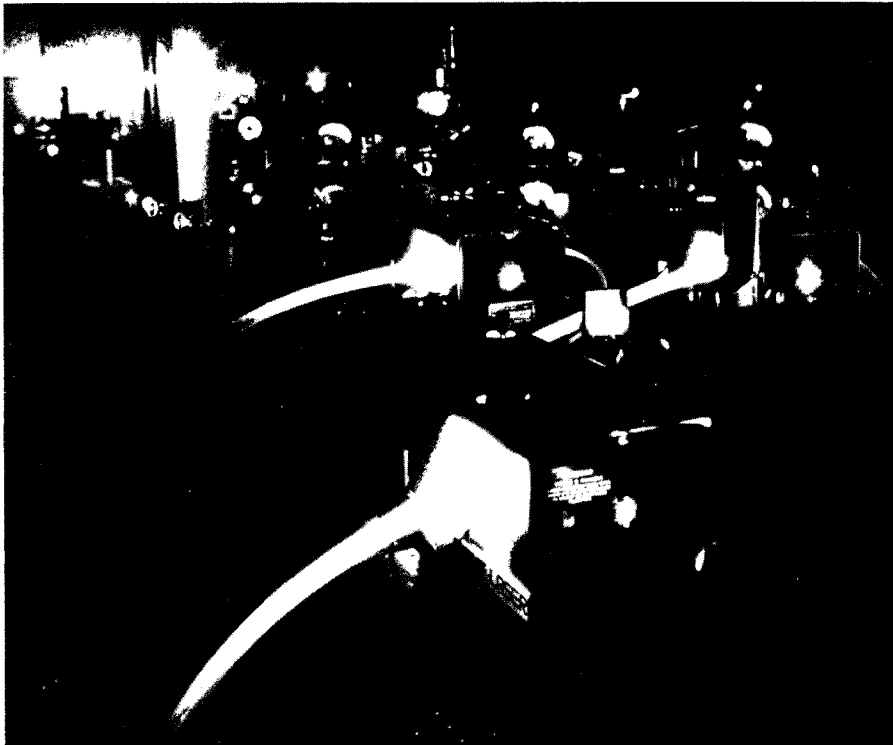
SPIN PHYSICS Lasers at work

Lasers are now an everyday tool in particle physics, particularly for the spin polarization of beams, targets, and even short-lived particles.

Development has been boosted in recent years by the availability of reliable multiwatt tunable lasers to select spin in an experimentally useful sample.

One watt of laser light contains about the same number of photons as there are electrons in one ampere of current. If the photon polarization were transferred efficiently, a 1 watt

The dye laser system used for development of an optically-pumped polarized ion source at the Canadian TRIUMF Laboratory, Vancouver. The straight beams on the right are from argon lasers, powering four dye lasers. The curved paths are tubes carrying the dye solution. This source produces five microamps of 75 per cent polarized 500 MeV protons (December 1991, page 10).



polarized laser beam could in principle provide a nearly infinite angular momentum source to orient electron or nuclear spins. Although the process in practice is relatively inefficient, new standards of polarization have been set.

A major initial project was the laser-driven polarized electron source at the Stanford linear accelerator (SLAC), in operation in the late 70s. In this application, laser light interacts with the surface electrons of a semiconductor (gallium arsenide) photocathode where atomic levels are spread out into bands and spectroscopically pure light is not necessary. Circularly-polarized photons pump electrons from the semiconductor valence band into a spin state in the conduction band from which they can be emitted to form a polarized electron beam.

This technique is now being applied and perfected at many other electron

accelerator laboratories, including Kharkov, Nagoya, MAMI-B at Mainz, MIT-Bates, ELSA at Bonn, and the CEBAF machine under construction at Newport News, Virginia. Emphasis is on increasing electron polarization above 50% by means of solid-state effects to remove the degeneracy in the electron spin levels (May 1991, pages 4 and 6).

With narrowband lasers now available, polarized electron beams can also be made from helium, optically pumped in the metastable state formed in a radiofrequency discharge. This method is under development at Orsay and promises high polarization.

In research and development work for the electron-positron linear colliders of tomorrow, laser irradiated photocathode techniques are being used to generate intense electron pulses (November 1990, page 5).

If polarized particles other than

electrons are needed, an optically-pumped polarized alkali vapour can be used for spin exchange. In vapour or gas, the atomic absorption lines are narrow, and intense spectrally-pure laser light must be used to obtain adequate efficiency and vapour density. The polarized laser light pumps the alkali valence electrons out of one spin state and the vapour is left with nearly perfect electron spin alignment.

Depending upon the end-product required, one or more additional spin transfers are possible through atomic interactions. For example to make a beam of nuclear-aligned sodium atoms, the ordinary hyperfine magnetic interaction between valence electrons and nuclei will exchange spin.

Exchange of the valence electron spin orientation from the alkali (or in some cases transfer of the electron itself) to a different atom or ion makes possible the formation of other spin-polarized species. For example, TRIUMF (Canada), LAMPF (Los Alamos) and KEK (Japan) have optically-pumped polarized negative hydrogen ion beam sources in operation (December 1991, page 10) and the Moscow Institute for Nuclear Research has this source on the test bench. These sources produce negative hydrogen ions with proton polarizations around 65-70% and peak currents from 30-400 microamperes.

A group at Argonne (USA) is building a spin-exchange polarized deuterium target for the VEPP-3 electron storage ring at Novosibirsk.

TRIUMF uses a spin-exchange polarized helium-3 target. In this technique, first developed at Princeton, the helium nuclei exchange spins directly with polarized electrons in the alkali; the paired helium electrons play no role. Be-

LeCroy Pioneers

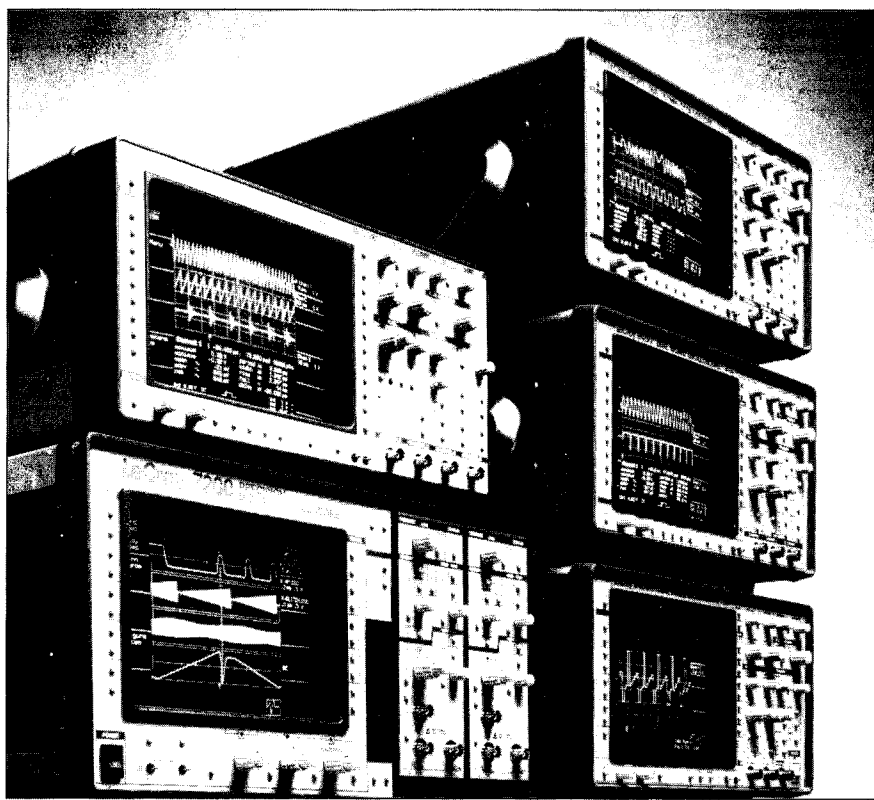
New Digital Scope Technology

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

cause the overlap of the nucleus with extra-orbital electrons is small, the spin exchange time is slow, of the order of a few hours. Once the alkali vapour is removed, the inert helium can retain its nuclear polarization for 100 hours.

Helium nuclear spin is so isolated from all perturbations except magnetic that the gas can be compressed above 1 bar in a mechanical pump while retaining most of its polarization, as shown by a group at Mainz.

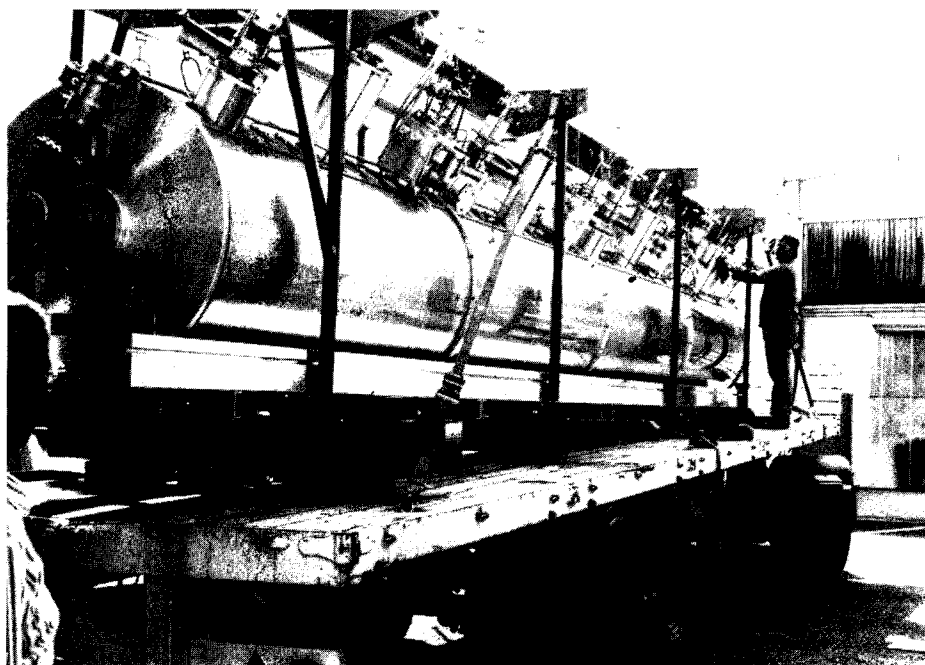
With spin exchange and helium, a Princeton-Syracuse team at LAMPF has manufactured highly-polarized muonic atoms. In the process of capture, a negative muon will eject both electrons from a helium atom. Polarization transfer to the muonic atom from a nearby polarized alkali electron occurs by spin exchange through the magnetic moments or by capture of the electron by the helium ion. With adequate density of optically-pumped polarized rubidium, the muonic atom polarizing time is less than the 2 microsecond muon lifetime and high polarizations are achieved. Results in the last few months show muonic atom polarizations more than ten times that resulting from retention of polarization in the muon beam, opening the door to new spin-sensitive experiments in the fundamental interactions.

