CERN COURIER

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CERN COURIER

International Journal of the High Energy Physics Community

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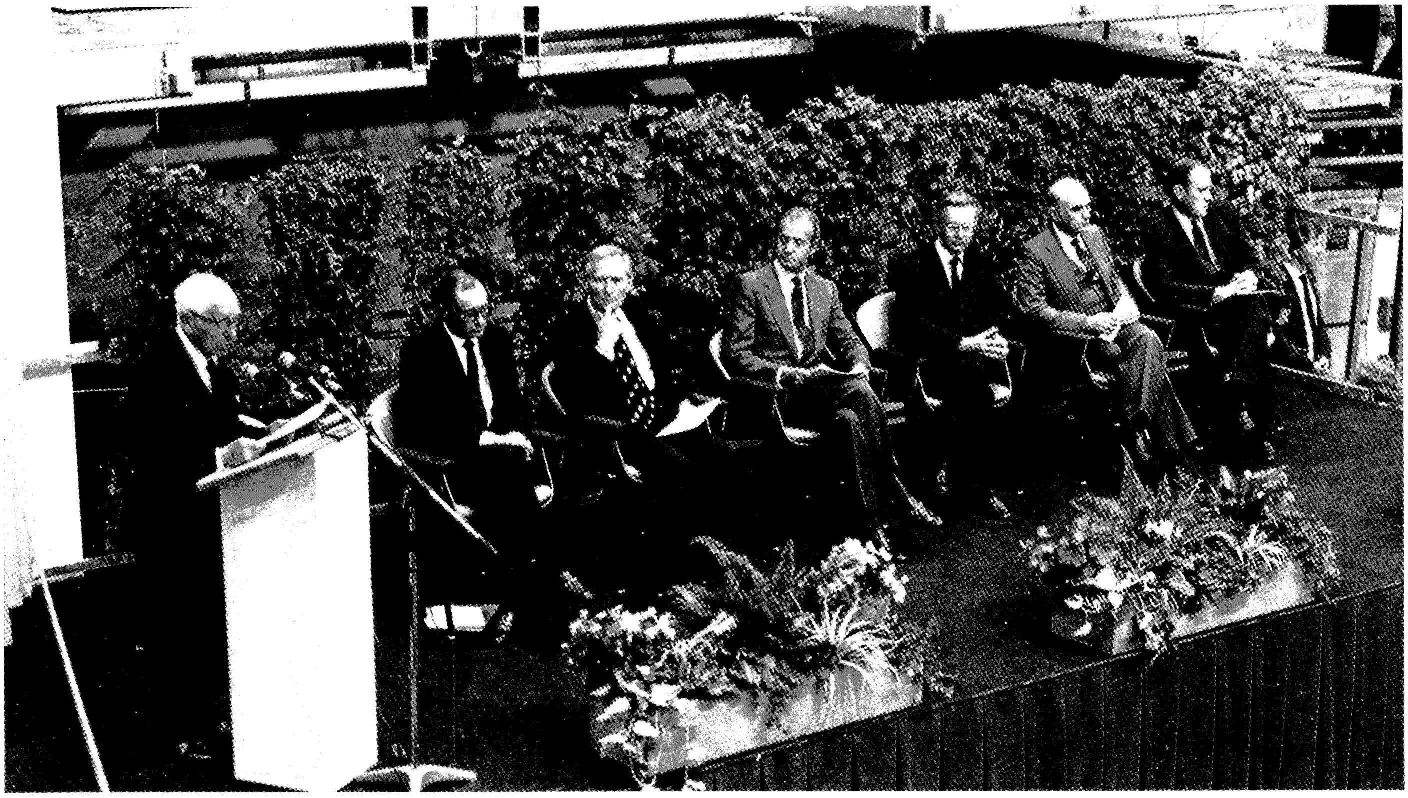
The distinguished speakers at CERN's 30th Anniversary ceremony in a hall of the Intersecting Storage Rings (the base of the Split Field Magnet can be seen in the background). At the podium is Isidore Rabi, who had launched the 'CERN resolution' at the 1950 UNESCO Conference. From left to right are: Pierre Aubert, Sir Alec Merrison, King Juan Carlos of Spain, Herwig Schopper, Hubert Curien and Peter Brooke.

(Photo CERN 823.9.84)



September marked the 30th Anniversary of the coming into force of the Convention establishing the European Organization for Nuclear Research (CERN). A formal ceremony, attended by the King of Spain, was the highlight of the celebrations. Throughout the month, an exhibition of many of the important documents from CERN's early history (including the original Convention, kindly loaned by UNESCO, with the signatures of representatives of the twelve founding States) was presented at CERN. A concert by the Geneva Orchestre de la Suisse Romande was given in CERN's honour. An Open Day at the Laboratory drew thousands of visitors. A full day's 'history seminar' enabled a team presently working on CERN history to consult with many of the pioneers.

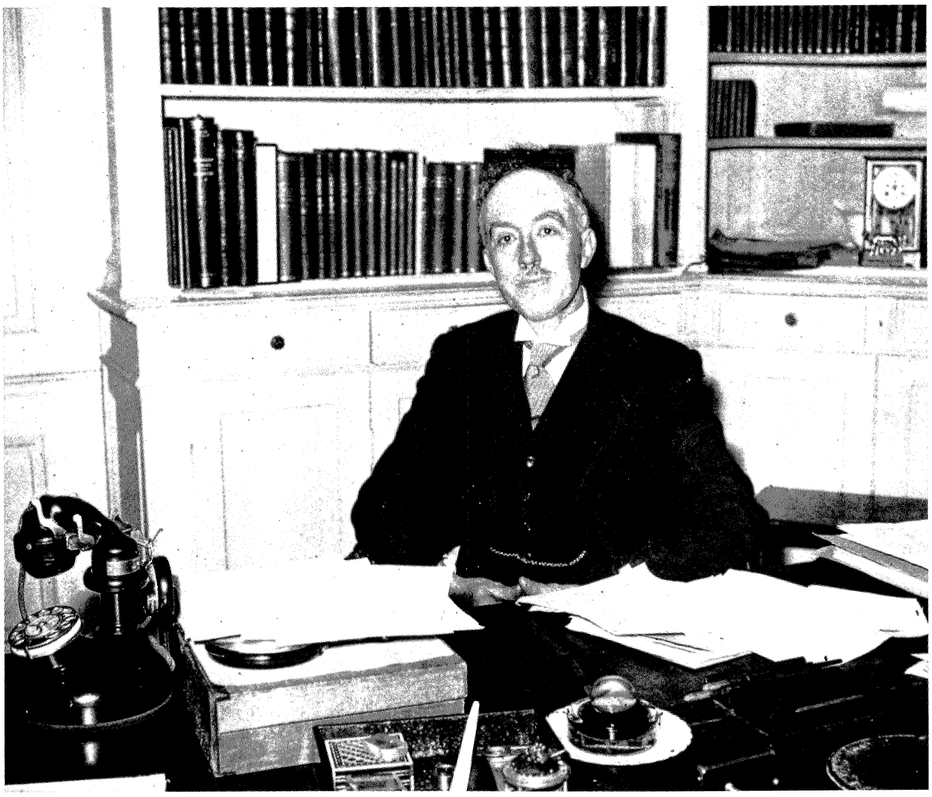
The exhibition of documents from the days of CERN's genesis traced the remarkable efforts to achieve the twin goals of establishing a world-class research Laboratory and of a concrete step towards European co-operation. It included the text of the speech of Louis de Broglie (actually read by Raoul Dautry) to the European Cultural Conference at Lausanne in December 1949, which is often quoted as the first public expression of the ideas on scientific collaboration which were circulating at that time.

This speech called for the establishment of 'a Laboratory or Institution where it would be possible to do scientific research in some way beyond the limits of the participating nations. Since it would be the product of the co-operation of a large number of European States, this body could be accorded greater resources than those available to national Laboratories and could, in consequence, undertake tasks which by their size and cost are not open to national Laboratories. It would serve to coordinate the research and the results obtained, to compare techniques, to adopt and implement programmes of work, with the collaboration of scientists from different nations'. Apart from not specifying the precise scientific field of research of the Laboratory, this proposal remains an excellent template for CERN, even after thirty years of CERN's existence.

The next major thrust came at the UNESCO Conference at Florence in June 1950 and the exhibition included the resolution put forward by the USA delegation, spearheaded by Isidore Rabi, which authorized the UNESCO Director General 'to assist and encourage the formation and organization of regional centres and laboratories in order to increase and make more fruitful the international collaboration of scientists in the

Louis de Broglie photographed in his office in Paris at the time when his speech to the Lausanne meeting of the European Cultural Conference publically launched the idea of a European science laboratory.

(Photo Agence France Presse)



search for new knowledge in fields where the effort of any one country in the region is insufficient for the task'. The Director General, Pierre Auger, did his job of 'assisting and encouraging' so well that at a UNESCO meeting in February 1952, the 'provisional organization' — the Conseil Européen pour la Recherche Nucléaire (from which the acronym CERN is drawn) — was created with Edoardo Amaldi as Secretary General. The meeting participants sent Rabi a telegram (also shown at the exhibition) saying 'We have just signed the Agreement which constitutes the official birth of the project you fathered in Florence. Mother and child are doing well and the doctors send you their greetings'.

On 1 July 1953 the Convention establishing the Organization was signed, subject to ratification, and it was this document which had pride of place at the exhibition. On 29 September 1954, the 'instruments of ratification' of France and the Federal Republic of Germany were deposited with UNESCO, joining those of seven other European States and the threshold was passed for CERN to come formally into being.

The History Seminar

A great volume of information about these early days was exchanged on 20 September when the small team of European science historians, financed by institutions in the CERN Member States, presented their work so far on CERN history to a gathering of some of the pioneers. We pick out here just a few features of the discussions which do not often find their way onto paper.

Prior to the present history study, most of the written history on CERN concentrates on the chronological sequence of events which brought the Organization into being and on the political forces at work at that time to achieve European collaboration. There is less emphasis on the scientific motivation for selecting particle physics as the field of research and on the eagerness of the European scientists to have access to a high energy accelerator.

The scientists at the seminar emphasised the importance of the discoveries of the muon and of strange particles in the cosmic ray experiments of the preceding years. This carried two messages. One, the list of known particles was not consistent; there were mysterious objects for which there was no explanation and thus there was a strong suspicion that the list was not complete. Two, the masses of the strange particles were high and the appropriateness of high energy accelerators for getting at them for thorough study was obvious.

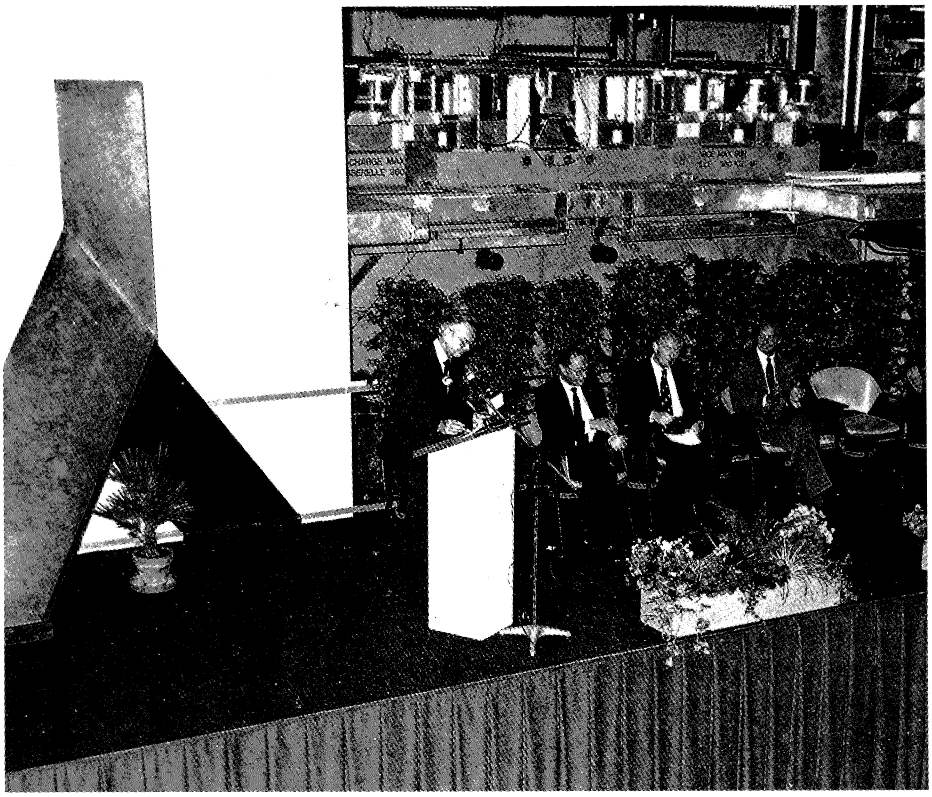
This last point, that accelerators were destined to take over, was encapsulated in a lovely story related by Yves Goldschmidt-Clermont about the great cosmic ray physicist Cecil Powell. Apparently Powell called his cosmic ray team together for lunch and announced to them that the Birmingham synchrotron had come on the air with a proton beam energy of 1 GeV! He finished his announcement by the exclamation 'Sauve qui peut!'

Two other stories illustrate the pioneering atmosphere and the extraordinary faith and courage of the people involved. They both concern Secretary General Edoardo Amaldi. Under pressure from the Geneva weather, to avoid a possible year's delay, Amaldi (with the support of Council) authorized construction on the Meyrin site before all the formal ratifications of the Convention were in place. Sir Ben Lockspeiser, then

Council President, said 'Now we have another task — keeping Amaldi out of jail!' The second story concerns the legal complication of the dissolution of the provisional organization some weeks before CERN came formally into being. The solution was to transfer all the assets to the Secretary General. Amaldi recounts that during those weeks his amused young colleagues took very good care of him!

Herwig Schopper thanks the Swiss authorities for the gift to CERN of a sculpture, visible on the left, by Piero Ischi.

(Photo CERN 725.9.84)



The Anniversary Ceremony

On 21 September CERN was honoured by the presence of His Majesty Juan Carlos, the King of Spain, at a ceremony to mark the 30th anniversary. He was accompanied by Queen Sophia and the two Infantas. Other guests of honour were Swiss Federal Councillor P. Aubert, French Minister for Research and Technology H. Curien, Italian Minister for Research L. Granelli, Norwegian Minister for Culture L. R. Langslet, Spanish Minister for Energy C. Solchaga-Catalan, Spanish Secretary of State for Research Mrs. C. Virgili, and UK Parliamentary Under-Secretary of State for Education and Science P. Brooke. The ceremony was held in one of the intersection region halls of the now-closed Intersecting Storage Rings.

Council President Sir Alec Merrison was Master of Ceremonies and in his introductory speech said 'CERN houses the largest complex of accelerators ever constructed, superbly operated by highly skilled engineers and technicians and exploited to the full by international teams of physicists on a scale undreamt of by the founding fathers of CERN. We should remember with gratitude that it is due to their vision and foresight that European high energy physics is so flourishing today and it is no accident that the recent spectacular discoveries of the intermediate bosons and of the top quark have been made at CERN. CERN is a success, a very great success, the outstanding example of European and indeed of international collaboration in science'.

