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DD4hep: an integrated detector description tool for HEP

The detector description is an essential component in simulation, reconstruction and analysis of data resulting from particle collisions in high energy physics experiments. The main motivation behind DD4hep is to provide an integrated solution for all these stages and addresses detector description in a broad sense, including the geometry and the materials used in the device, and additional parameters describing e.g. the detection techniques, constants required for alignment and calibration, description of the readout structures and conditions data. A core part of DD4hep is DDG4 which is a powerful tool that converts arbitrary DD4hep detector geometries to Geant4 and gives access to all Geant4 action stages. It is equipped with a comprehensive plugins suite that includes handling of different IO formats, Monte Carlo truth linking and a large set of segmentation and sensitive detector classes, allowing the simulation of a wide variety of detector technologies. Another important segment of the toolkit are DDCond and DDAlign, which expose a mechanism to manage detector data simultaneously for multiple versions depending on their validity. The detector conditions data are made available to the physics algorithms through a number of transient objects grouped to collections. Such a collection represents a coherent slice of all conditions data necessary to process one or several events depending on the interval of validity of the slice, which is the intersection of the individual conditions. A multi-threaded application may hold several such collections in parallel depending on the time-stamps of the events currently processed. In this presentation, we will give an overview of the project and discuss developments in DD4hep as well as showcase recent adaptions of the framework by LHC experiments and beyond.

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