Geant4 and fast simulations for physics and detector performance studies for a 100 TeV collider

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The FCC-hh conceptual design report [1] established the foundation for infrastructure preparation and technical design of a *pp* collider with the centre-of-mass energy of 100 TeV. The layout of the FCC-hh reference detector described in this report was optimized for a wide range of physics expected at 100 TeV collisions. Because the design of such a detector is constantly evolving, Monte Carlo simulations that are easy to reconfigure to study various design features and technologies are essential in order to establish the optimal design and explore trade-offs.

Another approach to the detector design for 100 TeV collisions has been proposed in Ref. [2]. This detector, called SiFCC, predates the final layout of the FCC-hh reference detector [1]. The SiFCC detector uses different technical solutions, making the SiFCC in the central region ($|\eta| < 2.5$) more compact than the FCC-hh reference and ATLAS detectors. The central region of the SiFCC detector is well-suited for studies of 100 TeV physics and reconstruction techniques but, compared to the FCC-hh reference design, the forward region ($|\eta| > 2.5$) of the SiFCC is less developed.

The main goal of the SiFCC detector was to provide a template for studies of detector technologies and event-reconstruction methods and their impact on physics at the 100 TeV energy frontier. A salient feature of the SiFCC simulation is a fast turnaround for modifying the detector and creating Monte Carlo events by users. For example, using several types of SiFCC simulations with different calorimeter cell sizes, the optimal cell granularity for calorimeters was established in Ref. [3, 4]. Full GEANT4 [5] simulations of the SiFCC detector were used to explore the physics potential of timing layers with a few tens of picosecond resolution in the calorimeters [6].

The Monte Carlo samples with 100 TeV collisions, before and after GEANT4 simulations with different SiFCC detector geometries are available in [7]. This web site also provides samples using parametric detector simulations, as well as documentation on analysis software.

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