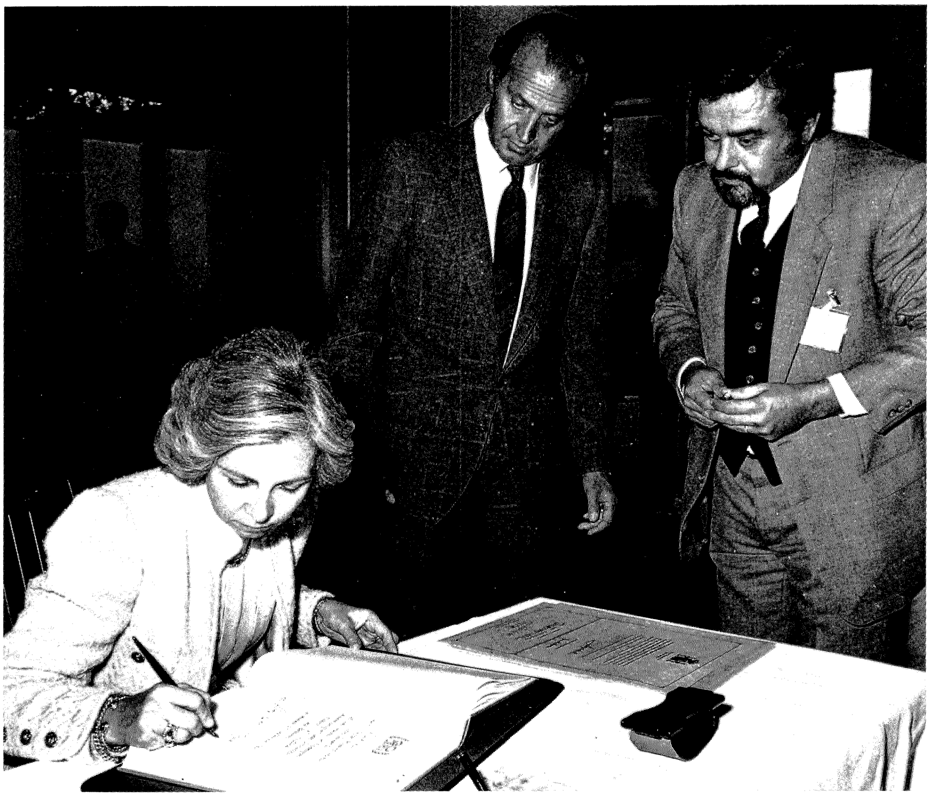
Nobel Prize laureate Isidore Rabi reminisced about the formative days of the Organization and rejoiced in the achievements since then. 'When I first saw the ISR it gave me a feeling of exaltation even greater than when I first saw the Grand Canyon, because this was a visible and human challenge to the unknown, an assertation of the innate human desire and determination to delve even further into the mysteries of creation... I have some disappointments, not about CERN itself, but about the failure of the shining example of the success of CERN to be followed in other fields of human endeavour. CERN illustrates how countries of different languages and different histories can join in the furtherance of human aspirations in the field of science'.

Hubert Curien spoke on behalf of the Host States, France and Switzerland, and stressed that 'the latest discoveries are not an end in themselves, but a glorious milestone in the march and conquest of science'. Peter Brooke represented the Member States. 'If I may be allowed a flight of metaphor, we are in Europe engaged in the building of a cathedral... But a cathedral is a century in design and construction and in the meantime we seem sometimes to be bogged down in a building site. At times like these it needs faith to lift one's imagination to what the cathedral will be like when we have completed it; and that faith needs the assurance of seeing on the ground the evidence of what we have built already, the individual chapels which will come together in the span and vaulting of the whole. CERN is just such a chapel, and it only takes a single glance to know that, soberly and seriously but with all the joys of the human condition, CERN does the task that it was set up to do'.

The King of Spain communicated the satisfaction of his country at being reintegrated in CERN. 'After thirty years of research, CERN has demonstrated that no human endeavour of real importance can be carried out in isolation. We can accept the words of George Sarton "science is fundamentally international or, more precisely, supernational. At all times and in every place, scientists are compelled to collaborate and could not do otherwise even if they wished because their task is essentially the same. They are all climbing the same mountain and even if their paths diverge sometimes, they are all aiming for the same goal. Thousands of scientists give their lives to that collective task like bees in their hive, and in this case the hive is the world".'

'My country has rejoined CERN motivated by a determination to work because we wish to push towards new frontiers of science while at the same time promoting the spiritual and material progress of man in the framework of European solidarity... Spain is a young nation in the field of frontier research and this can manifest itself by bringing fresh enthusiasm and devotion to this European venture which we are joining, motivated by our double objective of full integration in Europe and improvement in the level of science and technology in our country. I am very happy to be able to say this at CERN which, thanks to scientific research which daily surpasses what is possible on a national scale and requires European solidarity, tries to convert into reality the old dream of a united Europe'.

The ceremony concluded with the presentation to CERN by Pierre Aubert, on behalf of the Swiss, Geneva and Meyrin authorities, of a sculpture by Geneva sculptor Piero Ischi. Director General Herwig Schopper expressed the thanks of the Organization. 'I would like to say again how conscious CERN is of how much its successes owe to the Member States... My wish, at the start of the new era which has opened for CERN with the beginning of LEP construction, is that these harmonious relationships will be maintained and further strengthened for the good of Europe and of science.'



A proud day for Spanish CERN staff member Georges Boixader (right) as he and King Juan Carlos of Spain watch Queen Sophie sign the CERN 'livre d'or' after the 30th anniversary ceremony.

(Photo CERN 823.9.84)

OPAL

In the continuing series of articles on the experiments for the big LEP electron-positron collider being built at CERN, after DELPHI (see July/August issue, page 227) and ALEPH (September issue, page 269), the spotlight turns to OPAL — Omni Purpose Apparatus for LEP. This massive effort to build a general-purpose detector costing 75 million Swiss francs (recent prices) involves some 130 physicists from 21 institutes in nine countries.

The OPAL collaboration includes Birmingham, Bologna, Bonn, Cambridge, Carleton (Canada), CERN, Chicago, Freiburg, Haifa (Israel), Heidelberg, London (Queen Mary College and University College), Manchester, Maryland, Montreal, National Research Council (Canada), Rutherford Appleton, Saclay, Tel-Aviv, Tokyo and Weizmann Institute (Israel).

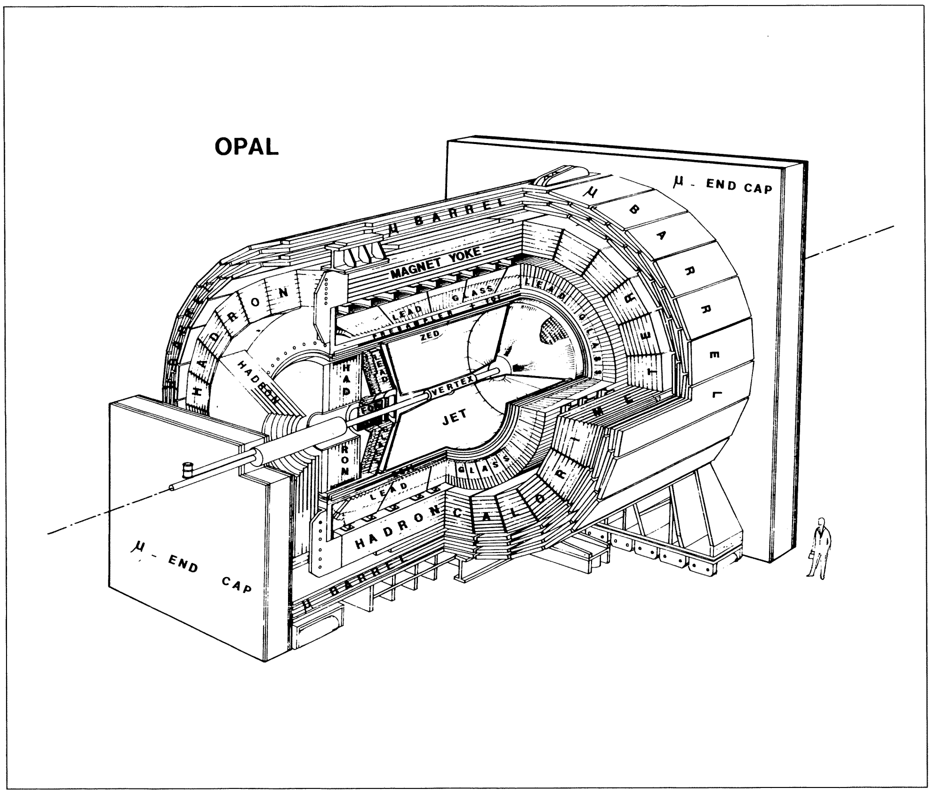
The detector aims to cover a wide range of physics, much of it unexplored, and the design uses well tested technologies together with reliable and powerful techniques.

OPAL's design features a central detector consisting of a slim vertex detector wrapped around the beam pipe and the main jet chamber for recording particle tracks and measuring particle momenta. This will pin down the position, angle and momentum of charged particles using true three-dimensional space coordinates, together with the energy loss (for particle identification).

The central detector will be surrounded by a solenoid, of conventional type for initial operations, but the plan is to replace this by a stronger superconducting coil after several years of operation.

Outside the magnet will be the calorimetry for measuring the deposition of electromagnetic and hadronic energy, and finally the outer muon chambers.

Schematic diagram of the OPAL detector for the LEP electron-positron collider now being built at CERN.



The central detector design benefits from experience gained with the JADE detector at the PETRA electron-positron ring of the German DESY Laboratory in Hamburg. The major component is the 3.85 m-diameter jet chamber containing 24 sectors each of 160 stretched sense wires separated by potential wires.

It is planned to operate the chamber at several atmospheres pressure. Particle tracks will be recorded over almost the entire solid angle, while particle identification will be achieved through multiple sampling of energy loss. Readout electronics will be based on 100 MHz flash analog-digital converters.

The 3940 sense wires and 19 800 field wires of the jet chamber will be mounted between two conical aluminium end-plates which carry a load of some 15 000 kg. As well as the jet chamber experience at JADE, promising results, with space resolutions better than 150 microns, have been obtained with model OPAL chambers. A full scale prototype is currently taking data and already shows encouraging results.

Embedded in the jet chamber will be the vertex detector (23.5 cm outer radius, 8.5 cm inner radius and 1 m in length) wrapped around a thin beryllium beam pipe. This detector is built up from drift chamber cells and is designed to achieve 50 micron precision. The vertex chamber permits a more precise extrapolation of the jet chamber tracks back to the beam crossing region. Offsets from the collision point will indicate the production and decay of long-lived particles.

Another feature of the central detector design is the series of 'z chambers', providing mechanical support for the jet chamber and carrying out additional precise measurements in the (z) direction parallel to the beams. The combined information from the three components of the central detector will provide good measurement of almost all particle tracks.

Surrounding the central detector will be the coil of the solenoid. In its initial version, an aluminium coil carrying a current of 7000 A will supply a field of 0.4 T. Outside the coil, 2500 tons of iron return yoke will also function as part of the outer hadron calorimeter.

The 'barrel' electromagnetic calorimeter around the solenoid will consist of a layer of 9440 lead glass blocks, each pointing towards the interaction point. The electromagnetic calorimetry will be completed by two endcaps either side of the central detector, containing a total of 2300 additional lead glass blocks.

The light produced in the machined lead glass of the barrel will be picked up by conventional photomultipliers, while the cast lead glass of the end caps (situated inside the magnetic field) will be read out by specially developed vacuum phototriodes.

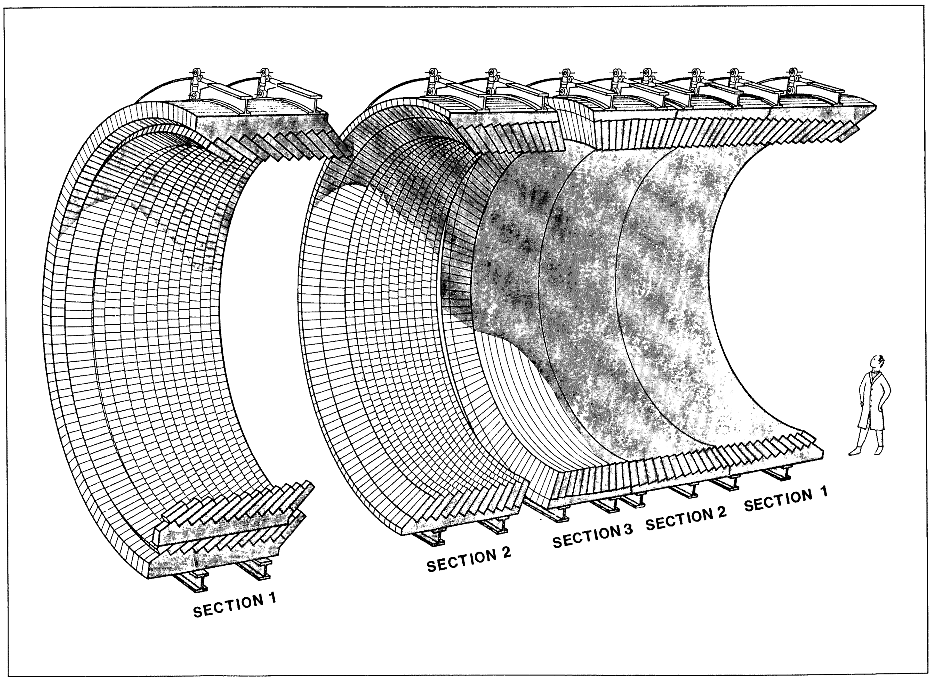
Lead glass was chosen for the electromagnetic detector because of its well proven high energy resolution, excellent detection efficiency and granularity. Special care has been taken to avoid cracks through which photons might escape.

Fitted between the barrel lead glass array and the solenoid will be the electromagnetic presampler, a double layer of streamer tubes to pick up electromagnetic showers originating in the magnet coil. This will improve the energy resolution, selectivity and identification power.

To aid charged particle identification, a time-of-flight system, based on a shell of scintillation counters, will be mounted between the coil and the electromagnetic presampler.

The hadron calorimeter design consists of three main sections —

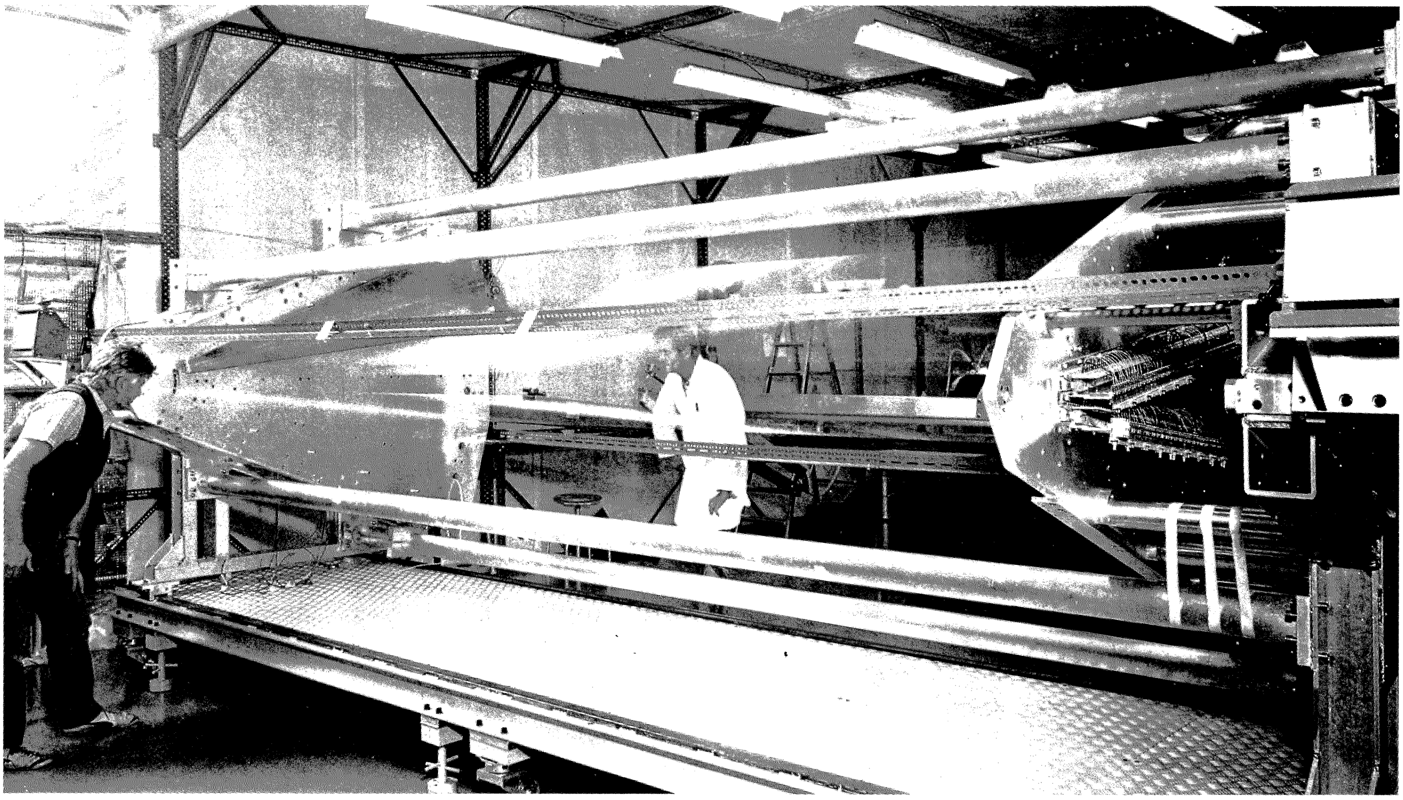
The 'barrel' of the OPAL electromagnetic calorimeter will contain 9440 lead glass blocks, all pointing towards the central interaction point.



