

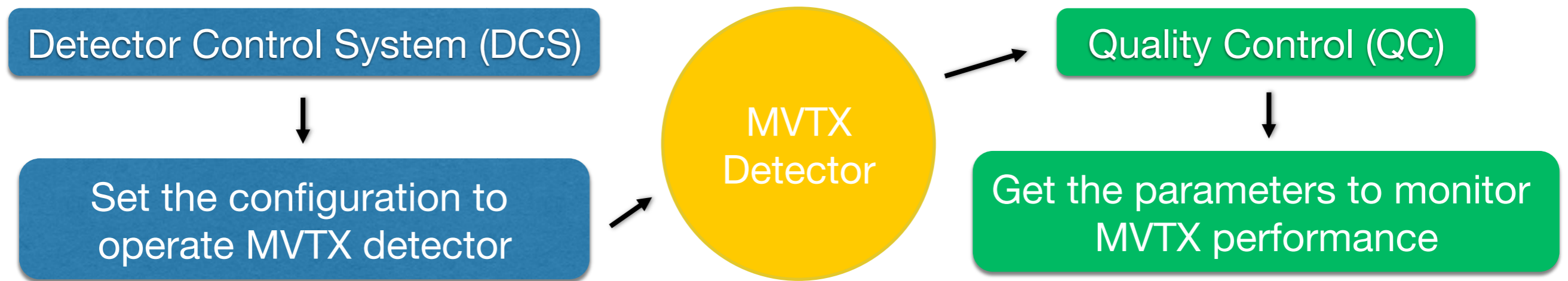
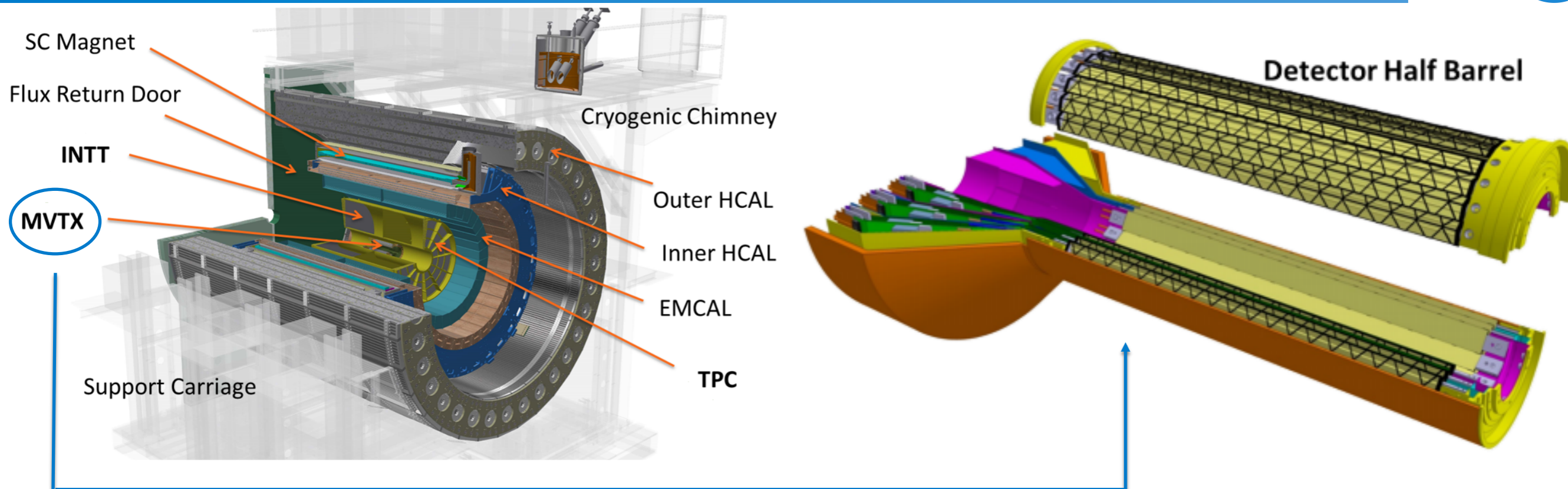


sPHENIX MVTX Detector Quality Control and Online System

Zhaozhong Shi

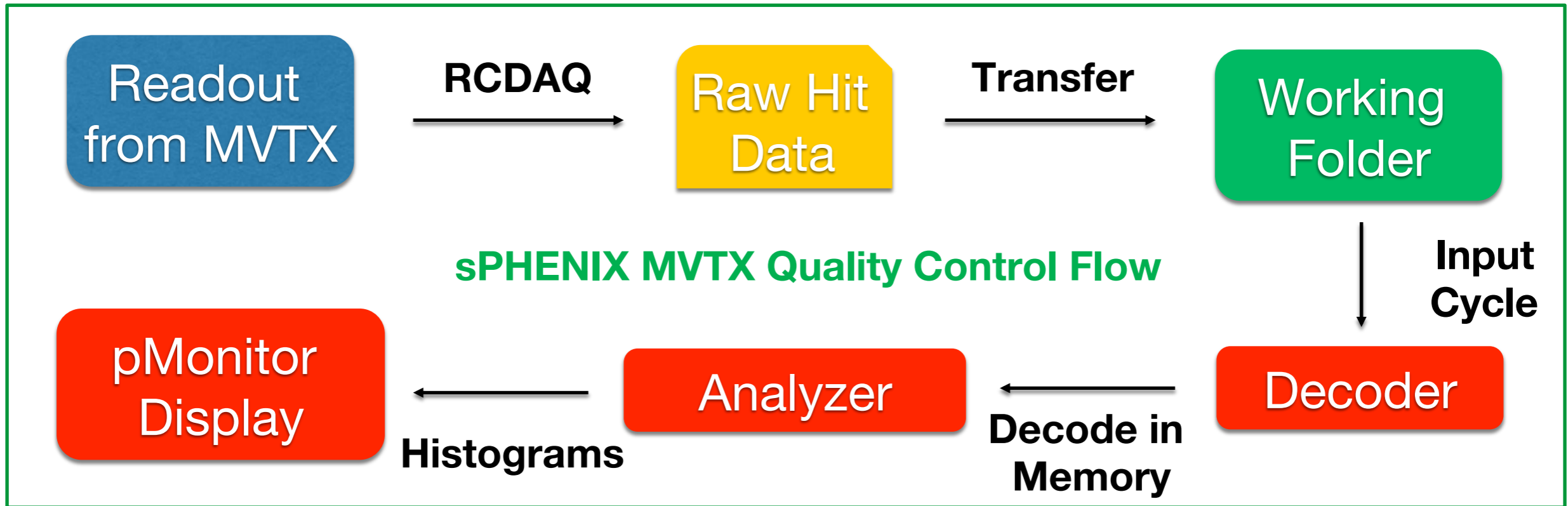
Los Alamos National Laboratory
on behalf of the **sPHENIX** collaboration

