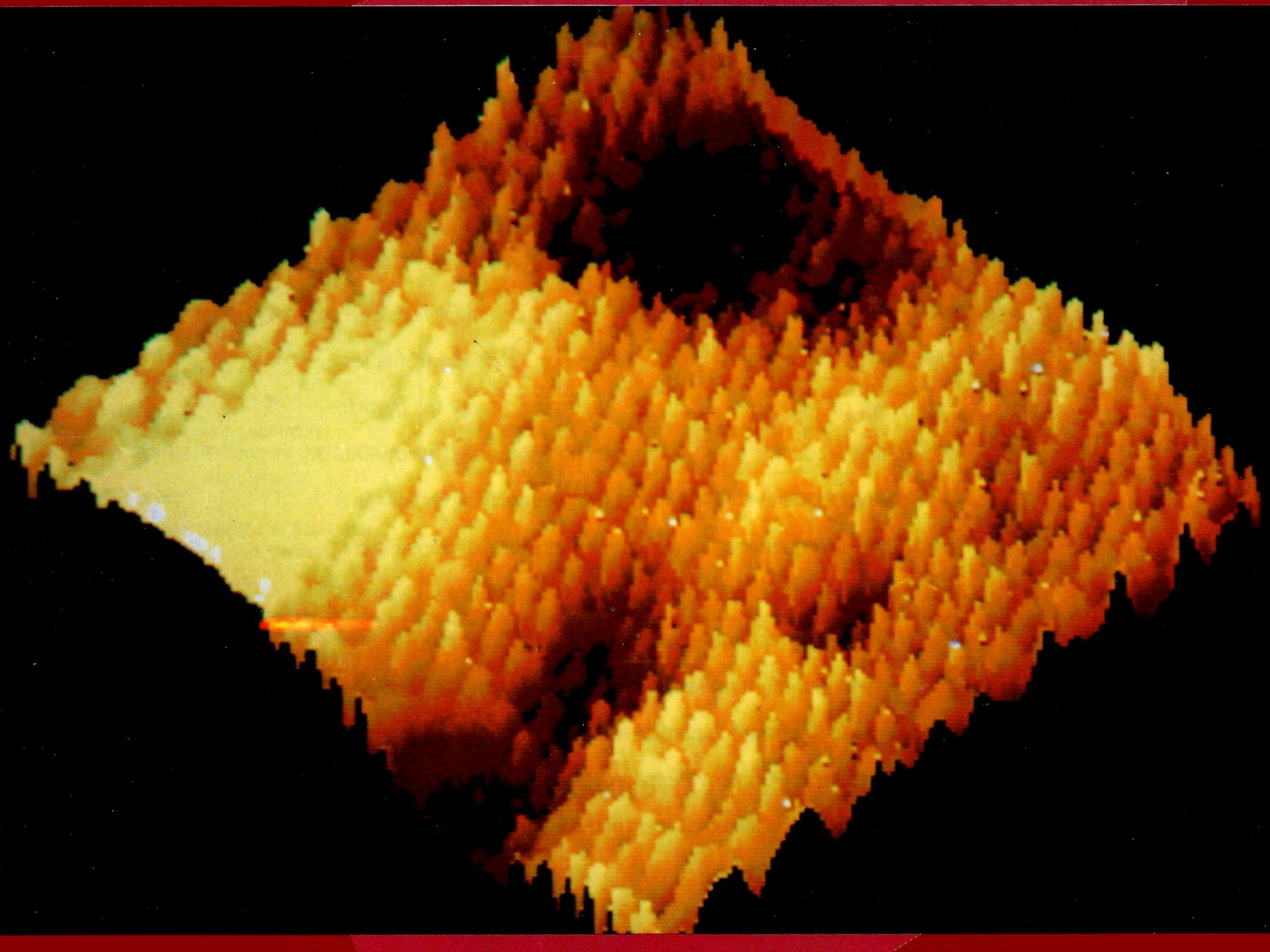
CERN COURIER

INTERNATIONAL JOURNAL OF HIGH ENERGY PHYSICS

VOLUME 33 **2** MARCH 1993



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
820 Town Center Drive
Langhorne, PA 19047
Tel.: +1 (215) 750 2642
Fax: +1 (215) 750 6343

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

General distribution

Jacques Dallemagne
CERN, 1211 Geneva 23, Switzerland

In certain countries, copies are available on request from:

China

Dr. Qian Ke-Qin
Institute of High Energy Physics
P.O. Box 918, Beijing,
People's Republic of China

Germany

Gabriela Heessel
DESY, Notkestr. 85, 2000 Hamburg 52

Italy

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

United Kingdom

Su Lockley
Rutherford Appleton Laboratory,
Chilton, Didcot, Oxfordshire OX11 0QX

USA/Canada

Cyndi Rathbun (B90904 @ 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 33
No. 2
March 1993

Covering current developments in high energy physics and related fields worldwide

Editor: Gordon Fraser (COURIER @ CERNVM)*
Production and Advertisements:
Micheline Falciola (FAL @ CERNVM)*
Advisory Board: E.J.N. Wilson (Chairman), E. Lillestol, H. Satz, D. Treille; with W. Hoogland, H.I. Miettinen

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

Around the Laboratories

Physics monitor

Reader service form, page 30.

Cover photograph: Using a scanning tunneling microscope as a particle detector. Specialists from Beijing's Institute of High Energy Physics see the damage produced by irradiation of molybdenum sulphide (MoS_2) by gold ions (at the GSI Darmstadt Laboratory). The craters are a few thousandths of a micron across. The bumps are the sulphur atoms, some 3 angstroms apart.

Quand seul le meilleuR Suffit!

Le catalogue

25 000 produits, tous tenus en stock
Tous les grands fabricants répertoriés
Facile à consulter
Deux éditions par an : février et septembre

La gamme

Un sommaire clair pour une consultation plus simple et plus rapide

1	Accumulateurs, piles et chargeurs	Composants
2	Alarmes et sécurité	
3	Alimentations	
4	Appareillage industriel	
5	Câbles et fils	
6	Câbles - accessoires	
7	Châssis et coffrets	
8	Circuits imprimés	
9	Condensateurs	
10	Connecteurs audio et vidéo	
11	Connecteurs coaxiaux	
12	Connecteurs multipoints	
13	Connecteurs - supports	
14	Connecteurs - autres	
15	Dissipateurs thermiques	
16	Entretien et maintenance	
17	Equipement de dessin	
18	Fibre optique	
19	Filtres et protection	
20	Fusibles	
21	Haut-parleurs	
22	Indicateurs de tableau	
23	Inductances	
24	Informatique	
25	Interrupteurs et commutateurs	
26	Opto-électronique	
27	Relais	
28	Réseaux locaux	
29	Résistances et potentiomètres	
30	Semiconducteurs - discrets	
31	Semiconducteurs - logiques	
32	Semiconducteurs - analogiques	
33	Semiconducteurs - µP mémoires	
34	Transformateurs	
35	Ventilateurs	
36	Alimentations de laboratoire	Test et Mesure
37	Calculatrices	
38	Environnement	
39	Multimètres	
40	Oscilloscopes et générateurs	
41	Test électrique	
42	Antistatique	Outillage
43	Outils à main	
44	Outils électro-portatifs	
45	Production	
46	Rangement	
47	Soudage/Dessoudage	
48	Visserie et fixations	
49	Bibliothèque technique	

BIRDÉPUB 2029

Le service

Aucun minimum de commande
Tarif fixe pour la durée du catalogue
Service STAR ®, une ligne directe avec un technicien conseil au (16) 44 02 55 55
Une équipe locale toujours disponible

NOUVEAU

La rapidité

Toute commande passée avant 18 h. est expédiée le jour même afin de garantir la livraison, franco de port, le lendemain

COMMANDEZ AUJOURD'HUI
LGV+
Livraison Franco Garantie Demain
RECEVEZ DEMAIN

Je désire recevoir gratuitement le catalogue février à août 93

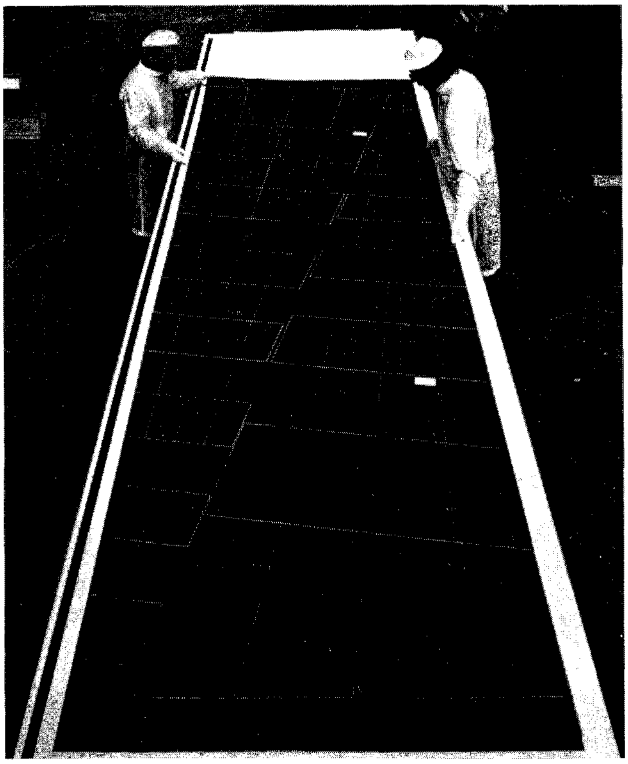
Nom : ______________________ Prénom : ______________________
Fonction : ______________________ Service : ______________________
Société : ______________________
Adresse : ______________________
____
______________________ Tél. : ______________ Fax : ______________

CERN

RS Composants - B. P. 453 - 60031 Beauvais Cedex - Tél. (16) 44 84 72 72 - Télex 145 759 - Fax (16) 44 05 13 49

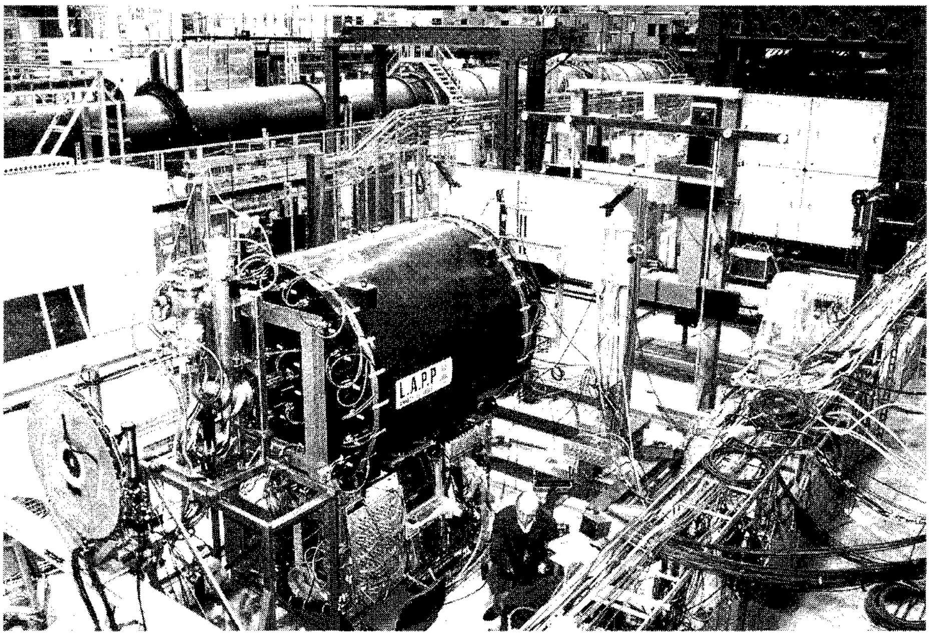
RS
RS Composants
(16) 44 84 72 72

PREMIER DISTRIBUTEUR ELECTRONIQUE EUROPÉEN



Around the Laboratories

The GAMS experiment took final data at CERN last year. An Annecy (LAPP)/KEK (Japan)/Los Alamos/Pisa/Serpukhov collaboration, it is one of the long standing examples of Russian collaboration at CERN. The GAMS acronym stems from the Russian abbreviation for the experiment's large lead-glass arrays, seen in the background.
(Photo CERN 22.4.1991)



CERN
Fixed target targets

While the immediate priority of CERN's research programme is to exploit to the full the world's largest accelerator, the LEP electron-positron collider and its concomitant LEP200 energy upgrade (January, page 1), CERN is also mindful of its long tradition of diversified research.

Away from LEP and preparations for the LHC proton-proton collider to be built above LEP in the same 27-kilometre tunnel, CERN is also preparing for a new generation of heavy ion experiments using a new source, providing heavier ions (April 1992, page 8), with first physics expected next year. CERN's smallest accelerator, the LEAR Low Energy Antiproton Ring continues to cover a wide range of research topics, and saw a record number of hours of operation in 1992. The new ISOLDE on-line isotope separator was inaugurated last year (July, page 5) and physics is already underway.

