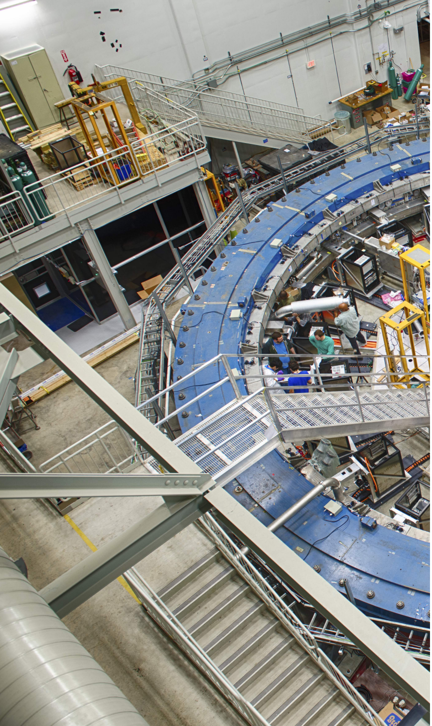


Stato del software/produzione dati g-2

A. Driutti

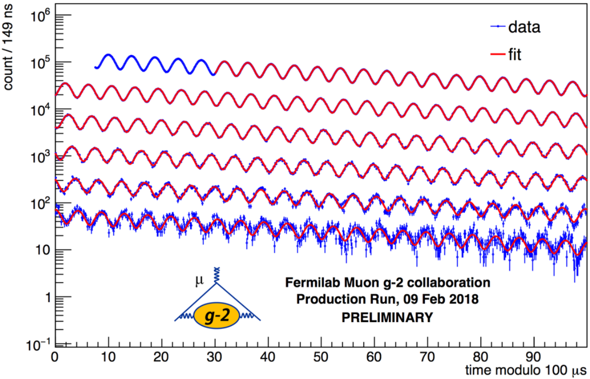
Riunione g-2 con i referee computing

Friday, 16 March 2018

Scientific Goals for the Upcoming Years

- Run the experiment and collect physics data:
  2018: $\sim 3 \times$ BNL statistics
  2019: $\sim 15 \times$ BNL statistics
  2020: $\sim 5 \times$ BNL statistics

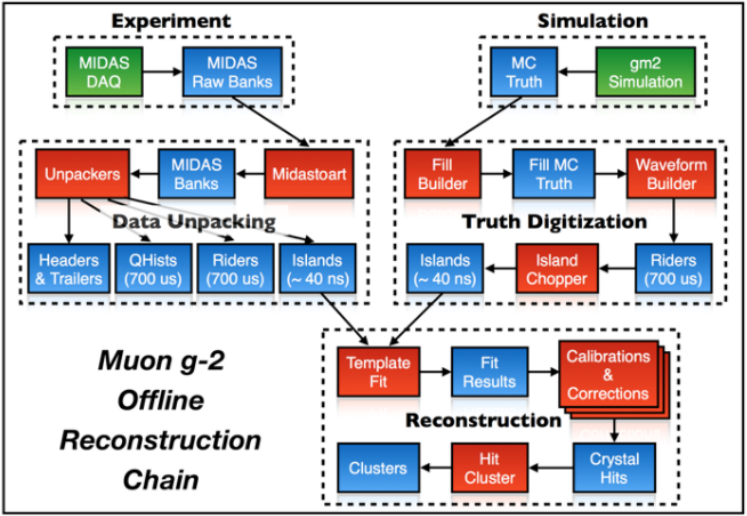
- Aim to have first results ready for the 2019 winter conferences
- First publication in summer 2020
- Final publication in 2021 with full dataset



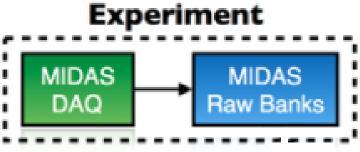
Wiggle plot with approximately 35 million positrons made using several hours of data taken on February 9th 2018.

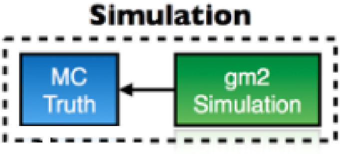
Muon g-2 Offline Reconstruction Chain

- A production team provides the reconstructed and simulated data to analyzers using the following fully automated chain (using Fermilab's SCD tools):



First Step: Data-Acquisition and Truth-Simulation



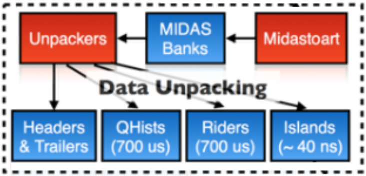


- MIDAS for data acquisition
- backend machines collect data from:
    - 24 calorimeters and laser calibration monitoring system
    - 3 (2) tracking stations
    - 4 fiber harps
    - Inflector Beam Monitoring System (IBMS) and T0
    - 4 quadrupoles and 3 kickers
- expected 20 GB/s of data
- "island chopping" in the GPUs to reduce the amount of data

- performed with GM2Ringsim (a GEANT based model of the storage ring)
- includes all of the detectors (but not laser system)
- includes different particle guns *e.g.*, GasGun, BeamGun
- unfortunately we continue to find problems in our simulation (recently discovered an error in Geant4).

