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Overview of the GRETINA – Auxiliary Detector Interface

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Auxiliary Detectors Workshop
Washington Universtity
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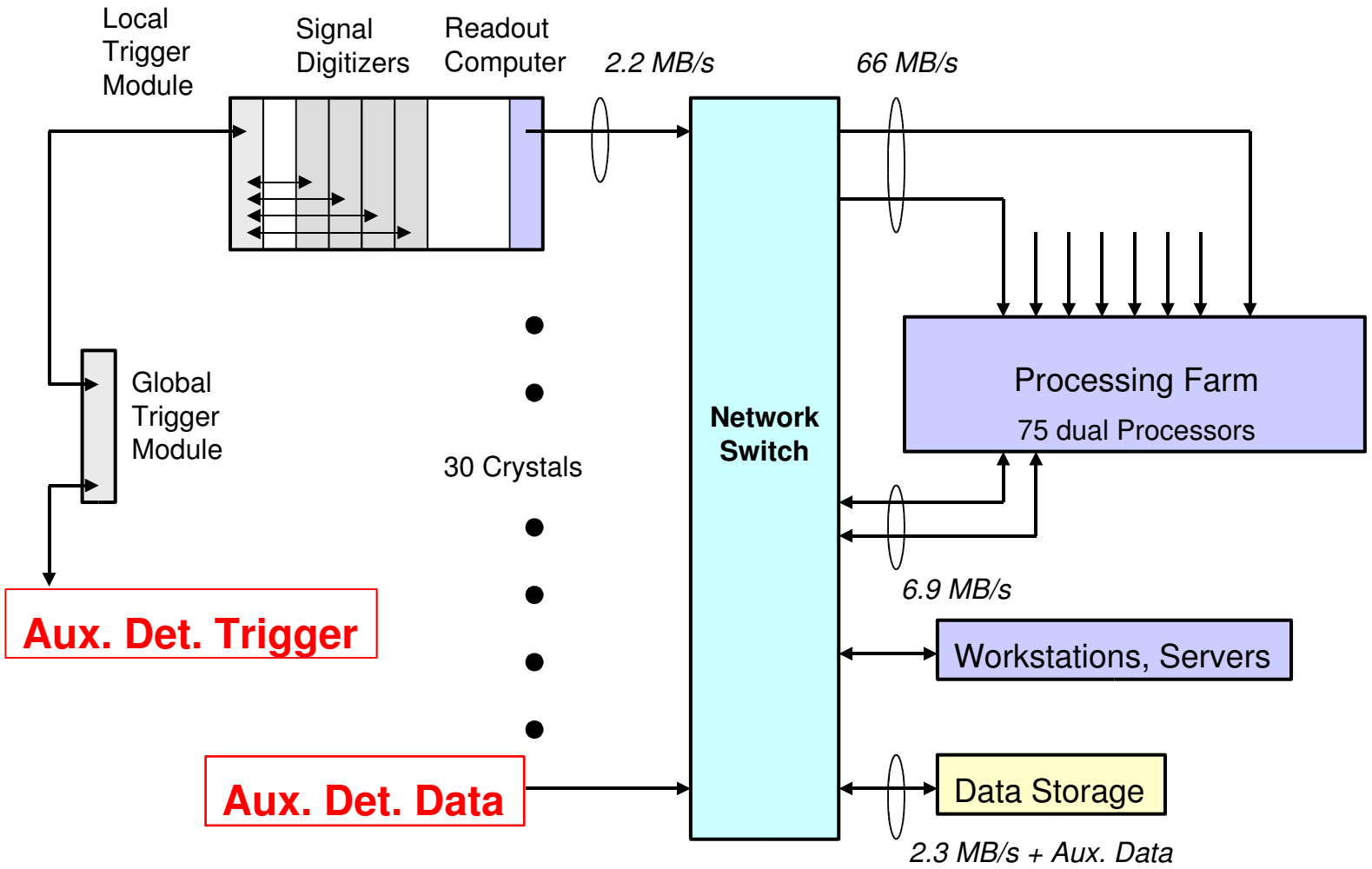
Outline

- The Plan from the point of view of GRETINA (Requirements document)
- The needs of the Aux Detector builders
- Can we arrange some way(s) to make the interface “easy”?

