

# Calorimeter Data Processing

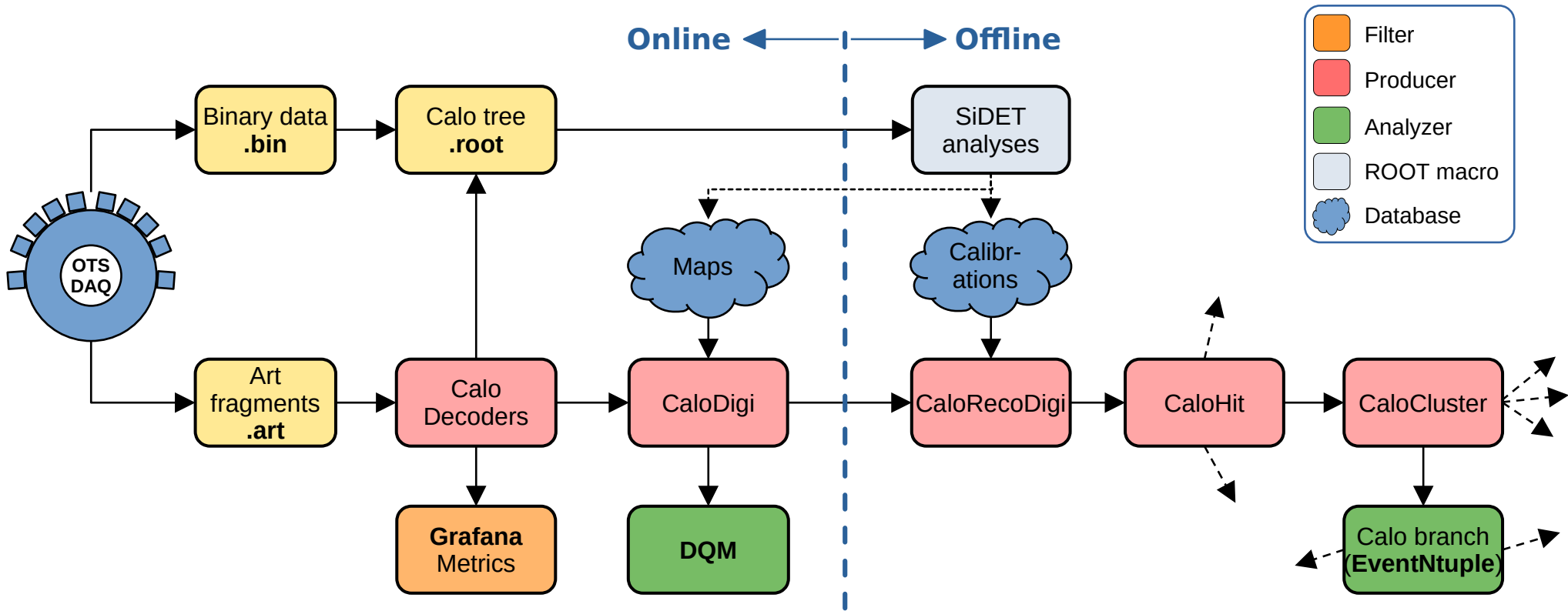
Calorimeter Workshop

Mu2e Collaboration Meeting  
June 9th 2025

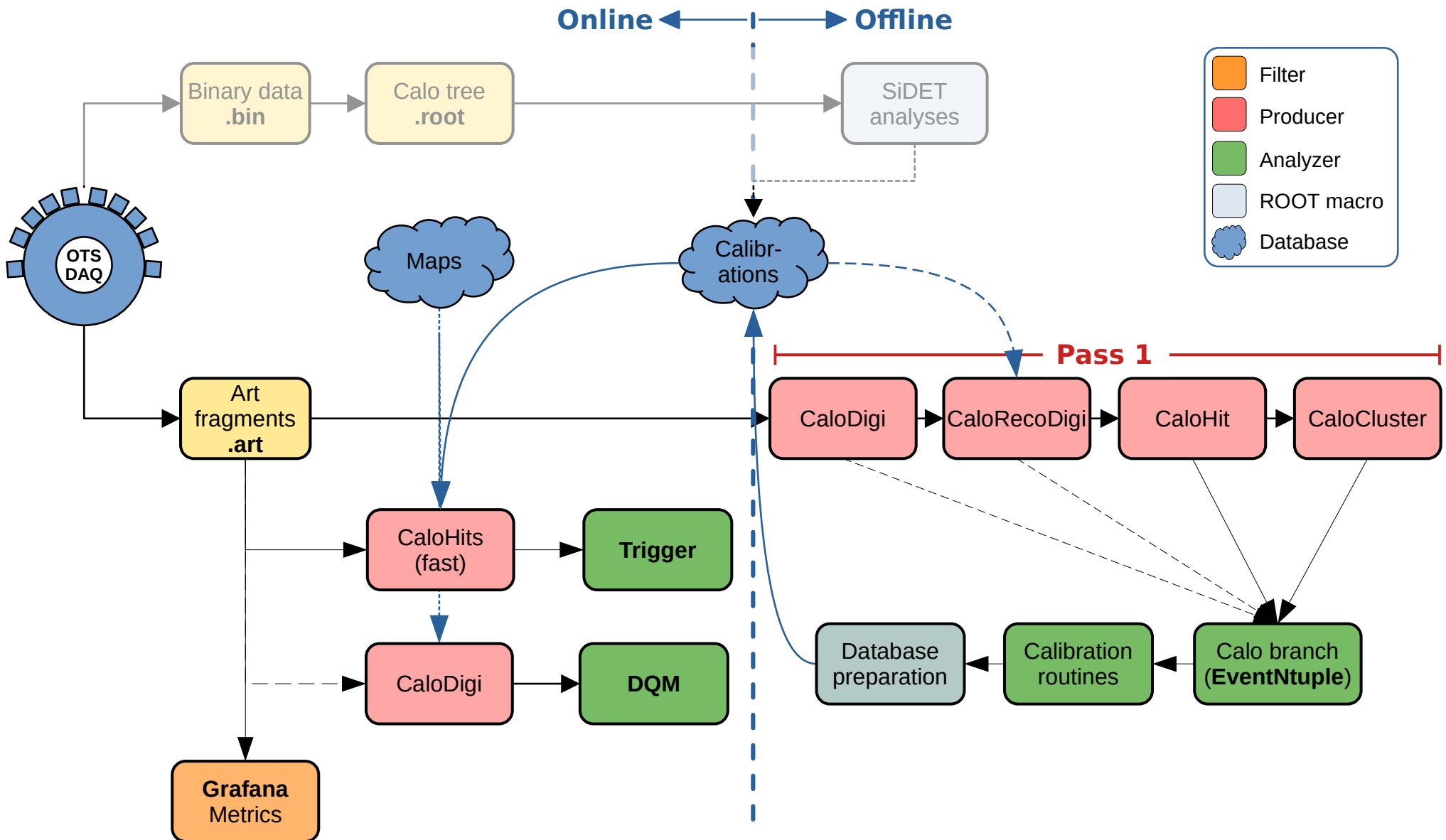
Paolo Girotti (INFN LNF)

# Commissioning @SiDet

(From March CM)

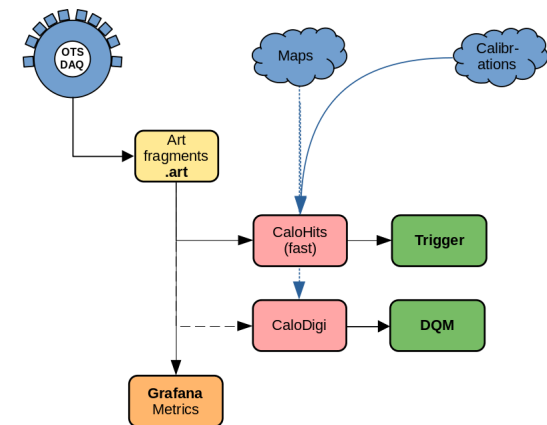


# Transition to KPP



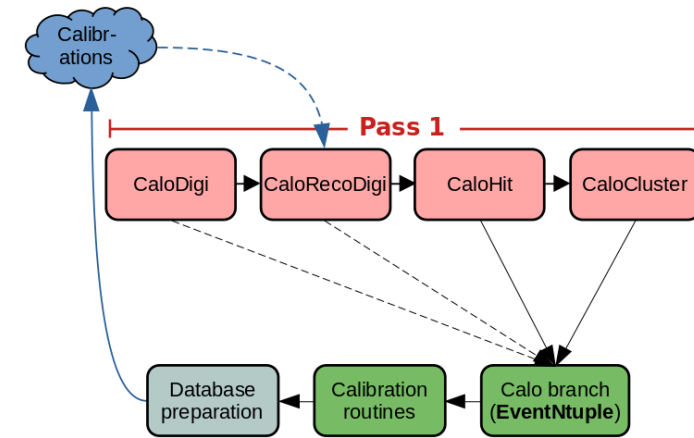
# Online processing

- Online data taking of art files is stable
- **Grafana** monitoring
  - Tested at SiDet with basic
  - Next: expand with metrics useful for shifters
- **DQM**
  - Started testing online DQM modules at SiDet
  - Mark's complete module installed, pending extensive testing
  - Next: test data rate capability – current dispatcher prescale 1/100
- **Trigger**
  - Raw-to-hit fast module prepared and tested offline
  - Next: test online rate capability for trigger purposes



