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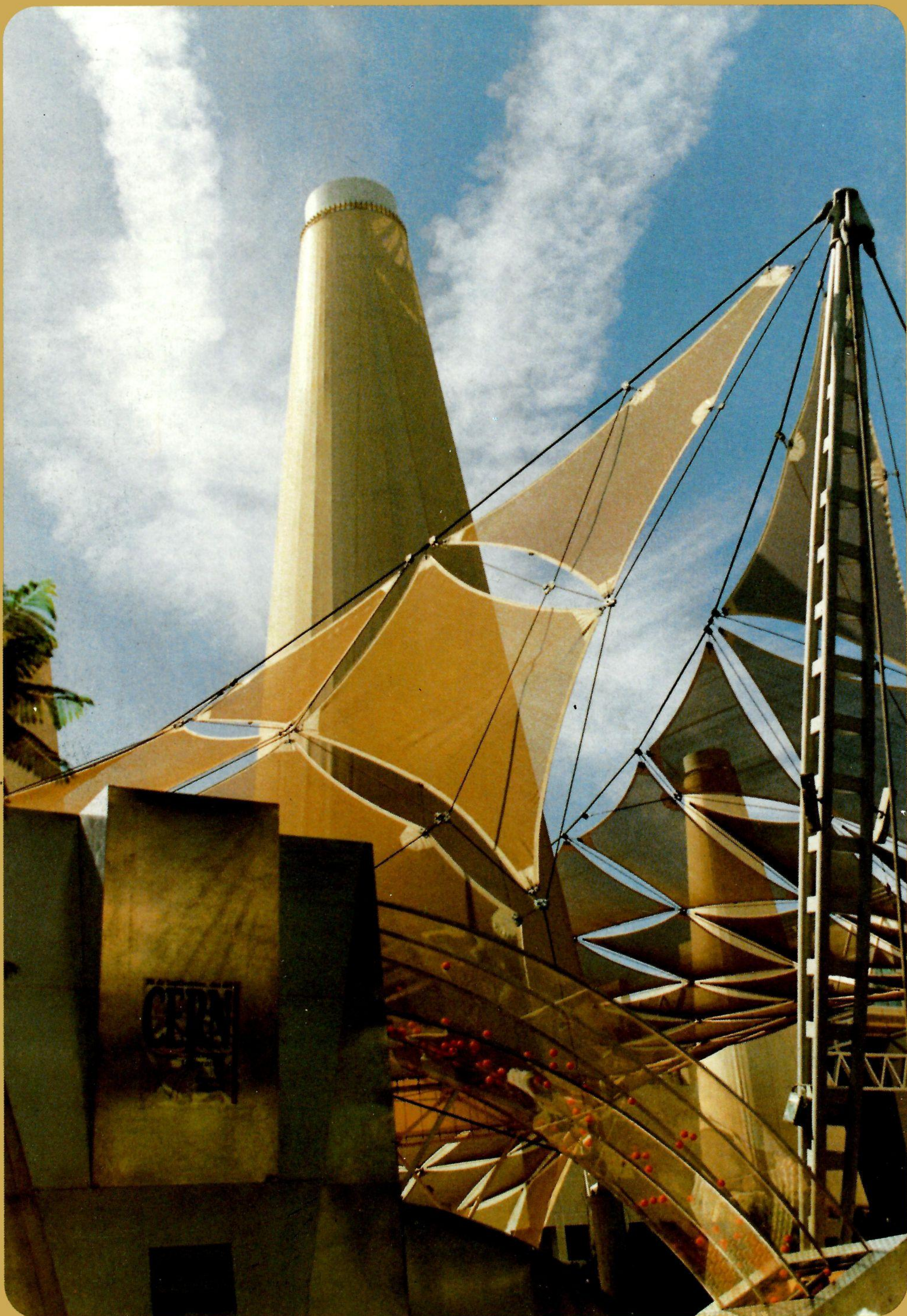

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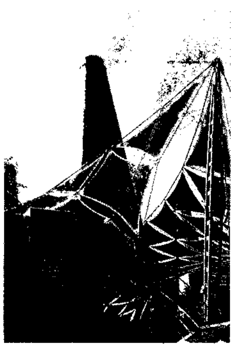

Cover photograph: The particle accelerator float in the 30 September CERN Day parade at Seville's Expo 92 (Photo CERN EM15.10.92).

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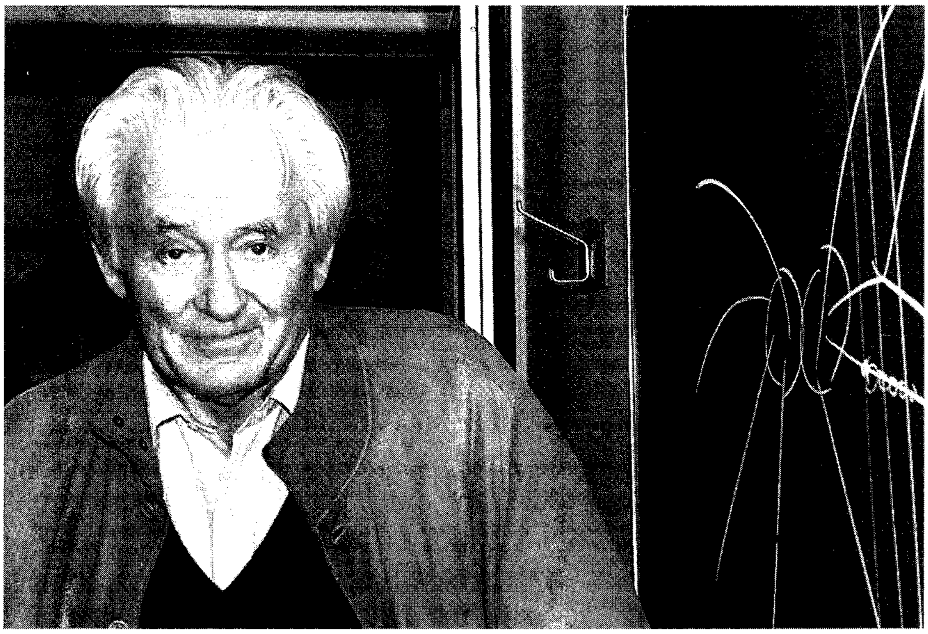
Georges Charpak
Nobel Physics Prize 1992



Georges Charpak at CERN just after hearing the Nobel news.

Wednesday 14 October looked like being a day like any other for detector specialist Georges Charpak. Except he had an unwelcome appointment with the dentist early that afternoon. Late that morning he was able to telephone to cancel the appointment. 'I have a small problem...', he explained.

The problem was the announcement that Georges Charpak receives 1992's most prestigious award for physics – 'for his invention and development of particle detectors, in particular the multiwire proportional chamber – a breakthrough in the technique for exploring the innermost parts of matter', reads the citation from the Royal Swedish Academy of Sciences.

A means of making the invisible become visible, Charpak's Nobel-winning contribution has an immediate appeal to the man in the street, who is often left in the dark about the significance of other major science awards, not that these are any less important for the development of their subject.

Physics is all about observation, and improved measuring techniques have always been at the forefront of new directions in science. Just as development of the microscope and the telescope did in the seventeenth century, so the new methods of the 20th century have lifted scientists' horizons.

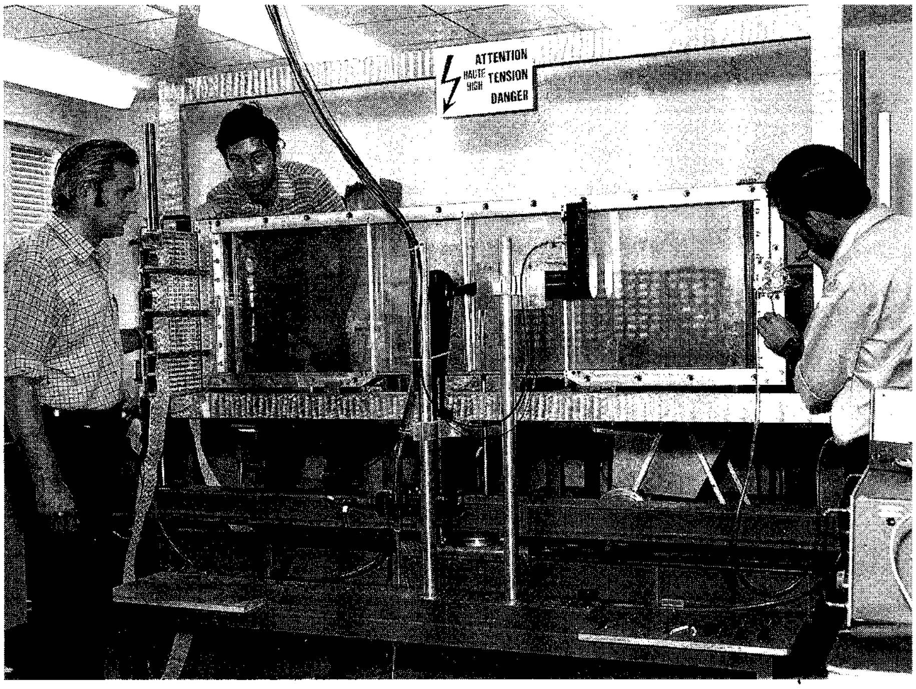
Since its invention in 1968, Charpak's multiwire proportional chamber and his subsequent developments heralded the age of fully electronic particle detection. They revolutionized detection techniques and have become the principal tools of the particle physicist's trade, enabling them to handle high reaction rates and to preselect special types of interaction.

Charpak's Nobel is also the latest addition to a periodic Nobel physics theme of improved 'position sensitive detectors' – measurement techniques for telling physicists where particles have passed. In 1927 the award went to C.T.R. Wilson for his invention of the cloud chamber; in 1948 Patrick Blackett received the coveted prize for his further development and discoveries with cloud chambers; in 1950, Cecil Powell's prize was in recognition of his work with photographic emulsions and its physics outcome; in 1960 came Donald Glaser, for the bubble chamber, while Luis Alvarez was recognized in 1968 for his further development of this technique.

Georges Charpak has always been concerned about seeing things that are visually obscure but nevertheless important. Before joining CERN in 1959, at the Joliot-Curie Laboratory in Paris he had an introduction to particle detectors ('most of them didn't work', he later admitted) and pioneered new techniques in the then traditional method of photographing the sparks left in the wake of charged particles. At CERN, he initially worked on the first precision measurements of the anomalous magnetic moment of the muon (g-2), an experiment which turned out to be a training ground for some of the most gifted post-war European physicists.

After g-2 he returned to his major preoccupation – particle detectors. Any particle physics detection scheme uses ionization – the atomic havoc of charged particles left in the wake of a subatomic projectile. In 1968 Charpak was looking for ways of localizing spark signals without having to take photographs. To achieve this he realized he had to understand the details of what happens when a gas is ionized between two high voltage electrodes, to chart the different ways that electron chain reactions caused signals to grow into sparks, the role of photons, and the effect of localized high electric field gradients on the drift of electrons and ions and on the way the signal is formed. When his work was done, not only did he understand better what happened between high voltage

The first large multiwire proportional chamber built at CERN. Left to right, Georges Charpak, Fabio Sauli and Jean-Claude Santiard. (Photo CERN x8.8.70)



electrodes, but the spinoff was virtually immediate.