From Olin van Dyck

WORKSHOPS

Radiofrequency superconductivity

In the continual push towards higher energy particle beams, superconducting radiofrequency techniques now play a vital role, highlighted in



One of the superconducting cavities arriving at CERN's LEP electron-positron collider, where it will help push collision energies towards 200 GeV.

the fifth workshop on r.f. superconductivity, held at DESY from 19 – 24 August 1991.

Since the previous workshop at KEK, Japan, in 1989, there has been increased operational experience of superconducting electron and heavy ion accelerators. At KEK a total of 32 superconducting cavities are now routinely operated in the TRISTAN electron-positron collider.

At CERN three modules with four superconducting cavities each (two of solid niobium and one of niobium-sputtered copper cavities) have been installed in the LEP electron-positron collider as the first step towards higher energy running. In addition two more niobium-copper cavities are routinely operated in the SPS synchrotron. At DESY twelve four-cell cavities have been installed in the HERA electron ring.

In the domain of electron accelerators for nuclear physics, the first recirculating beam has been achieved at the Darmstadt S-DALINAC (May 1991, page 10), and

an electron energy of 103 MeV attained. At the CEBAF machine under construction at Newport News, Virginia, the 45 MeV injection energy has been reached in cryomodules with eight superconducting cavities (September 1991, page 28), and the production of a total of 360 cavities at industry is steadily advancing. At Saclay in France the MACSE test facility with 5 superconducting cavities at 1.5 GHz has been started.

Higher acceleration fields are vital for new projects, and a large coordinated effort is going on, particularly at Cornell, Saclay and Wuppertal. Field emission of electrons by surface defects is the most limiting factor. New and refined diagnostics like field emission microscopes have been developed and it is hoped that this will lead to a better understanding of the defects causing field limitations.

It has been shown that small surface areas can withstand electric surface r.f. fields up to 140 MV/m (corresponding to accelerating fields

At CERN, recent work using this 50J carbon dioxide laser setup has given lead ions up to charge 28.

of some 70 MV/m). For large accelerating cavities (low frequency or multicell) these values are considerably reduced by surface defects which still escape control.

Nevertheless continuous accelerating fields of 25 MV/m have been repeatedly reached in single-cell cavities at 1.5 and 3 GHz, while multicell cavities in this frequency range have attained 15-20 MV/m.

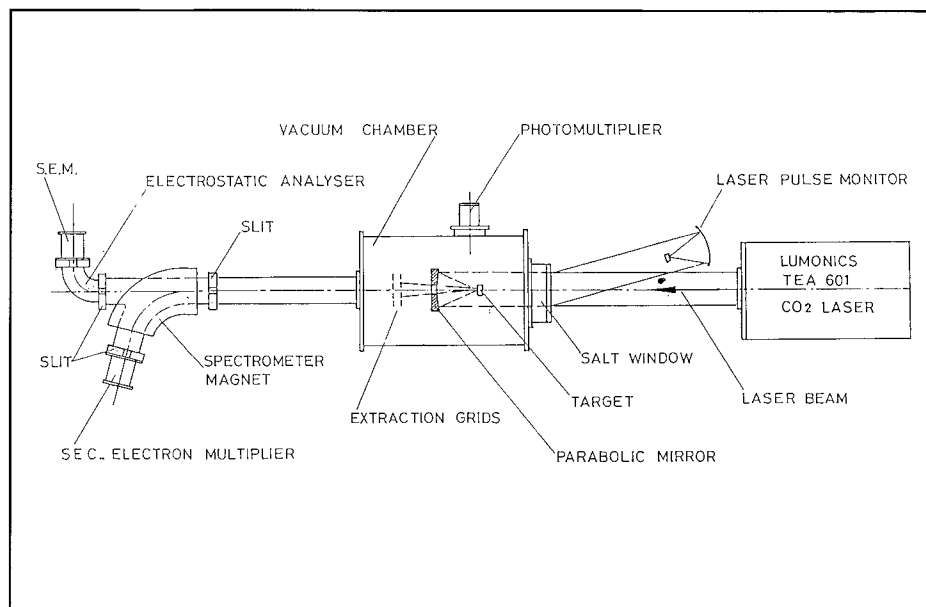
At present the highest fields are achieved by high temperature annealing under ultrahigh vacuum at 1500 C. It is hoped that this treatment, combined with the use of very pure niobium, can push field limits even higher.

Recent promising results at Cornell used pulsed high power processing at many 100 kW, a method already used extensively at the kW level. Rinsing with clean dust-free water at high pressure has been applied successfully at CERN.

The sputtered niobium on copper cavities pioneered at CERN for 350 MHz are now applied elsewhere at higher frequency and to more complex structures (at INFN Legnaro).

The natural extension of this method to reactive sputtering for superconductivity at higher temperatures is being pursued in a number of laboratories. The increased use of high purity niobium for better thermal stabilization of defects has sometimes unexpectedly degraded cavity resonance. In a remarkable common effort, this has been traced to hydrogen introduced into the niobium by chemical treatments. Remedies like annealing at 700 C have been developed.

One review talk was devoted to high temperature superconductivity and its r.f. properties. Although a large number of sophisticated production processes are now at hand, performance is severely limited by



high defect density. Small-scale applications for passive microwave devices are already under development at Wuppertal.

Superconducting cavities are now considered for new applications such as particle factories and linear colliders. For the former, new geometries have been designed, combining low impedances with extremely strong damping of higher order modes against multibunch instabilities (Cornell).

The biggest challenge is in the field of linear colliders, and a special series of talks concentrated on the TeV Energy Superconducting Linear Accelerator (TESLA) idea, with the two last days of the Workshop devoted to a TESLA collider in the 500 GeV range.

The basic advantage of superconducting cavities is the very efficient storage of r.f. energy, so a low frequency (around 1 GHz) and a rather long pulse (1 ms) can be used. The former gives a large aperture (low wakes, long bunches, low alignment tolerances, ...) while the latter allows multibunch operation

(with long bunch separation, modest peak power, r.f. feedback, ...). Niobium cavities at 1.3 GHz with an accelerating field up to 25 MV/m are anticipated.

In a final talk Maury Tigner from Cornell underlined the considerable progress achieved since 1960. Superconductivity is at the heart of new and fascinating challenges in modern accelerators and hopefully the remarkable progress so far will continue.

The Workshop was attended by 150 participants from 35 institutions and from industry, and was splendidly organized by local chairman D. Proch and his team.

Ion sources

Against a background of increasing use of radiofrequency- or microwave-driven ion source plasmas, the recent International Conference on Ion Sources – ICIS 92, held at the GSI Darmstadt Laboratory, included some interesting new developments.

I.A. Bykovsky and V.N. Nevolin from Moscow surveyed 20 years of work on laser-induced ion source plasmas, including commercially available machines built in the Ukraine for ion beam analysis with 100 nanometre resolution, or for ion implantation for surface modification.

Ray Sherwood of CERN showed recent results using a 50 J carbon dioxide laser, giving lead ions up to charge 28. A collaboration with ITEP Moscow has also investigated five-microsecond pulses and a repetition rate of 1 Hz, well suited for synchrotron injection.

A good source of metallic ions is the MEVVA – Metal Vapour Vacuum Arc – technique. These sources are usually pulsed, but now there are results with DC operation with ion currents up to 1 A (I. Brown, Berkeley). For metallic ion production, negative ion sources also show remarkable results, with 10 mA DC or more than 100 mA pulsed (Y. Mori, KEK Japan).

Special applications like micro-probes for ion beam analysis or for direct writing or etching of micromechanics or microelectronics are the domain of liquid metal sources (R. Muehle, Jena). For ion etching, broad low energy ion beams are used (H.C. Scheer, Berlin). Large area intense ion beams of some 10 keV are needed for ion beam assisted deposition techniques (W. Ensinger, Heidelberg).

C. Jaquot of the French Cadarache centre reported on the joint European programme for neutral beam injection into Tokamaks. Large cusp ion sources generate 4 A of negative deuterium ions which will be accelerated to 1.2 MV.

Ion beams are also used as thrusters in satellites and space probes. Although producing low thrust, they can be maintained from solar panels

for a very long period and are well suited for long-term stabilization (H.W. Loeb, Giessen).

On-line mass separators need efficient ion sources. Besides classical discharge and microwave (electron cyclotron resonance – ECR) sources, surface ionization is also effective, while laser ion sources provide a fresh approach.

ECR sources are widely used to generate high currents of multiple charged ions. By injecting electrons or by coating the source chamber, high charge yields can be improved. Special source optimization to an afterglow mode of 100 microamps of lead 28+ during a 0.4 ms pulse and at a repetition rate of 1-4 Hz have been detected (P. Sortais, GANIL, France).

Even higher charge states with moderate intensities can be produced in electron beam ion sources (EBIS) and are mainly used for atomic physics experiments.

In an electron beam ion trap (EBIT), extremely high charges (thallium 80+ and uranium 70+) have been creat-

ed, stored and used for spectroscopy (D. Schneider, Livermore). Until now such highly charged ions could only be generated by stripping high energy beams of heavy ions.

The next meeting in the series – ICIS 93 – will be held end-August 1993 in Beijing. Contact Zhao Weijian, Institute of Heavy Ion Physics, Beijing University, Beijing 100871, China, fax +86-1-2564095.

From B. Wolf

Theory flexes its muscles

With the Standard Model of interactions between the fundamental quark and lepton constituents of matter so

A highlight of the 1991 DESY Theory Workshop was the interest in possible baryon and lepton number violation at high temperatures. Among the speakers looking at the implications were V. Rubakov (right) and L. McLerran.



successful at describing laboratory experiments, theorists have looked at the possibility of new phenomena occurring under extreme conditions – high temperatures, high densities or high energies.

Thus the 1991 event of the annual DESY Theory Workshop looked at 'The Standard Model at High Temperature and Density'. Three main topics were covered – baryon and lepton number violation at high temperatures and energies; high temperature transitions between ordinary hadronic matter and the quark-gluon plasma; and cosmological and astrophysical implications.

The mathematical structure of the Standard Model allows for baryon (B) and lepton (L) numbers – the numbers of strongly and weakly interacting particles respectively – to be not strictly conserved. However under usual conditions the effects are tiny, and can only happen via highly damped quantum tunneling. For example, the deuteron is in principle unstable, decaying into an antinucleon and three antileptons. Its lifetime, however, is of the order of 10^{200} years!

At the Workshop, V. Rubakov (INR Moscow) reviewed (B+L) violation at high temperatures. At temperatures of order 10 TeV and above (B+L) violation is no longer a quantum effect. Quantitative studies and real-time computer simulations support this expectation.

