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Loading and integration of the strips end-cap tracker for the phase-II upgrade of the ATLAS detector

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The High-Luminosity LHC (HL-LHC) plans to increase the integrated luminosity of the current accelerator more than an order of magnitude, up to around 4000 fb-1, and the instantaneous luminosity from 2x1034 to ˜7.5x1034 cm2s-1. The current detectors need to cope with this increased particle environment with more channels per unit area, faster electronics, and higher radiation tolerance, keeping power consumption, material, and cost to a minimum. The inner detector of the ATLAS spectrometer will be replaced by a new, all-silicon tracker, the so-called Inner Tracker (ITk). It is composed of a pixel tracker, covering the innermost layers, and a strips tracker on the outer layers. The ITk strips tracker consists of the "barrel", 4 concentric cylinders of silicon microstrips modules in the central region, and two "end-caps"in the forward regions, each containing six double-sided disks of silicon modules. The modules of the end-cap are mounted on double-sided, wedge-shaped local support structures, called "petals", with embedded cooling and data lines. Each disk contains 32 petals, each of them with 18 silicon modules. A total of 192 petals are needed for a single end-cap structure.

This contribution describes the process of loading an end-cap naked structure with fully populated petals. High precision tooling is required for this step, given the high value of the petals once fully populated (around 50-100 kEur each) and the tight position and stability requirements for the microstrips modules of the detector. The latest design of the petal insertion tool envisions a mechanical "arm"that clamps into the petal support structure and enables the safe and precise translation, rotation and tilting of the petals during insertion around the end-cap structure. Once each petal is located in its final position, additional tooling has been designed to safely lock it in place. A number of prototype versions for this tool have been designed and built at DESY in the past year. Numerous tests have been performed with this tool using dummy petals and mockup versions of the end-cap structure, both at DESY and Nikhef laboratories during the recent months, and more are scheduled in the near future. The outcome of these insertion tests will also be presented in this contribution.

The whole petal insertion process is performed with the end-cap in a vertical orientation, that is, with the beam direction pointing upwards. An end-cap frame allowing the required rotation is currently under design. This contribution will also cover the status of this multi-purpose frame. The frame hosts the petal insertion tool during the end-cap assembly, and allows access to all possible petal locations with a system of rails around it. This frame will also be used for the transport of the fully loaded end-cap, in horizontal orientation, from the institutes in which its integration takes place (DESY and Nikhef) all the way to CERN. In addition, the same frame takes care of the final insertion of the end-cap into the ITk outer cylinder, along with the rest of the ITk detector, in the SR1 surface laboratory at CERN. This is the last step before the ITk tracker, as a single unit, is lowered into the ATLAS cavern.

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