OPAL participating institutions	Main responsibilities
Birmingham + Cambridge + Manchester + Queen Mary College + RAL + University College	E.M. endcap, Muon detector, Data acquisition, Trigger system, Forward detector, Vertex detector
Bologna + Maryland	Forward detector, Data acquisition Hadron calorimeter, Beam pipe
Bonn + Freiburg + Heidelberg	Central detector, Data acquisition
Montreal + Carleton + NRC-Canada	Vertex detector, Data acquisition, Central detector
CERN	Magnet, Central detector pressure vessel and gas system
Chicago	E.M. barrel presampling detector
Technion + Tel-Aviv + Weizmann	Hadron calorimeter, Data acquisition
Saclay	Data acquisition, Time-of-flight hodoscope, Trigger system
Tokyo	E.M. barrel calorimeter, Central detector, Trigger system

Two segments of a full size (4 metres) prototype of the central detector for the OPAL experiment, showing two anode wire planes and some cathode wiring. Current data taking has already shown encouraging results.

(Photo CERN 127.7.84)



the cylindrical barrel plus outer and inner endcaps. Except for the inner endcaps (magnet pole tips) instrumented with thin multiwire proportional chambers, the calorimetry will use the now well established technique of plastic streamer tubes. The barrel will consist of 24 wedge-shaped elements, each subtending 15° and over 10 m long. Prototypes have been tested both at CERN and Brookhaven.

The physics capabilities of the detector will be extended by the outer muon detection system. Penetrating muons which traverse the rest of the apparatus will be picked up either in four planes of drift chambers in the outer barrel or in four planes of streamer tubes in the endcaps, and these tracks correlated with signals from the central detector. A novel feature of the barrel muon chambers is the measurement of the longitudinal coordinate (along the wire) by induced charge readout on a series of specially shaped pads printed on the inner surface of the chamber, giving one millimetre resolution.

Complementary detecting power close to the beam pipe will be provided by a pair of forward detectors, each consisting of tracking chambers to pick up slightly deflected particles and additional electromagnetic calorimetry (lead-scintillator).

Data handling

The goal of the OPAL data handling effort is to ensure, at LEP turn-on, a completely tested and debugged data acquisition and analysis system for rapid evaluation of physics results.

Assuming a LEP luminosity of 5×10^{30} cm^{-2} s^{-1} and 4000 hours of data taking per year at the requisite energy, roughly 3.5 million Z^o events would be recorded (about a dozen have been collected at the CERN proton-antiproton Collider so far). While these figures might be optimistic for initial operation, OPAL's design nevertheless keeps this goal firmly in mind.

From some 45 000 beam crossings per second (22 microsec between bunches), less than one 'good' event per second can be expected. Thus the initial triggering and selection procedures will have to do a lot of filtering, and fast.

In the first level trigger, information coming from all elements of the detector is provided within 10 microsec, leaving the remaining 12 microsec before the next bunch crossing for execution and resetting. Some parts of the detector (e.g. the vertex detector) will respond quickly, providing information within 2 microsec, while others (e.g. the barrel chambers of the outer muon detector) will take up to 5 times longer.

Data from accepted events will be passed to temporary buffer storage for the second level of processing to further reduce background. High level processors, carrying out on-line calculations, are envisaged. Given the readout speed of the first level trigger, about 10 millisec per event will be available for this stage of the data handling without incurring any deadtime.

Even before recording the data on magnetic tape, fast emulators might be able to flag rare event types, which could then be diverted to a special output stream.

With the excellent position and energy loss measuring power of its central detector for charged particles, together with the good energy resolution of its electromagnetic calorimeter, OPAL is well set both to study a wide range of physics and to seek out and explore the new phenomena which hopefully will appear under LEP conditions.

10 years of SIN

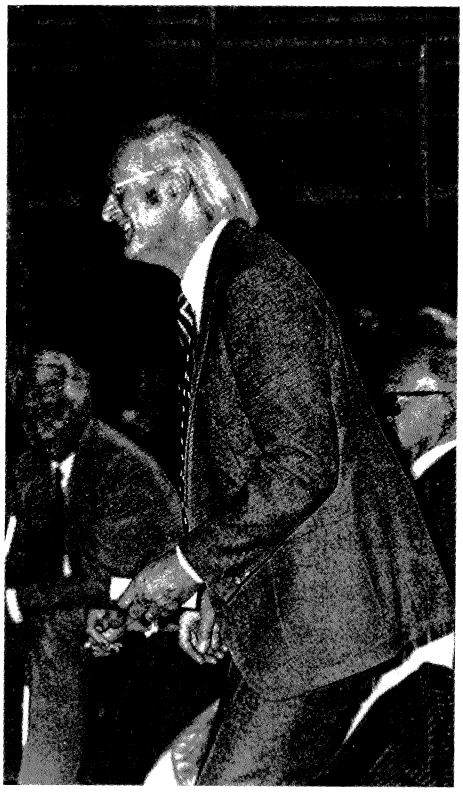
The Schweizerisches Institut für Nuklearforschung (Swiss Institute for Nuclear Research, or SIN) proudly celebrated its 10th anniversary earlier this year. Welcoming the audience at a reception on 22 June, Swiss Federal Councillor Alphons Egli recalled that only about one human lifetime ago was it demonstrated that the atom, despite its name (from the Greek for indivisible), could in fact be split. Since then, questions arising from this discovery have continued to fascinate research workers all over the world.

Turning to the work of SIN, Egli explained how the Institute is attached to the Swiss Federal Institute of Technology and was conceived as a research centre for all Swiss universities. The collaboration of groups from foreign universities, especially the important contribution from Federal Germany, is an important element of its research programme. With its applications projects, for example, in the field of nuclear medicine, SIN is demonstrating that the results of research can turn out to be of considerable benefit to industry and society, even if its initial motivation is purely scientific.

Adding his congratulations, former Swiss Secretary of State Raymond Probst reviewed Switzerland's impressive contribution to international science and technology, including of course CERN, the first international scientific organization to emerge, and the last 30 years have shown what a united Europe is capable of. Connections made through science have become a factor in political stability and economic wellbeing. But international collaboration in no way reduces the need for a country's own efforts. Quite the contrary is true, and SIN is among the best demonstrations of this.

Ernst Heer of the University of

Maurice Cosandey — the challenge of matching SIN's ambitions to its resources.



SIN Director J.-P. Blaser — ten bottles of wine from Laboratory users.

Geneva and Chairman of the Advisory Board of SIN spoke on behalf of the users. He stressed the importance of SIN both for Switzerland and on the international scene, and drew a parallel with the Federal Republic of Germany, with its highly successful national high energy Laboratory at DESY in Hamburg. He then sketched the history of the last decade in physics, and described the role of medium energy physics in looking for rare or 'forbidden' events; SIN has a very good reputation in this field, having amongst other facilities its muon channels and polarized beams and targets. Pion reactions and absorption in nuclei, nucelon-nucleon scattering, pion production and scattering can all be studied. Work is done in solid state, chemistry, biology and medicine.

For the future, the high level of activity at SIN has to be maintained, continued Heer, and the new injector and other improvements will play a vital role. Looking further ahead, the central installations have to be upgraded and extended, as has been done at CERN and DESY. Prof. Heer closed by thanking those who have worked at SIN, its authorities and its director, J.-P. Blaser; and paid tribute to the memory of Hans Willax, whose name is so closely linked to the accelerator, and who did not live to see the anniversary celebration. Finally, on behalf of the users, he presented Blaser with ten bottles of wine, one for each year of SIN's service; nine bottles came from the nine Swiss institutes that use SIN, each from vineyards of the corresponding Canton, and one from the other side of the Rhine as a sign of appreciation from the German community.

Maurice Cosandey, Chairman of the Board of the Swiss Federal Institute of Technology, underlined SIN's unique position in Switzerland. As well as amply fulfilling its role in nuclear physics education and research, SIN has also contributed to work in other fields, particularly in superconductivity, radioisotope production and cancer radiotherapy. Expertise in superconductivity was first developed for the installation of muon channels at SIN; it has since been applied to pion radiotherapy and to the 'Large Coil Project' with the International Energy Agency. Radioisotopes are routinely produced with the injector beam for use in industry and medicine. The pion radiotherapy project is still at the experimental stage; for the moment it is not clear whether pions can be produced cheaply enough for routine therapy. Prof. Cosandey concluded by looking forward to the commissioning of the new injector, which will deliver proton beams of milliamp intensity.

SIN enters its second decade of operations full of ideas and promise. Perhaps the main problem in the coming ten years will be to match the Institute's ambitions to its resources, added Cosandey.

Chairman of SIN Advisory Board Ernst Heer — maintaining a high level of activity at SIN.

ISOLDE looks forward

P. G. Hansen of Aarhus (right), chairman of the Zinal workshop, in congenial discussion with CERN Research Director R. Klapisch.

The original ISOLDE on-line isotope separator at the CERN 600 MeV Synchro-Cyclotron (SC) was commissioned in 1967 and worked successfully until being essentially rebuilt in 1973/74 at the same time as the SC was upgraded to give higher extracted intensities. Since then there have been continual improvements to practically every aspect of the facility, but two fundamental limitations appeared; the lack of running time for experiments and the lack of space to house those experiments. At the end of the 1970s and the early 1980s, ISOLDE-2 used close to 250 shifts per year but it became clear that this was the maximum the facility could handle.

At about this time the CERN management decided the SC should become more and more an accelerator dedicated to ISOLDE experiments, with the aim of doubling the time allocation to 500 shifts per year. In order to achieve this increase it was necessary to build a second target station and a second isotope separator since the existing facility was already saturated. Several possibilities were discussed during 1978/83 and finally a solution emerged whose cost was reasonable: the new target station to be situated in the SC Hall, with the new isotope separator sending beam to the existing Proton Hall, a room several times larger than the present cramped, underground zone. This proposal was approved by CERN and the ISOLDE Collaboration in December 1983 and is at present being actively implemented in a collaborative effort by several ISOLDE member Laboratories, the CERN-ISOLDE group and the CERN-SC group. An important point is that ISOLDE-2 operation will continue throughout the preparation for the new ISOLDE-3, although there is inevitably some slowdown due to lack of manpower. Design of the new installation is at an advanced stage and it is hoped that the first beam might be obtained towards the end of 1985.

To prepare the way for the extended ISOLDE installation, the ISOLDE collaboration organized a workshop entitled 'On-line in 1985 and beyond — a workshop on the ISOLDE programme', from 18-22 June in Zinal, Switzerland, and chaired by P. G. Hansen of Aarhus. The aim was to review present and future research perspectives, and around 100 physicists from Europe, North America and China joined in the intense discussions in the beautiful setting of the Swiss Alps.

The programme began with a report on the progress of the construction of the new ISOLDE separator, presented by CERN project leader B. W. Allardyce. The new separator, which will be operated in a push-pull mode together with the present one, is a medium-current machine characterized by extremely good mass-resolving properties. With the new installation in operation, ISOLDE will be able to accept 4000 hours of beam time per year and will produce a large variety of radioactive beams.

H. L. Ravn, CERN, made an extensive summary of present and future ISOLDE beams and indicated that beams of almost all elements below uranium may become available within a few years. The interest of the physics community in the research possibilities was clearly demonstrated from the large number of contributions with new ideas for the scientific programme. Proposals for the construction of new on-line isotope facilities in Canada and Germany emphasized the importance of this field of research and the need for more experimental beam time.

The topics discussed included nu-

At the recent workshop on the possibilities with CERN's new ISOLDE on-line isotope separator facilities, held at Zinal in the Swiss Alps, Alvaro de Rujula, left, chaired the session on astrophysical and other fundamental applications.

clear, atomic, solid-state, particle and astrophysics as well as isotope separator techniques, new ideas for storage rings and post acceleration of radioactive beams.

The largest number of contributions were those dealing with different types of laser spectroscopy on exotic atoms. R. Neugart, Mainz, reviewed experiments using collinear laser spectroscopy which is one of the most successful current programmes at ISOLDE. These experiments, which determine nuclear spins, moments and mean square charge radii (from isotope shifts), have collected a large amount of data over the past years. This programme has an even more exciting future in the light of new target developments and a possible increase in the sensitivity of laser techniques. An interesting new laser technique was proposed by V. S. Letokhov, Moscow, and S. Libermann, Orsay. Their idea is to detect optical resonances in collinear spectroscopy by field ionization of atomic Rydberg states (almost hydrogen-like levels with outer electrons lying close to the ionization limit).

S. P. Møller, Aarhus, described a small heavy-ion storage ring now under construction at Aarhus which will be unique of its kind. A great variety of laser and atomic physics experiments will be possible, and with very high optical resolution. Similar techniques can be applied at a later stage at ISOLDE to store radioactive ions. Recirculation of the radioactivity will mean an effective intensity gain of a factor of at least 10^6.

The contributions and proposals for experiments in nuclear physics reflected the strong influence of recent experimental and theoretical developments in nuclear and particle physics that have raised many fundamental questions. One example is the observed quenching of the Gamow-Teller strength, observed in the positron decay of proton-rich nuclei. This quenching, which has been observed in a series of proton to neutron reaction experiments, may partly be due to the role of the delta (1236) resonance in nuclei. Another interesting development is the discovery that intrinsic reflection symmetry is spontaneously broken in the ground states of certain heavy nuclei. This could lead to stable octupole deformation of the nuclear ground state. Experiments to search for fingerprints of such nuclear states, revealing themselves as, for example, low energetic parity doublets, were proposed by G. Løvhøiden, Bergen, and W. Kurcewicz, Warsaw.

The highlights in the study of nuclei far from stability include the discovery and studies of new nuclear decay modes such as delayed particle emission processes (protons, two-neutrons, etc.) and ground state proton radioactivity. Recently, carbon 14 emission was discovered by a team from Oxford studying the decay of radium 223. B. Price, Berkeley, pointed out that the variety of beams available at ISOLDE, combined with his plastic track detector techniques, would be the ideal combination for a systematic study of the occurrence of this new decay mode. On 4 July, Price showed that he was right since his first test experiment at ISOLDE found the second case of carbon 14 radioactivity, this time radium 222 (and 224).

In the session devoted to astrophysical and other fundamental applications, W. Hillebrandt, Munich, pointed out that nuclear data of key importance for our understanding of the origin of the chemical elements is still required. Some of these would easily be available at ISOLDE in the coming years. In the same session,

F. Calaprice, Princeton, discussed experiments with oriented radioactive isotopes where magnetic and electric dipole moments could be measured with NMR methods. A non-zero electric dipole moment can arise only through violations of parity and time-reversal invariance. Calaprice suggested the element radon (Z = 86) as the most interesting case for future experiments.

Use of radioactive probes in solid state physics is a very rapidly developing field with great potential for novel experiments. The solid state physics session began with an excellent review by E. Recknagel, Konstanz, who pointed to interesting applications such as defect studies in metals, lattice location of impurities, surface studies and internal tracer diffusion.

