

Scenario planning for the future: possible “plan A” options for CERN and scenarios for risk mitigation.

Thursday, 9 January 2025 11:45 (45 minutes)

It was agreed in November that we should aim to discuss the future roadmap in terms of optimisation/risk mitigation for different scenarios. For the January drafting day, we have prepared two lists of scenarios for the community to provide input on (both before the meeting and during the meeting). The first considers alternative “plan A” roadmaps for CERN, and the second focuses on risk-mitigation assuming (as a starting point) CERN’s default plan of HL-LHC through to 2041 followed by FCC-ee in ~ 2047 . The first set of scenarios will be discussed before lunch and the second afterwards; however, it is anticipated that some of the considerations may be linked.

Framing discussion (<15’) on the key (collider-related) recommendations from the last ESPPU, i.e. that

- The successful completion of the high-luminosity upgrade of the machine and detectors should remain the focal point of European particle physics, together with continued innovation in experimental techniques. The full physics potential of the LHC and the HL-LHC, including the study of flavour physics and the quark-gluon plasma, should be exploited.

- An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy.

Scenarios for discussion:

Discussion of possible “plan As” - what are the risks and opportunities? (Note that 1b, 3,4 and 5 are in tension with the recommendations of the last ESPPU so this discussion should also be steered by the input above).

1) FCC tunnel- part of discussion above but also additional options:

- a) FCC-ee followed by FCC-hh (baseline integrated programme)
- b) Intermediate energy FCC-hh as the first step (aggressive energy frontier programme)
- c) FCC-ee, FCC-hh, FCC-eh (extended integrated programme)

2) Linear e+e- Higgs factory @ CERN

3) Expand LHC infrastructure (LHeC, FPF and other auxiliary experiments)

4) Delay next big collider experiment and focus on R&D

5) Muon collider @ CERN

6) LEP3 in LHC tunnel

Example risk mitigation exercise: assume CERN’s default plan is HL-LHC to 2041 followed by FCC(ee) in ~ 2047 .

- 1) HL-LHC delayed/technical problems requiring $>\sim 5$ years additional data-taking to reach 3000 /fb.
- 2) Updated HL-LHC projections place Higgs coupling sensitivities closer to e+e- projections.
- 3) Another Higgs factory begins construction prior to approval of FCC.
- 4) A significant (5sigma) deviation from the SM observed within the field (either at the 5) HL-LHC/LHC or at another experiment).
- 6) Technology (i.e. RF) required to deliver e+e- programme delayed by $>\sim 5$ years.
- 7) FCC integrated programme deemed technologically, environmentally or financially unfeasible

Session Classification: Session 1