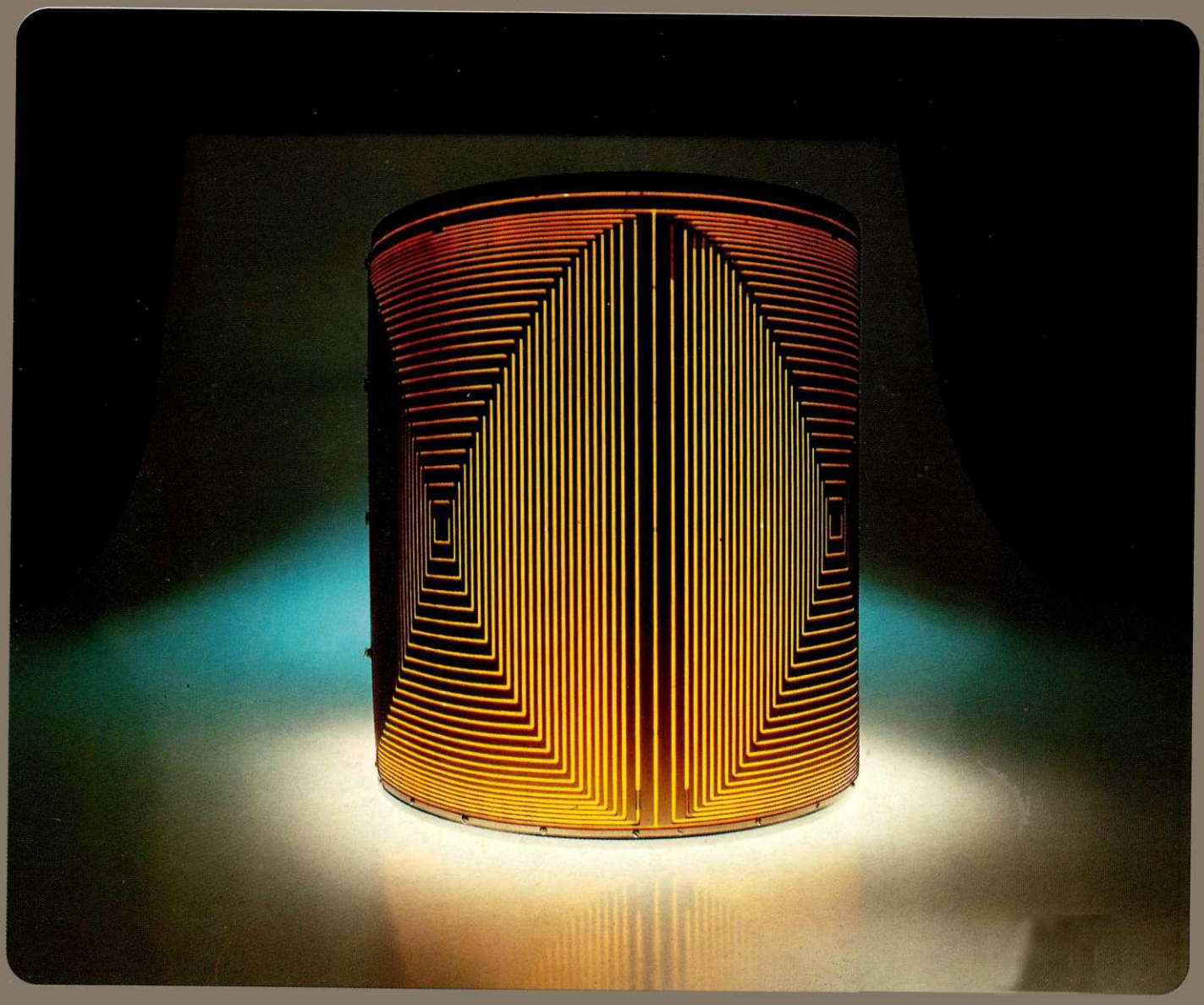
CERN COURIER

International Journal of High Energy Physics



VOLUME 28 4 MAY 1988

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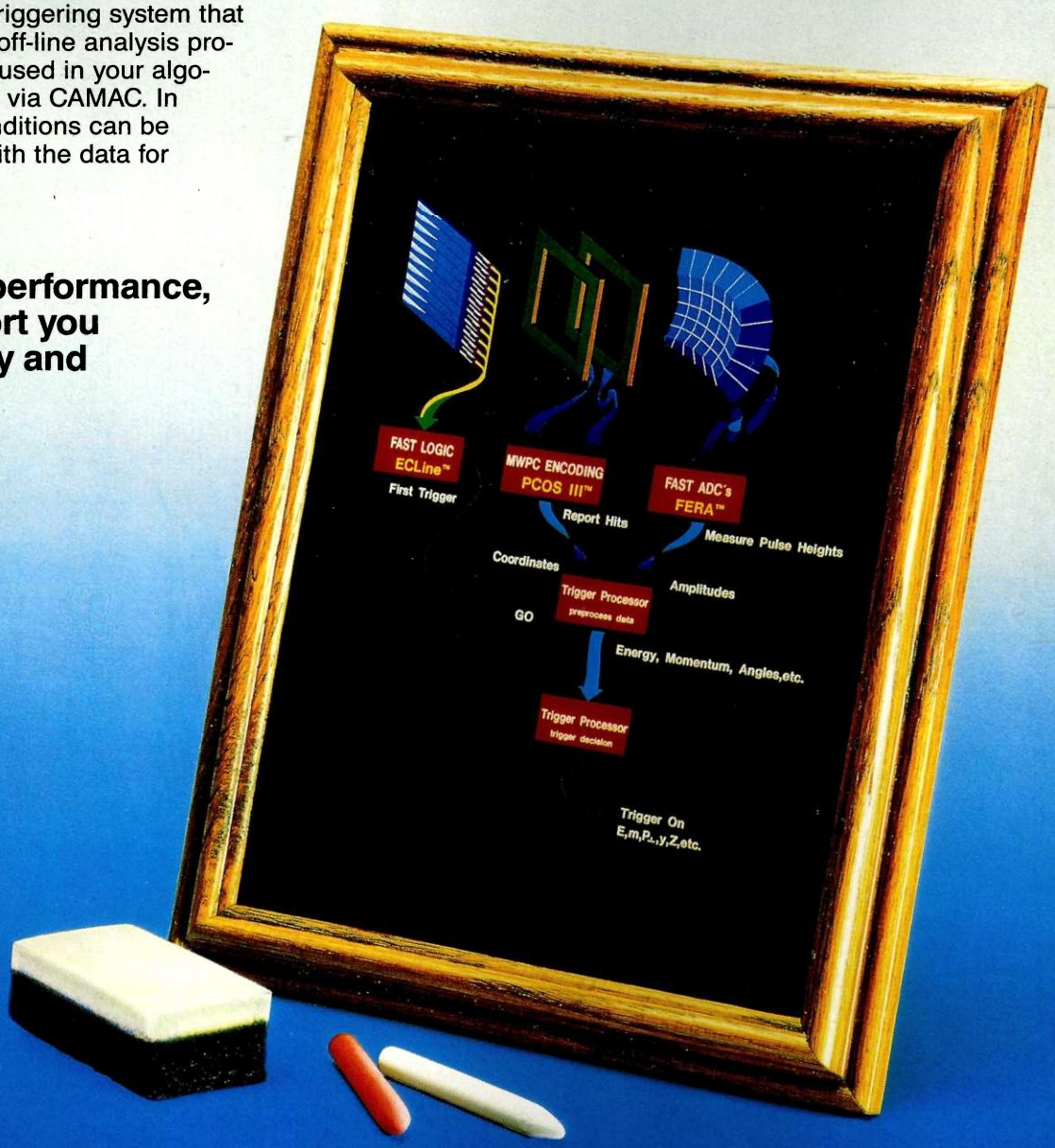

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Copies are available on request from:
China —
Dr. Qian Ke-Qin
Institute of High Energy Physics
P.O. Box 918, Beijing,
People's Republic of China
Federal Republic of Germany —
Gabriela Martens
DESY, Notkestr. 85, 2000 Hamburg 52
Italy —
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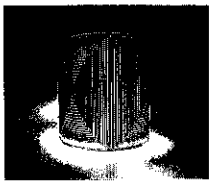

Cover photograph:
Printed circuit magnetic lens combination (dipole-quadrupole-sextupole) used at the French Saturne Laboratory (see page 5).

Italy at CERN

Italian Industrial Exhibition at CERN (Bldg 60)
(Geneva, 31.5/3.6.1988)

31.5 – 3.6.1988

LIST OF EXHIBITORS

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A.C.S. S.p.A.

Angelantoni Climatic Systems
I-06056 MASSA MARTANA (PG)
Tel. 075/88 92 21
Telex 660 147 ACS PGI
Telefax 075/88 97 70

Main production line:
Environmental test chambers and burn-in systems.

Exhibited products:
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Thermal shock test chamber mod. CST 27/2 T.

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I-16151 GENOVA
Tel. 010/41 031
Telex 270 006 ANSCOS
Telefax 010/41 68 68

Main production line:
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Exhibited products:
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API
ASSOCIAZIONE PICCOLE E MEDIE INDUSTRIE

Corso Galileo Ferraris 70
I-10129 TORINO
Tel. 011/55 28 1
Telex 221 109 APITO I

– CIFET S.r.l.

Via Vagnone 1
I-10143 TORINO
Tel. 011/76 79 02
Telex 221 108 TO

Main production line:
General steel structures, miscellaneous metals, construction with special metals.

Exhibited products:
Parts of steel structures.

– C.I.P. – COMPAGNIA ITALIANA PROFILATI S.p.A.

Strada Statale 23 – km. 16,300
I-10060 CANDIOLO (TO)

Main production line:
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Exhibited products:
Photographs and specification sheets.

– DEMO ARMADI RACKS

Corso Lombardia 52
I-10099 S. MAURO TORINESE (TO)
Tel. 011/24 43 52/6 [illegible]
Telex 213 275

Main production line:
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Exhibited products:
Card baskets.

– E.E.D. S.r.l.

Via Brandizzo 178
I-10088 VOLPIANO (TO)
Tel. 011/988 46 66
Telex 214 489 EED TO

Main production line:
Security access control for LEP. FASTBUS modules for nuclear physics experiments. CAMAC modules for nuclear physics experiments.

Exhibited products:
Security access control for LEP. FASTBUS modules TDP for ALEPH. FASTBUS modules TDP for OPAL. Modules UCAL for UA1. FASTBUS modules FEMC for DELPHI.

– GALLO & QUAGLIA S.N.C.

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I-10142 TORINO
Tel. 011/70 16 93

Main production line:
Planning and manufacturing of dies for sheet cold-working, planning and construction of any compressed air or oleodynamic operating equipment. Manufacturing of lead parts for radioactivity shielding.

Exhibited products:
Lead containers. Syringes shieldings.

– ITALCONTAINERS S.r.l.

Strada del Drosso 59/A
I-10135 TORINO
Tel. 011/34 38 25 – 34 52 95

Main production line:
Sheet metal and latticework containers. Special containers, ramps, bar-holders.

Exhibited products:
Sheet metal containers.

– ITALVALV DI R. ROVETA & C.

Strada del Corriere 27
I-15060 SANT'ANTONIO DI BASALUZZO (AL)
Tel. 0143/49[illegible]-2
Telex 215 014 ITY SAB

Main production line:
Ball valves, butterfly valves, diaphragm valves, check valves.

Exhibited products:
Photographs and specification sheets.

– **Consorzio METALLIA**

Corso Orbassano 249
I-10137 TORINO
Tel. 011/32 31 17
Telex 220 286

– – **AMERIO S.N.C.**

Via Caraglio 132/7
I-10141 TORINO
Tel. 011/335 98 61 – 33 65 02
Telex 220 286

Main production line:
Small and medium series of turned parts. Thread rollings.

Exhibited products:
Turned and rolled parts.

– – **ATLA S.r.l.**

Via Padana Inferiore 44
I-10023 CHIERI (TO)
Tel. 011/947 23 46
Telex 220 286

Main production line:
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Exhibited products:
Vacuum tanks, flanges and honeycombs.

– – **DUE M.C. S.N.C.**

Via Berc 43/2
I-10142 TORINO
Tel. 011/70 16 72 – 70 71 800
Telex 220 286

Main production line:
Equipment, prototypes and mechanical components of medium and small series.

Exhibited products:
Flanges, rings and shafts.

– – **FIL-PA**

Via Caraglio 132/11
I-10141 TORINO
Tel. 011/38 32 83
Telex 210 442 CALIER I

Main production line:
Medium and high series of small turned parts.

Exhibited products:
Small turned parts.

– – **FIMS Spirale Fabbr. Ital. Molle**

Via Frejus 16
I-10098 BETNASCO (TO)
Tel. 011/34 90 596
Telex 220 286

Main production line:
Springs in steel wire and strips.

Exhibited products:
Springs.

– – **OMICRON DUE S.N.C.**

Vicolo Mungis 13
I-00043 ORBASSANO (TO)
Tel. 011/90 11 205 – 90 03 568
Telex 220 286

Main production line:
Dies for sheet, plastic and rubber. Cold forming of parts.

Exhibited products:
Flanges, supports and parts.

AUR EL S.p.A.

Via Casadei 7
I-47015 MODIGLIANA (FO)
Tel. 0546/91 124
Telex 550 518

Main production line:
Hybrid thick film circuits, charge preamplifiers, thick film manufacturing equipments, hybrid circuits production equipments.

Exhibited products:
Charge preamplifiers. Amplifiers. Custom high energy physics and research products.

AUR EL MICRO-SYSTEM S.r.l.

Via Monte Grappa 73
I-21049 TRADATE (VA)
Tel. 0546/91 124
Telex 550 518

Main production line:
Hybrid thick film circuits, charge preamplifiers, thick film manufacturing equipments, hybrid circuits production equipments.

Exhibited products:
Charge preamplifiers. Amplifiers. Custom high energy physics and research products.

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Via Vetraia 11
I-55049 VIAREGGIO
Tel. 0584/39 56 74 - 39 60 90
Telex 580 112 CAEN I Telefax 0584/39 60 34

Main production line:
Electronic instruments for high energy physics in different standards (NIM, CAMAC, FASTBUS). Discriminators, logic modules, data acquisition and control modules, etc.

Exhibited products:
SY 127 General purpose multichannel high voltage system. SY 170 Multichannel high voltage divider-distributor. PS 35-100 3, 5kV, 100mA power supply. N 126 8kV reversible polarity 1-Unit NIM power supply. N145 Quad scaler and preset countertimer. N 146 Programmable delay unit. N 147 Programmable attenuator unit. N 96 8-fold fast discriminator. 2225B Dual gate generator and timer. N81 A double programmable logic unit. A119A CAENET control box. C111 CAMAC controller interface. C177 32-channel programmable fast discriminator. C117A CAENET CAMAC controller. C139 CAMAC controller for SY 127 system. C 187 Streamer tubes data acquisition system. PCFB PC to FASTBUS interface. FBI FASTBUS backplane indicator (CERN design).

CONSORZIO PROVEX

Viale Milano 16
I-21100 VARESE
Tel. 0332/24 00 06
Telex 380 378

- C.E.A.I. Elettronica S.p.A.

Via Genova 11
I-21052 BUSTO ARSIZIO (VA)
Tel. 0331/633 598
Telex 355 648 CEA
Telefax 0331/63 00 64

Main production line:
Electrical apparatuses for low and medium voltage. Electric switch board. Electronic apparatuses for automatic process control.

Exhibited products:
Samples of electrical apparatuses and catalogues.

- ICEL S.R.L.

Via Carlo Jucker 16
I-21053 CASTELLANZA (VA)

Main production line:
Synthetic film and aluminium electrolytic capacitors. Machines and complete lines for electric capacitors production.

Exhibited products:
Samples of electrical capacitor and catalogues.

- MARCORA FORGIATURA SAS

Via Marconi 17
I-21052 BUSTO ARSIZIO (VA)
Tel. 0331/63 43 56
Telex 323 187 FORGA I
Telefax 0331/62 43 53

Main production line:
Free die steel forgings up to kg. 5000. Rolled steel rings up to diam. max. mm. 2500.

Exhibited products:
Photos of production and catalogues.

- PIOTTI GIUSEPPE SAS

di Francesco Piotti & C.
Via S. Alessandro 6
I-21041 ALBIZZATE (VA)
Tel. 0332/49 34 38
Telex 331 586 PROBJ I PER PIOTTI
Telefax 0331/63 91 76

Main production line:
Special screws and bolts both lathed from bars or electropressed. Small metallic precision items. Building and assembly of small mechanical devices. Plugs and sockets for electronic apparatus.

Exhibited products:
Small samples of turned items and catalogues.

- SIPUR SDF

di Puricelli P. e C.
Via S. Bernardo 82
I-21010 VERGHERA (VA)
Tel. 0331-22 03 38
Telex 331 596 PROBJ I PER SIPUR
Telefax 0331/63 00 65 PER SIPUR

Main production line:
Hand pallet truck. Hand and electric powered fork lift trucks. Lifting crane.

Exhibited products:
Photos of production and catalogues.

- **TA-MEC Off. Mecc. di Giorgio e Paolo Tagliabue S.N.C.**

Via Cavour 5
I-21019 SOMMA LOMBARDO (VA)
Tel. 0331/25 44 65
Telex 310 893 ASARVA
Telefax 0331/25 44 24

Main production line:
Working of tubes, profiles and cold working of wires by automatic CNC machines and up-to-date control systems.

Exhibited products:
Small samples and catalogues.