M. Shaposhnikov (INR Moscow and CERN) reported on the cosmological implications of unsuppressed high-temperature (B+L) violation. The explanation of matter/antimatter asymmetry in the Big Bang model of the Universe is a challenge for theoretical physicists. However the weak interactions in the hot plasma of the early Universe fulfilled all

necessary conditions for such an asymmetry – B is violated strongly at high temperatures; weak interactions violate charge and charge/space reflection (CP) parity; and there are large effects in the electroweak phase transition between the high-temperature phase of massless particles, and the low-temperature phase, where the W and Z particles become heavy.

As a result, the matter asymmetry of the Universe may originate from the electroweak phase transition at temperatures around 100 GeV, without resorting to 'Grand Unified Theories' incorporating strong interactions as well, and needing energies of 10^{16} GeV.

Electroweak generation of matter asymmetry requires a relatively light Higgs boson, preliminary estimates giving an upper limit of 64 GeV in the minimal Standard Model. No stringent bounds come from extended versions of the Standard Model with multiple Higgs particles.

While electroweak (B+L) violation comes into its own at very high temperatures, it is not yet clear whether it would show up in high energy collisions above 10 TeV. L. McLerran (Minneapolis) thought that while at first sight it might look difficult to provide the conditions for (B+L) violation in high energy scattering, the heavily damped tunneling factor may go away.

A. Ringwald (CERN) looked at ways of estimating effects at energies around 10 TeV. Extrapolating existing calculations shows that the exponential suppression of (B+L) violation disappears at collision energies around 30 TeV, so that these processes might be seen at future supercolliders.

G. 't Hooft (Utrecht), the 'father' of low-energy electroweak (B+L) violation, concluded the first day by

presenting an alternative method for investigating high energy (B+L) violation and looking at the implications.

The workshop also looked at quark systems at high temperature – the thermodynamics of hot and dense strongly interacting matter. The theoretical basis is provided by quark field theory of a lattice, explored by computer simulation.

F. Karsch (Juelich) reviewed these studies, which concentrate on the predicted deconfinement of quarks in dense matter and on the properties of the resulting new state of matter, the quark-gluon plasma. The deconfinement temperature is found to depend on the number of quark 'flavours', and the best present estimate for the 'physical' case of two light quark species lies around 150 MeV.

This means quark deconfinement sets in when matter reaches twice the density of a single nucleon. The transition itself has been the centre of much attention; three light quark species behave one way (first order transition), two such species another (continuous changeover). Which of these two alternatives is correct in the real world of two light and one heavy (strange) quark appears to require more extensive studies on still larger lattices.

An experimental test of quark thermodynamics is the ultimate aim of high energy heavy ion collision studies. Experiments were started at CERN and Brookhaven just five years ago, and have so far used only rather light ions (silicon-28 and sulphur-32). J. Schukraft (CERN) summarized the present experimental situation, concentrating on the overall conditions reached so far, on evidence for thermalization, and on possible probes of the early phase of the produced matter.



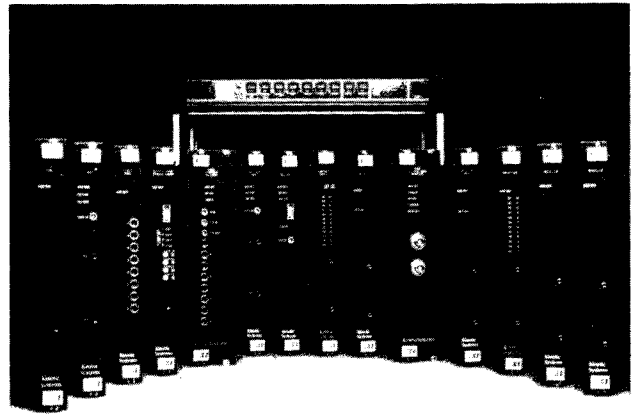
Realtime Data Acquisition in VXIbus

Want high speed...realtime performance...and flexibility in VXIbus modules?

Call Kinetic Systems. We offer a full line of VXI products—everything you need to configure data acquisition and control systems:

- Analog & digital I/O...register-based for high speeds
- Signal conditioning...for RTDs, thermocouples and strain gages
- Counters...to 100 MHz
- Transient recorders...to 100 MHz, with 16 megasamples of storage
- Monitors & controllers...for pressure scanners, MIL-STD-1553B, and ARINC-429

Call today to receive your catalog describing our full VXI product line.



Realtime. Real World. Results.



3 chemin Tavernay • 12 18 Geneva, Switzerland
[41] (22) 798 44 45 • FAX [41] (22) 798 05 25
11 Maryknoll Dr. • Lockport, IL 60441 USA • (815) 838 0005

Definitive Leadership in Data Acquisition

22 Circle advertisement number on reader service form

TUBE OR NOT... by MEDELEC

CUSTOMIZED... METAL PRECISION TUBE...
PROTOTYPE IN 3 WEEKS ???
AY-YI-YI!!! WHO CAN HELP ME?
OUT OF ORDER

CUTTING AND PIERCING
BENDING FABRICATING FINISHING

ELEMENTARY OLD CHAP, MEDELEC IN SWITZERLAND NEAR LAUSANNE SWISS MADE

FAST CUSTOMIZED PRECISION TUBE PRODUCTION...
• Ferrous/Non-ferrous Pure Metals and Alloys
• Small O.D.: 10.0 - 0.1 mm;
Thin Wall : 1.0 - 0.02 mm
• On Time Delivery
• NO MINIMUM ORDER REQUIREMENT

DELIVERY ON TIME EVERY TIME!
DONG! 2 1/2 WEEKS DING!
THANK YOU, MEDELEC

FAX (+41 21) 946 35 31
TEL (+41 21) 946 26 57 • TLX 452 122 MEDI CH
Route de Chardonnas • CH-1604 Puidoux Switzerland

Medelec
SWISS TUBE PRECISION

SINCE 1952

READER SERVICE FORM CERN COURIER

JANUARY/FEBRUARY 1992

Please send information on items circled:

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
40	42	43	44	45	46						

Please send to:

Nina Ruderman, **CERN COURIER**
P.O. Box 786, Cooper Station
New York, NY 10276, USA

Name	Title		
Employer	Dept.		
Address			
City	State	Zip	
Telephone ()	Country		

23 Circle advertisement number on reader service form

At the DESY Theory Workshop, R. Barbieri of Pisa provided a theory overview of solar neutrinos, neutrino masses and neutrino mixing.



The achieved energy densities are indeed sufficient for deconfinement. There are clear nuclear effects which point to an onset of thermalization and indicate the formation of very dense initial systems.

The third day of the workshop was given over to astroparticle physics.

I. Appenzeller (Heidelberg) reviewed the current status of structure in the Universe. The known mass in the Universe forms a sponge-like structure with 'walls' of galaxies, clusters and superclusters, and intervening 'voids'. Structure is observed to at least sizes of 300 Mparsecs (galaxies are in the 0.01 to 0.3 Mpc range while clusters go from about 1 to 20). Beyond 500 – 1000 Mpc the mass distribution appears to be more smooth.

M. Turner (Fermilab) discussed the formation of structure in the Universe. This is in a certain sense an initial data problem: given the matter content and the initial density fluctuations at the epoch when the Universe becomes matter-dominated, one may

evolve the system and determine the typical final structures produced by gravitational growth of fluctuations. There is no 'Standard Model' of structure formation, only different scenarios corresponding to different choices of matter content and density fluctuations. The limits on irregularities in the microwave background put stringent limits on the initial fluctuations. The matter content is not so well determined, apart from the fact that the baryonic matter content is constrained from primordial nucleosynthesis.

Turner discussed some recent observations which suggest a considerable amount of non-baryonic dark matter. He presented in detail one possible scenario for structure formation, with most of the Universe consisting of so-called cold dark matter (for example light neutrinos, axions, neutralinos) and where the initial fluctuations are scale-invariant. The result is that galaxies form first and the larger structures later (even now).

The experimental status of solar neutrinos, neutrino masses and mixing was reviewed by M. Spiro (Saclay). Direct mass measurements of the three known species of neutrinos yielded so far only upper bounds, 9.5 electronvolts for the electron neutrino, 170 keV for the muon neutrino, and 35 MeV for the tau neutrino. Other bounds come from double beta decay limits (December 1991, page 16). If neutrinos are massive, they can mix, giving neutrino oscillations. So far there is no evidence. Evidence for a 17 keV neutrino (April 1991, page 9) is still controversial.

The new solar neutrino experiments SAGE and GALLEX may help resolve the solar neutrino problem – the conflict between the flux of solar neutrinos predicted by calculations

and the observed levels – as they can see neutrinos from the dominant proton-proton fusion reaction. Initial data is appearing, but Spiro urged physicists to 'wait and see'.

In the closing talk, John Ellis (CERN) summarized our understanding of phase transitions in the early Universe. In the quark-hadron transition quark confinement made its first appearance, the quarks combining to form strongly interacting elementary particles. Although lattice studies have given semi-quantitative results for this transition for very low baryon density, there remains a need for corresponding studies of baryon-rich systems, such as possible quark stars.

In the electroweak phase transition, the W and Z bosons acquired mass, unlike the photon. This transition is sensitive to the as yet unknown masses of the Higgs boson and the top quark, and could lead to bounds on these masses. In addition, this transition could be responsible for matter dominance in our present Universe.

Beyond both these transitions lies the question of the fate of the Standard Model at temperatures higher than the Planck mass (10^{19} GeV). Ellis concluded with a 'triple symbiosis' of theory, with model and lattice calculations; experiment, with heavy ion studies as well as particle searches; and cosmology, with neutron stars, element abundances and the baryon asymmetry of our Universe.

From H. Satz and A. Ringwald

LE GUIDE DE LA TECHNIQUE
UNE RÉFÉRENCE, UN OUTIL DE TRAVAIL

Le Guide de la Technique est le fruit de la collaboration de plusieurs dizaines de spécialistes. Par le sérieux de son information, il constitue une référence solide et un complément utile à la formation de l'ingénieur; par son souci de clarté, il est l'outil d'information des non-spécialistes: il fournit les principes de base, un certain vocabulaire et de nombreuses illustrations. Cette conception originale place cet ouvrage à part des encyclopédies ou des ouvrages de vulgarisation. Le volume III, traitant de l'énergie et le volume IV, traitant des constructions, paraîtront en novembre 1992.

I. L'INFORMATION

Électronique ■ Informatique ■
Télécommunications ■ Robotique
1991, 242 pages, 21 x 27 cm, broché, SFr. 62.-
ISBN 2-88074-219-6.

II. LES MATÉRIAUX

Métaux ■ Liants ■ Plastiques ■ Composites ■
Matières vivantes
1991, 232 pages, 21 x 27 cm, broché, SFr. 62.-
ISBN 2-88074-220-X.