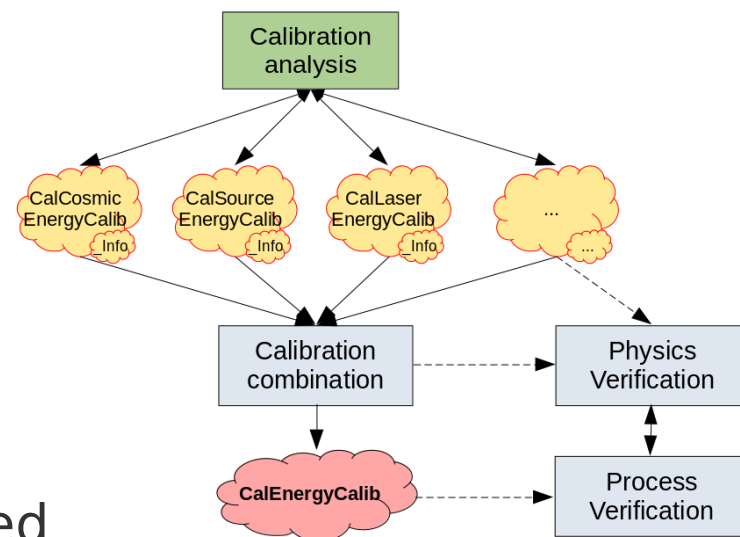
# Offline processing

- Offline reco (pass-1) tested on some CR data
- **Database**
  - First open-IOV (CosmicEnergyCalib) is on database
  - Next: implement producers to create and test calibrations
  - Then: prepare laser and source (+templates?) tables and calibration merging procedures (Sophie) and test with official CaloRecoDigi producer
- **EventNtuple**
  - Being developed and tested
  - Next: complete branch and convert current analysis routines to run on these files
- **Pass-1 & Pass-2**
  - Coordinate with Offline team for integrated tests



# Database

- Offline database under development
- **Archive** tables
  - CosmicEnergyCalib table is live
  - Upload and retrieval with openTool
  - Art-reader module available, to be tested
  - Thanks to Ray for the massive help
  - See the wiki: <https://mu2ewiki.fnal.gov/wiki/OpenIntervals>
- **Ad-hoc** tables
  - Used to assign useful info and metadata to main tables
- **Production** tables
  - Infrastructure is already there
  - Next: create a starting calibration and test offline



# Calo decoders

- Calo decoders still used online but no longer saved as intermediate dataproducts for speed efficiency
  - See Giani's talk [DocDB#52180](#)
- They serve decoding functions for:
  - Counters
  - Debug hits (for commissioning)
  - Normal hits
  - Hits for trigger (skips waveform mem copy)
- New hit structure under development (Luca)

# New hit structure

```

struct Hit_Header_t {
  uint32_t hit_RESERVED_1      : 12; // Bit 84-95
  uint32_t hit_BOARD_ID        : 8;  // Bit 76-83
  uint32_t hit_DET_ID          : 3;  // Bit 73-75
  uint32_t hit_CH_NUMBER       : 5;  // Bit 68-72
  uint32_t hit_HITTIME         : 16; // Bit 52-67
  uint32_t hit_EWTAG           : 16; // Bit 36-51
  uint32_t hit_BASELINE        : 12; // Bit 24-35
  uint32_t hit_INDEX_OF_MAX    : 10; // Bit 14-23
  uint32_t hit_ERRORS          : 4;  // Bit 10-13
  uint32_t hit_NSAMPLES        : 10; // Bit 0-9
};

```

+

```
vector<uint32_t> hit_SAMPLES; //12-bit words
```

- New hit structure collects header info at the beginning and the waveform at the end
- Knowing NSAMPLES before the waveform will greatly improve fast decoders for trigger purposes
- 4-bit error flag to link underflow/overflow of each channel's FIFO
- Baseline and max\_index words for fast reconstruction
- Reserved words for sanity checks
- To be deployed and fully tested

# Conclusions

- Calorimeter data processing continues to evolve rapidly to address and bridge the needs of calo commissioning and TDAQ development
- Now that the calo is commissioned (@SiDet), focus is shifting to prepare for stable and complete art online and offline processing for commissioning @MC-2 and for KPP
- TODO list:
  - **Online:** fully deploy grafana metrics and DQM for system monitoring and data visualization.
  - **TDAQ:** perform rate tests with full disks for trigger capabilities
  - **Offline:** complete calibration tables, prepare combination scripts, tests and validate procedures. Test pass-1.
  - **Analysis:** complete, deploy, and use calo Ntuple branch