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Measuring the borders of the active area on silicon strip sensors

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Silicon strip sensors for the ATLAS Inner Tracker (ITk) have been designed to provide reliable particle detection in the high-radiation environment of the High-Luminosity Large Hadron Collider. One important design criterion for their development is the minimisation of inactive sensor area (bias ring, guard ring and edge implant surrounding the active sensor area), as inactive sensor areas impact the hermeticity of particle detection inside the detector.

In previous measurements of ATLAS silicon strip sensors, the charge collecting area of individual strip implants has been mapped and found to agree well with the sensor strip pitch and strip length. For strip implants next to the sensor bias ring, the extent of their charge collecting area towards the inactive sensor area was previously unknown, which limited the accuracy of both overall detector hermeticity estimates and the position resolution for particle detection at the sensor edge.

Therefore, measurements were conducted to map the area of charge collection for sensor strips at the edge of the active sensor area. Using a 1micro-focused X-ray beam has made it possible to map this shape both within the sensor plane as well as inside the sensor volume.

This contribution presents measurements showing the extent of charge collection in the edge strips (with a condition where the AC metal of a strip between the bias ring and the edge strips is being floated) of silicon strip sensors. The edge regions of two generations of ITk strip sensor modules were studied: one module with a short strip (ATLAS12 with 2.5 cm strip length) sensor and ABC130 readout chips and one module a long strip (ATLAS17LS with 5 cm strip length) sensor and ABCstar readout chips.

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