DOCUMENTATION DÉTAILLÉE SUR DEMANDE

**PRESSES POLYTECHNIQUES ET
UNIVERSITAIRES ROMANDES**

EPFL - Ecublens
CH - 1015 Lausanne

tél: 021/693 21 30
fax: 021/693 40 27



46 Circle advertisement number on reader service form



LURE

MENJS
CEA

The Laboratory for the Use of Synchrotron Radiation (LURE) has a **senior position** open for an **engineer** with an advanced degree and a minimum of ten years' experience in the area of **Radio Frequency Systems** for electron circular accelerators.

Knowledge of beam dynamics is desirable.

The successful candidate will be responsible for overseeing all RF activities at LURE, including operation of existing facilities DCI (25 MHz) and Super-ACO (100 MHz), current developments, and studies for a future project (350 MHz ?).

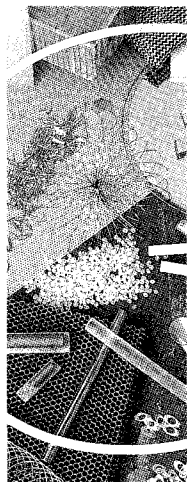
Applicants should submit a curriculum vitae and the name of three references to

LURE

*H. Zyngier, Chef du Département Anneaux
Centre Universitaire Paris Sud
Bât. 209 A
91405 Orsay Cedex France*

**METALS AND MATERIALS FOR
RESEARCH AND INDUSTRY**

1991/92 CATALOGUE NOW AVAILABLE



- Pure metals, alloys, ceramics, polymers, composites, compounds
- Foils, wires, rods, powders, tubes and many other forms
- Small quantities – FAST
- More than 3600 items in stock – 55,000 standard packs
- 480 page catalogue – including many new items
- Over 40 years serving research and industry

For further details on metals and materials please contact us

Goodfellow

Cambridge Science Park Cambridge England CB4 4DJ
Tel: (0223) 420631 Fax: (0223) 420639

19 Circle advertisement number on reader service form

Gravity Referenced Measures: Slope, Tilt Angle, Pitch
37 Years Experience
Electrolytic Tilt SENSORS

Features
Small, compact, easily mounted. Rugged in hostile environments. Single or double axis. Low cost. Excellent repeatability and stability. Ranges to 120°. Resolutions to 0.1 arc second.

Electrolytic gravity sensors offer an excellent solution to systems that require a gravity reference or tilt indication. They transduce the tilt of your sensor for the most demanding applications. Write for our catalogue.

G+G Technics AG
Leimenweg 4
CH-4419 Lupsingen
Switzerland
Tel. 061/911 90 66
Tel. 061/811 24 25, Fax 061/811 24 26

45 Circle advertisement number on reader service form

LHC milestone

At the December meeting of CERN's Council, the Organization's Governing Body, the delegates from the 16 Member States unanimously agreed that the LHC proton-proton collider proposed for the 27-kilometre LEP tunnel is the 'right machine for the advance of the subject and of the future of CERN'. Detailed information on costs, technical feasibility and prospective delivery schedules, and involvement of CERN Member States and other countries, together with an outline of the LHC experimental programme, its goals and its implications, including funding, will be provided before the end of 1993 so that Council can move towards an LHC decision.

Following the vote, Council President Sir William Mitchell said 'this is a historic occasion'. 'The LHC project now exists', he added.

The vote followed a special extended Council session on the LHC Project on 19 December before extended delegations from CERN Member States and invited guests from other nations. They heard presentations from Scientific Policy Committee Chairman Chris Llewellyn Smith on the physics potential for LHC, from European Committee for Future Accelerators (ECFA) Chairman J.-E. Augustin on the LHC user aspects, and from CERN Director General Carlo Rubbia in the LHC project and the future of CERN. This special meeting helped prepare the ground for Council's vote the following day.

CERN's 17th Member State

At the December Council session, delegates voted unanimously to admit the Czech and Slovak Federal Republic as CERN's 17th Member State, as from 1 January.



At a special session of CERN Council on the LHC project on 19 December, Director General Carlo Rubbia spoke on the LHC project and the future of CERN.

Following the special session, Council

delegates voted unanimously that 'the LHC is the right machine for the advance of the subject and of the future of CERN'.

(Photo CERN HI 47.12.91/5)

The Czech and Slovak Federal Republic has an excellent tradition in physics, with research centres in Prague, Bratislava and Kosice. Work at CERN dates back to the early 1960s when Prague physicists collaborated in bubble chamber experiments. For a period, Czechoslovak physicists maintained only indirect contact with CERN via the Joint Institute for Nuclear Research in Dubna, but in the 1980s formal collaboration was reestablished with Czechoslovak physicists working in the UA2 and Helios experiments.

Current participation includes an important collaboration in the Delphi experiment at LEP. The country's high energy physics research programme will be expanded in the next few years to exploit the new opportunities offered by the CERN programme.

The move continues CERN's new spirit of pan-Europeanization. Established originally among West European States, the Organization extended its membership to Poland last year. Discussions with other European countries are at an advanced stage, with Hungary prominent in the queue of prospective Member States. Outside Europe, cooperation agreements have been signed with Australia, Chile, China and India, while the Russian Federation and Israel now participate in CERN Council meetings as official observers.

The December Council meeting also approved the new composition of the Laboratory's Directorate under Director General Carlo Rubbia: Pierre Darriulat, Walter Hoogland and John Thresher as Research Directors; Gunther Plass as Director of Accelerators, Helmut Weber as Head of Administration; Hans Hoffmann as Director for Technical Support; Giorgio Brianti as Associate Director for Future Accelerators; Roy

Billinge as Associate Director for Informatics; and Christian Roche as Associate Director for Forecast and Planning. Bjorn Brandt, Swedish delegate to the Finance Committee, was elected as the Committee's new Chairman and Gunther Wolf of DESY becomes a member of the Scientific Policy Committee.

Council also stood in memory of Gosta Funke of Sweden, Council President from 1967-9 and Finance Committee Chairman from 1961-3, who died in December aged 89.

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)

W. Kirk

Superconducting Super Collider, (USA)

N. V. Baggett

TRIUMF Laboratory, (Canada)

M. K. Craddock

Probably the best magnet technology you can buy...

CONGRATULATIONS TO OUR FRIENDS IN THE JET NEUTRAL BEAM HEATING DIVISION, FOR BEING PART OF THE SUCCESSFUL BREAKTHROUGH IN CONTROLLED FUSION RESEARCH ON NOV. 9, 1991.

DANFYSIK DELIVERED THE MAGNET SYSTEMS FOR THE NEUTRAL BEAM INJECTORS WHICH WERE USED TO FUEL AND HEAT THE PLASMA.



DANFYSIK A/S · Møllehaven 31 · DK-4040 Jyllinge
Denmark · Tel.: +45 46 78 81 50 · Fax: +45 46 73 15 51
In USA: GMW Associates · Tel.: (415) 368-4884 · Fax: (415) 368-0816

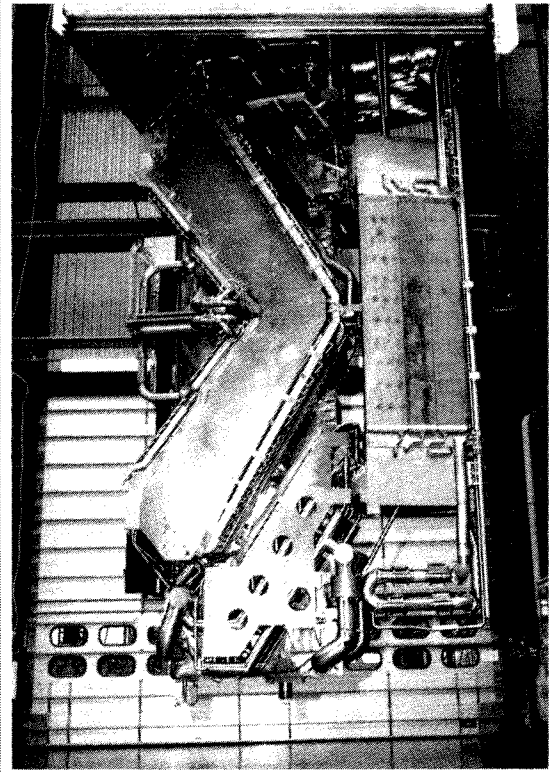


Photo shows the 8 m high magnet assembly at JET.

20 Circle advertisement number on reader service form

Kmax™ and MacVEE - The Perfect Combination



bergoz
CROZET
01170 GEX,
FRANCE
TEL: 50 41 00 89
FAX: 50 41 01 99

SPARROW
P.O. BOX 6102
MISSISSIPPI STATE
MS, 39762 USA
TEL: (601) 324-0982
FAX: (601) 324-3231

The direct link from Macintosh II to CAMAC and VMEbus with full support in the Kmax environment.

16 Circle advertisement number on reader service form

People and things

On people

Robin Marshall of the UK Rutherford Appleton Laboratory has been appointed Professor of Experimental Physics at the University of Manchester, taking up his duties in April. Since 1978, he has led the RAL team involved in the JADE and H1 experiments at DESY, Hamburg. Manchester collaborates in H1 as well as the Opal experiment at CERN, and has begun preparations for the proposed LHC collider at CERN.

New Award

The new Faraday Cup award, sponsored by Bergoz and worth \$5000, for innovative beam instrumentation will henceforth be presented at the annual Accelerator Instrumentation Workshop. Nominations to Jim Hinkson or Greg Stover, Lawrence Berkeley Lab, MS 46-125, 1 Cyclotron Road, Berkeley, CA 94720.



T.G. Pickavance 1915-1991

T.G. ('Gerry') Pickavance, who died on 12 November, was one of the enthusiasts who worked hard to ensure that the United Kingdom became a Member State of CERN, although his relative youth at the time prevents him from being thought of as one of its founding fathers. He went on to play important roles in CERN affairs: advisor to the cyclotron project and Chairman of the European Committee for Future Accelerators (ECFA) in 1970. For many years he was scientific advisor to the UK CERN delegation.

His particle physics research career began at Liverpool under James Chadwick. At the end of World War II he moved to the Atomic Energy Research Establishment at Harwell, under John Cockcroft, as Head of the Cyclotron Group. Pickavance would almost certainly have moved to a senior post at CERN if Cockcroft had been prepared to release him. Instead he took charge at Harwell of a 600 MeV proton linear accelerator project. This ambitious machine was never completed, but served as a basis for the design of the 50 MeV injector for the CERN PS.

In 1957 Pickavance became the first Director of the UK's Rutherford Laboratory, charged with the task of building the 7 GeV Nimrod proton

Franz Plasil of Oak Ridge Laboratory, Tennessee, chaired the Organizing Committee of the recent 'Quark Matter '91' meeting, the ninth International Conference on Ultra-Relativistic Nucleus-Nucleus Collisions, held in Gatlinburg, Tennessee, from 11-15 November. Dedicated to the memory of Leon Van Hove, the meeting attracted about 50 per cent more physicists than originally planned, reflecting the current interest in the interface between particle and nuclear physics. Even just at CERN, this research attracts more than 500 scientists.