- **TERZI ENFICO PROFILATI**

Via Trieste 82
I-210011 CASARATE SEMPIONE (VA)
Tel. 0331/29 52 62
Telex 325 103 PROTER I
Telefax 0331/63 00 85 PER TERZI

Main production line:
Cold shaped steel profiles. Standard and on request special profiles.

Exhibited products:
Small samples of cold profiles and catalogues.

- **VENTAX SRL**

Via Boncalza 102
I-21012 CASSANO MAGNAGO (VA)
Tel. 0331/20 74 04
Telex 331 526 PROBEL I PER VENTAX
Telefax 0331/22066 69

Main production line:
Axial fans for industrial applications of 500 mm up to 6MT propeller diameter, made of aluminium alloy.

Exhibited products:
Photos of production and catalogues.

- **ZA-BER S.p.A.**

Via Adua 21
I-21015 LONATE PAZZOLO (VA)
Tel. 0331/66 81 31
Telex 331 586 PROBLO I PER ZABER
Telefax 0331/331/66 12 62

Main production line:
Special mechanical workings with high technology and C.N.C. machines. Electronic and chrome cast iron workings.

Exhibited products:
Photos of production and catalogues.

DE PRETTO-ESCHER WYSS S.p.A.

Via Daniele Manin 16-18
I-36015 SCHIO (VI)
Tel. 0445/69 15 11
Telex 480 138 DPEW S I
Telefax 0445/51 11 38

Main production line:
Special mechanical components for ultra high vacuum, cryogenic or high temperature environments. Hydroelectric machinery and plants. Machinery and equipments for paper industry. Steam turbines (ABB licence). Turbocompressors. Iron castings.

Exhibited products:
Pictures of special mechanical components such as vacuum vessels, RF cavities, RF antennæ. Prototype of high precision mechanical stainless steel vacuum brazed component for RF transmission.

ELEMER SRL

SS. 407 Basentana KM. 75,500
I-75010 BORGO MACCHIA FERRANDINA (MT)
Tel. 0835/75 71 87
Telex 812 564 IMPES I
Telefax 0835/75 71 96

Main production line:
MV switchboards (metal clad, protected type, MCC type). LV switchboards (power center, MWW with drawers). LV distribution switchboard, LV control, LV protection, electromechanical logic. LV switchboards, programmable logic LV, distribution batteries, mimic-diagram boards.

Exhibited products:
Light blowups posters.

EUROPA METALLI LMI S.p.A.

Borgo Pinti 99
I-50121 FIRENZE
Tel. 055/49 741
Telex 571 598 SMIFI I
Telefax 055/247 90 67

Main production line:
Superconducting wires and cables, mineral insulated cables, copper for nuclear fusion, special section, copper and copper alloys sheets, copper tubes bars and insulated, copper tubes for air conditioning.

Exhibited products:
Superconducting wires and cables, mineral insulated cables, copper for nuclear fusion.

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Telefax 02/213 32 29

Main production line:
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Exhibited products:
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METALTRECCE S.N.C.

Via Meucci
I-36040 BRENDOLA (VI)
Tel. 0444/60 00 90 - 60 16 05
Telex 480 155 INDVI PER METALTRECCE
Telefax. 0444/60 16 05

Main production line:
Solid/flexible signal and control cables, security and fire alarm cables, telephone cables, RG and TV down lead, TV camera and CCTV cables, superflexible cables for special purposes, special cables produced under customer specification.

Exhibited products:
Samples of cables.

O.C.E.M. S.p.A.

Via 2 Agosto 1980 11
I-40016 S. GIORGIO DI PIANO (BO)
Tel. 051/89 71 72
Telex 510 893 OCEM I
Telefax 051/89 75 49

Main production line:
Power electronic.

Exhibited products:
Power supplies for scientific laboratories. No-break power supplies (500 VA up to 200 kVA). Frequency-converter. Regulators for airfield lighting. Cathodic protection. Fiber optic links.

OLIVETTI ING. C. & C. S.p.A.

Via Jervis 77
I-10015 IVREA (TO)
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Telex 210 030 OLIVR I
Telefax 0125/52 16 71

Main production line:
Electronic typewriter and wordprocessing, microcomputers, printers, minicomputers, terminals, telecommunication systems and archives systems.

Exhibited products:
Personal computers: M240, M280, M290, M380, M380C et M380T; printers: DM 100, DM 296, DM 600 PG 208 and minicomputer LSX 3020.

OLIVETTI-HERMES (Suisse) SA

Industriestrasse 50
Postfach
8304 WALLISELLEN
Tel. 01/830 62 62
Telex 828 650 OLI CH
Telefax 01/830 56 84

Main production line:
Electronic typewriter and wordprocessing, printers, minicomputers, terminals.

OLIVETTI VENTE SA

Rue Thalberg 8
1201 GENEVE
Tel. 022/45 09 30
Telefax 022/34 24 66

Main production line:
Electronic typewriter and wordprocessing, printers, minicomputers, terminals.

PASSONI E VILLA S.p.A.

Viale Suzzani 229
I-20162 MILANO
Tel. 02/642 14 51 - 647 38 21
Telex 330 420 PASVIL
Telefax 02/642 34 22

Main production line:
Condenser bushings up to 1200 kV. Capacitor voltage transformers. Coupling capacitors for carrier transmission. Capacitors for HV circuit breakers. Power factor capacitors. HV capacitors for special applications. HV pulse generators. HV direct current generators. Test transformers. Gas standard capacitors.

Exhibited products:
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RAFFAELE RIMASSA S.p.A.

Via M. Dusma 87
I-16042 CARASCO (GE)
Tel. 0185/35 00 72
Telex 270 679
Telefax 0185/35 08 80

Main production line:
Raripress hydraulic cylinders and rams, hand pumps, power units, valves and accessories for high pressure circuits (700 bars), custom-built raripress, raritest pneumatic and hydraulic educational and industrial test stands.

Exhibited products:
Cylinders, hand pumps, power units and accessories for high pressure circuits (700 bars).

RIAL S.p.A.

Via Novara 6/A
I-43100 PARMA
Tel. 0521/77 12 75 - 77 21 93
Telex 531 543 RIALI I
Telefax 0521/77 32 68

Main production line:
Ion pumps and systems related to clean vacuum and ultra high vacuum, evaporation, surface studies, microscopy, etc.

Exhibited products:
LEP bellows, ultra high vacuum valves, motion feedthroughs, tridimensional manipulators, multiways crosses, knudsen evaporation cells.

S.C.L. SRL SECURITY COMPUTER LINE

Via Brescia 6
I-25018 MONTICHIARI (BS)
Tel. 030/996 11 80 - 996 11 79
Telex 304 470 CSP DIE I
Telefax 030/67 61 67

Main production line:
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Exhibited products:
"Tutor" computer.

SILENA S.p.A.

Via Firenze 3
I-20063 CERNUSCO SUL NAVIGLIO (MI)
Tel. 02/923 33 31 - 934 86 26
Telex 322 523 SILENA I
Telefax 02/923 32 93

Main production line:
Design, production and sale of electronic instrumentation for analysis of nuclear radiations.

Exhibited products:
Date acquisition system in the CAMAC standard, multichannel analyser mod. "Varro". New NIM-standard analyser "Series 89", system based upon use of the memory buffer mod. 7937 for nuclear spectroscopy measurements, environmental monitoring system.

VARIAN S.p.A.

Viale Rivoltana 8
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VARMIL I
Telefax 02/753 40 03

Main production line:
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Exhibited products:
Turbo molecular pump system mod. Turbo-VCART/200, ion pump mod. Star-cell 60 L/SEC., control unit mod. Star Link. Leak detection system mod. Helium SPY 2000, flanges and supplies.

VEAM S.p.A.

Via Statuto 2
I-20020 ARESE (MI)
Tel. 02/938 02 12
Telex 332 502
Telefax 02/938 50 00

Main production line:
Electrical connectors according to spec. MIL-C-5015/MIL 26482 Serie 1 and 2 / VG95234 / VG95328 / COAX / DIN41612 / IEEE323-344-383.

Exhibited products:
Electrical connectors.

ZANON E. S.p.A.

Via Vicenza 113
I-36015 SCHIO (VI)
Tel. 0445/67 04 00
Telex 480 069 ZANON I
Telefax 0445/67 05 62

Main production line:
Pressure vessel of any type, vacuum chambers, internals for reactors, heat exchangers, test circuits, reactors, columns, autoclaves, vessels and tanks, piping systems and components for nuclear power stations such as special heat exchangers, circuits with instruments etc.

Exhibited products:
Enlarged slide panels.

A solid chUNK of new physics

Delegates at last year's meeting at Protvino (Moscow region) reviewed the exciting prospects for experiments at the new UNK 3 TeV proton accelerator/collider now under construction.

Opening the International Workshop on the Experimental Programme at the future Serpukhov accelerator and storage complex (UNK), held at Protvino, Moscow Region, USSR, under the sponsorship of the USSR State Committee for Atomic Energy and of the Protvino Institute of High Energy Physics last year, Vice-President of the USSR Academy of Sciences A.A. Logunov reminded the audience that an important decision on the future of high energy physics in the Soviet Union had been made only a few months previously. The UNK project is now considered as one of the major government enterprises for the coming years, and will be strongly supported by the national industry resources (see January/February issue, page 3).

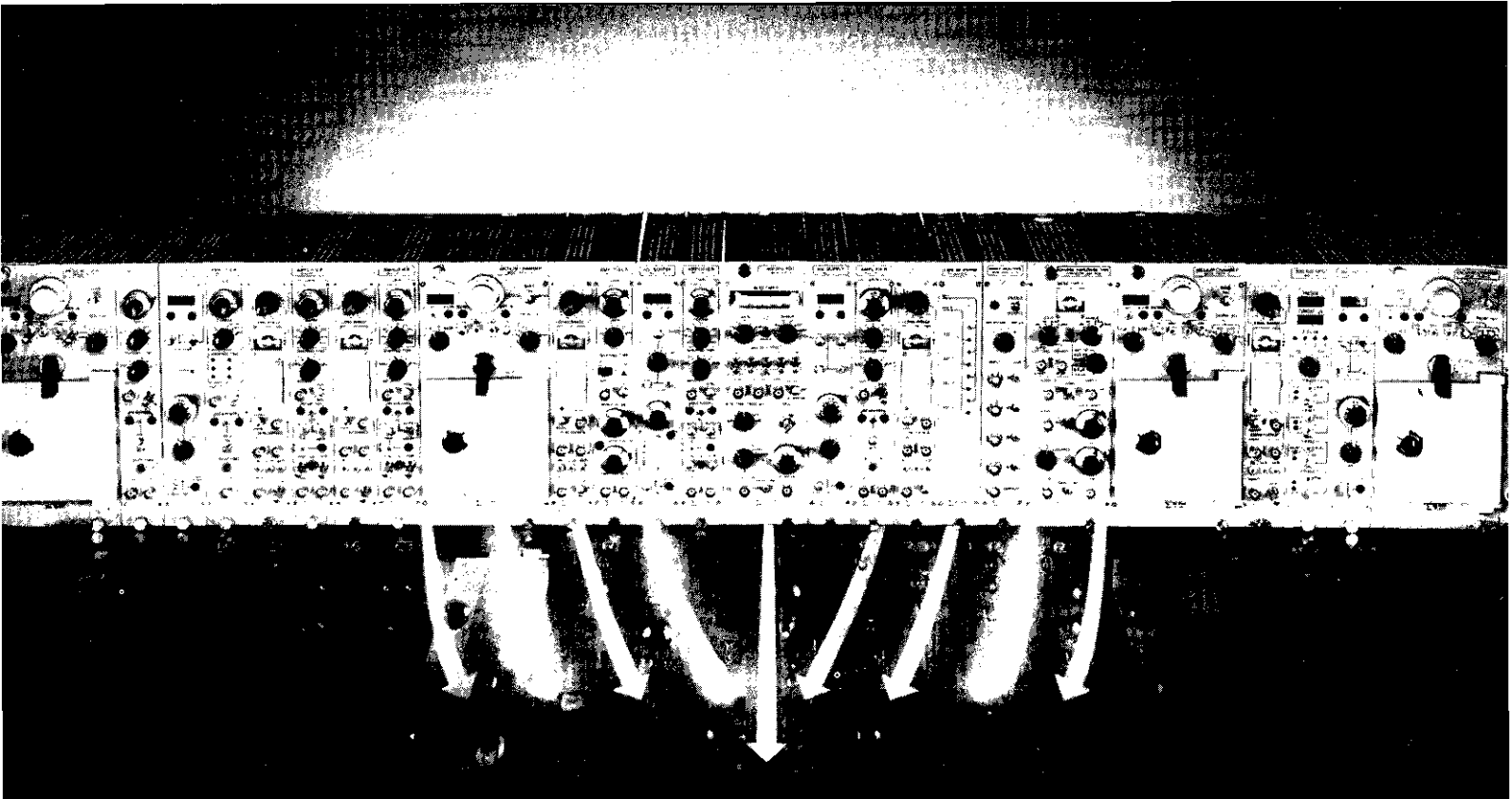
Logunov stressed that following these decisions the physics community should be ready for extracted beams from the superconducting 3 TeV (3000 GeV) machine in 1993, while the addition of a second ring would give 6 TeV total energy proton-proton collisions in 1995.

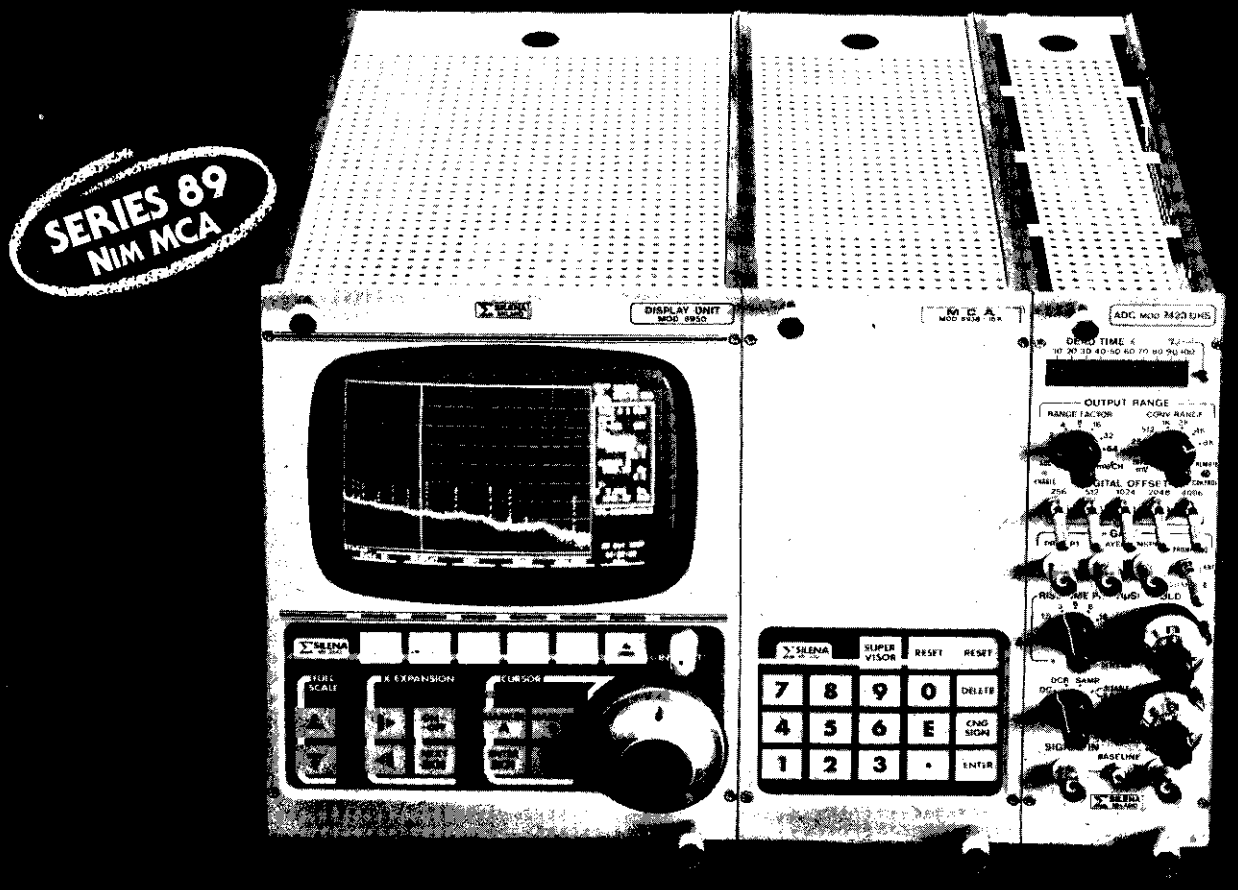
In addition, as soon as the tunnel for the UNK proton machine is ready, the construction team will start tunneling for the electron-positron linear collider on site close to Protvino. This collider will begin operations around 1996 at an energy of 500 GeV per beam, and will later be upgraded to 1 TeV.

The meeting was designed to update the international physics community on the UNK project and evaluate critically the main aspects of the research programme now being planned for the first years of operation. It was structured in three sessions, with theoretical, experimental and instrumentational aspects of the UNK research programme covered.

Machine structure and parameters as well as the status of the construction were covered by K.P. Myznikov.

