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First Double-Sided End-Cap Strip Module for the ATLAS High-Luminosity Upgrade

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The ATLAS Experiment will upgrade its Inner Tracking system for the High-Luminosity-LHC with an all-silicon system. The strip part will be based on individual modules, constructed by gluing the front-end hybrids directly onto the strip side of the sensors. The modules will then be glued onto a low-mass local support core with services integrated. We have constructed the first double-sided module made from full-size sensors by gluing modules on a reduced-size core. We will report on the experience gained and discuss results obtained from running this module, with emphasis on signal integrity and noise performance.

Summary

For the High Luminosity upgrade of the Large Hadron Collider foreseen to commence in 2024 (HL-LHC), the ATLAS experiment will undergo a major upgrade of its detector system, including a completely new all-silicon Inner Tracking system (ITk).

The strip detector system will employ modules made from 6-inch n-in-p silicon strip sensors with front-end electronic hybrids glued directly onto the active side of the sensor. Hybrids will be made from dedicated low mass flex circuits carrying custom designed ASICs for read-out. The central part of the strip system will be made from four barrel layers, while the end-caps will consist of six discs on each side. The discs will be made up from individual wedge-shaped structures with also wedge-shaped modules on both sides. These structures are termed petals.

Modules will be glued on both sides of a rigid low-mass carbon-based local support structure known as the petal core. The petal core integrates read-out and command lines as well as HV and LV supply lines on a bus tape on top of the core, and titanium cooling pipes, which are embedded into the core structure.

For the first time, two full-size End-Cap modules each with a production-grade sensor and two pre-production hybrids and have been glued to both sides of a reduced size core to form a double-sided module (or two-module petal) to be powered and read out simultaneously. The module type chosen is the one that will be exposed to the highest radiation dose and has the smallest strip pitch, known as the R0-Module.

In this contribution, we will review the experience gained when building the double-sided module and discuss the results obtained from running this module. Particular emphasis is placed on the grounding strategy, the signal integrity and the noise performance of the module when both sides are read out together.

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