SRO from JLab Experimental Halls

Progress and Pipelines

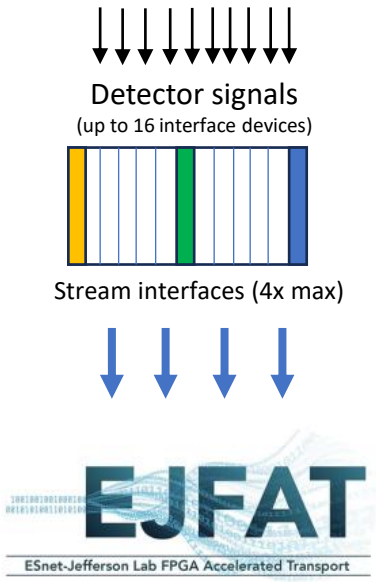
Jon Zarling

Experimental Physics Software and Computing Infrastructure (EPSCI) Group
Jefferson Lab

Streaming DAQ Hardware

VXS Crate

- CPU runs a software component ROC. It is responsible for payload board configuration and readout, as well as data formatting and passing it to the next stage.
- VTP relieves the ROC of all the “Readout” tasks and implements them in the FPGAs.
- Triggered or Streaming readout from ALL payload modules in parallel
- The Software ROC is now primarily responsible for configuring, controlling, and monitoring the VTP-based DAQ.
- TI Trigger interface card, responsible for trigger and clock distribution.



EJFAT Load Balancers

- ESnet
- JLab internal

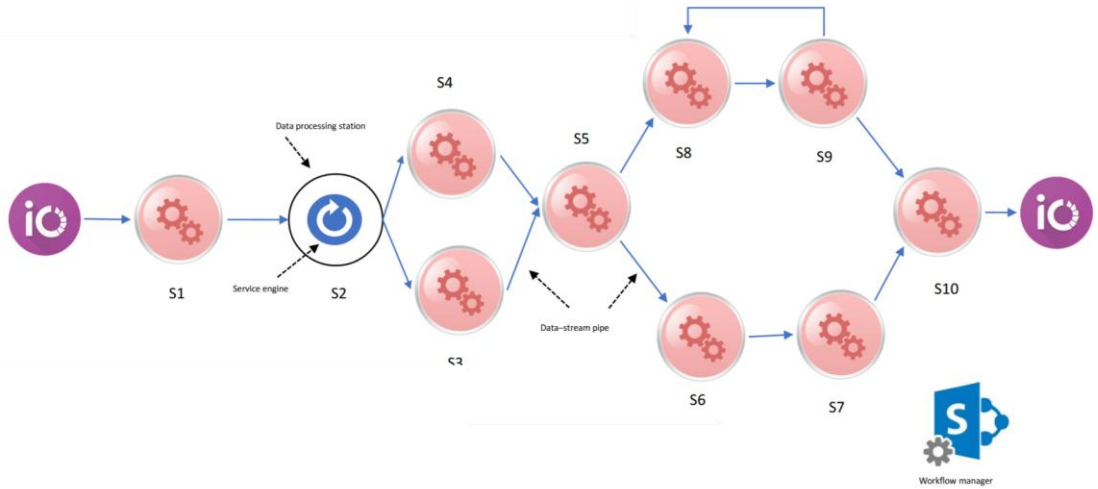
Streaming DAQ Software

CODA

- JLab's long-running DAQ software suite
- Designed around triggered hardware
- Updated to support streaming

ERSAP

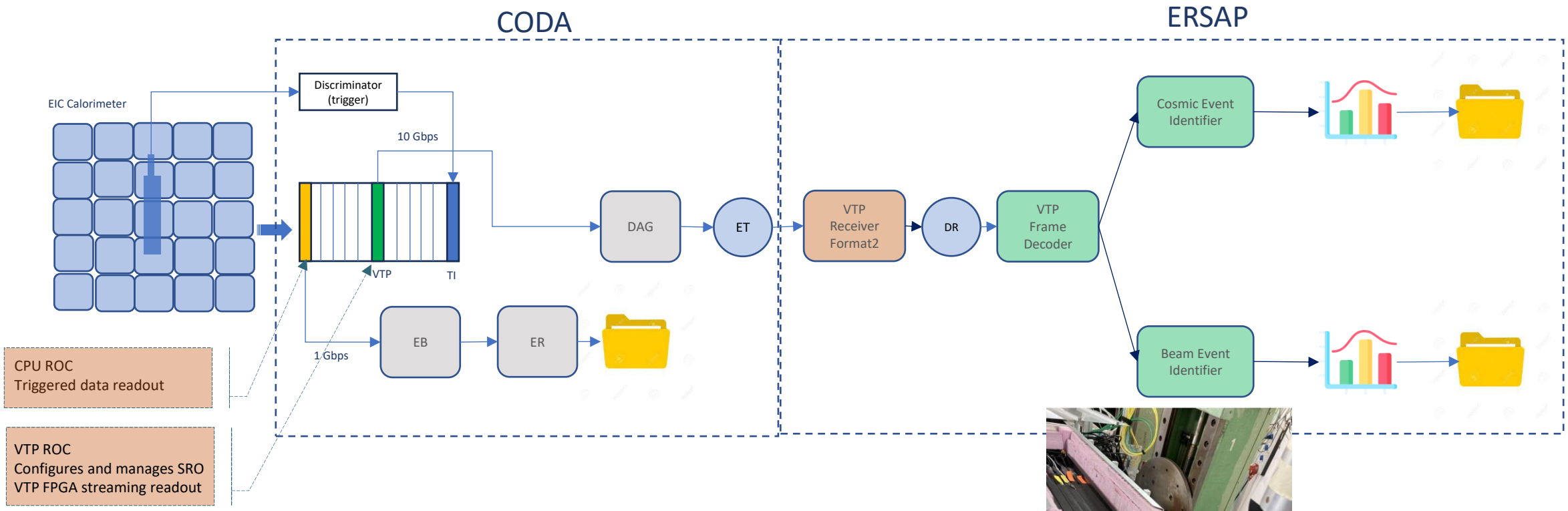
- Data processing orchestrator
- Reactive, actor-based approach to workflows







Single Crate SRO (EIC calorimeter @ DESY)

