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Simulation of the Dynamic Inefficiency of the CMS Pixel Detector

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The Pixel Detector is the innermost part of the CMS Tracker. Therefore it has to prevail in the hardest environment in terms of particle fluence and radiation. Also it is one of the most important detectors of CMS: it gives essential information for vertex reconstruction which is crucial for every analysis.

The efficiency of the Pixel Detector can decrease throughout a run by several reasons. It is mainly caused by DAQ problems and/or SEUs (Single Event Upset). Besides that there is still a smaller but significant efficiency loss called the dynamic inefficiency. It is caused by various data loss mechanisms inside the ROC (Read Out Chip) and depends strongly on the data occupancy. In the 2012 data, at high values of instantaneous luminosity the efficiency reaches 98% (for the first layer) which is not negligible. In the 2015 run higher instantaneous luminosity is expected, which will result in lower efficiencies, therefore the simulation of this effect is necessary. A data-driven method has been developed to simulate dynamic inefficiency in which the efficiency is parametrised as a function of instantaneous luminosity and detector geometry using past data. This way the dynamic inefficiency is independent of the quality of the physics simulation, but has to be calibrated for different run conditions. With this method the dynamic inefficiency is successfully simulated resulting in a much improved description of the Pixel Detector.

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