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Geant4 simulations for the design, verification and calibration of ground experiments and space missions

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Abstract: Geant4 is an open-source toolkit library for Monte Carlo particle transport simulations at high energies (from few eV), developed by CERN and maintained by a large, international collaboration. Thanks to its ability to build a 3D mass model of the instrumentation and simulate the transport of particles through matter, with a variety of physics interaction libraries to choose from, Geant4 is now a widely used simulation software for the design, verification and calibration of high energy space-borne instrumentation and on-ground experiments. INAF has become a leading institute for developing Geant4 applications for the X-ray and Gamma-ray background simulation, instrument response definition, shielding optimisation and performance characterisation of high energy missions and instruments. INAF coordinates the background simulation activities for both the Athena instrument international consortia, the Athena magnetic diverter simulation group, the THESEUS XGIS and HERMES instrument background, response matrix and sensitivity simulation and the simulation of the IXPE and eXTP background. INAF has also led the ESA funded projects AREMBES and EXACRAD for the X-ray radiation effect analysis and minimisation of the Athena mission, and INAF researchers are coordinating Geant4 simulations activities within the European HORIZON2020 AHEAD2020 project and contributing to the simulations of either accepted or under proposal COSI, XRISM, ASTROGAM, and STACEX projects. We present here some examples of the INAF's central role in the development of Geant4 applications, also to highlight the coordination among the several contributing institutes (OAS, IAPS, IASF-Mi, IASF-Pa) as the critical factor in helping share internal knowledge and boost the scientific results.

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