From the left, W. Schmidt-Parzefall, P. Schlein and B.H. Wiik in front of the EPS stand at the 1991 LP-HEP Conference.

some extent at LEP and in heavy ion collisions at CERN-SPS and later at RICH. He underlined the importance of supercomputer calculations at APE in Rome and information on the spectroscopy of bound hadronic states from LEAR and planed e^+e^- colliders. Finally, while the K meson system is too complicated to distinguish between competing models for CP violation, mixing in the B quark system has opened up a new field to search for CP violation. Powerful new sources of B quarks are thus planned at LEP, a future e^+e^- collider, SSC, and at LHC.

New accelerator techniques for high energy facilities, notably linear and circular ep machines, for the next century were discussed by Y. Kimura. The progress that has been made in detector design, mainly in the field of calorimetry, particle identification and high resolution tracking devices, was covered by P. Jenni, who quoted test beam measurements with a spatial resolution down to 20 μm: detectors with such a resolution would be used for lifetime measurements at colliders.

Passive Experiments

New results from non-accelerator experiments gave rise to animated discussions. The observed flux of energetic solar neutrinos seems to be significantly lower than model calculations would predict. If this is verified, the observations could be the first hint of a new physics beyond the standard model. It therefore remains important to measure the neutrino flux from the sun with low threshold detectors (first generation detectors using a chloride solution only measured ^{8}Be and ^{7}B fluxes in the solar neutrino spectrum). Two experiments with Ga as the detector medium (GALLEX and SAGE) are on the verge of obtaining data within the next few years. SAGE in the USSR involving 60 t of metal rather than a solution of the chloride is more compact, but extraction of the ^{71}Ge produced is more complicated. However, a background radiation problem has held up calibration of GALLEX with a ^{51}Cr source. It arose owing to the generation during storage of ^{68}Ge by cosmic radiation. Heating the solution was evaluated in "hot runs" that started in late-1990 and the cool down last April resulted in a satisfactory background level.

First results from the SAGE experiment for five months in 1990 show interesting results, which need further cross-checking. Assuming a 100% extraction efficiency for ^{71}Ge, which is presently being verified with

Professor Y. Yamaguchi, IUPAP President-Designate, with Dr. B. Richter, Director of SLAC, seated in the background.

a ^{51}Cr source, the measured flux was low (< 79 Solar Neutrino Units — SNU — at 90% confidence limits) as compared to the theoretically predicted rate of 132 SNU. Finally, two new experiments are in preparation (BOREX and SNOW) for measuring the solar neutrino spectrum.

The existence of a 17 KeV neutrino (page 182) gave rise to controversial discussions which only further experiments will be able to resolve (talks by B. Barish and R. Mössbauer). In an audience dominated by experimental physicists, C. Itzykson succeeded in explaining to a largely non-expert community the most recent trends and developments in abstract field theory. The impact of particle physics on cosmology was reviewed by M. Turner, one of the top experts in the field.

W. Bartel, *DESY, Hamburg*

1991 EPS High Energy Physics Prize
Nicola Cabibbo

The 1991 EPS High Energy Physics Prize, which is awarded every second year on the occasion of the Divisional conference, was given to Professor Nicola Cabibbo at the joint International Lepton-Photon and Europhysics Conference on High Energy Physics held in Geneva on 25 July–1 August.

Nicola Cabibbo, who has been Professor of Theoretical Physics at the University of Rome since 1982 and is at present President of the INFN, received the prize for his "fundamental contribution to the theory of weak interactions leading to the concept of quark mixing". He is credited with a long list of honourable memberships in various committees and other bodies, amongst them the Academia Nazionale dei Lincei in Rome.

He started his scientific career in 1958 with a degree in physics from the University of Rome. After positions in Rome, Frascati, CERN and LBL, Berkeley, he became a lecturer at Harvard University. In 1965, he obtained his first position as a professor in theoretical physics at the University of L'Aquila, where he stayed for

M. Jacob, President of EPS, presenting the 1991 EPS High Energy Physics Prize to N. Cabibbo (facing camera).

only one year before moving to the University of Rome. He left Rome for short stays at the Institute for Advanced Studies, CERN, Paris, New York, Syracuse, and he held the Enrico Fermi professorship at the University of Chicago.

The work of N. Cabibbo has covered a wide range of physics and everywhere he made important contributions. We find him amongst the early advocates of e^+e^- colliding beam experiments (1961). He, together with others, proposed the use of crystals for producing multi-GeV polarized bremsstrahlung photon beams. In collaboration with Doniach he proved the existence of trapped flux units in Type I superconductors and recently he has been interested in the construction of parallel processors for QCD lattice calculations — the APE Project, one of the most ambitious and advanced projects in the field.

His contributions to the theory of weak interactions, which is the basis for the EPS award, is published in a paper "Unitary Symmetry and Leptonic Decays" in *Phys. Rev. Lett.* **10** (1963) 531. In those days in 1963 there were three phenomena in weak interactions which were awaiting a physics interpretation: there was the observation of strongly suppressed strangeness-changing weak decays and an apparent violation of the universality of weak interactions, or the CVC theorem. The vector coupling constants derived from O^{14} nuclear β decay and μ decay were different. Furthermore, the observed rate of hyperon β decays did not fit into any theory.