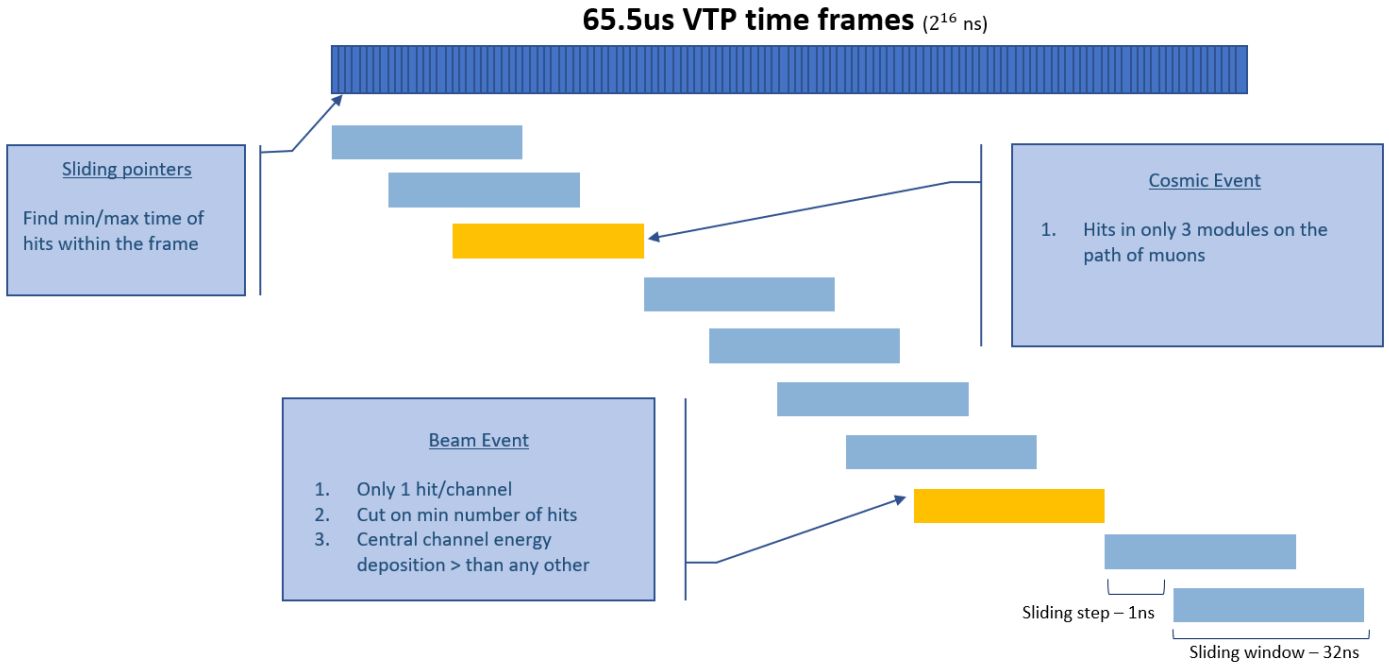


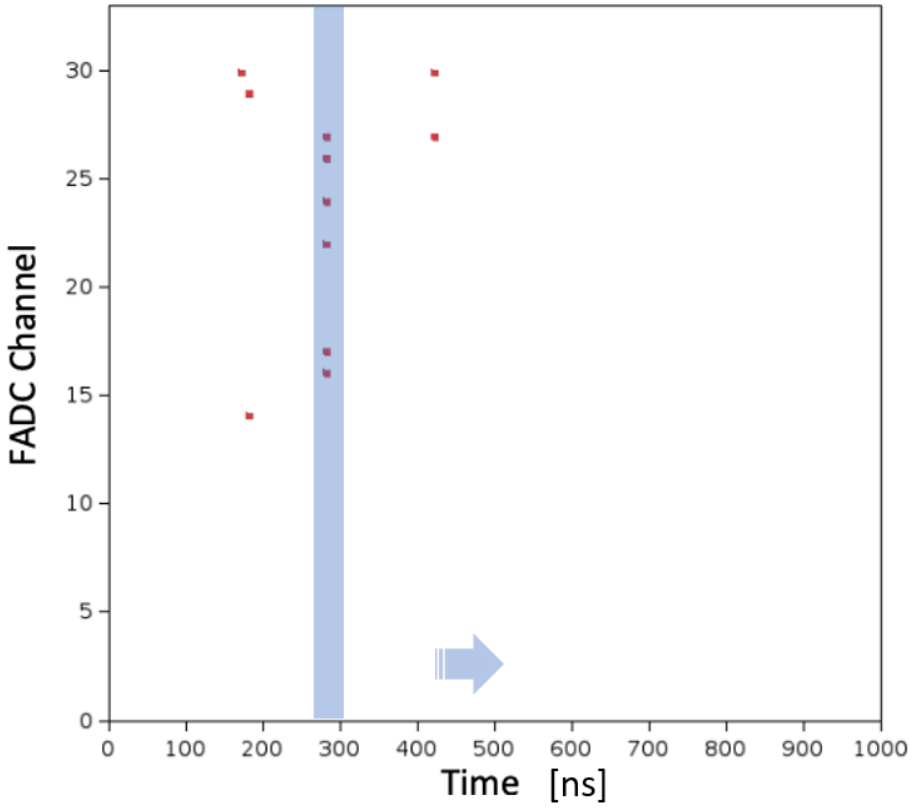
Triggered data are waveforms read out over the VME bus.
Stream data are integrated sums and times of all hits over a threshold in the calorimeter regardless of the trigger status.