The remaining effort concentrates around fixed target experiments at the SPS synchrotron, which formed the main thrust of CERN's research during the late 1970s. With the SPS and LEAR now approaching middle age, their research future was extensively studied last year. Broadly, a vigorous SPS programme looks assured until at least the end of 1995. Decisions for the longer term future of the West Experimental Area of the SPS will have to take into account the heavy demand for test beams from work towards experiments at big colliders, both at CERN and elsewhere. The North Experimental Area is the scene of larger experiments with longer lead times.

Several more years of LEAR exploitation are already in the pipeline, but for the longer term, the ambitious Superlear project for a superconducting ring (January 1992, page 7) did not catch on.

Neutrino physics has a long tradition at CERN, and this continues with the preparations for two major projects, the Chorus and Nomad experiments (November 1991, page 7), to start next year in the West Area. Delicate neutrino oscillation effects could become visible for the first time, and help explain the continuing dilemma of the dearth of solar neutrinos (December 1992, page 12).

For the longer term future, a larger detector could provide an increased yield, boosting the neutrino capture rate by up to a factor of ten. Other, more spectacular, option is to shine the CERN neutrino beam towards a detector a long way off. Such a beam is practically unimpeded by matter and could pass right through the earth. Possible contenders for underground target stations equipped with big detectors are the Italian Gran Sasso laboratory, 730 kilometres south, or Superkamiokande, 8750 kilometres away in Japan.

Other major ongoing 'flagship' SPS projects include the NA48 experiment to continue precision measurements on the still unexplained phenomenon of CP violation (March 1992, page 7) and the 'Spin Muon Collaboration' looking to probe the spin structure of the proton and the neutron using high energy muon beams (April 1992, page 21). Both these experiments address important physics issues. While SMC is already taking data, NA48 will not become operational until 1995, but should run then for more than three years.

Elsewhere at the SPS, ongoing studies include a programme using hyperon beams, and a study of beauty particles (WA92) which would be hampered once the new neutrino programme starts. The spectroscopy of particles containing light quarks, although far from having solved all outstanding questions, is slowly coming to the end of its SPS career. The WA91 glueball search at the big

Omega detector will continue taking data in1994. The GAMS experiment took its final CERN data last year. One of the long-standing examples of CERN-Russian collaboration, GAMS earned its acronym from the Russian abbreviation for its characteristic large lead-glass arrays. GAMS experiments have run both at CERN and at Serpukhov's Institute for High Energy Physics near Moscow.

CORNELL Synchrotron 25

Cornell notables (left to right) Robert Wilson, Boyce McDaniel, Maury Tigner and Karl Berkelman at the 25th anniversary celebrations of Cornell's electron synchrotron.

A recent celebration marked the twenty-fifth anniversary of the Cornell Electron Synchrotron. The major milestone in the commissioning of the synchrotron was on October 11, 1967 when Helen Edwards, Boyce McDaniel, and Maury Tigner achieved a 7 GeV beam, a world-record energy for electron synchrotrons at that time. Like so many advances in experimental physics, this occurred early in the morning - 3 a.m.!

The transition from accelerator commissioning to high energy physics operation was extremely rapid; 7 GeV operation for data collection was routine just five weeks later. Throughout its life as a source of photon and electron beams for fixed target experiments, the synchrotron maintained energy leadership for circular electron machines. Originally designed for operation at 10 GeV, eventually it consistently provided beams for experiments at energies up to 11.6 GeV. It now operates at 5 GeV, serving as the injector for the CESR electron-positron storage ring.

Robert Wilson was director of the laboratory during the design and most of the construction of the machine. He left near the end of the construction to become the first director of Fermilab and was replaced by Boyce McDaniel, who guided the laboratory from the completion of the synchrotron to the construction and early operation of CESR.

Wilson recalled how the laboratory had originally proposed a 3 GeV turnkey machine to be built entirely by industry and would fit in the space previously occupied by earlier Cornell accelerators. However, members of the laboratory realized that 3 GeV would not open new physics frontiers, that the construction of the accelerator was much of the fun of doing high energy physics experiments, and that a more challenging project was needed. This led to the proposal for the 10 GeV synchrotron which was built in the "Cornell Style" with many of the components fabricated and nearly all of the assembly done at Cornell.

The Cornell synchrotron introduced a number of innovations in accelerator design and construction to keep the cost down. To reduce the radiofrequency power required to replace energy lost through synchrotron radiation, the circumference chosen (757 m) was significantly larger than that of other electron synchrotrons of that era. This choice turned out to be particularly fortunate because this tunnel size is excellent for an electron-positron storage ring operating in the region of the upsilon resonances and the threshold for B meson production. From the beginning a storage ring in the tunnel was envisioned as an eventual upgrade, although nobody had any idea what the most interesting energy region would be.

The synchrotron is located 16 m under Cornell's athletic fields. The depth of the tunnel and the continual use of the playing fields meant that standard cut-and-fill techniques for digging the tunnel were impractical. This led to the use of a tunnel boring machine, the first time that this technique was utilized in construction of a synchrotron tunnel.

To achieve sufficient intensity, electron synchrotrons were rapid cycling (60 Hz at Cornell). At such high frequency a simple metal vacuum chamber inside the magnet gap is impossible due to eddy currents. The glass, ceramic, or composite vacuum chambers used in other electron synchrotrons were necessarily large, leading to large magnet gaps and expensive facilities. The solution chosen was to put the magnets inside the vacuum chamber. The resulting magnet is very small, with cross-section comparable to the size of this page. By now this unique design has proved its value in a quarter century of trouble-free operation.

The control system designed and built by Raphael Littauer broke new ground in accelerator design. Measurements of the accelerator conditions at each of 192 magnets were transferred to the control room by a "shift register" system for display on oscilloscope screens. This system was based on the then-new integrated circuit technology and was a step towards the computer control systems of the future.

From 1967 to 1978 the synchrotron provided beams for fixed target photoproduction and electroproduction experiments. Because of the large duty factor of the synchrotron, it was possible to do coincidence experiments with relatively large solid angles. Investigations of vector meson photoproduction and the verification of the validity of quantum electrodynamics dominated the early years of the programme.

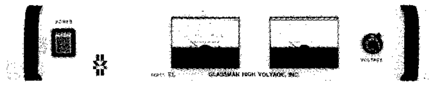
Studies of the final states produced in highly inelastic electroproduction were the main emphasis of the program in later years. In these experiments, pions, kaons, and vector mesons (rho, omega, and phi) were detected in coincidence with scattered electrons. Among other results, the pion electroproduction experiments yielded measurements of the electromagnetic form factor (or size) of the charged pion.

A variety of experimental techniques were utilized in the synchrotron programme. Early experiments depended primarily on scintillation counters and optical spark chambers. Later multiwire proportional chambers were introduced in a number of relatively large aperture focusing spectrometers. One of the last experiments utilized a 12,000 wire system in a large aperture magnet covering nearly the full solid angle to study the final states in electroproduction. A DESY streamer chamber was also used in an experiment to investigate the particles produced in highly inelastic electroproduction events.

Late in the fixed target era, several atomic physics experiments exploited X-ray beams from the accelerator's synchrotron radiation. This led to the creation of CHESS, the laboratory for utilizing the synchrotron radiation X-rays produced by CESR. Hundreds of experiments in physics, chemistry, biology, and medicine now use the CHESS X-ray beams.

The fixed target programme was completed in 1978 and the synchrotron found a new role as injector for the CESR storage ring. It has been very successful in this role. CESR was originally designed for a luminosity of 10^{32} per sq cm per s at 8 GeV; with improvements including multiple bunches it has reached 2.5 x 10^{32} at 5.3 GeV. In 1991 and 1992, CESR produced a total of 2.7 inverse femtobarns of luminosity for the CLEO experiment. This is about a factor of seven larger than the luminosity delivered to a single experiment at any other electron-positron storage ring. With modest upgrades the synchrotron will also serve as the injector for a B Factory at Cornell (July 1991, page 8).

CERN Courier correspondent and Associate Director of Cornell Laboratory David Cassel (left) is amused by a recollection of Robert Wilson.



LABORATORY HV SUPPLIES...
to 60 kV and 45 W

High performance and low cost DC high voltage are now available for the lab bench with the EL Series of tightly regulated, low ripple, and highly stable power supplies. Voltage ranges are 0 to 3 kV through 0 to 60 kV. Operating features include low stored energy for safety and an automatic crossover from constant-voltage to constant-current regulation for protection from overloads, arcs, and shorts.
Glassman High Voltage

100 W POWER SUPPLY TO 60 kV
3.5 in. and only 13 lbs.

The EH Series offer 100 W high voltage power supplies of superior quality in a compact and low weight package and at an affordable price. Rack panel height is only 3.5 inches and weight 13 lbs. Standard features include local and remote control and monitoring, tight regulation, low ripple, and fast response. Voltage ranges are 0 to 1 kV through 0 to 60 kV. Positive, negative, or reversible polarity models are available.
Glassman High Voltage

TWO UNBEATABLE HV MODULES...15 W/75 W

The 15 W Series MJ, with outputs from 0 to 3 kV through 0 to 30 kV, and the 75 W Series MK, 0 to 1 kV through 0 to 60 kV, both provide premium regulated and low-ripple power supply performance in a line-operated, compact, and lightweight package. Air insulation allows for easy serviceability, in contrast to wasteful "throw-away" modules.

- Constant voltage/constant current operation
- Low stored energy for safety
- Local and remote control
- Remote TTL enable/disable
- External interlock terminals
- Available with positive or negative polarity

Call for full information on the MJ and MK Series, or other Glassman supplies, 1 kV to 500 kV, 15 W to 15 kW.

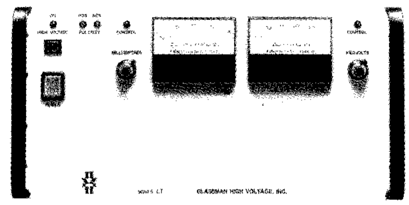
Innovations in high voltage power supply technology.

GLASSMAN HIGH VOLTAGE INC.

Glassman High Voltage, PO Box 551, Whitehouse Station, NJ 08889, telephone (908) 534-9007. Also Glassman Europe, in the UK call (0256) 810808 and in Asia, Glassman Japan (044) 877-4546.

46 *Circle advertisement number on reader service form*

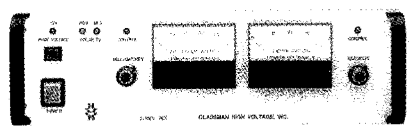
2 kW HV SUPPLIES TO 125 kV...
only 8.75 in. and 47 lbs.



No longer does the combination of high DC voltage and high power mean a big, clumsy supply. The new LT Series from Glassman provides up to 2 kW of power with voltage ranges, depending on the model, from 0 to 1 kV through 0 to 125 kV in only a 8.75 inch high rack panel. Weight is less than 47 pounds. Line voltage is 220/240 V single-phase.

Voltage regulation is better than 0.005% for both load and line variations. Ripple is less than 0.03%. Automatic crossover from constant-voltage to constant-current regulation protects both the supply and load against shorts, arcs, or overloads. Current regulation is 0.05% from short circuit to rated voltage. The LT Series can be ordered with an optional current "trip" circuit that can be switch-selected to provide either current limiting or trip operation in the event of an overload.

All LT Series supplies feature full remote control capabilities including voltage/current program and monitoring terminals, TTL high voltage enable/disable, safety interlock terminals, and a +10 V reference source. Positive, negative, or reversible polarity models are available. Choice of dual analog or digital meters or a blank panel.
Glassman High Voltage



HV TO 75 kV AND 1000 W
Rack panel height only 5.25 in.

The WX Series of 1000 W regulated power supplies are available with DC outputs from 0 to 1 kV through 0 to 75 kV. Rack panel height is only 5.25 inches and weight less than 30 lbs. The Series WX is offered with a choice of dual analog voltage and current meters, dual digital meters, or with a blank panel for OEM/system applications. Positive, negative, or reversible polarity models are available.
Glassman High Voltage

SUPERCOLLIDER
Boosters

The conventional construction contract for the Low Energy Booster (LEB) at the Superconducting Supercollider (SSC) being built in Ellis County, Texas, was awarded in December to Cajun Contractors of Dallas, Texas.

The construction includes 1870 feet of cut-and-cover tunnel with a shielding berm, an equipment access corridor, and provision for emergency exits. It also includes ten surface buildings, as well as the usual infrastructure (concrete pads, roads, and utilities). In addition, 575 feet of cut-and-cover tunnel for the next machine in the chain, the medium Energy Booster (MEB), is included. Beneficial occupancy of all structures is projected for mid-April next year.

The ring magnets for the LEB include 96 conventional (non-superconducting) dipoles, each 2 metres long, and a total of 90 quadrupoles of the same cross-section as the dipoles but in eight different lengths between 0.55 and 0.71 meters. Prototypes of the dipoles and quadrupoles are being constructed by Stanford (SLAC) and Lawrence Berkeley Laboratory respectively. Production magnets are expected to be fabricated in collaboration with the Budker Institute for Nuclear Physics (BINP), Novosibirsk, starting this summer. BINP is also collaborating on the design and the fabrication of 12 dipole and 20 quadrupole magnets for the beam transfer and abort lines from the LEB to the Medium Energy Booster (MEB).

