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The TOPAS Tool for Particle Simulation

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TOPAS lets users model any sort of radiation therapy or medical imaging apparatus in three dimensions by combining a set of pre-built geometry components. Users can then send any form of fundamental particle through this setup, from x-rays and electrons to protons and heavy ions. Users can easily import patient models, animal models or phantoms through DICOM and other formats and see where the particles travel. TOPAS users can score Energy, Dose, Fluence, RBE, Time of Flight, etc. to various formats: csv, binary, nTuple, phase space, or DICOM dose files, and can also directly calculate DVH or perform output modeling for TCP or NTCP. TOPAS also allows users to make almost any parameter vary over time, hence we speak of TOPAS as not just 3D but 4D. TOPAS has been widely accepted, currently in use by over 2500 users at 638 institutions in 68 countries.

While the primary use of TOPAS has been for studies in medical physics, its unparalleled combination of flexibility and ease of use make it an excellent tool for developers of any form of apparatus where Monte Carlo particle tracking is useful including any form of imaging detector. Indeed, at the core of TOPAS is the same Geant4 Simulation Toolkit used by the majority of HEP detector developers worldwide. I will show the general capabilities of TOPAS, present a quick overview of how the user builds their TOPAS simulation, and show some examples of how it has been used for a wide variety of research projects. TOPAS is freely available to all users both as a pre-built executable and as open source code.

TOPAS is further described in the open-access manuscript: Perl J, Shin J, Schumann J, Faddegon B, Paganetti H. TOPAS: an innovative proton Monte Carlo platform for research and clinical applications. *Med Phys.* 2012 Nov; 39(11):6818-37. (View in: PubMed). This manuscript has been cited 888 times in Google Scholar. Further details can be found at <https://www.topasmc.org/>

Early Career

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