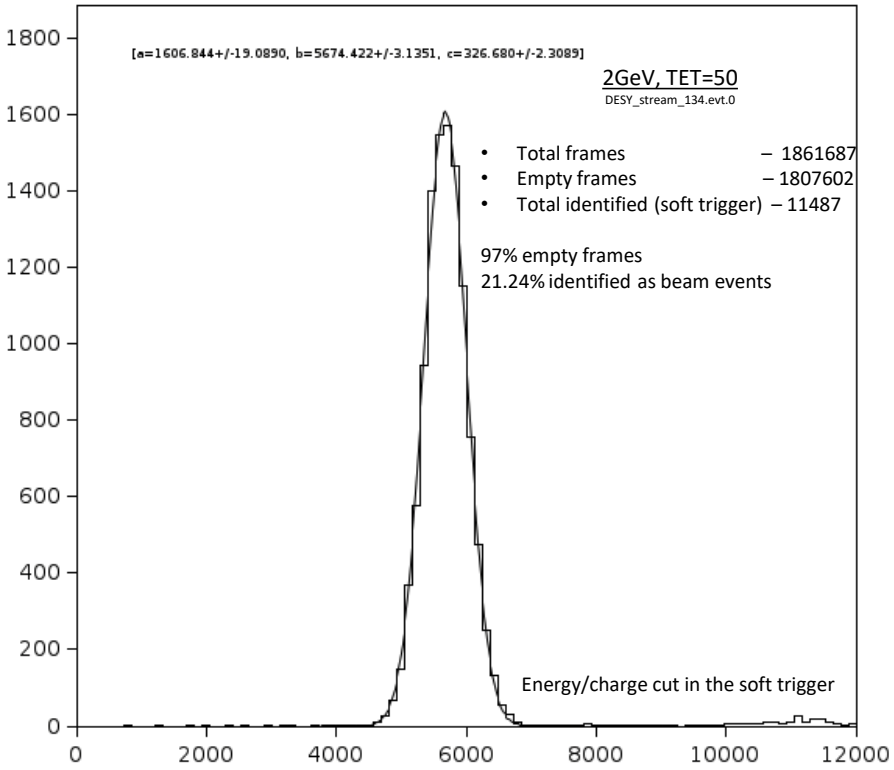
- 5x5 PbWO4 Crystal Array
- 2-5GeV electron test beam

