FRIB DATA ACQUISITION WORKING GROUP

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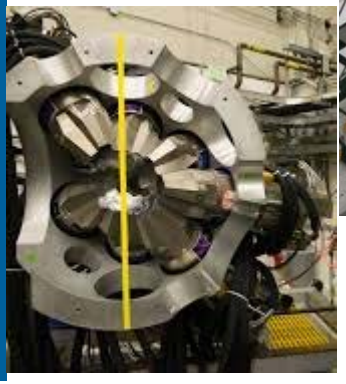
Plans for Integration of GRETINA into the DGS-DFMA distributed timing/trigger system for the 2017-18 campaign



JOHN T. ANDERSON
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2017 Low-Energy Community Meeting
Argonne National Lab

REVIEW OF PREVIOUS AND CURRENT SETUPS

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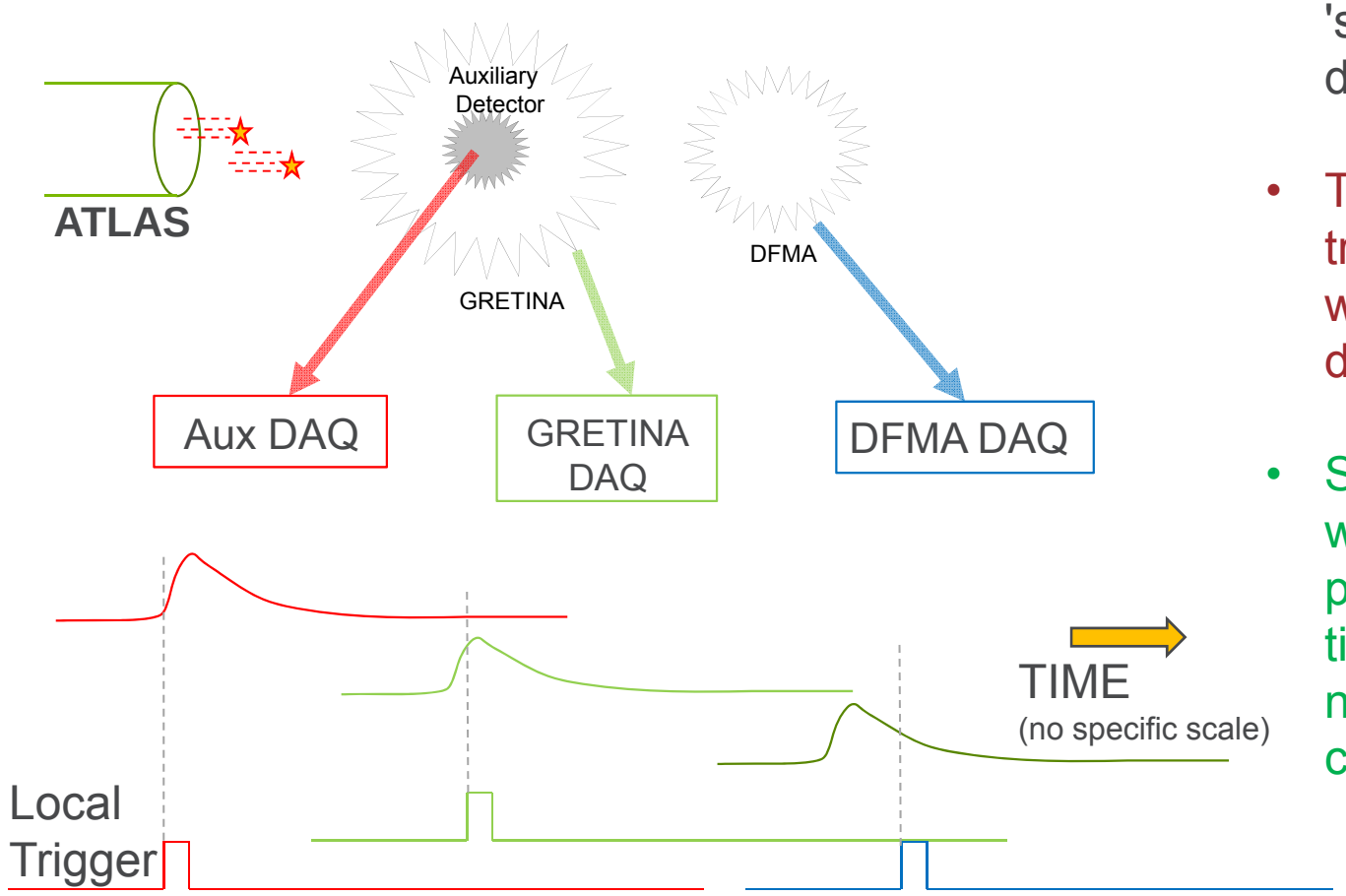
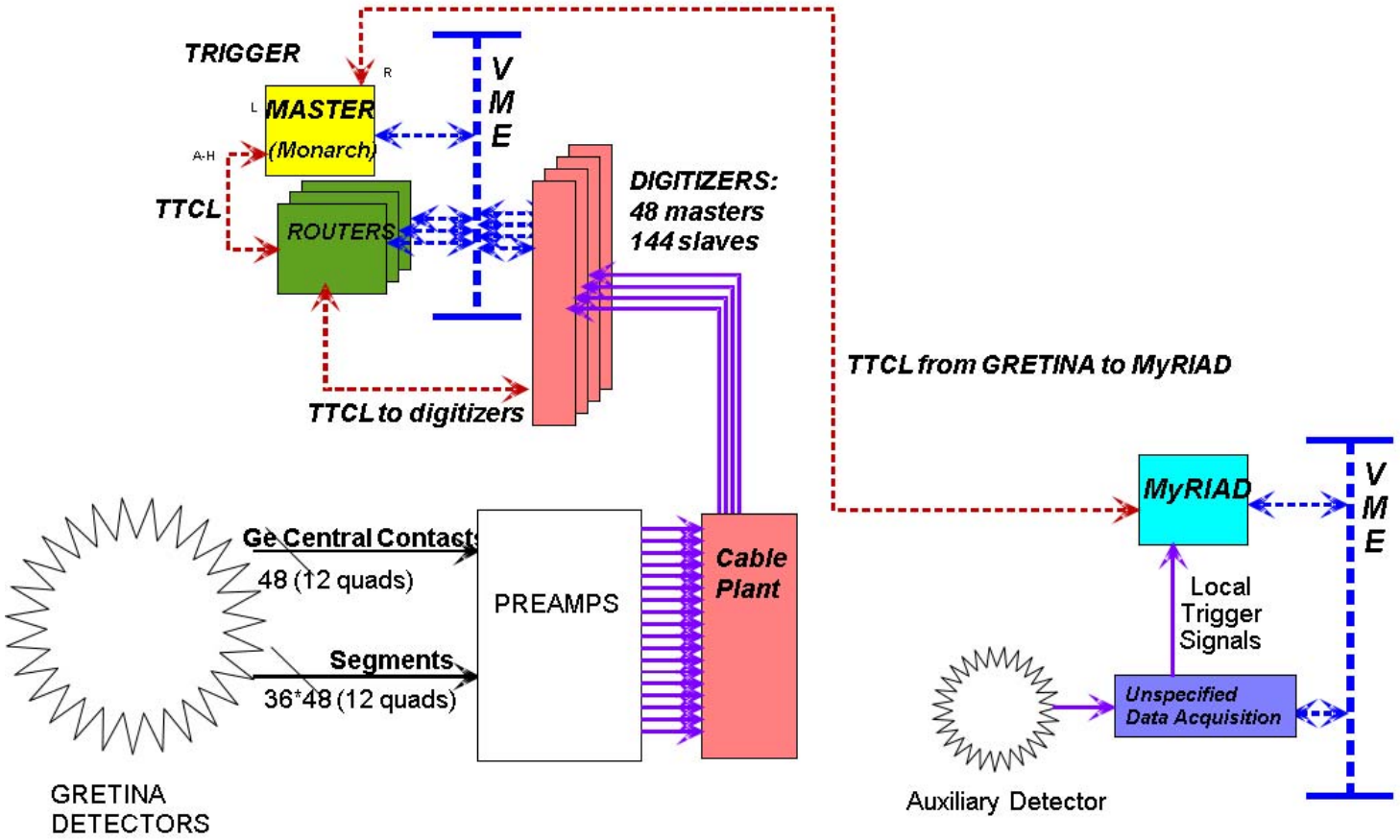
General timing cartoon



