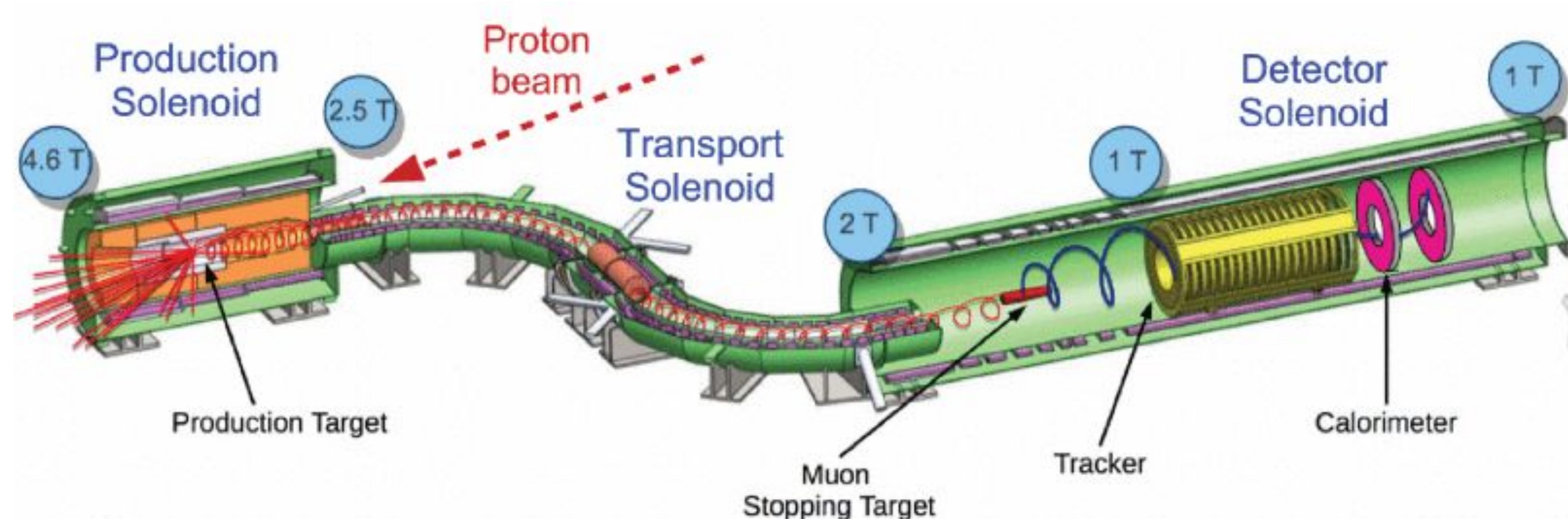


# Enhancements and Deployment of the TDAQ System for the Mu2e Experiment

