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## The Phase-2 ATLAS ITk Pixel Upgrade

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### Content

The entire tracking system of the ATLAS experiment will be replaced during the LHC Phase II shutdown (foreseen to take place around 2025) by an all-silicon detector called the "ITk" (Inner Tracker).

The innermost portion of ITk will consist of a pixel detector with five layers in the barrel region and ring-shaped supports in the endcap regions. It will be instrumented with new sensor and readout electronics technologies to improve the tracking performance and cope with the HL-LHC environment, which will be severe in terms of occupancy and radiation. The total surface area of silicon in the new pixel system could measure up to 14 m<sup>2</sup>, depending on the final layout choice, which is expected to take place in early 2017.

Several layout options are being investigated at the moment, including some with novel inclined support structures in the barrel-endcap overlap region and others with very long innermost barrel layers. Forward coverage could be as high as  $|\eta| < 4$ . Supporting structures will be based on low mass, highly stable and highly thermally conductive carbon-based materials cooled by evaporative carbon dioxide circulated in thin-walled titanium pipes embedded in the structures.

Planar, 3D, and CMOS sensors are being investigated to identify the optimal technology, which may be different for the various layers. The RD53 Collaboration is developing the new readout chip. Ideally the readout chips will be quite thin (100-150  $\mu\text{m}$ ) to save material; this presents a challenge for sensor-chip interconnection and options are being evaluated in collaboration with industrial partners to identify reliable processing technologies.

The pixel off-detector readout electronics will be implemented in the framework of the general ATLAS trigger and DAQ system. A readout speed of up to 5 Gb/s per data link will be needed in the innermost layers going down to 640 Mb/s for the outermost. Because of the very high radiation level inside the detector, the first part of the transmission has to be implemented electrically, with signals converted for optical transmission at larger radii.

Extensive tests are being carried out to prove the feasibility of implementing serial powering, which has been chosen as the baseline for the ITK pixel system due to the reduced material in the servicing cables foreseen for this option.

### Summary

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