**Quark Matter 2022 - the 29th International Conference
on Ultra-relativistic Nucleus-Nucleus Collisions**
4-10 April 2022, Krakow, Poland

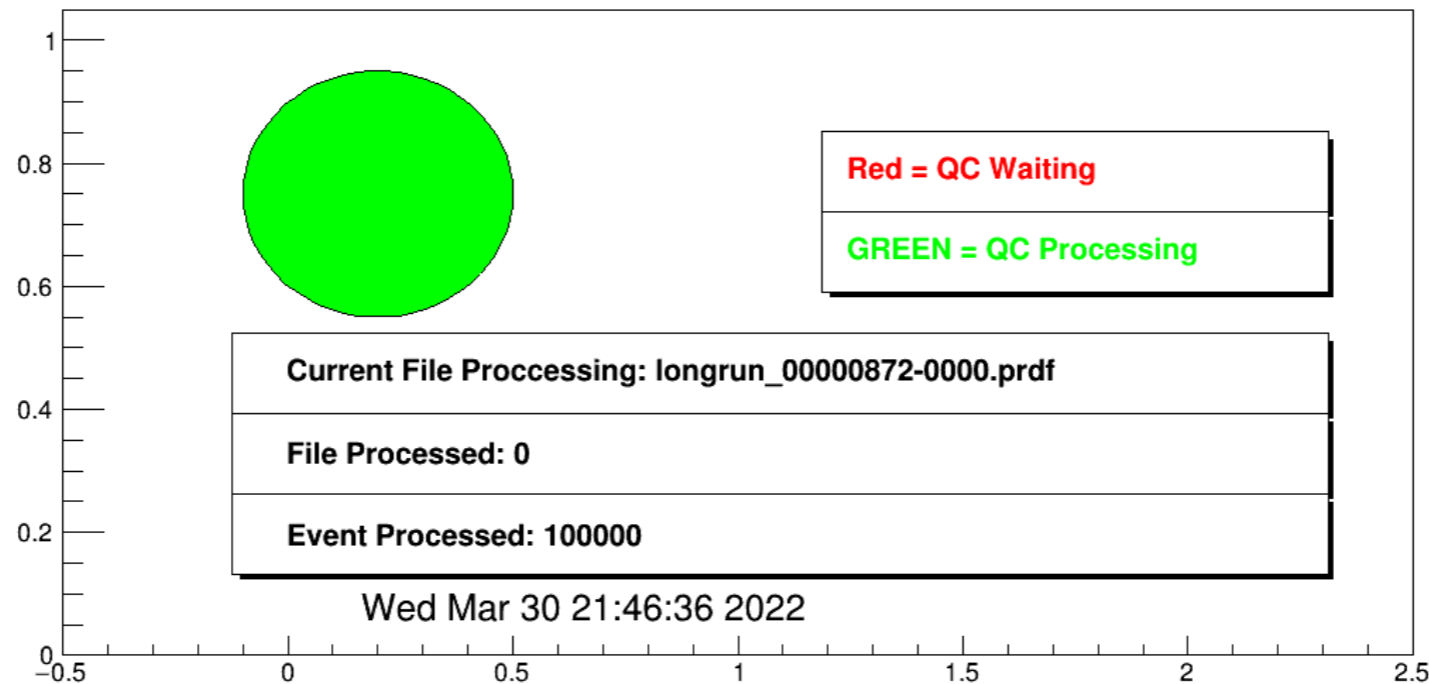


sPHENIX MVTX Online System

- **MVTX:** Monolithic Active Pixel Sensor (MAPS)-based-vertex-detector
- Adapting the inner most 3 layers of the ALICE Inner Tracking System (ITS)
- High granularity of pixel pitches with excellent position resolution ($\sim 5 \mu\text{m}$)
- Track vertex distance of closest approach (DCA) resolution $< 30 \mu\text{m}$ for $p_T > 1 \text{ GeV}/c$
- Precise vertexing which enables the heavy-flavor jets and open heavy flavor physics programs