Theoretical problems related to future experiments at UNK were discussed in several talks by members of the theory working group from the Protvino Institute of High Energy Physics. These included soft and semihard hadronic collisions (V.A. Petrov), composite structure of leptons and quarks (Yu. F. Pirogov), supersymmetry and superstring manifestations (A.G. Liparteliani), heavy quarks (S.R. Slabospitsky) and polarization phenomena (S.M. Troshin). Perspectives for TeV neutrino beams were reviewed by V.A. Tsarev (Lebedev Physical Institute). Almost all speakers were optimistic about UNK's potential for revealing new phenomena, even when competing





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(Krnphysikalische Meßsysteme)
Hänfig Strasse 7, 6467 Hasselroth 2
Tel. 06055 / 4021 - Telex 418491 siwi d

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Gruener Weg 2
A - 2432 SCHWADORF, Austria
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with other hadron colliders.

R.D. Peccei and A. Ali from DESY looked for the challenges of fixed target physics at UNK. In their opinion, enthusiastically accepted, UNK may operate as a hadronic B-factory (for particles containing the sixth 'beauty' quark), opening the door to rare phenomena, in particular the CP violation in the B-sector (so far the study of CP violation has been limited to neutral kaons). G. Preparata (Bari) spoke on spin physics at high energies.

A number of experimental proposals were presented, and the discussion centred around the priority experiments expected to be ready when the new accelerator starts running. A jet-target technique is proposed for polarization experiments in the internal beam (presented by V.L. Solovjanov, IHEP). The intention is to use both the warm iron 400 GeV booster and the 3 TeV superconducting accelerator.

An extension of the current IHEP research programme in the study of gluon-gluon interactions was presented by Yu. D. Prokoshkin (IHEP). The proposed setup continues along the lines of the successful GAMS programme at IHEP and CERN which has recently discovered the G(1590) and X(1800) 'glueball' candidates. Discovery of the glueballs (particles composed of gluons rather than quarks) and the measurement of their spectrum are generally considered a key step in understanding how to apply quark-gluon field theory (QCD) at large distances.

The design for a new high-resolution wide-aperture multiparticle spectrometer for heavy quark studies was presented by A.M. Zaitzev (IHEP). This physics concentrates on B-particles, including the mixing of neutral B mesons and CP-violation studies. Ultimately, the experiment will run with beams of about 10^7-10^8 particles per second, using a sophisticated trigger.

A second proposal along these lines but with a special emphasis on the hyperon beam was presented by A.A. Vorobjev from Leningrad (Institute for Nuclear Physics).

The neutrino programme was the last in the list of fixed target experiments but took longest to discuss. An approach to use neutrino experiments as a tool to look for deviations from the currently accepted standard model was presented by V.V. Ammosov (IHEP) and S.A. Bunjatov (JINR, Dubna), and updated in comments by R. Leiste (Zeuthen, GDR), V. Khovansky (ITEP, Moscow) and I.A. Savin (JINR, Dubna), who concentrated on a search for new phenomena in the tau lepton sector.

A separate session was given over to experiments at the future UNK proton-proton collider at 3 TeV per beam and luminosity 4×10^{32}. S.P. Denisov (IHEP) and V.N. Roynishvily (Tbilisi)) had two complementary proposals aimed at different domains of collider physics. The first is a full solid angle calorimetric detector with precision tracking inside a superconducting solenoid to look for new behaviour in violent collisions, while the second, still exploratory, envisages a large streamer chamber surrounded by photon calorimeters.

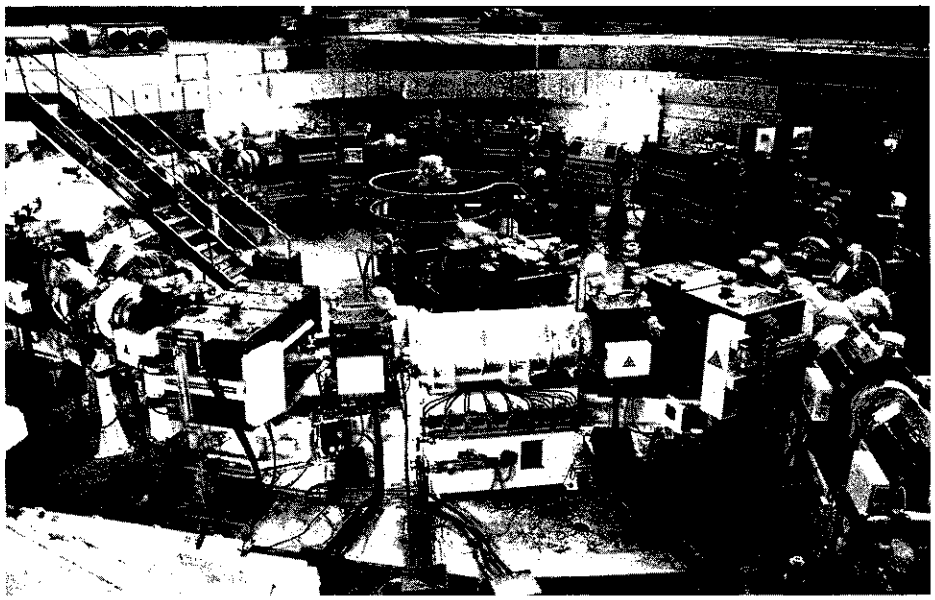
The Workshop was complemented with detailed and very interesting review talks by L. Montanet, CERN (fixed target programme at CERN), R. Ruckl, DESY (physics at electron-proton colliders), R. Dixon, E. Knapp and T. Toohig (present and future particle physics in the United States).

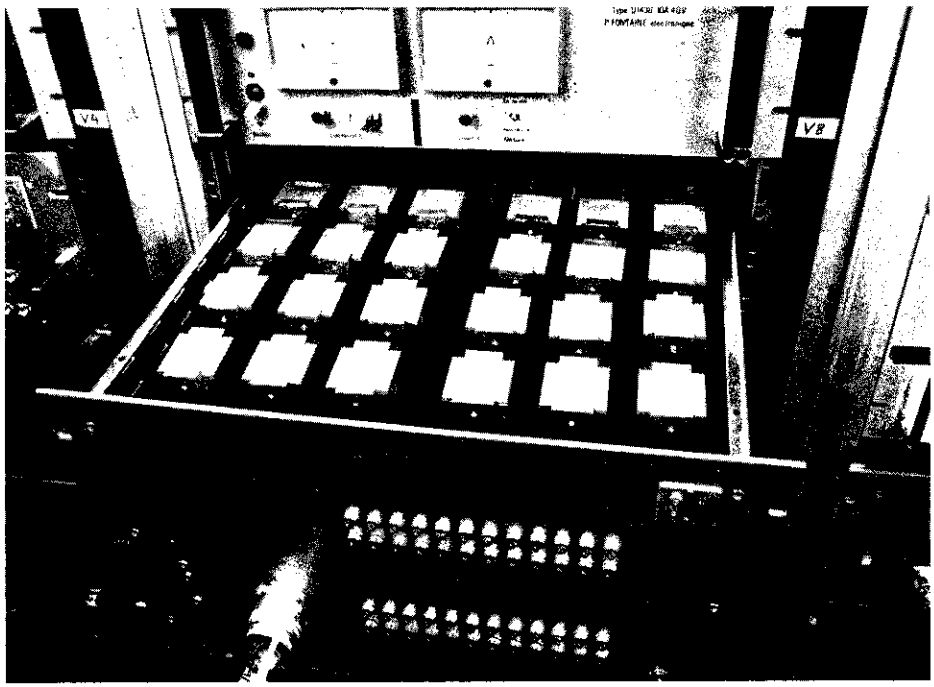
The UNK meeting highlighted the high hopes that a new physics domain will be opened in 1993 with the start of the 3 TeV fixed target programme at UNK, while the subsequent provision of 6 GeV collision energies would be a unique research attraction.

From E. Kištenev

Another ring for Saturne

The new MIMAS accumulator-injector ring at the French National Saturne Laboratory.





With the very satisfactory commissioning of the new MIMAS accumulator/booster ring, the French National Saturne Laboratory is providing its community of 400 research scientists (half from abroad) with a fivefold increase in the supply of polarized (spin oriented) deuterons at 1.15 GeV/nucleon, reinforcing its position as the world's most powerful source of polarized particles, and up to tenfold increases in the available levels of light ions.

With also a wider range of ion beams available for experiments, Saturne is in a good position to extend its important physics achievements at the intriguing interface between particle and nuclear physics. With results from higher energy experiments at other Laboratories with particle beams showing how proton and neutron structure can change with nuclear environment (the 'EMC Effect'), and with ion beams showing a new richness of detail, physicists are looking hard at the behaviour of particles in nuclei. Results from Saturne on the behaviour of nucleon excitations and heavy mesons in nuclear collisions could provide more valuable insights.

In addition, the subtle effects of spin in particle interactions are still far from perfectly understood. Specialists are quick to point out that spin is not just a 'useless complication', and that particle physics will only be well understood when spin is made to fit nicely into the picture.

In 1982, Saturne successfully tracked a path through the jungle of depolarizing resonances to provide beams of spin oriented particles at the GeV level. With the world's most intense beams of polarized particles, Saturne is a natural focus for spin physics.

The 31-metre MIMAS ring commissioned last October optimizes the transfer of polarized particles and heavier ions to the main ring, while the old linac is retained for use with light ions from the Amalthee source.

To minimize particle losses, MI-

The French National Saturne Laboratory has granted the Groupe Européen de Productions Electromécaniques et Electroniques (GEPE) sole rights to these patented static relays, designed and developed originally for rapid switching in the supply for the magnet coils of the Saturne synchrotron.

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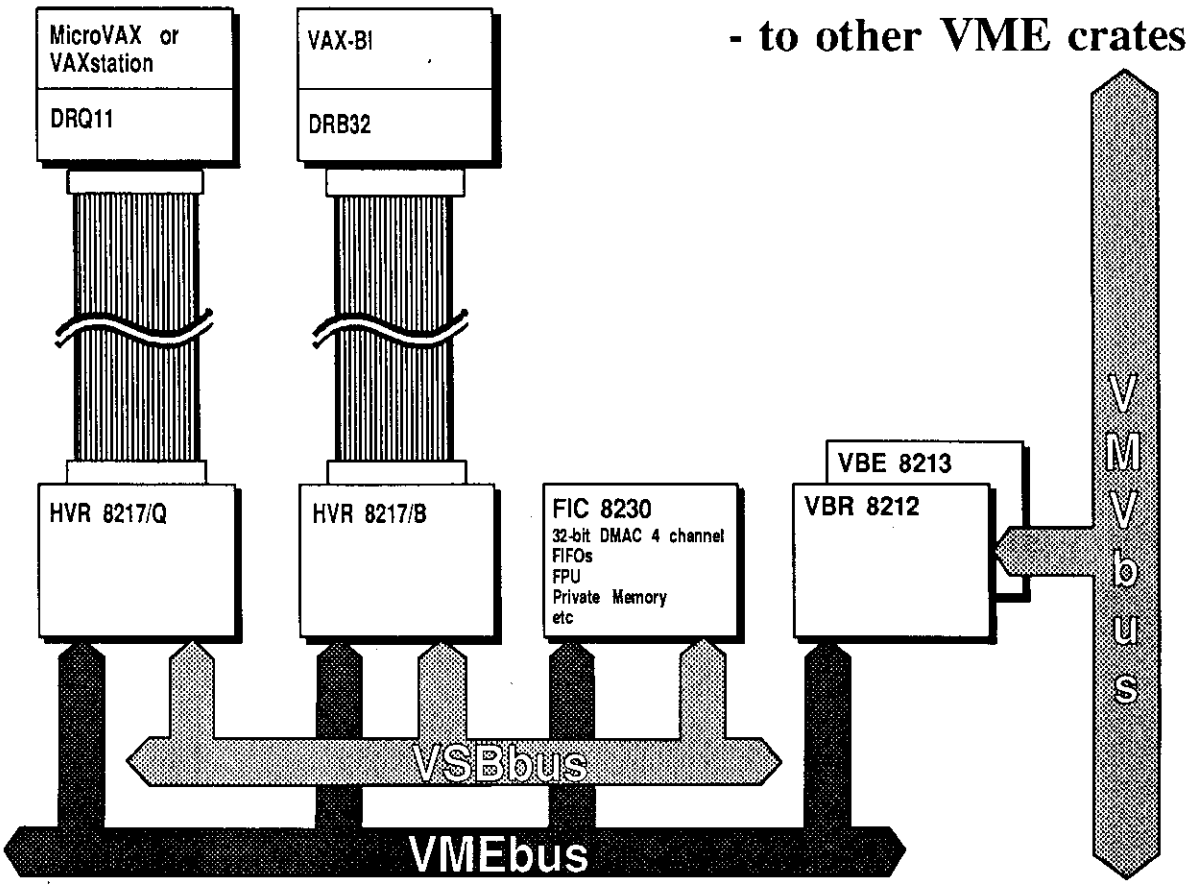

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CREATIVE ELECTRONIC SYSTEMS

MAS vacuum attains 5 x 10^{-11} torr, with the whole ring undergoing a week-long bakeout at 300C. Fast kicker magnets pass beams to the main ring in less than a microsecond at 12.9 MeV/nucleon. The two radiofrequency accelerating cavities operate between 160 kHz and 2.48 MHz for accumulation and subsequent acceleration, while a special decelerating mechanism facilitates injection (at 187.5 keV/nucleon) and stacking.

To reap the benefits of the increased supply of particles, the experimental areas are being extended, in collaboration with the German GSI Laboratory, Darmstadt, and with the Italian National Institute for Nuclear Physics (INFN).

Studies using the SPES IV spectrometer have shown how the production of the delta (excited nucleon) particle changes with different nuclear targets, with the delta appearing to show an affinity for, and increased stability with, nuclear matter. Other experiments have shown an interesting correlation between the production of eta mesons and of pairs of pions. Capitalizing on the copious supply of polarized particles, the production of neutral pions is found to be highly spin sensitive.

Saturne is one of the two Laboratories operated jointly by the Institute of Fundamental Research of the French Atomic Energy Commission and the National Institute for Nuclear Physics and Particle Physics of the National Centre for Scientific Research, the other being the GANIL heavy ion accelerator at Caen.

Control systems for experimental physics

At an international conference last year at Villars-sur-Ollon (Switzerland), scientists from all over the world looked at the problems of controlling complex physics installations, including particle accelerators, nuclear reactors, large telescopes and high energy physics detectors.

The meeting, organized by the European Physical Society's Interdivisional Group on Experimental Physics Control Systems, EPCS, brought together 180 scientists from the world's leading experimental physics research laboratories, universities and industries, including substantial delegations from Czechoslovakia, Iraq, Israel, Japan, the People's Republic of China and Poland. The absence of the USSR delegation was much regretted.

As physics installations get larger and more complex, manual operation becomes increasingly difficult. Safety, reliability and high performance require highly sophisticated control systems, necessarily more expensive, conflicting with the current economic restrictions. Nevertheless a continual effort ensures that controls, aided by advanced technology, keep pace with emerging requirements.

Main issues and trade-offs were covered by invited papers giving overviews of major control systems, and by contributed papers, workshops, tutorials and exhibits. To stimulate debate on topical matters, panel workshops (Architecture, Interfacing and Intelligent Process Equipment, Applications Software, Operational Aspects, Automation, Software Engineering) covered a substantial part of the programme.

While more complex machines need more complex controls, rapidly advancing technology makes hardware costs dive. Current controls tend towards fully distributed systems with more local intelligence at the device level. Control architectures are mainly based on two-level networks, with a backbone, token ring or Ethernet, connecting workstations to mostly VME-based front-end microprocessors, or concentrators, in turn driving local distribution networks (e.g. 1553B) to individual devices.

In such environments software is becoming increasingly complex and expensive, and the meeting emphasized software engineering. With few well-integrated software engineering tools for large projects on the market, a number of recommended strategies and techniques were presented. Structured engineering methods have proved their worth in a number of control projects, and, though still in the prototype stage at accelerator Laboratories, object-oriented concepts show some promising signs of success.

Process control systems should be reliable and flexible. Mainte-

Discussing systems architecture at the recent experimental physics controls meeting in Villars, Switzerland, are left to right, Michael Shea (Fermilab, US), Shin-Ichi Kurokawa (KEK, Japan), Rudolf Steiner (GSI, Darmstadt, Germany) and Winfried Busse (Hahn-Meitner Institute, Berlin).

nance eats into resources and precious operation time, so it is essential to include monitoring to trace system behaviour, or misbehaviour, and software should be largely data driven. On-line data, needed for real time activities, relates to off-line data describing operational constraints or providing management information. The database is thus an essential part of the control system.

Good management requires solid planning with identified milestones, realistic schedules and defined budgets. Gone are the days when ingenious engineers or physicists could timber together some ad hoc solution in their 'spare time'.

Smaller installations with fewer resources run into problems. There was a clear call from the smaller institutes for help from bigger brothers, for example with subsystems available in kit form. Along these lines, an initial working group aims at standardizing the operational control protocols of power converters. Seven institutes are participating to this first collective EPCS endeavour.

Applications software, a major fraction of today's development work, was looked at in detail. Recommendations included – a layered structure of modules each catering for a specific type of activity; separation of code (a library of reusable routines) and data (the online data base); and housekeeping, scheduling and similar activities in standard modules. This should provide basic process-independent packages into which specific applications can be embedded relatively cheaply using data tables and short special-purpose procedures. However further development towards appropriate structures and standardization is still necessary . Future large controls projects should also invest in appropriate engineering tools developed in parallel with the real-time system.

Efficiency, both in operation and exploitation, calls for a single control room with standard consoles. Traditional consoles with alphanumeric and graphic displays, touch panel, tracker balls, etc, are tending to be replaced by modern workstations with powerful operating systems and graphics packages. Experience with these has shown that their extreme flexibility requires rules for consistent everyday use. Questions included – Should alarms be included on the main console workstation? Can a single workstation display be modified for multiple access? Recommended standard features included summary status display, chronological recording of events, covering hardware faults and operator requests, etc.

