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Simulation of Pile-up in the ATLAS Experiment

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In the 2011/12 data the LHC provided substantial multiple proton-proton collisions within each filled bunch-crossing and also multiple filled bunch-crossings within the sensitive time window of the ATLAS detector. This will increase in the near future during the run beginning in 2015. Including these effects in Monte Carlo simulation poses significant computing challenges. We present a description of the standard approach used by the ATLAS experiment and details of how we manage the conflicting demands of keeping the background dataset size as small as possible while minimizing the effect of background event re-use. We also present details of the methods used to minimize the memory footprint of these digitization jobs, to keep them within the grid limit, despite combining the information from thousands of simulated events at once. We also describe an alternative approach, known as Overlay, where the actual detector conditions are sampled from raw data using a special zero-bias trigger, and the simulated physics events are overlaid on top of this zero-bias data. This gives a realistic simulation of the detector response to physics events. The overlay simulation runs in time linear in the number of events and consumes memory proportional to the size of a single event, with small overhead.

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