The ATLAS inner detector will be entirely replaced in preparation for the High-Luminosity LHC (HL-LHC) upgrade, scheduled for the middle of 2026. This upgrade will increase the total number of collisions by a factor of 10, allowing the experiment to collect an unprecedented integrated luminosity of 3000 fb⁻¹ over its lifetime. In order to deal with the very high expected collision rate at the HL-LHC, the ATLAS Inner Tracker (ITk) upgrade will be composed entirely of silicon, consisting of a pixel detector surrounded by a strip detector.

**Detector Challenges**

The high pileup and radiation environment of the HL-LHC represents a significant challenge:

- up to 7.5x10⁴ cm⁻² s⁻¹ instantaneous luminosity
- average 200 interactions per bunch crossing
- 12.2x10¹⁴ ncm⁻², Total Ionizing Dose (TID) of 50 Mrad for the strip detector
- low material budget to limit multiple scattering (<1 X₀ up to 2.7)

**The ITk Layout and Strips Sub-Detector**

Silicon sensors will be arranged in a cylindrical geometry in the central region (the “barrel”). There will be five pixel layers, surrounded by two short-strip (24.1 mm) layers followed by two long-strip (48.2 mm) layers. The forward region, on either side of the barrel, will consist of pixel rings surrounded by six strip end-caps on either side. The baseline layout, “ITk Inclined”, extends the tracking coverage to |η| = 4.0, which will benefit a variety of physics analyses. The defining characteristic of the Inclined layout are inclined pixel modules outside of the barrel pixel, which better cover the transition region from barrel to end-cap. The current solenoid will remain, and will embed the detector in a 2 T magnetic field. Cooling will be provided by CO₂.

**Production Model**

Modular concept to share production among multiple sites, early testing, and easy final assembly.

**Module Design**

The ITk strip sensors consist of n-type implants in a p-type float-zone silicon bulk to avoid radiation-induced type inversion. The sensor thickness should be 300-350 μm, and can be depleted up to 700 V. Sensor shape and layout depends on the geometry of the detector at each location (i.e.: truncated conic for track inside, rectangular for the barrel).

**Sensor and Module Testing**

Un-irradiated and irradiated barrel modules (short and long strips) have been tested. For the end-cap, full-sized sensors were not yet available, and so mini-sensors were tested (un-irradiated, irradiated ASIC, irradiated ASIC+sensor). In addition, TID bump measurements are in progress, and HCC irradiation has begun.

**Expected Performance**

The ITk must maintain or improve the performance of the current ATLAS inner detector. Sample plots are shown to demonstrate expected performance of the ITk Inclined Layout, fully simulated using GEANT4.