The ISOLDE collaboration chairman, H. J. Kluge, Mainz, gave a summary of the workshop. He emphasized the rapid growth of the field and how the many new proposals made at the workshop require facilities such as the extended ISOLDE installation. He also welcomed the healthy competition that will be provided if new facilities proposed in Canada and Germany are constructed.

Exotic radioactivity

It is beginning to seem as though there are nearly as many kinds of radioactivity as there are nuclei.

According to the textbooks of just a few years ago, four kinds of radioactivity can be seen: alpha decay (emission of a helium nucleus), beta decay (emission of an electron), gamma decay (emission of a photon) and spontaneous fission (when a big nucleus splits into two smaller ones).

Now all that has changed, and studies of rare isotopes are turning up more and more 'exotic' decays. For example an experiment at the UNILAC heavy ion machine at GSI (Gesellschaft für Schwerionenforschung) Darmstadt (see October 1981 issue, page 357) saw nuclei decaying with the emission of a single proton.

One of the most prolific isotopes for producing unusual nuclear decay modes is lithium 11. This has large energy 'windows' for a number of different decays and over the past five years has provided examples of the emission of two and three neutrons as well as helium 6 nuclei. These decays were 'beta-delayed' — occurring only from intermediate excited states (in beryllium 11) such as are formed as a result of beta decay.

Several years ago, it was predicted that beta-delayed emission of tritons (hydrogen 3 nuclei) could occur for many highly neutron-rich nuclei. Of these nuclei, today only lithium 11 and helium 8 can be produced in substantial enough yields for detailed experiments.

At the ISOLDE on-line isotope separator at the CERN Synchro-Cyclotron lithium 11 beams were produced by the fragmentation of a uranium target by 600 MeV protons. Energy and energy loss measurements were carried out by a silicon surface barrier detector and a proportional counter respectively.

From an 11-hour exposure (6×10^6 lithium 11 ions), the energy loss versus energy spectrum showed twelve events corresponding to triton emission.

Earlier this year, an experiment at Oxford saw carbon 14 emission in the breakup of radium 223, which was soon followed up by a study at ISOLDE which found that carbon 14 emission takes place in radium 222 and 224.

Readership survey

A big 'thankyou' to the many people who completed and returned the readership survey form distributed with our March issue. It is some ten years since we last had such extensive feedback from our readership and the high response enabled us to achieve our aims — to get a better idea who reads the CERN Courier these days and to check readers' reactions to the level and style of the journal. It also enabled us to refresh our ageing mailing lists (though it may take us a while to complete the updating).

The forms came rolling in from all over the world over several months (enriching several local stamp collections with replies from as far afield as Papua-New Guinea, Zaire, Burundi, etc.). From a total of 17 200 distributed copies of the journal, we received just over 3 000 completed questionnaires. This corresponds to a 17.5 per cent response level, unusually high for this type of survey. In fact if we subtract the response to the 4 000 copies distributed within CERN itself (which was a disappointing 2 per cent), the response level rises to 22 per cent.

The survey showed that, on average, each copy is read by 3.2 people implying that the total readership is in excess of 50 000. Library copies apart, the record for the number of readers came from an address in the People's Republic of China where fifty people regularly read a single copy. We now send along a few extra! About 40 per cent of readers absorb the journal 'from cover to cover', 50 per cent read some of the articles, while the rest have a quick glance through.

The majority of readers (32 per cent), not surprisingly, work in high energy physics. In fact, if the estimate of the world high energy physics population as some 5000 people is correct, CERN Courier reaches every one of them. The next large category of readers is the teaching profession (21 per cent), with industrialists (12 per cent) in third place.

Much more important for the CERN Courier editors than the readership statistics was the question which sounded out readers' reactions to the level of the articles, and it was here that the most gratifying response was received. 96 per cent of readers judge the level to be 'satisfactory'. This agreeable state of affairs was reinforced by a large number of readers who added comment at the end of the questionnaire. These were almost without exception very complimentary. One reader from San Francisco summed it up succinctly stating 'It is exactly the right level required to follow fairly closely the development and progress in the field for people who do not want to become too involved'.

Many readers stated explicitly that they consider CERN Courier 'excellent' or that they look forward to reading it every month, and the most regular message was 'carry on the good work'. There were compliments on our coverage of news from Laboratories throughout the world which we pass on with pleasure to our correspondents, listed inside the front cover of the journal.

There were also constructive comments on content which we will try to keep in mind. Quite a few readers expressed a wish for more general surveys of the field, frequently citing the November 1983 issue on the W/Z discoveries as an example. Others requested references for further reading. Others reminded us to be careful of overuse of acronyms.

Another impressive feature was the fervour with which readers from areas of the world where there are no high energy physics facilities, and where the flow of information is less smooth, expressed their appreciation of the journal. To an extent that the editors had not realized, it is clear that CERN Courier provides a special service in these regions.

The unfavourable comments were also interesting. A few readers reacted strongly to what they perceive as an exaggeratedly pro-CERN bias (almost balanced by internal CERN comment that we are obviously pro-American!). It is inevitable that we pick up more information on CERN activities than on other Laboratories, given our geographical location. And recently the range and liveliness of the CERN programme has merited more attention. Nevertheless the aim is a balanced coverage of the field. A few readers protested that our style is too 'rosy' in projecting the work and pomp of high energy physics. Well, we think that such projection is a recognized part of our mission but we hope we do not go as far as the average 'house journal' which we have heard described as 'like going down in warm maple syrup for the third time'.

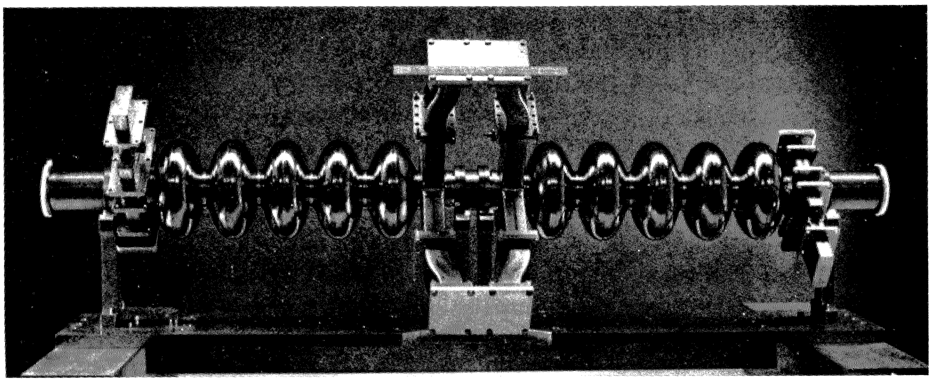
The results of the survey are most gratifying and encouraging. It seems that the CERN Courier is widely read and appreciated and is fulfilling well a specific need. Most of the credit for sustaining the reputation of the journal now rests with Gordon Fraser who has been doing the lion's share of the work for some time. It is a great stimulus to our work to have the support which has been so warmly expressed in the readership survey. Special thanks are due to Henri-Luc Felder who drew up the questionnaire, and Monika Wilson who coolly processed and painstakingly analysed the 3 007 replies.

Brian Southworth

Around the Laboratories

By attaining accelerating fields of up to 15.3 MV/m, these five-cell superconducting radiofrequency cavities developed at Cornell could point the way towards improved performance at future big electron storage rings.

(Photo Cornell)



CORNELL
Improved accelerating performance from superconductors

Superconducting radiofrequency techniques hold the key to the higher accelerating fields required for the big machines of tomorrow. Progress was highlighted by the recent International Workshop at CERN, which included a thorough survey of the vigorous development programmes underway at major Laboratories throughout the world. We follow up the report of this Workshop (see October issue, page 331) with encouraging news of the work going on at Cornell.

The superconducting radiofrequency group at Cornell has achieved high accelerating electric fields that demonstrate the possibilities of superconducting cavities as practical accelerating devices for future high energy electron storage rings. Record accelerating gradients of 8 and 15.3 MV/m were observed in two 1500 MHz five-cell cavities fully equipped with the input and higher order mode couplers required for accelerator operation. At the same time, a magnetic field of 850 gauss, corresponding to an accelerating field of 18.2 MV/m in a five-cell cavity, was achieved in a single cell 1500 MHz cavity.

Recently the Cornell group has been developing cylindrically symmetric 'elliptical' cavities which are easier to construct than the earlier 'muffin-tin' design. The new cavities are made of reactor grade niobium that is pretreated with yttrium to remove interstitial impurities and raise the thermal conductivity by a factor of three. The higher thermal conductivity tends to stabilize the surface of the cavity against loss of superconductivity due to the presence of surface defects. The cavities are constructed by electron beam welding preformed half shells using a 'rhombic raster' parameter which is a substantial improvement over previous techniques.

Among other efforts to gather information on the maximum performance of this design, a single-cell cavity was studied in nine separate cold tests, each with a fresh surface preparation. The low-field quality factor (Q) values at a temperature of 1.5 K ranged between 1×10^{10} to 5.8×10^{10} with an average of 2.4×10^{10}. The peak surface magnetic fields ranged from 400 to 850 gauss, with an average of 570 gauss. The average and maximum magnetic field represent a substantial improvement over the maximum fields in the neighbourhood of 300 gauss typically found in previous experiments. The peak surface electric fields in this single cell ranged between 16 MV/m and 34 MV/m with an average of 23 MV/m. If comparable surface fields were available in a five-cell unit, the corresponding accelerating fields would range between 6.3 MV/m and 18.2 MV/m, depending on whether electric or magnetic fields were the limiting factor.

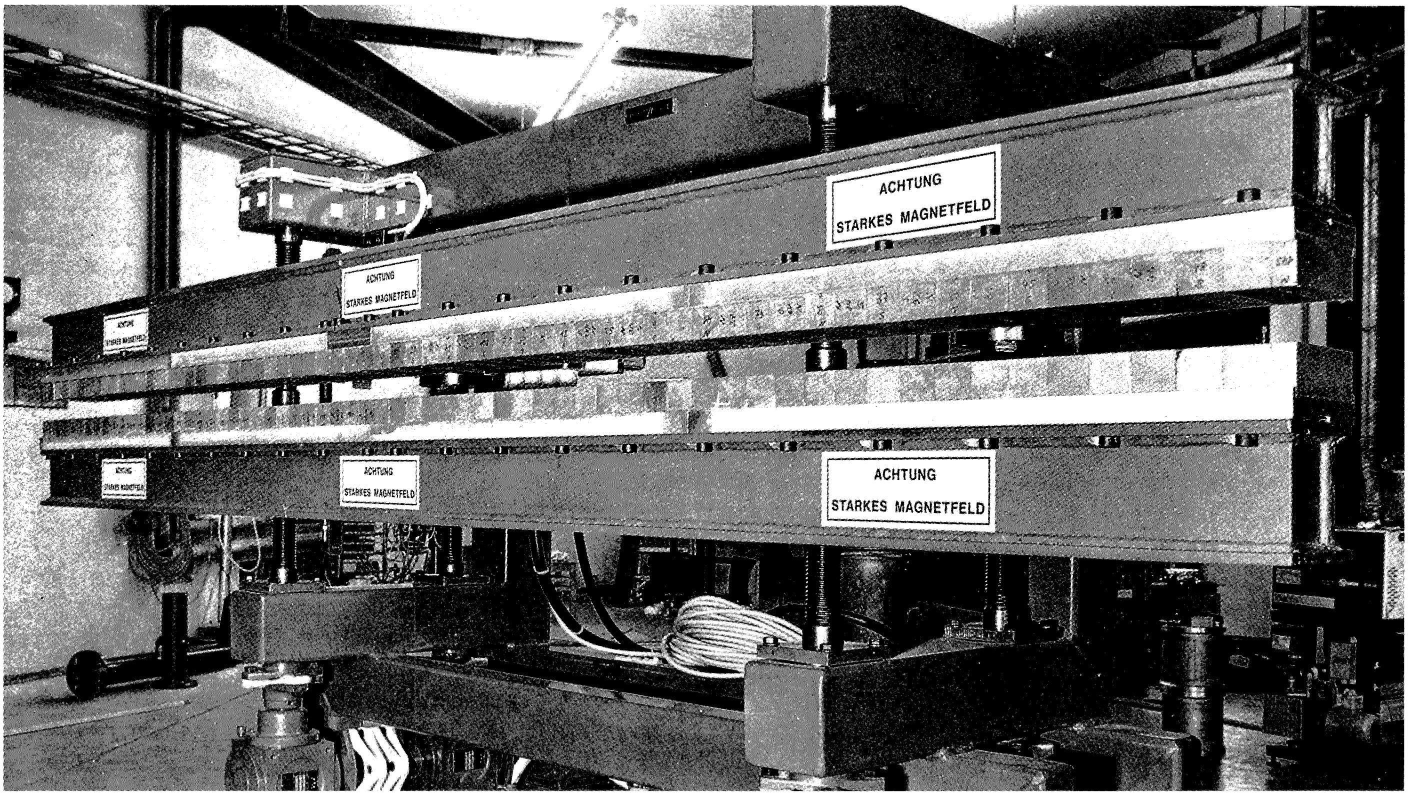
Although these single-cell results are very encouraging, extrapolating such results to a practical multi-cell cavity has not always been straightforward. Besides the problem of maintaining quality in the fabrication of the individual cells of a multi-cell cavity, performance can be lost in welding cavities together. Furthermore, previous experiments indicated that the waveguides necessary to extract higher order modes in practical accelerator cavities can degrade performance.

To test the new design under accelerator operating conditions, two five-cell cavities, each equipped with two higher mode waveguides, were prepared for a beam test in the CESR storage ring. In tests, one of the two modules reached an accelerating gradient of 8 MV/m at a Q of 3×10^9; the second one reached 15.3 MV/m at a Q of 2×10^9, with the Q nearly constant at 4×10^9 below 11 MV/m. Previous performance by multi-cell superconducting cavities equipped with higher mode coupling guides has been in the neighbourhood of 4 MV/m.

With these results, practical superconducting accelerating cavities have reached a new performance regime. If they can be reproduced under accelerator operating conditions and with the mass production of such cavities, they are good news for the big electron rings being built at CERN (LEP), KEK in Japan (TRISTAN) and DESY in Germany (HERA).

The wiggler magnet now installed at DORIS II, showing its small component samarium-cobalt blocks.

(Photo DESY)



DESY
Wiggling at DORIS

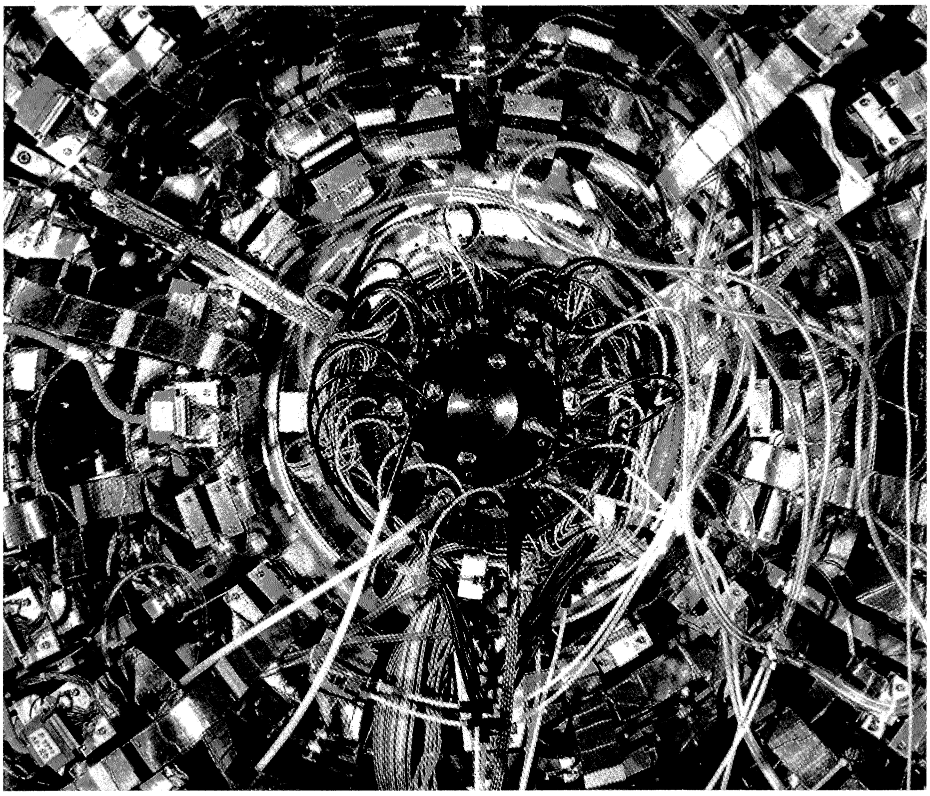
This summer, a 2 metre-long wiggler magnet closed its magnetic teeth around the slim beam pipe of the DORIS II storage ring, running with 60 milliamps of electrons at 3.7 GeV. Exactly 361 watts of emitted photon radiation were immediately registered in the beam direction — compared with 365 computed from theory. This corresponds to a factor of 10 to 50 — depending on the photon energy — more than the synchrotron radiation obtained under similar angular conditions in a normal bending magnet. Machine operators were very happy to find no deterioration of the beam or of the running conditions. They also injected new particles into the storage ring without removing the wiggler magnets and did not find any problems.