Fortunately, a high energy charged particle passing through matter is the proverbial bull in a china shop, scattering and breaking whatever atomic material is in its path. However this trail of subatomic destruction needs some method of amplification to make it visible, when and where it happens.

Some techniques already existed – ion chambers; proportional tubes; and the famous Geiger counter – but they all had limitations. The classic proportional tube uses a thin anode wire along the axis of a cylindrical cathode filled with a suitable gas. As a charged particle passes through, liberated electrons are pulled towards the wire anode, producing more electrons in their wake. An electron 'avalanche' is formed.

The resultant signal shows that a charged particle has passed through, but with a tube of radius one centimetre, no real precision is given. It is impractical to build large detecting surfaces of such modules, and the irregular time response (up to a microsecond), makes precision measurements difficult.

Charpak's brilliant idea was to use a plane of anode wires a few millimetres apart stretched between two cathode planes. This improved geometry and higher field of the multiwire proportional chamber (MWPC) make the ionization electrons move faster and more uniformly, so that the time resolution improves to, say, 25 nanoseconds.

At first it was feared that the large mutual capacitance between neighbouring wires would spread the signal throughout the mesh, frustrating any attempt to localize tracks. However Nature lent a hand in the form of an opposite and almost equal signal induced by positive ions in the avalanche in all wires but the one directly concerned. Understanding this helpful signal, Charpak realized it could be exploited to greatly improve localization in the MWPC – a set of wires of strips in the cathode plane would pick up this induction, providing a powerful means of localizing ionization away from an anode direction. This two-dimensional localization allowed detection of X-rays and opened up MWPC applications in medicine and biology.

By adding suitable additional ingredients to the gas in the chamber, secondary by-products are quickly absorbed so that one avalanche does not trigger another and the initial ionization is quickly confined. The technique can be extended to cover large areas, with each wire read out into appropriate electronics. For the first time, high volumes of data became available on line.

A further Charpak development, the 'drift chamber', measures the time it takes for the electrons to get to the anode. This time then gives a fix on where the initial ionization took place, and requires less closely spaced detection and readout channels.

Describing those early days, Charpak says his first attempts at building proportional tube were so clumsy that when the time came to prototype the MWPC, his team took such care that it worked first time!

Charpak also pays tribute to the facilities at CERN and the team spirit. 'If you ask someone to do something difficult, you're sure to get good response,' he says. An ideas man, he stands aside and lets others get on with mass-production and nitty-gritty applications problems, again an area where CERN excels.

In more recent years his interest has turned to applications of physics instrumentation in other areas, particularly biology and medicine. Here the improved accuracy and response of modern electronic detectors promise faster scanning and lower radiation doses.

Eight year series – three physics Nobels enjoy the CERN Charpak party entertainment. Left to right CERN Director General Carlo Rubbia (1984), Sam Ting (1976) and Georges Charpak (1992).
(Photo CERN HI84.10.92)

Using a wire chamber viewed by an image-intensified CCD camera, a CERN/Geneva Cantonal Hospital team obtained a radiograph of a rat kidney a hundred times faster than conventional methods. 'This rat kidney changed my life,' says Charpak.

For the future, the quest for 'Dark Matter' – the missing material that makes up most of the Universe – will continue to challenge detector builders. 'The detector research and development work being done for the LHC will also provide valuable spinoffs,' claims Charpak. 'When people ask "what use is this work", these are the things to point to'.

Charpak admits to having been surprised by the Nobel news. 'But CERN wasn't surprised,' retorted CERN Director General Carlo Rubbia. 'It underlines that physics instrumentation is just as important as accelerators. The prize is also a great honour for CERN, and underlines its preeminent position in the forefront of particle physics.'

Born in Poland in 1924, Georges Charpak was educated in France, the country whose nationality he now holds. After an introduction to research at the Collège de France, Paris, he joined CERN in 1959. He passed a formal 65th birthday career milestone in 1989, but is still very active with his driving ambition to apply frontier detection ideas.

While ideas in physics are quickly incorporated into ongoing research, convincing the medical community of the value of new techniques needs a special effort, he says. Charpak has made a considerable personal investment in this research and development work, to the extent of making personal sacrifices. 'Now I can buy some new shoes,' he joked after hearing the Nobel news.

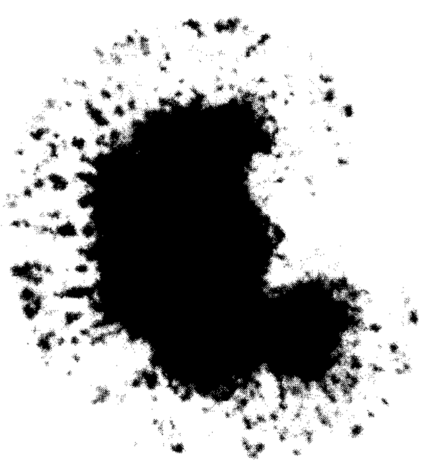
Charpak is popular and widely admired at CERN. On hearing the Nobel news on the car radio, a CERN acquaintance was moved to tears. Charpak inspires loyalty – he has worked with three skilled and dedicated specialists – Roger Bouclier, Gilbert Million and Jean-Claude Santiard – for practically the whole of his CERN career. At CERN, he was soon joined by Fabio Sauli, who has continually shared in a long series of new developments, and who now formally heads the unit at CERN. At Charpak's 65th birthday celebrations at CERN, Sauli declared that the name 'Charpak Group' will continue to be used.

Another aspect of Charpak's personality is his continual concern for less privileged colleagues. He was a driving force in the late 70s and early 80s in the action by physicists that eventually led to the release of Yuri Orlov and Andrei Sakharov.

With his fame previously restricted to physics circles, Charpak became a celebrity overnight after the Nobel announcement. With last year's physics prize won by Frenchman Pierre-Gilles de Gennes, the news had special impact in France.

Charpak's numerous contributions

This wire chamber radiograph of a rat kidney was obtained about a hundred times faster than using conventional means. 'This rat kidney was a turning point in my life,' says Georges Charpak.



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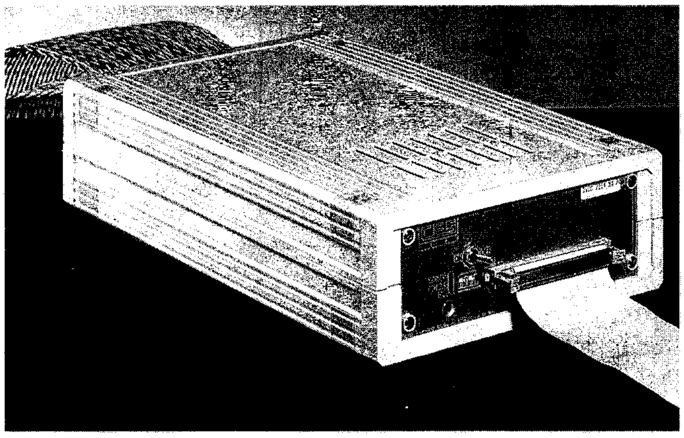

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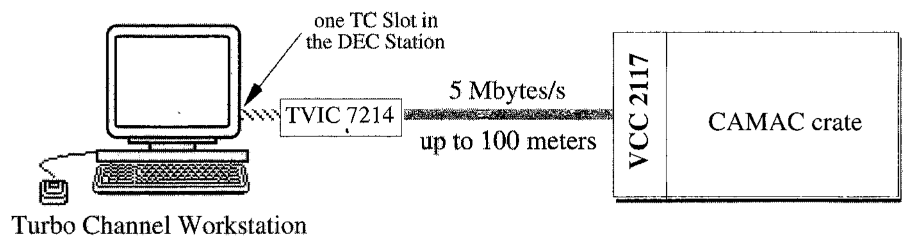

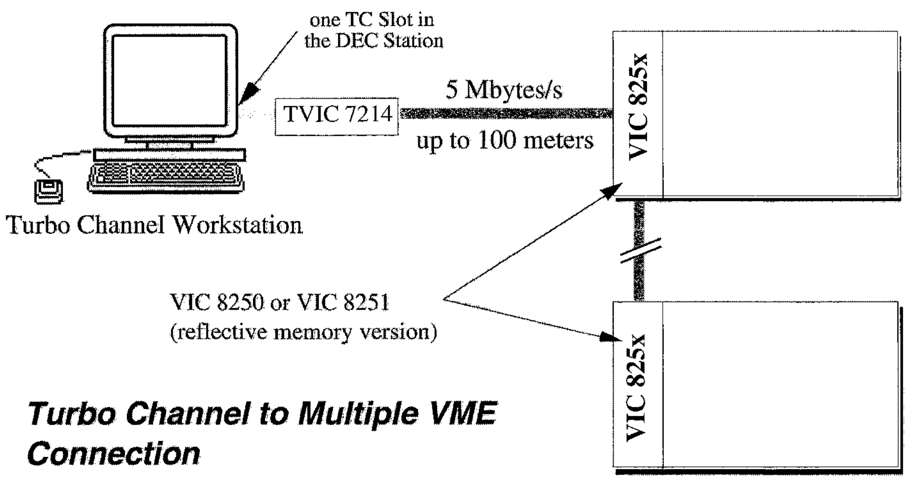

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Circle advertisement number on reader service form 9d to science have earned him a series of distinguished awards in recent years, including the European Physical Society's High Energy and Particle Physics prize in 1989. The Nobel comes as the well-deserved culmination.

Physics in the street

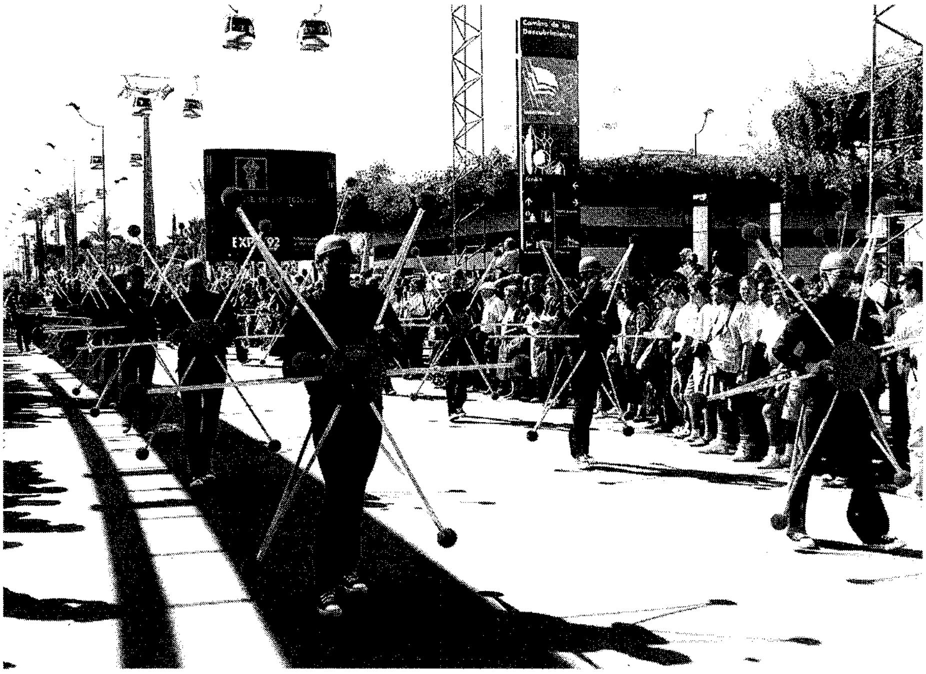
Culmination of CERN's involvement in the Expo 92 World Fair fiesta in Seville came on 30 September with in 'CERN Day' – the only day devoted to science in the whole six-month Expo 92 programme. A cast of nearly 500 scientists from all CERN's 18 Member States brought Cinderella Science out of its dusty laboratory seclusion, dressed it up, and took it to the ball.

