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The silicon strips Inner Tracker (ITk) of the ATLAS Phase-II upgrade detector

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The inner detector of the present ATLAS detector has been designed and developed to function in the environment of the present Large Hadron Collider (LHC). At the next-generation tracking detector proposed for the High Luminosity LHC (HL-LHC), the so-called ATLAS Phase-II Upgrade, the particle densities and radiation levels will be higher by as much as a factor of ten. The new detectors must be faster, they need to be more highly segmented, and covering more area. They also need to be 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 performance. For those reasons, the inner tracker of the ATLAS detector must be redesigned and rebuilt completely.
The inner detector of the current detector will be replaced by the Inner Tracker (ITk). It consists of an innermost pixel detector and an outer strips tracker. This contribution focuses on the strips tracker. The basic detection unit of the strips tracker is a silicon microstrips “module”. It consists of a ˜ 10 x 10 cm2 n-in-p silicon microstrip sensor fabricated in a float-zone (FZ) substrate, with its associated power, control and readout electronics directly glued on top of it. There are eight flavors of modules in total with slightly different geometries and strip lengths, two for the barrel central region and six for the end-cap forward regions. The barrel modules contain rectangular, 10x10 cm2, sensors, and the end-cap modules have wedge-shaped sensors of different geometries. The modules use binary readout architecture by means of differential SLVS data signaling. The readout electronics consists of readout chips manufactured in 130 nm CMOS technology, mounted on top of polyimide-copper Printed Circuit Boards (PCBs) called “hybrids”and connected to the microstrips via wirebonds. A power board contains the power and control electronics, based on Low Voltage (LV) DC-DC power conversion, a High Voltage (HV) multiplexer, and an Autonomous Monitoring And Control ASIC (AMAC). The modules are glued on both sides of lightweight carbon fiber-based support structures, called “staves”for the barrel region and “petals”for the end-cap regions. The petals and staves consists of a carbon fiber sandwich structure with embedded titanium cooling pipes, hosting 28 modules in the staves and 18 modules in the petals. Dual-phase, evaporative CO2 is used as a coolant. Connection to the modules is achieved via thin, polyimide-based circuit boards, called “bus tapes”, which include low impedance differential data lines, control lines, LV and HV power rails and shielding. The bus tapes are co-cured directly with the carbon fiber facesheets, on the skins of the staves and petals. Additionally, a data concentrator board called “End of Substructure”(EoS) is mounted on each stave/petal side. The EoS board interacts with the modules and with the outside world, hosting the components and connectors that multiplex the module data and sends it in and out the detector via high-speed optical links. The support structures are then mounted into lightweight carbon fiber-based global structures (the barrel and the end-caps), providing mechanical support for the staves and petals and the electrical, optical, and cooling services. The barrel and the end-caps are integrated together into the ITk tracker, inside the Outer Cylinder (OC), which, along with the pixel tracker, also integrated in the OC, constitute the full ITk.
This contribution will focus on the latest R&D activities performed by ITk strips community with respect to the assembly and test of the strip modules and the stave and petal structures, and their integration into the global structures. The overall plans for the production phase of the experiment will also be detailed.

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