(As well as running as an electron-positron collider for particle physics experiments, the DORIS II ring at the German DESY Laboratory also runs periodically with just electrons, supplying synchrotron radiation for HASYLAB — the Hamburg Synchrotron Radiation Laboratory.)

Wigglers for the production of synchrotron radiation have already been installed in several Laboratories (see March 1983 issue, pages 47-49). Pioneer work was done on this field by Klaus Halbach (permanent magnet design) and by Hermann Winick (designing and operating wigglers for SSRL, the Stanford Synchrotron Radiation Laboratory) at Berkeley and Stanford. Winick was previously at the Cambridge (USA) Electron Accelerator, where Ken Robinson had proposed using wigglers to increase radiation damping of stored beams. Soviet physicists also made early and original contributions. In Western Europe, wigglers were developed for ADONE at Frascati, for DCI at Orsay, for Daresbury and recently for LEP (see June issue, page 191).

The wiggler now operating at DORIS was designed in 1982 by Peter Gürtler (from HASYLAB) and visitor Alan Jackson from Daresbury. It is optimized for the production of synchrotron radiation in the particular conditions of the DORIS II storage ring. It was built at HASYLAB, and installed at DORIS in April. One of the problems which had to be overcome was that particle injection takes place just where the wiggler is installed!

Small permanent magnets built from blocks of samarium-cobalt provide a field of .6 tesla with a gap of 34 mm. Four blocks form a period 132 mm long and the whole magnet



End-on view of the ASTERIX detector at the CERN LEAR Low Energy Antiproton Ring which has succeeded in seeing the K spectral lines from the lowest lying energy level transitions in antiprotonic hydrogen. In the centre can be seen the special X-ray drift chamber which surrounds the hydrogen gas target.

(Photo CERN 399.9.83)

is made of 16 periods. The opening angle of the produced photon beam is 2.2 mrad with 3.5 GeV electrons and 1.5 mrad at 5.0 GeV.

While at low energy machines, strong wiggler magnets are used to shift the spectrum of the emitted photons to higher energies, at DORIS this is not necessary. The machine already has an excellent spectral range reaching hard X-rays, due to the high energy of the circulating particles. At DORIS the wiggler can be optimized to deliver higher photon fluxes in the horizontal aperture.

The photon beam from the wiggler goes into the main HASYLAB hall (see May 1981 issue, page 157) which is at present one of the best facilities available for experiments with synchrotron radiation. There are 24 fully installed measuring stations using beams from the DORIS II bending magnets. The new wiggler beamline will cater for experiments in the X-ray range, for surface structure analysis (surface EXAFS, surface Bragg diffraction and X-ray standing waves) and in the soft X-ray region for photoemission and photon stimulated desorption experiments. The latter will also help to understand and solve vacuum problems in electron storage rings.

There are new plans for an additional experimental hall at DORIS to be supplied with a wiggler beam optimized for hard X-rays. This photon beam should be well suited for medical applications like computer angiography of blood vessels in the heart region (see March 1983 issue, page 47). The new facility is proposed to be ready in 1986.

(From E.-E. Koch)

CERN K-LEAR signal

The study of exotic atoms, in which an orbital electron of a conventional atom is replaced by an antiproton or other negatively-charged particle, can supply a wealth of detailed information on nuclear forces and has long been a speciality at CERN. The availability of intense beams of low energy antiprotons at CERN's LEAR ring considerably extended the possibilities with antiprotonic atoms (see March issue, page 54).

Information on the forces at work between protons and antiprotons can be gleaned from the spectroscopy of the simplest exotic atom — protonium or antiprotonic hydrogen — with a proton and an antiproton orbiting round each other under the influence of their electromagnetic attraction.

Antiprotonic hydrogen can be formed simply by stopping a beam of antiprotons in a hydrogen target. Using liquid targets it is easy to stop all the antiprotons, but most of the produced atoms undergo too many collisions with the surrounding hydrogen molecules and annihilate before reaching the ground state, leaving no trace of low-lying spectral lines which could provide vital information on the strong forces.

Using hydrogen gas targets, collision effects are reduced by a factor of about a thousand, so that in principle the very soft (down to 2 keV and therefore difficult to detect) X-rays from the lowest energy level transitions can be reached. However to stop the same amount of incident antiprotons the target must be much longer.

Even before the advent of LEAR, an X-ray detector with large angular acceptance and low threshold, used with a gas target, succeeded in seeing the antiprotonic hydrogen 'L' lines — transitions to the energy level just one rung up from the antiprotonic ground state. But the 'K' lines — transitions down to the ground state — remained hidden. There was even speculation whether the 'nuclear' forces between protons and antiprotons were so strong as to completely mask the atomic ground state.

The low energy antiprotons from LEAR stop much more readily. For antiprotonic hydrogen studies, all LEAR groups use gas targets, while new detectors and techniques were developed. The ASTERIX (Antiproton STop Experiment with tRigger on Initial X-rays) experiment by a CERN / Mainz / Munich / Orsay / TRIUMF / Zurich group constructed a 'Spiral Projection Chamber' — an X-ray drift chamber using a radially decreasing electric field providing energy measurement and three-dimensional localization of the produced X-rays. Final annihilation products are picked up in the outer DM1 magnetic spectrometer inherited from electron-po-

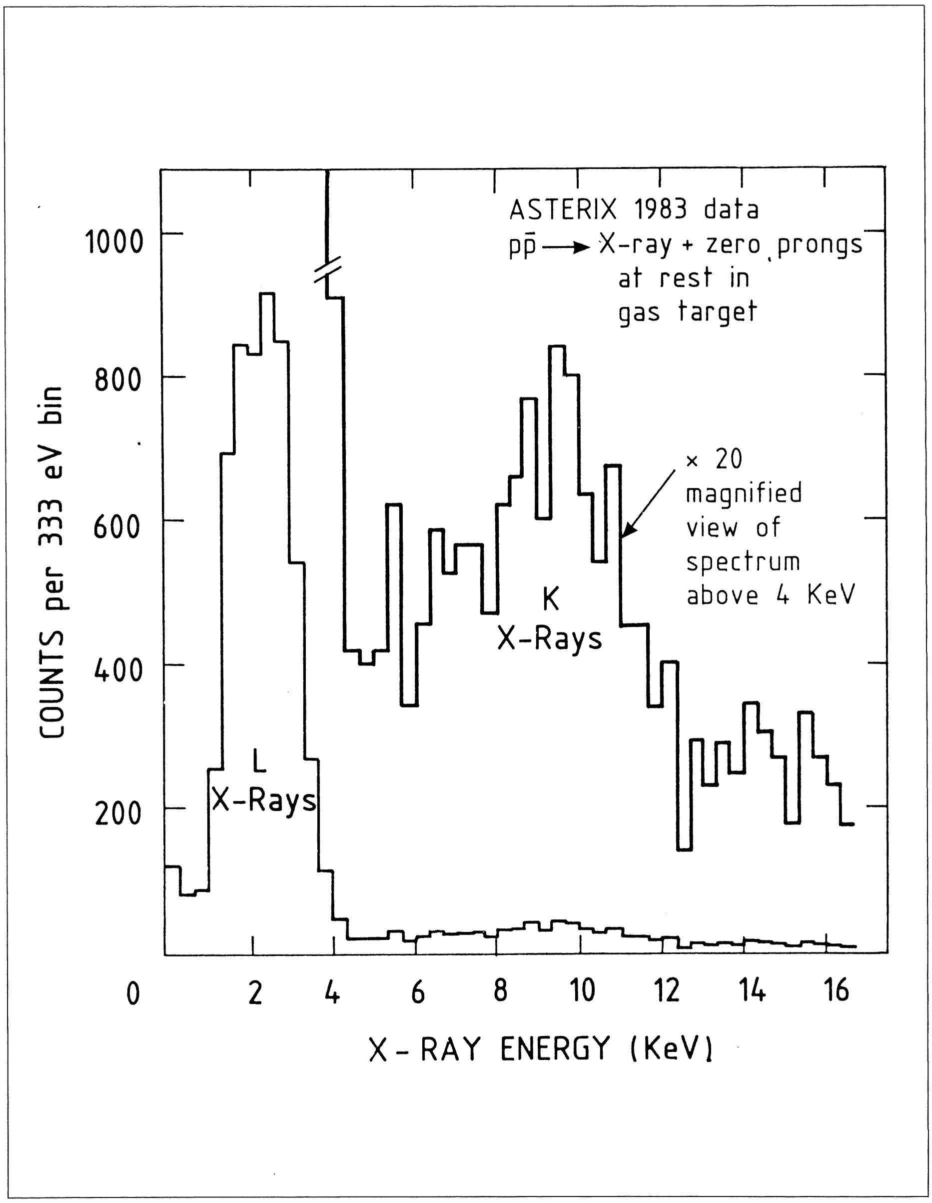
The CERN Courier congratulates Carlo Rubbia and Simon van der Meer of CERN, who share the Nobel Prize for Physics 1984.

sitron colliding beam experiments at Orsay. An Amsterdam / Birmingham / Rutherford / William and Mary College collaboration uses a specially developed silicon detector, while a Karlsruhe group employs a novel technique in which antiprotons rotating in a magnetic field spiral inwards as they lose energy due to gas collisions, accumulating at a central region viewed with a semiconductor detector.

In the analysis of about 150 000 antiprotons annihilating into neutral particles, the ASTERIX group finds some 4000 X-rays due to the atomic L lines (clustered around 2 keV), and about 200 of the long awaited K transitions to the atomic ground state. The first K line is at about 8.8 keV, showing that the ground state in antiprotonic hydrogen is shifted upwards from its 'theoretical' (electromagnetic) level by about 0.5 keV because of the strong interactions between protons and antiprotons. So while the opposite electric charges of protons and antiprotons attract, the strong interaction in the protonium ground state is repulsive.

Another feature is the highly reduced yield of K X-rays compared to the L lines. This shows that atoms attaining the penultimate rung in the energy level ladder have a very high (greater than 95 per cent) probability of annihilating. Only a small proportion manage to emit a K X-ray and attain the ground state.

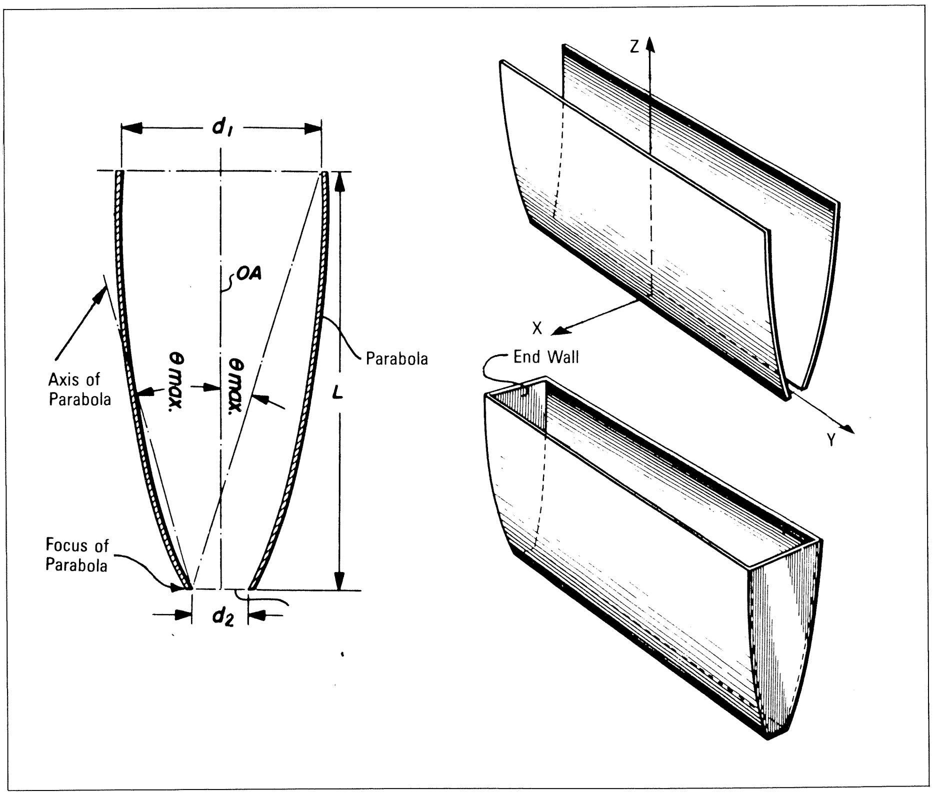
Looking at the events producing an L X-ray, the experiment is able to analyse proton-antiproton annihilations from states carrying one unit of angular momentum (P wave). Zero angular momentum (S wave) annihilations were studied in detail two decades ago in bubble chamber experiments at CERN and Brookhaven, and the comparison of the data will be useful.



The antiprotonic hydrogen X-ray spectrum in the ASTERIX experiment, showing how the K lines are suppressed by proton-antiproton annihilation.

Physics monitor

Left, cross-section profile of a non-imaging cone concentrator such as is used with Cherenkov counters, and right, a two-dimensional trough concentrator suitable for use as a solar energy collector.



From Cherenkovs to solar energy

Ever since the energy crisis of the mid-70s, the use of cheap solar energy has boomed. In many countries, even with quite modest climates, arrays of flat-plate solar energy collectors are used for low temperature thermal applications.

However the intensity which can be intercepted with a simple flat-plate collector is of course limited by the maximum solar flux on the earth's surface, about a kilowatt per square metre, even under favourable conditions. Even using subtle refinements, the temperature which can be attained with these systems is insufficient to achieve significant increases in the efficiency of heat engines.

To attain higher working temperatures and increased efficiencies, the collectors have to concentrate the incident solar energy into a much smaller area. However problems of geometrical optics limit the efficiency of mirror systems which produce a reduced image of the sun.

An alternative approach has emerged from work on coupling photomultipliers to Cherenkov counters and other extended light sources. Rather than producing an accurate image of the object, the main criterion with these optical concentrators is instead to bring the collected rays together on a minimal area of sensitive absorber.

For Cherenkov counters, these non-imaging optical couplers are cones whose cross-sections take the form of tilted parabolic segments. For solar energy applications, these cones have to be accurately positioned and guided to follow the sun. This is avoided with a (tilted) parabolic trough design. With its long axis aligned East-West, such a collector can achieve moderate concentration (up to a factor of ten) without following the sun, and can even maintain useful concentrations (factor of two) maintaining a fixed position all year.

The basic tilted parabolic trough design has now been considerably refined. Non-evacuated collectors, where a high temperature is not the main objective, outperform the classic flat-plate collector. For high performance, dewar-type vacuum containers are used for the outside walls, with production models having highly integrated components. Such versions have been introduced in the US and in Switzerland, while development work on non-imaging optics and its applications continues in university laboratories throughout the world.

