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(G*) Probing of ABCStar Readout ASICs Through a Semiconductor Test Industry Partnership for use in the ATLAS ITk Strips Tracker

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The ABCStar (ATLAS Binary Chip –Star Version) is a front-end readout chip for the silicon-strips portion of the ATLAS Inner Tracker (ITk) upgrade. These radiation-hard application specific integrated circuits (ASICs) are implemented in a commercial 130 nm CMOS process and are intended to handle the high rate of collision data at the High Luminosity LHC (HL-LHC), and last throughout the lifetime of the detector. Over 350,000 ABCStar ASICs need to be extensively tested to ensure that chips used for sensor module assembly follow all design specifications.

Conventionally, electronics for particle physics experiments have been tested using custom equipment in dedicated research facilities that allow for extensive research and experimentation. Rather than duplicating this approach, Carleton partnered with DA-Integrated, a specialist ASIC testing company in Canada, to implement an industrial-standard wafer testing program for the first time in a particle physics detector project. By leveraging their expertise and infrastructure we were able to obtain large improvements in throughput compared to existing approaches, without compromising test coverage or data collection. In addition, the enhanced wafer testing capabilities at DA-Integrated allowed for a detailed investigation of the digital performance of the ABCStar under different duty cycles and supplied voltages. These results were used to determine the operational window of the ABCStar to prevent data loss in the detector.

Production probing of the ABCStar is underway, with Carleton set to test half of the ABCStar ASICs required for ITk. Collaborating with DA-Integrated has bridged the methodological, technical and semantic gap between research facilities and the semiconductor testing industry. This will open new possibilities for ASIC testing in future particle physics projects.

Keyword-1

Wafer Testing

Keyword-2

Readout Electronics

Keyword-3

Silicon Detector

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