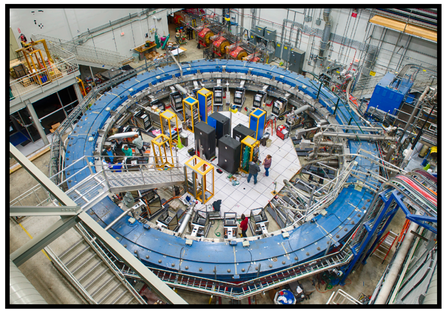
Muon g-2 reconstruction and analysis framework for the anomalous precession frequency

Kim Siang Khaw on behalf of the Fermilab Muon g-2 collaboration
University of Washington

Muon g-2 experiment



140 ppb measurement of a_μ (anomalous magnetic moment) to resolve >3σ discrepancy between SM predictions and BNL measurements

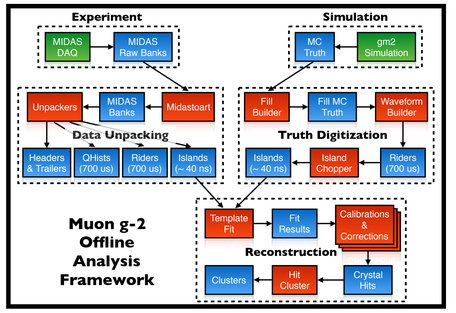
Data Acquisition

Modern DAQ system for fast DAQ and slow control. 12 Hz average DAQ rate, 20 GB/s raw data to 200 MB/s for storage using GPU farm.

art framework

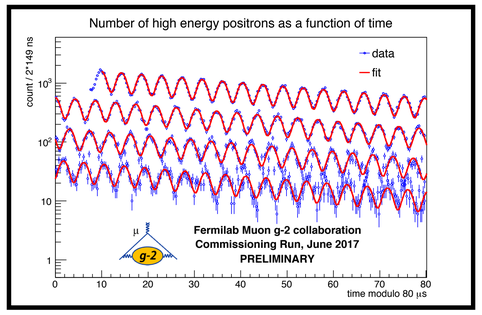
C++ event-processing framework (evolution from CMS framework) for "Intensity Frontier" (Mu2e, NOvA, DUNE, etc) experiments at Fermilab

Recon framework



Reconstruction "modules" built on top of art framework. Interface to MIDAS (midas-to-art) and Geant4 (artg4) developed.

Data Analysis



Users' analysis "modules" for extracting precession frequency from high level physics objects such as positron candidates

Main features of the framework

Intel TBB

- parallelize data unpacking and pulse fitting (24 calorimeters)
- indispensable for online DQM and nearline operation