The ring magnets for the MEB include 364 conventional dipoles (340 6.45 metres long and 24 5.75 metres long) and 230 quadrupoles (206 2.40 metres long and 12 each 2.8 and 0.54 metres long). A full-size development model of the dipole magnets is under construction at Fermilab. The Moscow Radiotechnical Institute is being considered as a collaborative source for the production of the quadrupole magnets, with production to start in summer of 1994 after approval of prototypes.

The increasing Russian involvement in the SSC project was formalized in January when US Department of Energy Secretary James Watkins signed an intergovernmental agreement on SSC collaboration between the US DoE and the Russian Federation's Ministry of Atomic Energy. The agreement had been signed in Moscow in December.

DESY
HERA moves on

First encouraging physics results from the new HERA electron-proton collider at DESY, Hamburg, reported last year (October, page 6), came from the machine operating at less than 1% of its design luminosity (a measure of the proton-electron collision rate).

In the short time available to the machine specialists, several substantial improvements have been made, and the HERA operating crew is confident of substantially improved performance when operations get underway again in April.

The 820 GeV superconducting proton storage ring is behaving as expected. The number of stored bunches has been increased from 10 to 160 (the maximum is 210). Without any optimization the current reached 13 mA, nearly 10% of the design level, and the beam lifetime is generally longer than 50 hours.

The protons can thus be kept in the machine over several successive electron fills. The long proton beam lifetime attests to the excellent vacuum in the beam pipe (much of it at liquid helium temperature) and to minimal beam losses.

In the electron ring, 100 bunches were stored in the most recent tests (initially only ten bunches could be handled) and the multibunch feedback system brought into action. The 23 mA current represented about 40% of the design figure. The energy is usually kept around 27 GeV, but could be increased to 30 GeV if required.

The problem previously limiting electron beam current now seems to be resolved. Beam loss monitors had revealed considerable background in a small section of beam pipe near the East Hall, and when this section was replaced, the background disappeared, the intensity was no longer limited, and beam lifetimes also improved. Curiously the replaced section had no visible defects, and did not contain any foreign objects.

Longitudinal polarization (spin orientation) of HERA electrons is vital for weak interaction studies, in the conventional H1 and Zeus collider detectors as well as the recently approved Hermes spin experiment. Here the objective is to resolve the 'spin crisis' and find how constituent quarks and gluons provide the proton spin.

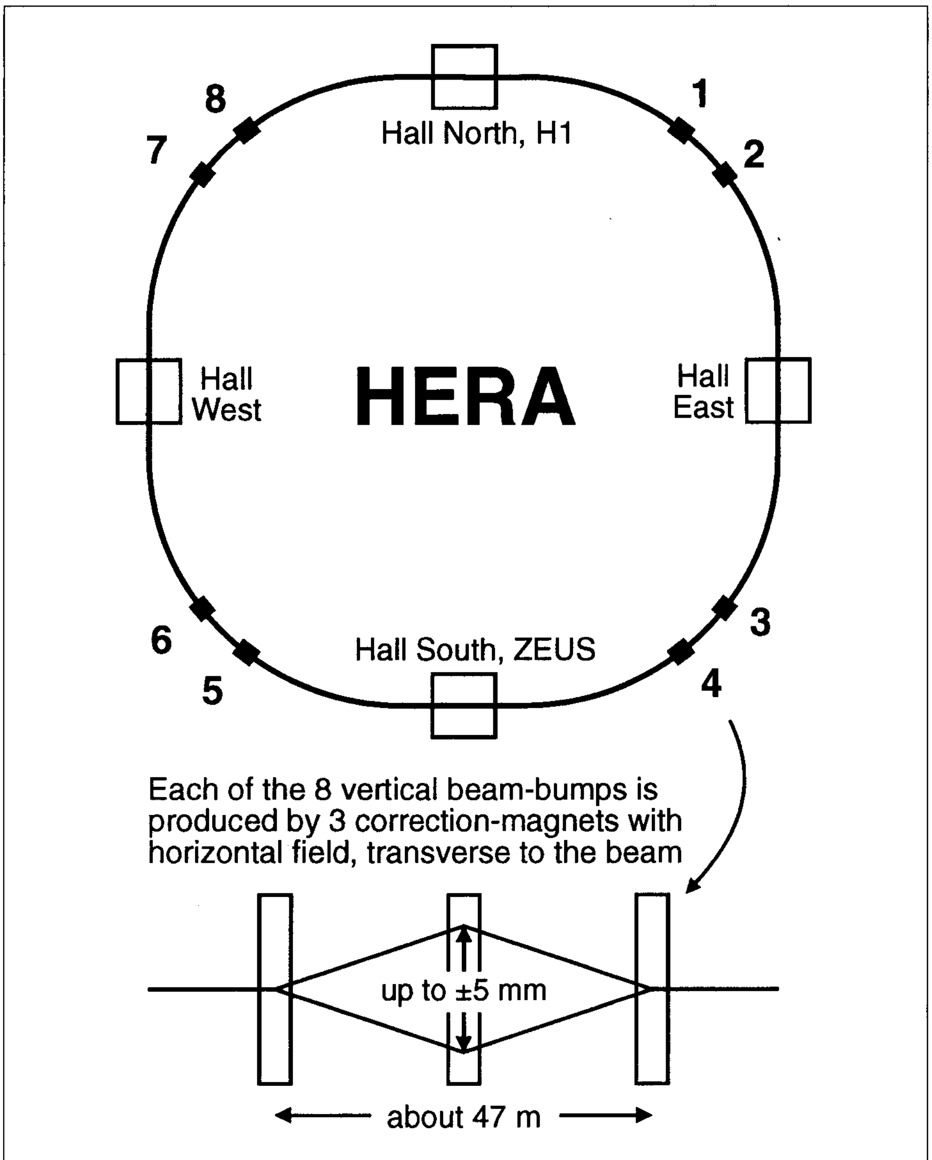
Transverse polarization of the HERA electron beam has been in action since 1991, and precise determinations using a sophisticated laser beam scattering device revealed initial polarization levels of 8%. After realigning quadrupoles last year, this figure climbed to 15%.

Later in the summer, electron polarization exceeded 50% using a

system of eight very small "harmonic" vertical beam bumps strategically placed in the ring arcs.

This technique to reduce 'spin diffusion' was developed at DESY and has been further refined in recent years. Computer simulations have also led to improved understanding. Specialists think there is a good chance of maintaining these high polarizations in realistic running conditions. However several potential trouble spots remain to be ironed out, such as the effect of the crossing proton beam, and the spin rotation needed to establish longitudinal polarization at the collision points.

The system of eight beam bumps used at the HERA electron ring at DESY to correct the average tilt of the equilibrium polarization axis. This compensates for magnet imperfections and substantially improves the final polarization.



Physics monitor

10 years of Ws

Ten years ago, on 25 January 1983, the discovery of the W particle at CERN's proton-antiproton collider was announced to the world. The W, the electrically charged carrier of the weak nuclear force, had been predicted 24 years earlier in the classic formulations of modern weak interaction theory by Feynman and Gell-Mann and by Marshak and Sudarshan, and went on to play an important role in the subsequent electroweak unification of electromagnetism and the weak nuclear force.

Following the discovery of the neutral current at CERN in 1973, it became clear that the W was an extremely heavy particle, some 80 times heavier than the proton, too heavy to be detected by any accelerator in operation at the time. Pushed by Carlo Rubbia, the CERN proton-antiproton collider was built to find the W and its electrically neutral companion, the Z.

Collider operations at CERN in 1982 had been compressed into a two month run, from October to December. The teams at the big UA1 and UA2 experiments eagerly sifting through their 1982 data noticed the first signs of Ws. The initial candidate W events were announced in CERN seminars by Carlo Rubbia, for UA1, on 20 January 1983*, and the following day by Luigi Di Lella for UA2. As well as new science, these two seminars also set a trend for packing the CERN auditorium to overflowing.

Several days later, the growing weight of evidence had tilted the scales, and the 'candidate' qualifier was dropped. The W had arrived.

It was a triumph for CERN's antiproton project and for the experi-

Ten years ago, on 25 January 1983, a press conference announced the discovery of the W particle at CERN's proton-antiproton collider. Herwig Schopper, CERN's Director General at the time, holds up a copy of the CERN Courier showing the characteristic tracks recorded in the UA1 detector. Around him, left to right, are Carlo Rubbia and Simon van der Meer, who went on to receive the Nobel Physics Prize in 1984, CERN Research Director at the time Erwin Gabathuler, and Pierre Darriulat of the UA2 experiment.

(Photo CERN 245.1.83)

ments which finally saw it. It set the stage for the masterstroke discovery of the Z several months later, and for the award of the Nobel Physics Prize the following year to Carlo Rubbia and to Simon van der Meer, the inventor of the stochastic cooling technique which made antiprotons tractable.

Over the years, the UA1 experiment at CERN went on to collect 625 Ws (273 decaying into a muon and a neutrino, 323 decaying into an electron and a neutrino, and 29 examples with the rare tau lepton and its neutrino), while UA2, which could not see muons but ran for longer, saw 3559 Ws, including about 170 producing tau leptons.

The W hunt was joined later by Fermilab, where the ongoing CDF and D0 experiments at the Tevatron proton-antiproton collider together have details on nearly thirty thousand Ws*. Proton-antiproton annihilation was for several years the only source of Ws and Zs, but this Z market dried up with the arrival of CERN's LEP electron-positron collider in 1989, which has gone on to provide Zs by the million.

However until the LEP energy upgrade (January, page 1) is ready for physics in 1995, proton-antiproton collisions remain the sole source of W particles. The 1990 precision W mass measurement by UA2 was crucial input to the consistency calculations supporting the Standard Model. These have reached an impressive level of accuracy, particularly with LEP's energy now being known to 20 parts in a million.

CERN's proton-antiproton collider is no longer operational, but Fermilab's collider experiments continue to compile valuable W data. Probing deep into the electroweak picture to prise out information on the 'Higgs mechanism', the vital but obscure spontaneous symmetry breaking at the heart of the electroweak picture, needs a fix on the missing sixth ('top') quark from Fermilab's collider, and a still more accurate measurement of the W mass.

(*By an odd coincidence, the tenth anniversary of Carlo Rubbia's historic W seminar at CERN was 'marked' by another memorable presentation, this time from the most recent physics Nobel, Georges Charpak.)

*Fermilab Ws
After registering 22 Ws in 1987, CDF went on to log 6,380 in the 1988-9 Tevatron collider run - 4,800 in the electron channel, 1,400 in the muon channel and 180 accompanied by tau leptons. In the current run, CDF has seen 9,700 and 4,400 in the electron and muon channels respectively, while D0's initial W sample has 6,700 with electrons, 600 with muons.

More spinoff from spin

Despite playing a major role in today's Standard Model, spin - the intrinsic angular momentum carried by particles - is sometimes dismissed as an inessential complication. However several major spin questions with important implications for the Standard Model remain unanswered, and recent results and new technological developments made the 10th International Symposium on High Energy Spin Physics, held in Nagoya, Japan, in November, highly topical.

The symposium covered a wide range of physics, reflecting the diversity of spin effects, however four main themes were - the spin content of the nucleon, tests of symmetries and physics beyond standard models, intermediate energy physics, and spin technologies.

Opening the meeting, T. Kinoshita reviewed the status of measurements of the anomalous magnetic moment (g-2) of the electron and the muon. The forthcoming experiment at Brookhaven (September 1991, page 23) will probe beyond the energy ranges open to existing electron-positron colliders. For example muon substructure will be opened up to 5 TeV and Ws to 2 TeV.

R.L. Jaffe classified quark-parton distributions in terms of their spin dependence, pointing out their left-right attributes, and emphasized the importance of measuring transverse spin distributions through lepton pair production.

