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Serial powering and signal integrity characterisation for the TEPX detector for the Phase-2 CMS Inner Tracker

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The entire CMS silicon pixel detector will be replaced to operate at High Luminosity LHC. The novel scheme of serial powering will be deployed to power the pixel modules and new technologies will be used for a high bandwidth readout system. In this contribution the new TEPX detector will be presented, with particular focus on a novel concept to provide both power and data connectivity to the modules through a disk-shaped PCB. As TEPX also features the longest serial powering chains in IT, an emphasis on serial powering results will be shown, together with signal integrity and data transmission performance.

Summary (500 words)

The High Luminosity Large Hadron Collider (HL-LHC) at CERN is expected to collide protons at a centre-of-mass energy of 14 TeV and to reach the unprecedented peak instantaneous luminosity of 5 x 10ˆ34 cmˆ-2 sˆ-1 with an average number of pileup events of 140. This will allow the ATLAS and CMS experiments to collect integrated luminosities up to 4000 fbˆ-1 during the project lifetime. To cope with this extreme scenario the CMS detector will be substantially upgraded before starting the HL-LHC, a plan known as CMS Phase-2 upgrade. The entire CMS silicon pixel detector (IT) will be replaced and the new detector will feature increased radiation hardness, higher granularity and capability to handle higher data rate and longer trigger latency.

The upgraded IT will be composed of a barrel part, TBPX, and small and large forward disks, TFPX and TEPX. The novel scheme of serial powering will be deployed to power the pixel modules and new technologies will be used for a high bandwidth readout system. The TEPX detector has four large disks on each side, extending the coverage up to |eta|<4.0. Furthermore, the services will be redesigned for the new system. In this contribution the new TEPX detector will be presented, with particular focus on a novel concept to provide both power and data connectivity to the modules through a disk PCB. As TEPX also features the longest serial powering chains in IT, an emphasis on serial powering results will be shown, together with signal integrity and data transmission performance. In TEPX the modules are arranged in five concentric rings. The chains corresponding to the first and third rings have been tested with 5 and 9 quad digital RD53A modules, respectively. Their performance in the disk, while being powered in series, has been compared with the one achievable in stand-alone mode, in terms of noise, threshold uniformity, signal integrity. No degradation of these parameters was observed for these serial power chains and it was possible to establish a simultaneous communication to all the modules. The study will continue with the implementation in the chains of quad modules with sensors, to study the HV distribution, and with the serial power operation of the longest chain in Ring 5, where 12 modules are located.

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