Minutes from the first roundtable discussion. July 2, 2026.

Transcribed by Felix Yu.

- Interdisciplinary aspect of machine learning - connections to other fields of science and broader society, will play an essential role in collider physics as a result of big data science in the coming decades. Need to have/Can justify a coordinated improvement in machine learning coming from theoretical particle physics. Can make a connection to revolutions in society (internet age, WWW coming after LEP, LLMs and AI tools after LHC)

- Statistical precision needed for FCCee will overwhelm current theory uncertainties. These tables (see 2505.00272) will need a coordinated effort. Helps address the "Coherence" question. Include the comparative table of SM measurements with different assumptions of theory uncertainties as a figure in Section 2. It is also known exactly what statistical precision will be achieved/expected, so we have a clear target for the theory precision goals.

- Parametric uncertainties are currently underestimated and will be highly relevant for successful global fits

- Fundamental question of the SPP proposal to be answered, "Why now?" Possible answers: work done in preparation for the FCCee could come either too late if not in the umbrella of an SPP. Work is also not incremental - simple extrapolations of the time needed to perform the next fixed order calculation in precision processes motivates the creation of new techniques and new methodology. Helps to address the "Rethinking known fields" language of the DFG. Z-physics will happen first, the top run will happen much later in the future. On the other hand, the flavor program is being developed now, and we need to construct and develop a clear roadmap with what new observables will be accessible and testable at FCCee. In particular, for flavor, QED corrections and their treatment require a combination of perturbative physics, lattice calculations, and experimental analyses - very appropriate for a Theory Hub.

- Can we use the Theory Hub to help define and influence detector design? The feasibility study has already defined the detector requirements given the SM measurements. All detectors are multipurpose, and current subsystems are being analyzed/coordinated as proto-collaborations.

- Monte Carlo will play an essential role in FCCee. What we will gain in experience in the time before physics runs of FCCee will be invaluable and help address the timeliness question of the Theory Hub. We will have new machine based learning tools and can push modeling, and Monte Carlo becomes more central and enabling in the future versions of collider analyses. In particular, in one year, FCCee will have 26 *times* the data in the LHC (such as on the Z-pole).

- Another exaxmple of the interplay of a coordinated theory effort and why it is necessary to start well in advance of the experimental measurement is $(g-2)_\mu$. It took $\mathcal{O}(15)$ years for a paradigm shift and there were of course surprising developments along the way.

- Connections to LEP - there is a lot of old data that current analysis techniques cannot analyze. There is a new effort/alliance to reanalyze LEP data (ALEPH, L3, etc.). This motivates issues of Data stewardship and Data management and storage. Would help justify a Theory-driven initiative to store and understand FCCee data. In particular, some LEP data automatically included QED subtraction effects which cannot be recovered.

- We should emphasize big physics questions, such as baryogenesis and the matter–anti-matter asymmetry of the universe. This physics case helps unify aspects of flavor physics, Higgs physics, top physics, and makes contact among different observables. Even further, we can connect FCCee physics to gravitational wave observables.

- A Theory Hub would be essential in the continued development of optimal observables, understanding and constructing new ideas and how to guide experiment on how to make measurements, what we need to measure, and the interplay with HL-LHC observables to make FCCee as successful as possible.

- Important to understand New Physics interplay in SMEFT and precision measurements, for example, the W mass measurement, NP effects in standard candles and the overall precision question. Could move away from pseudo-observables to cross sections as driven by precision.

- We have to emphasize what Germany can do and specialties of Germany.

- The BSM case may be "harder" to make compared to the precision physics case, especially with regards to timeliness. On the other hand, the interpretation of precision for its own sake is best understood in the context of BSM sensitivity. Will need the right balance in the proposal.

- Photoproduction processes at FCCee will play a significant role and need to be studied. Also need to interplay with PDF measurements and HL-LHC measurements that will be helpful.

- We can make a case for studying QCD on its own right. There is also a possibility that we will have another physics run below the Z-pole.

- Luminosity measurements, in particular Bhabha scattering, will also be critical to address in a Theory Hub. Possible double counting for beamstrahlung and luminosity.

- We expect to have competition from an EIC SPP proposal. There is very limited overlap with some physics (fragmentation functions, for example). There is also an EPJ C paper discussing high intensity lasers part of the "beyond collider program" and interplays with photon science.

- For top physics, it is important to have unified attention for both on-shell and off-shell tops and differential distributions and precision calculations.

- Flavor and lattice connections will help us bridge to lattice community.

- Other physics case includes $\delta\alpha_{had}$ - there is a minor controversy and lattice community is likely vital to understand.