The intensive efforts to resolve the proton spin content were extensively

CES PRESENTS:

The VMDIS 8004 : a brand-new VME / VSB Display and Diagnostic Module, essential to monitor the backplane activity and measure the performance of modern VME / VSB systems

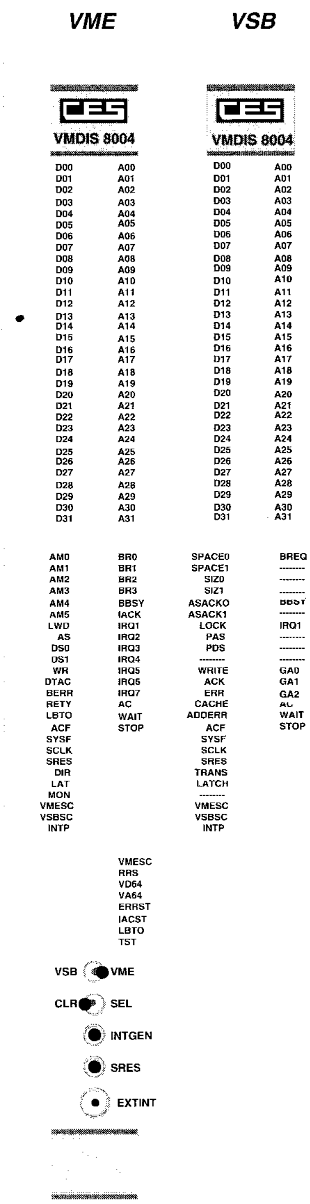
- Switch selectable VME or VSB Display
- VME mode displays :
  - Address Lines, including A64
  - Data Lines, including D64
  - Address Modifier Lines
  - Control Lines
- VSB mode displays :
  - Address Lines
  - Data Lines
  - Control Lines
- Direct, Latched or Monitor display modes
- Control and Status registers accessible over VME through a VME Slave interface
- High-Speed Slot 1 functions
- VSB Central Arbiter
- Block transfer counter and Cycle duration timer
- Delay between DS and DTACK programmable in monitoring mode
- VME interrupter, activated by front-panel push-button or external signal (NIM / TTL)
- VME SYSRESET, activated by front-panel push-button or external signal (NIM / TTL)
- VME SYSRESET can be generated in response to software request

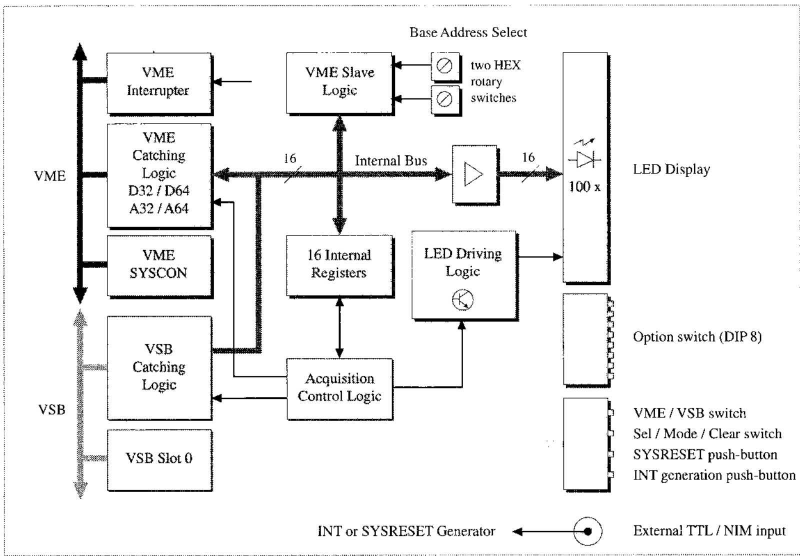
The VMDIS 8004 is an extension of the VMDIS 8003 Display and Diagnostic Module, providing additional visual and computer controlled test features. Among these features:

- Designed to monitor modern VME systems using D64 and / or the VSB bus.
- Provides extended VME test features when booting a VME based microprocessor system. All data, address and control lines of the VME and VSB busses are latched in a set of registers which can be read back over the VME bus.
- Generates VME interrupts on programmable levels under manual control. This feature is extremely useful when debugging software requiring interrupt handling.

Performance measurement section

- The VMDIS 8004 can count the number of VME cycles which respond to selected criteria. This feature is of great help when debugging DMA transfers.
- It is also equipped with timing logic which measures the duration of VME cycles.





If you liked the VMDIS 8003, you will love the VMDIS 8004

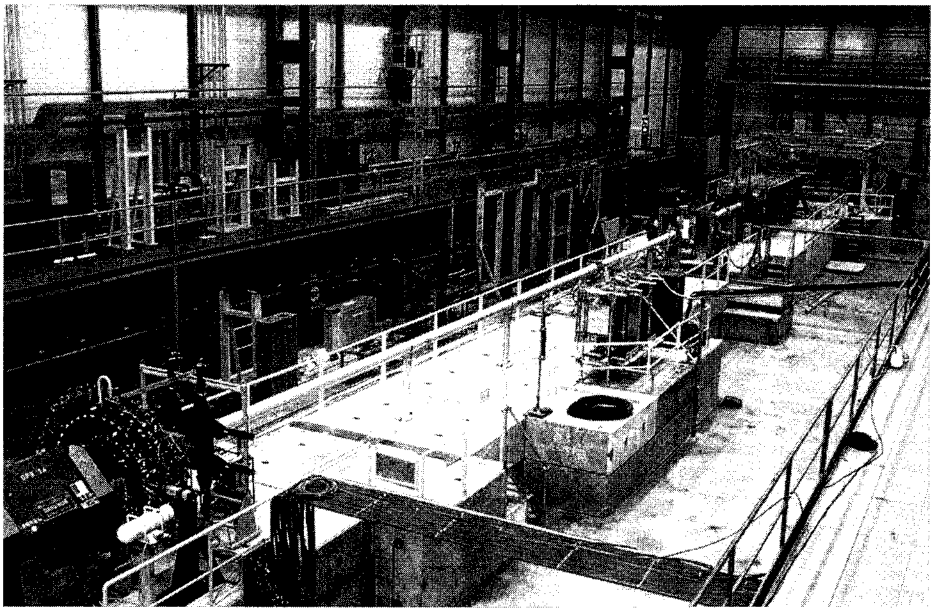
CES, at the leading edge in system conception

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

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

The Spin Muon Collaboration experiment at CERN is looking hard at the inner spin structure of the proton and neutron. Seen here is the pipe of the polarimeter which measures the spin of the emerging muons.

(Photo CERN EX28.1.93)



covered, and new data from a range of upcoming experiments is eagerly awaited.

Interpretations of experimental data included a suggestion from J. Soffer to test sum rules in spin experiments at Brookhaven's RHIC collider through asymmetries in W-boson production. S. Brodsky demonstrated calculations on polarization mechanisms including higher order effects, in particular for charmonium and lepton pair production in negative pion-proton collisions. He successfully reproduced the kinematical dependence of charmonium production.

A new approach to quark spin through jet 'handedness' was proposed by A.V. Efremov, and could be reached through analysis of LEP data.

Long-time spin specialist A. Yokosawa summarized results with 200 GeV polarized proton and antiproton beams at Fermilab (which come from hyperon decays). Comparison of the asymmetries seen in various production processes in the proton-proton and proton-antiproton channels is interesting. New results came from channeling using bent crystals (January, page 28).

Another Fermilab speciality is the magnetic moments of hyperons, reported by K. Heller, K. Johns, K.B. Luk and J.T. Lach. Results have been updated and extended, and it is difficult to explain all the phenomena.

The high precision Standard Model measurements and possible contributions from beyond were presented by several speakers. As well as results from the LEP electron-positron collider at CERN, including now results from tau polarization, the availability of polarized beams at Stanford's SLC collider gives an additional window on left-right asymmetry. This was considered by K. Hagiwara to be a very sensitive probe for the Standard Model and possible physics beyond. However high polarization levels are called for.

C. Lulec reviewed nucleon-nucleon(antinucleon) scattering. Narrow structures reported at the Japanese KEK Laboratory have not been seen at Saclay's Saturne II. Conventional phase shift analysis continues to yield important results.

A.P. Kobshkin reported that a reduced nuclear model in quantum chromodynamics (QCD) reproduces the polarization transfers seen in deuteron-proton scattering. Recent results from the Japanese RIKEN cyclotron were presented by H. Sakai, while continuous electron machines in Bonn and Mainz were dealt with by W. Meyers. J. Cameron showed how the charge symmetry breaking seen in polarized proton-neutron scattering shows rho-omega mixing. A new experiment is underway at TRIUMF, Vancouver.

The polarized proton/neutron data from LAMPF, Los Alamos, and the kinematics of proton scattering from Indiana have been analysed in terms of hadron mass shift in dense matter suggested by QCD sum rules.

Intermediate energy spin physics was represented by polarized beam storage rings at Indiana, CELSIUS (Uppsala) and COSY (Germany), with additional information coming from internal gas jet targets, and from the 'Grand Raiden' high resolution spectrometer at Osaka.

D. Barber surveyed electron polarization in storage rings, now seen at LEP (CERN), TRISTAN (KEK) and HERA (DESY, Hamburg). An effort is underway at LEP to acheive higher and faster polarization using asymmetric wigglers and orbit corrections. A scheme to overcome depolarization effects using 'partial snakes' is in progress at Brookhaven's AGS (December 1991, page 9).

On ion sources, proton polarization of more than 80% with optical pumping at TRIUMF was reported by P. Schmor (December 1991, page 10), and a polarized gas jet target of the atomic beam type developed at Heidelberg by E. Steffens, where the

proton density is more than 10^{14} per sq cm.

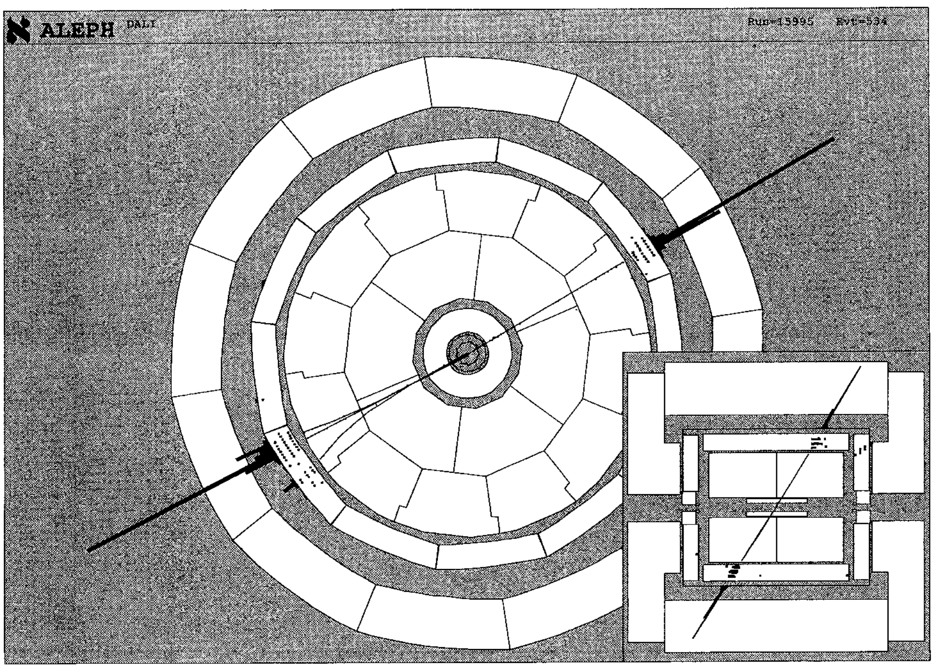
T. Niinikoski looked at polarized solid target developments, where the high deuteron polarization in organic materials through r.f modulation is impressive. High polarizations in lithium compounds have been achieved at Saclay, LAMPF and PSI (Switzerland), and the possibility of proton polarization at room temperature proposed by the Kyoto/KEK group is intriguing. S.Y. Lee explained polarized beam acceleration with 'snakes', indicating the possibilities for major ongoing projects.

Highlights of the parallel workshop on polarized electron sources and electron spin polarimeters were summarized by T. Nakanishi. Remarkable progress in photoemission from semiconductors has been seen in recent years. Nagoya has obtained 86% polarization with strained gallium arsenide, while SLAC/Wisconsin has achieved 71% with indium gallium arsenide (May 1991, page 6). More complex superlattices have been investigated by a KEK/Nagoya/NEC group.

Turning to the future, A.D. Krisch looked at what is in store at UNK, Fermilab and the US Superconducting Supercollider. RHIC at Brookhaven will also offer interesting polarized proton possibilities. KEK's 12 GeV proton machine will cover a complementary kinematic range.

P. Taxil showed how polarized beam physics at future large proton colliders will probe beyond the Standard Model, while D. Burke looked at what electron-positron colliders will offer. Spin physics will continue to be a fruitful field.

From Akira Masaike



Tau production and decay in experiments at CERN's LEP electron-positron collider provides valuable precision information on Standard Model parameters.

Light cone approach

One of the most challenging problems in theoretical high energy physics is to compute the bound-state structure of the proton and other hadrons from quantum chromodynamics (QCD), the field theory of quarks and gluons.

The goal is not only to calculate the spectrum of hadron masses from first principles, but also to derive the momentum and spin distributions of the quarks and gluons which control high energy hadron interactions.

One approach to these difficult calculations is to simulate QCD on an artificial lattice. Recently, several new methods based on "light-cone" quantization have been proposed as alternatives to lattice theory for solving non-perturbative problems in QCD and other field theories.

The basic idea is a generalization of Heisenberg's pioneer matrix formulation of quantum mechanics: if one could numerically diagonalize the matrix of the Hamiltonian representing the underlying QCD interaction, then the resulting eigenvalues would give the hadron spectrum, while the corresponding eigenstates would describe each hadron in terms of its quark and gluon degrees of freedom.