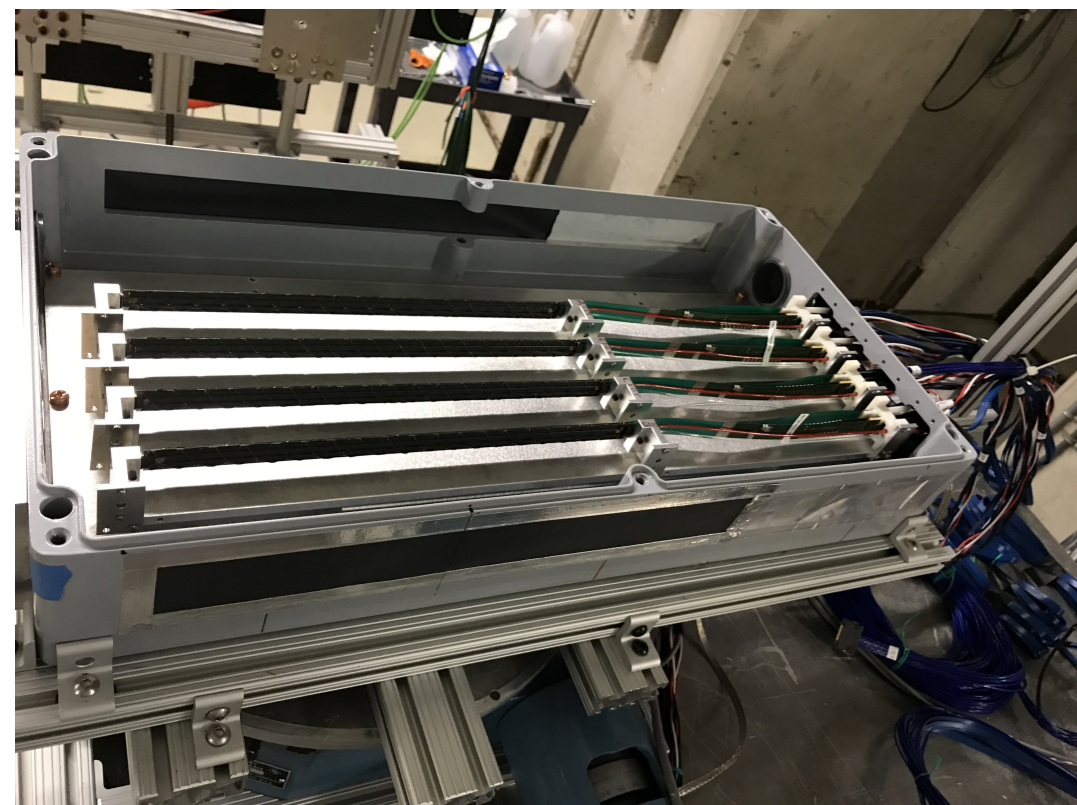


QC Process Information Canvas

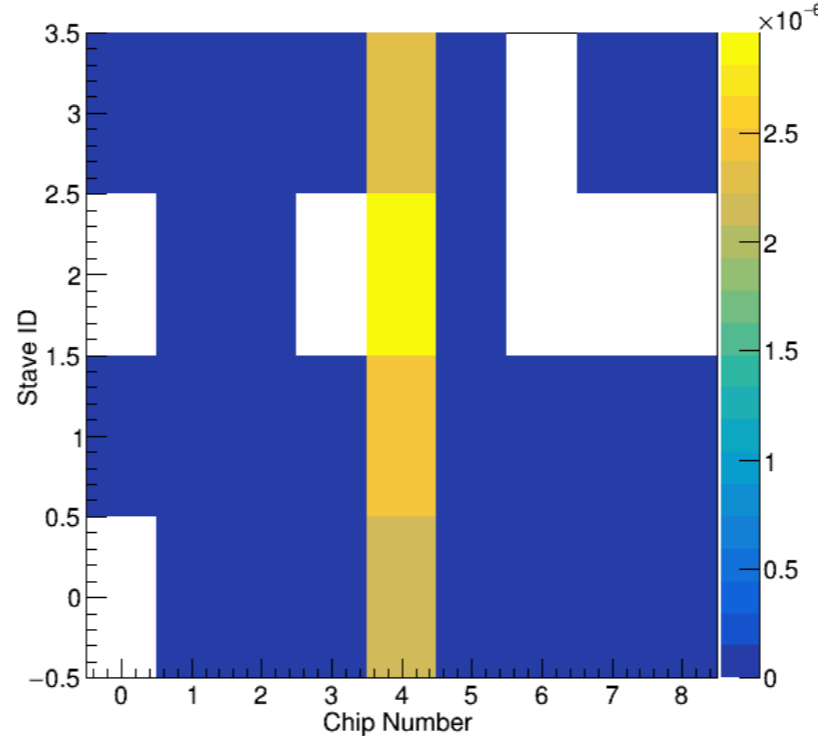


- Quality control (QC) system dedicated to monitor the MVTX performance in realtime
- Based on the sPHENIX software framework, with workflow design similar to ALICE ITS
- User friendly interface to display the status of the QC with time stamp for run recording

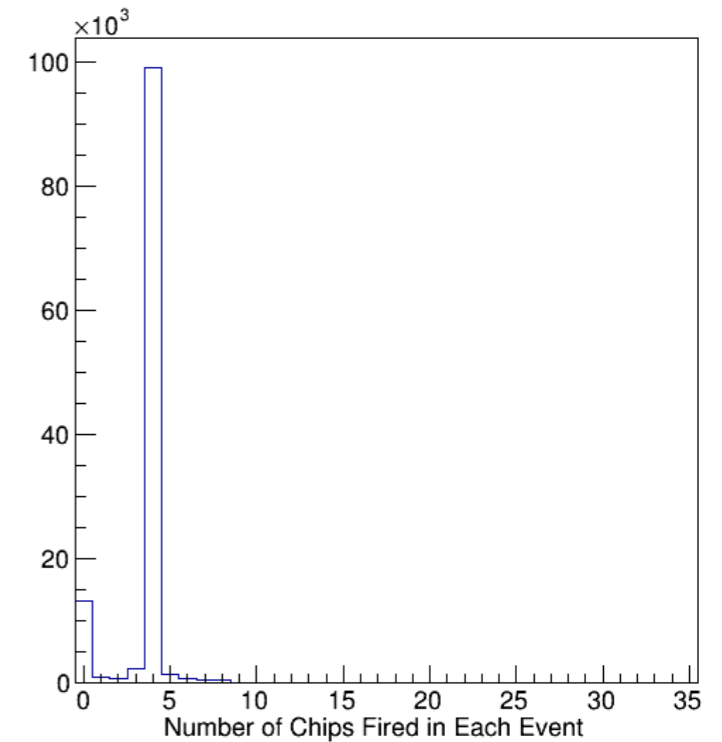
Example: QC for 2019 Fermilab Test Beam Data