CERN's permanent exhibition in Expo 92's Pavilion of the Universe, including a 27 metre long section of LEP 'tunnel', had already attracted one and a half million people, but for the CERN Day a carnival had been planned months in advance. With 'discovery' the central theme of Expo 92, the special CERN event stressed how scientists are the explorers of our age, having embarked on the greatest voyage of all – back to the creation of the Universe.

The event began conventionally enough with the official greeting of the CERN delegation, led by Director General Carlo Rubbia and Council President Sir William Mitchell, by Expo Commissioner-General Emilio Cassinello. The official business continued with the opening ceremony at the central 'Palenque' with short speeches by the CERN Director General, Commissioner Cassinello, and Spain's Secretary of State for Universities and Research Elias Fereres.

Then came the awards for "The Young Scientist of the Future", a specially-arranged pan-European competition. (The winners were: Austria – Christoph Simon; Belgium – Stefan Rummens; Czech and Slovak Federal Republic – Jiri Vanicek; Denmark – Morten B. Pedersen; Finland – Ville Voipio; France – Frédérick Jeske; Germany – Robert Nitzschmann; Greece- Marcallos Rallidis; Italy – Alberto De Fanis; Netherlands- Martijn Leisink; Norway – Joakim Bergli; Poland – Barbara Smalska; Portugal – Orlando Moreira; Spain – Ana Colorado-

CERN Director General Carlo Rubbia enjoys the action at 'CERN Day', the culmination on 30 September of CERN's involvement in the Expo 92 World Fair fiesta in Seville.



McEvoy and Rosa del Carmen Amores-Munoz and Jose Antonio Vega-Vidal; Sweden – Erik Brandin; Switzerland – Marco Ziegler; United Kingdom – Robin Michaels.)

Outside the Palenque there were flashes, sparks and bangs as 200

▲ *A cast of nearly 500 scientists from all CERN's 18 Member States took part in the fun.*

▼ *On duty for CERN Day at Seville were CERN Courier Advertising Manager Micheline Falciola (left) and Régine Chareyron from CERN's Visits Service.*

Helping Russian science

The CERN Day at the Seville Expo 92 also included a forum on international aid for Russian fundamental science, with a proposal to establish an international foundation to protect the future of Russian science by providing additional support for individual teams or projects. The funding needed for this operation (supporting some 5000 scientists in all branches of science, from biology to mathematics) is estimated at around $100 million. Following an appeal from Carlo Rubbia to President Mitterrand of France in September 1991, a recommendation was formulated at the G7 Summit in Munich in July of this year.

The Seville forum provided a valuable opportunity for the prime movers of this scheme to outline the next steps to be taken.

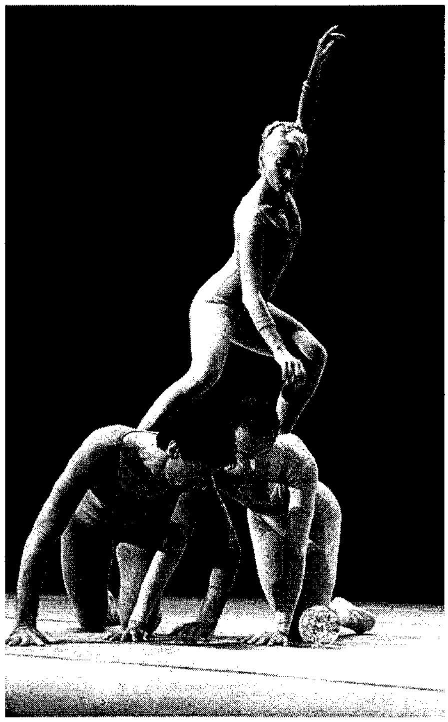
The participants at the Forum were: Carlo Rubbia (CERN Director General); Jean Audouze (Conseiller Technique à la présidence de la République Française); Boris Saltykov (Vice-Prime Minister of Russia); Hermann Strub (Ministerial Dirigent at the German Ministry for Research and Technology; Rainer Gerold (European Commission); and Elias Ferreres (Spanish Secretary of State for Universities and Research).

intrepid young physicists from 20 countries, including 'The Flying Circus of Physics' from Copenhagen and Amsterdam, began their dramatic demonstrations of physics principles. Thousands of visitors participated in the fun, which showed how fascinating science can be. Interactive video stations, with programmes specially developed at CERN in collaboration with Olivetti, helped visitors explore science.

The carnival continued with scientists and gymnasts, disguised as particles, printed circuits, atoms and Einstein clones, dancing around a particle accelerator float. Throughout the day CERN's glamorous 'Les Horribles Cernettes' belted out their special brand of 'hardronic' rock with songs about the hassles of science life and how making it with physicists is tough.

The day finished on a more serene note with the première of a 'Universe of Light' ballet playing to a packed auditorium at the Plaza of America. This specially-commissioned work featured scientifically accurate lyric verse by French astrophysicists Jean Audouze and Michel Cassé, music by Graciane Finzi, and a dance allegory of the Big Bang and the creation of the Universe with choreography by Jean Guizerix, Wilfride Piollet and Jean-Cristophe Paré from the Opéra de Paris. (The sound track, featuring film star Michel Piccoli, has been recorded by Radio–France.) For more mundane tastes, a CERN scientist Latino funk band jammed on the central Expo 92 stage until late into the night.

Tired but happy, the scientists prepared to return to their laboratories. 'Genius, Originality and Participation........ the scientists from CERN showed the public that physics can be really interesting,' applauded the Expo 92 Information Bulletin. Maybe physics should go to the ball more often.



The CERN Day at Seville finished with the première of a specially-commissioned 'Universe of Light' ballet.

DESY focuses on HERA

On 1 October, a special 'Fest-Kolloquium' at DESY marked the official start of the research programme at the new HERA electron-proton collider, which began operations earlier this year (July, page 2). The timing could not have been better, as HERA performance had improved by a factor of ten during the two weeks beforehand. More than 600 guests assembled in one of the big halls previously used for assembly of major components for HERA experiments.

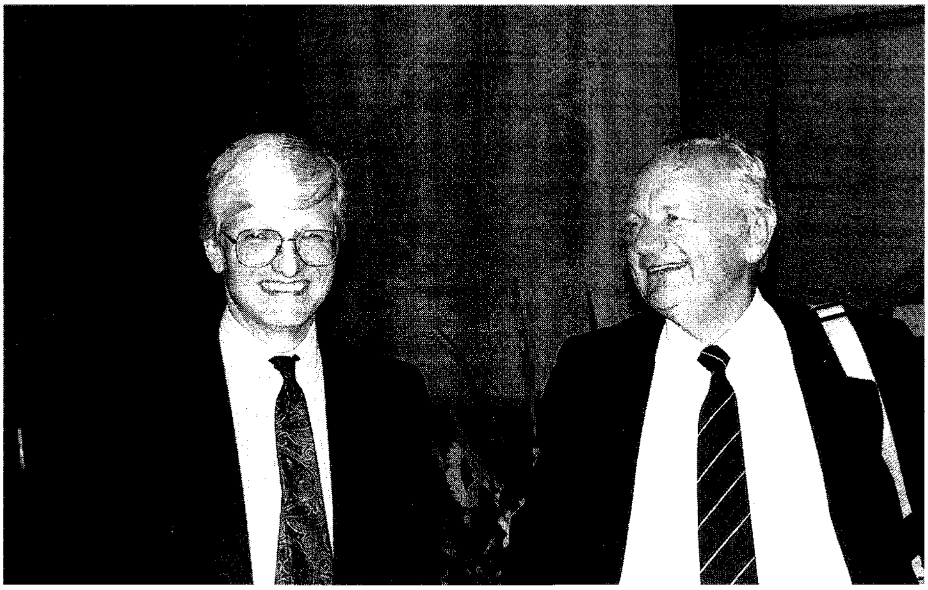
Introducing the ceremony, Volker Soergel, Chairman of the DESY Directorate since 1981, after many years of presenting news bulletins of HERA construction progress, was proud to announce the start of operations.

Leonhard Hajen, Senator for Science and Research of the City of Hamburg, reflected his city's pride in being home to a major world Laboratory. Hinrich Enderlein, Minister of Science, Research and Culture of Land Brandenburg reported the successful integration of the Zeuthen (formerly East Berlin) Laboratory into an enlarged DESY infrastructure. While similar research institutions were also being successfully integrated, overall economic integration was not proceeding so smoothly.

After Vice-Chairman of the DESY Research Council Gustav Kramer congratulated the HERA team on their accomplishments, keynote speaker Christopher Llewellyn Smith, long a proponent of the benefits of electron-proton experimentation, painted a picture of the HERA experimental objectives which was well illustrated with appealing analogies.

Gus Voss covered the HERA machine and its most recent performance. The machine is behaving as expected and Voss felt confident that

On 1 October, a special 'Fest-Kolloquium' at DESY marked the official start of the research programme at the new HERA electron-proton collider, which began operations earlier this year. Christopher Llewellyn Smith of Oxford (left) covered the new physics HERA will attack, while Gus Voss of DESY described the HERA machine itself. Llewellyn Smith has been proposed as the next Director General of CERN, in which case he would take office on 1 January 1994.
(Photo P. Waloschek)



it would reach its design objectives (luminosity) within one or two years. First results from the experiments (which had also been aired several days before at the DESY Theory Workshop – see below) were reported by Sergei Levonian (Moscow) for the H1 experiment and Matthias Kasemann (DESY) for Zeus.

Finally Bernd Neumann, Parliamentary State Secretary of the Federal Ministry of Research and Technology, assured the audience that his Government will fulfil all its obligations for high energy physics, where Germany's annual expenditure is currently running at about 500 million deutschmarks, mainly for CERN and DESY. The goal, he said, is now optimum utilization of existing resources and facilities.

HERA back on.......

After a short shutdown following its initial production run in July, the new HERA electron-proton collider restarted on 20 August. Maximum luminosities increased from the 6×10^{28} per sq cm per s achieved in July to above 10^{29}. Already ten times the luminosity provided during June/July has been delivered, the improvements coming mainly from better stability of the proton beam and from increased reliability.