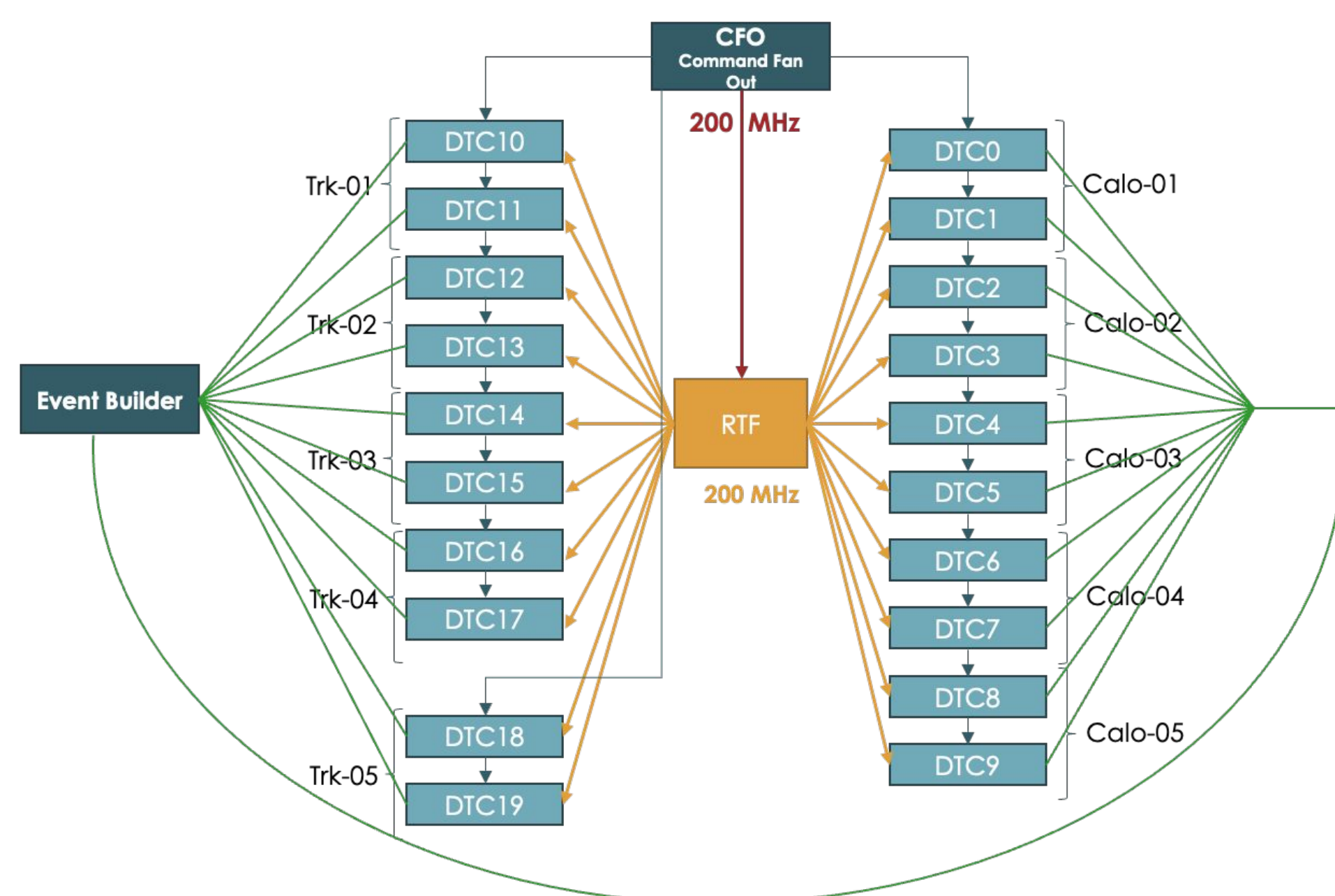
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## Mu2e Experiment