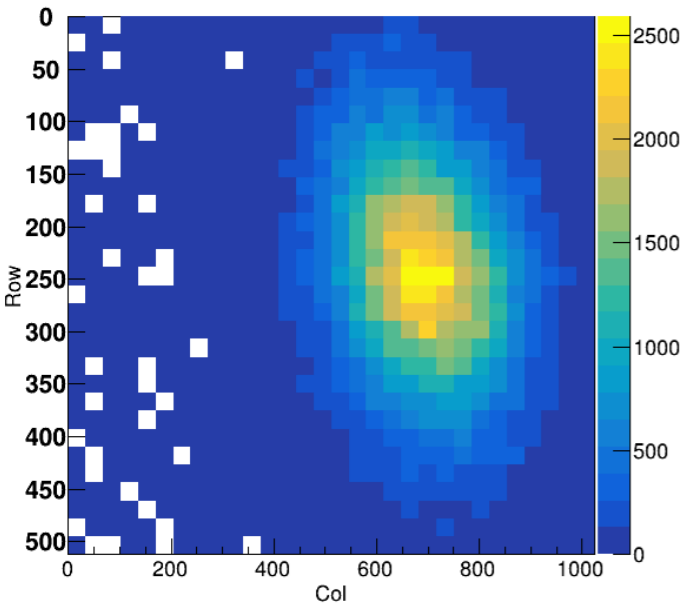
Average Occupancy: Run 872 Stave Number and Chip Number



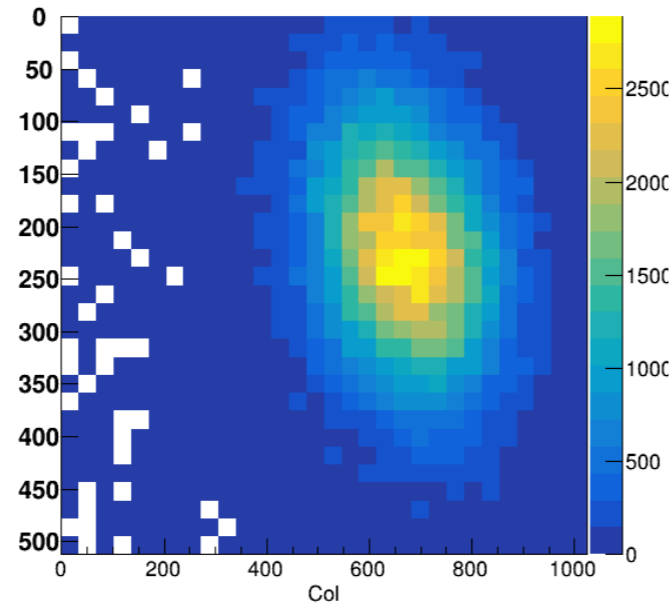
Number of Chips Fired in Each Event Distribution: Run 872



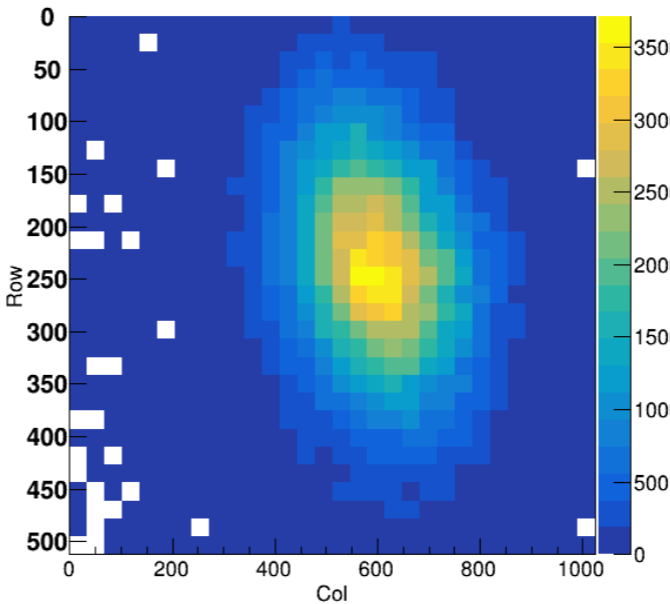
2D HitMap: Run 872 Stave 0 and Chip ID 4



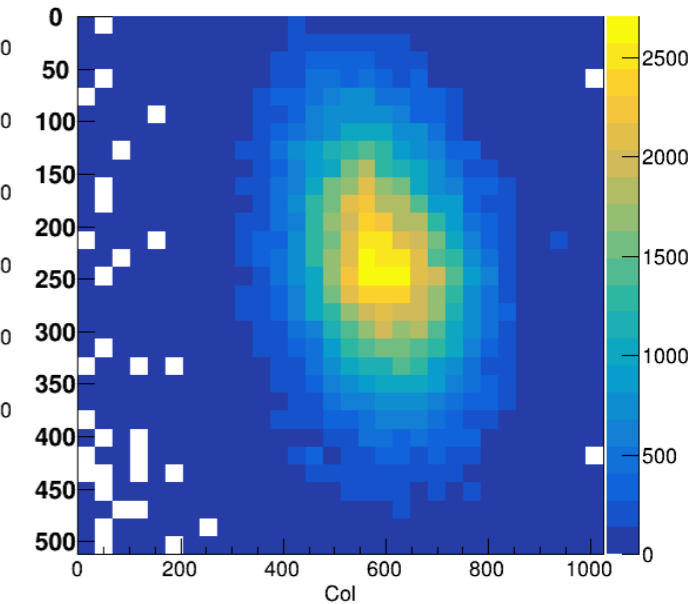
2D HitMap: Run 872 Stave 1 and Chip ID 4



