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The Phase-1 Upgrade of the CMS Pixel Detector

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The CMS experiment features a pixel detector with three barrel layers (BPIX) and two disks per side (FPIX). While the detector was delivering high-quality data during LHC Run 1, it was designed for the nominal instantaneous LHC luminosity of 1.0 x 10ˆ34 cmˆ-2 sˆ-1. It is expected that the instantaneous luminosity will reach twice the design value before Long Shutdown 3. Under such conditions, the present readout chip would suffer from data loss due to buffer overflow. The CMS collaboration is constructing a new pixel detector, to replace the present device during the Winter shutdown 2016/2017.

The goals of the Phase-1 Pixel Upgrade is three-fold: to operate with full efficiency at 2.0 x 10ˆ34 cmˆ-2 sˆ-1; to increase detector acceptance and redundancy; and to reduce the material budget. The upgraded device thus features a modified readout scheme and a new readout chip, additional detection layers, and a new support mechanics as well as improvements of the services, including an evaporative cooling system based on CO2. This contribution will motivate the detector design and technological choices of the new pixel detector. Focussing then on BPIX, the implementation as well as the performance of new technical solutions will be outlined. Results from BPIX beam and system tests will be presented. The status of the BPIX construction and pixel module production will be described, and challenges, difficulties encountered as well as lessons learned will be discussed.

Author: KLEIN, Katja (RWTH Aachen)

Presenter: KLEIN, Katja (RWTH Aachen)

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