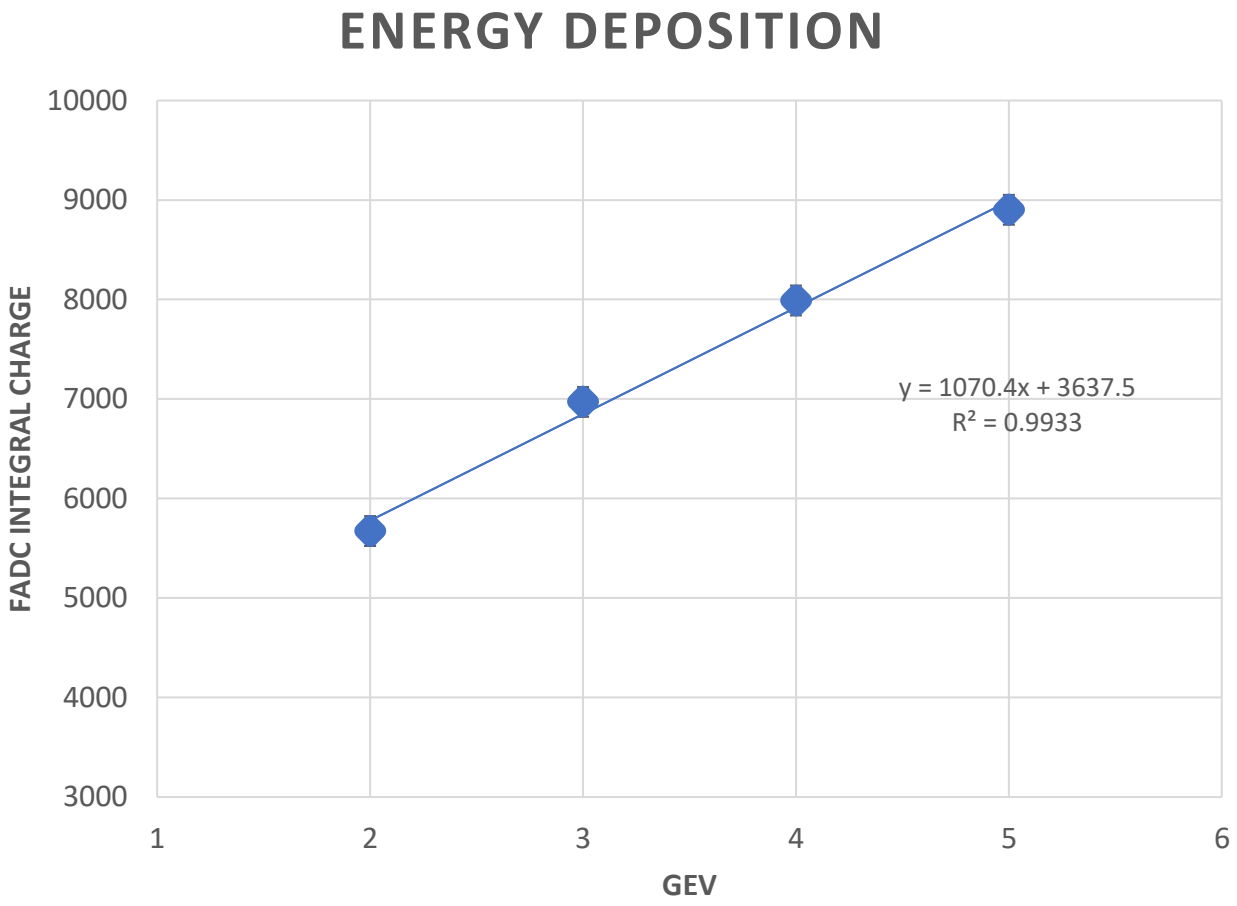
Shower Identification



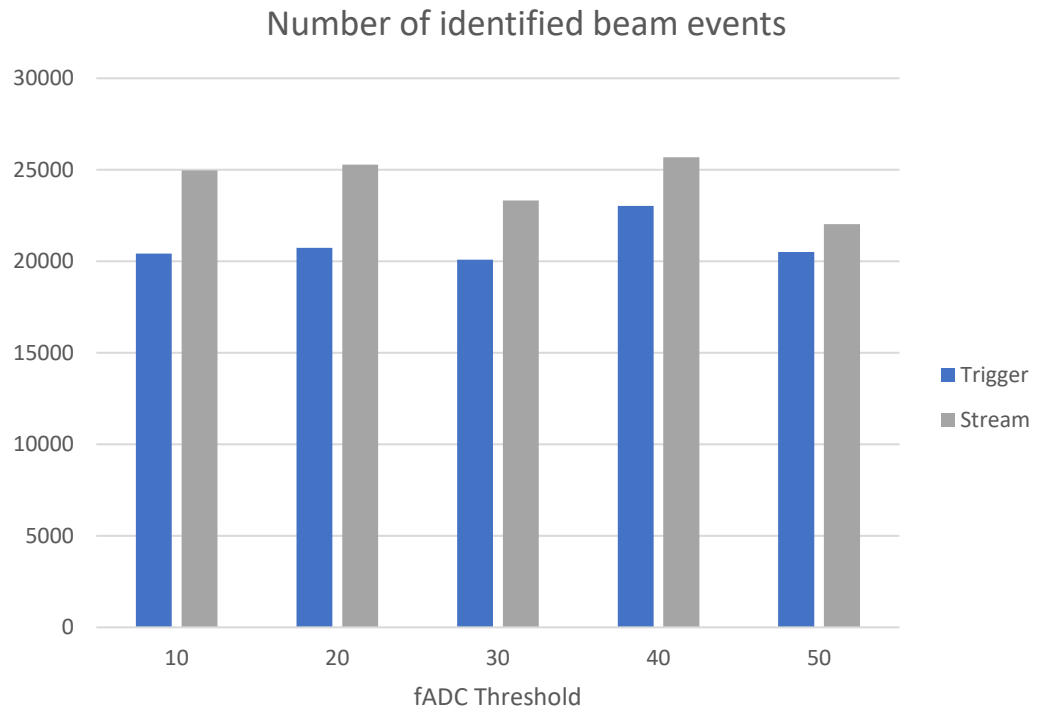


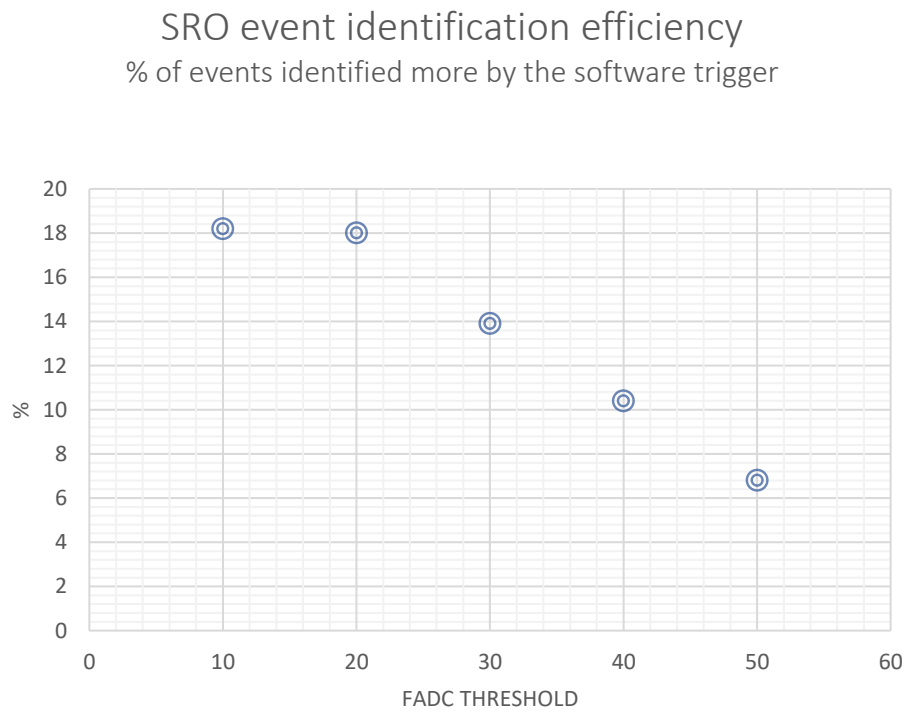
Enabling Measurements





Comparison to External Trigger

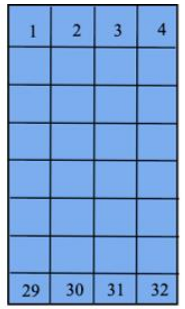


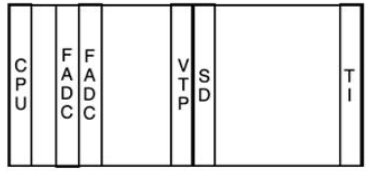


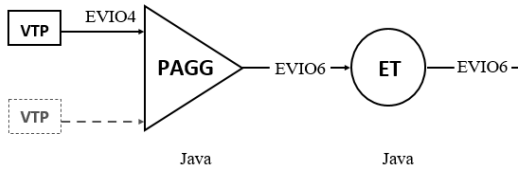
Streaming identifies more hits than external trigger (attributed to geometric acceptance)

