

News from the CERN Council and European Strategy The future of Particle Physics at PSI

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The foundation of particle physics in Europe

European particle physics is founded on strong national institutes, universities and laboratories and the CERN Organisation,

Europe should maintain and strengthen its central position in particle physics

large-scale common projects like ISR, SPS, PETRA, SppS, LEP, HERA, LHC. It is fundamental that, as the scale of the frontier machines increases and hence their number worldwide decreases, Europe maintains and strengthens its central position in particle physics

The changing global environment for particle physics

Increased globalisation, concentration and scale of particle physics make a well coordinated strategy in Europe paramount;

this strategy will be defined and updated by CERN Council as outlined below

Uncovering the fundamental physics is likely to need new facilities (ILC, neutrino sources,..) and upgrades to existing ones (LHC...) that require global collaboration. It is paramount that Europe has a clearly articulated and well-coordinated strategy. The CERN Council has, through its convention, the necessary authority to assume this role.

The LHC

The LHC will be the energy frontier machine for the foreseeable future, maintaining European leadership in the field;

the highest priority is to fully exploit the physics potential of the LHC, resources for completion of the initial programme have to be secured such that machine and experiments can operate optimally at their design performance

Tunnel closed end of August 2007, first stable collisions at 450 GeV end of November 2007, 7 TeV operation late spring 2008. A few fb^{-1} by the end of 2008. An amount of 7.5 MCHF are missing for the end-cap crystals of CMS

For the operation at design luminosity $10^{34} \text{ cm}^{-2}\text{s}^{-1}$ about 30 MCHF are missing for CMS (and 20 MCHF for ATLAS).

The LHC accelerator complex needs consolidation with additional resources

Advanced accelerator R&D

In order to be in the position to push the energy and luminosity frontier even further it is vital to strengthen the advanced accelerator R&D programme;

a coordinated programme should be intensified, to develop the CLIC technology and high-performance magnets for future accelerators, and to play a significant role in the study and development of a high-intensity neutrino facility

The LHC accelerator complex needs consolidation with additional resources. Other projects are CLIC, DLHC (energy doubled), SLHC, very high intensity neutrino beams

The International Linear Collider (ILC)

It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on SC technology, will provide a unique scientific opportunity at the precision frontier; *there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision, to be ready for a new assesment by Council around 2010*

The physics programmes of the LHC and ILC are highly complementary, as demonstrated and documented by studies performed in many workshops. Thus, an electron-positron collider with the appropriate energy reach is of fundamental scientific importance

The neutrino programme

Studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino programme based on the information available in around 2012;

Council will play an active role in promoting a coordinated European participation in a global neutrino programme

Europe is very active in analysing or preparing current experiments (HARP, K2K, MINOS, OPERA), and in preparation of experiments for the near future (Double-Chooz, T2K, perhaps NovA). Goal is the discovery of leptonic CP violation.

The community is self-organizing at an inter-regional level in the study of the next-generation facility, and for the R&D leading to them, both on accelerator side (MICE at RAL, MERIT at CERN, the beta-beam study in the context of EURISOL) and on the detectors (liquid-argon TPC, water Cherenkov and photosensors).

Europe should be ready to host or to participate with strong visibility to the realisation and exploitation of a very important global future neutrino facility.

Non-accelerator physics & interface to the cosmos

A range of very important non-accelerator experiments take place at the overlap between particle and astroparticle physics exploring otherwise inaccessible phenomena;

Council will seek to work with ApPEC to develop a coordinated strategy in these areas of mutual interest.

Four areas of primary importance to particle physics require strategic planning: Proton lifetime, double-beta decay, dark matter searches, dark energy (both space- and ground-based)

Flavour physics and low-energy precision measurements

Flavour physics and precision measurements at the high-luminosity frontier at lower energies complement our understanding of particle physics and allow for a more accurate interpretation of the results at the high-energy frontier;

these should be led by national or regional collaborations, and the participation of European laboratories and institutes should be promoted.

A flavour-physics programme is a necessary complement to the direct searches for new physics at the high-energy frontier. Increased sensitivity and accuracy requires a new generation of facilities and a matching effort on the theoretical side for an accurate interpretation of the data. Key words are:

flavour physics, CP violation and lepton flavour violation at a high luminosity B factory, precision physics at low-energy e^+e^- facilities, precision physics with electrons, muons, neutrons and kaons

Strong interactions and the interface of particle physics and nuclear physics

A variety of important research lines are at the interface between particle and nuclear physics requiring dedicated experiments;

Council will seek to work with NuPECC in areas of mutual interest, and maintaining the capability to perform fixed target experiments at CERN

Spectroscopy and strong interactions at large distance (fixed target at CERN, SpS, FAIR-GSI, LNF), nucleon structure (LHeC, FAIR, eRHIC, JLAB), diffraction and forward physics (LHeC important to understand ultrahigh energy cosmic rays), new states of matter at high temperature and density (LHC, FAIR, identifying a QCD critical point), use of DAFNE2

Theoretical physics

European theoretical physics has played a crucial role in shaping and consolidating the Standard Model and in formulating possible scenarios for future discoveries. Strong theoretical research and close collaboration with experimentalists are essential to the advancement of particle physics and to take full advantage of experimental progress.

The forthcoming LHC results will open new opportunities for theoretical calculations, which should be widely supported.