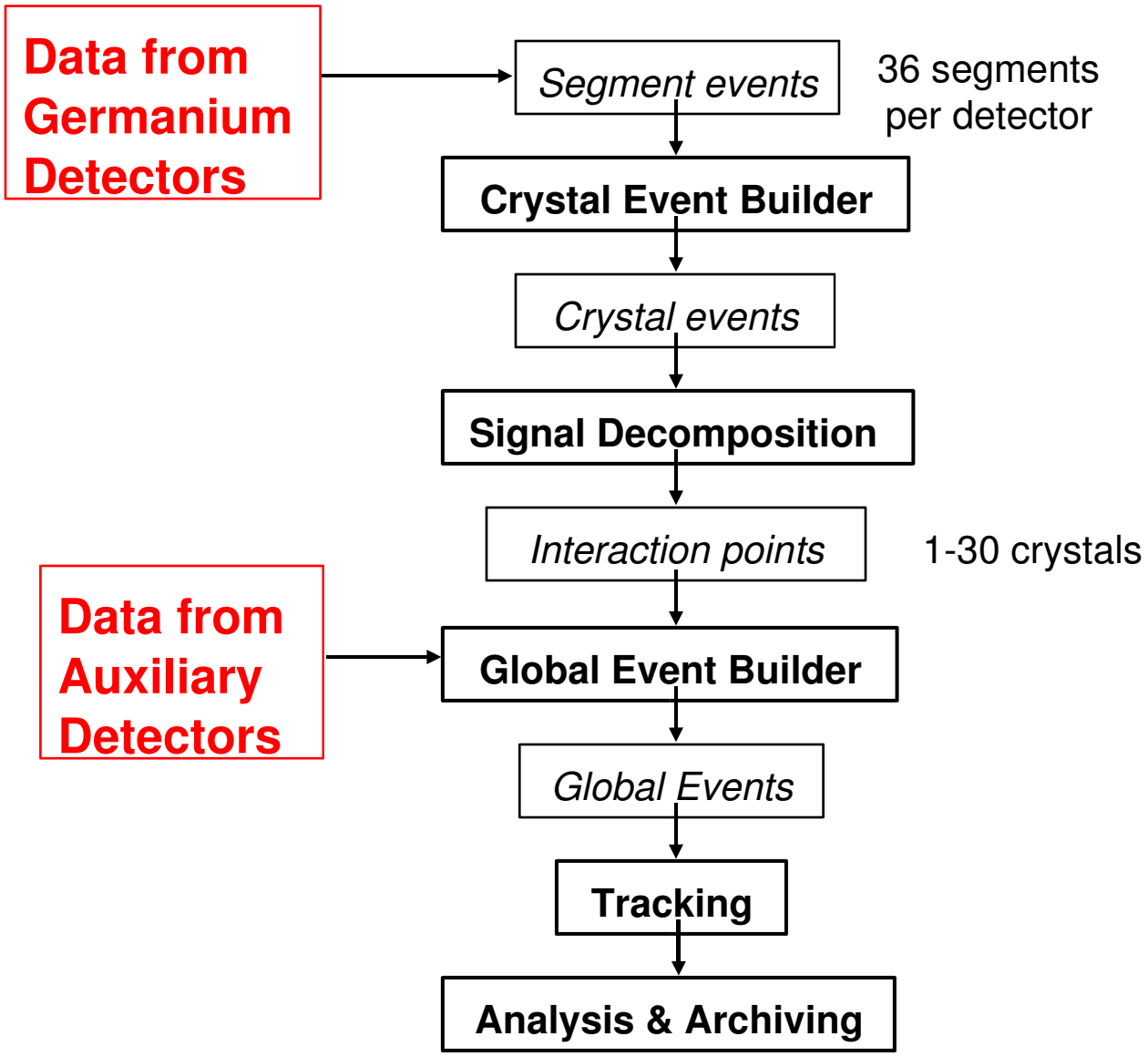
- Lots of overlap with following talks by Sergio and Mario

Data Acquisition system



Event Processing

Event Building Data Flow:



Data Merging

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Event building is done on the basis of timestamps.

In order to merge the two data streams, the Aux. Det. data must include the same timestamps as the Ge data.

- This is really the only constraint on the Aux. Det. data stream.
- Is there an easy way to implement it?

The Trigger

The Global Trigger Module will provide for 8 + 8 general purpose input + output lines for the aux. detectors.