Eigen

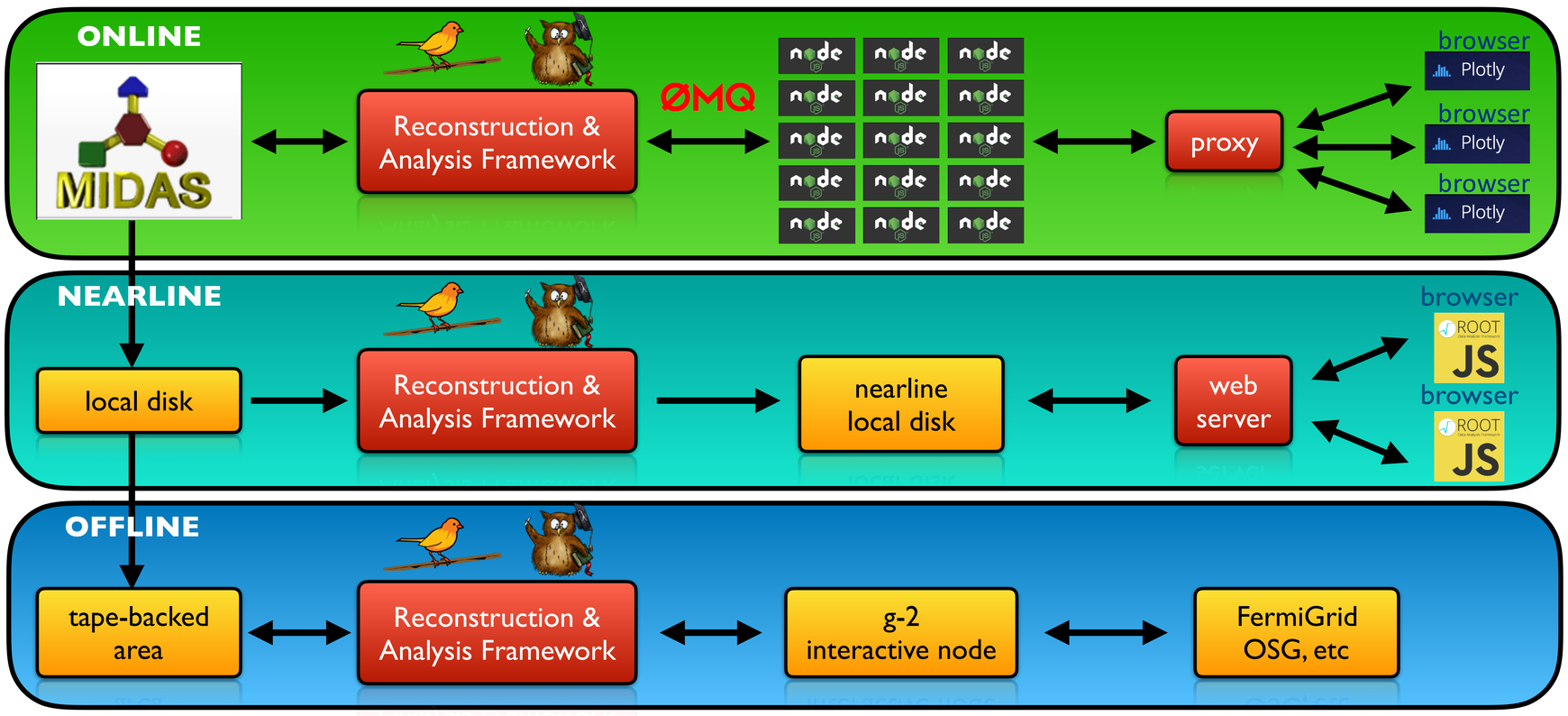
- pulse fitting is computing-intensive
- utilize fast and expressive linear algebra library
- could fit 100,000 pulses/s

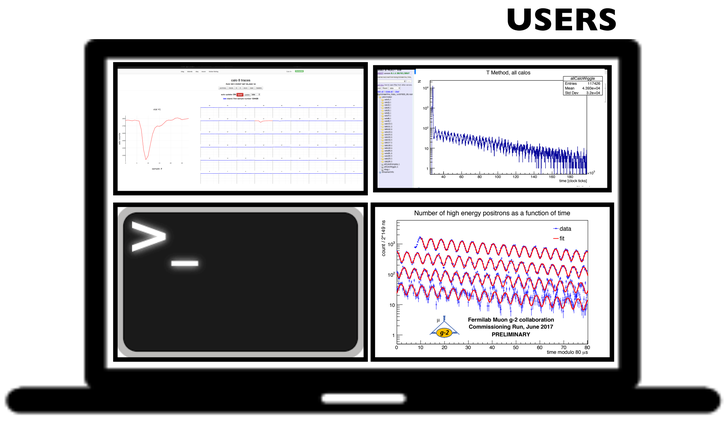
ZeroMQ

- *art* is not particularly interactive
- stream data out from art jobs
- data picked up by web GUIs, event display, etc

Plotly

- highly interactive
- high quality graphs
- a multitude of visualization types





Highly-integrated system from online to nearline to offline

- same code bases (online/nearline/offline)
- utilizes Fermilab computing tools
- complex architecture hidden from users
- positive feedbacks for commissioning run '17
- ramping up for design DAQ rate (12 Hz)