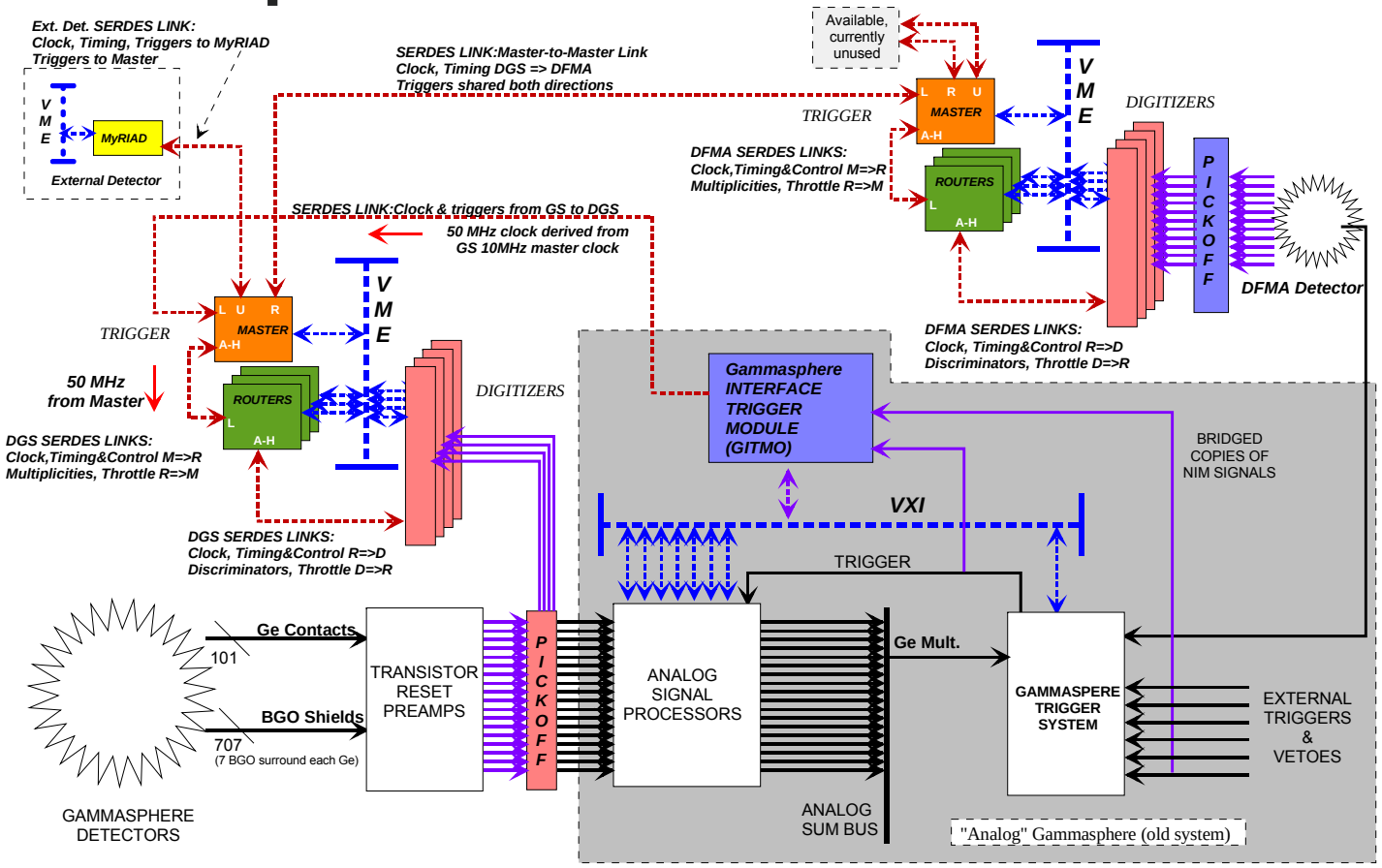
- Detector systems 'see' the event at different times
- Time to form local triggers varies widely between detectors
- Shared timestamp with programmable positive or negative timing offsets a necessity to form coincidences