In July, maximum intensity per proton bunch had been restricted to about 20 per cent of the 750 microamp design value because of difficulties in the proton supply upstream. After sorting out some magnetic problems in the DESY III proton synchrotron, the proton level increased, only to run into another bottleneck in the intermediate PETRA ring. However this is being worked on and the proton should soon improve.

With careful beam centering and tune adjustments, the proton beam can be kept for about a day, the electron beam being refreshed several times during this period. The HERA superconducting magnets are performing well, and, last but not least, ugly 'persistent' eddy current problems widely expected to plague proton injection have not materialized, thanks to the special monitoring system based on reference magnets.

Running has used about ten

600 guests were at the HERA 'Fest-Kolloquium' at DESY.
(Photo K. Desler)

bunches per beam. The design figure is 210 bunches in both beams, but efforts to push more current into the electron ring are currently coming up against problems. These are not avoided by the powerful bunch-to-bunch damping system, based on a design successfully used in the PETRA ring, which has already demonstrated how well it can counter coherent instabilities in both PETRA and HERA beams. The problem can be partially overcome by careful orbit steering, but this is treating the symptoms rather than the cause. A special positron run planned for November could reveal more.

With the luminosity per bunch already running at about 30% of the design level, the electron and proton intensities are the main obstacle to more HERA collisions.

The design energy of the electron beam is 30 GeV and has already been reached in precommissioning tests. However current running prefers 26.67 GeV, which leaves some radiofrequency flexibility and allows spin polarizations studies to continue. The recent polarization achievements (October, page 35) open the door to the HERMES proposal for a gas jet target in the HERA electron ring for measurements of proton spin structure.

For the future, DESY machine physicists are playing a major role in the international effort to develop the next generation of electron-positron linear colliders (November, page 23). With a wide range of technology to exploit, DESY is looking particularly at low frequency (S-band) with conventional cavities and lower frequency TESLA (superconducting) schemes. However with having to look after the nine DESY machines currently operating, DESY's machine specialists already have a lot on their plate.

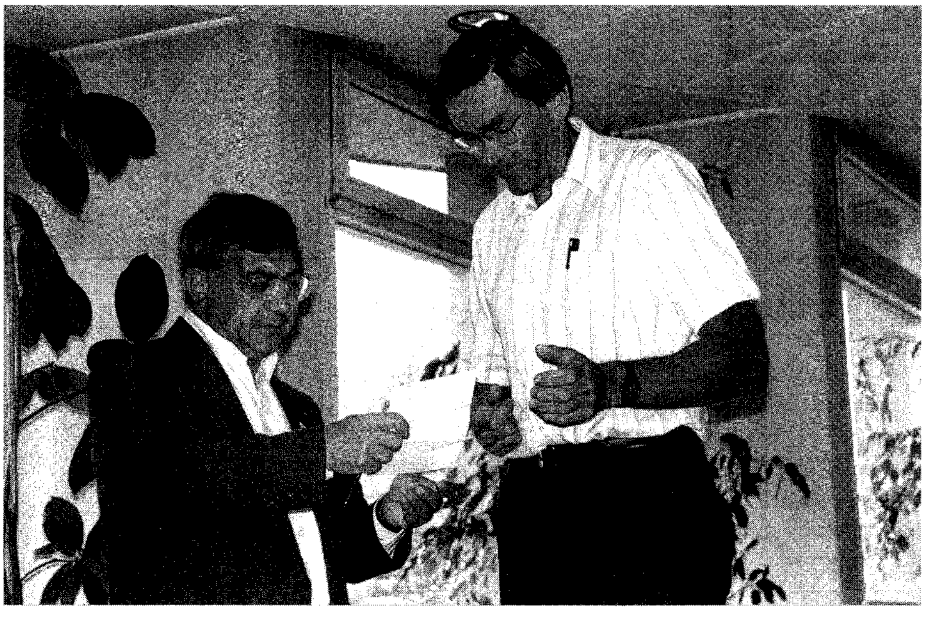
.........and theory with flavour

With first results from the HERA electron-proton collider now emerging, this year's traditional Theory Workshop at DESY could change gear. This annual event has become a focus for the large theory community in DESY and even further afield. Under the theme 'Flavour Physics', the meeting set the scene for HERA's appearance, and looked at the potential impact this new experimental venture could have.

For the experiments, G. Bernardi of Paris and S. Bhadra from Toronto spoke for H1 and Zeus respectively. These results were based on the three inverse nanobarns of luminosity received during July, and had made their public debut at the International Conference on High Energy Physics in Dallas in August (October, page 6).

These initial presentations show dramatically how HERA probes deep inside interesting and hitherto very remote new kinematical regions, now called 'deep diffractive' in the trade. As well as charting photoproduction rates at higher energies, results already given at Dallas, the analyses had subsequently sharpened to produce evidence for photoproduction jets, confined sprays of hadrons signalling constituent interactions deep inside the target protons.

After this foretaste of HERA physics to come, attention turned to the main business of the meeting. Today's Standard Model uses six quark flavours, grouped pairwise with three lepton flavours. A number of talks covered the phenomenology of heavy quarks, a domain where HERA will help to plug empirical holes in the Standard Model. The picture is still clouded by the non-appearance of the sixth ('top') quark.



The DESY Theory Workshop in September assessed at the impact HERA could make on physics. J.D. Bjorken (right) of SLAC looked at what could happen in the new kinematical region opened up by HERA. He is seen here in discussion with Workshop organizer E.A. Paschos of Dortmund. (Photo P. Waloschek)

As one speaker said, 'everybody knows where to expect the top quark, but nobody knows where it is'.

Heavy quark business dominated the meeting. There are several approaches to heavy quark calculations, and both were covered at the DESY meeting. A technique becoming increasingly popular is an expansion in the reciprocal of the quark mass. For heavy quarks, such a series should become rapidly convergent. The fourth (charm) quarks can begin to be considered in this way, the fifth (beauty) is better, but the idea should really come into its own with top, the heaviest quark. At the international conference in Dallas in August, after several speakers pointed out the potential of this approach, the message was underlined by Steven Weinberg in his Dallas summary.

The second approach to quark calculations is field theory supercomputer calculations on a hypothetical lattice. As well as computer power, many improvements are being incorporated into the calculations.

On the final day of the workshop, the spotlight turned from quark to lepton flavours. W. Hampel of Heidelberg gave an excellent review of solar neutrino measurements, which this year have been boosted by the first sightings of neutrinos from the proton-proton fusion mechanism which provides the bulk of the sun's thermonuclear power.

The results from the Gallex experiment in the Italian underground Gran Sasso Laboratory had been first announced in June at the Grenada Neutrino 92 meeting (September, page 1), while an updated number from the SAGE Russian/US collaboration emerged at Dallas (October, page 6).

Hampel pointed out that the compilation of all solar neutrino results suggests that the deficiency between the observed and expected signals in all solar neutrino channels (the 'solar neutrino problem') is due to neutrino oscillation resonance. Doing the calculations identifies two small allowed regions, with implications for neutrino masses.

These implications were seized by neutrino specialist Lincoln Wolfenstein – 'it is still not clear whether neutrinos have masses or not'. Neutrino mass limits from laboratory experiments are still being attacked but are unlikely to improve drastically. But there is indirect evidence, said Wolfenstein, that neutrinos are much lighter.

'The solar neutrino problem is really the solar neutrino opportunity', claimed Wolfenstein, one of the architects of the neutrino oscillation resonance mechanism. He went on to describe how improved solar neutrino measurements could help fix neutrino mass parameters and help probe the role, possibly very considerable, that neutrinos played and continue to play in the large scale structure of the Universe.

Finally J.D. Bjorken of SLAC, who has been looking at new possibilities using parton dynamics at the energies which will be opened up at the next generation of proton colliders, adapted these ideas for HERA consumption. This deep diffractive behaviour should extrapolate smoothly from today's elastic (diffractive) scattering, dominated by the 'Pomeron' mechanism, whatever this might be. Bjorken suspected it could be of gluon origin. Electron-proton collisions, with their reduced complexity compared with traditional proton-proton approaches, should provide a valuable new window.

Ably organized by E.A. Paschos of Dortmund, the DESY Theory Workshop provided an excellent snapshot of some of today's physics frontiers, interesting to physicists from all walks of life, not just theorists. A graduate student remarked 'these were three wonderful days where many new ideas were discussed. You could feel the excitement at DESY with the expectation of new results from HERA'.

CERN
New cooperation agreement with China

Vice Chairman of the Chinese State Science and Technology Commission Hui Yongzheng (right) and CERN Director General Carlo Rubbia sign the new CERN-China cooperation agreement in Beijing. (Photo S. Ting)

As preparations gather momentum for its LHC proton collider to be built in the 27-kilometre LEP tunnel, CERN is encouraging increased international involvement in the project, both for the machine itself and for the experiments which will use it.

Earlier this year, the successful 'Towards the LHC Experimental Programme' meeting at Evian-les-Bains staged the first public presentations of ideas for LHC experiments. With this meeting showing the remarkable level of world interest in this physics, top-level CERN delegations subsequently scheduled overseas trips to Russia and to Japan to stimulate further interest in the LHC experimental programme. At these meetings, specially-arranged seminars provided a reciprocal picture of ongoing projects and plans, and the fruitful in situ discussions are now being followed up.

Latest venue was Beijing, China, in October, bringing together about 100 physicists from all over China, including four from Taiwan. The Beijing seminar covered current perspectives in physics, together with developments around the LHC machine and experiments on the CERN side. On the Chinese side, presentations highlighted the remarkable progress at the BEPC Beijing electron-positron collider, together with important work on new materials and in magnetic field measurements.

After full plenary presentations, the main meeting broke up into more detailed parallel sessions on specific accelerator and detector developments. In the latter, Chinese experience in manufacturing crystals of fluoride salts could go on to play an important role for electromagnetic calorimetry for LHC experiments.

During the top-level CERN delegation's visit to Beijing, a new cooperation agreement was signed between the Chinese government and CERN. This complements the July 1991 accord with the Chinese Academy of Sciences and further consolidates existing Sino-CERN scientific and technical cooperation.

The signing of the new agreement was attended by State Councillor and Chairman of the State Science and Technology Commission (SSTC) Song Jian, SSTC Vice Minister Rongzheng Hui, Director General of the Chinese International Cooperation Department Wang Shaogi, and Beijing Institute for High Energy Physics Directors Shouxian Fang and Zheng Zhi-Peng, together with CERN Director General Carlo Rubbia, CERN Research Director Walter Hoogland, and L3 spokesman Sam Ting.

