

# Glowing backplanes

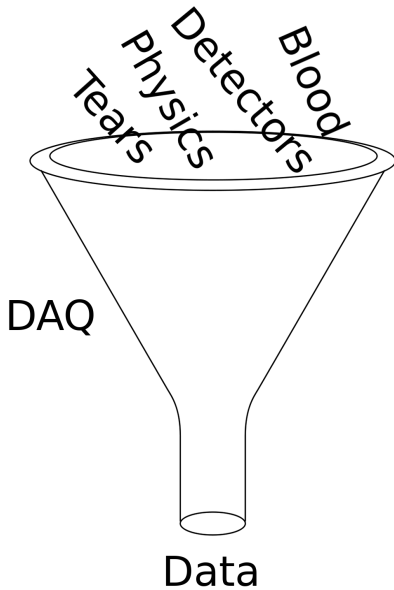
VME Readout at and Below the Conversion Time Limit

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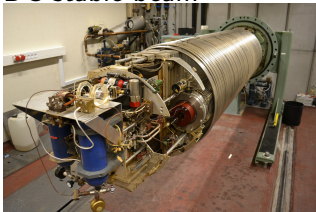
May 27<sup>th</sup> 2019, DFS2019

# Experiments

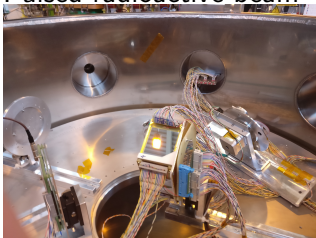


# The physics

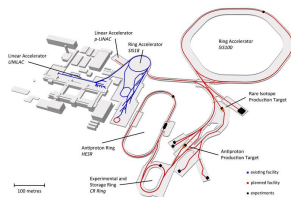
Van de Graaf @ AU  
DC stable beam



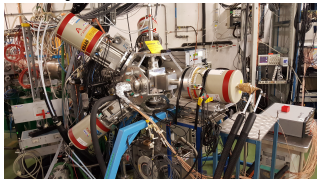
SEC @ HIE-ISOLDE, CERN  
Pulsed radioactive beam



R3B @ GSI  
Relativistic radioactive beam



IDS @ ISOLDE, CERN  
Decay studies



Truth

More (good) data  
=  
easier (better) analysis

### Man power

MAGISOL  $\sim$  20 people

ATLAS  $\sim$  3000 (scientific) people

### Money

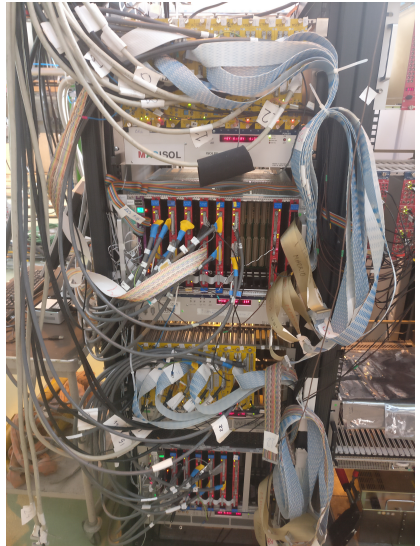
MAGISOL  $\sim$  0.5 MCHF

ATLAS  $\sim$  500 MCHF

## Solution?

Modular electronics.