2D HitMap: Run 872 Stave 2 and Chip ID 4



2D HitMap: Run 872 Stave 3 and Chip ID 4

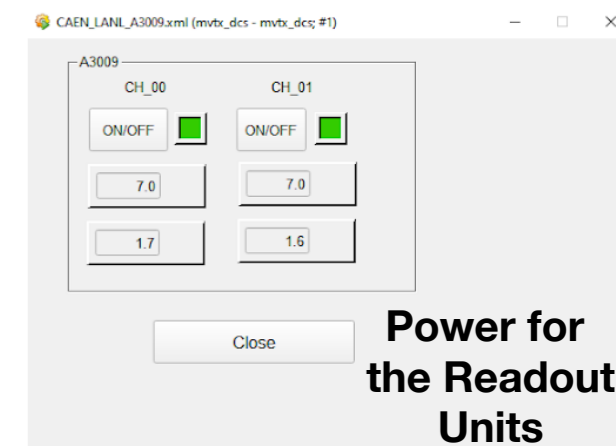
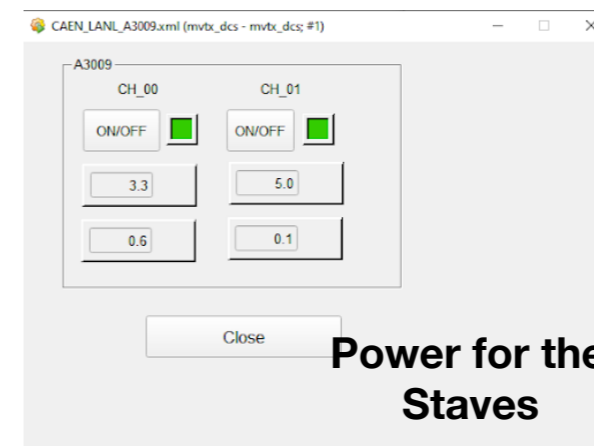
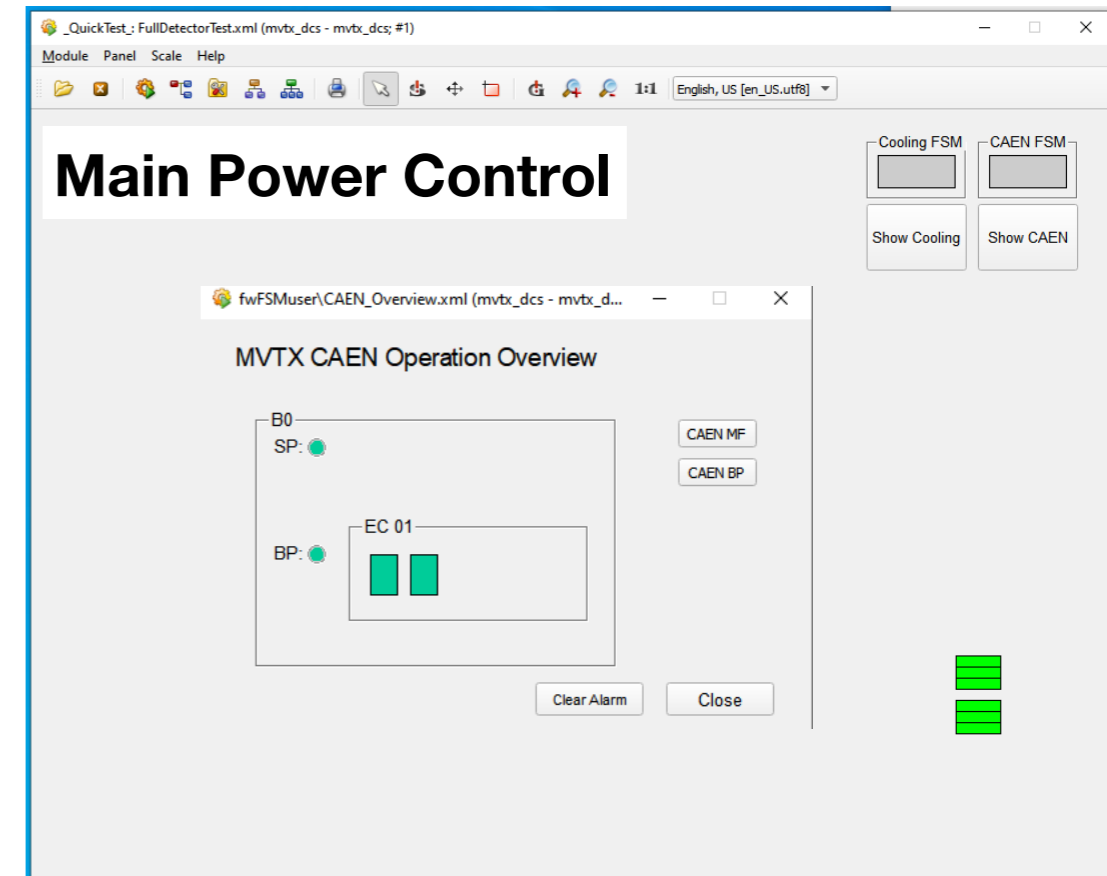
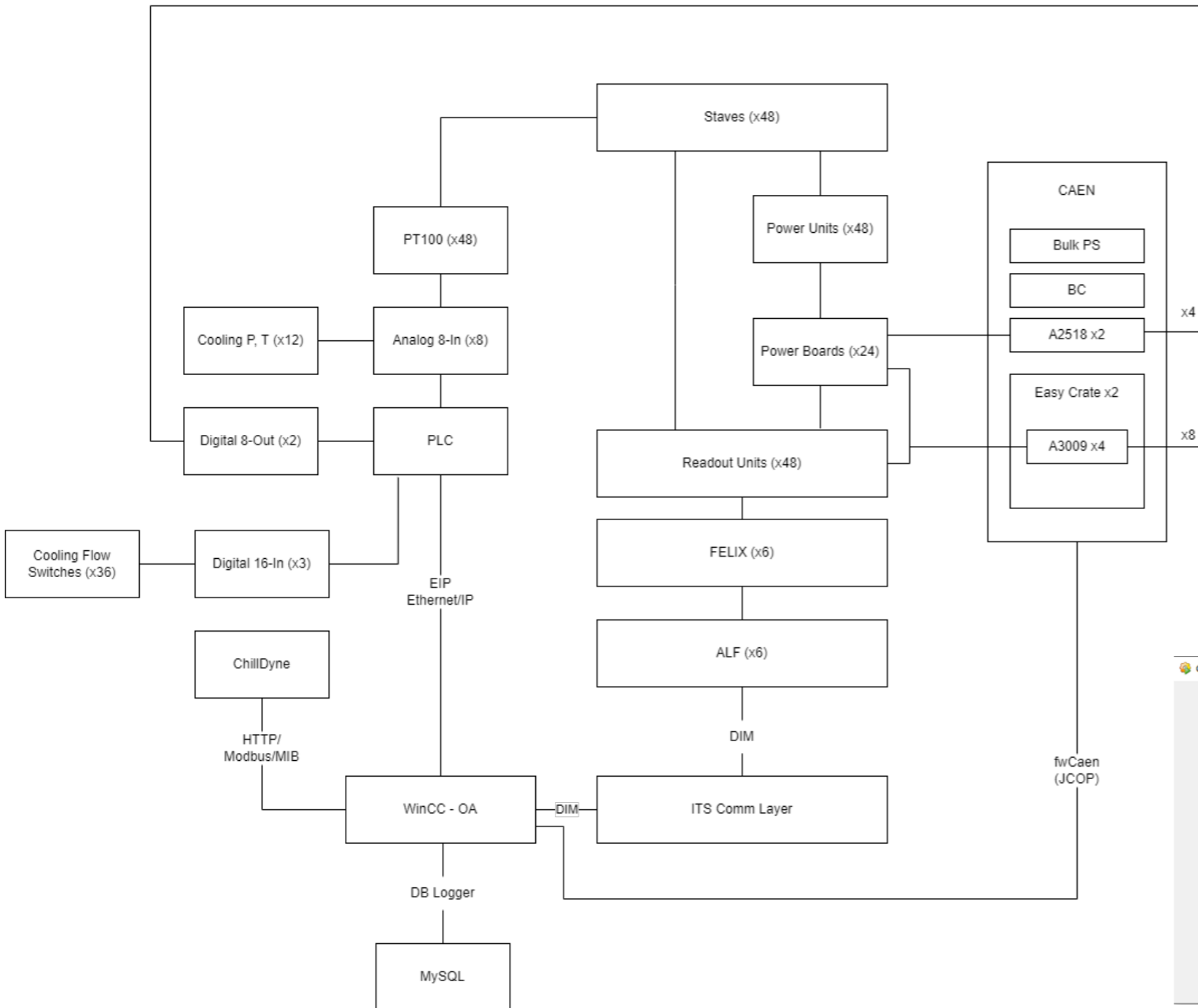