Promoting interaction between theory and experiment, improving flexibility and maintaining diversity of career paths (greater weighting of the level of difficulty and originality relative to the number of produced publications), changes in the working environment of theory groups, support for lattice field theory.

Better EU funding (longer time scale of the projects, more certainty in their continued availability, more flexibility in the utilization of the support, and recognition of particle physics as a subfield)

Organizational issues: taking responsibility for the European strategy for particle physics

There is a fundamental need for an ongoing process to define and update the European strategy for particle physics;

Council, under Article II-2(b) of the CERN convention, shall assume this responsibility, acting as a council for European particle physics, holding a special session at least once each year for this purpose. Council will define and update the strategy based on proposals and observations from a dedicated scientific body that it shall establish for this purpose.

A specific proposal for a so called “European Strategy Group” could consist of 15-20 scientists nominated by the present Council Strategy Group, and thereafter 2/3 could be nominated by the group itself and 1/3 by Council. Every few years the Council should enlarge the group to include representatives of all member states and major European national laboratories for a specific meeting where the medium- and long-term European strategy for particle physics is reviewed and updated.

European participation in global projects

Future major facilities in Europe and elsewhere require collaborations on a global scale;

Council, drawing on the European experience in the successful construction and operation of large-scale facilities, will prepare a framework for Europe to engage with the other regions of the world with the goal of optimizing the particle physics output through the best shared use of resources while maintaining European capabilities.

In the new area of very large projects, it is essential that there is a coordinated European approach, otherwise European influence risks being fragmented and thus diluted.

Particle physics and the European Union

Through its Framework Programmes, the European Union establishes in a broad sense the European Research Area while European particle physics has its own established structures and organisation;

there is a need to create formal relationship between the two for communicating issues related to the strategy

The European strategy for particle physics has to be visible in the context of European planning. This is in particular important in relation to the road map proposal that the European Strategy Forum on Research Infrastructures (ESFRI) is preparing for the Commission.

European particle physics, through Council, needs to be fully engaged in the construction of the European Research Area and the emerging European Research Council (ERC)

Outreach and education

Fundamental physics impacts both scientific and philosophical thinking, influencing the way we perceive the universe and our role in it. It is an integral part of particle physics research to share the wonders of our discoveries with the public and the youth in particular. Outreach should be implemented with adequate resources from the start of any major project;

Council will establish a network of closely cooperating professional communication officers from each member state, which would incorporate existing activities, propose, implement and monitor a European particle physics communication and education strategy, and report on a regular basis to Council.

Communication should be delivered in the language of the receiver wherever possible (e.g. schools). Good communication is also timely.

Technology transfer, knowledge transfer and computing

Technology developed for nuclear and particle physics research has made and is making a lasting impact on society in areas such as material sciences and biology (e.g. synchrotron radiation facilities), communication and information technology (e.g. the web and grid computing), health (e.g. PET scanner and hadron therapy facilities);

to further promote the impact of the spin-offs of particle physics research, the relevant technology transfer representatives at CERN and in the member states should create a technology transfer forum to analyze the keys to the success in technology transfer projects in general, make proposals for improving its effectiveness, promoting knowledge transfer through mobility of scientists and engineers between industry and research.

Particle physics and industry

The technical advances necessary for particle physics both benefit from, and stimulate, the technological competences available in European industry;

Council will consolidate and reinforce this connection, by ensuring that future engagement with industry takes account of current best practices, and continuously profits from accumulated experience.

Technology transfer occurs not only through people, patents and licenses but also through contracts with industry for cutting edge projects

Selected Topics of next Council Meeting, 19-Oct-2006

- **Election of new president of Council. Candidates are:**
 - **M. Aguilar, T. Akesson, J. Niederle, R. Wade**
- **Election of new chairman of Finance Committee**
 - **M. Steinacher, F. Ferrini**
- **European Strategy for Particle Physics**
 - **Discussion on Implementation of Organizational Issues**
 - **Discussion of Complementary Issues**

End of CERN Issues

The following pages address some specific issues for PSI

Missing education in nuclear physics in Switzerland

CHIPP has noticed, that Switzerland will soon have no professor in nuclear physics. Nuclear physics is an integral part of the education in nuclear medicine, astrophysics, detector development, heavy element search etc.

PSI could be the host of nuclear physics knowledge in Switzerland.

- *nuclear physics with polarized cold and ultra-cold neutrons at PSI*
- *nuclear physics (and chemistry) of ultra-heavy elements together with GSI*
- *measurement of nuclear cross sections relevant for astrophysics, nuclear medicine (radio-pharmacy), space electronics, ... at the test-beam of the COMET accelerator*

The possible strategies of LTP at PSI

The strategy should fit into the mission of the whole institute, i.e. provide sophisticated infrastructure as a user laboratory or help to solve problems of society with a long time scale. Besides the continuation of the CMS-experiment imagine the following scenarios:

- *emphasis on “niche” experiments with neutrons and muons such as lepton flavour violation, neutron-antineutron oscillations, $edm(n)$, τ_n*
- *establish a new research field in non-accelerator physics (double beta decay, dark-matter search.)*
- *technology and detector development laboratory for particle physics experiments in collaboration with universities for CLIC, ILC, nu-factory and spin-offs to other fields*