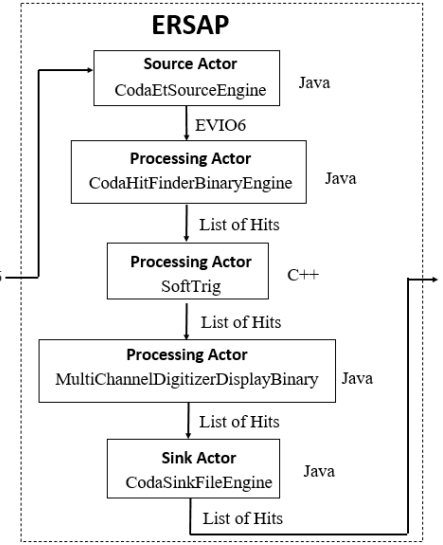
Single Crate in Experimental Hall

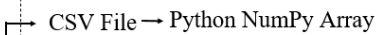






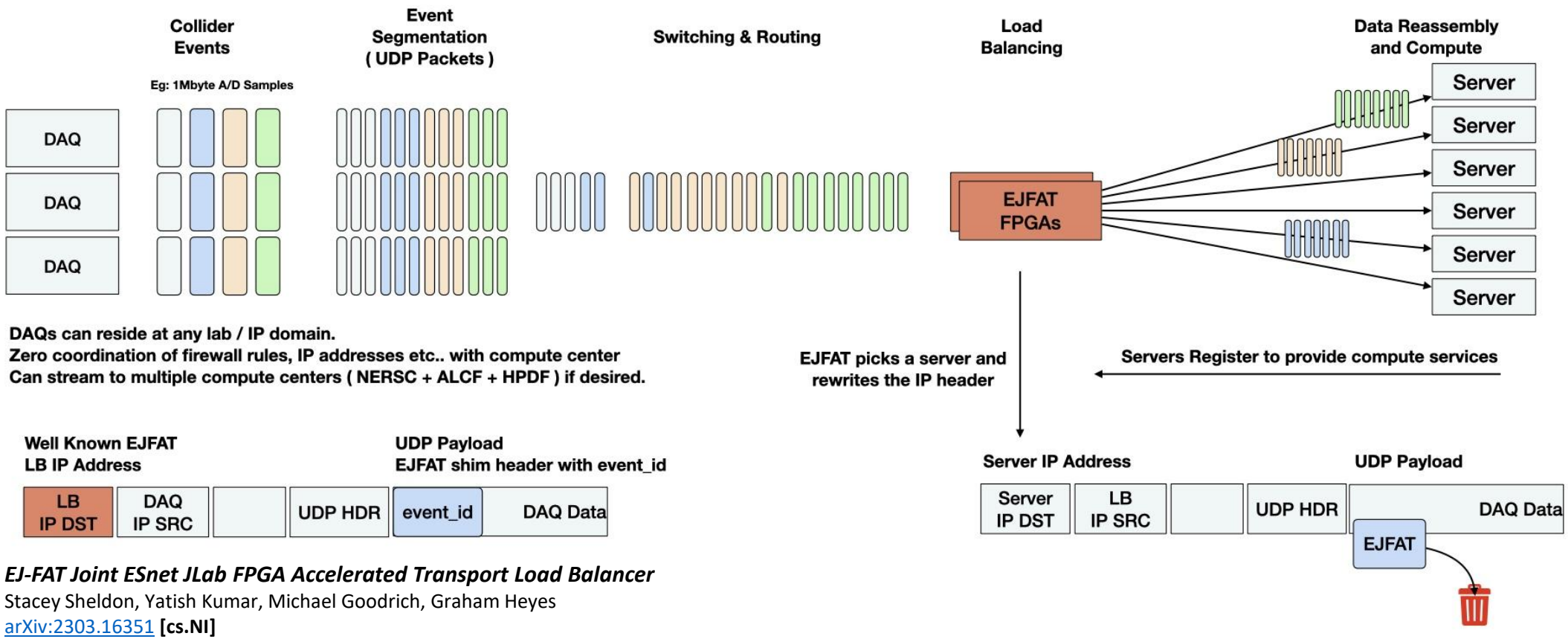






EJFAT: ESnet JLAB FPGA Accelerated Transport



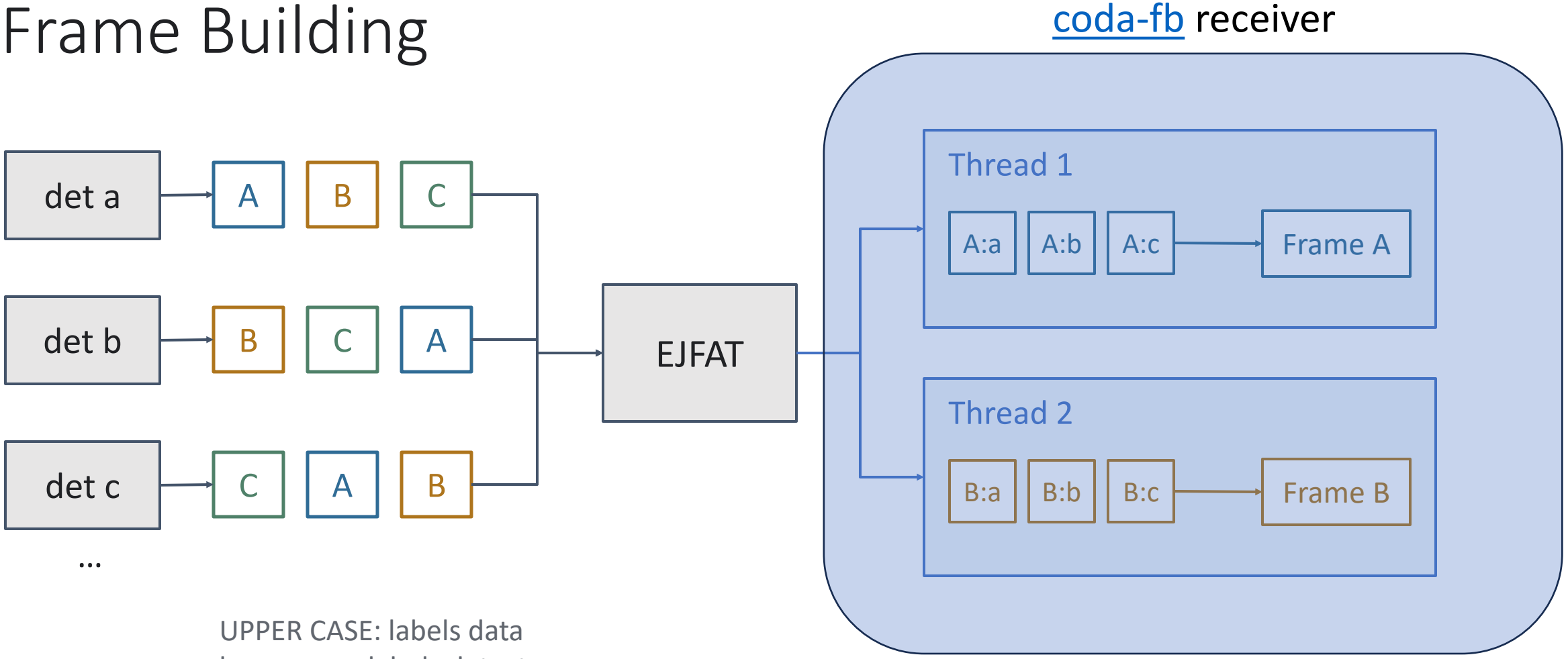


EJ-FAT Joint ESnet JLab FPGA Accelerated Transport Load Balancer
Stacey Sheldon, Yatish Kumar, Michael Goodrich, Graham Heyes
arXiv:2303.16351 **[cs.NI]**