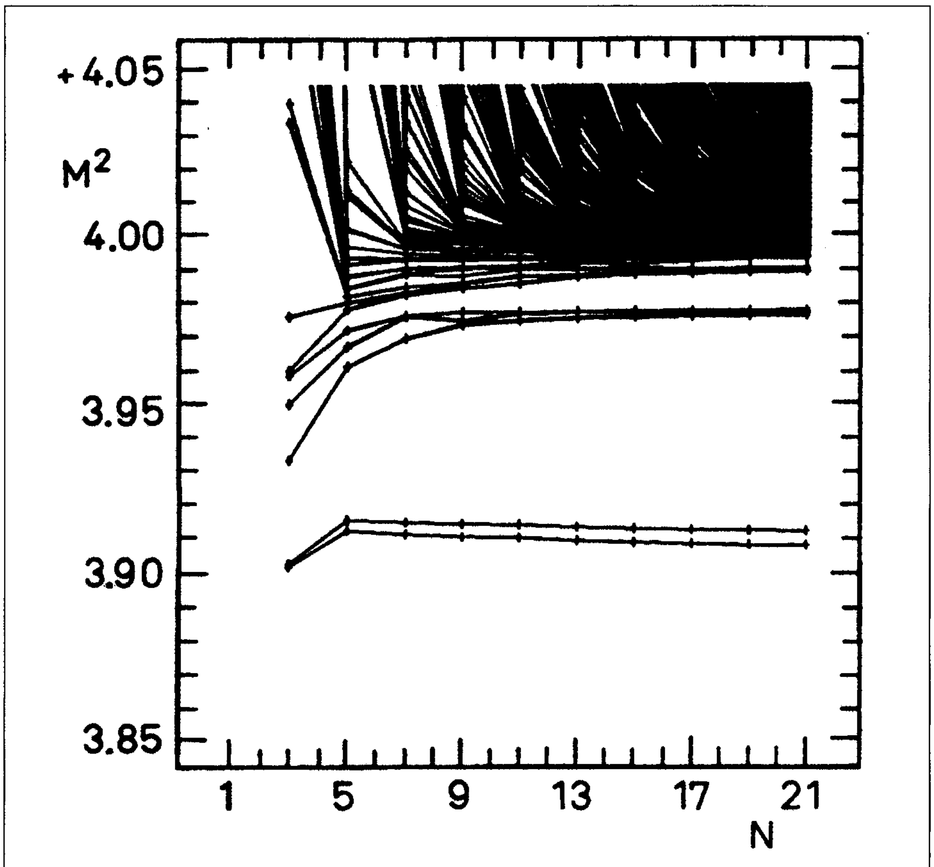
The new ingredient which appears to make this method tractable is quantization on the light-cone - as if the observer were travelling at the speed of light. For example if a laser is shone along the z-axis of an atom, the scattered photons determine the coordinates of each electron at a fixed value of t-z/c, where c is the speed of light. The equations of quantum electrodynamics then predict the electron coordinates at later values of t-z/c.

This allows a finite basis of non-interacting quark and gluon states without violating the essential relativistic invariance of the theory.

The foundations of light-cone quantization date back to Dirac, who in 1949 showed that there are remarkable advantages in quantizing relativistic field theories at fixed "light-cone time", t-z/c, rather than ordinary time.

In the traditional formulation, handling a moving bound state is as complicated as diagonalizing the Hamiltonian itself. On the other hand, quantization on the light-cone can be formulated without having to choose a specific frame of reference. Thus a light-cone QCD Hamiltonian describes bound states of confined relativistic quarks and gluons of arbitrary four-momentum. It also provides a precise definition of model structure in terms of quarks and gluons, and a general calculus for computing relativistic scattering, form factors, electroweak transitions, and other hadronic phenomena.

The problem of computing the hadronic spectrum and the corresponding light-cone wavefunctions of QCD can thus be reduced to the diagonalization of a finite matrix representation of the light-cone Hamiltonian. This method, called "discretized light-cone quantization" (DLCQ), has now been successfully applied to a number of quantum field theories in one-space and one-time dimension, including QCD, quantum electrodynamics, Yukawa models, and the two-dimensional matrix models of superstring theory.



For QCD(1+1), complete numerical solutions for the spectrum and light-cone wavefunctions can be obtained as a function of the coupling strength, the quark masses, and the number of flavours and colour.

Light-cone quantization of QCD in physical space-time is a highly-challenging numerical computational problem. In the DLCQ method, the size of the quark and gluon basis and the discretization of the transverse momenta quickly leads to very large matrices. In addition, the Hamiltonian must be supplemented by renormalization terms.

Approximate methods have also been developed which use effective light-cone Hamiltonians and a truncation of the quark and gluon states (the "Light-Front Tamm Dancoff method"), or a combination of light-cone quantization with traditional lattice gauge theory in the transverse dimensions. In the case of quantum electrodynamics in 3+1 dimensions, the positronium spectrum has been obtained at large coupling strength (α=0.3) by solving an integral equation derived from the truncated QED light-cone Hamiltonian.

The most subtle problem now confronting light-cone quantization methods is how to understand the spontaneous symmetry breaking normally associated with the structure of the vacuum. In light-cone quantization the momentum-independent "zero modes" of the quantum fields are determined from

The positronium mass spectrum (for α=0.3) computed from a truncated quantum electrodynamics light-cone Hamiltonian (from M. Krautgärtner, H. C. Pauli, and F. Wölz) showing the convergence of the bound and continuum spectrum of positronium, including the hyperfine splitting, as one increases the number of integration points. This light cone approach promises new insights into complex field theory calculations.

constraint equations derived from the equations of motion of the theory. Although the vacuum is simple in light-cone quantization, these vacuum zero modes thus determine the phase and physics of the theory.

There are other fundamental renormalization and gauge invariance issues that still have to be completely understood, such as how symmetries lost in the truncation can be restored, how to deal consistently with massless particles, and how to control singularities. All of these problems make the field quite exciting and challenging.

In addition to its potential for solving QCD problems, light-cone quantization has already led to many new insights into the quantization of gauge theories. Light-cone quantization not only provides a consistent language for representing hadrons as QCD bound-states of relativistic quarks and gluons, but it also provides a novel method for simulating quantum field theory on a computer and understanding features of QCD.

The appealing features of light-cone quantization for quantum field theory have brought together a new community of theorists interested in solving both the practical and formal problems. A series of conferences were held in 1991 and 1992 at Heidelberg, Aspen, Telluride, and Dallas. Two light-cone meetings in this series are being planned for this summer. Daniel Wyler of Zurich University (wyler@forty2.physik.unizh.ch) is organizing a conference from 14-18 June at the Paul Scherrer Institute near Zurich, and Antonio Bassetto (bassetto@ipdinfn) under the support of the Istituto Nazionale di Fisica Nucleare (INFN) is organizing a workshop at the Gran Sasso Laboratory from 17-27 August.

By Stan Brodsky

Proton-proton reaction rates at extreme energies

Results on proton-antiproton reaction rates (total cross-section) at collision energies of 1.8 TeV from experiments at Fermilab have suggested a lower rate of increase with energy compared to the extrapolation based on results previously obtained at CERN's proton-antiproton collider (CERN Courier, October 1991).

Now an independent estimate of the values for the proton-proton total cross-section for collision energies from 5 to 30 TeV has been provided by the analysis of cosmic ray shower data collected over ten years at the Akeno Observatory operated by the Institute for Cosmic Ray Research of University of Tokyo.

These results are based on the inelastic cross-section for collisions of cosmic ray protons with air nuclei at energies in the range 10^{16-18}eV.

A new extensive air shower experiment was started at Akeno, 150 km west of Tokyo, in 1979 with a large array of detectors, both on the ground and under a 1-metre concrete absorber. This measured the total numbers of electrons and muons of energies above 1GeV for individual showers with much better accuracy than before. Data collection was almost continuous for ten years without any change in the triggering criteria for showers above 10^{16}eV.

The mean free path for proton-air nuclei collisions has been determined from the zenith angle of the observed frequency of air showers which have the same effective path length for development in the atmosphere and the same primary energy. The effect of fluctuations in the longitudinal development of showers in the atmosphere has been estimated from simulations assuming no significant break in kinematical scaling up to the highest energies and that the number of secondary particles increases as the square of the logarithm of the collision energy.

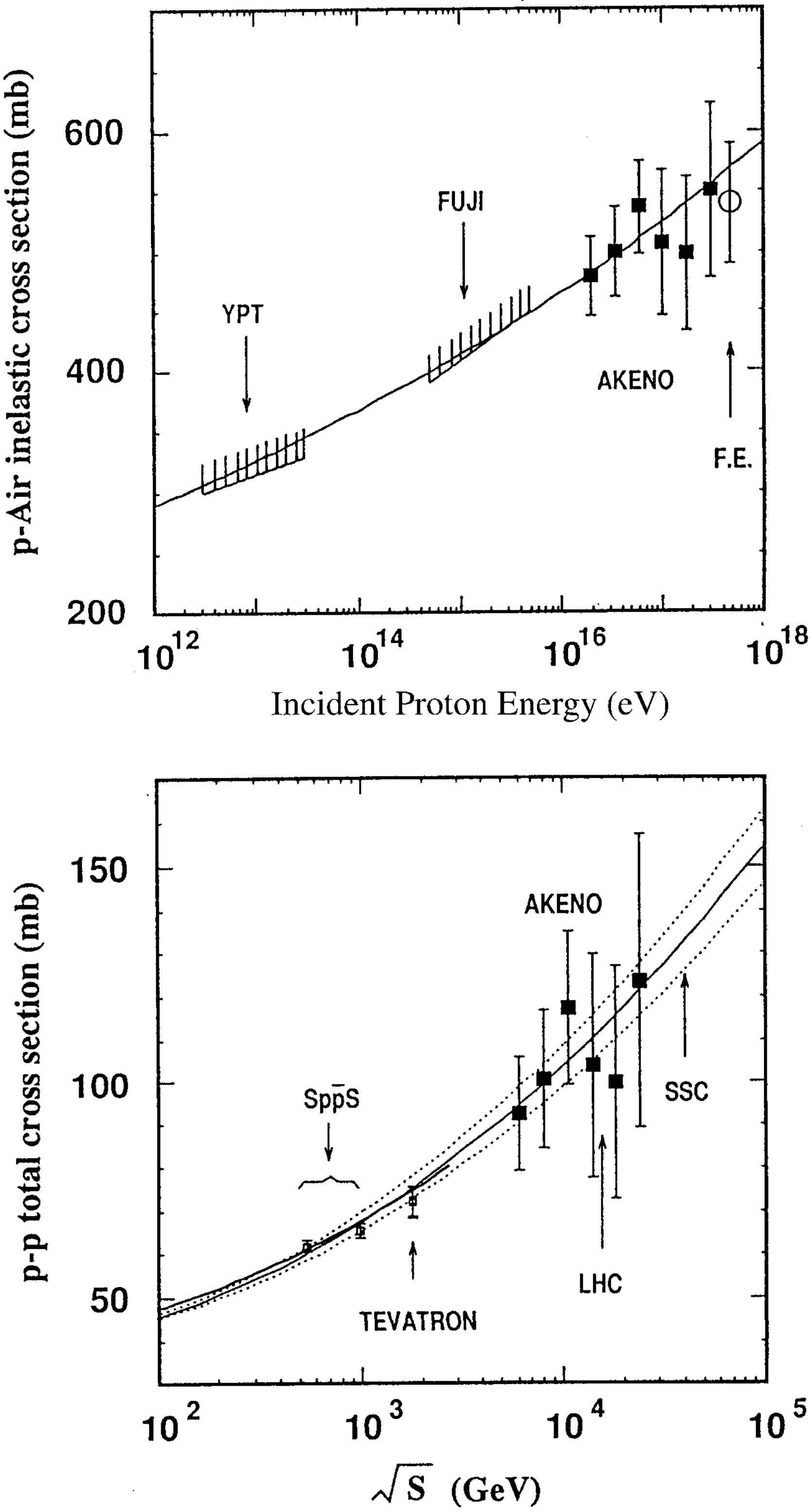
The proportion of showers produced by primary protons among the observed showers is unknown at such ultra-high energies. Air showers initiated by heavier primaries generally start their cascades in the higher atmosphere. In order to optimize selection of showers which have a larger probability of being produced by primary protons, only 10% of the total showers in each energy range, those which have developed deep in the atmosphere, have been used to determine the proton attenuation length.

The upper bound on the proton-air inelastic cross-section increases with energy as $290E^{0.052}$mb in the energy range 10^{16-18}eV, where E is the incident proton energy in TeV (see figure). The total cross-section for proton-proton collisions has been derived from the proton-air inelastic cross-section using conventional (Glauber) theory of multiple scattering inside the nucleus and a nucleon profile function derived from a QCD parton model using a diffraction scattering formulation.

The total cross-section is found to vary as $38.5+1.37\ln^2$(collision energy/10GeV)mb. These fit fairly well with results from CERN's proton-antiproton collider at 540GeV and 900GeV and from Fermilab's Tevatron collider at 1.8TeV, although the Tevatron value is a little smaller than what is expected from the best fit to the Akeno results.