The details of the implementation have not been finalized yet…

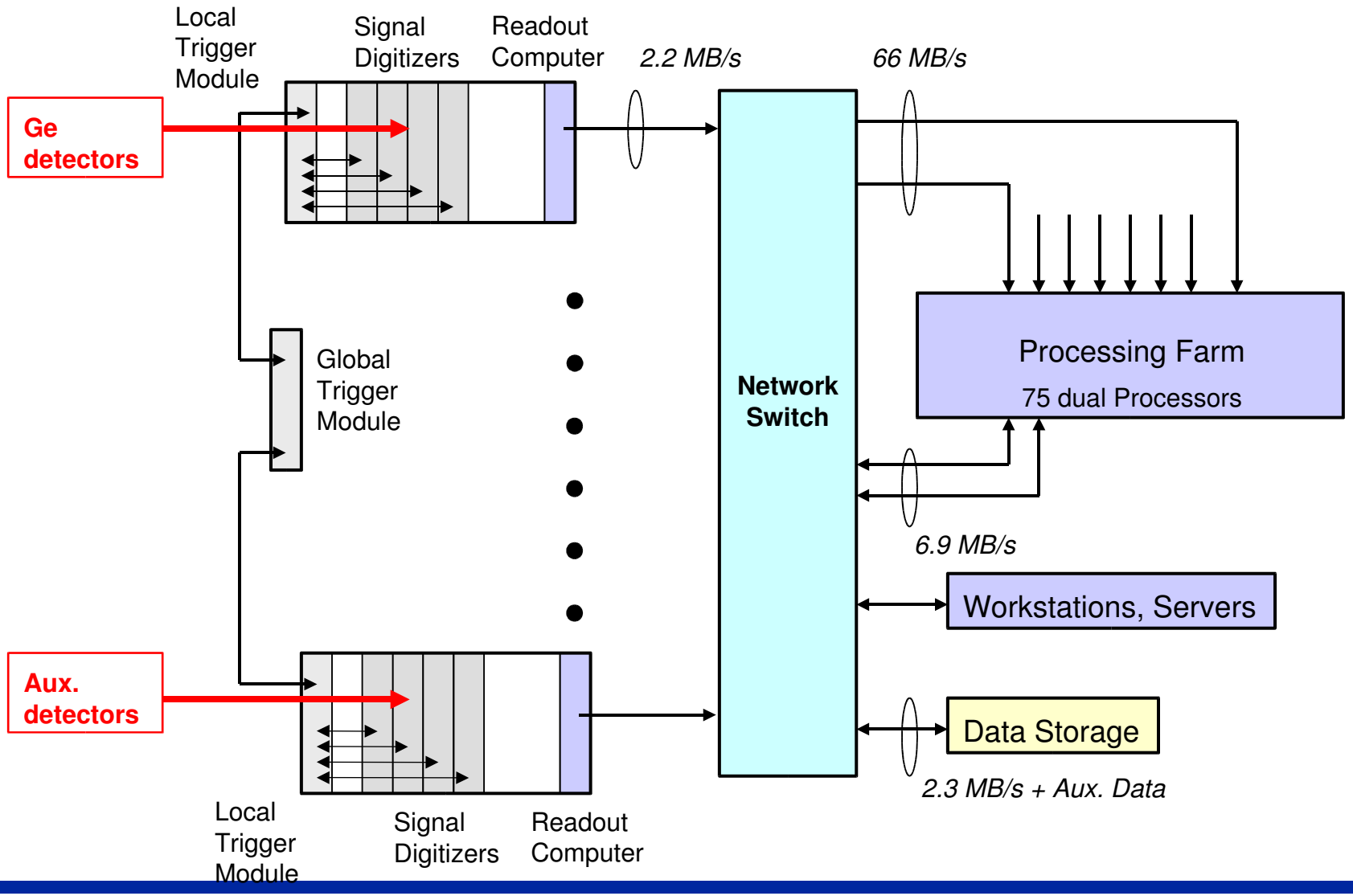
- Will it be synchronous or asynchronous (timestamps)?
- If asynchronous, how will the timestamps be made?
- How much *latency* will be allowed?

Easiest Solution?

One easy solution for both the data stream and the trigger is simply to **use the GRETINA digitizers** for your auxiliary detectors.

- Identical timestamps, clock synchronization
- Easy integration into the trigger system
- Don't (usually) have to worry about trigger latency
- Digital pulse processing is ideal for *e.g.* CsI, neutron detectors, *etc.* – anything requiring Pulse-Shape Analysis
- Flexible preprocessing: no need to read out waveforms

Data Acquisition system



Easiest Solution (cont'd)

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- Should we ask DOE for money for some number (~100-200?) channels of digitizer to be reserved for auxiliary detectors?