At the workshop on Automation, a number of levels were proposed to define successive degrees of sophistication, useful when reconciling goals and available resources. The lowest level is data acquisition, for monitoring operation and for developing control algorithms. The second is more concerned with supervisory controls, and the third incorporates modeling programs to test proposed changes. The fourth level performs continuous controls with the setpoints of the control loops available to the operator, but maintained by the system to assure steady operation. At the next level the system is able to change the state of the process according to a master sequence, involving automatic start-up and shut-down with sequential control algorithms for all process devices. The penultimate level extends this sequential control

to fault diagnostics and possible system recovery. The highest level of sophistication is automatic optimization through setpoint adjustment and state changes, a field ripe for artificial intelligence.

Present particle accelerators are not highly automated, as it is felt that measurements are not reliable enough, there are insufficient control parameters and their settings are often not sufficiently reproducible.

By special request, an additional session was improvised on VMS versus UNIX, highlighting the differences between a highly flexible proprietary operating system and a public one.

It is increasingly becoming clear that industry is ahead of the physics labs, both hardware- and software-wise. Several tutorials addressed this problem:
buses, vital for connecting intelligent physics equipment, were the object of two lively sessions, including one on the rising star of VME;
the underlying principles of expert systems, a new discipline, highly promising for the experimental physics field, drew a large audience, and was followed by examples from industry and a demo;
highly relevant for controls was object-oriented software design;
and finally SASD (structured analysis and design), a computer assisted methodology for software design and implementation.

Visits to CERN and to Ciba-Geigy illustrated differences between industrial and scientific control systems. The former operate in well defined, stable and understood production environments, while the latter, as exemplified by particle accelerators, are less well defined, subject to change and have to cope with process effects often not fully understood.

Reflecting its success, it was agreed that this type of conference should find a venue once every two years, in the intervening time complemented by workshops and study groups on specific subjects.

From A. Daneels and B.Kuiper

Around the Laboratories

With CERN's prototype large diameter lithium lens for antiproton work on its testbed at the Soviet Institute for Nuclear Physics at Novosibirsk Laboratory are (left to right) Robert Bellone, Gregory Silvestrov, Tanja Vsevolozhskaya, Peter Sievers, Juri Petrov, Victor Volokhov, Boris Bayanov and Sacha Chernyakin. The lens underwent 500,000 pulses at 800 kA.

CERN/NOVOSIBIRSK Lithium lens collaboration

The idea of lithium lenses to boost the collection of antiparticles was born at the Soviet Institute for Nuclear Physics at Novosibirsk and subsequently exploited for use with antiprotons at Fermilab and at CERN, where 2 cm-diameter lenses are employed.

For the ongoing consolidation programme for CERN's antiproton supply, a larger (3.6 cm diameter) lens is foreseen and a first prototype has been built at CERN. To

test performance at peak currents up to 1 MA, this lens recently went to Novosibirsk, where a 1 MA current pulser had been made available to CERN.

Negotiations are continuing between CERN and Novosibirsk with a view to extending this collaboration.

CERN
Tale of two TPCs

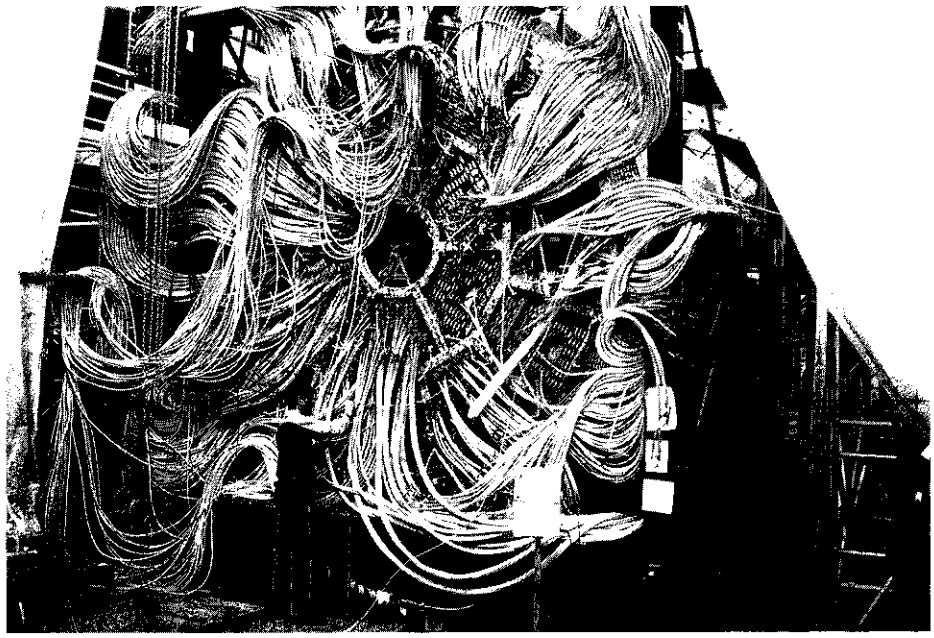
Taking shape at CERN are the two big Time Projection Chambers (TPCs) for the Aleph and Delphi experiments now being assembled for CERN's new LEP electron-positron collider. These TPCs will track and measure the particles in the main central region surrounding the electron-positron collision point.

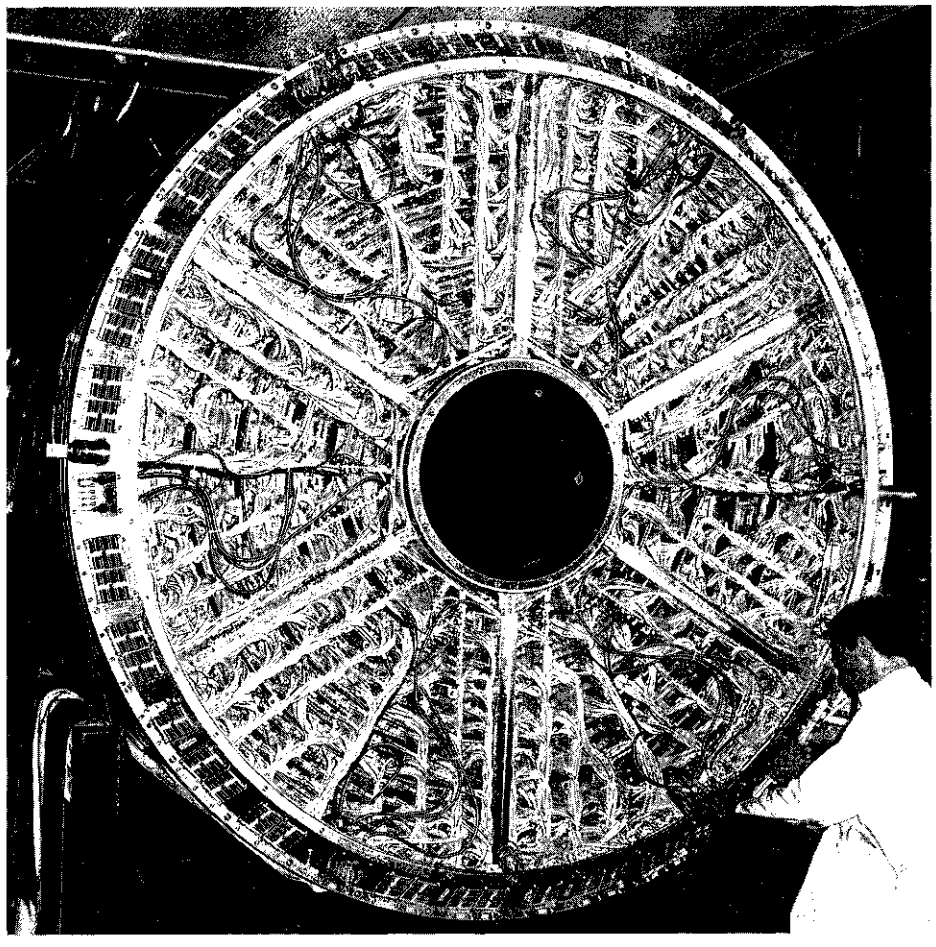
The Delphi TPC recently arrived from the French Saclay Laboratory, and will undergo cosmic ray tests in the coming months. Construction of the 3.1 metre long and 2.4 metre diameter cylindrical detector is a CERN/France (Collège de France/Orsay/Saclay) collaboration. The casing is made of carbon fibre to provide a rigid shell while interfering minimally with traversing particles (0.04 radiation lengths thickness). 12 wire chambers using 16 layers of readout pads should pinpoint to about 100 microns, and provide particle identification below 8 GeV.

Electronics for the 22,000 readout channels include the 8-bit 15 MHz flash analog-digital converters built by Thomson and specially developed in collaboration with French research institutes (see May 1986 issue, page 17).

Aleph's TPC effort is a collaboration between CERN, Glasgow,

Time Projection Chambers for experiments at CERN's LEP electron-positron collider. Top, Aleph (Photo CERN X577.2.88), and below, Delphi (Photo Saclay).





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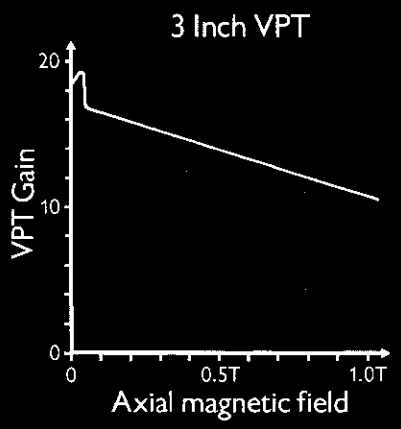
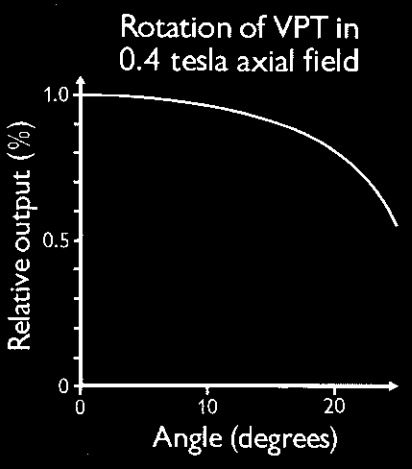
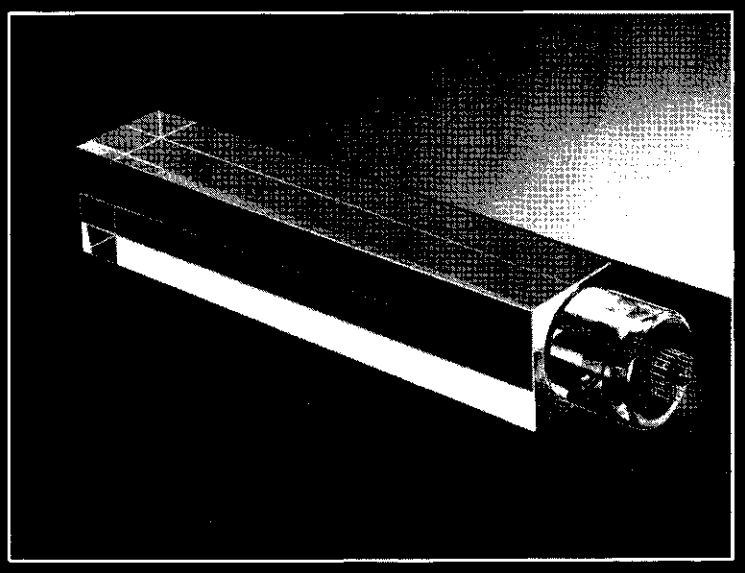
The OPAL and DELPHI end-cap calorimeters at CERN require lead-glass arrays to be read out in full axial fields up to 1.2 tesla. Not a task for conventional PMTs. So, building on our experience in vacuum photo diodes, we developed a family of Vacuum Photo Triodes to do the job. In 1½", 2" and 3" sizes, and with low capacitance to minimize contribution to preamplifier noise. With gains ≈10 at 1 T axial. Even at 20° from axial, gains still high enough to lift the signal well clear of preamplifier noise. We're prepared to discuss versions for fields up to 70° from axial.



A timely solution to a new problem in HEP instrumentation – and one with an extra benefit at zero field: the multiplication statistics of the VPT dynode are better than those of a conventional PMT; at high light levels this can result in better energy resolution. Using our 3" VPTs, the RAL/OPAL collaboration has achieved normalized energy resolutions of $5\%/\sqrt{E}$ for electrons of above 0.5 GeV energy at 1T axial field. If your experiment involves high magnetic fields, VPTs may be the answer. For further details contact:





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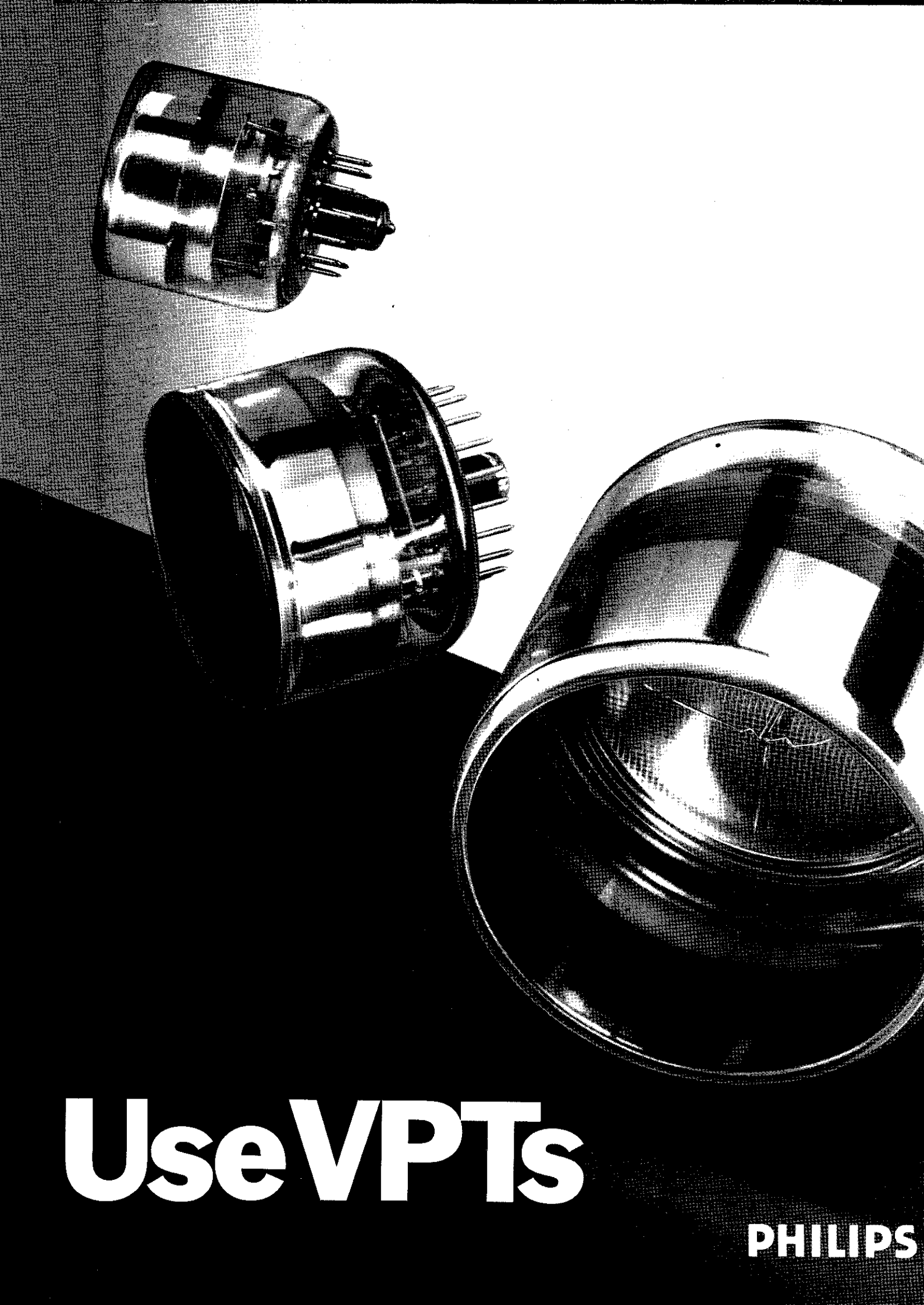

Use VPTs

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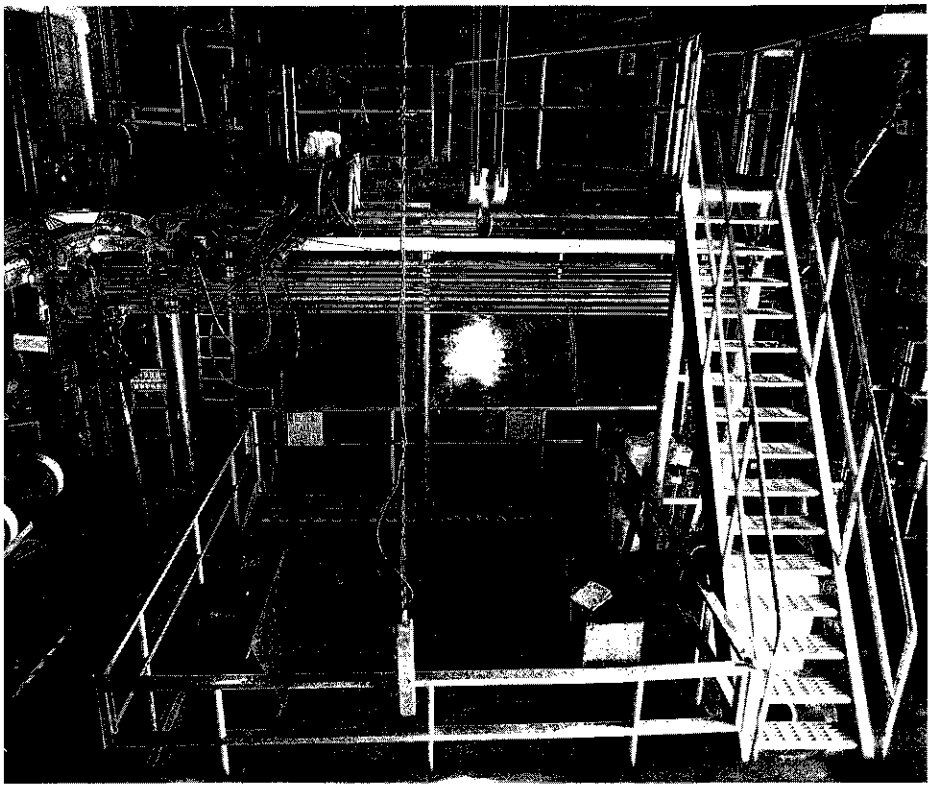
Mainz, Munich (Max Planck Institute), Pisa, Trieste and Wisconsin. With the accent on accurate momentum measurements, the chamber is big – 4.4 metres long and 3.6 metres across, making it the world's largest. Momentum resolution of better than 0.15 per cent above 5 GeV is envisaged. More than 20 of the 36 wire chambers have arrived from Munich, and the full complement is expected to be ready this summer.