Detector → Preamp →  
Amp → ADC → PC





VME

## Challenge

More (good) data

=

easier (better) analysis



*Push the modules*



# Digitization time

CAEN v785 ~ **7us**

Mesytec MADC32 ~ **2us**

# Readout time

Motorolla MVME ~ **1.3us/word**

Mesytec MADC32 ~ **0.5us/word**

Readout time  $\gg$  digitization time

# Bottleneck II

Trigger requests

Single-event readout

Multi-event readout

Shadowed multi-event readout



Gate + Conversion



DAQ overhead, synchronization check



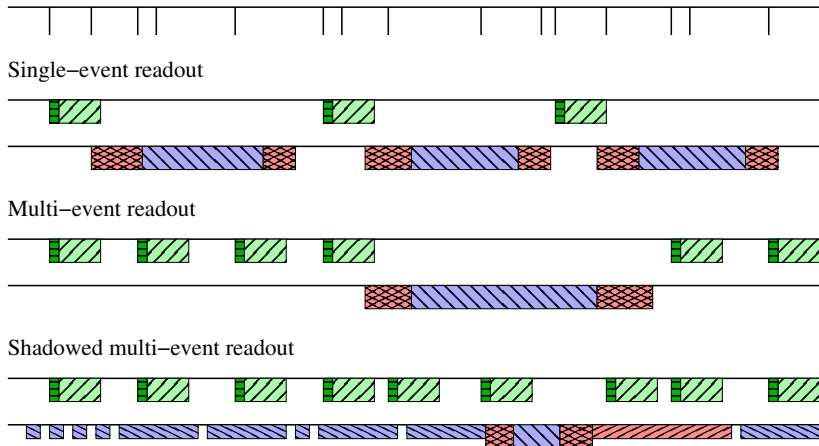
DAQ read-out



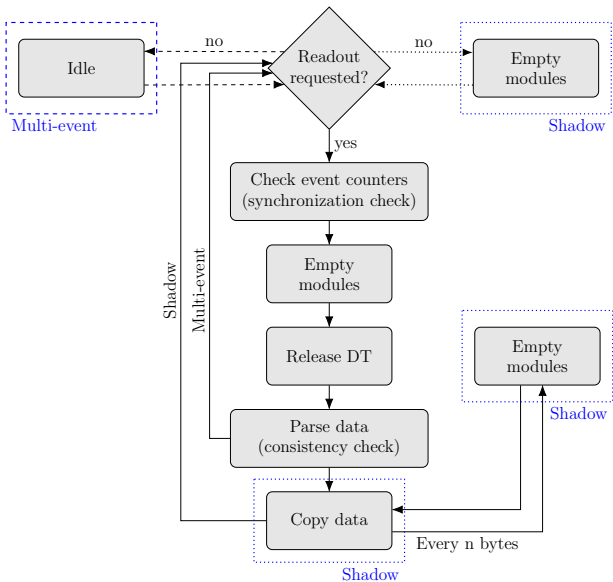
(after deadtime release)



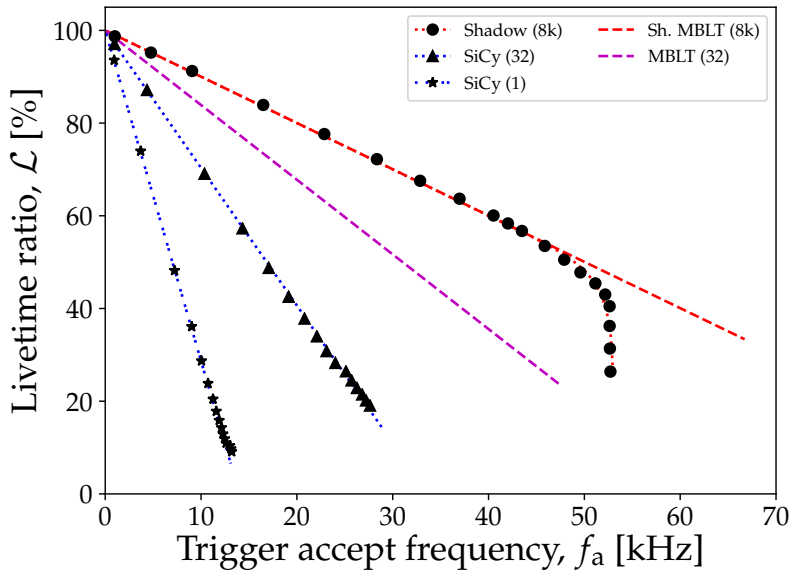
(shadowed, background)



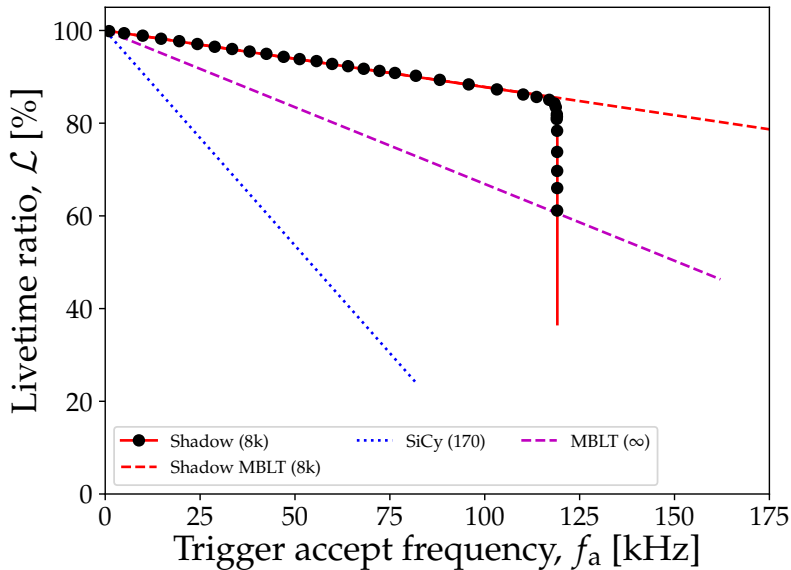
# Software



# Benchmark CAEN v785



# Benchmark Mesytec MADC32



## Conclusion

Optimized readout software



More than factor 2 throughput.

Details → IEEE TNS, Vol. 66, 2019, pp. 575-584  
arXiv:1810.03574

# Nomenclature

- ▶ Livetime, LT : Time where triggers are accepted
- ▶ Deadtime, DT,  $\Delta t$  : Time where triggers are *not* accepted
- ▶ Livetime fraction,  $\mathcal{L}$  : Fraction of events accepted
- ▶ Deadtime fraction,  $\mathcal{D}$  : Fraction of events rejected
- ▶ Trigger request frequency,  $f_r$  : Frequency of total triggers
- ▶ Trigger accept frequency,  $f_a$  : Frequency of accepted triggers

$$\mathcal{D} + \mathcal{L} = 1$$

$$\mathcal{L} = \frac{1}{1 + f_r \Delta t}$$