N. Cabibbo in his two page long paper proposed a solution to both problems. He defined an octet of unit currents J_μ with vector and axial vector components to describe strangeness changing and strangeness non-changing weak decays. The weights for the two components were expressed as sin and cos of an angle θ, the Cabibbo angle. By comparing $K^+ \to \mu^+ \nu$ with $\pi^+ \to \mu^+ \nu$ he obtained a value of $\theta = 0.26$ which is very close to the number given in the most recent edition of the particle data tables. This approach applied to hyperon decays led to predictions of branching ratios which agree within errors with today's measurements. The ansatz of current mixing explains at the same time the difference in the vector coupling constants measured in nuclear β decay and μ decay. Thus three pending problems were solved at once.

Only one year later, in 1964, Gell-Mann and Zweig introduced quarks to physics and Gell-Mann rewrote Cabibbo's octet of currents in terms of quark wave functions

$$J_\mu = u\gamma_\mu(1+\gamma_5)(d\cos\theta + s\sin\theta).$$

In 1970, six years later, S.L. Glashow, J. Iliopoulos and L. Maiani (GIM) introduced two quark doublets with pure charged 2/3 state and mixed charged $-1/3$ states in order to correct some shortcomings of the weak interaction theory. The weak hadronic current then reads as

$$J_\mu = (u,c) \begin{pmatrix} \cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \gamma_\mu(1+\gamma_5) \begin{pmatrix} d \\ s \end{pmatrix}$$

The last step brings us to the present status of the quark mixing scheme with three doublets and the incorporation of CP violation through a non-trivial phase in the Cabibbo-Kobayashi-Maskawa matrix:

$$Q_1 - \begin{pmatrix} u \\ \alpha_{11}d+\alpha_{12}s+\alpha_{13}b \end{pmatrix}$$

$$Q_2 - \begin{pmatrix} c \\ \alpha_{21}d+\alpha_{22}s+\alpha_{23}b \end{pmatrix}$$

$$Q_3 - \begin{pmatrix} f \\ \alpha_{31}d+\alpha_{32}s+\alpha_{33}b \end{pmatrix}$$

with the corresponding weak current

$$J_\mu = (u,c,t)\, M\gamma_\mu(1+\gamma_5) \begin{pmatrix} d \\ s \\ b \end{pmatrix}$$

where M is the Cabibbo-Kobayashi-Maskawa matrix. Considerable experimental effort is being devoted at present to determining the elements of the matrix and to understanding the origin of CP violation.

The EPS High Energy Physics Prize is sponsored by industry. The following firms have contributed:

Cray Research France (France)
Digital Equipment Corporation Europe (Switzerland)
Interatom (Germany)
Le Croy (USA)
Philips (The Netherlands)
Siemens AG (Germany)
Thomson Tubes Electroniques (France)

W. Bartel, *DESY, Hamburg*

The 17 keV Neutrino Quest Continues With Improved Techniques

Confirming the existence of a 17 keV neutrino would represent the first evidence for a physics beyond the standard model with a breakdown of the electroweak theory predicting massless neutrinos (extended models propose Dirac or Majorana mass terms depending on the symmetry of the underlying theory). Evidence for the 17 keV neutrino was first reported in 1985 by John Simpson in the β decay of ^3H implanted in a Si-Li detector. Six experiments in 1985-89 looking for distortions of the β spectra of ^{35}S and ^{63}Ni owing to the emission of the 17 keV neutrino then gave negative results.

In 1991, Simpson and Hime (working with ^3H and ^{35}S) and Hime and Jelley (^{14}S with a Si-Li detector) then obtained another positive result, as did groups at Berkeley (^{14}C) and Zagreb (^{71}Ge) also using semiconductor detectors. G.G. Ross mentioned a preliminary report of another positive result — this time for ^{63}Ni — at the 1991 LP-HEP Conference.

However, Becker *et al.* at Caltech using a ^{35}S source and a double focussing spectrometer reported negative results. Additional negative results were presented at the LP-HEP Conference by Bahran and Kalbfleisch who measured β decay in ^3H with an apparatus constructed of hydrogen-free material (to reduce distortion of the β spectrum by adsorption from the walls). Curve fitting spectra showed that a $< 0.4\%$ admixture of the 17 keV neutrino could be excluded with a 99% confidence limit.

Physics Heads Meet

Some so-called "mainstream" fields of physics (fission, high energy, synchrotron radiation, nuclear) have well established organizational structures while others (neutron scattering, high magnetic fields) are developing arrangements. Dr. K.H. Chang, Director of the Dutch physics research organization FOM, speaking at the meeting of the EPS Associate Members in Cracow last month, stressed how the historical "internationalism" of physics as well as political pressure for europeanization call for new networks and large facilities. National funding agencies find planning within this framework increasingly difficult owing to reductions in long-term structural investments being offset by special short-term funding. Dr. Chang reported on a first meeting, held last April in the UK, of a group with the provisional title CEPCRC (Chairman of the European Physics Committees of the Research Councils) where physics division heads of national funding agencies considered mechanisms to stimulate multinational collaboration. The CEPCRC's next meeting will be hosted by Germany.

Quantum Electronics & Optics Division

The 1991 EPS Council in Zurich recommended that the Quantum Electronics Division (QED) consult members to see if the Division's name should be changed to reflect wider interests in meeting the needs of members belonging to the former Optics Division. Professor Peter Knight, Chairman of the QED Board, reports that, on the Board's recommendation, the Division Business Meeting held in September in Edinburgh voted unanimously to adopt the name "The Quantum Electronics and Optics Division".