

Performance of a new operating system by FELIX board for INTT in sPHENIX

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sPHENIX is scheduled to start operations at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory in 2023 to study quark-gluon plasma and cold-QCD.¹⁾ The Intermediate Tracker (INTT) is a silicon barrel tracker located between the other two tracking detectors of the sPHENIX detector complex. INTT is responsible for tracking and jet flavor tagging with high precision and low background. It inherits much of the electronics, such as the readout card (ROC), from the FVTX detector²⁾ in the PHENIX experiment to significantly reduce development time and cost. FVTX is controlled by slow control commands from the VME modules, Front-End Module (FEM), and FEM Interface Board (FEM-IB), and data from the detector was initially processed by FEM and recorded by Data Collecting Module-II (DCM-II) and other equipment (Fig. 1).

was hired and optimized for each detector. INTT has almost completed the migration to the new system with Felix (Fig. 1), although the initial plan was to assume control of the FEM/FEM-IB system from FVTX.

To evaluate the performance of the Felix system, measurements of pulses generated by the ROC, referred to as *calibration*, were performed. The chips received pulses with various amplitude and performed analog-to-digital conversion. Further, *calibration* provides the correlation between analog amplitude and digitized value. Another crucial performance evaluated from *calibration* is the number of the chip responses, which can be predicted, as the readout system must receive signals from the chip under many restrictions such as timing. Figure 2 shows the channel distribution of a readout chip, comprising 128 channels, from the calibration performed with the FEM/FEM-IB or Felix systems. Both measurements yielded consistent results. The slight differences are owing to fluctuations around the thresholds. Calibration with the Felix system was continuously performed to confirm good stability. The difference in the number of data from the expectation was no more than 0.1% provided as the data in the low amplitude noisy region were excluded. The INTT operation with Felix was confirmed stable and consistent with the FEM/FEM-IB system.

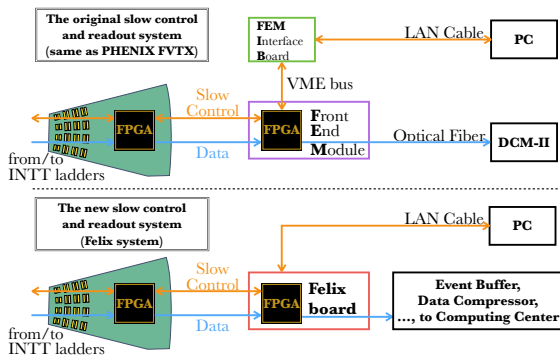


Fig. 1. Schema of the INTT operating system using the FEM/FEM-IB (top) or the Felix board (bottom).

As part of the transition from PHENIX to sPHENIX, all tracking detectors including INTT adopted a streaming readout (data readout without triggering). The streaming readout can collect two to three orders of magnitude more data than calorimeter triggers and eliminate trigger bias.¹⁾ To enable streaming readout, the Felix board³⁾ used in ATLAS experiment at CERN

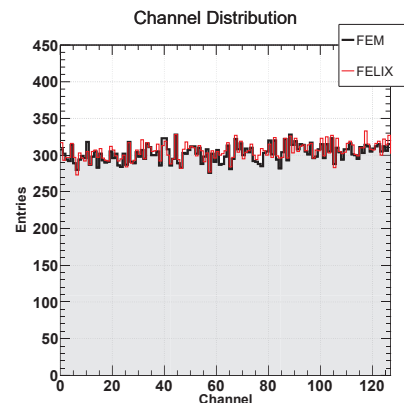


Fig. 2. Comparison of the channel distribution of a readout chip using the FEM (black) or the Felix (red) system.

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