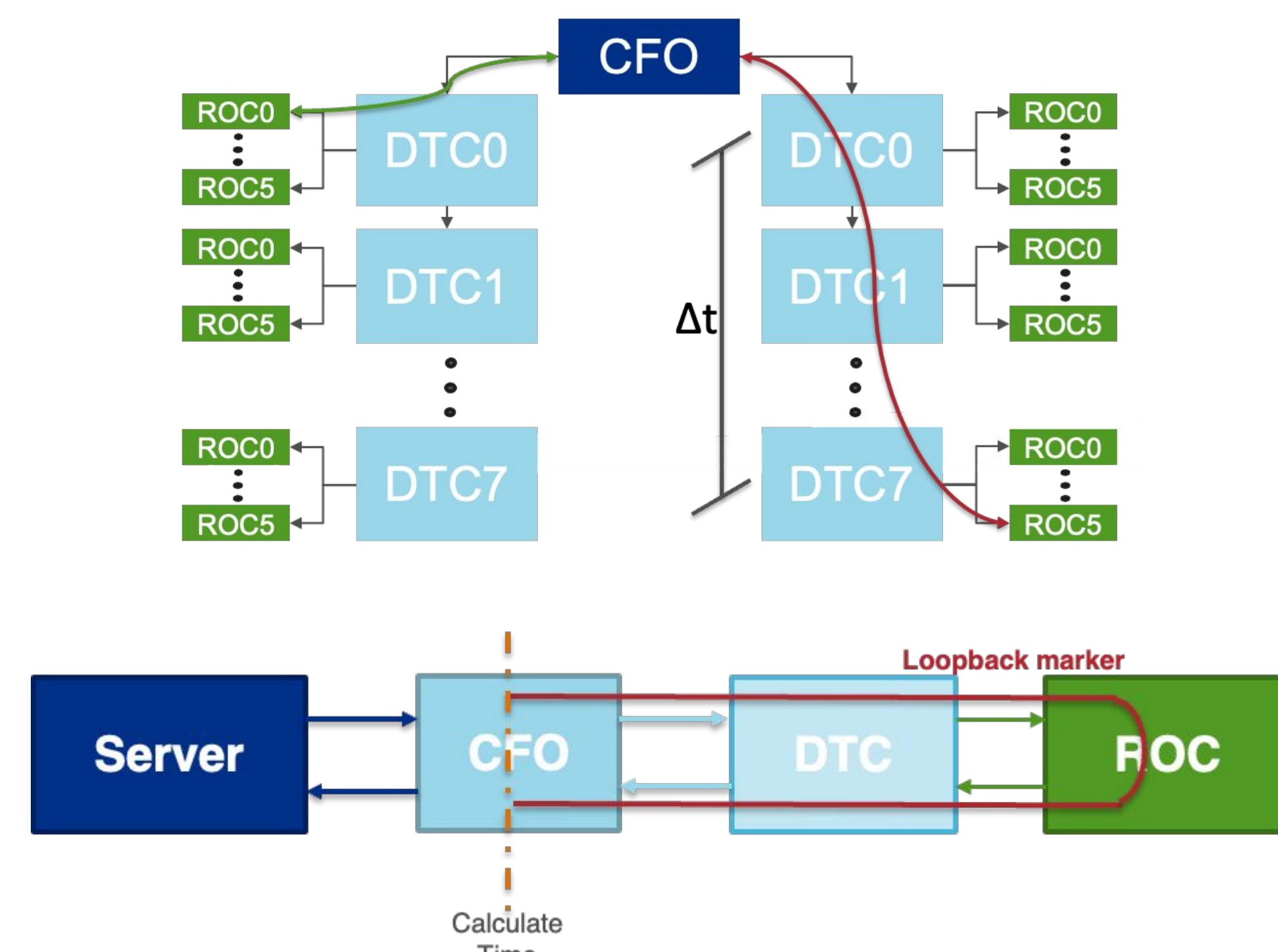
The Mu2e experiment will search for the coherent neutrino-less conversion of a muon into an electron in the field of an aluminum nucleus with a sensitivity improvement 10,000 over times previous experiments. Such a charged lepton flavor-violating reaction probes new physics at a scale unavailable with direct searches at either present or planned high-energy colliders.