Jefferson Lab

Jefferson Lab EPSCI

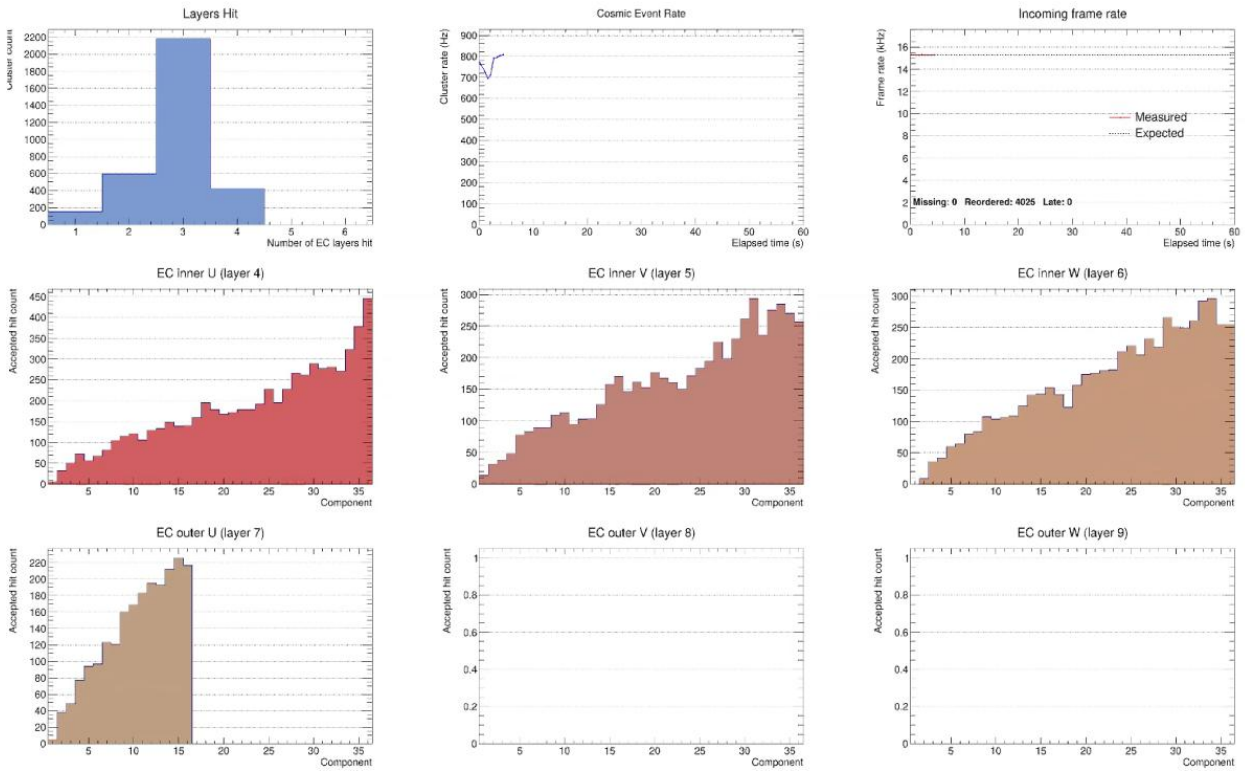
Frame Building



UPPER CASE: labels data
lower case: labels detector

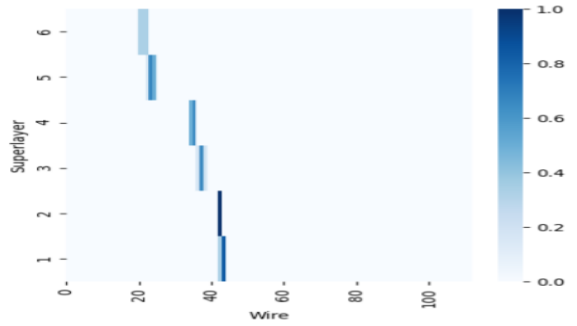
SRO Status in Hall B

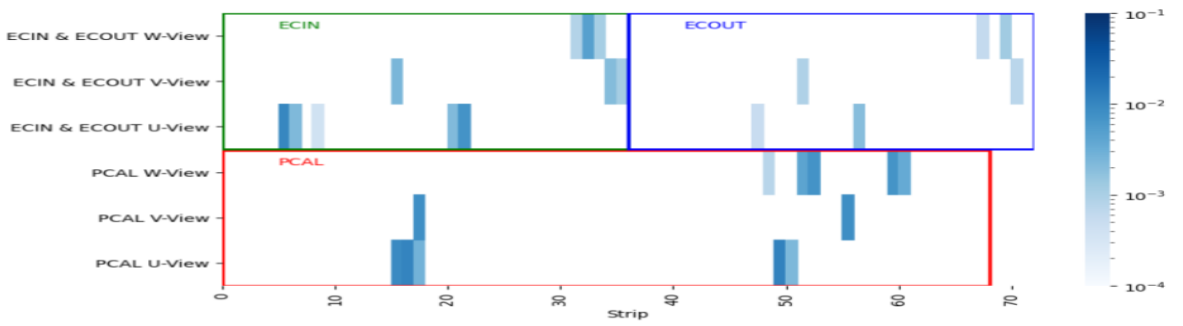
- 39 crates are streaming ready
- Hall B (physics) DAQ: TCP/local
- Our DAQ: UDP/EJFAT
- 18 noise crates streamed
- Few hour cosmic runs taken (using 2 of 6 ECAL sectors)
  - Zero packet loss on ~ few minute time



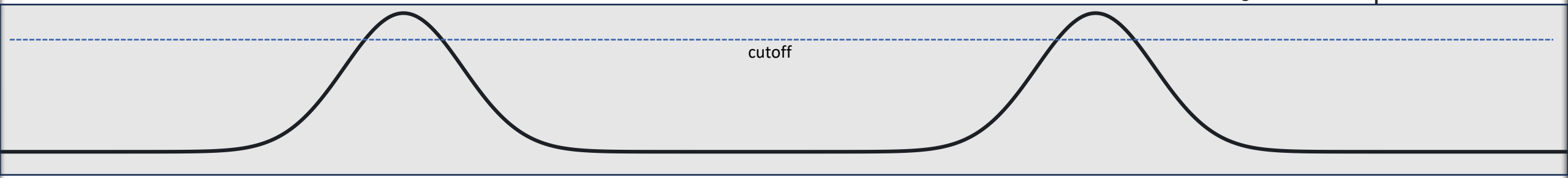
Future: Trigger Tags?

