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Development and Testing of the ATLAS ITk HCCStar ASIC

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The ITK strips project is an integral part of the HL-LHC upgrade of the ATLAS detector in 2026, allowing for a fast and accurate reconstruction of charged particle tracks in a busy pileup environment while withstanding the extreme radiation conditions associated with a peak instantaneous luminosity of 7.5 x 10^{34} $cm^{-2}s^{-1}$. A major component of the ITK strips projects is the HCCStar, one of three ASIC chips that, alongside the ABC-Star and AMAC chips, together collect and compress data from the silicon strip detectors, control and serialize the fast dataflow, and provide monitoring and control of all aspects of the combined system. A comprehensive verification campaign in simulation validated the HCCStar design and trigger rates under many scenarios, and probe station testing has confirmed functionality of thousands of chips. Various irradiation campaigns using gamma, proton, and heavy ion radiation tested the reliability of the chips, the recovery from single-event upsets, and the effects of a total ionizing dose on the chips, while providing real-world experience with the HCCStar.

Primary author: DANDOY, Jeff (University of Pennsylvania (US))

Presenter: DANDOY, Jeff (University of Pennsylvania (US))

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