The 47,500 readout channels are also equipped with Thomson flash ADCs. The detector is being put through its paces before being taken to the experimental hall underground later this year.

Fermilab's 15-foot Bubble Chamber made its last physics run for Experiment 632.

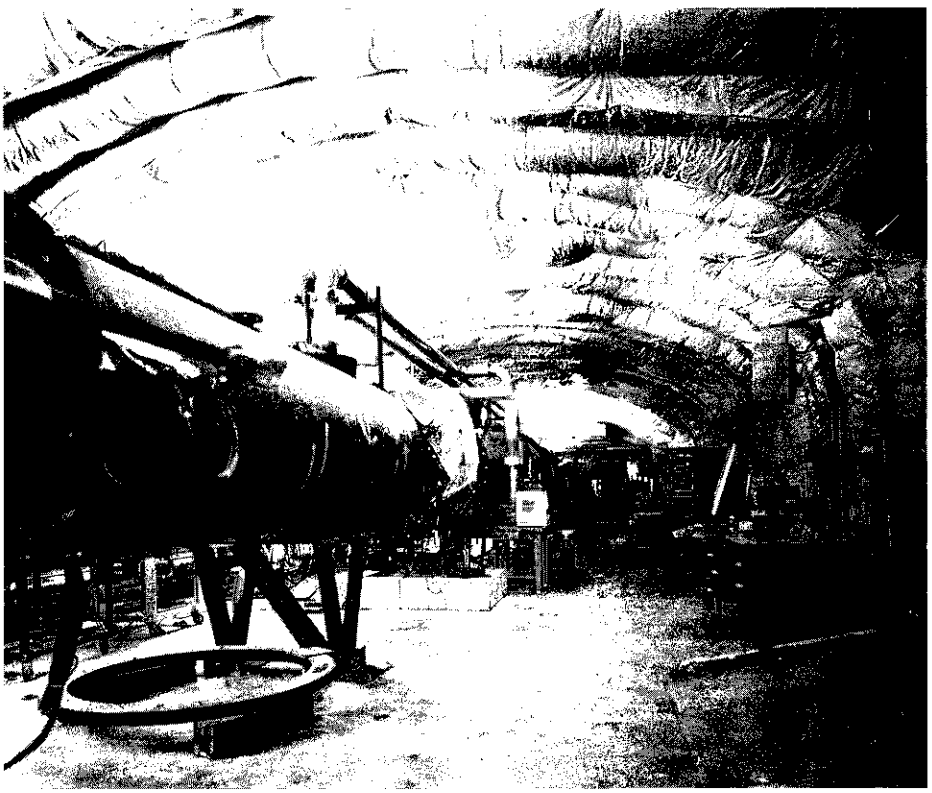


FERMILAB Successful fixed target run

After eight months, 3000 physics hours, and 35,000 data tapes, Fermilab's most successful fixed-target physics run ended in mid-February with the highest superconducting accelerator intensity, 1.8×10^{13} protons per pulse, and with a total of 2.192×10^{18} protons accelerated.

This was the first 800 GeV physics run to use all the fixed target experiments and beams built for the Tevatron upgrade, and ten experiments were completed.

Experiment 731 (Chicago/Elmhurst College/Fermilab/Princeton/Saclay) completed taking data with the goal of detailing the CP (combined charge/parity) nonconservation in the decays of neutral



The Fermilab experiment looking at the decays of neutral kaons needs ample space for the particles to decay.

kaons to one part in a thousand, collecting 250 thousand decays of long-lived neutral kaons into neutral pion pairs, 370 thousand into charged pion pairs, and three times as many short-lived neutral kaons decaying into neutral and charged pion pairs.

Studying the polarization and magnetic moment of the omega-minus hyperon, Experiment 756 (Fermilab/Michigan/Minnesota/Rutgers/Washington) accumulated about 82 thousand examples of this once rare particle.

Experiment 770 (Chicago/Columbia/Fermilab/Rochester) collected 1.6 million neutrino and 0.35 million antineutrino events to measure nucleon quark content (structure functions) at higher energies than previously possible, looking also at the production of charmed particles and of pairs of oppositely charged muons.

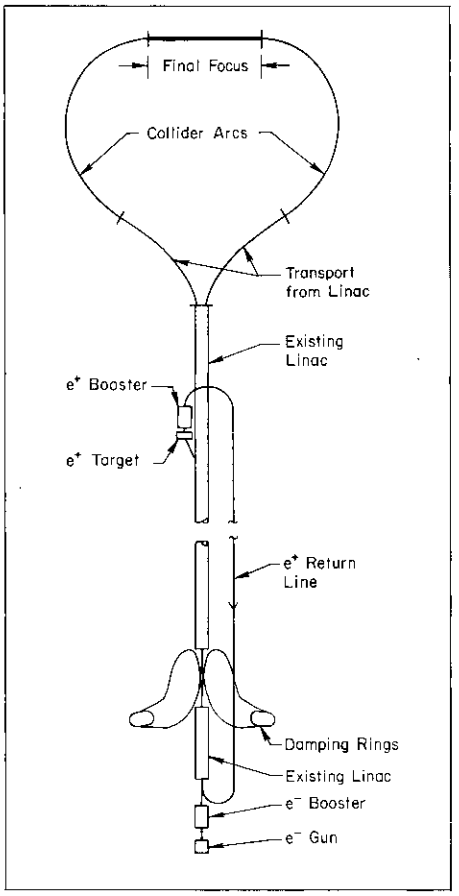
The final run of the 15-foot bubble chamber was for Experiment 632 (US, European and Indian universities) using the wideband neutrino beam to produce 48 thousand photographs and 4.6 thousand holograms to search for new particles and to study muon plus electron and muon pair combinations carrying net electric charge (same sign pairs).

Experiment 687 explored the photoproduction of particles containing heavy quarks (charm and beauty). Heavily damaged in a fire which destroyed the electromagnetic calorimeter and other components, the experiment (a US/Italy joint venture) was revitalized in a tremendous effort by Fermilab's Research Division and Physics Section, and accumulated about 70 million triggers. Also looking at the production of particles containing heavy (charm) quarks was Experiment 769 (see March issue, page 7), accumulating over 500 million triggers.

From photon production using a variety of hadron beams, Experiment 706 (US and Indian universities) studies the gluon structure of hadrons and the materialization of produced gluons as particles (gluon fragmentation). Although the experiment accumulated millions of triggers, it is not yet complete and will continue during the next fixed-target run.

With the Collider Detector at Fermilab (CDF) back in the spotlight for a year-long run with a full complement of analysis techniques (see December 1987 issue, page 16), beamline and detector upgrades for next year's fixed-target run get underway backstage, while analysis of the 35,000 data tapes from the latest run pushes ahead. Computing bottlenecks should be removed when Fermilab's big new mainframe arrives (see April issue, page 20) while Advanced Computer Program (ACP) systems facilitate off-line data reconstruction.

Schematic of the SLC Stanford Linear Collider, now preparing for its first electron-positron collisions.



STANFORD
Collision course

Anticipation grew during March that electron-positron collisions were about to happen at the new Stanford Linear Collider (SLC). The worrisome muon backgrounds which had earlier dogged the Mark II detector (see April issue, page 12) now seem under better control.

A major milestone was attained on Sunday 13 March, when the big detector operated with all systems fully on as a beam of 10^{10} electrons/pulse passed through it. This is essentially the beam intensity needed (together with and equally intense positron beam) to begin doing physics on the SLC.

This encouraging result was achieved by collimating the electron beam not at the final focus but further upstream at the beginning of the arc. That way most of the off-energy particles inevitably produced are swept away by magnets further downstream as the beam proceeds along the arc.

These collimators are not yet in their optimum configuration, and more will be added soon. It has become clear, however, that the final focus is not the appropriate place to attempt primary collimation of the SLC beams.

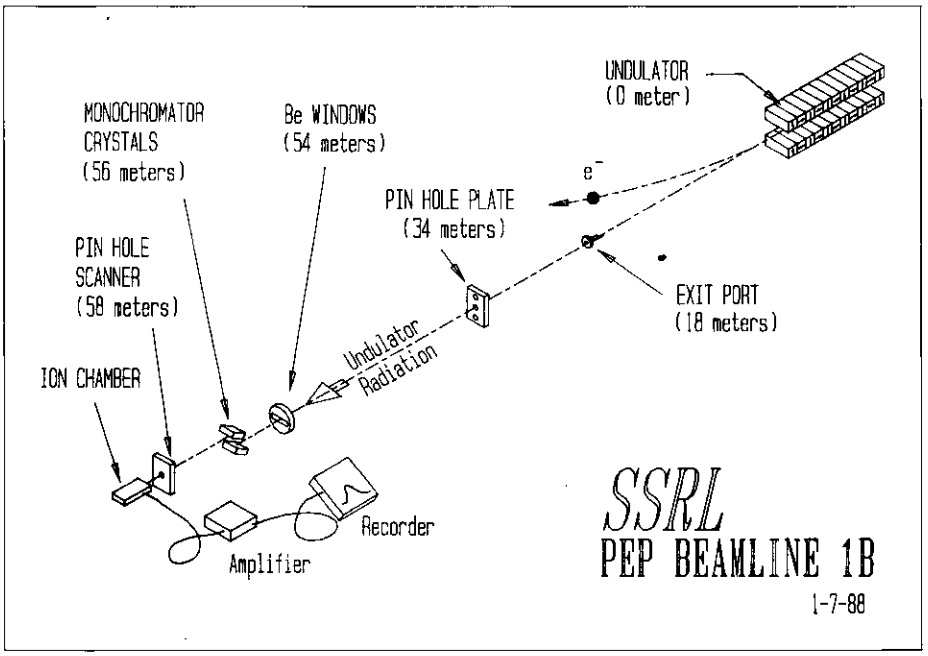
By late March, electrons were

passing routinely through the final focus, and positrons were knocking at the door. The hard lessons learned last year in tuning up the magnets for the electron arc have allowed the same process to occur much more smoothly and rapidly in the positron arc.

Though still a serious problem, the growth of emittance – the tendency of electron and positron bunches to spread out as they travel down the linac and through the arcs – was gradually being solved. By the end of March the emittance of the electron beam had been cut in half at the end of the linac. Studies were underway to determine what impact this improvement has upon the Mark II backgrounds.

As summarized by Jonathan Dorfan, leader of SLAC Group C, there are two principal backgrounds to worry about: hard (10-20 GeV) muons, and soft photons. Of these, the muons are far more serious. Produced when low-energy tails of the beam scrape metal in the final focus, they affect essentially every particle detector in the Mark II, particularly the calorimeters. With 5 x 10^9 electrons passing through the detector per pulse, for example, the end-cap calorimeters witness at least 5 muons/pulse, the equivalent of a 2 GeV energy deposit. With another factor of ten reduction in backgrounds and both beams passing through the Mark II simultaneously, Dorfan noted, they should be able to trigger on and analyse almost all visible Z^0 events. Some combination of upstream collimation and control of emittance growth is needed to achieve this improved performance.

Schematic of the synchrotron radiation beamline at Stanford's PEP electron-positron ring showing the undulator source, X-ray pinhole camera system and double crystal X-ray monochromator. Two such lines are now operational.



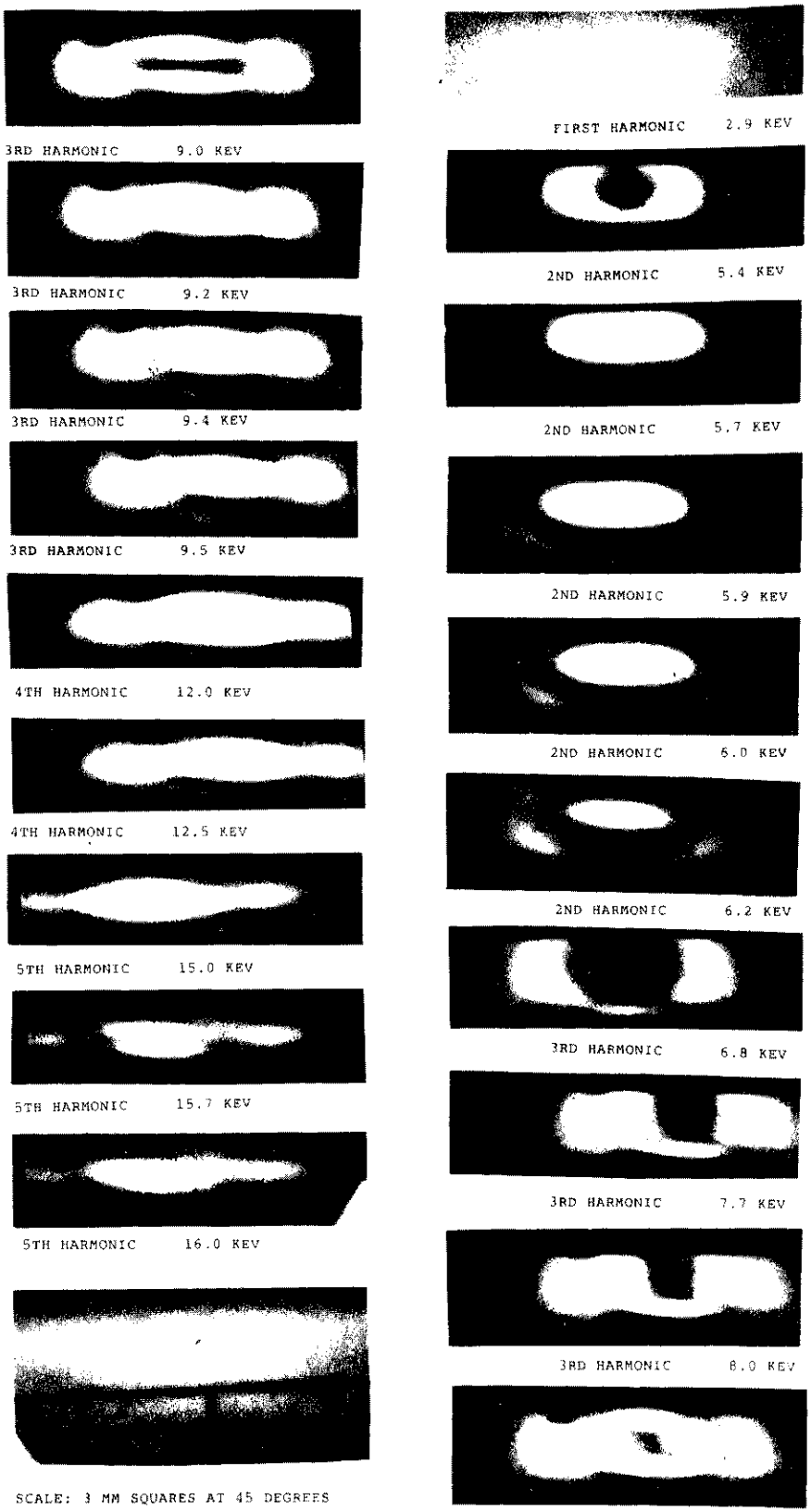
A PEP for synchrotron radiation

Interest is growing rapidly in the use of the PEP electron-positron storage ring at the Stanford Linear Accelerator Center (SLAC) for synchrotron radiation research. A demonstration came during a very successful 12-day run last December with the ring operated at 7.1 GeV in a 'low emittance' mode to produce bright synchrotron light. This run came shortly after a Workshop on PEP as a Synchrotron Radiation Source, organized by the Stanford Synchrotron Radiation Laboratory (SSRL) in October, attended by 125 scientists from the US, Europe and Japan.

Synchrotron light, the electromagnetic radiation emitted by electrons curving in magnetic fields, has revolutionized basic and applied research in physics, chemistry, and biology because it offers intense, polarized, collimated, pulsed, partly coherent beams over a broad spectral range including X-rays and vacuum ultraviolet light. The synchrotron radiation from the bending magnets of storage rings is more than ten thousand times brighter than conventional sources. Brightness has been increased by several more orders of magnitude using special wiggler and undulator magnets inserted in the straight sections between bending magnets. Even brighter beams would open up new science, much as boosting beam energy opens new frontiers in particle physics.

