Evaluation of a multi-module demonstrator for the ITk Pixel Outer Barrel for the ATLAS Phase-II upgrade

The ATLAS tracking system will be replaced by an all-silicon detector for the HL-LHC upgrade around 2027 [1,2].

- Innermost five layers of the detector system will be pixel detector layers which will be most challenging in terms of radiation hardness, data rate and readout speed.
- Outer Barrel Demonstrator program aims to validate this part of the design.

A serial powering scheme will be used for the pixel layers to reduce the radiation length and power consumption in cables.

New elements are required to operate and monitor a serially powered detector including a
- Front-end electronics with shunt regulators.
- Constant current sources.
- Custom serial power protection chip (PSPP) - to be replaced by MOPS monitoring chip.
- Detector control system (DCS).

A demonstrator prototype was built using about 40 FE-I4 modules powered in six serial chains with realistic mechanics and services:
- Readout system.
- Power supplies.
- CO₂ Cooling infrastructure.
- Interlock system.

Next Generation Prototype using RD53A FE Chips


System Tests

- Important qualification steps of the system design and its operation were trained using the FE-I4 + electrical prototype.
- An extensive program of mechanical, thermal, powering and readout tests was performed.
- The full production flow (with few components), including integration, was performed.

Noise level stable over integration steps within errors and slight threshold differences.

Most module losses during program steps stem from cabling / connection difficulties, not from modules failures.

Grounding and shielding: different failure scenarios studied.

References


Paper on the presented results is in preparation

Gerhard Brandt (gbrandt@cern.ch)
Bergische Universität Wuppertal
On behalf of the ATLAS Collaboration

TIPP 2021
Vancouver,CA 24-29 May 2021

- Updating all aspects to be closer to final detector.
- New services concept with distributed PP0.
- Type-1 services like foreseen in detector

Next next Generation:
Use ITkPixVx modules ...