https://arxiv.org/pdf/2302.07635





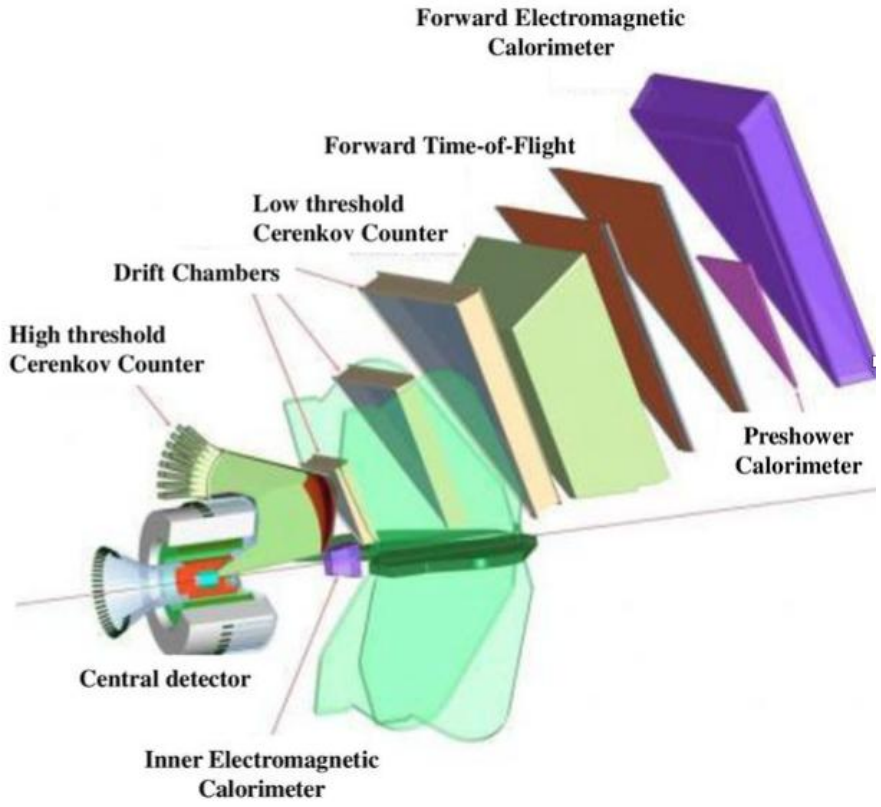


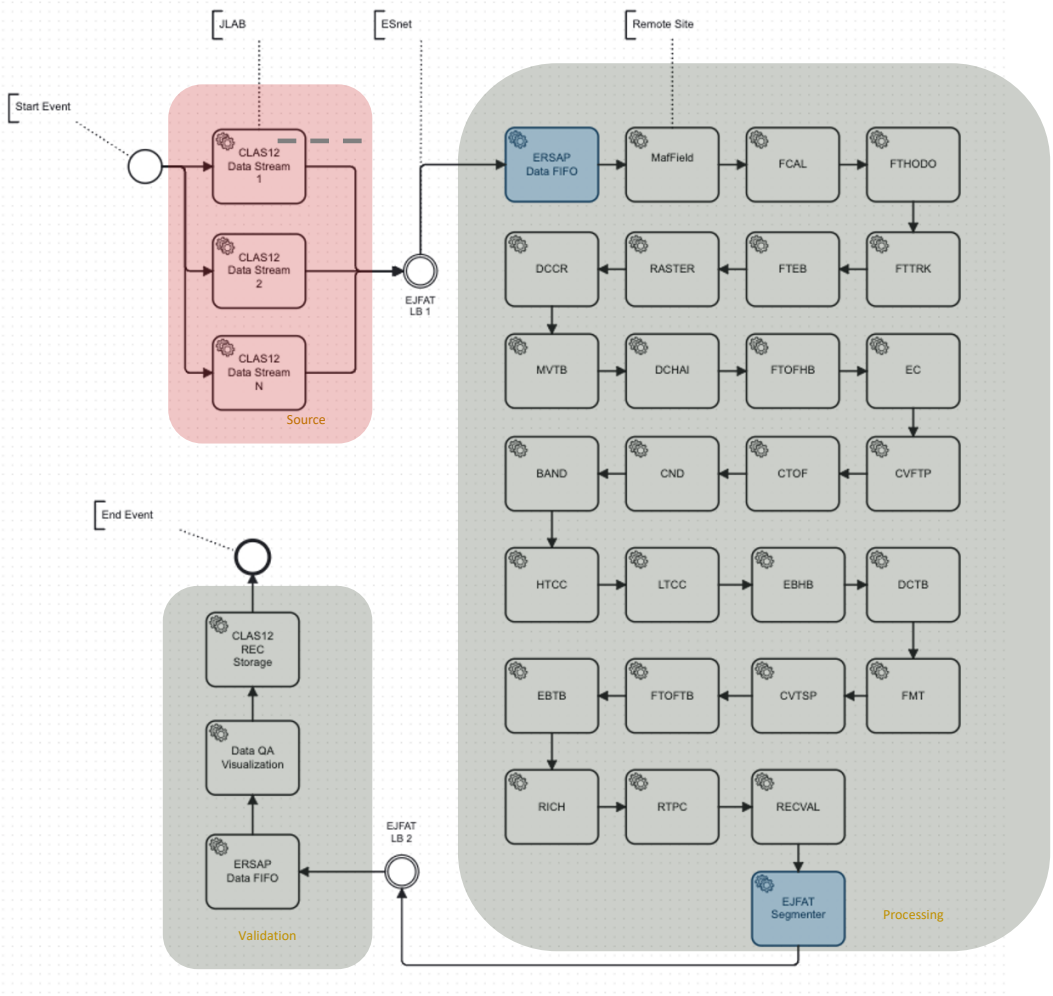


Electron trigger probability (ML)

CLAS12 Reconstruction Application

(ERSAP actor pipeline using EJFAT)