During the December run a very slender, or low emittance, electron beam was stored instead of counter-rotating beams of electrons and positrons. The lower the emittance, the brighter the X-rays, particularly when the electrons are bent many times by undulator magnets.

Patterns of radiation produced by the PEP undulator. Interference in the radiation from the 52 poles of the undulator, acting as a series of essentially collinear source points, reinforces certain wavelengths and angles, a unique feature of undulator radiation offering new opportunities in a variety of applications.



SSRL gained some brief experience from PEP in 1986 when the first undulator line was used parasitically during colliding beam runs at 14.5 GeV. Under these conditions PEP produces ten times brighter X-ray beams above about 10 keV than any other source in the world. Dedicated operation, as in the recent run, gives beams several orders of magnitude brighter. SSRL now has a second undulator beamline on PEP and plans to begin major experimental work with very bright beams when PEP resumes colliding beam operation in August and in dedicated low emittance single beam runs next year.

The emittance can be reduced by increasing the current in the quadrupole focussing magnets. During the December run this gave the lowest calculated emittance ever obtained in a synchrotron radiation source, about the same as that planned for the next generation of 6-7 GeV dedicated light sources for the mid-1990s (Grenoble in France, Argonne in the US and Japan).

PEP's performance can be further improved by changing the damping partition, and by using about 100 metres of damping wiggler magnets in the long straight sections, which could also accommodate very long undulator magnets and possibly bypasses for special insertions.

Considering that it had been idle for about one and one half years due to budget constraints and SLAC's commitment to the new Stanford Linear Collider (SLC), PEP performed extremely well. The highest current stored was 33 mA, although stability and reproducibility were then poor; 10-15 mA beams were more reliable.

Also during the run the second SSRL undulator beamline was com-

missioned and used to study the photon spectrum over a wide range of undulator fields, while an X-ray pinhole camera measured the electron beam profile.

The success of the run was largely due to the close collaboration of more than 20 scientists from SSRL, SLAC, Argonne, Brookhaven and Berkeley. One of the participants described the experience as a 'Woodstock of accelerator physics'.

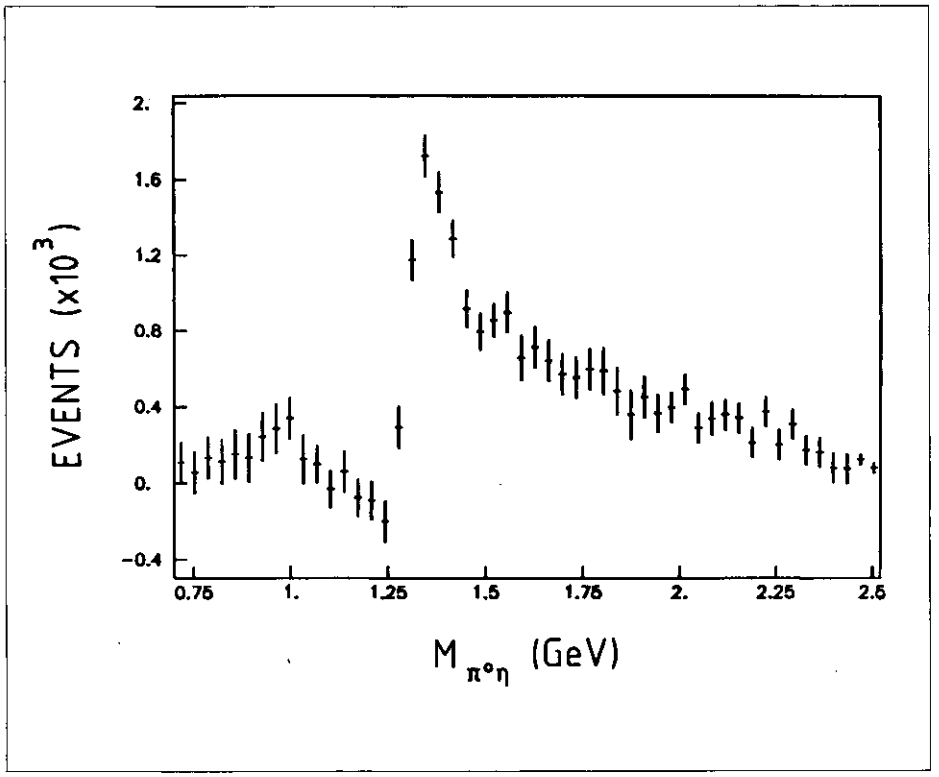
By Herman Winick

CERN/SERPUKHOV GAMSmanship

In the simple quark picture, a meson consists of a quark and an antiquark bound tightly together. Taking all the possible quark properties in turn, these mesons fall into neat nonets, described by SU3 symmetry. However other kinds of mesons could exist – 'glueballs', containing gluons (the carriers of the inter-quark force) instead of quarks; hybrids, with gluons in addition to quarks; and those containing two (or more) quarks and antiquarks.

There is no general way of differentiating between mesons and these exotic states, but some exotic quantum numbers cannot be formed by quark-antiquark combinations. An example is a spin one, negative parity and positive charge conjugation particle, whose simplest decay would be into an eta meson and a neutral pion.

Under the CERN/USSR agreement on collaboration in particle physics, a series of experiments at CERN and at Serpukhov have been looking at the decay of heavy neutral particles into photons using large lead glass arrays (which have earned the Russian acronym GAMS).



The deviations from zero show the distinct forward-backward asymmetry of the eta mesons in eta/neutral pion combinations observed by the NA12/2 experiment at CERN, explained by an exotic meson at 1405 MeV.

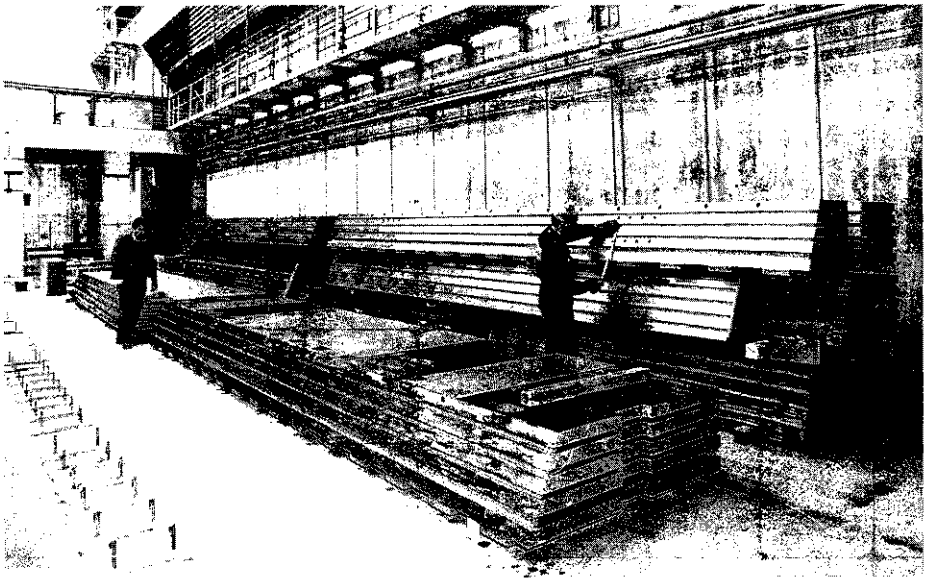
A Serpukhov/Interuniversity Institute (Belgium)/Los Alamos/LAPP (Annecy, France) collaboration (NA12/2) used a 100 GeV negative pion beam at CERN and the big GAMS-4000 detector to look for patterns of four emerging photons, and the eta/neutral pion sample was carefully separated. On looking closely at the eta-pion system, physicists find a marked difference between forwards and backwards produced etas around 1400 MeV, (a hint was seen in earlier joint CERN/USSR studies using beams at the Serpukhov 70 GeV proton synchrotron) suggesting interference effects between the known a_2 at 1320 MeV and something else.

By carefully unravelling the contributing amplitudes, the culprit is identified as a particle at 1405 MeV whose exotic quantum numbers (spin one, negative parity, positive charge conjugation) exclude any quark-antiquark or glueball assignment, suggesting instead a hybrid quark-gluon or four quark composition.

Sightings from other experiments can be explained as quark-antiquark combinations, but earn their exotic label by being difficult to fit into recognizable nonets. This new 1405 MeV state is the first example of a quantum number combination defying classification as a quark-antiquark pair. Others are expected to follow.

The experiment is being joined by a contingent from Japanese research centres.

Iron from Leningrad arrives for the H1 detector at the HERA electron-proton collider being built at the German DESY Laboratory.



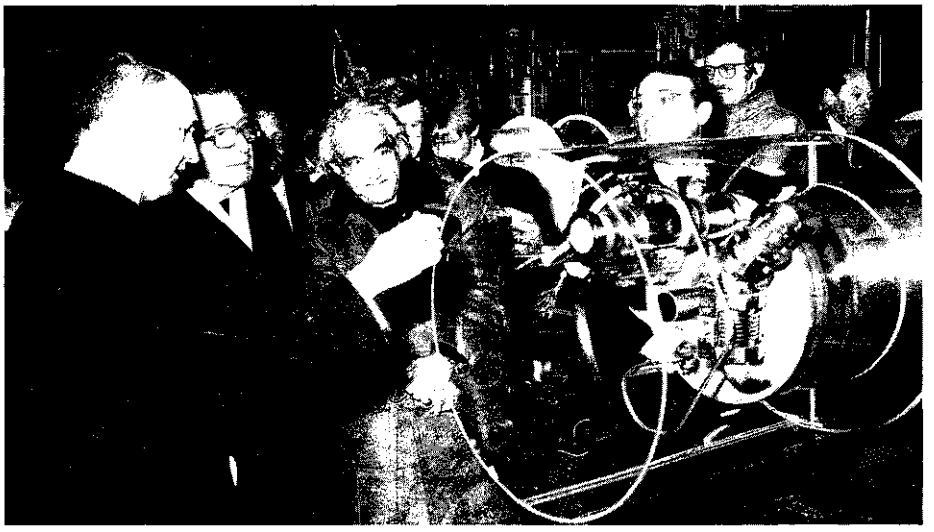
DESY
Gearing up for HERA experiments

Mid-March saw the arrival of the first major component for the two big experiments at the HERA electron-proton collider being built at the German DESY Laboratory – the 426-ton lower part of the steel structure of the H1 detector. Including over 2000 tons of steel, the complete supporting structure will also return the magnetic flux of the detector as well as identifying muons.

The structure comes entirely from Leningrad, where it is being built in the Izhorsky Zavod factory, ordered by the N.P.Lebedev Physical Institute (LPI) of the USSR Academy of Sciences, Moscow. Two Moscow research institutes, the Institute for Theoretical and Experimental Physics (ITEP) and LPI, participate in the construction of the H1 detector.

With fabrication of the superconducting magnets for the HERA proton ring progressing well, the start of installation of the proton ring was formally marked by a ceremony with Italian Foreign Minister Giulio Andreotti as guest of honour, reflecting Italy's role as one of the major international contributors to the HERA project.

DESY Director Volker Soergel explains an Italian-made dipole-end of a HERA magnet to Italian Foreign Minister Giulio Andreotti (centre) and Antonino Zichichi.



DARMSTADT
Element 109 revisited

Using heavy ion beams from the UNILAC accelerator, the GSI (Gesellschaft fuer Schwerionenforschung) Laboratory in Darmstadt has made a speciality of synthesizing new heavy elements, notably those with atomic numbers 107, 108 and 109.

Element 109, discovered six years ago, has stubbornly refused to show up elsewhere. To reexamine its nuclear credentials, a 300 MeV iron 58 beam from the UNILAC machine bombarded a bismuth target, and velocity filtered nuclear products were implanted in a position sensitive silicon detector. From the impact points and the emerging alpha particles, the disintegration of the implanted nuclei could be charted and the parent isotope determined.

In a ten day run, two nuclei of element 109 with mass number 266 were found. The energies of the alphas in the decay chain gave the binding energies of these nuclei, showing they are stabilized by nuclear shell effects.

How to visit CERN

Comment visiter le CERN

Organized visits take place only on Saturdays, at 9.30 a.m., and/or 2.30 p.m. The visits last about three hours and are free. The minimum age limit is 16 years.

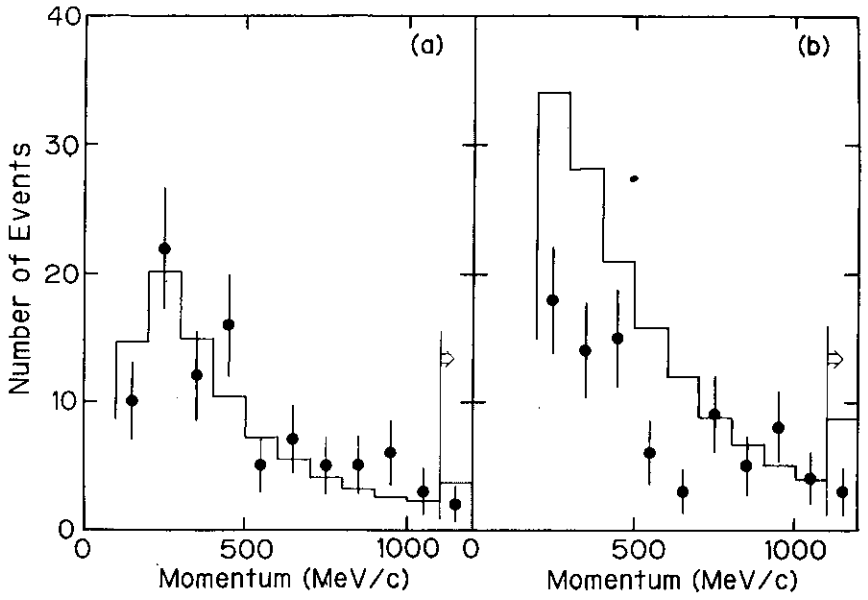
Les visites commentées ont lieu seulement le samedi, à 9 h. 30 et/ou à 14 h. 30. Elles durent environ trois heures et sont gratuites. La limite d'âge minimum imposée est de seize ans.

Please write or call:
Ecrire ou téléphoner:

CERN
Visits Organization / Organisation des Visites
1211 GENEVA 23 Switzerland
Tel. 022/83 40 52 or/ou 83 41 02
Telex 2 36 98

Physics monitor

Momentum spectra of atmospheric electron-like (a) and muon-like (b) neutrinos from the Kamiokande underground detector in Japan, compared to the expected signals (histograms), showing an interesting suppression in the muon-like case. This could have important implications for neutrino behaviour.



Stable neutrinos

The 'solar neutrino puzzle' – the large difference between the calculated neutrino power pumped out by the sun and the signal detected on earth – is one continuing neutrino enigma.

One possible explanation, not even ruled out by the new neutrino data from last year's supernova – much more distant than the sun – is that some neutrinos could disintegrate on the way between the sun and the earth.

The possibility of neutrinos disintegrating to give photons has now been ruled out by a small team from the French Saclay Laboratory. The very simple experiment used a photomultiplier monitoring the core of a fission reactor (a strong source of antineutrinos), to look for photons with an energy of 1-3 eV which might result from neutrino disintegration. A few days of measurement were enough to discount the idea, and the solar neutrino puzzle lives on.

NEUTRINOS Oscillations come and go

The Moriond Workshop on Neutrinos and Exotic Phenomena held recently at Les Arcs in the French Alps highlighted again the fascination of this volatile area of particle physics.

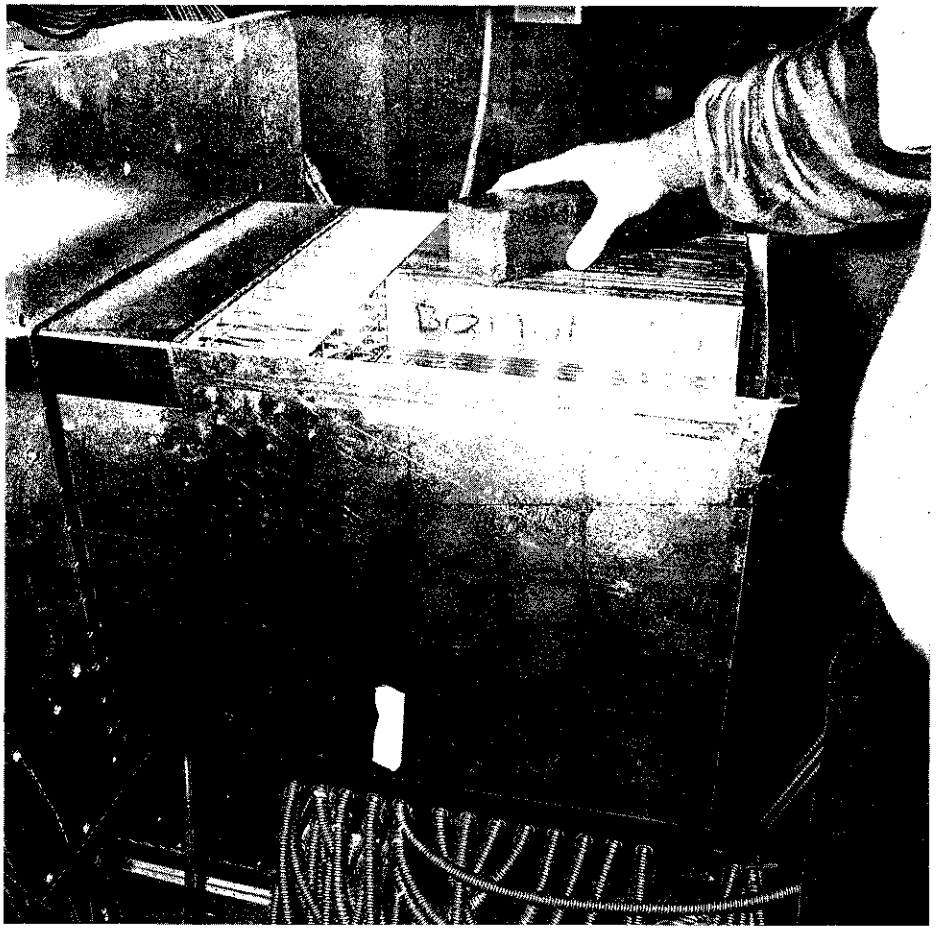
One important recent discovery is double beta decay (see January/February issue, page 32), with two nuclear neutrons of selenium transforming into protons, giving krypton, and emitting two neutrinos. The halflife of the reaction is 10^{20} years, in good accord with geochemical estimates. Progress in the underlying theory of double beta decay, both with neutrino emission, and the as yet unseen neutrinoless variety, was summarized by P. Vogel.