(From information supplied by Roland Winston, Enrico Fermi Institute, University of Chicago)

Synchrotron radiation in the Soviet Union

Ingold Lindau, Associate Director of the Stanford Synchrotron Radiation Laboratory, was one of the two US participants at the National Synchrotron Radiation Conference held in Novosibirsk in July. The meeting was attended by 200 Soviet scientists and about a dozen international visitors. The working language was Russian, but simultaneous translation into English was available. Here is an update on the present situation on facilities for synchrotron radiation research in the USSR, culled from Prof. Lindau's excellent trip report.

At the Novosibirsk Institute of Nuclear Physics itself, two electron storage rings are used intermittently for such research. The first is VEPP-2M which is a dedicated radiation

People and things

source for some 40 days per year. It then operates at 750 MeV with typical currents of 50 mA and beam lifetimes of 3 to 4 hours. Six experimental stations are in operation and four more are nearing completion. One is heavily used for X-ray lithography (including wafer exposures for integrated circuits) and a further large experimental area for lithography is being built, intended mainly for industrial use. Other research includes spectroscopy — reflectivity and luminescence measurements — with photoelectron work on surfaces and interfaces under preparation.

A helical undulator, yielding circularly polarized light, had been installed in one of the straight sections but is now removed in a ring reconfiguration. Intended for operation in 1986 is a 7.8 T superconducting undulator which is nearing completion in the Institute workshop. The development of undulators and optical klystrons as radiation sources is particularly interesting.

The second storage ring is VEPP-4 which is used for synchrotron radiation research in a dedicated mode for 40 days per year and in a parasitic mode for the rest of the time when the primary aim is particle physics. It typically operates at around 5 GeV with 30 mA beams and lifetimes of 6 hours or more. Six stations are devoted to X-ray work (EXAFS, diffraction, small-angle scattering, angiography, microscopy). There is excellent work in trace element analysis, dynamical processes in materials, and scanning microscopy.

The Novosibirsk Institute has also built a 450 MeV ring, called Siberia-I, for the Kurchatov Institute in Moscow. Operational responsibility was handed over in February of this year when the design current of 100 mA was achieved. However operating currents are usually limited to some 80 mA and reliability still needs to be improved. The main problems are bad vacuum and poor injector matching. Sixteen beamlines can be installed around the ring and two are in operation. A second ring, Siberia-II, is being planned for 2.5 GeV beams; it is unlikely to be in action before 1990.

At Yerevan the 6 GeV electron synchrotron is used for synchrotron radiation research for about 10 per cent of the time with currents of 10 mA. There are three beamlines (one for studying radiation effects and biological diffraction, one for EXAFS and spectroscopy, and the third for small angle scattering). There are plans for a 1.5 to 1.8 GeV dedicated machine.

Wolfgang 'Pief' Panofsky and his wife Adele proudly display the medal received during the ceremony in which he was awarded the degree of Doctor of Natural Sciences honoris causa by the University of Hamburg.

(Photo P. Waloschek)

Panofsky stands down

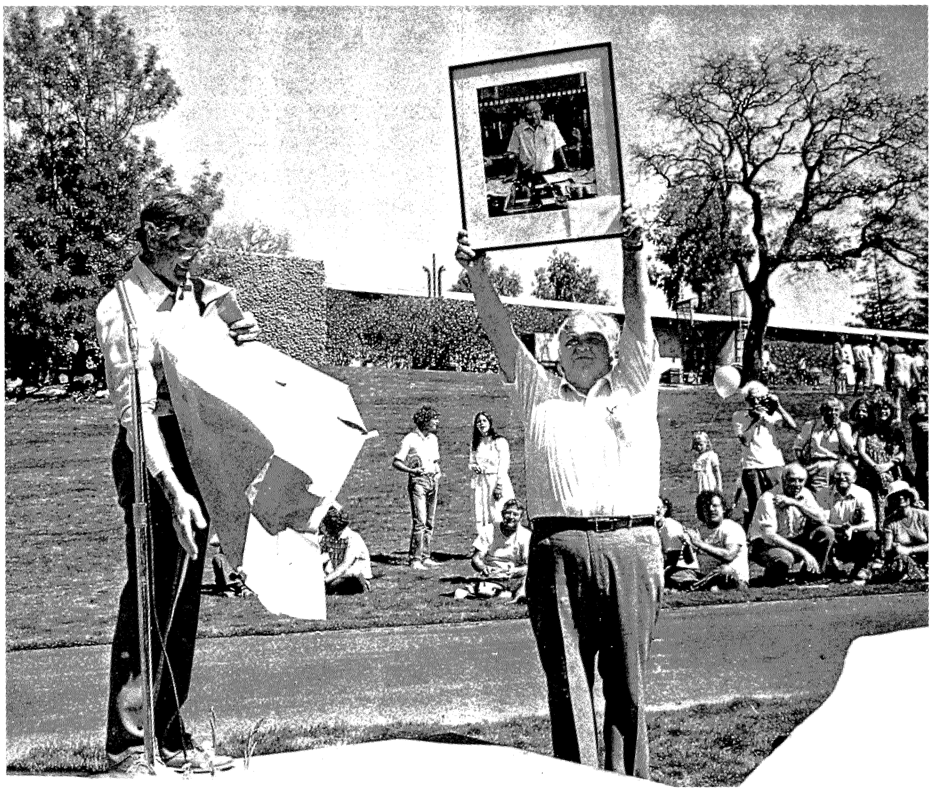
A landmark event took place at Stanford on 3-4 August in the form of a 'Pief-fest', a celebration tacked onto the end of the traditional annual Stanford Linear Accelerator Center (SLAC) Summer Institute to mark the retirement of Wolfgang 'Pief' Panofsky as the Laboratory's Director.

This was no ordinary retirement. As Stanford University President Donald Kennedy once said, 'If the institution is the shadow of the man, in the case of Pief Panofsky that shadow is two miles long.'

Friends and colleagues gathered to pay tribute to a man who, as well as pioneering the use of big electron machines and creating the SLAC Laboratory, is also known all over the world through his contributions to physics, his

To mark the retirement of Wolfgang 'Pief' Panofsky as Laboratory Director, the Stanford Linear Accelerator Center (SLAC) was recently the scene of a 'Pief-fest'. Here new SLAC Director Burt Richter holds aloft a framed photo of Panofsky at his desk, presented on behalf of SLAC and Berkeley users by John Matthews, left.

(Photo Joe Faust)



teaching, his deep involvement in science policy, and his steadfast commitment to peaceful international collaboration. He also holds the honour of being one of the few physicists to be profiled by 'Playboy' magazine, which dubbed him 'arguably the brightest man in the world'.

At the Pief-fest, SLAC Deputy Director Sidney Drell declared 'Pief's achievements and leadership are so important, so extensive and diverse that there is an almost endless list of reasons for us to welcome this opportunity to be here today to honour him. But perhaps no reason is more compelling than the warmth of our affection for this friend we all cherish.

'I am amazed at the invariance principles that characterize all of Pief's actions and interactions,' Drell continued. 'His optimism, his warmth, his patience, his integrity, his kindness, his courage, and his persistence — like the gravitational constant or the fine structure constant — haven't wavered or altered one bit during all these years. Neither have his clothes, habits or geometry!'

Panofsky's successor as SLAC Director is Burt Richter, who was master of ceremonies for a series of tributes to Panofsky at SLAC's Family Day, culminating in the dedication of a grove of redwood trees, given by the SLAC staff as a symbol of affection and respect.

In September, Panofsky travelled to Europe where he was one of the principal speakers at the ceremony to mark the 25th anniversary of the German DESY Laboratory in Hamburg (an event which will be covered in our December issue).

On 25 September, the former SLAC Director was awarded the degree of Doctor of Natural Sciences honoris causa by the University of Hamburg. In his speech, Panofsky underlined the common interest in electron accelerators at Hamburg and Stanford.

The occasion was especially apt as Hamburg was the city in which Panofsky grew up, and his father, Erwin, was one of the University's first professors, teaching the history of arts.

Ernst Stueckelberg

Ernst Stueckelberg, giant of modern theoretical physics, died in Geneva on 4 September. His influential work spanned wide areas, including molecular spectroscopy, relativity and thermodynamics as well as particle physics and field theory. In the late 1930s, he was among the pioneers already applying the nascent theory of quantum fields long before the advent of the powerful techniques which emerged in the 1940s. The classic work 'Introduction to the Theory of Quantized Fields' by N. N. Bogoliubov and D. V. Shirkov explicitly underlines Stueckelberg's subsequent role in developing the modern formulation of quantum field theory.

In 1953, he went on to lay the groundwork for the renormalization

Ernst Stueckelberg.

Historic picture of the four Chairmen of the Directorate of the German DESY Laboratory since its foundation 25 years ago. Left to right and in order of term of office, Willibald Jentschke, Wolfgang Paul, Herwig Schopper and current Chairman Volker Soergel. All four have also participated significantly in CERN affairs, Schopper of course being the current CERN Director General. The picture was taken at the celebrations for the 25th anniversary of the foundation of DESY (report in our next issue).

(Photo DESY)

group, so profitably exploited in condensed matter physics as well as particle physics. During the last twenty years of his life, he turned his attention to thermodynamics, and in 1976 he received the prestigious Max Planck Award from the German Physical Society. In addition to his contributions to physics he will be long remembered for his scientific integrity and rigour.

Design centre for Superconducting Super Collider

The University of California's Lawrence Berkeley Laboratory has been chosen as the host institution for the Central Design Group for the Superconducting Super Collider (SSC) — the 20 TeV colliding beam accelerator recommended for construction by the US Department of Energy's High Energy Physics Advisory Panel (HEPAP). Maury Tigner of Cornell is the Group's director.

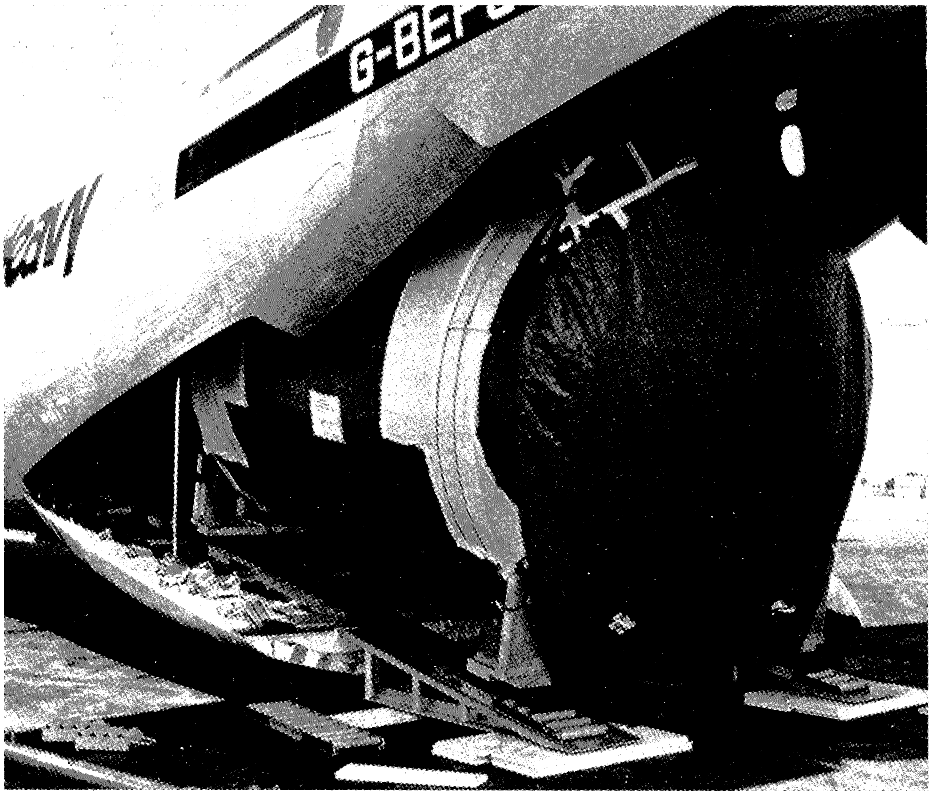
Design work for the accelerator will take about three years, and construction would require an additional six years. The total construction cost of the project is estimated at approximately $3000 million.

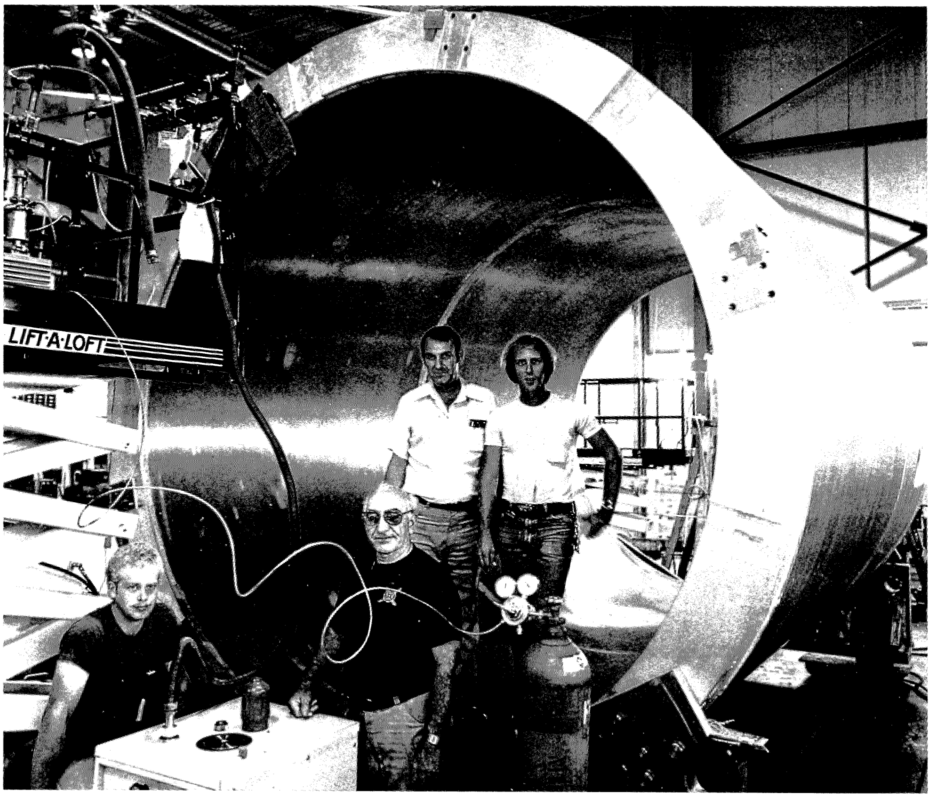
The choice of location for the design centre in no way affects the eventual choice of a construction site for the SSC. Vigorous competition is already developing for that honour. The location will be determined in part by the extensive land requirements for an accelerator ring expected to be up to 100 miles in circumference.

The Department of Energy decided to proceed with research and development for the SSC after a reference design study was submitted earlier this year. DOE has commissioned the Universities Research Association (URA), an organization of 54 leading research universities, to take responsibility for the research and development phase. URA has created a Board of Overseers chaired by Boyce McDaniel of Cornell.

The SSC Central Design Group at Berkeley is responsible for the direction and coordination of all of the first phase of activities — preparation of the conceptual design, performance of backup research and development, preparation of site criteria, preparation of the construction plan proposal and other activities essential to developing an acceptable SSC proposal for Department of Energy approval. The actual design work and other research and development tasks, however, will be carried out at many research centres throughout the US.

The elements of the Fermilab Collider Detector begin to come together. Above, the large superconducting coil for the detector slips out of the belly of the transport plane. The coil was designed by Fermilab, Tsukuba University and Hitachi, funded by Tsukuba and built at Hitachi. Below, the magnet (3 m in diameter and 5 m long) at Fermilab. With its iron yoke in place, it is designed to provide a field of 15 kilogauss at a current of 5000 amps. The coil has been tested to 2800 amps in Japan.





Earlier this year Presidential science adviser George A. Keyworth, testifying before the House Committee on Science and Technology, called the physicists' decision to focus on the SSC 'a bold step... I believe such a project has strong merit if it can be designed and built for a reasonable cost, in a reasonable time frame. We're proposing that we begin the process of trying to find out.'