Previous experience - GRETINA + auxiliary detector



- In previous campaigns at ANL GRETINA has been connected to CHICO2 and Phoswich Wall
- The MγRIAD module was used to propagate the GRETINA timestamp to allow for offline reconstruction of coincident events
  - Fast trigger from auxiliary detectors sent via NIM cable, not through MγRIAD.

Current experience - DGS/DFMA/Aux



- Correlation of three detectors has been repeatedly demonstrated
  - Synchronization of clocks and timestamps in all three DAQs
  - Cross-triggering (DGS from DFMA, DFMA from DGS, DGS from Aux)
  - Aux detectors include CHICO, Phoswich, ORRUBA
  - Triple coincidence selection of events for readout in DGS

PLAN FOR GRETINA IN 2017-2018 CAMPAIGN

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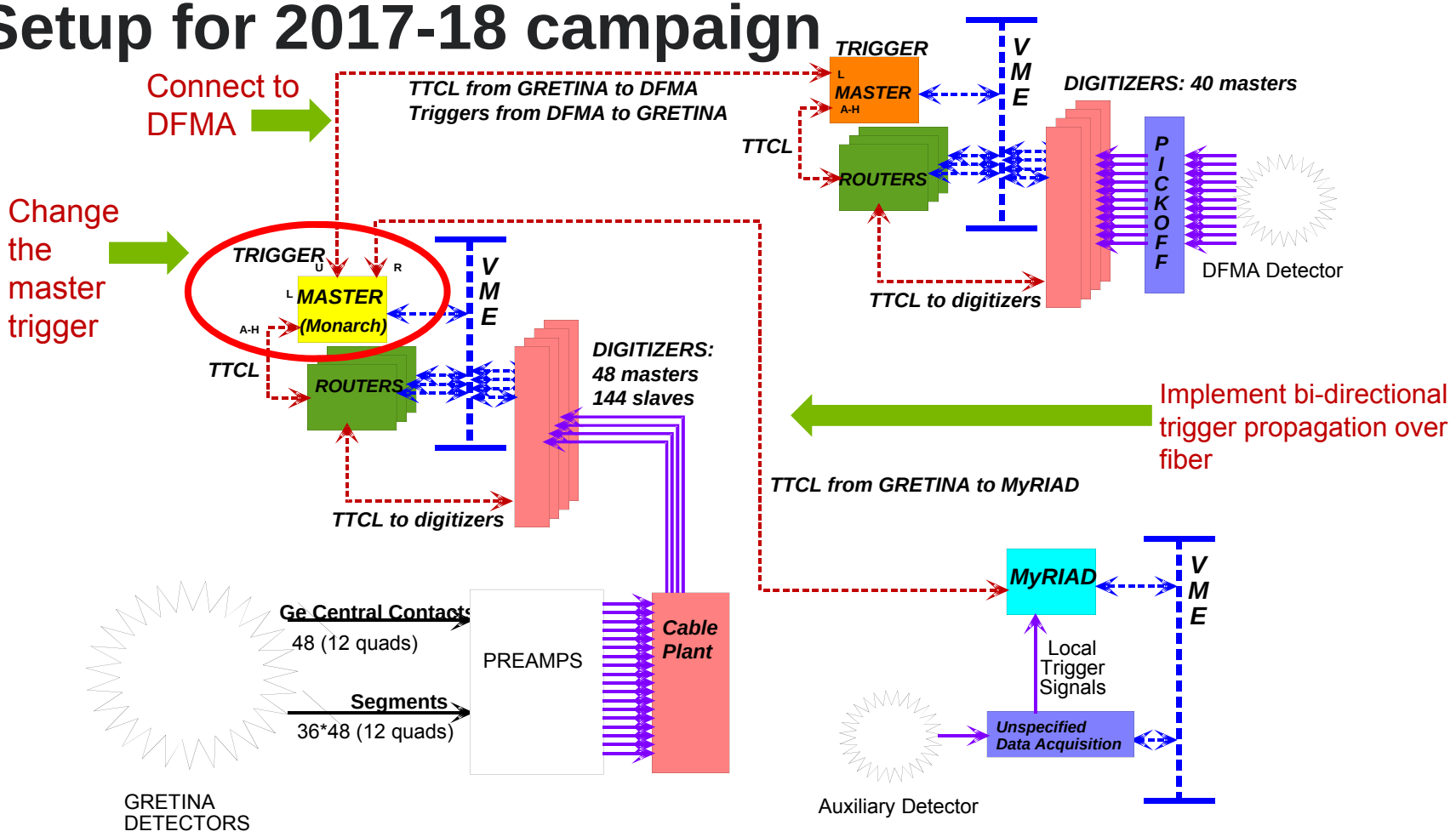
Setup for 2017-18 campaign