- Four layers of staves facing proton beam at normal incidence
 - ➔ Average 4 chips fired per event
 - ➔ Proton beam goes through chip 4 of each stave, leaving clear beam spots
- Beam spots in nearly same pixel location for each -> Excellent alignment of the staves

Block Diagram of DCS and Safety System Design

WinCC Control GUI for the Power

MVTX DCS & Safety System



- MVTX detector slow controls system interfaces with the WinCC-OA framework to provide user friendly controls
- Configure and monitor the parameters such as temperature, voltage, current, and pressure
 - ➔ Control and monitor various MVTX detector subsystems including power, cooling, and readout

- **sPHENIX MVTX Detector**
 - ➔ Silicon pixel detector with excellent vertexing capabilities
 - ➔ Crucial for open heavy flavor physics program
- **MVTX Detector Online System**
 - ➔ **QC:** Monitor the MVTX performance
 - ➔ **DCS:** Operate the MVTX detector
 - ➔ Ensures detector safety and high-quality data taking
- **Next Steps: 8-Stave Telescope Setup at LANL**
 - ➔ Implemented with both QC and DCS
 - ➔ Test the readout chain
 - ➔ Study alignment performance
 - ➔ Get ready for full MVTX system commissioning at BNL in **April this year!**
 - ➔ **Installation by the end of this year!**



This work is supported by the United States Department of Energy Office of Science Nuclear Physics Program and Los Alamos National Laboratory Director's Postdoctoral Fellowship



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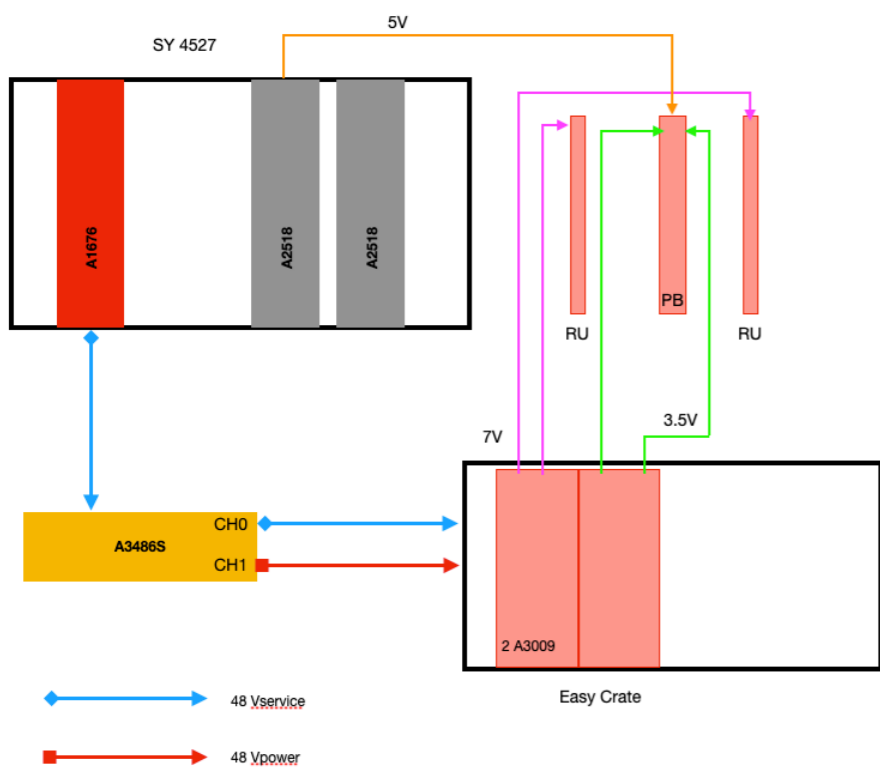
Office of
Science