After a period of initial groundwork, SSC plans are beginning to crystallize, and we will be carrying much more news of this ambitious new project in the months to come.

Meetings

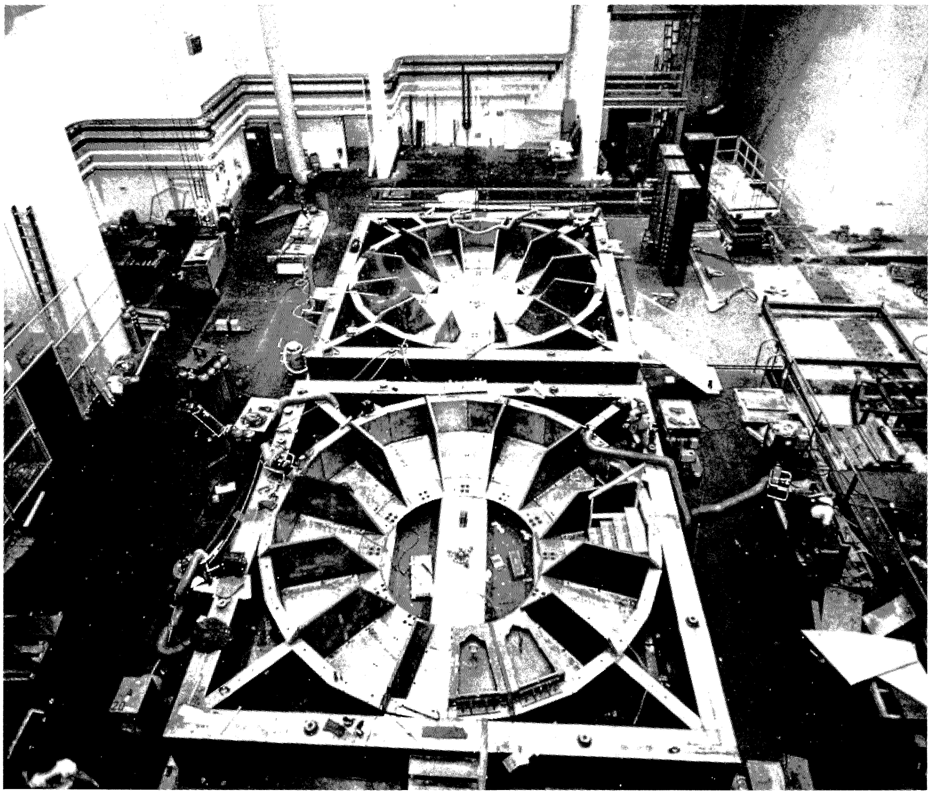
The fifth Topical Workshop on Proton-Antiproton Collider Physics will be held in Saint-Vincent, Aosta Valley, Italy, from 25 February to 2 March 1985, continuing the series of noteworthy meetings (Rome 1983, Bern 1984). The number of participants will be limited to about 300, with priority being given to physicists active in the field. Further information from Mario Greco, Laboratori Nazionali, INFN, C.P. 13-I-00044, Frascati, Italy, or Rudolf Böck, EP Division, CERN, 1211 Geneva 23, Switzerland.

The local users' organization at the Stanford Linear Accelerator Center is organizing a Workshop on Electron-Positron Physics at High Luminosities, to be held at SLAC from 30 November to 1 December. Its object is to review the physics possibilities opened up by the 'microbeta' installation scheduled to be operational at the PEP electron-positron ring in 1986. Information from Jeffrey Weiss, c/o Helen Mogilev at the Workshop Secretariat, SLAC, Bin 96, Stanford University, Stanford, California 94305, USA.

The Aspen (Colorado, USA) Center for Physics announces a Winter Physics Conference Series — Collider Physics at Ultrahigh Energies from 6-12 January 1985 and Electroweak Interactions from 13-19 January. Attendance is limited to invited participants. Information from Prof. Martin Block, Physics Department, Northwestern University, Evanston, Illinois 60201, USA.

On people

To mark the 80th birthday of D. Ivanenko of Moscow University, his colleagues organized a symposium in October, featuring presen-



Above, the two endpieces of the Fermilab Collider Detector magnet superstructure are welded together on the floor of the BO pit which will house the complete detector. Tests of the complete magnet are scheduled for December. Below, work in progress for the housing of the proton extraction system to feed the new Fermilab antiproton source.

(Photos Fermilab)

tations and discussions by Soviet scientists on 'the Modern Picture of the World'. Prof. Ivanenko began to make his mark on the Soviet theoretical scene at the end of the 1920s, and his subsequent work has spanned many areas of theory, including nuclear forces, synchrotron radiation, gravitation... As well as being the author of two books, he has played a major role in scientific publishing. In 1932 he was the organizer of a central Soviet physics journal in western languages, and he has served on the editorial boards of both Soviet and foreign journals.

75 on 50

To mark the 75th birthday of Italian physicist Gian Carlo Wick, Soviet researchers S. M. Bilenky and B. Pontecorvo have written a stimulating article 'neutrinos from decays of intermediate W and Z bosons', submitted to Nuovo Cimento Letters.

Professors Pontecorvo and Wick were among the honorary guests of the National Meeting of the Italian Physical Society held in Bologna earlier this year to mark the 50th anniversary of Fermi's first formulation of the theory of nuclear beta decay (see September issue, page 272). The other guests honoured for their distinguished contributions to the field of weak interactions were Edoardo Amaldi, Milla Baldo Ceolin, Gilberto Bernardini, Nicola Cabibbo, Piero Caldirola, Carlo Castagnoli, Marcello Conversi, Giuseppe Fidecaro, Ettore Fiorini, Raoul Gatto, Alberto Gigli Berzolari, Luciano Maiani, Giuseppe Occhialini, Emilio Picasso, Oreste Piccioni, Giampietro Puppi, Franco Rasetti, Bruno Rossi, Antonio Rostagni, Carlo Rubbia, Giorgio Salvini, Claudio Villi, Gleb Wataghin, Emilio Zavattini and Antonino Zichichi.

CERN Collider back in action

As this edition was going to press, the CERN SPS proton-antiproton collider was back in action for physics for the first time since the historic run last year which produced the Z particle and the first evidence for the sixth ('top') quark. This time, the Collider is providing 630 GeV collision energy, compared to the 540 GeV in previous runs, and the initial collision rates are good.

RESEARCH ASSOCIATE POSITION

Duke University
High Energy Physics Group

The Duke high energy physics group has a research associate position available starting January 1985. There is the possibility of teaching part time for applicants with appropriate qualifications. The tenure of the position would generally be three years.

The research program at Duke consists mainly of experiments run at CERN and FNAL. Charm and beauty production is being studied using ($\pi\pm$, $p\pm$) p interactions in the momentum range 400 to 1000 GeV/c (CERN exp. NA-27, FNAL exp. E-705 and E-743). A quark-gluon plasma search using $\bar{p}p$ collisions at $\sqrt{s} = 2$ TeV will be carried out at FNAL in 1986 (E-735).

Applicants should contact

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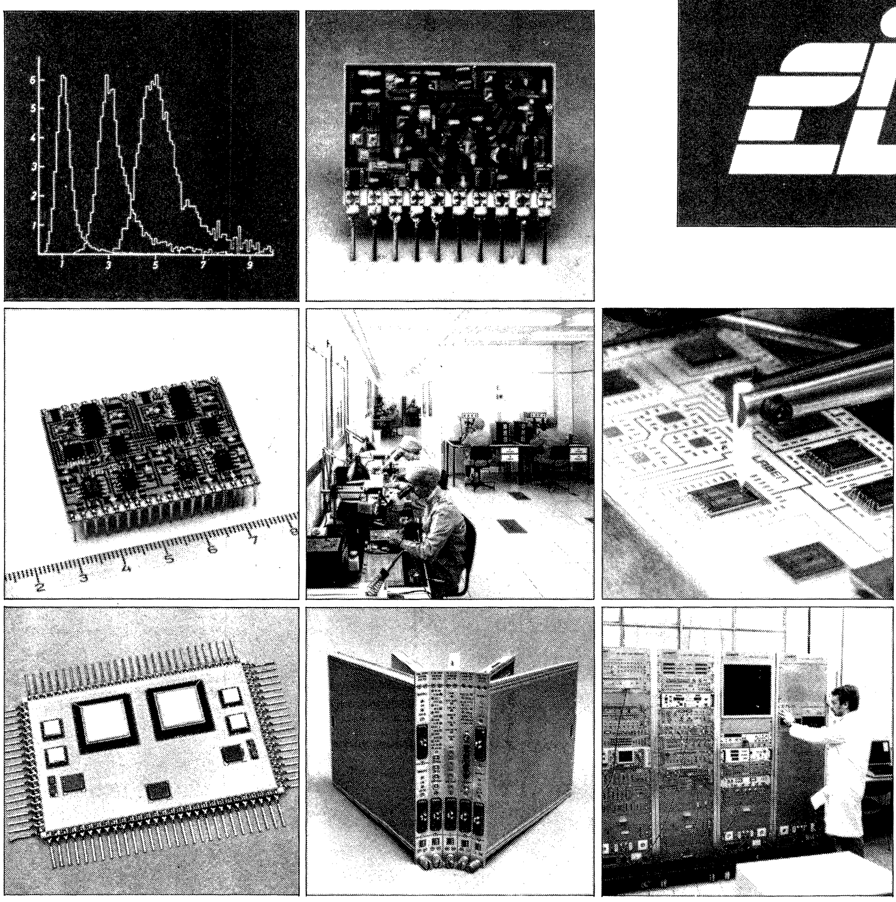

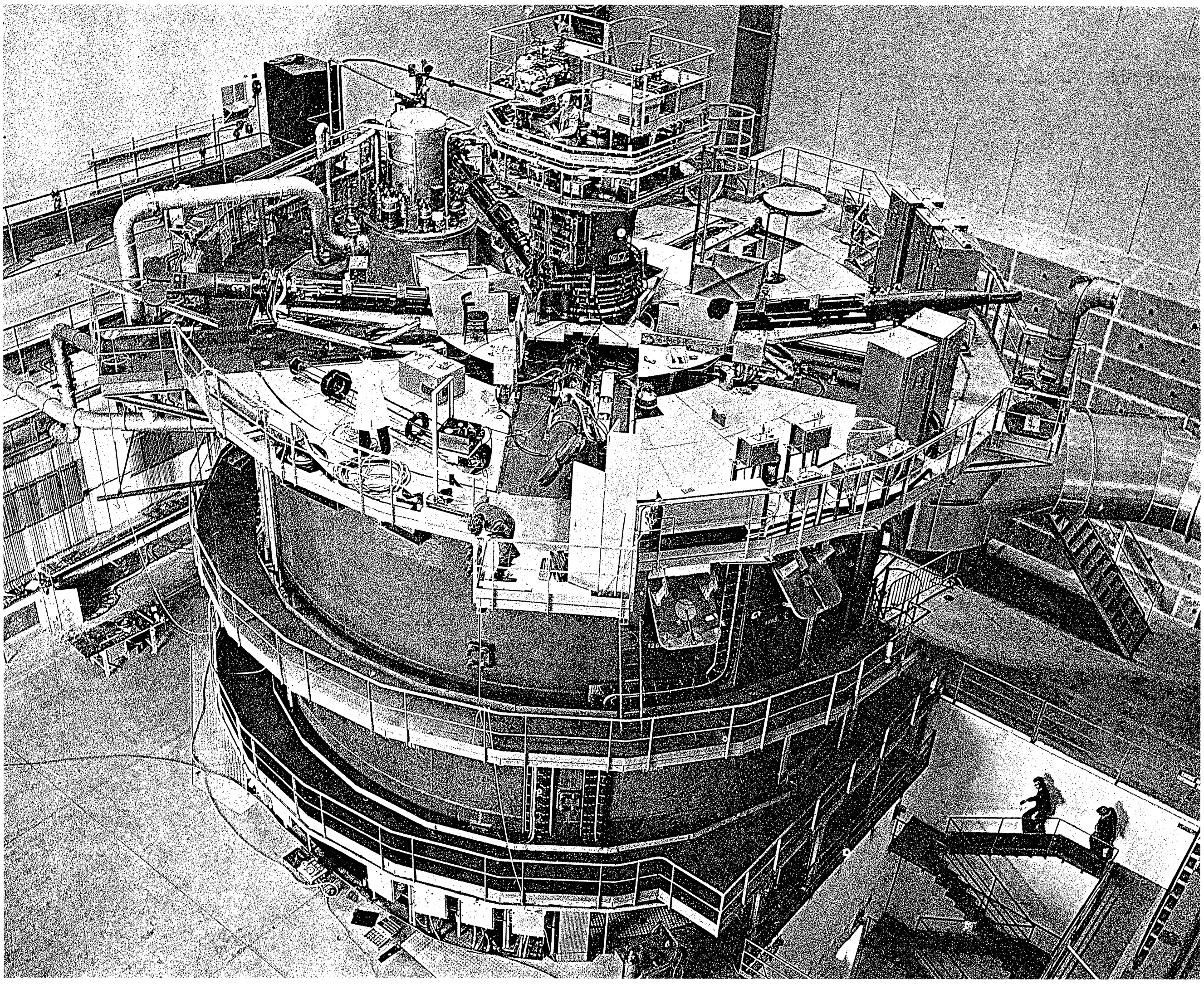

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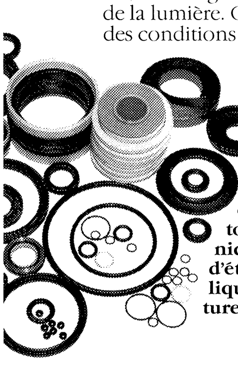

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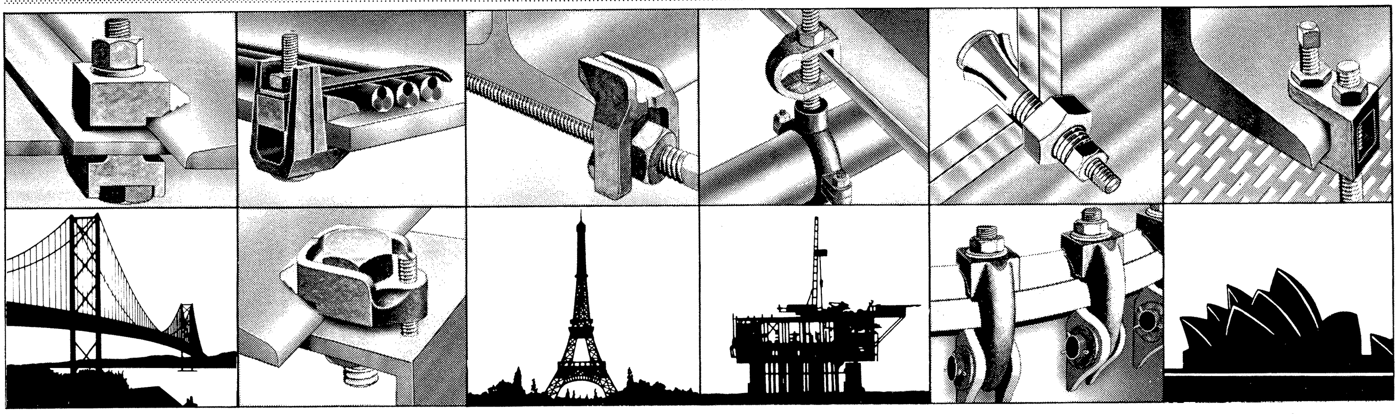