- Replace the GRETINA master trigger with a DGS master trigger
  - Same module, different firmware; DGS TTCL a superset of GRETINA TTCL
- Modify GRETINA control & DAQ to use the features of the DGS firmware for cross-triggering and timestamp correlation
  - Limits GRETINA to use of fast multiplicity as the "internal" trigger
  - Allows triggering of GRETINA by DFMA or Auxiliary including coincidence

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Risks & rewards

- RISKS
  - Requires changes to GRETINA DAQ and EPICS pv database
  - DGS master trigger firmware is not pure replacement of GRETINA master trigger; possibly some registers are implemented differently requiring software/firmware work
  - DGS master trigger algorithms other than fast multiplicity are different; more complex GRETINA-only algorithms would have to be ported in at some future time
  - GRETINA digitizer firmware may not be perfectly compatible with DGS's expanded TTCL format (superset).

- REWARDS
  - GRETINA will be trigger-able by DFMA
  - GRETINA will be trigger-able by auxiliary detector
  - GRETINA will be able to perform coincidence triggers of external + local
  - GRETINA will inherit target wheel interface from DGS/DFMA
  - GRETINA will inherit expanded auxiliary I/O features of DGS/DFMA
  - GRETINA will inherit TDC functionality of DGS/DFMA
  - Allows for eventual merging of DGS/DFMA/GRETINA master firmware into single tree, simplifying firmware maintenance

- ***We believe the rewards well outweigh the risks***

LOOKING AHEAD TO THE GRETA @ FRIB ERA

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Connections to GRETA @ FRIB

- The 2017-2018 campaign for GRETINA is a model for GRETA @ FRIB
  - Gives community a significant opportunity to understand and explore what connections GRETA must implement to other detectors and to the FRIB accelerator.
  - Provides a test bench to work with GRETA trigger & timing design team - GRETA L3 manager for trigger/timing is resident at ANL
- The parameters of timing accuracy, clock distribution, jitter and latency in the FRIB era can be inferred or extrapolated from the experiences that will be obtained in this campaign
  - How well does any experiment need to know the accelerator clock with respect to the local experiment DAQ clock? To bunch level? Sub-ns level?
  - What amount of buffering will be required to ensure all foreseen combinations of detectors can trigger each other without losing events?
  - How should various detector DAQ systems that run at different clock frequencies be synchronized?
  - What is the appropriate resolution of timestamps from linked detectors?
  - What is the appropriate *accuracy* of timestamps run-to-run from linked detectors?
  - What correlations of timestamps to "wall clock" or GPS time are required?
- ***Answers to questions like these will strongly influence design decisions in GRETA and the FRIB complex***
- ***Careful consideration of interfaces NOW mitigates a great deal of system-wide design risk LATER.***

THANK YOU

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