Inputs to European Strategy Update 2018-2020 by the Czech particle physics community

Abstract
Although the Standard Model has been very successful in predicting and interpreting current measurements in particle physics, it has become clear that it cannot answer all the outstanding questions. To resolve the remaining issues new theories have been developed and further measurements are needed. The experience shows that diverse and complementary scientific program is the right approach to tackle the questions. To maintain this, the Czech high-energy physics community agreed upon a strong support of the activities listed below.

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1. ***Full exploitation of the physics potential of the CERN LHC***

Successful completion of Run-3, upgrade to high luminosity (HL) LHC and subsequent long-term data-taking should be of the highest priority. The Czech community foresees to continue a strong participation in both ATLAS and ALICE experiments at the LHC. In both experiments Czech scientists, students and technicians are actively involved in detector operation, upgrade projects (Inner Tracker and TileCal of ATLAS for HL-LHC, Inner Tracking System, Forward Diffractive Detector and Muon Forward Tracker of ALICE for Run-3) and various data physics analyses. As the luminosities of the LHC will be too high for the upgraded ALICE detector, the Czech community strongly endorses a new successor project of a compact, next-generation multi-purpose detector at the LHC that is currently being prepared by the heavy-ion physics community.

2. ***R&D of detector and new accelerator technologies***

CERN should also continue to pursue the R&D of detector and new accelerator technologies as well as development of high-field magnets. These activities and their results should provide the basis for a future collider project (HE-LHC, FCC), that should be planned at CERN after (HL-) LHC in order to secure CERN its know-how and ability to build new experiments and accelerators in the future.

3. ***International Linear Collider (ILC)***

Europe should also support the ILC project if a positive decision on its realization is taken by the Japanese authorities in viable future. At the same time, the future ILC upgrade to the energy above tt threshold should be foreseen.

4. ***Electron-Ion Collider (EIC)***

There is a strong physics case to build an electron-ion collider in the US in the coming decade. Participation of the European particle physics community which can build on its experience from experiments at HERA (DESY) or current involvement at RHIC at BNL is essential for making the EIC project a success and for keeping the whole community active and ready for realization of a future LHeC collider.

5. ***Lower-energy experiments***

Precision measurements at smaller experiments, studying quark flavour physics, rare decays, spin physics etc. besides providing important tests of fundamental theories have also discover potential for new, in particular BSM, physics phenomena. Such experiments in Europe, e.g. at CERN Isolde, should be supported as well as participation in experiments in other regions of the world.

6. ***Neutrino experiments***

The neutrino platform should also be continued as it allows the European physicists' participation in the long-baseline neutrino experiments in US and Japan. The Czech community supports the DUNE and JUNO projects where our physicists are strongly involved, we also consider our participation in Hyper-Kamiokande.

7. ***Computing***

Current particle physics experiments require large computing resources for data processing, MC simulation and data analysis. High-performance and distributed computing, software developments and GRID technologies are the key elements of large scale experiments. The developments of software for super-computers and quantum computing are desirable for future needs in particle physics.

8. ***Theoretical physics program***

Particle physics strongly relies on theory that provides an essential input and ramification to experiments. Diverse theoretical physics programs should thus be supported. As it proved to be very useful in last years to establish dedicated common collaborations between theorists and experimentalists to speed up progress in both theory and experiment, we recommend to further continue similar activities.

9. Cooperation with astroparticle and nuclear physics communities

Europe should further continue successful collaboration with astroparticle and nuclear physics communities in activities that topically overlap with particle physics.

a) Cooperation with ApPEC

A close cooperation with the ApPEC shall be maintained and further developed, such a collaboration is crucial and beneficial for both particle and astroparticle physics communities. For the astroparticle experiments, the upgrade completion of Pierre Auger Observatory represents one of the most important goals of the Czech astroparticle community, we also fully support the Cherenkov Telescope Array project to start the construction as soon as possible.

b) Cooperation with NuPECC

A close cooperation with the NuPECC community is also crucial. The Czech particle physics community also supports a variety of dedicated experiments on the boundary between particle and nuclear physics (e.g. FAIR GSI) as well as smaller experiments.

10. Outreach

We should present particle physics as the field full of opportunities for a deep engagement in the fundamental research and challenges to solve a wide variety of practical questions, the field where the effort is rewarded by pushing forward the human knowledge. Outreach and communication in particle physics should continue to be strongly supported.