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Optimizing the ATLAS Geant4 detector simulation software

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The ATLAS experiment at the LHC relies critically on simulated event samples produced by the full Geant4 detector simulation software (FullSim). FullSim was the major CPU consumer during the last data-taking year in 2018 and it is expected to be still significant in the HL-LHC era [1, 2]. In September 2020 ATLAS formed a Geant4 Optimization Task Force to optimize the computational performance of FullSim for the Run 3 Monte Carlo campaign. This contribution summarizes the already implemented and upcoming improvements. These include improved features from the core Geant4 software, optimal options in the simulation configuration, simplifications in geometry and magnetic field description and technical improvements in the way ATLAS simulation code interfaces with Geant4. Overall, more than 50% higher throughput is achieved, compared to the baseline simulation configuration used during Run 2.

[1]: ATLAS Collaboration, “ATLAS HL-LHC Computing Conceptual Design Report”, CERN-LHCC-2020-015.

[2]: ATLAS Collaboration, “ATLAS Software and Computing HL-LHC Roadmap”, CERN-LHCC-2022-005.

Significance

This contribution summarizes novel physics and computing optimizations for the ATLAS experiment full detector simulation software. For the first time, these are implemented into the production of the required Monte Carlo simulations for the LHC Run 3. These improvements allow the production of 50% more simulated events, using the same computational resources with the previous baseline software.

References

1. Geant4 Technical Forum, Geant4 in ATLAS, <https://indico.cern.ch/event/1106118/timetable/?view=standard#19-geant4-in-atlas>
2. Geant4 Technical Forum, ATLAS Geant4 Simulation Update, <https://indico.cern.ch/event/1139613/timetable/?view=standard#23-atlas-geant4-simulation-upd>

Experiment context, if any

ATLAS Experiment at CERN

Author: KOURLITIS, Evangelos (Argonne National Laboratory (US))

Co-authors: VISHWAKARMA, Akanksha (The University of Edinburgh (GB)); SUKHAREV, Andrei (Budker Institute of Nuclear Physics (RU)); WYNNE, Benjamin Michael (The University of Edinburgh (GB)); MORGAN, Benjamin (University of Warwick); MARCON, Caterina (Università degli Studi e INFN Milano (IT)); KIM, Dong-won (Stockholm University (SE)); TCHERNIAEV, Evgueni (Tomsk State University (RU)); AMADIO, Guilherme

(CERN); APOSTOLAKIS, John (CERN); CHAPMAN, John Derek (University of Cambridge (GB)); BANDIERA-MONTE, Marilena (University of Pittsburgh (US)); MUSKINJA, Miha (Lawrence Berkeley National Lab. (US)); NOVAK, Mihaly (CERN); SCHMIDT, Mustafa Andre (Bergische Universitaet Wuppertal (DE)); LARI, Tommaso (University and INFN, Milano); HOPKINS, Walter (Argonne National Laboratory (US))

Presenter: KOURLITIS, Evangelos (Argonne National Laboratory (US))

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