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Full and Fast Simulation Framework for the Future Circular Collider Studies

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Software for the next generation of experiments at the Future Circular Collider (FCC), should by design efficiently exploit the available computing resources and therefore support of parallel execution is a particular requirement. The simulation package of the FCC Common Software Framework (FCCSW) makes use of the Gaudi parallel data processing framework and external packages commonly used in HEP simulation, including the Geant4 simulation toolkit, the DD4HEP geometry toolkit and the Delphes framework for simulating detector response.

Using Geant4 for Full simulation implies taking into account all physics processes for transporting the particles through detector material and this is highly CPU-intensive. At the early stage of detector design and for some physics studies such accuracy is not needed. Therefore, the overall response of the detector may be simulated in a parametric way. Geant4 provides the tools to define a parametrisation, which for the tracking detectors is performed by smearing the particle space-momentum coordinates and for calorimeters by reproducing the particle showers.

The parametrisation may come from either external sources, or from the Full simulation (being detector-dependent but also more accurate). The tracker resolutions may be derived from measurements of the existing detectors or from the external tools, for instance tkLayout, used in the CMS tracker performance studies. Regarding the calorimeters, the longitudinal and radial shower profiles can be parametrised using the GFlash library. The Geant4 Fast simulation can be applied to any type of particle in any region of the detector. The possibility to run both Full and Fast simulation in Geant4 creates a chance for an interplay, performing the CPU-consuming Full simulation only for the regions and particles of interest.

FCCSW also incorporates the Delphes framework for Fast simulation studies in a multipurpose detector. Phenomenological studies may be performed in an idealised geometry model, simulating the overall response of the detector. Having Delphes inside FCCSW allows users to create the analysis tools that may be used for Full simulation studies as well.

This presentation will show the status of the simulation package of the FCC common software framework.

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