Experiments using neutrinos from fission reactors have been looking for signs of possible switching between neutrino types (neutrino oscillations). Now the results from the group using the Bugey (France) reactor are consistent with those obtained by the group working at Goesgen (Switzerland), with no evidence any more for neutrino oscillations.

S.T. Petcov and S. Toshev covered the propagation of neutrinos in dense matter, where delicate resonance (MSW) effects could explain the longstanding disagreement between the predicted and detected levels of neutrinos from the sun. New results simplify considerably the necessary calculations.

The valuable neutrino signals picked up from last year's supernova provide astrophysicists with a new window on cosmic processes and particle physicists with new information on neutrinos.

One of the experiments detecting these supernova neutrinos was the Kamiokande underground study in Japan, where nearly a thousand specially developed large (20 inch) photomultiplier tubes monitor the Cherenkov light produced by particles captured in 2000 tons of water. Based on 220 days of running, this experiment also looked at the



Mounting a lead-optical fibre block in the calorimeter developed for the Omega spectrometer at CERN. On the left are the light guides. In four years, this module has served seven physics experiments.

(Photo CERN X503.5.86)

angular correlation of neutrino hits to detect particles from the sun (solar neutrinos). The upper limit of the signal is below the figure from confident calculations of solar neutrino emission, underlining for the first time the 'solar neutrino problem' identified in the classic studies by Ray Davis. The directional real time information from the Kamiokande experiment is especially valuable.

M. Koshiba of the Kamiokande collaboration was also able to report that, based on a sample of 277 captured neutrinos, the level of atmospheric electron-type neutrinos is as expected, but muon-type neutrinos appear to be suppressed by about 40 per cent. (Identification uses the distribution of photoelectrons in the single Cherenkov rings in 190 of the 277 neutrino events.) At face value, this decreased muon-like signal hints at neutrino oscillations, and is supported by a corresponding suppression of electrons characteristic of those from muon decay.

The corresponding measurement from the Frejus underground experiment near the French-Italian frontier still has large uncertainties, and the result hangs in the balance.

DETECTORS
Scintillating developments

To meet the stringent demands of today's experiments, detector specialists are looking to improve the performance of photon and electron detectors beyond the traditional solution using alternating plates of lead and plastic scintillator. Although robust and inexpensive, this technique has poor position resolution because of its coarse granularity, and gives irregular response.

One solution proposed by P. Sonderegger (CERN) and D. Perrin (then at Neuchatel) was to use scintillating optical fibres instead of scintillator plates. The fibres were developed by J.C. Thevenin at the French Saclay Laboratory, and a prototype using two-thirds of lead by volume with 1 millimetre diameter fibres was tested by a CERN/Lisbon/Neuchatel/Saclay team in 1982-3 using an electron beam (achieving an energy resolution of 7.8 % divided by the square root of the energy).

When the big Omega spectrometer at CERN had to be equipped for a new experiment with a forward photon calorimeter, it needed only the first six months of 1984 to design, develop and build a new unit and record the first photons from neutral pion decays. The lead-covered fibres, corrugated to ensure that even photons hitting a fibre end-on would eventually meet some lead absorber, are read by 169 downstream phototubes.

Covering a 42 centimetre square area, the 350 kg unit cost the same as a lead-glass scintillator in a conventional calorimeter, while coping better with ambient radiation. In four years, this detector has operated satisfactorily for a series of seven physics experiments.

Meanwhile other lead/fibre solutions have been developed. The new UA2 vertex detector provides increased electron identification (see June 1987 issue, page 9), while the Small Angle Tagger developed by Bergen for the Delphi experiment at CERN's LEP electron-positron collider will measure photons and electrons emerging close to the beam pipe.

A Clermont-Ferrand group, with help from CERN, developed a dense electromagnetic calorimeter (twice as much lead as fibre) for the NA38 experiment to measure transverse energy in heavy ion collisions. The suppressed signal from the J/psi resonance is a possible indicator for a new kind of quark matter (see April issue, page 5). The intense radiation levels at-

tained in these experiments have twice called for the central part of the calorimeter to be replaced.

For the future, this type of detector is being groomed for hadronic calorimetry. In 1986 Richard Wigmans found that a lead/scintillator calorimeter could 'compensate' – giving identical response to electromagnetic and hadronic particles at the same energy. This feature, previously believed to require the use of uranium plates, is crucial for precision measurements of hadrons. In addition optical fibres provide fast readout (10 ns), good uniformity, and an active surface with no 'cracks' where particles can disappear, while fine sampling promises excellent hadronic and electromagnetic energy resolution.

This technology is being developed in the LAA project at CERN with a future high energy, high intensity proton-proton collider in mind (see March issue, page 16), and a high density (lead to fibre ratio 4/1) multiton prototype could be ready for testing before the end of next year.

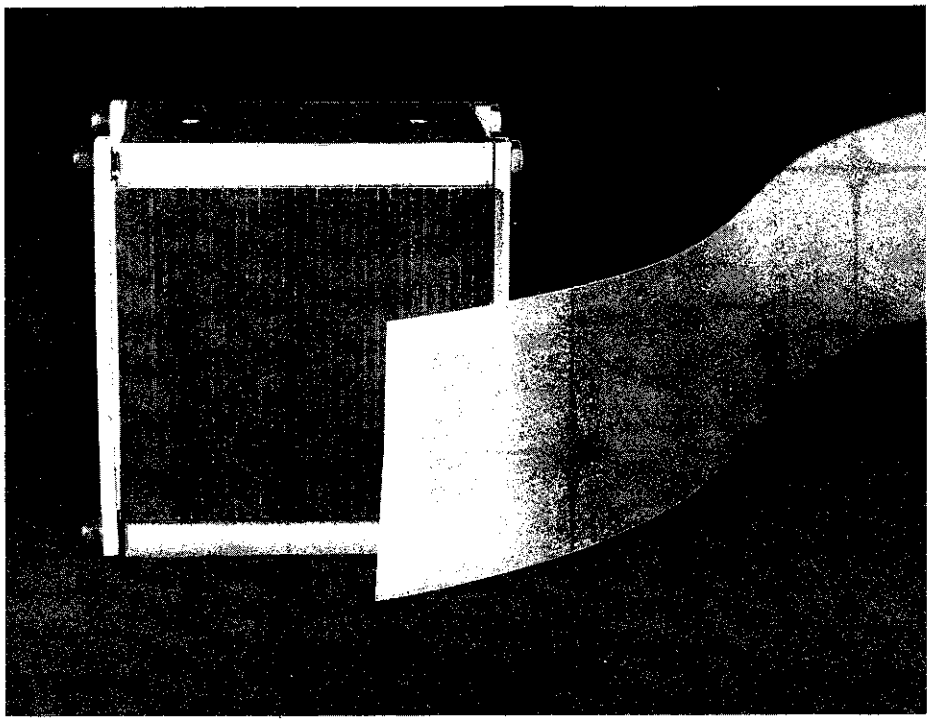
At Fermilab, a scintillating fibre and tungsten calorimeter will soon be part of the apparatus for experiment 774 in the new Wideband Photon Beamline.

Developed primarily by Alan Bross, the calorimeter is very dense and uses new doped polystyrene fibre ribbons as an active medium. The calorimeter is a 10 cm cubic stack of 3mm tungsten plates interspersed with 200 micron square scintillator fibres formed into ribbons. The sampling fraction of active medium to absorber is very low (about half a percent) to keep the calorimeter as short as possible, giving the highest sensitivity to short-lived particles. This is possible because the light fibres provide high quality light piping.

'Ribbon fibres' have distinct advantages over scintillator sheets, increasing light transmission and yielding a more uniform response.

Experiment 774 uses the new scintillating fibre plus tungsten calorimeter as an active beam dump calorimeter in a 400 GeV electron beam. As the beam interacts in the tungsten plates, the scintillator fibres react to the secondaries of the electron shower, the resultant light being picked up an array of 3/4 inch phototubes.

The goal is to search for light, neutral, short-lived particles that couple to the electron, following anomalous electron-positron pair production seen in heavy ion collisions (see March issue, page 13).



Tungsten/scintillating fibre sandwich calorimeter developed at Fermilab with one of the scintillator ribbons made from 200 micron fibres.

People and things

On people

Jean Saudinos, Deputy Director of the French National Saturne Laboratory at Saclay receives the honour of Chevalier de l'ordre national du merite.

In this year's UK Institute of Physics awards, John Stewart Bell of CERN receives the Paul Dirac Medal and Prize for his distinguished contributions to the foundations of quantum mechanics, and in particular for the formulation of the famous 'Bell's inequalities', while John Dowell of Birmingham and Peter Kalmus of London's Queen Mary College, and both of the UA1 collaboration at CERN, jointly receive the Rutherford Medal and Prize for their contributions to the discovery of the W and Z particles at CERN in 1983.

Ideals and Realities

Now published by World Scientific is the second edition of 'Ideals and Realities', a collection of non-scientific essays by, or on, Abdus Salam. The first edition (1984) was translated into Arabic, Chinese, Italian, Persian, Rumanian, Russian and Spanish, and under C.H. Lai the new edition incorporates valuable recent material, reflecting more fully Salam's deep commitment to physics, his love for Islam and its culture, and his untiring efforts to promote science in the Third World.

In the book, his presentation at the 1985 particle physics history conference at Fermilab recounts how Feynman met the universally admired Dirac at the 1961 Solvay Conference.

'At the old Solvay Conferences one sat at long tables arranged as if one was going to pray. Like a Quaker gathering, there was no fixed agenda; the expectation – seldom belied – was that someone would start the discussion spontaneously.

I was sitting at one of these long tables next to Dirac, waiting for the session to start, when Feynman came and sat down opposite. Feynman extended his hand towards Dirac and said 'I am Feynman.' It was clear from his tone that it was the first time they were meeting. Dirac extended his hand and said 'I am Dirac.' There was a silence, which from Feynman was rather remarkable. Then Feynman, like a schoolboy in the presence of a master, said to Dirac 'It must have felt good to have invented that equation.' And Dirac said 'But that was a long time ago.' Silence again. To break this, Dirac asked Feynman 'What are you yourself working on?' Feynman said 'Meson theories' and Dirac said 'Are you trying to invent a similar equation?' Feynman said 'That would be very difficult.' And Dirac, in an anxious voice, said 'But one must try.'

Vadim Genrikhovich Knizhnik 1962-1987

Vadim Genrikhovich Knizhnik 1962-1987

Vadim Genrikhovich Knizhnik, a brilliant young theoretician from Moscow's Landau Institute, died in December at the age of 25. A student of A.M. Polyakov, he gained recognition with his work on exactly solvable two-dimensional models and became a permanent staff member at the Landau Institute in 1986.

Superconducting cyclotron beams

The K800 cyclotron of the US National Superconducting Cyclotron Laboratory at Michigan State University has accelerated internal beams of helium 3 and carbon 12 to 165 and 660 MeV respectively. Beam from the electron cyclotron resonance source was injected on 11 February and after several interim trials accelerated to full radius on 22 February. After the very smooth startup, beam tests precede the first experimental runs, scheduled for the summer.

STAFF MEMBER, PRINCIPAL INVESTIGATOR

The Physics Division at the Los Alamos National Laboratory (LANL) invites applications for the position of Staff Member, Principal Investigator of an experimental program to measure the gravitational acceleration of the antiproton. This exciting project is the basis for an approved experiment with an international collaboration at CERN's Low-Energy Antiproton Facility (LEAR). The Principal Investigator will direct all phases of the LANL segment of the experiment as well as interface the LANL effort with the other collaborating institutions and funding sources.

Among the technical tasks involved are the construction of Penning-style ion traps, the development of ion cooling and transport techniques, and the construction of ultra-uniform electromagnetic field drift tubes.

Applicants should be able to demonstrate the ability to lead and inspire a diverse technical team in a complex, long-term project. Applicants must have an outstanding record of technical accomplishments demonstrated by past performance and evidenced by publications. The position also requires the ability to interface with international research groups. Experience interfacing with funding agencies should be explained if applicable to professional background.

Applicants should have a Ph.D. in one or more of the following fields: Atomic, Nuclear, High-Energy, Accelerator, or Low-Temperature Physics.

Los Alamos National Laboratory provides excellent compensation and benefits. To apply, submit detailed resume to: Richard O. Garcia (MS P205), Employment Group 80085-V, Los Alamos National Laboratory, Los Alamos, New Mexico 87545.

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UNIVERSITY OF OXFORD

THE DEPARTMENT OF NUCLEAR PHYSICS
and
THE QUEEN'S COLLEGE

Titular Lecturership in Experimental Particle Physics Praelectorship and Official Fellowship in Physics

Applications are invited for an official Fellowship and Praelectorship in Physics with effect from 1 October 1988 or a later date to be arranged. The appointment will be made by the College in conjunction with the Board of Faculty of Physical Sciences and the title of University Lecturer will be conferred upon the successful candidate, who will be expected to carry out the normal duties of a University Lecturer and Official Fellow.

The present research programme of the Nuclear Physics Department includes preparation for experiments with the DELPHI detector at LEP (CERN) and ZEUS detector at HERA (DESY), the measurement of neutrino mass, the search for proton decay and the development of solar neutrino and cryogenic detectors. Further details may be obtained from Professor D.H. Perkins FRS, Nuclear Physics Laboratory, Keble Road, Oxford, OX1 3RH.

Further particulars of the appointment may be obtained from the College Secretary, The Queen's College, Oxford, OX1 4AW to whom nine copies of applications (one only from overseas candidates) should be sent **to arrive not later than 31 May.** These should include a curriculum vitae, list of publications, and a statement of research interest and teaching experience, and the names of three referees. Referees should be asked to send references direct to the College Secretary to arrive **by the above date.**

Shortlisted candidates will be interviewed in Oxford on the 13th and 14th June. All applicants are asked to indicate a telex, fax or telephone number where they can be contacted during the period 31 May to 11 June.

UNIVERSITY OF CALIFORNIA, IRVINE

SENIOR FACULTY POSITION IN EXPERIMENTAL PARTICLE PHYSICS

RESEARCH POSITIONS IN EXPERIMENTAL PARTICLE PHYSICS

The Physics Department is seeking a senior experimentalist at the rank of Associate Professor (with tenure) or Full Professor. An appointment will be considered in any area of elementary particle physics, including accelerator, neutrino, and cosmic ray physics, etc. The existing program at UCI includes accelerator experiments at Fermilab, LASL and BNL, studies of proton decay (IMB), neutrino oscillations (SRP), double beta decay, ultra high energy astronomy (CYGNUS experiment), and gravitational studies. Planned experiments include studies of solar and astrophysical neutrinos and high energy gamma rays. An SSC program is anticipated. The successful applicant will be expected to play a leadership role in the existing program and/or contribute a new research area. He or she will teach at the undergraduate and graduate levels.

Experimentalists for research positions are sought to participate in experiments at Fermilab (Experiment E 760, a study of charmonium formations in antiproton-proton collisions) and the Brookhaven National Laboratory (Experiment E791, a search for separate lepton number violation and for direct CP violation in K_L^0 decays), as well as for the IMB and Cygnus programs. Positions are anticipated for the Sudbury Neutrino Observatory (SNO) and for the Large Cerenkov Detector (LCD) experiment at LAMPF. Appointments at a level from postdoctoral fellow to research physicist are available depending on the candidate's qualifications.