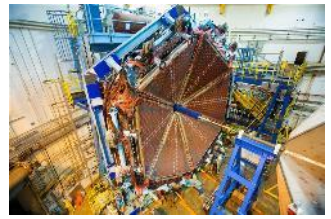




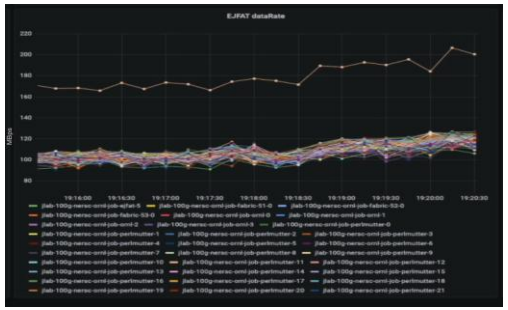
A Wide Web from Detector to Discovery

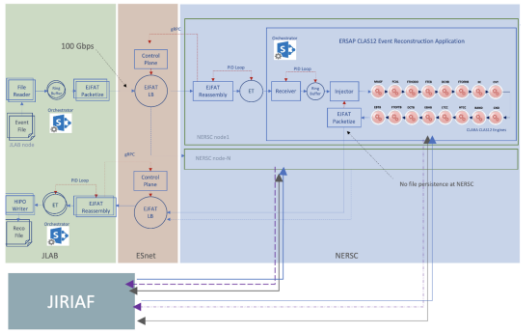
Scan for Press release

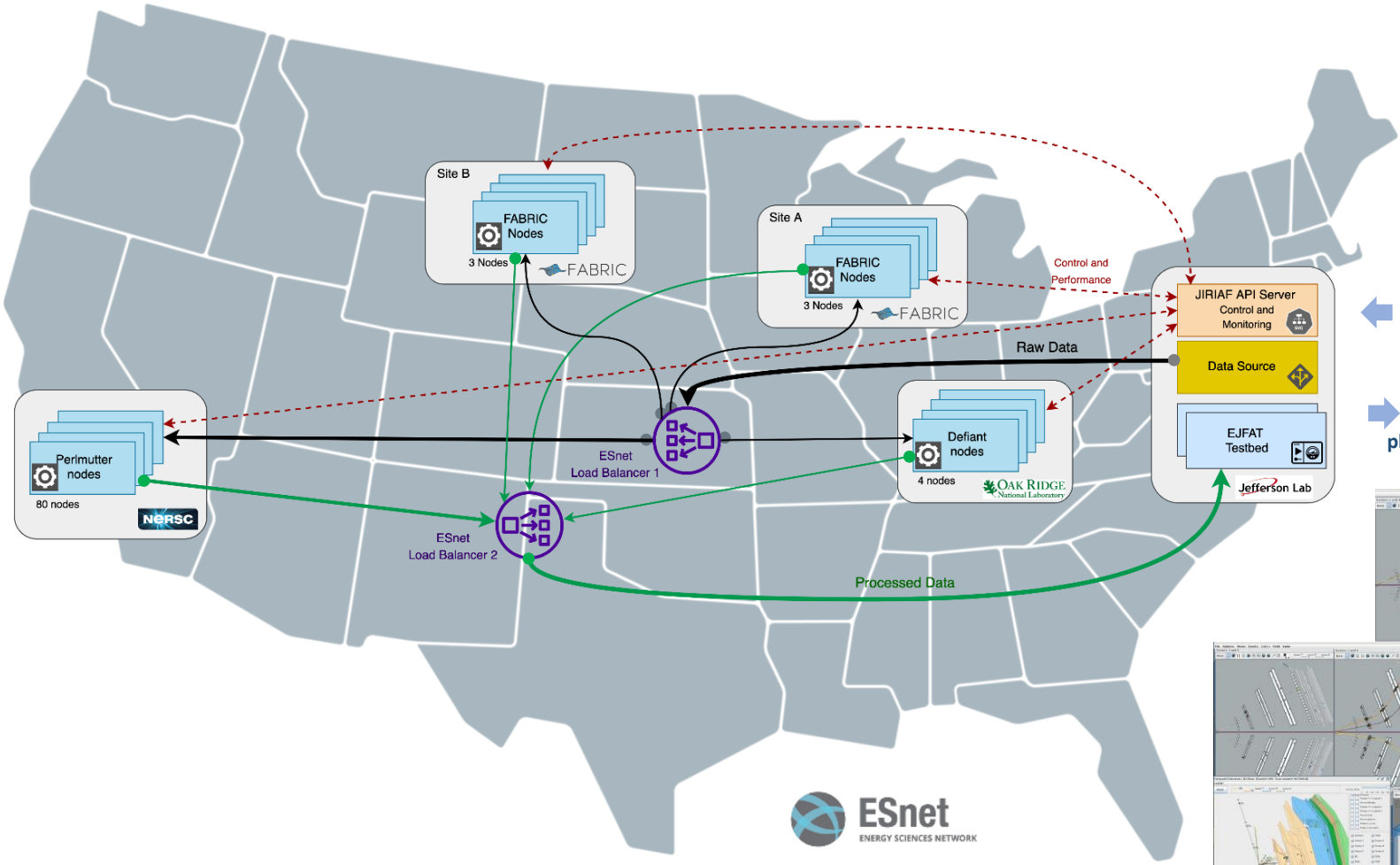
CLAS12 detector streaming readout

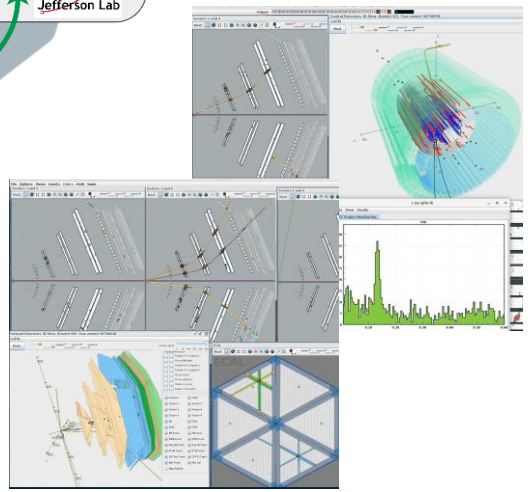


Processed event stream return for real-time visualization, physics validation, and persistence









Reconstruction of 100 TB raw data in 2 hours!

Jefferson Lab EPSCI