19th May 2021

Mandate Proposal for the FCC Detector Concepts working group

The first phase of the FCC design studies (2014-2019) identified numerous features that are unique to FCC-ee, to FCC-hh, and to the FCC integrated programme (FCC-int) submitted to the European Strategy Update. The FCC-int technical and financial feasibility study is supported by the CERN Council. A main goal of the Physics, Experiment, and Detector (PED) pillar is to assemble a community of users, who will submit Expressions of Interest (EoI) for a number of FCC-ee detectors by the time of the next European Strategy Update. An intermediate milestone will be an FCC PED CDR, which will include descriptions of detector concepts that demonstrate a performance suitable for the FCC-ee physics programme.

The creation of a FCC "Detector Concepts" group is aimed at facilitating this process.

Tasks (include but may not be limited to):

1. Develop, study and evaluate FCC-ee detector concepts in order to make sure that these are capable of delivering the detector requirements set by *the physics* (as established by the Physics Programme and the Physics Performance groups). A detector concept includes (but is not limited to):
    a. the assembly of sub-detectors;
    b. the magnet system;
    c. systems for data acquisition and processing, based on estimate of data rates and size;
    d. an overview of services, consumables, power consumption, and ecological impact;
    e. an evaluation of construction and operating costs.
2. Optimize the compatibility of the detector concepts with operation at the FCC-ee, with the Machine-Detector Interface layout (MDI), and with the timing and background conditions, in close collaboration with the accelerator and MDI groups;
3. Identify and encourage necessary detector R&D in the direction of the requirements for FCC-ee;
4. Gather and engage a wide community around the Detector Concepts effort, and foster collaboration towards the common goal of developing FCC-ee detector concepts;
5. Function as a forum, where progress, ideas, and results from individual R&D efforts and test-beam activities are presented, discussed and reviewed in view of the FCC-ee detector requirements and physics; in particular, follow technological developments that could lead to new physics opportunities.
6. Revisit the FCC-hh detector concept in the light of the evolution of the physics landscape, and the HL-LHC detector upgrade experience. Monitor detector ideas and technology progress that are relevant for FCC-hh. Explore detector possibilities for dedicated experiments.

How:

1. Promote the use of the common FCCSW software platform & tools, including the development of the sub-detector geometrical description, simulation, and local reconstruction;
2. Integrate sub-detectors into detector concepts: a plug-and-play technology is offered by the key4hep software framework;
3. In collaboration with the Physics Performance (PPe) group, simulate and evaluate the performance of detector concepts, including test-beam simulation and data analysis;
4. Establish links to a broad range of R&D groups and encourage work towards the common goal of developing FCC-ee detector concepts. Give necessary input to R&D groups. Set up the means and milestones for enabling this communication;
5. Set up a group of people to follow up and regularly report on technology progress;
6. Identify common areas where specific engineering efforts (not covered by dedicated sub-detector developments) are required;
7. Arrange regular group meetings and presentations in PED general meetings;
8. Report to the FCC PED Coordination Group;
9. Monitor and act upon the ECFA R&D roadmap and ECFA "Higgs and EW Factory" Detector Working Group activities;
10. Organize topical and general detector concept workshops.

Deliverables:

1. A list of milestones, to be established by the Detector Concepts group coordinators, in discussions with the PED pillar coordinators.
2. A group structure proposal, tailored around the deliverables and milestones;
3. Detector concept proposals compatible with the detector requirements and with enough details and knowledge for proto-collaborations to progressively take over and enabling them to deliver informed EoIs by the time of the next ESU;
4. FCC CDR+ contribution, including descriptions of:
   a. how the various detector requirements can be matched by detector solutions.
   b. the technical and financial feasibility of the detector concepts;
   c. R&D efforts and resources that are still required to achieve the detector requirements.