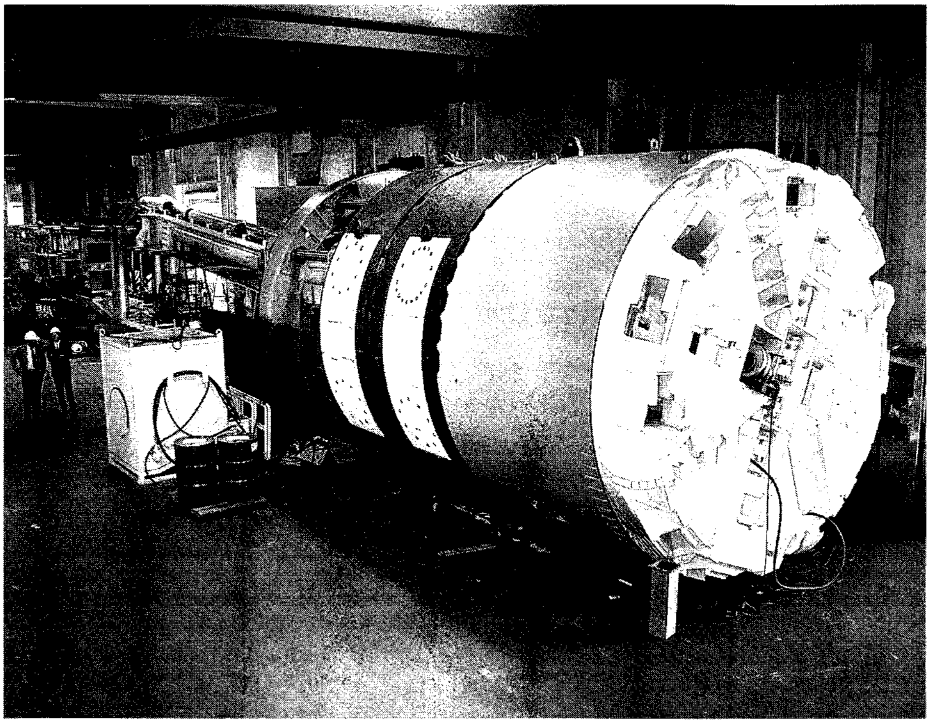
The new agreement reflects the growing links between China and CERN, which date back to 1973. In the late 1970s, Chinese participation began in several major experiments, but collaboration expanded quickly in the 1980s with the advent of LEP, where both the Aleph and L3 experiments attracted strong Chinese contingents, bringing valuable contributions. More than 100 Chinese physicists are currently working at CERN. Stemming largely from the existing involvement in the L3 experiment at CERN's LEP electron-positron collider, China has a strong representation on the L3P LHC Letter of Intent.

On the machine side, Chinese accelerator physicists have made major contributions at CERN to the design of the ACOL Antiproton Collector and LHC. Their rapidly acquired expertise played a key role in the design and construction of the BEPC machine at Beijing.

SUPERCOLLIDER
Update

After the oscillations in the financial fortunes of the US Superconducting Supercollider (SSC) this summer, a compromise bill was passed in

A new concept Tunnel Boring Machine, seen here being assembled by the Robbins Co. of Kent, near Seattle, will be used to excavate the first segment of tunnel for the Superconducting Supercollider in Ellis County, Texas, this winter. The 4.8-metre diameter machine features two sets of grippers – the white bands on the sides – used sequentially to allow the machine to push forward continuously. Hence the machine's nickname 'Inchworm'.



September that included $517million for the SSC in the new financial year, which began on October 1. This figure was midway between the $484M that the House appropriations committee had recommended (which the full House then reduced to $34M) and the $550M that the full Senate had passed in August. The funding level is $133M less than the $650M requested in the original President's budget, and the effect of the lower amount on the project's schedule is being studied.

On site in Ellis County, Texas, the first tunnel boring machine (TBM) has arrived at the N25 service area on the north arc of the 87 kilometre (54 mile) ring, about 5 miles northeast of the N15 area where much of the first construction activity has been centred. A rebuilt machine, the TBM will be used by the Gilbert-Shea construction team to bore about 8.3 miles of 14-foot diameter tunnel, from N25 to N40. Five shafts, 170 – 200 feet deep, are also included in the contract. One of them, the utility shaft at N25, will be used to lower the TBM to tunnel level.

Another shaft will be excavated on the south arc, at S30, to gain design experience with Taylor marl, the third main geological stratum the SSC tunnel will be bored through.

Two new TBMs, now being built, are due to arrive soon at N15 and N20. By the end of the year, boring of three sections (N15-20, N20-25, and N25-40) will be underway. Contracts are in place for tunneling of the entire north arc (N15 to 55).

On the accelerator front, the RFQ (radiofrequency quadrupole accelerator) has been delivered by Los Alamos National Laboratory, and is being installed and tested. The RFQ is the second stage of the Linac, taking protons from the 35 keV ion source up to a kinetic energy of 2.5 MeV. Modulators to control the klystrons that will power the DTL and CCL (drift tube linac and coupled cavity linac) have been ordered (at less than the baseline cost estimate) from Maxwell Laboratories. The DTL and CCL are the last two stages of the Linac, which will take the beam to 600 MeV.

Going further up in energy, prototype dipoles for the LEB (low energy booster) are being built at SLAC (Stanford) and INP (the Institute for Nuclear Physics in Novosibirsk, Russia); prototype quadrupoles at Berkeley and INP. Corrector magnet prototyping is being done at SSCL, and INP is beginning to study these, too. It is expected that INP will provide all the LEB magnets, with first production beginning next summer. Two competing radiofrequency system concepts are being developed at SSCL and INP; these will be tested early next year.

A full size mock-up of the dipole-dipole interconnect region in the MEB (Medium Energy Booster) is under construction. A prototype dipole magnet is to be built by Fermilab, and negotiations for the quadrupoles are under way with MRTI (the Moscow Radio and Technology Institute).

For the High Energy Booster (HEB), the first model dipole is being built by Westinghouse, who will design and develop the dipole, build prototypes, and deliver 50 low rate production magnets. The design and development of HEB quadrupoles is well advanced at Saclay. Spool pieces are being designed at SSCL, and corrector magnets will be developed through modifications to the existing contracts for Collider correctors. Westinghouse will study the observed ramp rate dependence of SSC superconducting magnets, a phenomenon that is more important for the rapid-cycling HEB than for the Collider.

General Dynamics is about to begin

winding coils for the first Collider dipole in its new magnet facility in Hammond, Louisiana.

KEK
PS – superconducting spectrometers

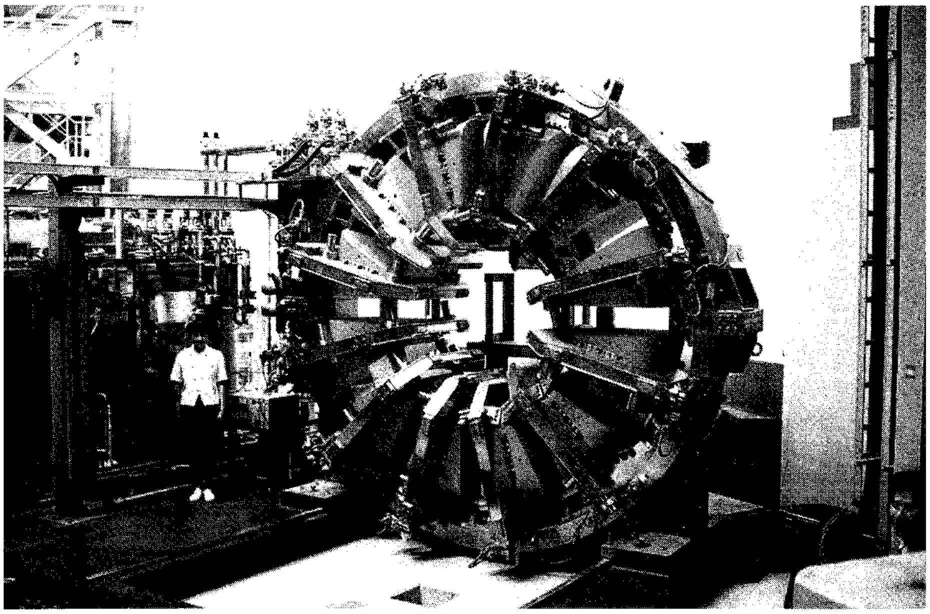
At the Japanese KEK Laboratory in Tsukuba Science City, the oldest research facility, the 12 GeV PS proton synchrotron, has been equipped with new beamlines and spectrometers. The faithful PS has been supplying stable proton beams of steadily increasing intensity for 16 years. After starting with particle physics, PS research has expanded to include nuclear as well as particle physics. A large proportion of proposed experiments request intense kaon beams.

To cope with this change in emphasis, the former bubble chamber hall has been replaced by a new (North) experimental hall served by two upgraded kaon beamlines – one for momentum up to 0.6 GeV/c for 'stopped' kaon experiments, and the other going up to 2 GeV/c. Both spectrometers are open to any users, subject to the usual approval from the PS Physics Advisory Committee. They are also movable to allow space for other experiments.

New large-aperture, general-purpose superconducting spectrometers have recently been installed, a 12-sector toroidal magnet in the low momentum beamline and a single sector dipole in the other.

The toroidal spectrometer system uses a magnet constructed by Tokyo University and a cryogenic system built at KEK. Its 12 sets of superconducting coil wound around an iron core are equivalent to 12 dipole magnets arranged in a rotationally symmetric way. Maximum central field is 1.83T, and a field integral of 1.5Tm is available.

One of the new superconducting spectrometer magnets recently commissioned at the 12 GeV proton synchrotron at the Japanese KEK Laboratory. Seen here is the toroidal magnet for the low momentum kaon beamline. Each of its 12 gaps provides 1.5 Tm of analysing power.



A pilot experiment (E218) was approved to ascertain the spectrometer's performance and then use it for hypernuclear physics. Two pions are detected in coincidence to study hyperfragment production.

A second experiment (E246) is being prepared to search for violation of time invariance in kaon decay by measuring muon transverse polarization in the decay of a positively charged kaon into a neutral pion, a charged muon, and a neutrino. The large solid angle and rotational symmetry of the spectrometer is expected to give high sensitivity.

The sector-type dipole spectrometer was constructed by the Institute for Nuclear Study, Tokyo, in collaboration with KEK. With nuclear physics applications in mind, it generates the maximum central field of 3T across a 50 cm gap, giving 0,1% momentum resolution in 100 msr.

The first two experiments are ready to take data with a pion beam. E140 will investigate heavy lambda hypernuclei while E269 will look at pion elastic scattering.

Meanwhile the TRISTAN electron-positron collider at KEK has entered its 7th year of operation, now delivering a peak luminosity of 4×10^{31} per sq cm per s at a collision energy of 58 GeV to serve three experiments, AMY, TOPAZ and VENUS. Its injector, the 2.5 GeV linac, is shared with the positron storage ring of the Photon Factory, now in its tenth year as a dedicated synchrotron light source.

CORNELL
Upgrading CESR

The Cornell Electron-Positron Storage Ring (CESR) has begun a major upgrade programme en route to a B Factory. CESR has been operating at the production threshold of the fifth

(b) quark since 1979. From 1979 through 1989 it was upgraded from its original single bunch configuration to the present scheme with seven bunches in each beam, colliding at two interaction points and separated elsewhere by electrostatic fields and with strengthened focusing at the interaction points.

