

Development of CaRIBOu: a modular readout system for pixel sensor R&D

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The ATLAS experiment is planning to build and install a new all-silicon Inner Tracker (ITk) for the High-Luminosity LHC (HL-LHC) upgrade. Extensive R&D on pixel sensors based on High-Voltage CMOS (HV-CMOS) process is ongoing. Given the potential advantages of this technology compared with the traditional planar pixel sensors, several prototypes with different pixel type have been designed and fabricated in the 180nm and 350nm HV-CMOS processes provided by Austria Microsystems (ams).

CaRIBOu (Control and Readout Itk BOard) is a modular readout system developed to test silicon-based pixel sensors. It currently includes several different front-end chip boards with compatible interface for pixel sensor mounting, a CaR (Control and Readout) board to provide power, bias, configurational signals and calibration pulse for sensors under test, a Xilinx ZC706 development board for data and command routing, and a host computer for data storage and command distribution. A software program has been developed in Python to control the CaRIBOu system and implement the tuning algorithm for different pixel sensors. CaRIBOu has been used in various testbeam at CERN and Fermilab for the HV-CMOS sensors fabricated in the ams HV-CMOS 180nm and 350nm processes since the end of 2015. We successfully integrated the ATLAS FELIX (Front-End Link eXchange) DAQ system into CaRIBOu by using a FELIX PCIe card for the testbeam data readout, slow control and clock distribution through two GBT optical links instead of the standard Gigabit Ethernet interface of CaRIBOu. The testbeam results have demonstrated that the CaRIBOu readout system is very versatile for the test of different pixel sensors, and works very well with the FELIX DAQ system. Further development is ongoing to adapt it to different pixel sensors (e.g. MIMOSA and CLICpix), to implement multi-channel readout, and to make it available to various lab test stands.

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