Next Easiest Solution?

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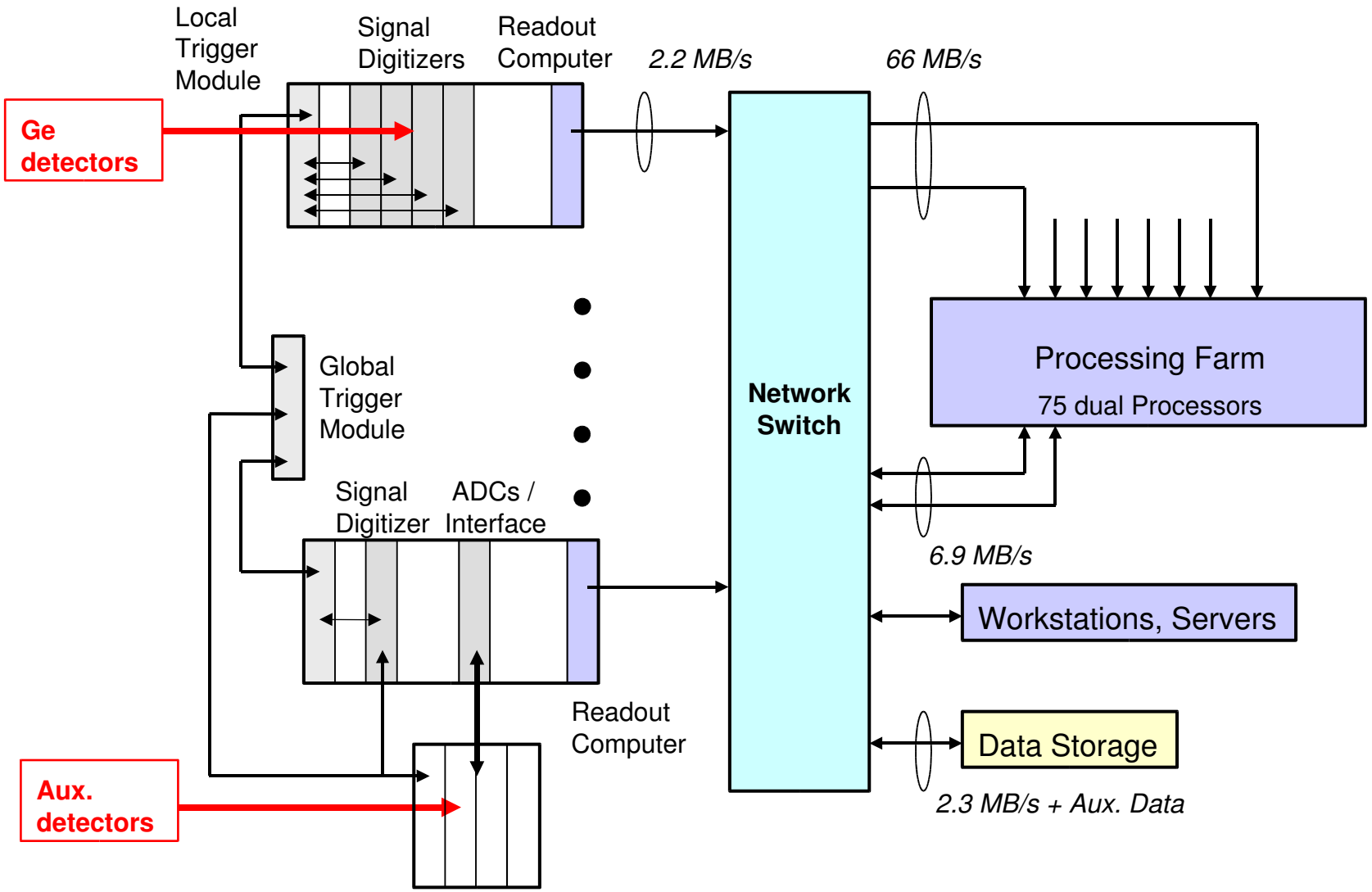
- Use at least one GRETINA digitizer, to digitize anything, even a logic signal
- Use VME ADCs / interfaces / bridges for remaining signals

- GRETINA digitizer provides timestamps, clock synchronization
- Trigger system not quite as easy; will need to generate gates and read-out triggers for the other modules
- Therefore we have to worry about trigger latency

Data Acquisition system



Next Easiest Solution (cont'd)

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- Could replace the GRETINA digitizer with a special timestamp / clock synchronization module

- Another option for high channel counts (Lee Sobotka et al.):

  Shaper + peak-detect-and-hold on each channel

  $\rightarrow$ time-slice-multiplex multiple channels

  $\rightarrow$ a single analog pulse train for multiple channels

  $\rightarrow$ digitize in a GRETINA digitizer channel

Trigger Latency?

