Radiation background simulation and verification at the LHC and its upgrades.

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The high collision rates at the new energy regime of the LHC gives rise to unprecedented radiation environments, especially in the inner regions of the experiments. Deleterious effects of radiation on the experiments include: damage to detectors and electronics; fake backgrounds in the selection and reconstruction of interesting physics events; single event upsets causing disruption in the data readout; radio-activation of components making access for maintenance difficult.

High fidelity codes such as FLUKA and GEANT4 are necessary for simulating the complex radiation backgrounds in detail. The results can then be used for predicting detector system behaviour and performance over the lifetime of the project.

In this talk the following will be covered: First the Monte Carlo tools used to simulate the radiation backgrounds will be discussed, which include the transport codes FLUKA and GEANT4, as well as the collision event generators PHOJET and PYTHIA. Examples of the predictions at the ATLAS experiment will be shown, focussing in the inner detector regions. The second part of the talk will deal with the verification of these simulations, where the fluence and dose predictions are compared with measurements. Finally, the radiation background situation for vertex detectors at the HL-LHC is discussed.