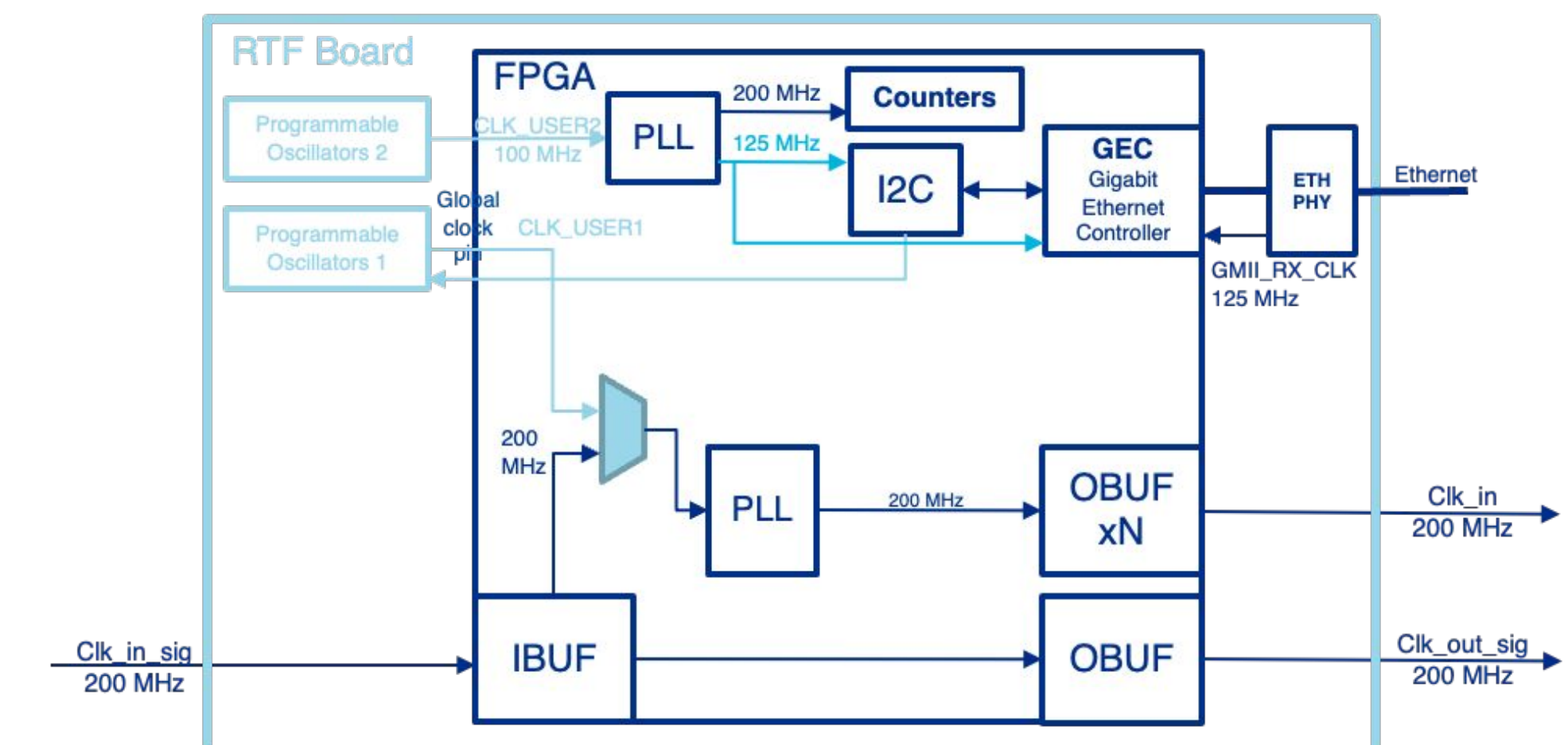
The proton beam enters from the right at the intersection of the Production Solenoid and the Transport Solenoid, where it strikes the production target producing pions that decay into muons. The Transport Solenoid uses superconducting magnets to create a low-energy muon beam. The Detector Solenoid holds an aluminium stopping target and detector system for electron and positron conversions. Not depicted in the diagram are the cosmic ray veto system, encircling the Detector Solenoid, and the muon stopping target.



High level configuration of the pre-production TDAQ system deployed at the Mu2e Experimental Hall. DTCs collect data from sub detector ROCs, perform event building, and data processing.