The observed frequency attenuation length depends on the fluctuation of air shower development


We Go to Great Lengths...
...Producing Your Plastic Scintillating Fibers.
• Blue scintillating fibers
• Green scintillating fibers
• Rad-hard fibers
• Ribbons and arrays
• Large cross-sections
• Custom formulations
Our tradition of advancing scintillation technology assures fiber properties which let you make the measurements you need.
Contact us today for our latest technical and pricing information.
BICRON
Bicron
12345 Kinsman Road
Newbury, Ohio 44065-9677
Telephone: (216) 564-2251
Telefax: (216) 564-8047
Telex: 980474 BICRON NWBY
European Office
Stadhoudersplein 1-401
P.O. Box 564
2400 AN Alphen a/d Rijn, The Netherlands
Telephone: 1720-25700
Telefax: 1720-24388
Nippon Bicron
Room No. 805 1-8, 1-Chome
Shinyokohama, Kohoku-Ku
Yokohama 222 Japan
Telephone: 045 (474) 5786
Telefax: 045 (474) 5787



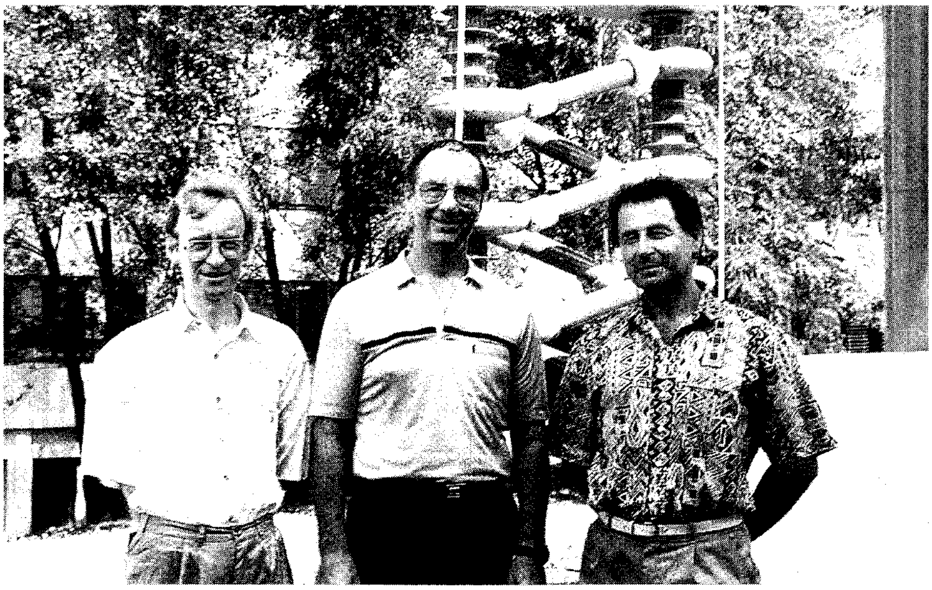
and therefore is dependent on details of ultra-high energy interactions . The total proton-proton cross-section is expected to be slightly smaller if there is a significant breakdown of scaling.

From Motohiko Nagano

Top, reaction rates seen by the Akeno cosmic ray experiments compared to other measurements. The Fly's Eye experiment (FE) has used a somewhat different method. Lower bounds on the cross-section have also been determined from measurements on the surviving proton flux (YPT) and the Mt. Fuji emulsion experiment (FUJI). Below Energy dependence of the total proton-proton cross-section deduced from the cosmic ray data compared with proton-antiproton results at lower energies.

People and things

Searching for infinity - left to right, award-winning Norwegian journalist Inge Sellevag, CERN/Norwegian physicist Egil Lillestol and CERN Courier Editor Gordon Fraser. Their new book appears early next year.



Searching high and low

Astronomers and high energy physicists used to go their own ways. But with new sensitive telescopes catching signals from the beginning of time, and with violent particle collisions recreating the conditions of the early Universe, the frontier sciences of astrophysics, cosmology and particles can now talk to each other.

Spanning almost 50 orders of magnitude, from the deepest subnuclear confines to the outermost reaches of the Universe, this new dialogue will be highlighted in a new book 'The Search for Infinity' by CERN/Norwegian physicist Egil Lillestol, award-winning Norwegian journalist Inge Sellevag and CERN Courier Editor Gordon Fraser. It will be published in the UK early next year by Mitchell Beazley, who specialize in high quality illustrated books for the international market.

With science input from Lillestol, an acclaimed series of illustrated articles by Sellevag in the Norwegian newspaper 'Bergens Tidende' was brought together in a booklet - 'Atomer og kvarker - den nye fysikken', and at CERN the international potential of the project soon became apparent. The message, as well as the science, has gone full circle.

On people

Klaus Winter of CERN receives the 1993 Stern-Gerlach medal of the Deutsche Physikalische Gesellschaft, one of the two highest DPG distinctions, the other being the Max Planck medal for theory.

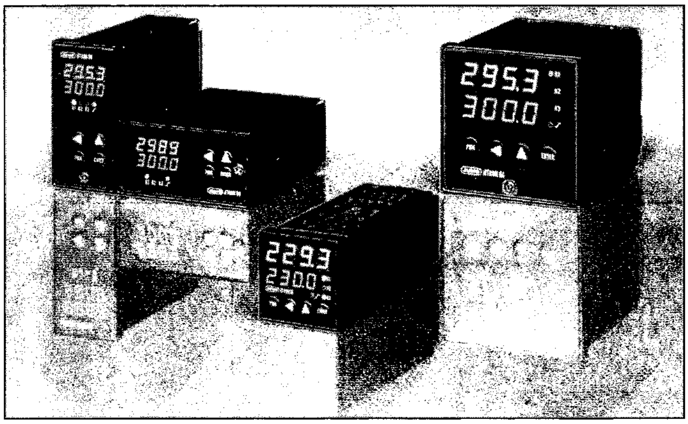
Lawrence E. Price has been appointed Director of High Energy Physics at Argonne after a period as Acting Director following the departure of Tom Kirk to become Manager and Co-spokesman of the SDC detector project for the SSC Superconducting Supercollider.

New Director for Italian Gran Sasso Laboratory

Piero Monacelli has been appointed by the Italian National Institute of Nuclear Physics (INFN) as Director of the Gran Sasso National Laboratory for the next three years, replacing Enrico Bellotti, who has served as the Laboratory's first director.

Title of the first 'Amaldi Lecture' in honour of the late Edoardo Amaldi, given in Piacenza, Italy, in December by W.F.K. Panofsky (right) was 'How to manage the excess plutonium from nuclear weapons'. Left is M. Migliavacca, chairman of the Edoardo Amaldi Foundation established by the province of Piacenza to honour its distinguished former citizen and promote awareness of his work. (Photo Maurice Jacob)

Interesting from any angle



JUMO dTRON microprocessor regulators

With their modular construction, this series of regulators can be used in a huge variety of fields. Their binary or analog inputs and outputs make them universally applicable. All manipulation, parametering and configuration operations are performed via only 4 keys on the sprayproof front panel. There's nothing simpler !

Programmable input and output values, self-optimisation and ramp function are standard features. If you would like to know more, please ask for our detailed documents now.

JUMO

Meß- und Regeltechnik

Meß- und Regeltechnik AG, Seestr. 67, CH-8712 Stäfa
Phone 01/928 21 41 - Fax 01/926 67 65

27 *Circle advertisement number on reader service form*

DATARAM

MEMORIES for DEC - HP/APOLLO - SUN IBM6000 - Silicon Graphics

LIFETIME GUARANTEE
FREE TRIAL PERIOD
FAST DELIVERY
EXPRESS HOT SPARE
SUPERIOR PERFORMANCES

TAKE BENEFITS OF THE SPECIAL CERN'S CONDITIONS :
Delivery directly from DATARAM USA to CERN site by speed post, exonerated from all taxes (icha) and duties.

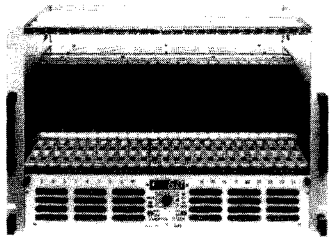
Inter Access *OFFICIAL DATARAM DISTRIBUTOR*

IAS Inter Accesss SA 4, av. de Champel CH-1206 Geneva
Tél: 022 346 04 40 Fax: 022 346 05 56

All references are trademarks of their respective manufacturers

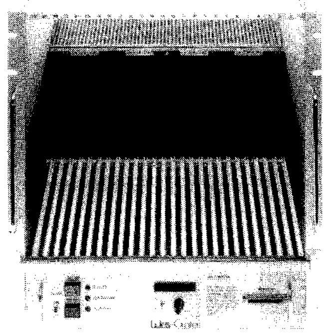
16 *Circle advertisement number on reader service form*

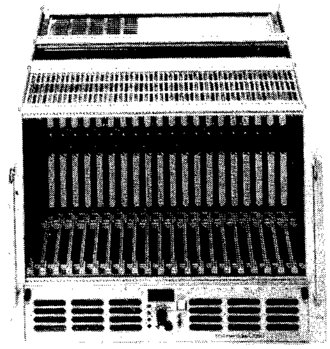
Powered Crates



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

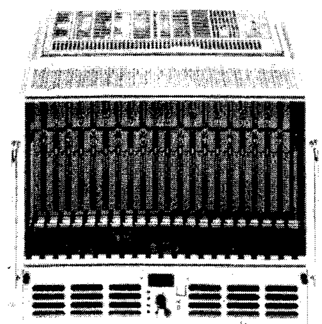
FASTBUS-Crates
To CERN-Spec. F6852, 3.300W, 3-phase input, switch mode regulated. Wes-Crate Power Supplies are distinguished by low noise and ripple. Electro-magnetically shielded.
Tested and accepted by CERN EP





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 Harrislee/Flensburg
Germany

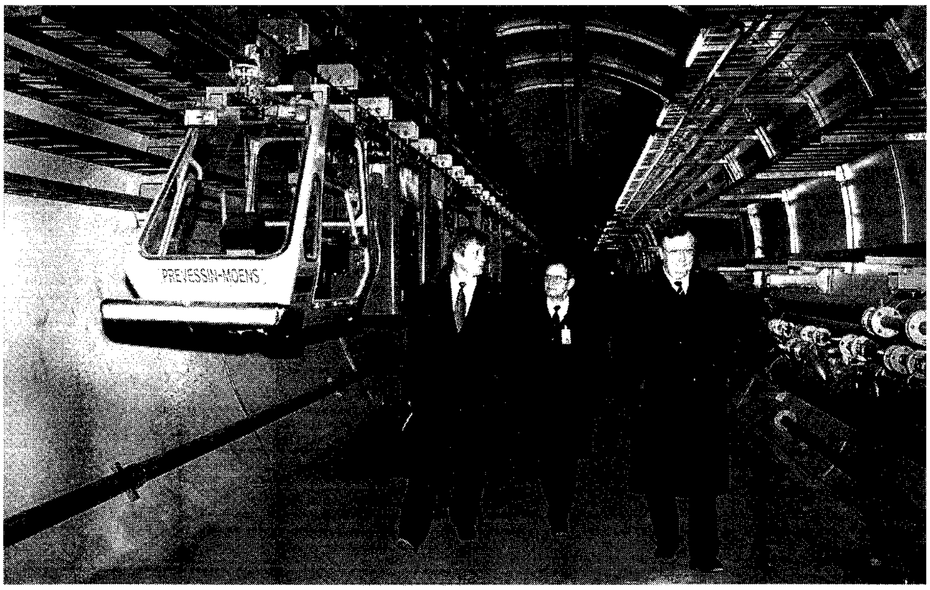
Telefon 0461 / 77 41 77
Telefax 0461 / 77 41 41
International + 49 461 /

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

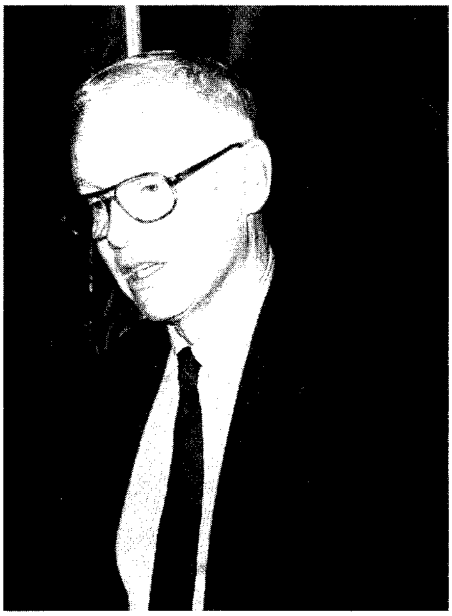
Your contact at PSI and ETH Zürich: Dipl.-Ing. Kramert AG, Villigerstr. 370, CH-5236 Remigen, Tel.: 056 / 44 15 55, Fax: 44 50 55

26 *Circle advertisement number on reader service form*

Swedish Science and Education Minister Per Unckel (left) visits the LEP tunnel at CERN on 19 January accompanied by CERN Director General Carlo Rubbia (right) and Steve Myers. (Photo CERN HI 22.1.93)



The Gran Sasso Laboratory, under the Gran Sasso mountain chain in Central Italy, has become the major world laboratory for underground physics. Experimentalist Monacelli is professor of physics at the nearby University of L'Aquila. After working at Frascati and at CERN, in recent years he joined the international collaboration involved in the construction and operation of the MACRO experiment in Gran Sasso's underground hall B, searching for magnetic monopoles and stellar collapses and studying the muon components of high energy cosmic rays.



