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Module Development for the Phase-2 ATLAS ITk Pixel Upgrade

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For the high luminosity upgrade of the Large Hadron Collider (HL-LHC), the instantaneous luminosity is expected to reach unprecedented values, resulting in about 200 proton-proton interactions in a typical bunch crossing. To cope with the resultant increase in occupancy, bandwidth and radiation damage, the ATLAS Inner Detector will be replaced by an all-silicon system, the Inner Tracker (ITk). The innermost part of ITk will consist of a state-of-the-art pixel detector, with an active area of about 14 m², which will provide tracking capability up to $|\eta|=4$.

Detector requirements in terms of radiation hardness and occupancy, as well as thermal performance depend strongly on the distance from the interaction region. Therefore, the innermost layer will feature 3D silicon sensors, due to their inherent radiation hardness and low power consumption, while the remaining layers will employ planar silicon sensors with thickness ranging from 100 μ m to 150 μ m. All hybrid detector modules will be read out by novel ASICs, implemented in 65nm CMOS technology and thinned to 150 μ m, which will be connected to the silicon sensors using bump bonding.

With the recent arrival of the first readout chip prototype, the RD53A chip, prototype modules are being built to study sensor and chip properties, thermal performance, as well as bump bonding yield in lab measurements and beam test campaigns. Irradiation studies are ongoing.

The talk will present latest results from the module characterization measurements both before and after irradiation.

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