In 1990 one of the two experiments, the Columbia – Stony Brook (CUSB) nonmagnetic detector experiment, completed its running and the ring was reconfigured for collisions in a single interaction region, occupied by the CLEO experiment. The peak luminosity at the fourth upsilon (b quark-antiquark) resonance is now 2.5×10^{32} per sq cm per s, six times the CESR design luminosity for that energy and a world record for storage rings. In 1991 CESR provided 1200 inverse picobarns of integrated luminosity.

During the last 13 years the CESR experimental programme has made substantial contributions to the physics of B mesons (containing a b quark). In 1989 the original CLEO detector was replaced by a more powerful CLEO-II detector, with optimal energy and angle resolution for both charged and neutral products of B decays.

An important particle physics goal is the understanding of the origin of violation of CP symmetry – invariance under a combined switch of particles to antiparticles and mirror reflection. CP violation so far has been seen only in neutral kaon decays. Given the CESR experience and high luminosities and the considerable investment already made in the machine and the CLEO-II detector, it was natural to start planning in 1988 for an upgrade that would make it possible to study CP violation in a new setting, the decays of B particles.

A proposal was submitted in February 1991 to the US National Science Foundation to upgrade CESR to a B Factory, an asymmetric electron-positron collider operating at the fourth upsilon resonance and optimized for the study of CP violation in B meson decays (July 1991, page 8).

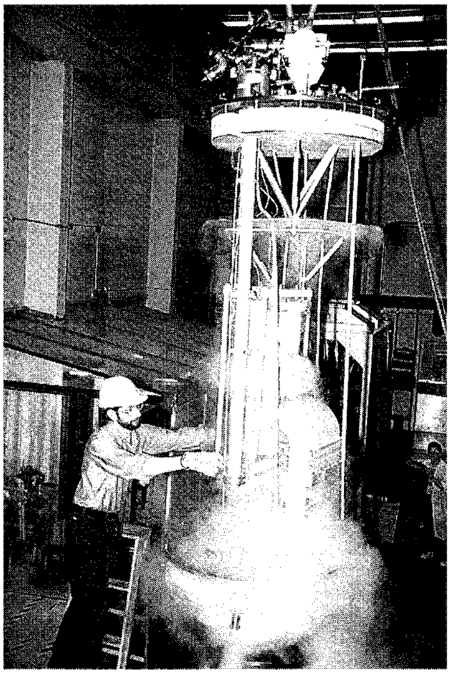
The design exploits three major features: 1 – the two beams are stored in separate rings with different energies, 8 and 3.5 GeV; 2 – at the interaction point the beams cross at an angle of ± 12 milliradians; 3 – the required luminosity of 3×10^{33} (12 times the present CESR peak luminosity) is achieved by storing many more bunches.

The upgrade would make maximum use of the existing facility: the laboratory, the 760 m circumference accelerator tunnel, the 8 GeV magnet ring, the linac-plus-synchrotron injection system (it has already performed at the current per bunch and total current levels required), and the CLEO-II detector. The major items of new construction would be the 3.5 GeV magnet ring, a new copper vacuum system for both rings, a superconducting radiofrequency system, focusing magnets for the interaction region, some detector upgrades, and additional building space.

In July 1991 the CESR-B cost estimate was reviewed by a panel of experts named by the US National Science Foundation. In April this year, the NSF said that, provided funding for large projects continued level for the next several years, then construction of the second ring for CESR-B could be envisaged for 1996.

Meanwhile the objectives of the CESR accelerator group's ongoing active R&D programme are: 1 – to finish the detailed engineering design of the B Factory components, includ-

Prototype niobium radiofrequency cavity for the CESR B Factory being lowered into a cryostat for test.



ing superconducting r.f. cavities, vacuum chamber and pumps, feedback circuitry, and magnets for the low energy ring and interaction region; 2 – to prototype these components and in most cases test them in the present CESR ring; 3 – to make all the modifications required for the CESR ring to serve as the 8 GeV B Factory ring and that are consistent with continued running as a single ring collider; 4 – to raise the luminosity of CESR in the present single ring configuration to as high a level as possible; and 5 – to get operational experience with high beam currents, superconducting cavities, high precision tracking measurements close to the interaction point, and other B Factory innovations.

The key to increasing the single ring CESR luminosity is a scheme to collide the beams at a small crossing angle, allowing each of the present seven bunches to be replaced by a train of several closely spaced bunches. This combined programme of luminosity upgrading and B Factory preparation is proceeding on a schedule that would allow construction of the second ring to begin in 1996.

Phase I, which began when the ring was reconfigured for a single interaction region, includes the imminent installation of redesigned copper r.f. cavities. This should allow more beam current per bunch and an increased peak luminosity. Phase II, now beginning, envisages storing 27 bunches, with a total of about 0.3 amperes per beam. The beams will cross at an angle of $\pm$ 2.5 milliradians and should provide a peak luminosity of 6×10^{32}. In Phase III the number of bunches per beam will be increased to about 40 (0.5 amperes per beam), requiring the installation of superconducting r.f. cavities and upgraded vacuum system components. The goal of Phase III is a peak luminosity above 10^{33}. Phase IV would be the construction of the 3.5 GeV ring.

The present CLEO detector is also being upgraded. Data readout has recently been accelerated so that CLEO can now write to tape at the rate of 30 Hz. Further improvements may double that speed. Construction has begun of a three layer silicon strip vertex detector to be fitted around a new 2 cm radius beryllium beam pipe. Research is continuing on schemes to increase the particle identification capabilities of the detector. A new main drift chamber will be built to accommodate the more restrictive geometry of the B Factory interaction region. This will be an opportunity to improve further the momentum resolution and reduce the amount of material in the path of the particles.

With these improvements the CLEO detector will be an ideal instrument for the investigation of rare B decays in the next few years: the measurement of branching ratios, improving the measurement of neutral B mixing, and fixing more precisely the weak flavour mixing parameters. Such measurements are necessary steps toward the study of CP violation in B decays. The improved ring and detector might make it possible to see a CP violating asymmetry before an asymmetric B Factory is built.

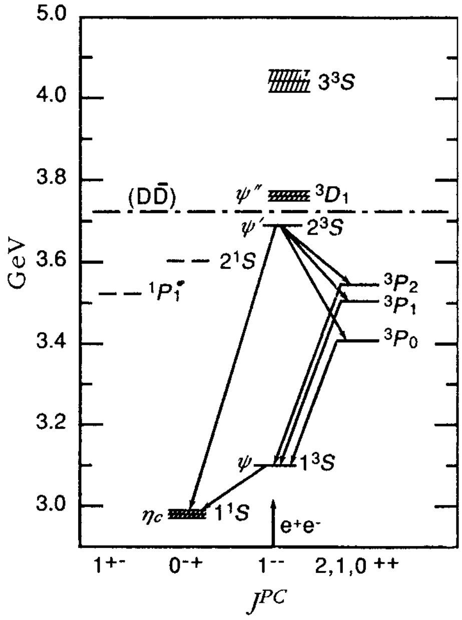
Besides subjecting the Standard Model to more incisive tests in the next several years, phases I, II, and III of the upgrade will be solving in advance most of the technical problems involved in building an asymmetric B Factory, and will provide a head start for the phase IV construction of the final facility.

FERMILAB
Missing charm

While the CDF and D0 detectors continue their search for the long-awaited sixth ('top') quark in high energy proton-antiproton collisions at Fermilab's Tevatron collider, a smaller experiment has seen an important new 'hidden charm' state.

In November 1974, the physics world was electrified by the dramatic simultaneous discovery of an unexpected new and very heavy particle – the J/psi at 3.1 GeV – by teams led by Sam Ting at the Brookhaven double spectrometer and by Burt Richter at the SPEAR electron-positron collider, Stanford.

This particle, and others which soon followed, opened a new chapter in particle physics. They were explained as bound states of a new type of quark, charm, and its corresponding antiquark. Hence the term 'hidden charm'. This spectroscopy, collectively called 'charmonium', was gradually unravelled in detailed studies at electron-positron colliders.



The spectroscopic ladder of 'charmonium' states, composed of a charmed quark and antiquark bound together. An experiment using an antiproton beam and a gas jet target at Fermilab has seen a ($^1P_1$) state at 3526 MeV in which the component quark spins point in opposite directions. Such states cannot be formed directly in electron-positron annihilations.

However electron-positron annihilation selection rules limit the directly produced charmonium states to those where the two quark spins point in the same direction. Other charmonium states, notably where the two quark spins point in opposite directions, had to be searched for by analysing the decays of the J/psi and its relatives.

The selection rules of proton-antiproton annihilation are less restrictive than those of electrons and positrons. Thus in 1984, just before CERN's Intersecting Storage Rings (ISR) were closed, a new kind of experiment was launched. Instead of the ISR colliding two circulating beams, an antiproton beam in one ring collided with a fine jet of protons (hydrogen gas).

This opened up the direct study of charmonium states which previously could only be accessed indirectly. In addition, a suggestion was seen of a new state around 3525 MeV, where

At the 20th anniversary celebration of the Los Alamos Meson Physics Facility earlier this year, the first LAMPF Director, Louis Rosen (centre), shares recollections with Los Alamos National Laboratory Director Sig Hecker (left) and present LAMPF Director Peter Barnes.

the quark spins were antiparallel (May 1986, page 19). Shortly afterwards the ISR was closed for good.

To continue these valuable investigations, a similar experiment, E760, a Fermilab/Ferrara/Genoa/Irvine/Northwestern/Penn State/Turin collaboration was mounted using a gas jet target in Fermilab's Antiproton Accumulator ring, which normally prepares antiprotons to feed into the Tevatron. E760 includes some members of the ISR team and has a considerable Italian contribution. First data emerged in 1990.

By sweeping the antiproton beam over a range of energy, the experiment is able to scan for resonances, and the excellent energy definition of the Fermilab Antiproton Accumulator enables these states to be pinpointed. The hint seen at the ISR back in 1984 has now been confirmed at 3526 MeV.

At this year's International Conference on High Energy Physics at Dallas in August, Nathan Isgur of CEBAF, speaking on hadron spectroscopy, said 'this completes the charmonium picture started in November 1974'.

LOS ALAMOS LAMPF at 20

This year saw the twentieth anniversary of the Los Alamos Meson Physics Facility, LAMPF, reaching its 800 MeV proton design energy. Speaking at a LAMPF users' meeting earlier this year, LAMPF founding Director Louis Rosen said:

'I take you back, for a moment, to the decade of the 1960s. Los Alamos Scientific Laboratory, as it was then called, was in transition and in a phase of critical self-assessment. It had developed and weaponized and miniaturized the fission bomb and the fusion bomb. What can one do for an encore?

On the other hand, the Cold War was in full bloom. A world-class Los Alamos Laboratory, strongly grounded in science and technology and engineering, was deemed critical to national security by almost everyone – to help maintain credible deterrence and to help avoid technological surprise. It was in this environment that the US was losing its preeminence in nuclear physics and Los Alamos was not assuring its future intellectual vitality. So, how does one address these problems?