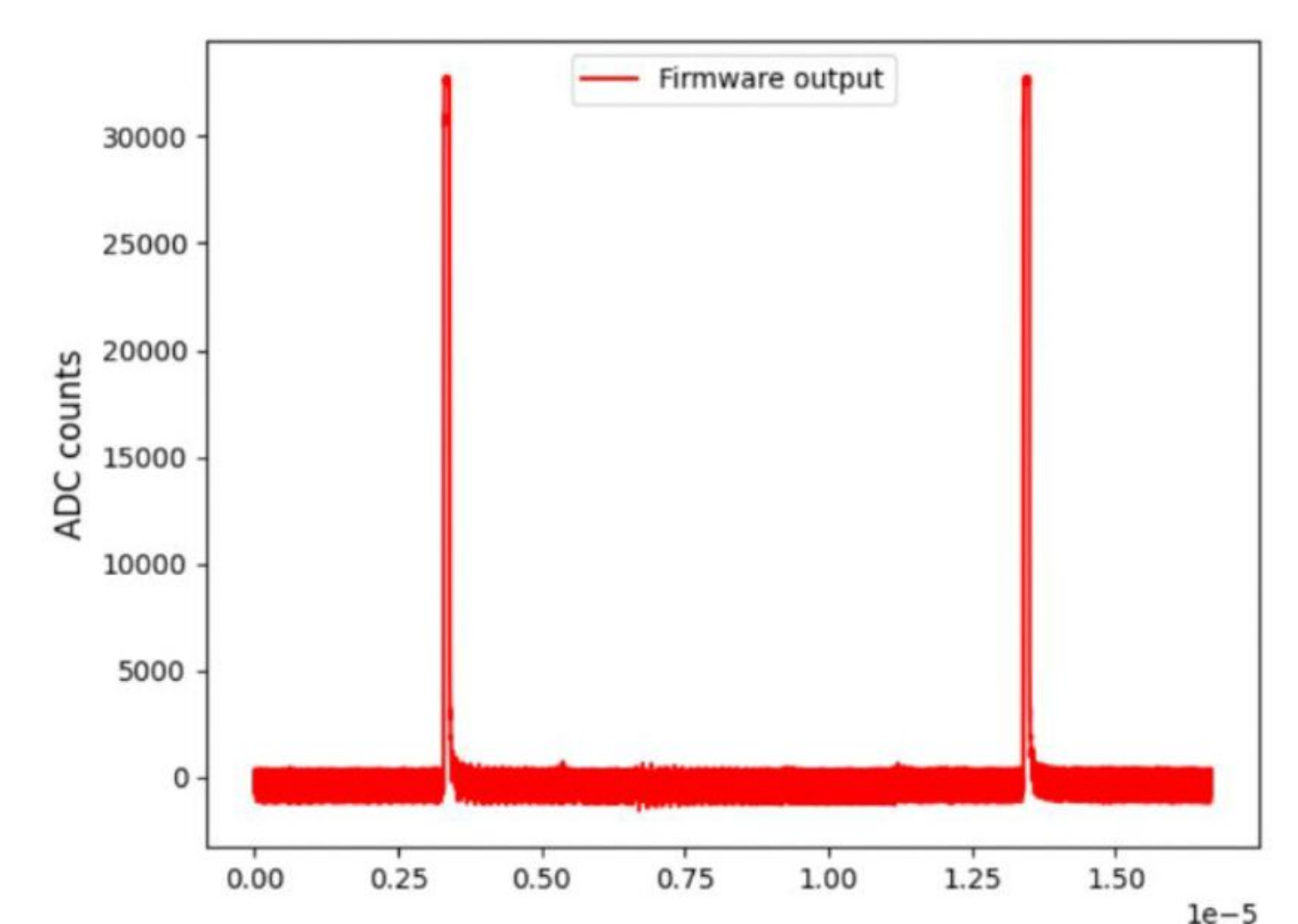


Signals travel to different boards through fiber and cable of various lengths leading to asynchronous timing of event windows. Loopback tests measure delays and guarantee timing alignment from all ROCs.



The RJ45 Timing Fanout (RTF) alleviates jitter accumulation. All DTCs receive a 200 MHz reference clock. RTF produces signal injections, emulating external events (e.g., cosmic rays for CRV ROCs).

To ensure event window synchronization, loopback tests measure the round-trip time of a marker. Each ROC is delayed by the longest latency measured. All subsystems have been tested for event handling levels, responses to loopback markers, and signal injection timestamping. Link stability tests with ten DTCs demonstrated proper data handling with the maximum DTC chain expected in the experiment.



Signal injection data has been recorded on the STM subsystem for the first time. All subsystems (Calo, Trk, STM, CRV) have been successfully tested with RTF signal injections.

## Trigger and Data Acquisition Deployment

The Mu2e Trigger and Data Acquisition (TDAQ) system uses *otsdaq* as its online Data Acquisition System (DAQ) framework. *otsdaq* integrates both the *artdaq* and *art* frameworks for event transfer, filtering, and processing. *otsdaq* is a web-based DAQ software suite focusing on flexibility and scalability and provides a multi-user interface accessible through a web browser. *artdaq* handles the full data stream, which is read over the peripheral component interconnect express (PCIe) bus to a software filter algorithm. Detector front-ends are configured through the PCIe bus by customized *otsdaq* plugins. Enhancements include synchronization via a loopback test, which ensures event window synchronization and accurate responses.

## Acknowledgements

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