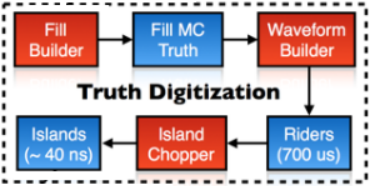
Second Step: Data-Unpacking and Truth-Digitization

Experiment



- unpacking stage: read the raw MIDAS file and store the information as an art event structure

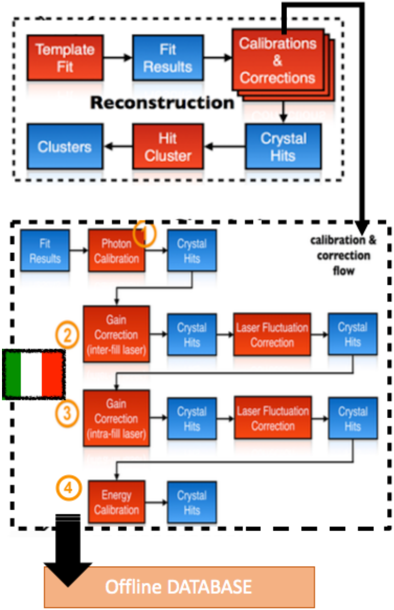
Simulation



- digitization stage:
  - a fill builder aggregates 16k muon decay events and converts them into a single g-2 fill event
  - waveform building module simulated the SiPM waveforms (responses + digitizer behaviors)
  - "island chopping" similar to the one done GPUs in the frontend machines

Third Step: Reconstruction

- Reconstruction stage:
  - process the raw data using algorithms (fitting, clustering ...)
  - identical for simulation and experiment - exception calibrations/corrections only for DAQ data.



- Calibrations/Corrections:
  1. Photoelectron Equailization (from fitted pulse integral to *n.p.e.*);
  2. Out-of-fill Correction (long term gain variations);
  3. In-fill Correction (short term gain variations);
  4. Energy Calibration (from *n.p.e.* to MeV) ;

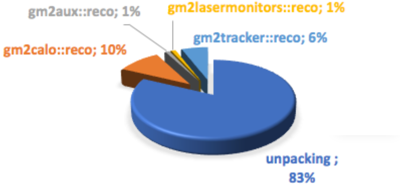
⇝ saved in the offline database

Status on the Software for the Gain Calibration Chain

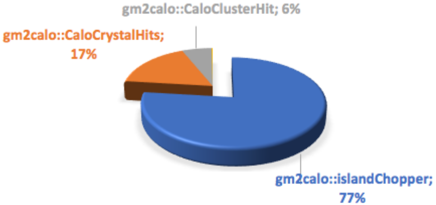
- MIDAS DAQ raw data stage:
  - ✓ all the data needed are collected
  - ✓ DAQ parameters are stored in the ODB
- Unpacking stage:
  - ✓ all unpackers in place
- Reconstruction stage:
  - ✓ pulse fitting for the calorimeters and pulse processor for laser monitors are working
  - ✓ photo-electron equalization module in place
  - ✓ out-of-fill and in-fill gain corrector modules are in development
  - ✓ energy calibration in development

$\rightsquigarrow$ test stand for whole gain calibration chain (from raw data to full reconstruction) requires the g-2 software and the databases + few days of raw data ($\sim$ 20 TB)

Production files content



Experiment



Simulation

- essential information for the measurement of ω_a with "T-Method" (threshold technique): energy and space-time coordinates of the calorimeters' crystals hits and reconstructed clusters ($\sim$ 10%).
- we are also interested in data from the laser calibration system ($\sim$ 1%);
- we tested an analyzer that collects this information and stores it inside ROOT files.

Production files size

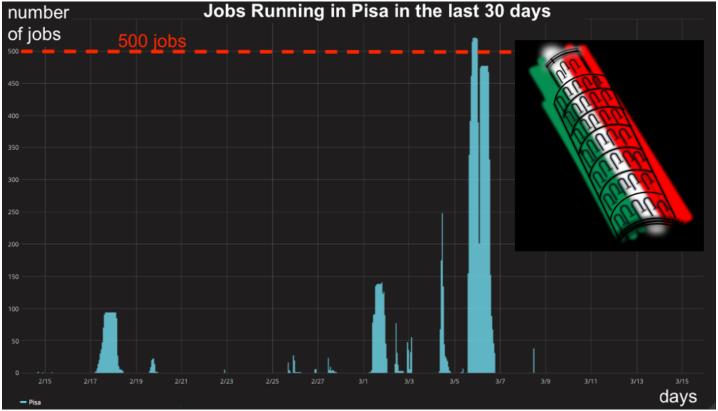
Year	N. detected positrons	BNL Statistics	Raw Data [TB]	Full Reconstructed Data [TB]	Simulated Data [TB]
2018 (6 m)	21×10^9	3	750	600	200
2019 (9 m)	105×10^9	15	1250	1100	1000
2020 (3 m)	35×10^9	5	400	350	400

Table 1: Expected space resources required for data storage in year 2018, 2019 and 2020.

- numbers for 2018 are obtained using “realistic machine conditions”;
- numbers for 2019 and 2020 are computed using the “nominal (TDR) operation” conditions.

Production Jobs on the Pisa Grid

- We are able to run at Pisa: first Italian site accessible by FIFE tools!
  - 13 Feb 2018: first job submitted by the Production Team in Pisa
  - 20 Feb 2018: completed the test using single-core queue - added Pisa to the Offsite list
  - ongoing: testing multicore



Summary

- The offline production architecture is in place and we are working to include gain corrections.
- We estimate that a storage space of 80 TB ($\sim$ 10% of reconstructed+simulated data) will be sufficient for storing the data for the analysis of the 2018 dataset and with an additional 20 TB we will be able to exercise the whole gain correction chain.
- In the following years we might need information from additional systems (up to $\sim$ 20% of reconstructed+simulated data) to improve the analysis.
- We were recently able to run jobs in the Pisa grid. Big accomplishment! We are planning to keep running in opportunistic mode to understand our needs in terms of dedicated CPUs.