T.G. ('Gerry') Pickavance 1915-1991



synchrotron and creating a Laboratory for visiting scientists. In 1969, he left the Rutherford Laboratory to become Director of Nuclear Physics for the UK Science Research Council.

Sadly the physics community was soon deprived of his talents. On a trip to a conference in Bologna he became ill with pneumonia, followed by a stroke which left him partially paralysed and seriously impaired his speech. His wife and family have always spoken with gratitude of Antonino Zichichi's efforts in securing for him the best possible medical treatment in Bologna, which may well have saved his life. Although forced to retire in 1972 at the age of 57, Pickavance always retained his enthusiasm for physics and, right up to his death, held court at his UK home for many friends.

He was awarded the order of Commander of the British Empire (CBE), elected Fellow of the Royal Society and a Visiting Fellow of St. Cross College, Oxford. He received an honorary doctorate from London's City University and the Glazebrook Medal and Prize from the UK Institute of Physics.

From Godfrey Stafford



SSC Laboratory

Superconducting Super Collider Laboratory

We're about to change the way we look at the universe.

The SSCL, located just south of Dallas, Texas, is rapidly moving to become the premier center of particle physics research in the world. Major activities at the SSCL include design and construction of the 20 TeV proton collider and its associated complex of accelerators and detection apparatus as well as research in particle physics.

As part of the SSC Laboratory team of scientists, engineers and computer scientists, you'll be doing work which will have incalculable consequences for the future of science and technology, as well as the growth of human knowledge.

ASSOCIATE DIRECTOR: COMPUTING DIVISION

We seek an exceptional scientist with management experience to provide strong leadership as Division Head of the newly established Computing Division. The Computing Division, at the forefront of scientific computing hardware and software, provides leadership, guidance and planning for scientific computing policy and environments; develops, operates and maintains central computing resources, support operations of distributed facilities and establishes/maintains the laboratory computer networking system. The Division Head should have experience with currently available mainframes & workstations, as well as UNIX, VMS and PC operation systems. Additionally this Division will do research and development in computing methodology, techniques and software relevant to the anticipated needs of its users. Division staff will be the contact points for joint development projects with industry and university groups. The Division Head, reporting to the Laboratory Director, will manage and lead a current staff of 75 people which is expected to increase to 100+ over time.

The Superconducting Super Collider invites applications from outstanding candidates with an advanced degree, preferably a PhD in Physics or Computer Science, who have had significant experience with computing as practiced in a particle physics research environment, along with management and supervisory experience.

To Apply: Send Complete Resume and Salary History

Fax: 214-708-5592

Mail: SSC Laboratory
2550 Beckleymeade Ave.
MS-2050 / 3438-LB
Dallas, Texas 75237

**An Equal Opportunity/Affirmative Action Employer.
As always the SSCL strongly encourages minorities and female candidates to apply.**

UNIVERSITY OF COPENHAGEN

The Niels Bohr Institute

Applications are invited for a Chair (Professorship) in **Experimental Physics** at the Niels Bohr Institute, to commence November 1, 1992.

The professor will be appointed as a Civil Servant under the Ministry of Education and Research. The annual salary will amount to approximately 360.000 Danish kroner.

The chosen candidate is expected to take part in the experimental research activities of the Niels Bohr Institute, - either in low- and medium-energy nuclear physics in connection with the Tandem Accelerator Laboratory and accelerators abroad, - or in experimental high-energy particle physics in connection with the Institute activities at CERN.

The professor will also participate in the university teaching at all levels. The language of instruction is Danish, but English will be accepted for the first two years of the appointment. In the evaluation of the applicant, importance will also be given to teaching experience and qualifications.

Information about research plans, facilities and staff at the Niels Bohr Institute may be obtained from the Director, Blegdamsvej 17, DK 2100 Copenhagen Ø, Denmark.

Applications should include a curriculum vitae, a complete list of publications, copies of scientific publications and further documentation which the applicant wishes to be considered, and a brief outline of proposed research. Information concerning the applicant's teaching experience, to be evaluated by the Study Board, should also be enclosed. The material should be submitted in triplicate together with a complete list of the material.

After evaluation of the applicants' qualifications by a specially appointed Evaluation Committee, the Committee's report will be sent to all applicants.

Applications are to be addressed to Her Majesty the Queen of Denmark, and sent to the Faculty of Natural Sciences, Panum Institutet, Blegdamsvej 3, DK - 2200 Copenhagen N, Denmark. The closing date for receipt of applications is April 1st, 1992.

Research Associate Experimental High Energy Physics

The J.W. Goethe Universität Frankfurt/Main, Institut für Kernphysik, is involved in the CERN Heavy Ion Program and is seeking a

Research Associate

to take part in the preparation of new experiments and in the analysis of the ongoing experimental work (NA35, NA49).

A Ph.D. in experimental physics and experience in the field of ultrarelativistic nucleus-nucleus collisions are requested.

The successful applicant will be offered an indefinite contract. The salary is defined by the German BAT regulations.

Applicants are requested to submit within 3 weeks of publication date curriculum vitae, list of publications, statements of research interests and names of three references to

Prof. Dr. R. Stock
Institut für Kernphysik
Aug. Euler Str. 6
D - 6000 Frankfurt/Main 90
Tel. 49-697984240

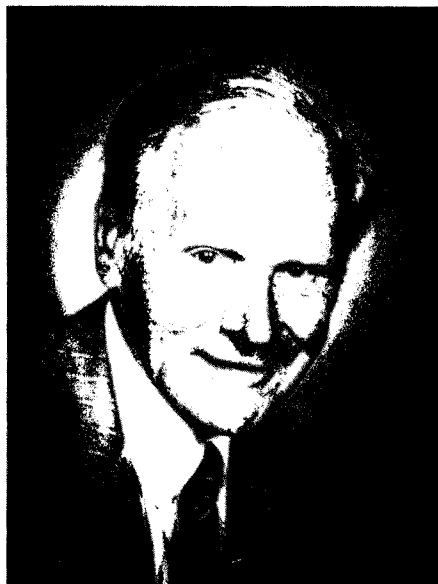
Theodorus J. Sluyters

Theodorus J. Sluyters, who retired at the end of June after 27 years at Brookhaven, died of a heart attack on 17 November while vacationing in his native Holland. He was 63 years old.

Sluyters had many friends in Laboratories all over the world. He earned his physics PhD at Amsterdam in 1958. After working at the F.O.M.-Laboratory in Amsterdam, and then at CERN, he joined Brookhaven in 1964. In 1971-72 he was visiting professor at the KEK Laboratory in Japan. Sluyters was a member of the Dutch Physical Society, the British Interplanetary Society, and the American Physical Society.

In the early 1970s Sluyters and his colleagues at Brookhaven began working on the development of ion sources. Pioneer work on negative hydrogen ion (H⁻) sources suggested a superior injection technique for high energy accelerators. This programme soon showed that negative ions of hydrogen isotopes can also have applications for plasma heating of fusion devices. Negative ion injection has since become a standard technique at proton accelerators, making possible, for example, a doubling of the Brookhaven Alternating Gradient Synchrotron (AGS) beam intensity. Later the group built a spin-polarized H⁻ source for experiments with polarized protons at the AGS.

Sluyters was a forceful organizer of people and events. In 1971 he organized the first Symposium on Ion Sources and Formation of Ion Beams, and from 1977 he and his colleagues have sponsored a broader Symposium, held every three years at Brookhaven, on the Production and Neutralization of Negative Ions and Beams; these meetings have become the most important on the subject worldwide.



In 1983 Sluyters became deputy head, and in 1986 head of the AGS Accelerator Division, overseeing the longterm upgrade programme to prepare the AGS for higher intensity operation and heavy ion operation with the new Booster. From 1990 until his retirement he was Deputy Chairman of the AGS Department.

With unbounded energy and enthusiasm, Sluyters was a generous colleague and friend. He chose early retirement with extensive plans to enjoy many years of travelling. His sudden death left his many friends shocked, with a deep feeling of loss. He was buried in Amsterdam on 21 November.

His colleagues

Sakharov Remembered

'Sakharov Remembered – A Tribute by Friends and Colleagues' is the title of a remarkable volume about a remarkable man. Edited by Sidney D. Drell and Sergei P. Kapitza and published by the American Institute of Physics, New York, in cooperation with the Physical Society of the

USSR, it covers both the life and the contributions to science of a man who was looked on by many as a living saint.

Some of the material has already been published – in Moscow in a special issue of 'Priroda' ('Nature') and in the US in 'Physics Today'. These essays are supplemented by other contributions, by many poignant photographs, and by a panel discussion ('On Free Thought') organized in Moscow by 'Priroda'.

The book is a worthy memorial to a man who 'was a moment in the conscience of humanity'.

Books

'Elementary Particles and the Universe', edited by John H. Schwarz and published by Cambridge University Press (ISBN 0 521 41253 6, hardback) includes essays from a two day-symposium at Caltech in 1989 marking the 60th birthday of polymath Murray Gell-Mann, with additional contributions from friends and colleagues.

Meetings

The XV International Conference on High Energy Accelerators will be held in Hamburg, Germany, from 20-24 July, organized by DESY and sponsored by IUPAP. Further information from HEACC 92 Conference Office, DESY, Notkestrasse 85, 2000 Hamburg 52, Germany, fax +49 40 8969-7305, e-mail HEACC92 at DHHDESY3.BITNET

The Third International Symposium on the History of Particle Physics will be held at the Stanford Linear Accelerator Center (SLAC) from 24-27 June. Co-sponsored by SLAC and

**FACULTY POSITION
EXPERIMENTAL HIGH ENERGY
PHYSICS
The Ohio State University**

The Department of Physics invites applications for a tenure track faculty opening in Experimental High Energy Physics. We are looking for a person with a strong record and outstanding promise as a researcher, who will also be a good teacher. Present research interests of our group of nine faculty include studies of heavy quarks and tau leptons, neutrino oscillations, high energy electron-proton collisions, and detector development for the SSC. Experiments are now running or staging at CESR, Fermilab, and HERA.

Applicants should send their curriculum vitae and the names of at least three references to :

**Richard Kass, Search Committee Chair
Department of Physics
The Ohio State University
Columbus, OH 43210**

Applicants will be screened beginning March 1, 1992 and will be accepted until the position is filled. Pending final administrative approval, the department hopes to fill this vacancy by Autumn, 1992. The Ohio State University is an equal opportunity and affirmative action employer.

