Contribution ID: **23** Type: **poster**

R&D on co-working transport schemes in Geant4

Tuesday 24 March 2009 08:00 (20 minutes)

A R&D project, named NANO5, has been recently launched at INFN to address fundamental methods in radiation transport simulation and revisit Geant4 kernel design to cope with new experimental requirements.
The project, that gathers an international collaborating team, focuses on simulation at different scales in the same environment. This issue requires novel methodological approaches to radiation transport across the current boundaries of condensed-random-walk and discrete methods: the ability is needed to change the scale at which the problem is described and analyzed within a complex experimental set-up.
An exploration is also foreseen about exploiting and extending already existing Geant4 features to apply Monte Carlo and deterministic transport methods in the same simulation environment.
The new developments have been motivated by requirements in various physics domains, which challenge the conventional application domain of Monte Carlo transport codes like Geant4: ongoing R&D for nanotechnology-based tracking detectors for HEP experiments, radiation effects on components at high luminosity colliders and in space science, optimization of astrophysics instrumentation, nanodosimetry, investigations of new generation nuclear power sources etc.
The main features of the project are presented, together with the first prototype developments and results. A new concept introduced in the simulation –mutable physics entities (process, model or other physics-aware object), whose state and behavior depend on the environment and may evolve as an effect of it, is illustrated.
The interdisciplinary nature of the R&D is described, highlighting the mutual benefits of collaborative contributions and beta-testing in HEP and other physics research domains.

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Session Classification: Poster session

Track Classification: Event Processing