31. Juli 2012

Statement by the German Committee for Particle Physics[1] (KET) on the European Strategy for Particle Physics

During the past half century, accelerator-based particle research has led to the key discoveries that paved the development of the Standard Model. These discoveries were predominantly made with machines that provided the highest energies or precisions worldwide. With its accelerators, Europe played a leading role with highlights such as the discovery of the gluon at DESY and of weak neutral currents and the W and Z Bosons at CERN. Experiments at LEP have tested the Standard Model with unprecedented precision and HERA pinned down the parton distributions.

With the start of the LHC operation in 2009, particle physics is now focusing on CERN. The beginning of the exploration of the TeV-scale and the impressive sensitivity for new physics demonstrated in the flavour sector are just a few indicators of the spectacular performance of the LHC which culminated in the discovery of a new particle consistent with the Higgs boson. On the other hand, recent measurements of the mixing angle Θ_{13} opened new prospects in neutrino physics.

Many excellent and challenging projects are being proposed worldwide, most of them will be discussed at the Cracow Symposium. They demonstrate the diversity and the wide scope of our field, the liveliness of the research community, and the importance of the questions addressed by particle physics. All proposed experiments have the potential of making important contributions to physics beyond the Standard Model, albeit with different sensitivity, precision and methods. However, resources will be limited and priorities have to be defined.

Currently, the major goals of particle physics are the exploration of the last missing sector of the Standard Model, responsible for the generation of mass, and the search for solutions to the many puzzles of the Standard Model through the discovery of new phenomena. The best opportunities to discover new effects and to study them in depth are provided by the LHC.

In view of these aims and the infrastructure presently available, and considering the technology options, KET has identified the following priorities for particle physics in Europe:

Running and optimisation of the Large Hadron Collider and its experiments at the design energy and luminosity, as well as analysis and interpretation of the data, have highest priority.

The exceptional physics potential of the LHC has been demonstrated by a large number of measurements of highest quality arising from the first twoyears of data taking. Clearly, the discovery of a Higgs-like particle by ATLAS and CMS can be considered a scientific breakthrough calling for a large number of subsequent precision measurements in order to determine the nature of this newly found particle. The discovery potential of the LHC will be further increased when running at design energy and luminosity.

---

[1] The Committee for Particle Physics (Komitee für Elementarteilchenphysik, KET) is the elected representation of the community of German particle physicists at universities, DESY, and CERN.

Precision measurements, analyses of rare decays, and searches for new phenomena call for unprecedented quality and size of data samples.

It is of utmost importance to maximize the luminosity of the LHC. The R&D needed for the planned upgrade of the LHC in the 2020s and its detectors for highest luminosities (Phase II of the LHC project) should be carried out with high priority.

An increase in integrated luminosity well into the 1000 fb^{-1} region can improve the measurement precision and enlarge the discovery potential of the LHC considerably. This requires the development of new detector technologies. Given the timescale of Phase II of the LHC project, special attention to the R&D program is needed now.

In parallel to LHC operation, the development and planning of an electron-positron linear collider and its detectors should be advanced forcefully in close agreement between CERN and its European partners and within the framework of a worldwide collaboration.

Past experiences show that precision measurements at highest energies are needed for a full understanding and a complete picture of physics for which lepton colliders are the ideal tool. From today's perspective, an electron-positron linear collider is the next large international project at the energy frontier. The long lead time for development, decision and construction of such a collider requires timely preparation. The centre-of-mass energy scale of such a machine will be determined by the observations made at the LHC. The recent observation of a Higgs-like particle provides the first valuable information of the anticipated energy scale.

Projects in the area of flavour physics that are already ongoing, in particular at LHC and at KEK must be continued.

Apart from direct measurements at the LHC and at an electron-positron linear collider, the TeV scale can be probed indirectly through rare processes and high-precision measurements at lower energies.

Indirect tests of very high scales can be done with high-precision experiments in the field of quark flavour physics with Kaons and most notably with B mesons. LHCb continues to be the prime experiment to study the physics of the bottom sector .The full exploitation of its physics potential requires further optimization in the future years. The electron positron collider SuperKEKB currently under construction in Japan will address complementary aspects in the heavy quark sector and the lepton sector. Participation of new European groups should be encouraged.

Projects in neutrino physics addressing fundamental questions should be pursued vigorously in an internationally coordinated effort.

Unanswered fundamental questions can also be addressed by physics with neutrinos produced at accelerators or coming from other sources like nuclear reactors or cosmic radiation, as well as with experiments without accelerators. The latter experiments include studies on proton decay, lepton number violation and neutrino mass, on lifetime and on electrical and magnetic dipole moments of particles, as well as experiments to search for the nature of dark matter and dark energy.

With the recent achievement in measuring the mixing angle 13, the road to a new class of measurements on the neutrino mass hierarchy and on CP violation has been paved, increasing the relevance of this field. We encourage a participation of European groups in next-generation, accelerator based neutrino experiments around the world. Moreover, we support a global R&D effort towards a neutrino factory with a coordinated European participation. We also support a strong involvement in non-accelerator based neutrino experiments where Europe has substantial expertise, such as neutrinoless double beta decay experiments or the measurement of oscillations of reactor neutrinos.

R&D for accelerator technologies for highest energies and highest intensities should advance at a high level. R&D for detector technologies should remain an essential element of particle physics. The advancement of information technologies needed for data analysis should also be supported.

The development of new technologies for accelerators and detectors is of fundamental importance to the long-term future of particle physics. Many promising ideas exist that can in the long run lead to excellent technical realizations within a globally coordinated research programme. Experiments entering new energy and intensity regimes demand a further development of the methods of information handling. The past has shown that research in high-technology fields produces applications for research and industry that go far beyond particle physics.

The large-scale projects of particle physics necessitate European coordination as firmly established through CERN, which has assumed a pivotal role. These structures are complemented by national funding structures, research laboratories, institutions and universities, which contribute decisively to the overall experimental and theoretical progress and have to be sustained.

CERN is the world's leading laboratory for particle physics. CERN must maintain its leadership, and further develop its potential. The leading position of European particle physics is based on a functioning network of central infrastructures, national laboratories, and universities. The continued development of this network is the prerequisite to maintain world class research at CERN and in Europe in general. Therefore, we strongly support an enhanced coordination of particle physics research between universities, national laboratories, and CERN.

To define a global strategy towards large-scale projects in particle physics, and to secure the required funds, it is essential for Europe to have a body comprising national funding agencies and scientific representatives. CERN Council is in a natural position to fulfil this role and to coordinate European activities worldwide.

Professor Bernhard Spaan, TU Dortmund
für das Komitee für Elementarteilchenphysik