Top-quark reconstruction at FCC-ee

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The Standard Model of Particle Physics (SM) describes the fundamental interactions of matter and has passed many experimental tests among which particle collider are of special importance, with its most prominent example, the Large Hadron Collider (LHC) at CERN. Although the SM well describes interactions on several energy scales, open questions remain like the seen asymmetry between matter and antimatter. Pushing the limits forward, the future circular collider (FCC) with its colliding electron and positron beams is expected to tighten constraints on beyond SM (BSM) theories. A precise reconstruction of the particles produced in the collision and, in particular the determination of their kinematics, therefore becomes one of the most important challenge to extract these constraints.

The focus of this internship project is on the reconstruction of top-quark pairs at FCC-ee, whose signature contains two final-state leptons. The algorithm for the top-quark reconstruction is well known but suffers from the lack of knowledge about the total energy of each event, since this final state also contains two non-measurable neutrinos. Going beyond traditional methods to extract the full event kinematic, the project will test the feasibility of multivariate approaches like a Neural Network to take full-phase space information into account for a more precise reconstruction. Testing several inputs and comparing the obtained performances on the final reconstruction of top quarks will be part of the project.

Basics in the field of particle physics are required and pre-knowledge of machine learning would be useful, as well as basics in programming languages like `C++` and/or `python`.