Report to the IUPAP General Assembly Tsukuba, Japan, October 15/16, 2008

C11. Commission on Particles and Fields

C11 membership

Officers 2005-2008

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G. Wormser	France
A. Olchevski*	Russia

Associate members

D.-O. Riska (C12)
S. Tonwar (C4)

*) new members

The work of the commission has been carried out through regular phone conferences of the chair, vice-chair and the secretary. The yearly commission meetings have been held during the main IUPAP sponsored conferences in Particle Physics, at the International Conference on High Energy Physics 2006 (ICHEP06) in Moscow, at the XXIII International Symposium on Lepton-Photon Interactions at High Energy (LP07) in Daegu/Korea and at the International Conference on High Energy Physics 2008 (ICHEP08) in Philadelphia, USA. For this report to IUPAP a short summary is given about recent developments in particle physics and about the main activities of C11 in the past three years.

Recent developments in Particle Physics

During the past three years there have been several interesting developments in the field of accelerator based particle physics. At the Electron-Positron Colliders in KEK, Japan, and SLAC, USA, the decay properties of hadrons containing the heavy b-quark have been studied. The measurements of the CP violation and the determination of the elements of the CKM quark mixing matrix have reached a precision which is better than

expected at the start of the projects. These measurements provide a very stringent test of the standard model of particle physics.

Important results of b-quark physics have also come from experiments at the Tevatron, Fermilab, USA. For the first time the mixing parameters of B_s – mesons could be measured, providing a further test of the validity of the Standard Model. The same experiments have also improved the data on top-quark production and decay. Because of the increase of luminosity at the Tevatron the experiments are now sensitive to the production of the hypothetical Higgs Boson, as predicted in the Standard Model. Depending on its mass the Tevatron experiments could find an indications for the existence of the Higgs boson prior to the start of the LHC. The Tevatron, being the highest energy collider in operation, has set stringent exclusion limits for new hypothetical particles.

An important milestone has been reached in 2007 with the completion of the HERA program on electron-proton collisions at DESY, Hamburg. For 15 years these experiments have provided stringent test of the strong interactions and have helped to establish Quantum Chromodynamics (QCD) as the theory of strong interactions. The results of HERA on the quark and gluon content of the proton will provide crucial input for the measurements at the Large Hadron Collider (LHC).

Another active area of research is the study of neutrino properties. After the discovery of neutrino oscillations several years ago the focus is now on the precise determination of the elements of the neutrino mixing matrix. These experiments are done with neutrino beams from accelerators, reactors and astrophysical sources as well as radioactive decays.

The construction of the LHC accelerator and of the experiments has been completed at CERN. A first single beam operation of the LHC on September 10, 2008, was very successful. Circulating beams could be achieved after one hour of LHC operations. Stable beams with good lifetime circulated in the 27 km ring for several minutes. Due to a failure of a superconductive connection between two magnets a large helium leak occurred, which forced a shutdown of the collider. Since the repair including warming up and cooling down could not be completed before the scheduled winter shutdown it has been decided to start LHC operations with proton-proton collisions in 2009. The LHC will increase the accessible center-of-mass energy by a factor of seven and will be able to probe for the first time in detail the TeV energy range, where several theoretical models predict new types of elementary particles.

A lot of activity is devoted to the R&D for future accelerators and detectors. A very active field is the development of technology for a high energy linear electron-positron collider, based on the well advanced superconducting RF technology (ILC) or novel two-beam accelerating schemes (CLIC). In addition, intensive R&D is conducted to produce high intensity neutrino beams and neutrino factories with the long term goal to fully measure the neutrino mixing matrix and to explore CP violating effects in the neutrino sector.

The interaction between particle physics and astrophysics continues to yield interesting new results in the fields of cosmology, astrophysical origin of cosmic rays, gamma ray astronomy, neutrino astronomy and dark matter searches. These fields profit from the combined competence of particle physicists and astrophysicists.

The particle physics research proceeds in close cooperation between experiment and theory. During the past years a lot of theoretical activity has gone into the interpretation of recent measurements with the aim to test the standard model (SM) and to place limits on models predicting effects beyond the SM. A variety of new theoretical approaches for theories beyond the SM have been proposed, awaiting the verdict of the LHC about the path which nature has chosen. Another field of theoretical particle physics, the lattice gauge calculations of low energy strong interactions, has made significant progress in the past years and provides now very stringent tests of the theory of strong interactions, the Quantum Chromodynamics (QCD).

Sponsored Conferences

Traditionally C11 is involved in the preparation and supervision of the two major international Conferences in Particle Physics, the International Conference of High Energy Physics (ICHEP) and the International Symposium on Lepton-Photon Interactions at High Energy (LP). Both conferences are held in alternative years. In 2006 the ICHEP Conference was held in Moscow, in 2007 the LP07 in Daegu /Korea and ICHEP08 in Philadelphia/USA. The forthcoming conferences will be LP09 in Hamburg, Germany, and ICHEP10 in Paris. Traditionally IUPAP has only sponsored the ICHEP and LP conferences in particle physics. In 2007, C11, together with C4 and C12, have sponsored the XXIII International Conference on Neutrino Physics and Astrophysics in Christchurch, New Zealand, demonstrating the growing importance of neutrino physics.

Instrumentation Conference

Research and development for instrumentation in particle physics and related fields is a very active field. Despite of the close international collaborations of many research groups and the intensive preparation for global projects, like the International Linear Collider (ILC), the field of particle physics lacks a large and truly international conference on instrumentation. Therefore C11 has taken the initiative to establish such a conference. It will cover all aspects of development in instrumentation and technology for particle physics and for applications in other fields. The conference is an extension of an established conference of SLAC and Novosibirsk and will have the new name Technology and Instrumentation in Particle Physics (TIPP). The first conference of this series will be held at Tsukuba, Japan, 12-17 March 2009.

ICFA

There is close communication between C11 and ICFA the International Committee on Future Accelerators. The C11 chair is ex-officio member of ICFA. The membership of ICFA is updated and confirmed by C11 on a regular basis. ICFA has submitted a report to IUPAP. Therefore ICFA activities are not reported here in more detail.

Young Scientist Prize
The first Young Scientist Prize in Particle Physics has been awarded to Yasaman Farzan, Tehran, for Theoretical Particle Physics and to Kai-Feng Chen, Taipeh, for Experimental Particle Physics. Both prizes were given at the ICHEP08 summer conference in Philadelphia.

Working group on assessment of individual achievements
C11 has initiated a working group on the assessment of individual achievements in particle physics. The motivation is that with the increasing size of experiments in particle physics it will be more difficult to assess the scientific achievements of individuals. Commonly used criteria based on publication lists and impact factors of papers with few authors, clearly disfavoring fields of science, where large international collaborations are required to make significant progress in the understanding of nature. The working group consisted of representatives from the large collaboration in experimental particle physics. The members of the working group propose measures to enhance the visibility of individual achievements in large collaborations. The report of the working group is available on the C11 web page. The findings of the working group and the successful collaborations in particle physics could be a model for other fields in science, where large collaborations are required to make significant advances in science.