Applicants should send a curriculum vitae, a statement of present and future research interests, and the names of at least 4 professional references to

Professor J. Schultz
Chair, Physics Department
U.C. Irvine, Irvine,
California 92717

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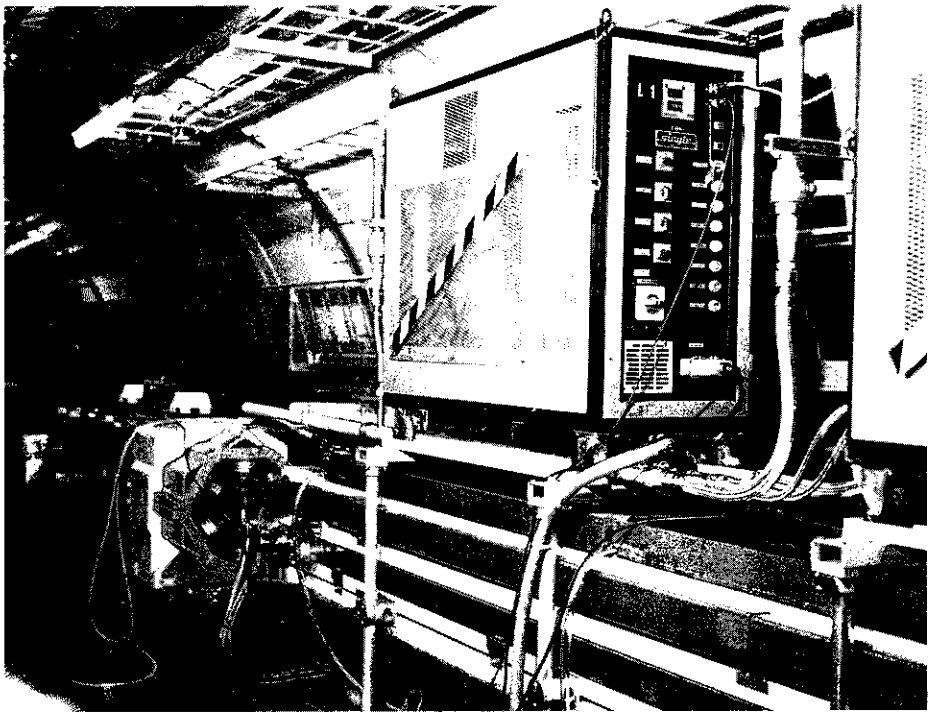
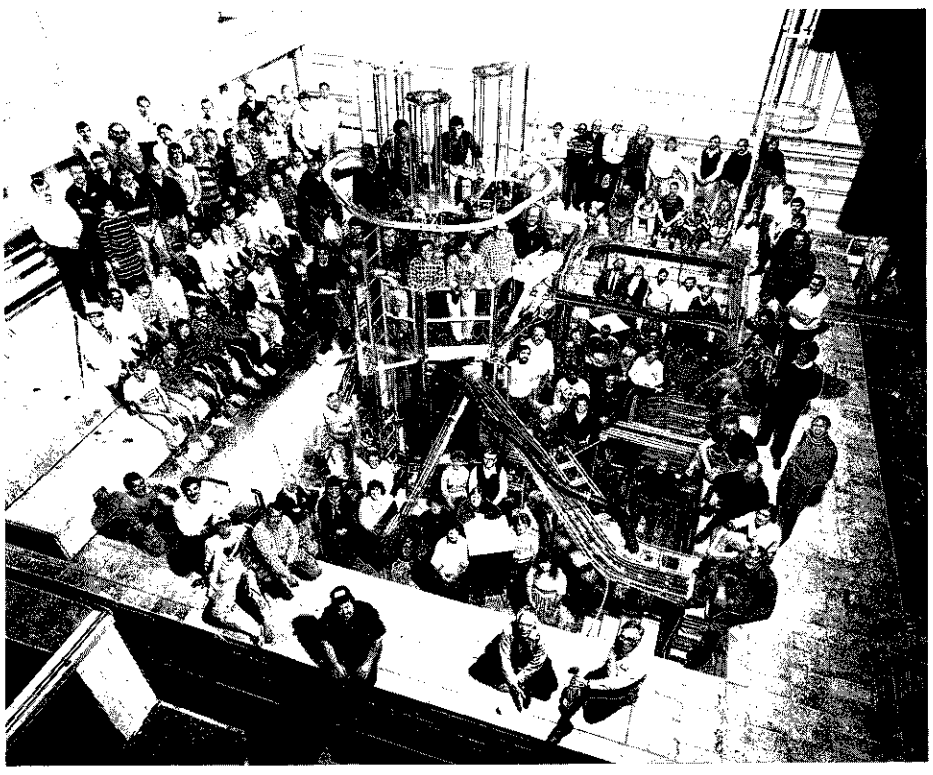
LEP progress

The first 1.5 kilometre (3×474 m) section of vacuum pipe in the LEP ring has been pumped down to the design level of about 10^{-11} torr. With these vacua, a high energy LEP electron could circulate for a third of a light year before running a serious risk of colliding with a residual gas molecule! When operating, synchrotron radiation from the circulating electrons and positrons will affect the LEP vacuum, giving a few 10^{-9} torr, when the particles' average undisturbed circulation time would be about a day. The vacuum in LEP's lead-clad aluminium beam pipe is now a permanent feature, and awaits initial test beams this summer.

Several kilometres of LEP magnets are now installed in the 27 kilometre tunnel, in line with the goal of having the mammoth machine complete next summer. Meanwhile the huge magnet for the L3 experiment at Point 2 takes shape, and work gets underway at Point 4 150 metres below the surface for final assembly of the Aleph experiment.

Bakeout of the LEP vacuum chamber with superheated water.





Staff of the US National Superconducting Laboratory at Michigan State University took advantage of the last opportunity to pose before the concrete wall being built for the K800 cyclotron will hide it from view. First internal beams were accelerated in February.

Fermilab gets a kick out of Spellman power supplies

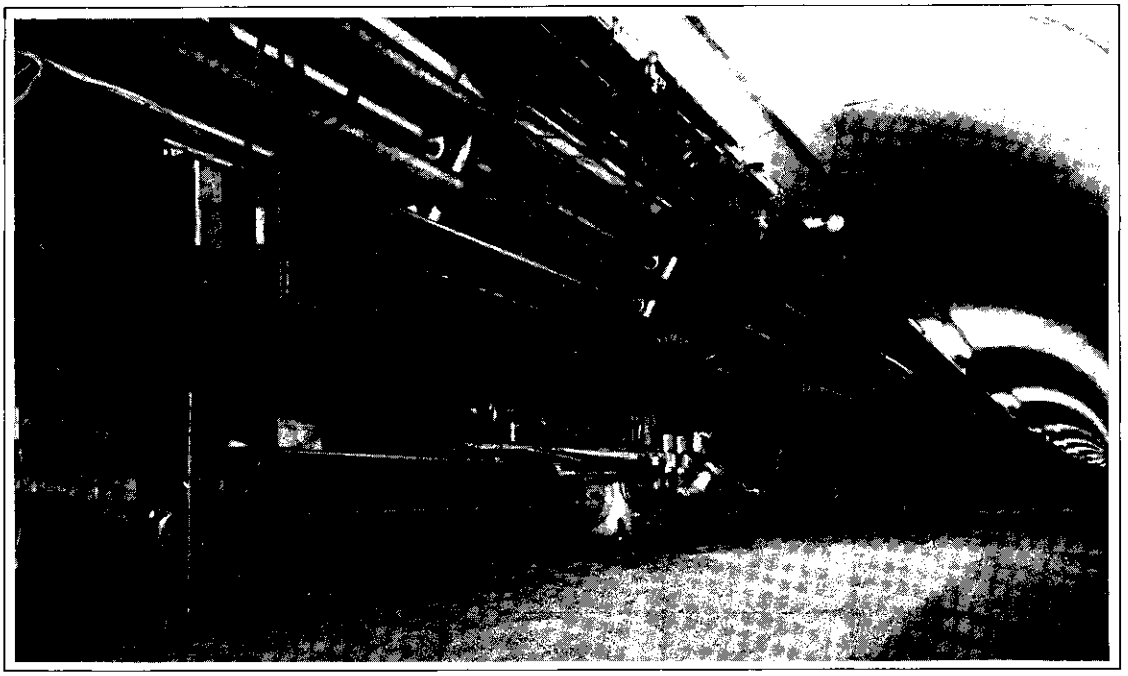
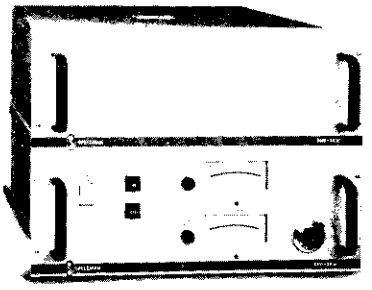


Photo: Courtesy of Fermilab

The abort system "kicker" magnets in the Fermilab accelerator require high voltage programmable energy sources. This energy is provided by 25 Spellman HV power supplies which maintain a precise charge across the storage capacitors.

Our resonant converter HV supplies are installed in a wide variety of applications throughout the world. Spellman offers you the best there is in high power at high voltage. You also enjoy competitive pricing, and miniaturization which saves up to two-thirds of the usual space requirements. Contact us for complete information on Spellman power supplies from 1W to 30kW. We know that you'll get a kick out of our incomparable performance.



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Books

'Collider Physics' by Vernon D. Barger and Roger J.N. Phillips, published by Addison-Wesley in the 'Frontiers of Physics' series, is a graduate student textbook reflecting the increasing emphasis in experimental particle physics on colliding beam machines, and concentrates on the description of fundamental hard scattering processes in electron-positron, electron-proton, proton-proton and proton-antiproton collisions, using many recent experimental results as illustrations and examples.

Meetings

The XII International Conference on Particles and Nuclei (PANIC 90) will be held from 24-29 June 1990 at the Massachusetts Institute of Technology, Cambridge, Mass., US.

The 1989 Real Time Conference will be held from 15-18 May 1989 at the Fort Magruder Inn and Conference Center, Williamsburg, Virginia and not at TUNL as previously announced. Tours of the Continuous Electron Beam Accelerator Facility and the NASA Langley Research Center are planned for the day following the Conference. Further information from Roy Whitney, CEBAF, 12070 Jefferson Avenue, Newport News, VA 23606.

Computer Conference on beauty physics at Fermilab

Following the Beauty Workshop recently held at Fermilab (see January/February issue, page 5), a Computer Conference has been organized to discuss the design of a Tevatron collider experiment to explore beauty physics. Those interested in either following the discussion or contributing may do so via VAX Notes available via the HEP DECnet. The conference is at: FNAL::USR$ROOT:[BEAUTY.CONFERENCE]B_COLLIDER.NOTE. Conference moderator is Ray Stefanski (FNAL::STEFANSK). To examine the conference contents via the VXCRNA VAX, at the $ prompt, type

$ NOTES
Notes›ADD ENTRY FNAL::USR$ROOT:[BEAUTY.CONFERENCE]B_COLLIDER
*Notes›OPEN B_*
Notes›do VAX Notes commander--for starters, just type digits 1,2,3,4,5,5.1,6,7,8 to see initial notes.

The IEEE Nuclear Science Symposium and Symposium on Nuclear Power Systems will be holding a joint conference from 9-11 November at the Hyatt Orlando Hotel, Florida. The meeting is an excellent opportunity for engineers and physicists to present their work in a wide variety of topics; physics instrumentation, reactor systems, nuclear medicine instrumentation, space instrumentation, etc. Abstracts and summaries should be sent as soon as possible to the programme chairman, Muzaffer Atac, Fermilab, MS 222 PO Box 500, Batavia, IL 60510, USA. Further information from Ed Barsotti, Fermilab MS 222, telephone (312) 840-4061.

An international conference entitled 'The Restructuring of Physical Sciences in Europe and the United States, 1945-60' to be held at the Department of Physics of the University of Rome 'La Sapienza' from 19-23 September will look at the development of 'big physics' after World War II. Further information from the Conference Secretary, Ms. E. Di Silvestro, Dipartimento di Fisica, Universita di Roma 'La Sapienza', P.le A. Moro, 2-00185 Rome, Italy.

The ninth UK Institute for Theoretical High Energy Physics to be held at the University of St. Andrews, Scotland, from 20 August to 10 September aims at postdoctoral researchers, with lectures providing some focal points. Further information from J.F. Cornwell, Department of Physics and Astronomy, University of St. Andrews, North Haugh, St. Andrews, Fife, KY16 9SS, Scotland.

Electronic Mail

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

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Distribution in the USA, West Germany, Italy, the UK and China is handled from regional centres (see page III).

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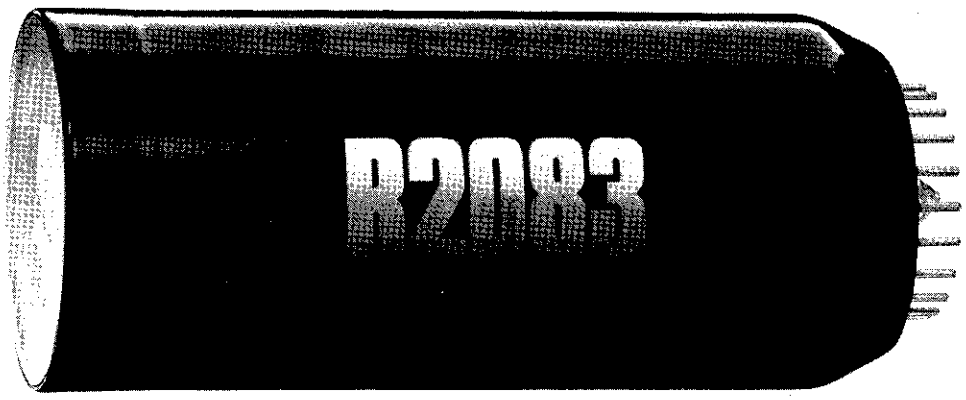

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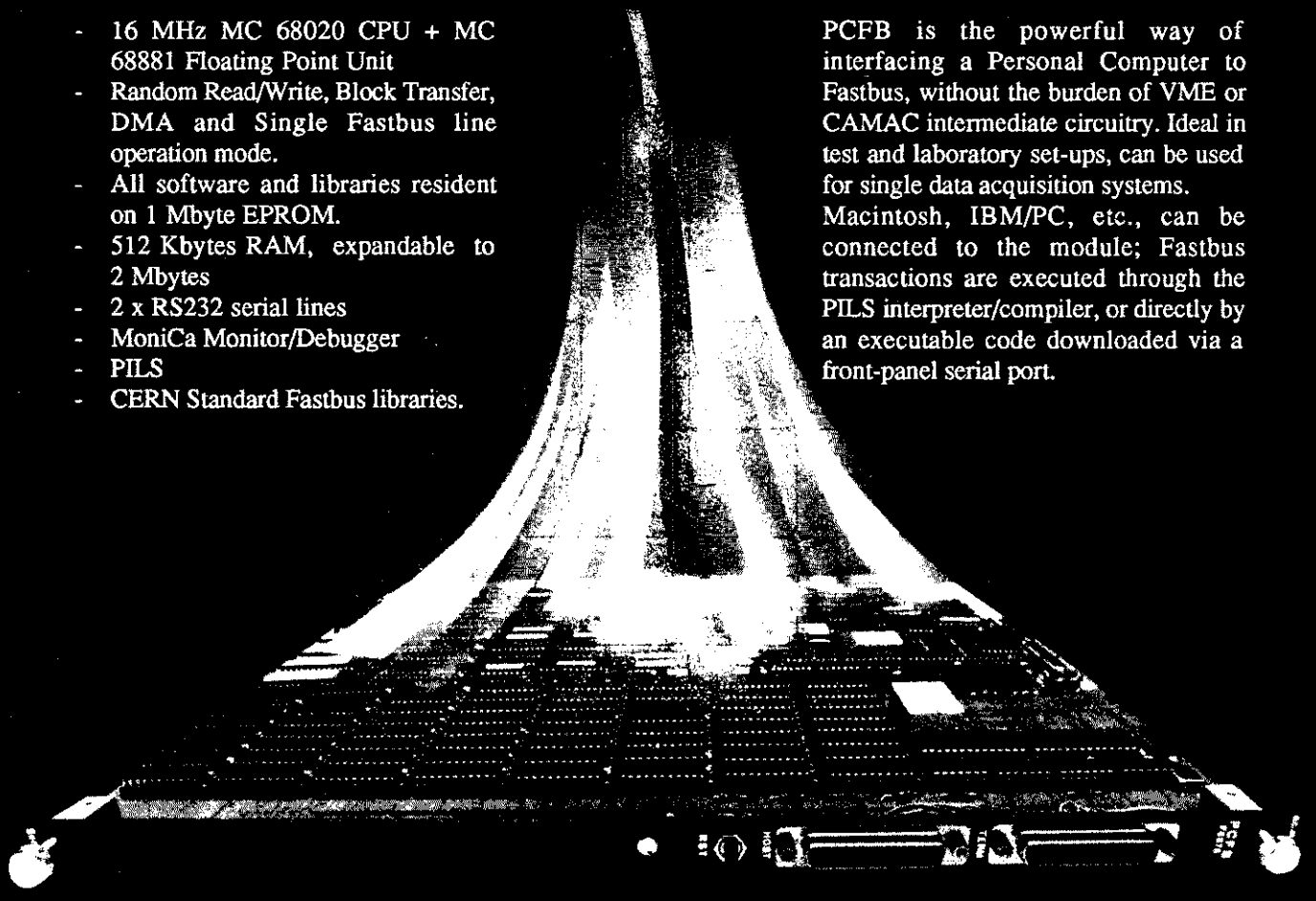

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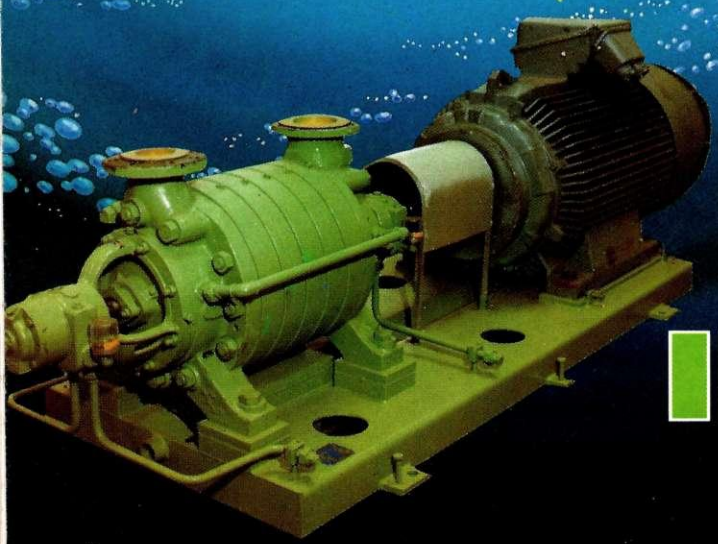

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