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BoGEMMS-HPC: development of Geant4 simulations in High-Performance Computing environments (Flagship UC 2.3.6)

The Geant4 toolkit is a widely used particle transport code for the simulation of high energy space missions, enabling the evaluation of their performance and driving the instrument design. The evolving landscape of modern large-scale simulations provides a new challenge in managing the production of increasingly large datasets, along with memory and computing requirements, that leads to the design of next-generation simulation frameworks in the realm of High-Performance Computing (HPC). We propose the development of an open-source multi-threading (MT) and multi-node Geant4-based simulation pipeline with ad-hoc I/O interfaces (e.g. run-time input configuration, output databases) based on the Bologna Geant4 Multi-Mission Simulator (BoGEMMS), an astronomy-oriented Geant4-based application developed at INAF OAS. The BoGEMMS-HPC framework will allow user-friendly, multi-purpose simulations in HPC environments. The current release uses the already built-in MT library of Geant4, which distributes events (where each event is a primary particle with its secondaries) on different threads. The multi-node parallelism is instead handled by the G4MPI library, the only plug-and-play Geant4 interface with MPI currently available. The node parallelism is also at the level of primary events. BoGEMMS-HPC supports two distinct output data formats: FITS files and SQLite databases. The test case for BoGEMMS-HPC is the simulation of the anticoincidence system of COSI (Compton Spectrometer and Imager), a NASA Small Explorer satellite mission with launch planned in 2027. We present the BoGEMMS-HPC architecture, the preliminary verification results, and the development plans for the near future.

Giorno preferito

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