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Improved Fast Calorimeter Simulation in ATLAS

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ATLAS relies on very large samples of simulated events for delivering high-quality and competitive physics results, but producing these samples takes much time and is very CPU intensive when using the full GEANT4 detector simulation.
Fast simulation tools are a useful way of reducing CPU requirements when detailed detector simulations are not needed. During the LHC Runs 1 and 2, a fast calorimeter simulation (FastCaloSim) was successfully used in ATLAS.
FastCaloSim provides a simulation of the particle energy response at the calorimeter read-out cell level, taking into account the detailed particle shower shapes and the correlations between the energy depositions in the various calorimeter layers. It is interfaced to the standard ATLAS digitization and reconstruction software, and it can be tuned to data more easily than GEANT4.
Now an improved version of FastCaloSim is in development, incorporating the experience with the version used during Run-1. The new FastCaloSim makes use of machine learning techniques, such as principal component analysis and neural networks, to optimise the amount of information stored in the ATLAS simulation infrastructure. This allows for further performance improvement by reducing the I/O time and the memory usage during the simulation job.
A prototype is being tested and validated, and it has shown significant improvements in the description of cluster level variables in electromagnetic and hadronic showers. ATLAS plans to use this new FastCaloSim parameterization to simulate several billion events in the upcoming LHC runs.
It will be combined with other fast tools used in the ATLAS production chain. In this Fast Chain the simulation, digitisation and reconstruction of the events are handled by fast tools. In this talk, we will describe this new FastCaloSim parametrisation and the current status of the ATLAS Fast Chain.

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