Title: The ATLAS ITk Strip Detector System for the Phase-II LHC Upgrade

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(the speaker to be selected by the ITk Speakers Committee after the contribution acceptance)

Abstract:

ATLAS is currently preparing for the HL-LHC upgrade, with an all-silicon Inner Tracker (ITk) that will replace the current Inner Detector. The inner detector of the present ATLAS experiment has been designed and developed to function in the environment of the present Large Hadron Collider (LHC).
At the ATLAS Phase-II Upgrade, the particle densities and radiation levels will exceed current levels by a factor of ten. The new detectors must be faster and they need to be more highly segmented. The sensors used also need to be far more resistant to radiation, and they require much greater power delivery to the front-end systems. At the same time, they cannot introduce excess material which could undermine tracking performance. For those reasons, the inner tracker of the ATLAS detector was redesigned and will be rebuilt completely.
The ATLAS Upgrade Inner Tracker (ITk) consists of several layers of silicon particle detectors. The innermost layers will be composed of silicon pixel sensors, and the outer layers will consist of silicon microstrip sensors. This contribution focuses on the strip region of the ITk. The central part of the strips tracker (barrel) will be composed of rectangular short (~ 2.5 cm) and long (~5 cm) strip sensors. The forwards regions of the strip tracker (endcaps) consist of six disks per side, with trapezoidal shaped sensors of various lengths and strip pitches. In response to the needs of the strip region for the ITk, low-mass highly modular structures are used, called staves for the barrel and petals for the endcaps. These structures integrate large numbers of sensors and readout electronics, with precision lightweight mechanical elements and cooling structures. The silicon sensors are fabricated in n-in-p float zone (FZ) technology. Low-mass kapton-based circuit boards (the "hybrids") are directly glued on top of the sensors, hosting the so-called ABCstar binary readout ASICs, and a Controller ASIC (HCCstar). Those ASICs are fabricated in a 130 nm CMOS process. The ASICs are connected to the sensors via wire bonds. The modules are then directly glued onto low-mass, carbon fiber-based stave and petal core structures, with embedded titanium cooling pipes and data and power rails. The staves and petals are subsequently arranged into cylinders and disks, respectively, by means of the integration and global structures. The service module elements, part of the global structure, provide data, power, and cooling to groups of petals and staves.

After the completion of final design reviews in key areas, such as Sensors, Modules, Front-End electronics, and ASICs, a large scale prototyping program has been completed in all areas successfully. We present an overview of the Strip System and highlight the final design choices of sensors, module designs and ASICs. We will summarise results achieved during prototyping and the current status of pre-production and production on various detector components, with an emphasis on QA and QC procedures.