One answer, on which we closed ranks after much debate, was to exploit the intensity frontier in nuclear science by developing the highest-intensity proton accelerator in the world (by a factor of at least 1000) and of energy above the pion production threshold, equip it with multiple beamlines for a wide variety of research, and operate the resulting complex as an open laboratory, the first such at Los Alamos.

This was also one of the routes we proposed to become full participants in the world science and technology enterprise. There were severe budgetary problems, including recession. Stanford Linear Accelerator Center (SLAC) and Fermilab had been authorized and needed lots of money. The nuclear science community was not of one mind about the direction nuclear science should take. Quite a few were happy to continue programs based on Cockcroft-Waltons, Van de Graaffs, and small cyclotrons. The $50M price tag was unheard of for a nuclear science facility. The Atomic Energy Commission (AEC) had experienced some serious cost overruns.

Norris Bradbury, the Los Alamos Director at the time, was asked whether he would guarantee that there would not be a cost overrun. His return teletype has become legend. 'If we overrun the construction cost estimate, you can use my blood in the cooling system.' Senator Clinton P. Anderson championed LAMPF in the senate just as Senator Pete Domenici is doing today. Four other laboratories were in competition for a meson factory, but our proposal was the most daring and the most risky.

Finally we were allocated one-half-million dollars for preliminary design work, so that cost estimates could be firmed up. We used most of the money to explore the integrity of the rock that would support the linac. By the time the $0.5M was spent, we had excavated the entire length of the tunnel. It came as quite a surprise to one of the AEC commissioners when he saw it on a flight into Los Alamos. The legality of the expenditure was never questioned, but that feat has never been repeated.

Four years later we achieved the beam we are today celebrating. That, too, did not come easily. Fortunately, we had decided to pioneer complete computer control. Without that the turn-on task would have been hopeless. As I now look back, what stands out most vividly in my memory and gives me the most satisfaction is the experience of working with the marvelously capable and dedicated and devoted participants in the project, of all ranks, who joined in the vision to create a great arena where accomplished researchers, young scientists starting their careers, students, engineers, technicians, and support staff could together learn and teach the science and art of multidisciplinary problem solving.'

WORKSHOP
Scintillating crystals

Scintillating crystals are one of the big spinoff success stories of particle physics, and from 22-26 September an international workshop in Chamonix in the French Alps looked at the increasing role of these materials in pure and applied science and in industry.

The meeting brought together some 200 participants from all over the world and all walks of crystal life – high energy and nuclear physicists and astrophysicists, together with specialists in nuclear medicine and nuclear security, and those with responsibilities in the protection of major construction projects and sensitive areas, in non-destructive industrial controls, and in geological and mining prospection. As well as crystal users, suppliers were also well represented.

The presentations and ensuing discussions underlined the importance of an interdisciplinary approach to the development of new materials. Industrial participation in these developments and the setting up of closer cooperation agreements would pay dividends if competition barriers can be avoided.

The meeting also showed how large projects in pure research, such as experiments for CERN's future LHC proton collider, could go on to play a major role in developing new technologies which could go on to find more widespread applications.

Following the recommendations of a CERN research and development project, two LHC experimental groups are proposing electromagnetic calorimeters requiring hundreds of tons of a new scintillator, cerium fluoride. The large scale manufacture of these crystals, with their faster response and increased resistance to radiation than the traditional bismuth germanium oxide (BGO), could open up important new possibilities both inside and beyond pure research.

At the Crystal 2000 meeting in Chamonix, France – Conference Organizing Committee Chairman Marcel Vivargent (left) and Paul Lecoq of CERN.

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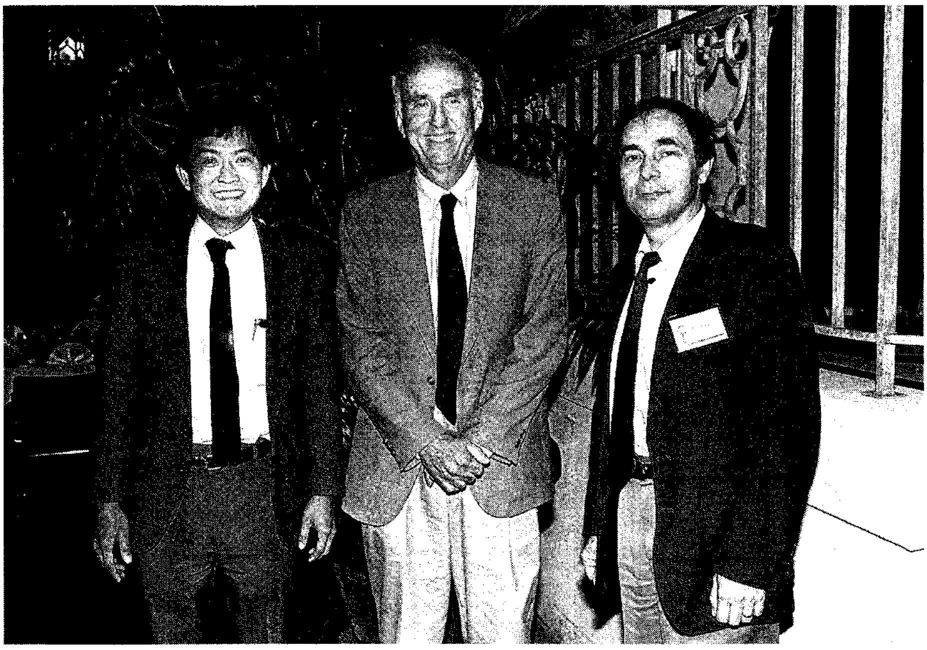
Tau lineup. At this year's workshop on tau lepton physics, the second in the series, and hosted by Ohio State University, tau pioneer Martin Perl is seen with workshop chairman K.K. Gan (left) and Michel Davier, one of the chairmen of the first workshop, held in Orsay, France, in 1990.



At the workshop it also emerged that a large amount of information on the scintillation properties of several materials and ions already has been compiled. In particular, cerium compounds can offer advantages when fast scintillation (some 20 ns) is needed. For ultrafast (nanosecond) scintillation, only crystals exhibiting special 'crossover' transitions can be considered, with the drawback of emitting in the vacuum UV. Similar expertise was gathered from extensive work in solid state chemistry and crystalline defects.

The Chamonix meeting was organized jointly by CERN, the French CNRS and the Italian INFN.

Tau leptons

Once an oddity, tau leptons are now being mass produced at electron-positron colliders, and tau physics is becoming daily life. This was reflected at the Second Workshop on Tau Lepton Physics, held at Ohio State University, September 8-11. This workshop was the sequel to the successful workshop organized by Michel Davier and Bernard Jean-Marie at Orsay in 1990.

The tau lepton, heavy cousin of the electron and the muon, was discovered in 1975 by Martin Perl and collaborators using the SLAC-LBL Spectrometer (Mark I) at the SPEAR electron-positron collider at SLAC, Stanford. This unexpected discovery broke the symmetry between quarks and leptons. This symmetry was partially restored with the discovery of the fifth quark (bottom) at Fermilab in 1977. Almost two decades after its discovery, the tau is giving interesting and vital results.

The workshop opened with a talk on new measurements of the tau mass. At the Beijing electron-positron collider, seven events were observed in a scan of the tau production threshold yielding a new measurement of the tau mass (July, page 13) an order of magnitude more precise than the previous measurement by DELCO (SPEAR) in 1978. In addition, ARGUS (DORIS) and CLEO (CESR) have reported new measurements of the mass using high statistics data samples collected near the bottom quark production threshold that are consistent with, albeit with larger errors, the Beijing result.

The meeting then focused on the tau lifetime and leptonic branching ratios, where the precision of these measurements (CLEO of the branching ratio into electron, ALEPH and OPAL of the lifetime) is now better than 2%. Together with the tau mass measurement, these measurements provide a stringent test of electron-muon-tau democracy (lepton universality). However despite the improvement in the precision of the measurements, there is still a nagging discrepancy.

Tau decays with one or three charged hadrons in the final states were the subject of two full sessions. New measurements from ARGUS (DESY, Hamburg), CLEO (CESR, Cornell), and the LEP experiments at CERN were impressive, some rivaling the old world averages in their precision. CLEO reported the observation of a new decay mode in which the tau decays into three charge pions and two neutral pions with a surprisingly large rate. A new method for measuring the tau neutrino mass based on this large decay rate was presented.

Tau physics could also help look beyond the confines of today's Standard Model. Jose Valle of Valencia emphasized that the search for exotic decay modes is a probe of the tau neutrino mass. In the session on tau neutrino mass and cosmology, ARGUS presented a new upper limit of 31 MeV of the tau neutrino mass.

Mike Turner of Fermilab/Chicago argued that excluding tau neutrino masses down 25 MeV is crucial since a tau neutrino mass in the 0.5 to 25 MeV region is forbidden in many theories. The 25 MeV mass upper limit is clearly within experimental reach in the near future.

One highlight was the examination of the so-called 1-prong decay problem, where a few percent of these decays may be unaccounted for. There are two ways of looking at the data: one is to pick the most precise measurement of each decay mode and the other is to use the world average of all measurements. Using the former method and assuming the most precise measurement is the best, there is no significant problem. With the latter method, there is a discrepancy. As emphasized by Michel Davier in his summary talk, there are significant differences between some of the measurements of the branching ratios, which suggests problems in some of the experiments. Reconciliation means more precise measurements, both by the reconstruction of the decays and by a global analysis of all decays in a single experiment. The next tau workshop will tell more.

The Tau Workshop was organized by K.K. Gan and his colleagues at OSU.

From K.K. Gan

People and things

At CERN on 6 October to open the 'Britain at CERN' trade exhibition, UK Under-Secretary for Trade and Industry Edward Leigh admires the CERN VIP visitors book with CERN Director for Technical Tasks Hans Hoffmann and Wendy Korda.

INFN President

Leading Italian theorist Luciano Maiani of Rome has been designated as next President of the Italian Istituto Nazionale di Fisica Nucleare (INFN), for three years, to succeed Nicola Cabibbo.

Emilio Picasso tribute

Friends and colleagues of Emilio Picasso attended a special event at CERN on 25 September to pay tribute to his 29 years of contributions to CERN's success. Recalling Picasso's vital role in the famous 'g-2' precision experiments to measure the magnetic moment of the muon, Francis Farley stressed Picasso's enthusiasm for physics and people, and his uncanny ability to motivate. From 1972-77 Picasso was leader of what became known as Experimental Physics Division. Covering this period, Jack Steinberger had collected many colourful Picasso tributes ('a series of sunny days'). In 1980 came the fateful call to be project leader for the LEP project, the largest accelerator ever built, using existing CERN finance and manpower, and close to a range of mountains. Gus Voss of DESY described how new teams were carved out of the existing CERN infrastructure and how, after an inevitably bumpy ride, the machine delivered on time. In recent years this remarkable accomplishment has rightly brought Picasso international honours and recognition. Finally Luigi Radicati di Brozolo covered Picasso's long interest in experimental searches for gravitational waves. Picasso's talents are now invested in a new career as director of Pisa's Scuola Normale Superiore.