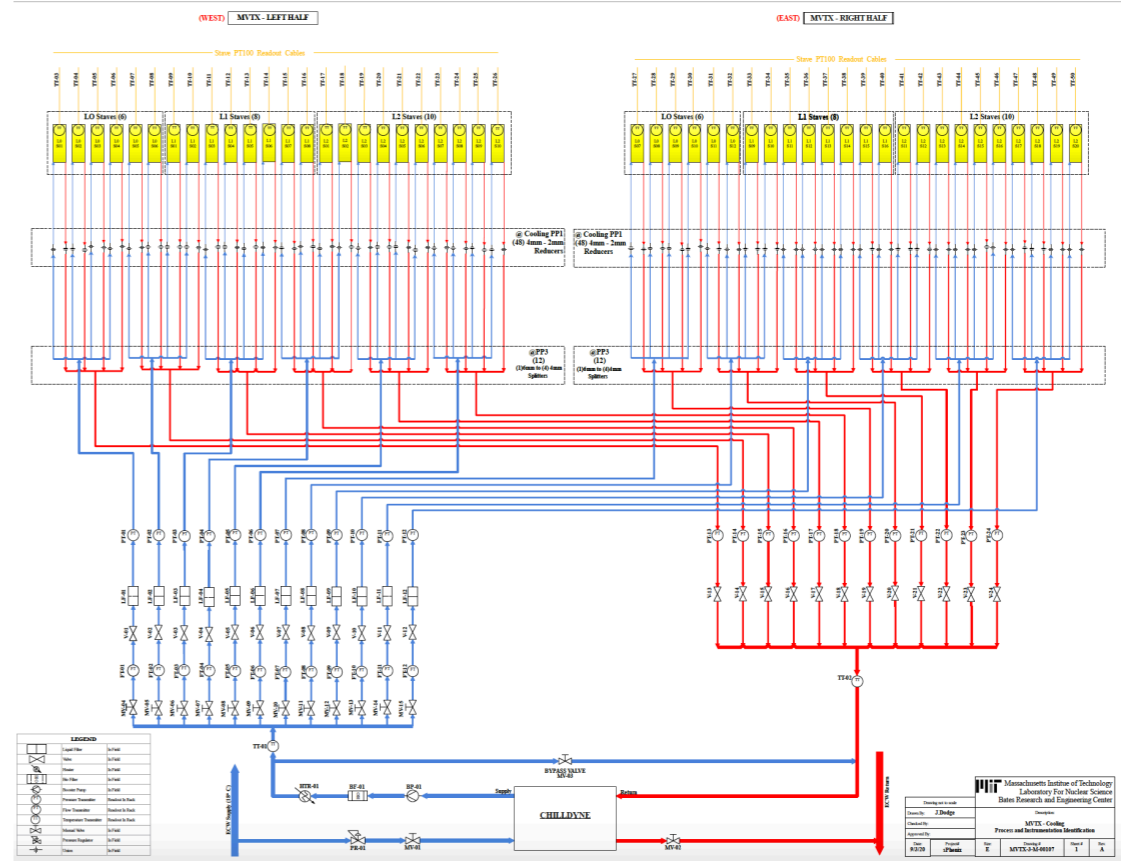
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Back Up