**UNIVERSITY OF CALIFORNIA,
RIVERSIDE
Faculty Position in Experimental High
Energy Physics**

The Department of Physics at the University of California, Riverside, expects to make a faculty appointment in the area of experimental high energy physics on or after July 1, 1992. This tenure-track appointment will be at the level of Assistant Professor. The department is seeking candidates with outstanding research records and strong commitment to teaching. The individual appointed will be expected to join, for the near term, the ongoing Riverside research program in high energy proton-proton and proton-antiproton collisions. Please send a resume and arrange to have at least three letters of recommendation sent to

**Chair, Search Committee
Experimental High Energy Physics
Department of Physics
University of California, Riverside
Riverside, California 92521**

The deadline for receiving applications will be February 29, 1992. Any applications received after this date will be considered only if an appointment is not made from the original pool.

The University of California, Riverside, is an Equal Opportunity, Affirmative Action Employer. Minority and women candidates are encouraged to apply.

UTRECHT UNIVERSITY

The Department of Physics and Astronomy of the University of Utrecht (Netherlands) has an opening in the subatomic physics group for a

Professor of Experimental Physics

[full time vac.nr. 566/63065]

The group with a staff of about 40 (including Ph.D. students and technicians) and about 15 undergraduate students performs research in the field of nuclear physics and high-energy physics with an emphasis on the thematic overlap of both disciplines, the subatomic physics. Electron and hadron experiments are carried out at national (Amsterdam, Groningen) and international (Geneva, Caen, Bonn) facilities.

The applicant is expected to play a leading role in the research programme and to take an active part in the teaching of subatomic physics, the general teaching programme of the faculty as well as the management tasks. We are looking for an experimental physicist with a broad knowledge and proven originality in the fields of experimental nuclear physics and/or high-energy physics, particularly in subatomic physics. The candidate should have experience and quality in scientific teaching (which, after two years, should also be done in Dutch). Furthermore good management abilities are required. The annual salary amounts to approximately Hfl. 100,000.- to Hfl. 150,000.- depending on experience.

More information may be obtained from Prof. R. Kamermans, P.O. Box 80.000, 3508 TA Utrecht, tel. +31 30 532517/531492. Those wishing to recommend candidates are also invited to contact him.

Applications with a curriculum vitae, a list of publications and the names of three referees, should be sent to the Dean of the Department * Prof. dr. H.P. Hooyman * Princetonplein 5 * P.O. Box 80.000 * 3508 TA Utrecht, within 4 weeks after appearance of this announcement.



**UNIVERSITE CATHOLIQUE DE
LOUVAIN, BELGIUM
Department of Physics**

**FACULTY POSITION
IN EXPERIMENTAL PHYSICS**

The Rector of the Catholic University of Louvain (UCL) in Louvain-la-Neuve, Belgium, invites applications for a full-time academic position beginning in fall of 1992. Applicants will have a Ph.D. or equivalent and postdoctoral experience. The appointed person is expected to teach physics courses in the university and play a leading role in both shaping and implementing the research program of the Institute for Nuclear Physics of UCL.

Presently this program includes experiments pertaining to the following domains of investigation :

- physics with radioactive ion beams (e.g. study of nuclear reactions of astrophysical interest) ;
- nuclear reactions induced by heavy ions ;
- fundamental interactions and symmetries ;
- high energy physics : neutrino induced reaction ; neutrino oscillations ;
- nuclear physics applied to medicine and radiobiology ;
- solid state physics studies using nuclear techniques.

At the beginning, only a good knowledge of English is required but, as the candidate is expected to teach physics in French, he should acquire a reasonable command of the language within two years. Rank and salary will depend upon qualification and experience. Candidates should send a curriculum vitae, a research program (short and long term), three letters of recommendation and a copy of their five most representative publications to Professor P. Macq, Rector of UCL, Halles Universitaires, Place de l'Université, 1, B-1348 Louvain-la-Neuve, Belgium. Closing date for applications is March 31, 1992.

For further information, especially about the current research programs of the Institute, write or call Professor J.-P. Antoine, Chairman of the Department of Physics, Chemin du Cyclotron, 2, B-1348 Louvain-la-Neuve, Belgium, Tel. +32.10.47.32.94, Fax +32.10.47.24.14.

Fermilab, the meeting is organized around the central theme of 'The Rise of the Standard Model' of particle physics from 1964-79. Topics include the growth of large international collaborations, the transition from fixed target to colliding beam work, the unification of the weak and electromagnetic forces, and the development of the quark model. Speakers include physicists, science historians and philosophers, and sociologists. Meeting chairpersons are Lillian Hoddeson and Michael Riordan. Further information from Nina Adelman Stolar, SLAC Public Affairs Office, MS 70, PO Box 4349, Stanford, California 94309, USA. Phone 415-926-2282, bitnet nina at slacvm or fax 415-926-4999 or telex 3722871 stanuniv.

The Seventh International Symposium on Very High Energy Cosmic Ray Interactions will be held at the University of Michigan in Ann Arbor, Michigan during the week 21-27 June, 1992. These symposia, held biennially over the past decade, focus on the nature of the interactions of elementary particles and nuclei at the highest attainable energies as studied with cosmic rays and at high-energy particle accelerators. Lawrence W. Jones of Michigan is chairman of the Local Organizing Committee. Information may be obtained from: ISVHECRI, University of Michigan, Department of Conferences and Seminars, 541 Thompson Street, room 112; Ann Arbor, Michigan, 48109-1360, USA, Telefax: 313-764-1557, E-mail: David H. Frankel at ub.cc.umich.edu.

A NATO Advanced Study Institute will be held from 12-25 July in Il Ciocco near Lucca (Tuscany), Italy, on Particle Production in Highly

Excited Matter, directed by G. Bellettini, H.H. Gutbrod, and J. Rafelski. It is intended for young scientists, such as final-year graduate students and postdocs, and will focus on the study of highly excited nuclear matter and quark-gluon plasma formation by observation of particle production and emission. All enquiries to: Hans H. Gutbrod, CERN, PPE-Division, 1211 Geneva 23, Switzerland, e-mail gutbrod at cernvax.bitnet fax: +41 22 782 4897. Students eligible for a NATO fellowship should send a short one-page CV and a letter of recommendation. Deadline for applications is 1 March.

The 10th International Symposium on High Energy Spin Physics will be held in Nagoya from 9-14 November. Information from the Symposium Secretariat, Department of Physics, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464, Japan. Fax +52-783-0365, e-mail kekvox::spin92 or spin92 at jpnkekvx

1992 CERN School of Physics

The next CERN School of Physics will take place from 13-26 September in Monschau (near Aachen), Germany. The topics covered will include Field Theory, Electroweak Interactions, QCD, Beyond the Standard Model, CP Violation and the Experimental Higgs Search; with additional lectures on electron-positron machines and on LEP results. Further information from Miss S.M. Tracy, CERN School of Physics, CERN - DG-A, 1211 Geneva 23, Switzerland, e-mail tracy at cernvm.cern.ch Telex: 419000 cer ch Telephone: + 41 22 767 27 24, Telefax: + 41 22 782 30 11. Closing date for applications is 30 March.

CERN Courier changes printer

This edition of the CERN Courier was printed by Lannoo Printers, Tielt, Belgium, breaking with a 12-year tradition dating from 1979, when the printing has been handled (apart from a short break in 1985) by Presses Centrales, Lausanne, Switzerland. As well as their continual reliability, quality and attention to detail, Presses Centrales also expertly guided the journal through the rapidly developing technology of publishing and printing in the 1980s.

Back in 1979 all text was prepared as typescript, often heavily annotated, and sent to the printer by mail. This was manually typeset (rekeyboarded) and the results returned as galley proofs for checking and dummy page makeup. A second production stage involved checking the subsequent page proofs. Repeated keyboarding was onerous and error-prone, and called for vigilant reading.

With the advent of electronic mail, CERN Courier material increasingly became available as computer files for editing on the screen. Soon these spellchecked files could also be marked-up on the screen by the Editor and forwarded to the printer by modem, with a dummy page layout produced by desk-top publishing.

The CERN Courier's easy access to computer systems has also acted as a catalyst for the printer, hastening the introduction of some new techniques. As well as cutting out drudgery and improving turnaround, the net result has decreased the ever-present risk of error.

The CERN Courier thanks Presses Centrales Lausanne for their courtesy, skill, enthusiasm and reliability.

ANNUAL REVIEW OF NUCLEAR AND PARTICLE SCIENCE, Volume 41

J. D. Jackson • Harry E. Gove • Vera Lüth • *Editors*
Price: \$55.00 USA / \$60.00 other countries
Postpaid • ISBN 0-8243-1541-3 • 558 pages

CONTENTS

- **Decays of B Mesons**, K. Berkelman and S. L. Stone
- **Subthreshold Particle Production in Heavy-Ion Collisions**, U. Mosel
- **Tests of the Electroweak Theory at the Z Resonance**, H. Burkhardt and J. Steinberger
- **Hadron Collider Physics**, M. D. Shapiro and J. L. Siegrist
- **Advances in Hadron Calorimetry**, R. Wigmans
- **Isobar Excitations in Nuclei**, C. Gaarde
- **Low Energy Antiproton Physics**, C. Amsler and F. Myhrer
- **Searches for New Macroscopic Forces**, E. G. Adelberger, B. R. Heckel, C. W. Stubbs, and W. F. Rogers
- **Superdeformed Nuclei**, R. V. F. Janssens and T. L. Khoo
- **Storage Rings for Nuclear Physics**, R. E. Pollock
- **The Stanford Linear Collider**, J. T. Seeman
- **Quasi-Elastic Heavy-Ion Collisions**, K. E. Rehm
- **Quantitative Tests of the Standard Model of Electroweak Interactions**, W. J. Marciano
- **Charm Baryons: Theory and Experiment**, J. G. Körner and H. W. Siebert
- **Indexes**

Available through booksellers and subscription agents worldwide or direct from . . .



ANNUAL REVIEWS INC.