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- GRETINA needs to know about the Aux Det event in order to decide on the master trigger
  - How much time do we have to provide that information?

- The Aux Det modules need gates and validation signals, generally provided by the master trigger
  - How quickly do we need that information?
  - *i.e.* How much time do we have to collect *all* the master trigger info, make a decision, and generate synchronous logic signals for gates?

Trigger Latency?

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- E.g.: Microball
  - Trigger info available *from* μBall at ~ 0.5 μs
  - First gates needed *for* μBall ADCs at ~ 0.8 μs

    Max. trigger latency
  - Could GRETINA meet this schedule?
  - What if it couldn't?
  - Alternative mode: "Fast Clear"; increases dead time significantly…

Readout Bandwidth

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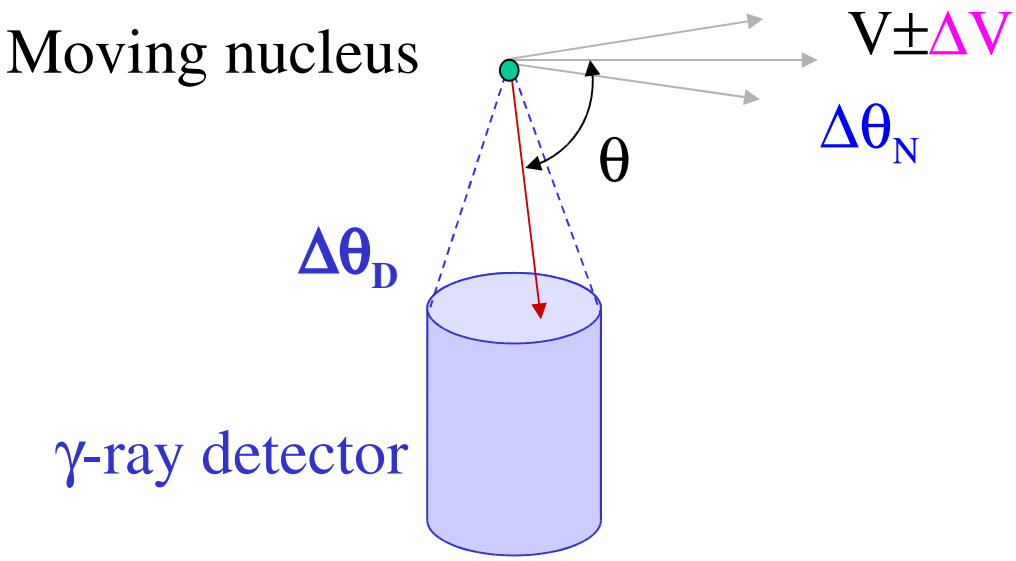
- VME 64x Bus Bandwidth
  - In principle ~ 160 MB/s
- Readout CPU to Farm
  - GigE ~ 120 MB/sec
- Readily achievable ~ 60 MB/s?
- High enough for all aux. detectors?

Two Important Types of AuxDet

- To help determine t_0 for the event
  - May be important for signal decomposition
  - Improve position resolution
  - E.g. BaF_2, LaCl
- To determine recoil direction, velocity
  - For Doppler correction
  - Energy resolution
  - Need $\leq$ 10 mrad

Doppler Broadening

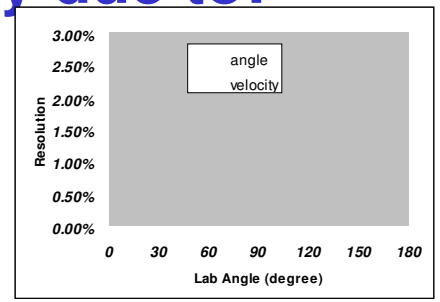


Doppler shift

$$E = E^{0}\frac{\sqrt{1-\frac{V^{2}}{c^{2}}}}{1-\frac{V}{c}\cos}$$

Broadening of detected gamma ray energy due to:

- Spread in speed ΔV
- Distribution in the direction of velocity $\Delta\theta_N$
- Detector opening angle $\Delta\theta_D$



➔**Need accurate determination of V and θ.**