New director at Legnaro

Massimo Nigro has been appointed by the Italian National Institute of Nuclear Physics as director of the Legnaro National Laboratory for the next three years, replacing Piero Dal Piaz, who has been elected Rector of the University of Ferrara.

The Legnaro National Laboratory, near Padua, is the main Italian Laboratory for nuclear physics. Its principal facilities are a tandem Van de Graaff accelerator and a superconducting linac for heavy ion beams (ALPI accelerator).

Massimo Nigro is Professor of Physics at Padua and his main research interests are in the field of experimental elementary particles, us-

Participants from the NATO Advanced Summer Institute on Particle Production in Highly Excited Matter, held at Il Ciocco near Pisa this summer, take time off in Florence.

NATO ADVANCED STUDY INSTITUTE

PARTICLE PRODUCTION IN HIGHLY EXCITED MATTER

IL CIOCCO, 55020 CASTELVECCHIO PASCOLI (PROVINCE OF LUCCA, TUSCANY), ITALY JULY 12-24, 1992

ing electron-positron storage rings. He previously served as Vice-president of Istituto Nazionale di Fisica and as Director of the Physics Department of the University of Padua.

Yerevan Director

Ruben Mkrtchyan is Director of the Yerevan Physics Institute in Yerevan for the next two years, succeeding Andrey Amatuni. For the same period Hrachia Asatryan becomes 1st Deputy Director for Research and Levan Vardanyan 1st Deputy Director for Production and Economic Activity.

Moves at Fermilab

At Fermilab, Roger Dixon, formerly head of D0 Department, has been appointed acting head of the Research Division, replacing Peter Garbincius, who has moved to a new assignment in the Physics Section. Gene Fisk takes over at D0.

Frank Turkot becomes head of the Technical Support Section. Former Head of Technical Support Paul Mantsch has moved to a new job as project manager for the calorimeter of the Solenoidal Detector Collaboration (SDC) for the SSC.

NATO Advanced Summer Institute 1992

Particle Production in Highly Excited Matter was the topic of a NATO Advanced Summer Institute held at Il Ciocco near Pisa this summer. Organized and directed by H.H. Gutbrod (GSI and CERN), G. Bellettini (INFN-Pisa) and J. Rafelski (Arizona), the meeting brought together leading experts from both nuclear and particle physics with researchers from major US and European nuclear and high energy laboratories. About 100 students from more than 20 countries attended.

Main interest was the behaviour of highly excited hadronic matter seen through particle production and emission in high energy nuclear collisions. After present studies at the Brookhaven AGS and CERN's SPS, new frontiers will soon be opened up at the RHIC and LHC colliders at the respective Laboratories, where the goal is the search for deconfined quark-gluon plasma. A major theme at the Institute was the interrelation between experimental observables, such as particle spectra and strangeness production, and theoretical concepts of highly excited matter.

Apart from the generous NATO support, significant financial contributions came from the US Department of Energy and National Science Foundation, the Italian INFN, and the German BMFT. Active support came from major research Laboratories including Pisa, GSI Darmstadt, and Brookhaven.

Kolar-less

The laboratory 2.3 km below ground in the Kolar Gold Fields in Southern India is being closed after a decision to stop mining operations. Set up in the 1950s by the Tata Institute for Fundamental Research, the laboratory reported its first cosmic ray neutrinos in 1964. When interest in Grand Unified Theories motivated the search for proton decay, Kolar hit the physics headlines ten years ago with the first candidate events. These were subsequently attributed to neutrino background.

1993 major meetings

Cornell has been selected by the International Union of Pure and Applied Physics (IUPAP) as the site of the

1993 International Symposium on Lepton and Photon Interactions, the sixteenth in the series of this important biennial meeting.

The sessions will run from Tuesday 10 through Sunday 15 August, inclusive, with the intervening Friday reserved for excursions and the conference picnic. The presentations will be summaries by invited speakers, although time will be reserved for important late-breaking developments.

Roughly half of the 725 participants will be from outside North America. Attendance, by invitation only, will be subject to IUPAP quotas. Contact Lepton-Photon '93, Newman Laboratory, Cornell University, Ithaca, NY 14853 USA, e-mail LEPPHO@CRNLNS via BITNET.

The 1993 International Europhysics Conference on High Energy Physics will take place in Marseille, France, from 22-28 July. Again attendance is by invitation only. Contact EPS Conference Secretariat, Luminy case 907, 13288 Marseille cedex 9, France, fax +33 91 41 45 32, e-mail EPS@MARVAX.IN2P3.FR

Spaceship Neutrino

For sheer fascination, you can't go far wrong with neutrinos. When such an elusive particle has so much to tell about physics and cosmology, then the science quickly becomes fascinating too. Thus 'Spaceship Neutrino', a new book, a real one you can read, by physicist/science writer Christine Sutton (Cambridge University Press, ISBN 0 521 36404 3 hardback, 0 521 36703 4 paperback) is fascinating as well. It is only fairly recently that the key role of neutrinos in both physics and cosmology has been recognized, so the book is timely. It traces the incredible intellectual and technological hurdles of neutrino physics – the idea and folklore behind the particle, the hunt for it, how neutrino beams became a laboratory tool, the physics results that emerged, the detection of extraterrestrial neutrinos, and the role of the ephemeral particle in cosmology. Well written, with anecdotes to get the professional and the interested layman turned on. Ongoing projects are well represented, however with solar neutrino measurements still in a state of flux, with neutrino masses anybody's guess, and no doubt with some more neutrino surprises still up Nature's sleeve, a new edition might be needed soon.

Other meetings

An International Workshop on Low Energy Muon Science (LEMS'93) will be held 4-8 April 1993 in Santa Fe, New Mexico, sponsored by the Los Alamos National Laboratory and LAMPF. The entire range of science possible with stopping muons will be reviewed, and new opportunities explored. For further information contact (e-mail, bitnet) LEMS93@LAMPF, or LEMS'93, MP-VC, MS-H831, LANL, Los Alamos, NM 87545, USA, fax 505 665 1712.

Organized by the CERN Accelerator School, a course on radiofre-quency engineering for particle accelerators will be held on the island of Capri, Italy, from 29 April-5 May. It is a repeat of the successful course given at Oxford, UK, in April 1991. Further information from Mrs. S. von Wartburg, CERN Accelerator School, 1211 Geneva 23, Switzerland, fax +41 22 782 4836, e-mail casrf@cernvm.cern.ch

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Microwave-Absorbing Materials for Accelerators Workshop

A Workshop on Microwave-Absorbing Materials for Accelerators will be held at the Continuous Electron Beam Accelerator Facility (CEBAF), Newport News, VA, February 22-24, 1993. Topics include microwave-absorbing materials in accelerators, microwave-power tubes, and other applications; manufacturing methods; ceramic, ferrite, dielectric, and artificial dielectric materials; microwave, structural, thermal, and vacuum properties and their characterization; and absorber design. A tour of the CEBAF accelerator, based on 338 superconducting microwave cavities at 2 K, is planned for those interested. Contact Paul Wheeler, MS 58B, CEBAF, 12000 Jefferson Ave., Newport News, VA 23606-1909; telephone 804/249-7407, fax 804/249-7658.

The CERN Courier

wishes its readers
a Happy Christmas
and
Prosperous New Year!

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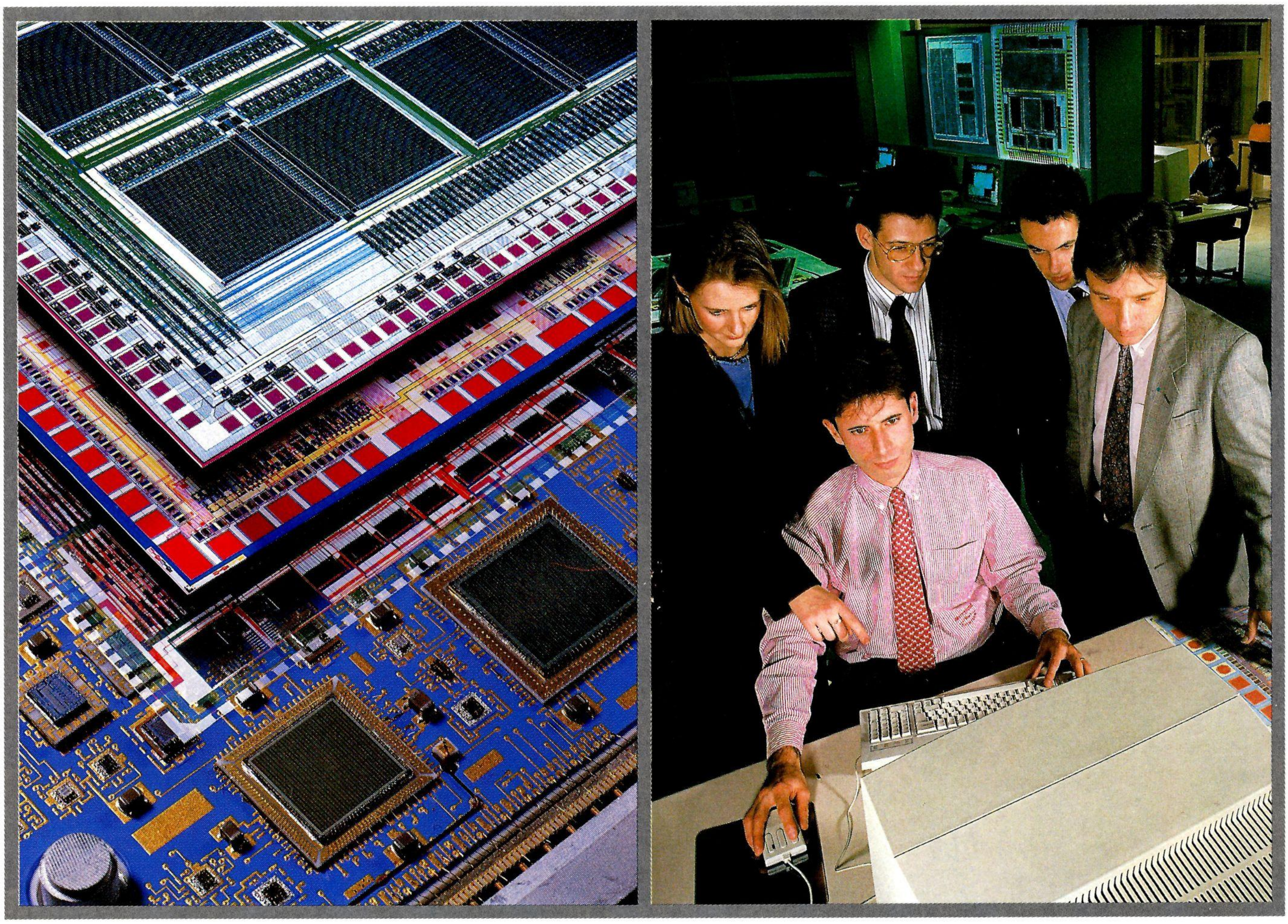
Elargir le champ du possible



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