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## Pixel module production and qualification for the Phase 1 Upgrade of CMS

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The instantaneous luminosity of the Large Hadron Collider (LHC) is being increased in several steps over the next 10 years to maximize its discovery potential for new physics. However, at a luminosity of twice the design luminosity of the LHC of  $1 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ , the performance of the current CMS pixel detector is degraded by substantial deadtime incurred by the readout chip (ROC). To make full use of the proton-proton collisions being provided by the LHC, CMS will replace its pixel detector during the extended winter shutdown in 2016-17 by a new detector with four barrel layers and three disks in each endcap. Module production includes bump bonding, wire bonding, and gluing processes, as well as a series of functionality tests, calibrations and thermal cycling. One of the calibration steps is the x-ray calibration, which provides an absolute energy calibration of an internal calibration circuit. This circuit injects charge into the preamplifier to simulate a signal, and is used to define several parameters of the readout chip, including the threshold. Therefore, an absolute calibration is required in order to know the threshold in units of electrons. In this talk the barrel module assembly is explained, with a special focus on the x-ray calibration of the pixel detector.

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