Klaus Winter - Stern Gerlach medal

Robert E. Marshak 1916-1992

Robert E. Marshak died in December. After an initial career at Los Alamos, he rose to fame in the late 1940s and 1950s, first with his fundamental contributions to meson theory (with Hans Bethe) and then with the structure of the weak interactions (with E.C.G. Sudarshan). Subsequently he turned to strong interactions, or indeed wherever there was physics interest. His 1952 book 'Meson Physics' was required reading for many years.

During his period at Rochester, New York, he launched in 1950 the major 'Rochester' meetings, now a major feature of the international physics scene, and which will serve as a lasting tribute. At the 40th Rochester anniversary, at Singapore in 1990, he poignantly recalled those early days.

He stepped down as President of City College of New York in 1979, a job he had taken in 1970 out of a desire to help the socially disadvantaged. The same commitment was evident in 1982 when Marshak became President of the American Physical Society and initiated programmes to assist physicists in China and South America. By then he had moved to Virginia Tech and undergone heart by-pass surgery. According to press accounts, he died while swimming in Cancun, Mexico, "far from the shore."

CERN retirements

Alec Hester retired from CERN in February. Alec was editor of CERN Courier from 1962, when he succeeded Roger Anthoine, until 1966, when Brian Southworth took up the pen. It was during Alec's editorship that the journal began to move beyond its original role as house journal for CERN staff and began to communicate the work of CERN to a broad scientific and technical audience.

Franco Bonaudi retires from CERN in March after over three decades of service in the Laboratory's accelerator community. Franco arrived for the building of the 28 GeV Proton Synchrotron and moved on to head the civil engineering group at the Intersecting Storage Rings. After an introduction to the challenges of major underground experimental areas at CERN's proton-antiproton collider, he took on major responsibilities for the experimental areas at LEP. En route he assumed major functions in CERN management up

New CERN Division Leaders: Jean-Pierre Gourber (left) for Accelerator Technology and John Ferguson for Administrative Support.

to Directorate level and was regularly involved in the committees studying the development of CERN facilities.

Franco Bonaudi, with his unassuming personality and total reliability, has been a very popular member of the CERN staff and has contributed much to the reputation of the Laboratory.

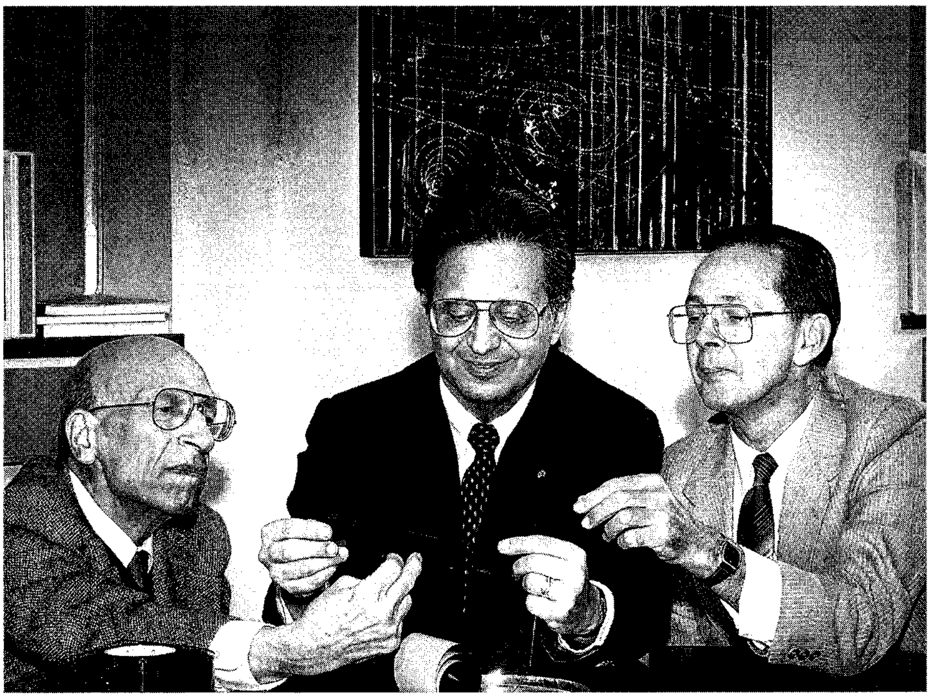
Guide to the Sun

'Guide to the Sun', a new book by Kenneth J.H. Phillips of the Rutherford Appleton Laboratory (Cambridge University Press, ISBN 0 521 39483 X) looks at the present understanding of the sun's surface and interior. A good, assimilable handbook for those interested in solar questions, such as solar energy and solar neutrinos. Without last year's initial results from gallium detectors, the section on solar neutrinos is already out of date, but neutrino specialists looking for background information will already know that.

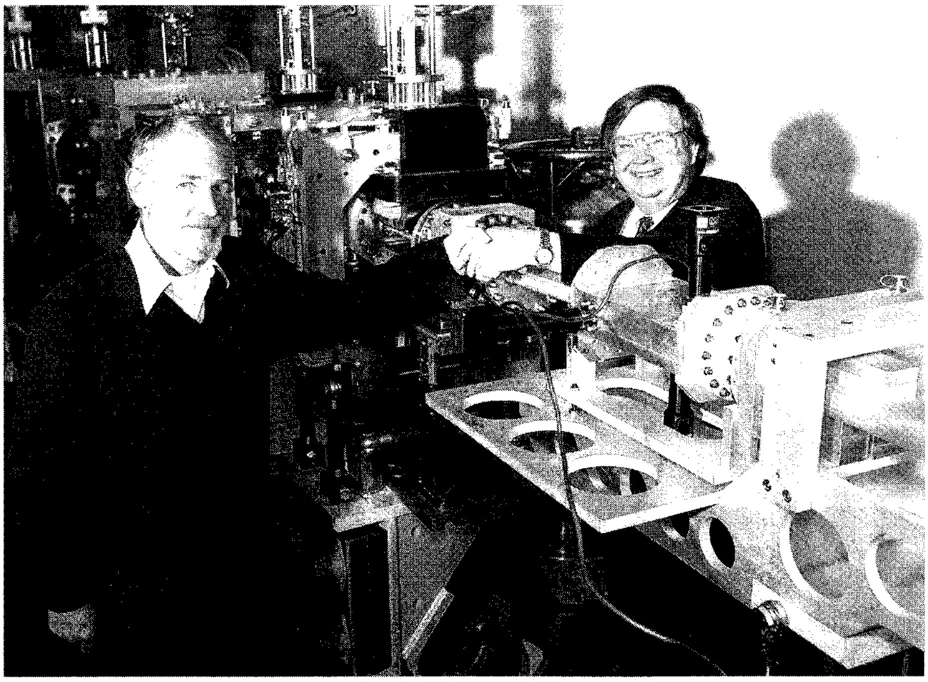
Meetings

The Third Meeting on Field Theory on the Light Cone and Non-Perturbative Methods will be held at the Paul Scherrer Institute, Villigen, Switzerland, from 14-18 June. Further information from Mrs. H. Schlaepfer, Paul Scherrer Institute, BG/C20, 5232 Villigen, Switzerland. Fax +41 56 993383, bitnet schlaepfer@cageir5a

The fifth Conference on the Intersections of Particle and Nuclear Physics, to be held in St. Petersburg, Florida, from May 31 to June 6, will focus on the common areas of interest of current Particle and Nuclear Physics including Theory and Experiment, Facilities and Technology, and will emphasize the Physics in the Energy Region of 1 to



Left to right, Ralph Shutt, Nick Samios and Robert Palmer of Brookhaven admire the original bubble chamber film that revealed the famous omega minus particle in 1964. For this historic discovery, they share the American Physical Society's 1993 Panofsky Prize.



Advanced Light Source (ALS) engineer Tom Henderson (left) and Lawrence Berkeley Laboratory Director Charles V. Shank shake hands over the final ALS storage ring vacuum component to be installed - a bellows/RF-flex band assembly. The last storage ring components were installed on December14, meeting the goal of complete installation by the end of 1992. The next step is to put beam in the machine.

150 GeV and beyond. Further information from Elly Driessen, Conference Secretary, TRIUMF, 4004 Wesbrook Mall, Vancouver, B.C., V6T 2A3, Canada. Telephone:(604) 222-1047 Telefax:(604) 222-1074 Telex:(0)-4508503 BITNET:DRIESSEN@TRIUMFCL INTERNET:DRIESSEN@REG.TRIUMF.CA DECNET:45397::DRIESSEN

The next San Miniato meeting (5th San Miniato Topical Seminar on Experimental Apparatus for High Energy Particle Physics and Astrophysics) will take place from April 26 to April 30 in San Miniato (Pisa), Tuscany. The meeting is organized jointly by F.-L. Navarria of the University of Bologna [vaxbo::KAOS, KAOS@bo.infn.it], P.G. Pelfer of the University of Florence [vaxfi::TOP93, TOP93@fi.infn.it] and G. Smadja of the University of Lyon [smadja@frcpn11.in2p3.fr].

The Seminar will focus on detectors, electronics, data acquisition systems and data analysis for the special conditions at the very high energy and/or luminosity available at LHC and at SSC, and in underground, surface and astrophysics experiments.

The international Hadrons-93 workshop will be held at Novy Svet (Crimea) from 12-18 May, organized by the Bogolubov Institute for Theoretical Physics (Kiev) of the Academy of Sciences of Ukraine. It will be dedicated to "soft" physics (strong interaction at large distances). Further information from: HADRONS, ITP, Kiev-143, Ukraine, e-mail: JENK%ITPHYS.KIEV.UA@RELAY.USSR.EU.NET fax: 7-044-2665998 Phone: 7-044-2669161.

The XXI Annual SLAC Summer Institute on Particle Physics will be held at SLAC from 26 July-6 August, the topic this year being spin structure in high energy processes. Further information from the coordinator, Lilian Vassilian, MS 62, SLAC, PO Box 4349, Stanford, California 94309, bitnet SSI@SLACVM

The Third Workshop on the proposed Tau-Charm Factory for Europe will be held in Marbella, Spain, from 1-6 June. Further information fax +41 22 767 4800, e-mail TCF_WORKSHOP@TCF.CERN.CH

CERN Courier Index

Due to reductions in available manpower, no 1992 CERN Courier index is being published.

Laboratory correspondents

Argonne National Laboratory, (USA)
D. Ayres

Brookhaven, National Laboratory, (USA)
P. Yamin

CEBAF Laboratory, (USA)
S. Corneliussen

Cornell University, (USA)
D. G. Cassel

DESY Laboratory, (Germany)
P. Waloschek

Fermi National Accelerator Laboratory, (USA)
J. Cooper, J. Holt

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)
C. Hoffman

Novosibirsk, Institute, (USSR)
V. Balakin

Orsay Laboratory, (France)
Anne-Marie Lutz

PSI Laboratory, (Switzerland)
R. Frosch

Rutherford Appleton Laboratory, (UK)
Jacky Hutchinson

Saclay Laboratory, (France)
Elisabeth Locci

IHEP, Serpukhov, (USSR)
Yu. Ryabov

Stanford Linear Accelerator Center, (USA)
M. Riordan

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

TRIUMF Laboratory, (Canada)
M. K. Craddock

UNIVERSITY OF GENEVA

The Department of Theoretical Physics has an opening for a position of

FULL PROFESSOR in THEORETICAL SOLID STATE PHYSICS

The duties involve teaching of physics and research activity in theoretical solid state physics.

The applicant should have a PhD in physics, or an equivalent degree. Experience in teaching physics courses.

This tenured position will become available on January 1st, 1994.

Letters of application, including a curriculum vitæ and a list of publications should be addressed before April 30, 1993 to :
Secrétariat de la Faculté des sciences, 30, quai E.-Ansermet, CH 1211 Geneva 4, Switzerland, where the specifications and additional information may be obtained.
The University follows a policy of equal opportunity in employment and invites both qualified women and qualified men to apply for this post.