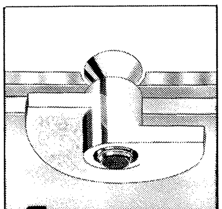

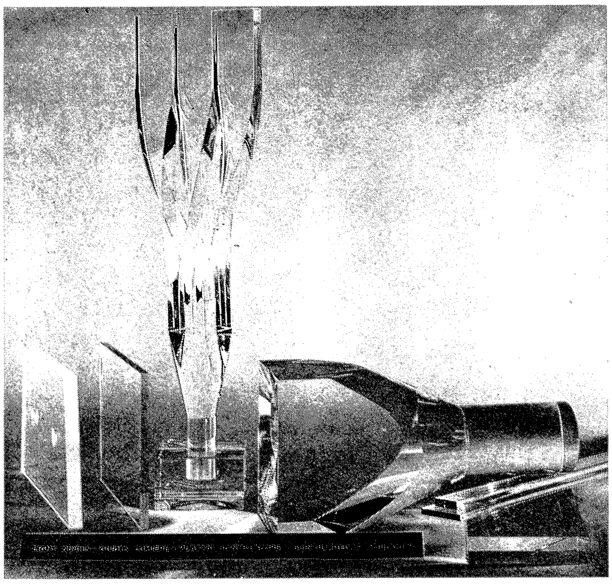

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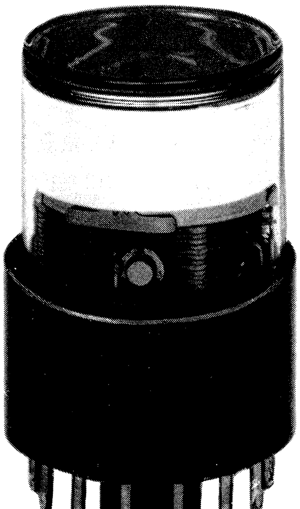

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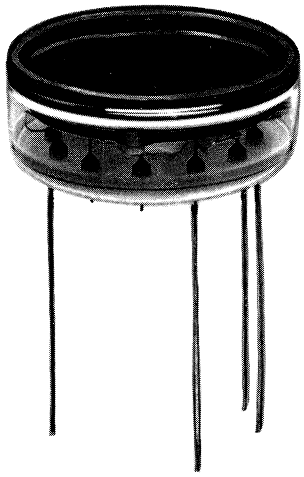

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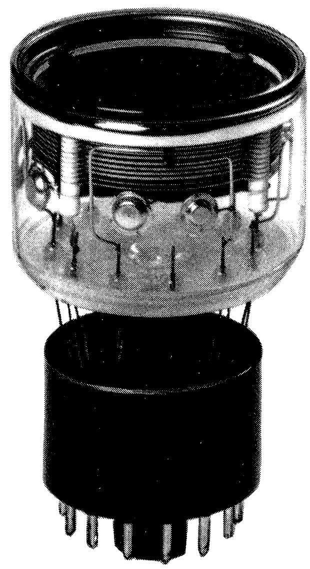

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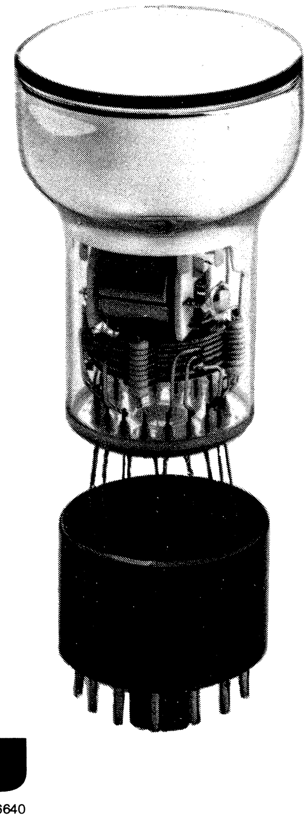

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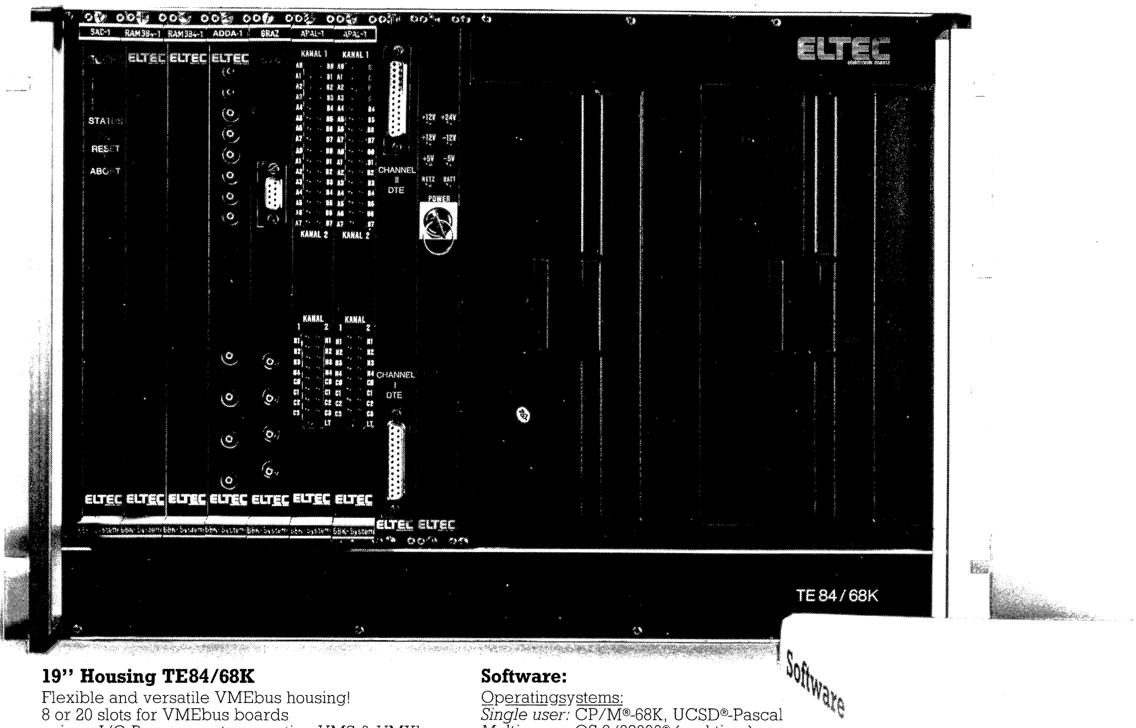

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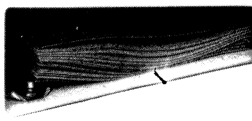

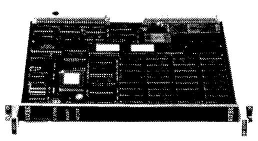

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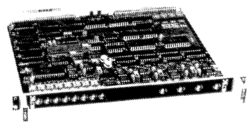

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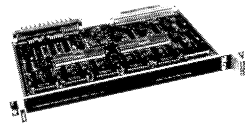

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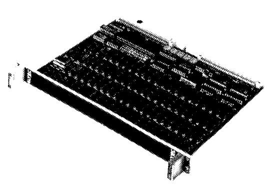

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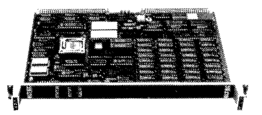

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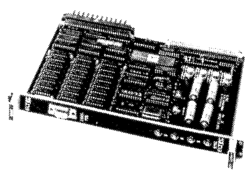

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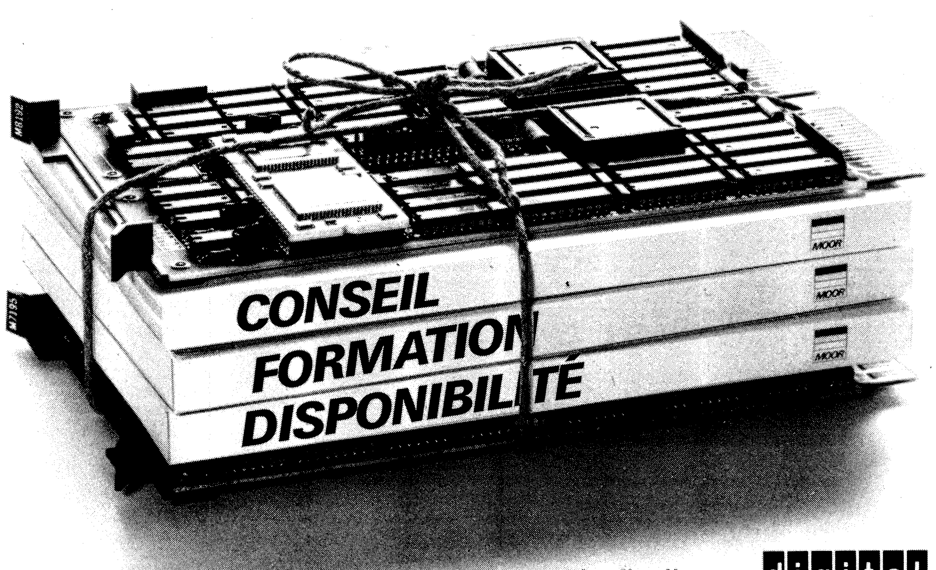

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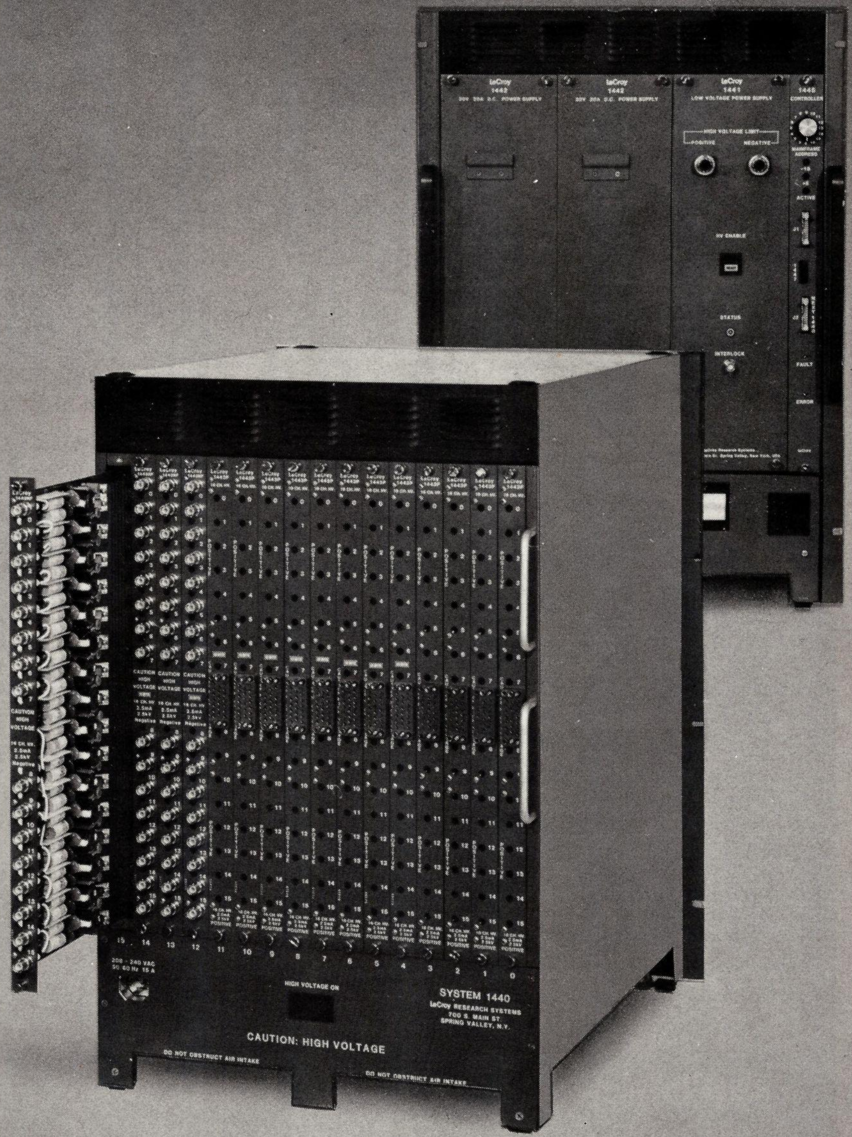

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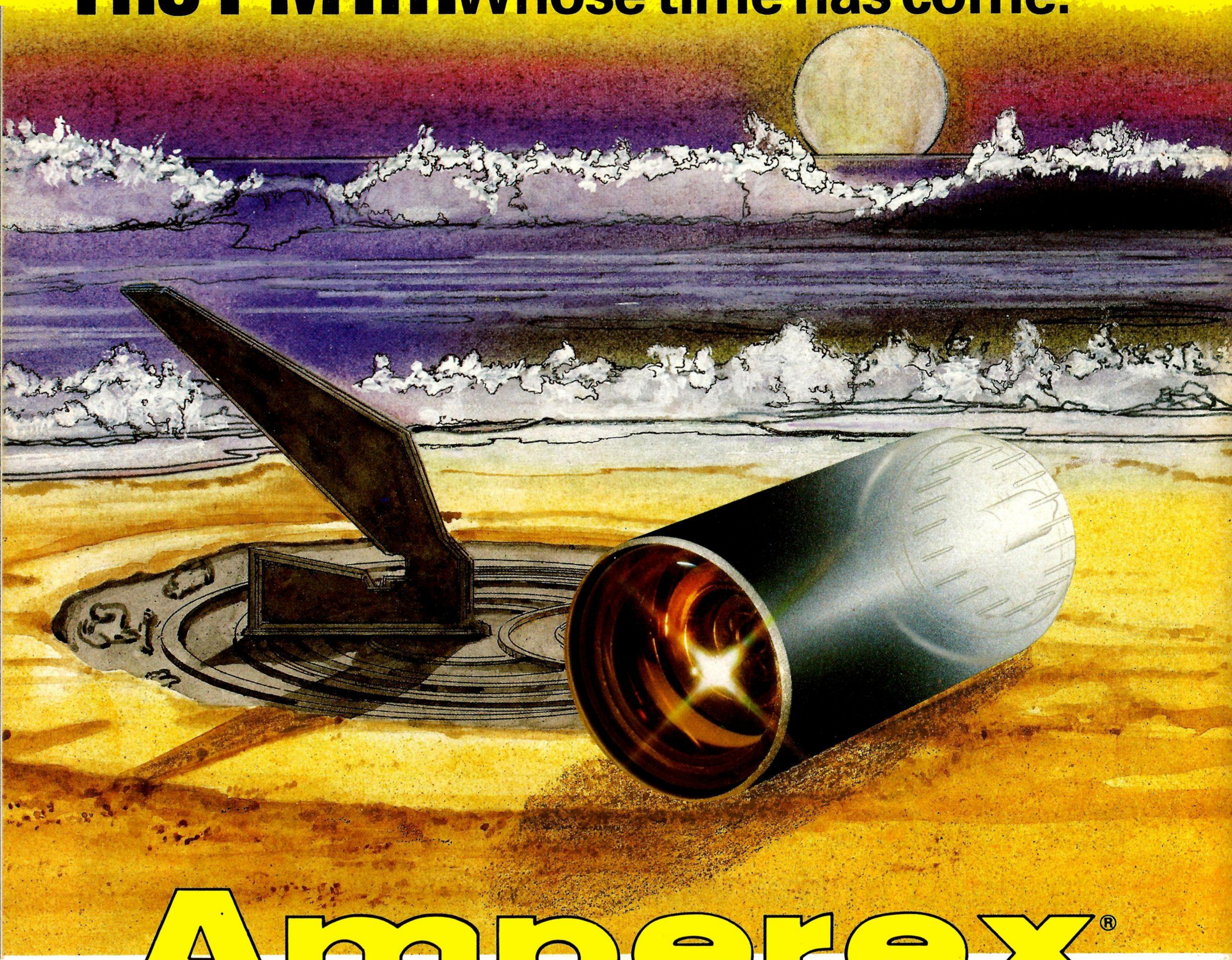

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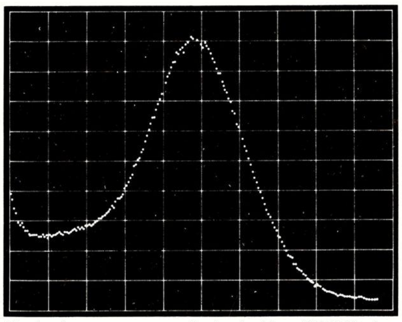

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