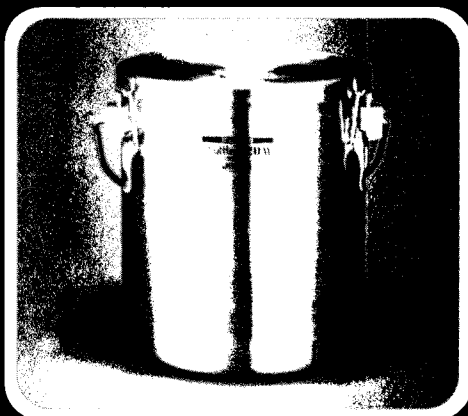
a nonprofit scientific publisher
4139 El Camino Way • P. O. Box 10139
Palo Alto, CA 94303-0897 • USA

32 Circle advertisement number on reader service form

all stainless steel THERMOS CONTAINERS

8 - 10 - 12 - 14 - 16 - 18 l

for experiments, storage, transportation



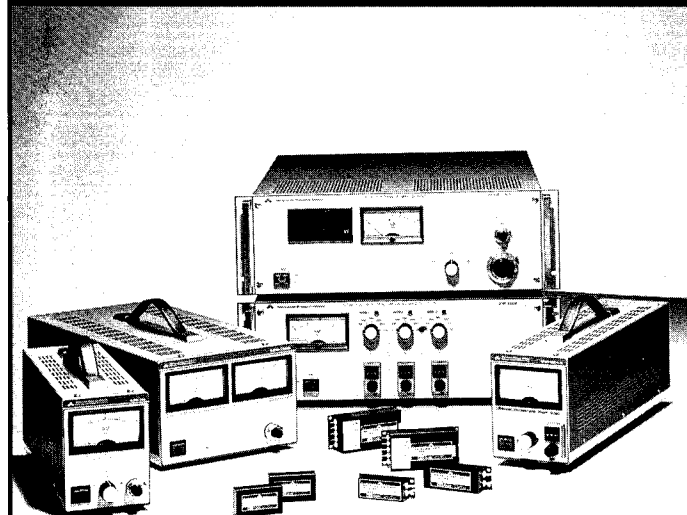
double wall stainless steel * permanent high vacuum insulation * tight closing insulated cover * temperature range 70 to 470 K *

European distributor: Dr. Ing. N. Eber & Co.,
CH-8103 Unterengstringen, Switzerland
Tel: (01) 750 55 72 - Fax: (01) 750 55 81

18 Circle advertisement number on reader service form

High Voltage Power Supplies

Optimum for Photomultiplier and MCP Applications



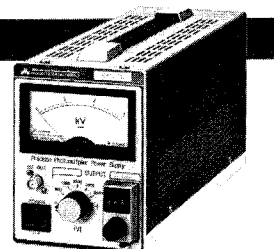
HPM Series

- High Performance, Regulated DC-DC On Board Modules
Up to 3000Vdc output (from 0V)
- Low ripple, high stability (output ripple 80mVp-p Typical)
- Small size (60L+40W+20Hmm)
- A wide range of input voltage (+11 to -16Vdc)



HJPM Series

- Bench-Top type power supplies
- Short circuit and Arc protected
- Up to 5kVdc output
- Reversible Polarity Available
- More precision SP models (output ripple 10mVp-p Typical)



Matsusada Precision Devices Inc.

European Representative

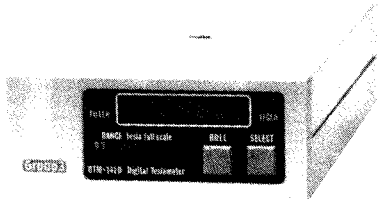
Zettachring 6, D-7000 Stuttgart 80, Germany
Tel: (0711) 7287143 Fax: (0711) 7289631

Head Office

745 Aojicho Kusatsu Shiga 525, Japan
Tel: 81-775-62-3111 Fax: 81-775-65-1211

31 Circle advertisement number on reader service form

Precision Magnetic Field Measurement



- Digital Hall Effect Teslameter
- Overall precision of 0.01%
- Temperature coefficient < 10 ppm/°C
- Field ranges from 0.03 to 3 T
- RS-232C or IEEE488 interface options
- Miniature probes for field mapping
- Precision, versatility and cost-effectiveness unequalled by any other manufacturer

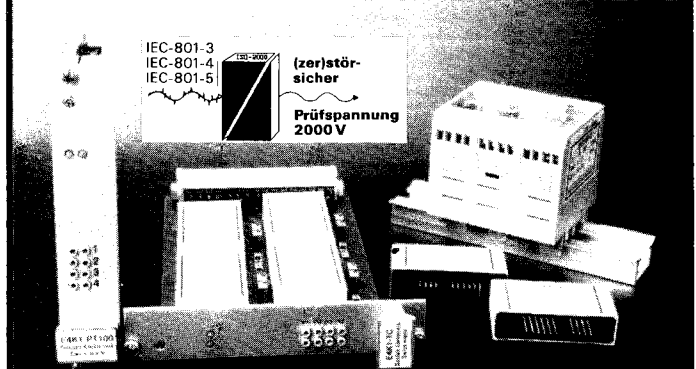


DANFYSIK A/S · Møllehaven 31 · DK-4040 Jyllinge · Denmark
Tel.: +45 46 78 81 50 · Fax: +45 46 73 15 51
In USA: GMW Associates · Tel.: (415) 368-4884 · Fax: (415) 368-0816

21 Circle advertisement number on reader service form

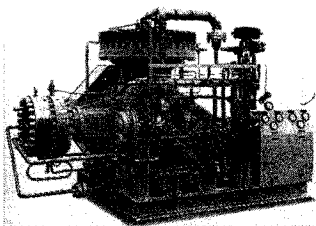
Isolated Transmitter

- Transmitter and Isolator, newest generation
- for PT100, thermocouple, CLTS, resistant,
- voltage, current and custom design
- Output 4/20 mA current loop (2-wire)
- or voltage f.e. 0/2, -5/+5, 0/10 V, 10 mV/K
- Accuracy from 0,05 % to 0,4 %
- Swiss made, 5 years Warranty
- conform with IEC-801-3, -4, -5
- EMC proof, newest EC standard



Rietacker 9
CH-9548 Matzingen
Tel. 054 53 12 12
Fax 054 53 12 83

42 Circle advertisement number on reader service form



Burton Corblin-Membrankompressoren

verdichten hermetisch alle Gase

Keine Umweltbelästigung, absolute Reinhaltung der Gase. Ein- und mehrstufig bis 2500 bar. In vielen Bauarten und Leistungsgrößen.

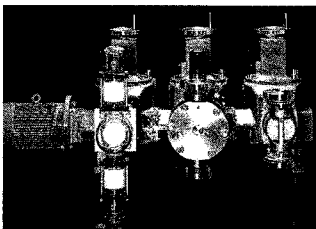
Generalvertretung in der Schweiz.

Fachberatung · Service · Ersatzteilhaltung

Missionsstrasse 22, CH-4003 Basel

Tel. 061/261 98 00, Fax 061/261 25 47

HERBERT OTT AG



LEWA-Dosierpumpen

Die ganze Spannweite der Flüssigkeitsdosierung

- Laborpumpen
- modular aufgebaute Dosierpumpen
- Triplex-Prozess-Membranpumpen
- kundenspezifische Dosiersysteme

Generalvertretung in der Schweiz.

Fachberatung · Service · Ersatzteilhaltung

Missionsstrasse 22, CH-4003 Basel

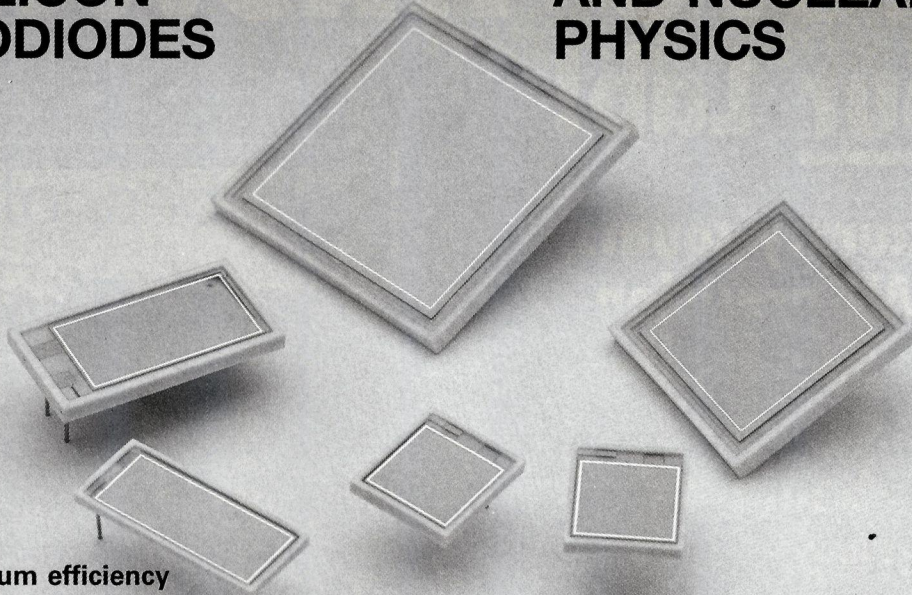
Tel. 061/261 98 00, Fax 061/261 25 47

HERBERT OTT AG

44 Circle advertisement number on reader service form

**LARGE-AREA
PIN SILICON
PHOTODIODES**

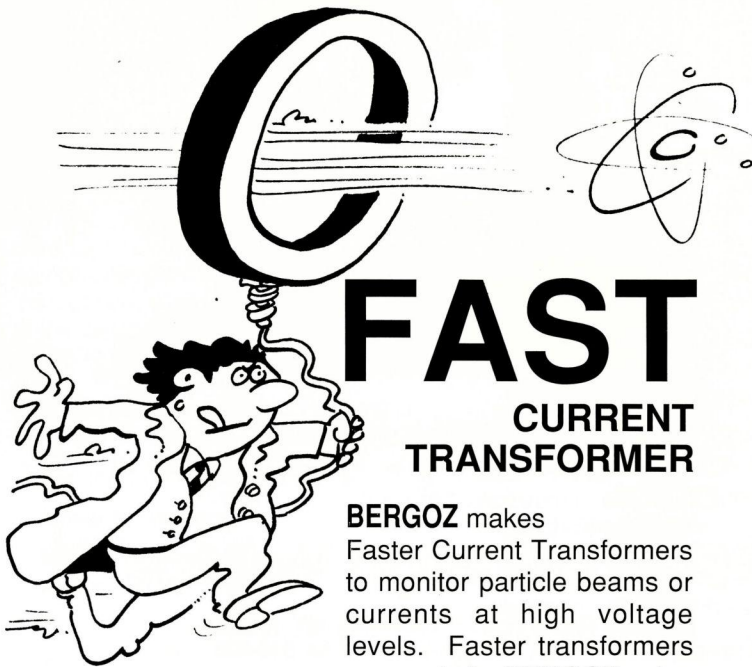
**FOR HIGH ENERGY
AND NUCLEAR
PHYSICS**



- High quantum efficiency
- Good energy resolution
- Windowless Types Available
- Large sensitive area :
10 x 10 mm, 10 x 20 mm, 30 x 30 mm, etc.
- 200, 300, 500 μ m Wafer Thickness Types

HAMAMATSU PHOTONICS FRANCE
Z.A. ORLYTECH - BAT. 523
3, allée du C^t Mouchotte - Paray-Vieilleposte
91781 WISSOUS Cedex
Tél. : 33.1.49.75.56.80 - Fax : 33.1.49.75.56.87
Tlx : HPF 262 082

28 Circle advertisement number on reader service form



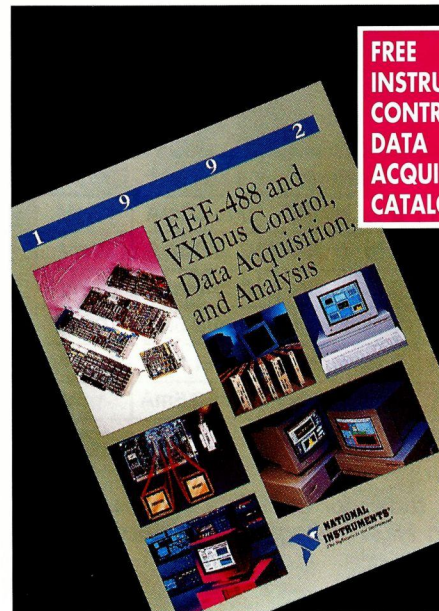
**FAST
CURRENT
TRANSFORMER**

BERGOZ makes Faster Current Transformers to monitor particle beams or currents at high voltage levels. Faster transformers are made by BERGOZ using specially annealed Cobalt

alloys. Standard models have 178mm inner diameter, risetime-falltime < 1ns and 1.25 V/A sensitivity. Special models can be as large as 300 mm, or very small. Other models can integrate picosecond risetime primary pulses with less than 1% ratio error.