Experimental High Energy Physics
The Ohio State University

FACULTY POSITION: The Department of Physics invites applications for an anticipated tenure track Assistant Professor position in experimental nuclear physics. The successful candidate, who should be capable of establishing an independent research program, would join an existing nuclear group. The present OSU group is comprised of three faculty members working typically with three postdoctoral fellows and about fifteen graduate students. Topics of current study include nuclear astrophysics, relativistic heavy ions, and spin variables in intermediate-energy charge exchange reactions. We are particularly interested in identifying strong candidates who would be able to augment our recent move into relativistic heavy-ion physics at such facilities as CERN and RHIC, but would encourage candidates in other subfields as well. A commitment to teaching is also required. Applicants should send their curriculum vitae and arrange for at least three persons who can provide a candid professional evaluation to submit references to: Professor Evan Sugarbaker, Chair of the Search Committee, The Ohio State University, Department of Physics, Columbus, OH 43210-1106, USA. Pending final administrative approval, the department hopes to fill this vacancy as early as Autumn, 1993. For fullest consideration, applications should be received by April 1, 1993. The Ohio State University is an Equal Opportunity/Affirmative Action Employer. Qualified women, minorities, Vietnam-era Veterans, disabled veterans and individuals with disabilities are encouraged to apply.

University of Cambridge
Cavendish Laboratory
High Energy Physics Group

Experimental Physicist

Applications are invited for a Research Associate or Senior Research Associate post in the high energy physics group of the Cavendish Laboratory. The group has an active research programme both in experiments (currently OPAL at LEP, NA48 at the CERN SPS and the proposed ATLAS experiment for the LHC) and in the development of electronic detectors for particle physics.

A graduate physicist, preferably with postgraduate research or industrial experience, is needed to work on the development of detectors, and on their exploitation within our experimental programme. This research is currently centred around semiconductor devices. The post is funded on a rolling SERC grant, on a salary scale up to £24,736 p.a. Further information may be obtained from Dr. Janet Carter, Cavendish Laboratory, Madingley Road, Cambridge CB3 OHE,, UK, telephone 0223-337235, to whom applications, including a curriculum vitæ and the names of two referees, should be sent by 24th March 1993.

Experimental High Energy Physics
The Ohio State University

FACULTY POSITION: The Department of Physics invites applications for an anticipated regular faculty position in experimental high energy physics. Applications from both junior and intermediate level candidates are welcome. The successful candidate, who should be capable of establishing an independent research program would join a large high energy group of eight present faculty members with experiments at CESR, Fermilab, HERA, and the SSC. We are looking for a person with a strong record and outstanding promise as a researcher, who will also be a good teacher. Applicants should send their curriculum vitae and the names of at least three persons who can provide a candid professional evaluation to: Chair, Experimental High Energy Search Committee, The Ohio State University, Department of Physics, 174 W. 18th Avenue, Columbus, OH 43210-1106, USA. Pending final administrative approval of this position, it is expected to be filled by Autumn, 1993. Applications will be screened beginning April 1, 1993 and will be accepted until the position is filled. The Ohio State University is an Equal Opportunity/Affirmative Action Employer. Qualified women, minorities, Vietnam-era Veterans, disabled veterans and individuals with disabilities are encouraged to apply.

Electronics Engineer
Fast Electronics Group Staff Position

The Continuous Electron Beam Accelerator Facility (CEBAF) is a 4 GeV high intensity (200 micro amp), high duty-factor electron accelerator under construction in Newport News, VA. Currently, an opportunity exists for an Electronics Engineer to assume responsibility for the design of high speed analog and digital electronics for detector systems; and the design, simulation and prototyping of detector electronics. Incumbent will work closely with physicists to determine promising design alternatives of detector electronics; consults closely with vendors and outside collaborators in the development and manufacture of detector systems; participate in the design and installation of data acquisition equipment; and work with standard bus systems such as FASTBUS, VME, and CAMAC. The minimum qualifications for this position are a BSEE with emphasis on circuit design and simulation plus five years of experience in high speed circuit design, or the equivalent combination of education, experience, and specific training. Incumbent should have experience in the use of analog circuit simulation and test techniques. Experience with ASICs and hybrids is desirable. Good written and verbal communication skills are essential. Interested candidates should send a curriculum vitae and an application to: CEBAF, ATTN: Employment Manager, 12000 Jefferson Avenue, Newport News, VA 23606. Specify position # PR3105 and job title when applying. To insure consideration, applications should be received before April 5, 1993. CEBAF is an Equal Opportunity/Affirmative Action Employer.

CEBAF
The Continuous Electron Beam Accelerator Facility

READER SERVICE FORM
CERN COURIER
MARCH 1993

Please send information on items circled:

7	9	13	15	16	17	17b	19	19a	22
23	24a	26	27	29	30	31	32	33	35
37	38	40	41	42	43	44	46	48	49
50	51	52	53						

Please send to:

Judy Pray, **CERN COURIER**
Gordon & Breach Science Publishers
Frankford Arsenal, Building 110
5301 Tacony Street, Box 330
Philadelphia, PA 19 137
USA

Name ______________________ Title ______________

Employer ______________________ Dept. ______________

Address ____

City ______________ State ______________ Zip ______________

Telephone ( ) ______________ Country ______________

How to visit CERN

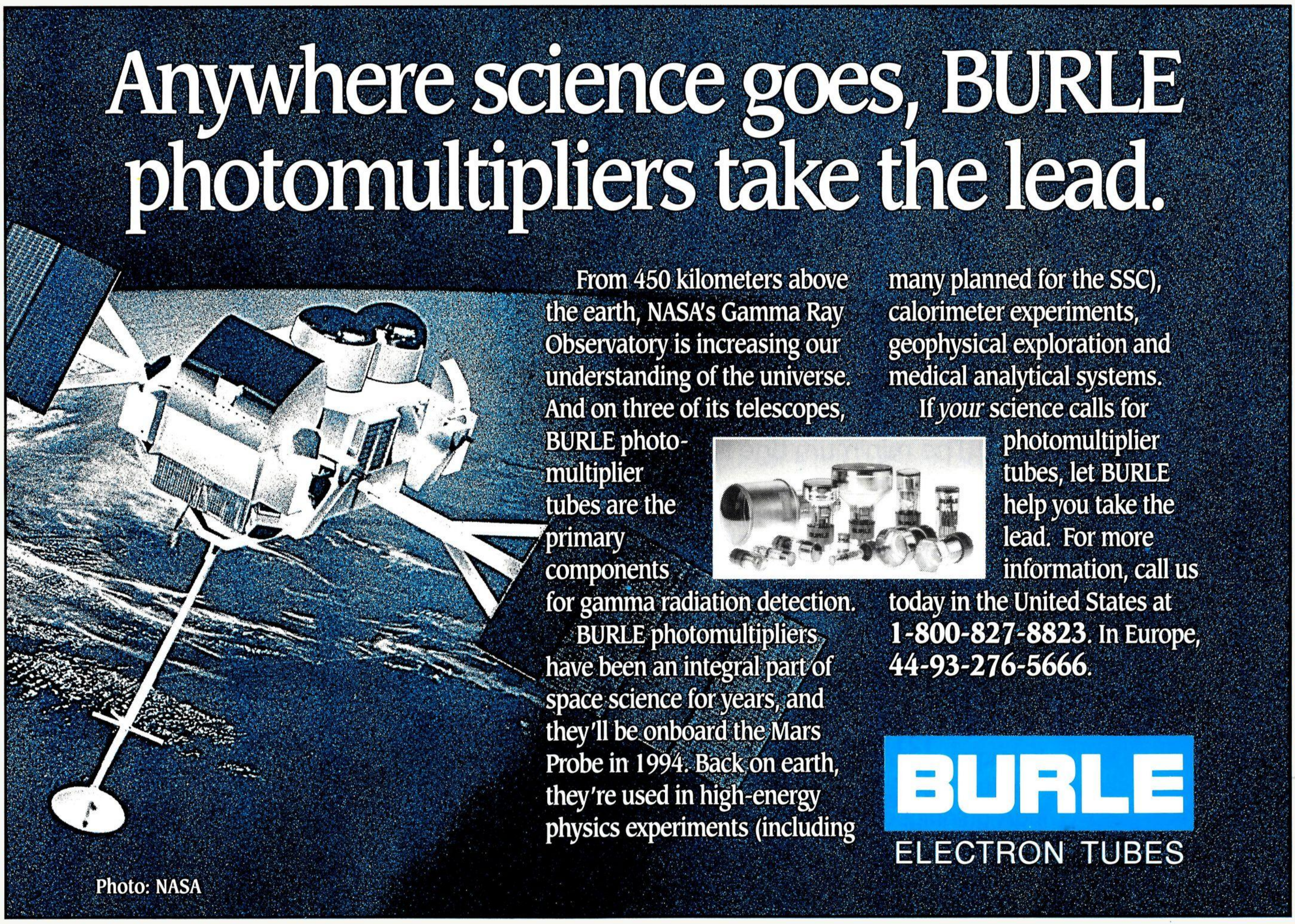
Comment visiter le CERN

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.

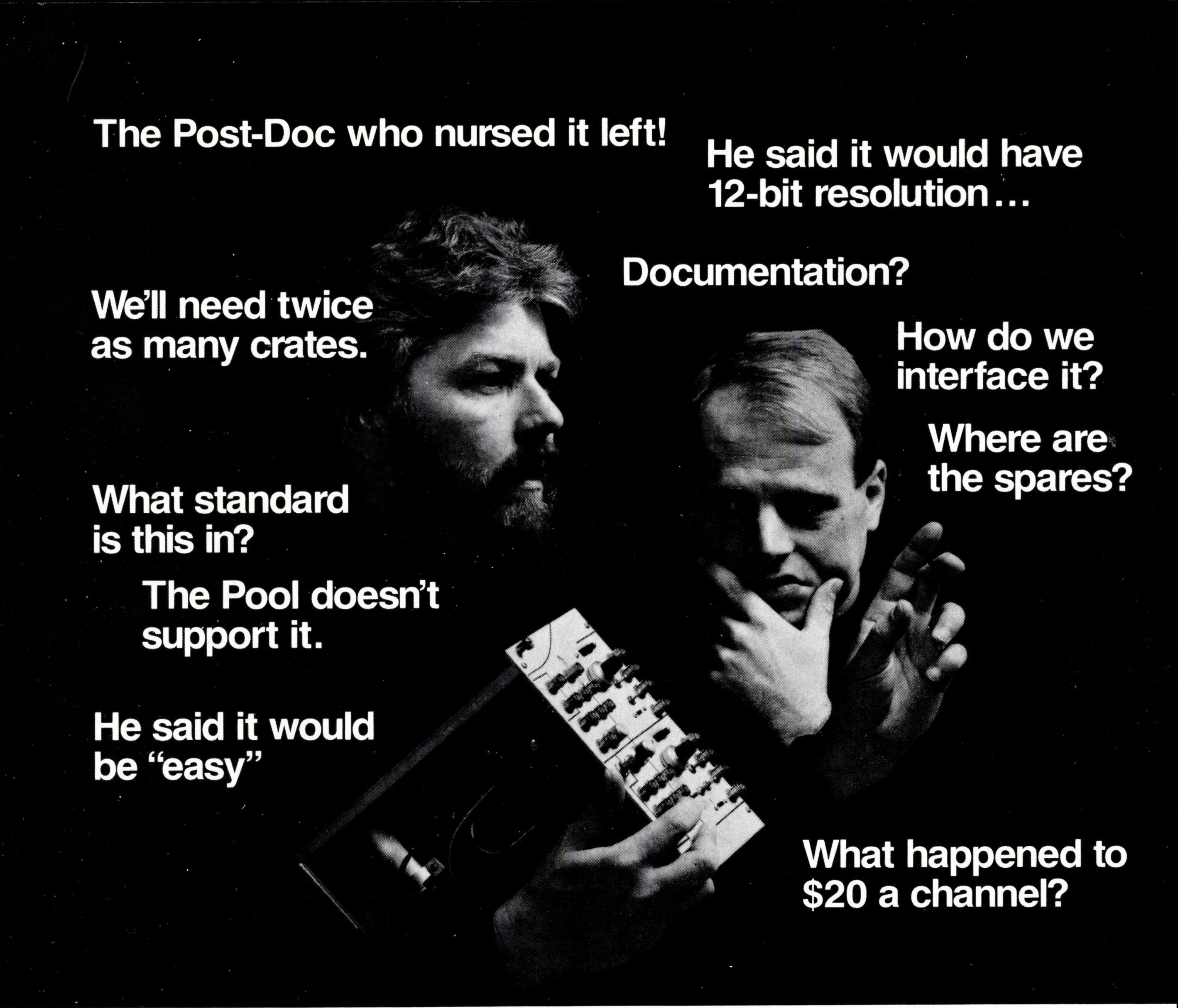
Please write or call:
Ecrire ou téléphoner:

CERN
Visits Organization / Organisation des visites
1211 GENEVA 23 Switzerland
Tel. 022/767 84 84
Telex 419 000 CER



42 *Circle advertisement number on reader service form*

22 *Circle advertisement number on reader service form*


The Post-Doc who nursed it left!
He said it would have 12-bit resolution...
Documentation?
We'll need twice as many crates.
How do we interface it?
Where are the spares?
What standard is this in?
The Pool doesn't support it.
He said it would be "easy"
What happened to $20 a channel?