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Geometric modelling in particle physics community

Building an experimental setup in the particle physics environment is a complex task which implies all typical steps such as product design, mechanical simulation, prototyping, assembly, etc. Nowadays most of these tasks are performed with support of the software which, in many cases, requires different 3D models. Usually, computer-aided design (CAD) systems are used for product design, software packaged based on the finite-element method (FEM) are used for mechanical simulation. However in particle physics there are a few specific steps like detector physics simulation, radiation dose simulation. The software for these simulations also requires the 3D model of the setup to perform geometrical computations during particle propagation through the setup. These algorithms are optimized to work with a rather rarely used geometrical representation consisting of constructive solid geometry (CSG) for shape definition and volume hierarchy for structure definition. Due to fundamental mathematical reasons a model, described using this geometrical representation, can not be automatically converted into or from a model, described using the boundary representation (BREP), which is used by almost all CAD systems.

A set of tools called “CATIA-GDML geometry builder”, which allows to facilitate significantly creation of a Geant4/ROOT-compatible geometry from the CAD system CATIA V5 will be presented. CATIA V5 is widely used in big physical laboratories like JINR, CERN, GSI, LNGS, etc. Geometry Description Markup Language (GDML) is used as exchange format as it is natively supported by both Geant4 and ROOT. “CATIA-GDML geometry builder” is being developed since 2010. Main functionality will be presented along with several successful use-cases during last years.

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