BERGOZ Crozet, France, Fax 50.41.01.99 • Tel 50.41.00.89
REPIC Tokyo, Japan, Fax 03-3918-5741 • Tel 03-3918-5110
GMW Redwood City, CA, Fax 415-368-0816 • Tel 415-368-4884

17 Circle advertisement number on reader service form



**FREE
INSTRUMENT
CONTROL AND
DATA
ACQUISITION
CATALOG**

Free 1992 catalog of instrumentation products for PCs, workstations, and more. Features IEEE-488.2 interfaces and software, plug-in data acquisition boards, VXIbus controllers, DSP hardware and software, and signal conditioning accessories. Application software for complete acquisition, analysis, and presentation of data, including graphical user interfaces. Application tutorials and training classes also detailed.
CALL (512) 794 • 0100 or
(800) 433 • 3488 (U.S. and Canada)
Fax: (512) 794-8411

© Copyright 1991 National Instruments Corporation.
All rights reserved.

**NATIONAL
INSTRUMENTS®**
The Software is the Instrument™

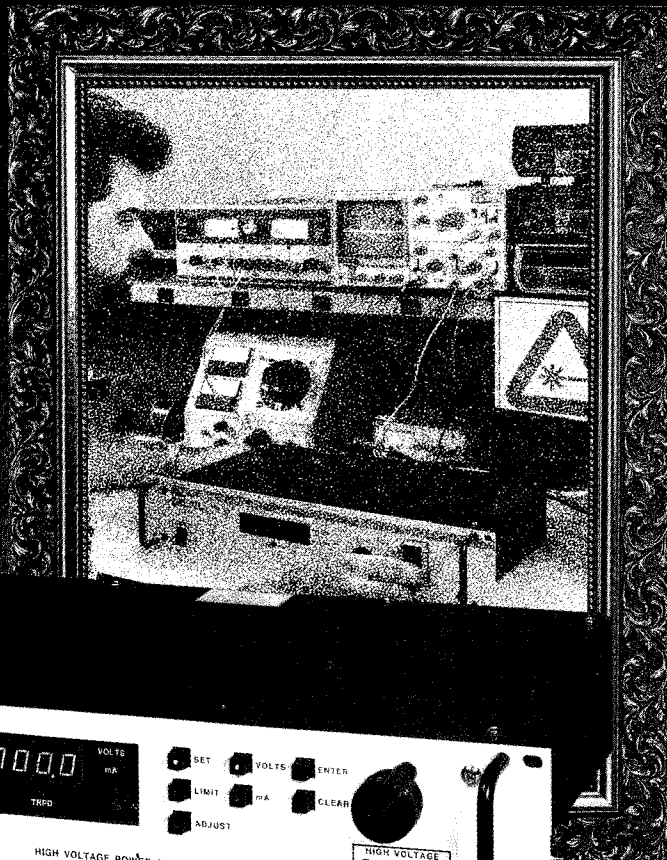
6504 Bridge Point Parkway
Austin, TX 78730-5039

34 Circle advertisement number on reader service form

Picture this... in your Lab!

Where accuracy counts, use BERTAN precision high voltage supplies to power detectors, E-beam, I-beam or X-ray sources.

- Continuously adjustable output voltage to 50kV
- The lowest ripple available: 0.001% P-P
- Outstanding accuracy: 0.1%
- Excellent temperature coefficient: 50 ppm/°C
- Short circuit and arc protected
- Precise remote monitoring



Model	Voltage	Current	Ripple*
205B/225-01R	0 to ± 1kV	0 to 30mA	10mV
205B/225-03R	0 to ± 3kV	0 to 10mA	30mV
205B/225-05R	0 to ± 5kV	0 to 5mA	50mV
205B/225-10R	0 to ± 10kV	0 to 2.5mA	100mV
205B/225-20R	0 to ± 20kV	0 to 1mA	500mV
205B/225-30R	0 to ± 30kV	0 to 0.5mA	1.5V
205B/225-50R	0 to ± 50kV	0 to 0.3mA	2V

* Measured P-P

Call or write today for complete information on all Bertan High Voltage Power Supplies.

What you see is what you get with Bertan High Voltage Power Supplies: digital LED readout, selectable for reading output voltage or current.

The Model 205B output is controlled via a front panel precision potentiometer and has remote analog programming and monitoring.

The Model 225 incorporates a microprocessor for front panel control and monitoring plus an IEEE-488 interface for remote operation.

BERTAN High Voltage

121 New South Road • Hicksville, NY 11801
516-433-3110 • TWX 510-221-2144 • FAX 516-935-1766



High Voltage Test Instruments

- Precision Divider Networks
- Electronic Loads



Series PMT Compact Modules

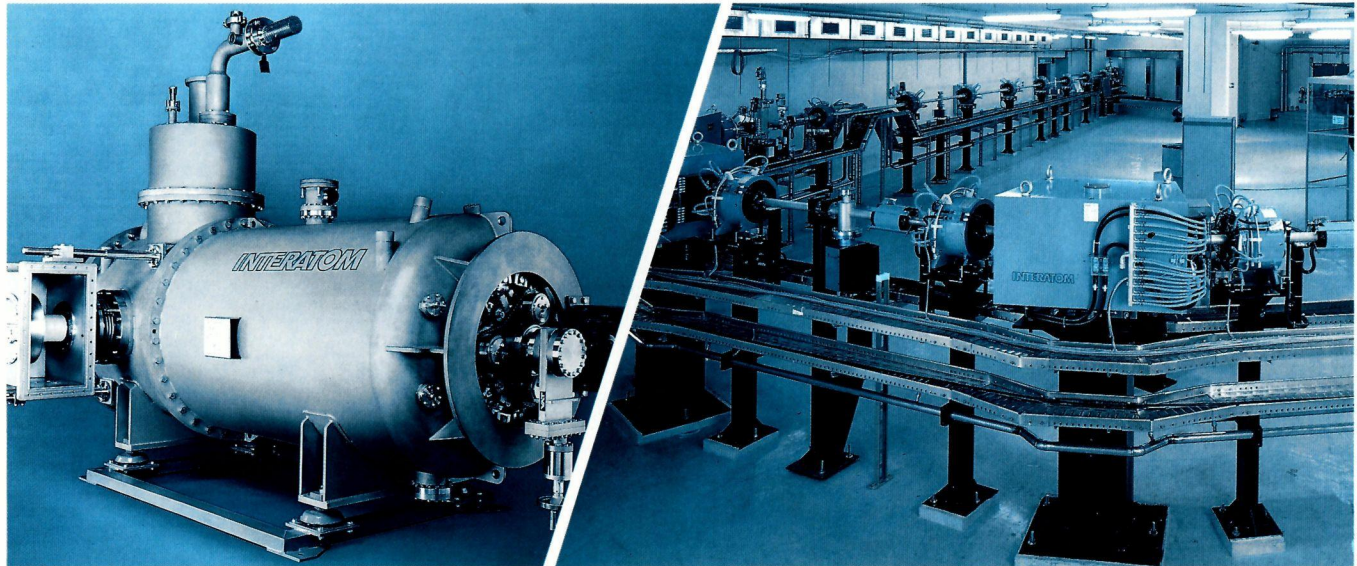
- Regulated DC-DC Converters
- Remote Programming/Monitoring



Models 206B/226 Dedicated ATE and System Applications

33 Circle advertisement number on reader service form

Accelerator and Magnet Technology



500 MHz superconducting accelerator module, INFN/Frascati

Injection beamline for the Cooler Synchrotron COSY, Forschungszentrum Jülich

On October 1, 1991, Interatom until then a wholly-owned subsidiary of Siemens AG, was merged into the parent company. For our present and future customers only the name has changed. Your contacts will be the same people at the same place, with the same dedication to meet your requirements.

We offer design, construction, commissioning and services for:

- Synchrotron radiation sources
- Linear accelerators
- Normal and superconducting accelerator cavities
- Normal and superconducting magnet systems
- Beam transport lines
- Vacuum chambers
- Cryogenic components and systems
- Beryllium windows

Accelerator and magnet technology from Siemens –
The full range of engineering and manufacturing services

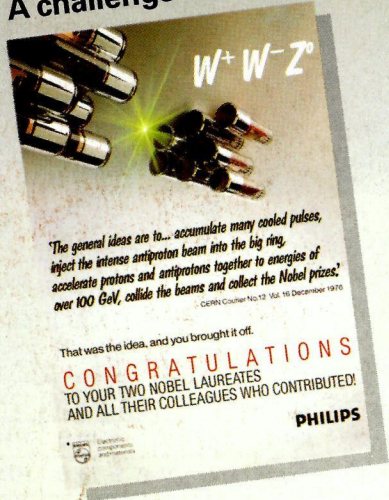
Siemens AG
Accelerator and Magnet Technology
Friedrich-Ebert-Straße
W-5060 Bergisch Gladbach 1
Germany
Telephone +49 22 04 84 22 88
Telefax +49 22 04 84 30 45

EPAC '92
European Particle
Accelerator Conference
Berlin
March 24-28, 1992
Exhibition of Siemens
Accelerator and Magnet
Technology

A 96 001-U 01-Z 230-V2-7600

HIGGS?

A challenge fulfilled



A challenge unfolding

To accumulate many proton pulses, inject two proton beams into the LHC ring in the LEP tunnel, accelerate the protons in twin-aperture superconducting magnets to energies of 8 TeV, collide the beams and collect the Higgs.

We wish CERN every success in launching the Large Hadron Collider enterprise. And for this challenge, as always, count upon our phototube design-in support to help bring it off again.

Still setting the standard

Philips Components



PHILIPS