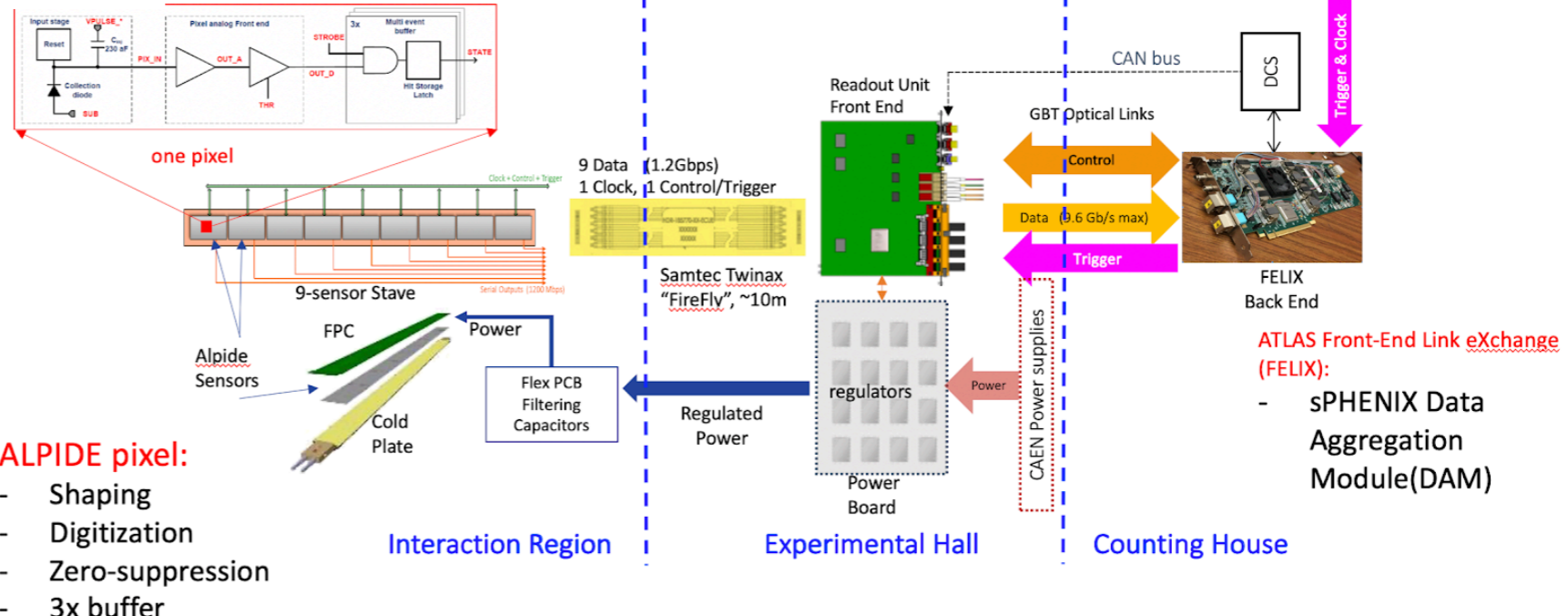
Power System



Cooling System



Readout System



- ALPIDE pixel:**
- Shaping
 - Digitization
 - Zero-suppression
 - 3x buffer

MVTX Detector Electronics consists of three parts

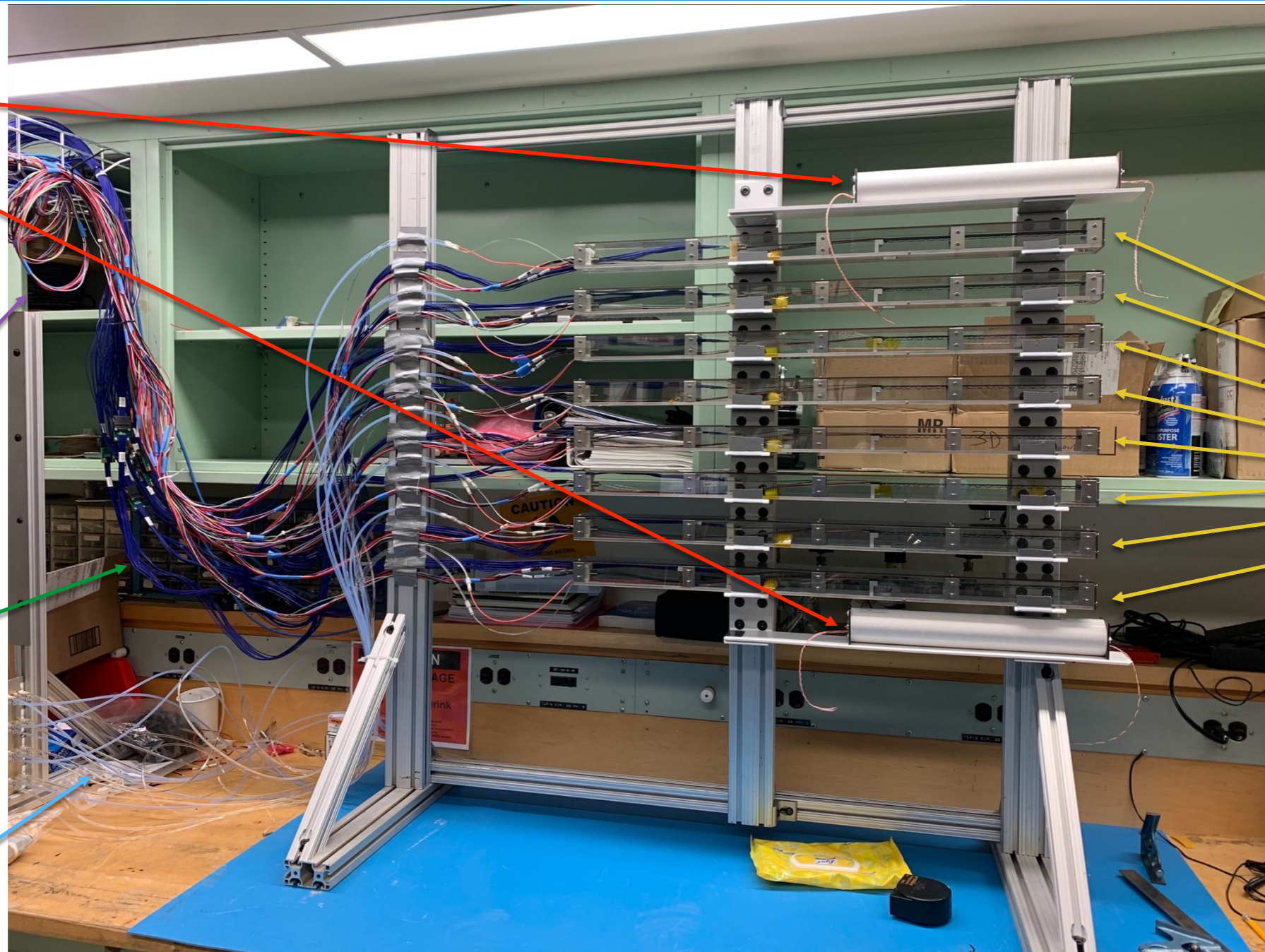
Sensor-Stave (9 ALPIDE chips) | **Front End**-Readout Unit | **Back End**-FELIX/DAM

**SiPM
Scintillators
(Triggers)**

**Power
Cables**

**Signal
Cables**

**Cooling
Tubes**



**MVTX
Staves**

- 8-stave telescope setup at Los Alamos National Laboratory for cosmic muon events
 - ➔ Complete readout chain: from the staves -> readout unit -> FELIX -> raw data
 - ➔ 6 copies of identical systems for the full MVTX system at sPHENIX
- Use both QC and DCS to operate the staves and monitor their performance in our test
- Study the staves functionality and alignment performance