S160 FRS Developments for APPA and NUSTAR experiments
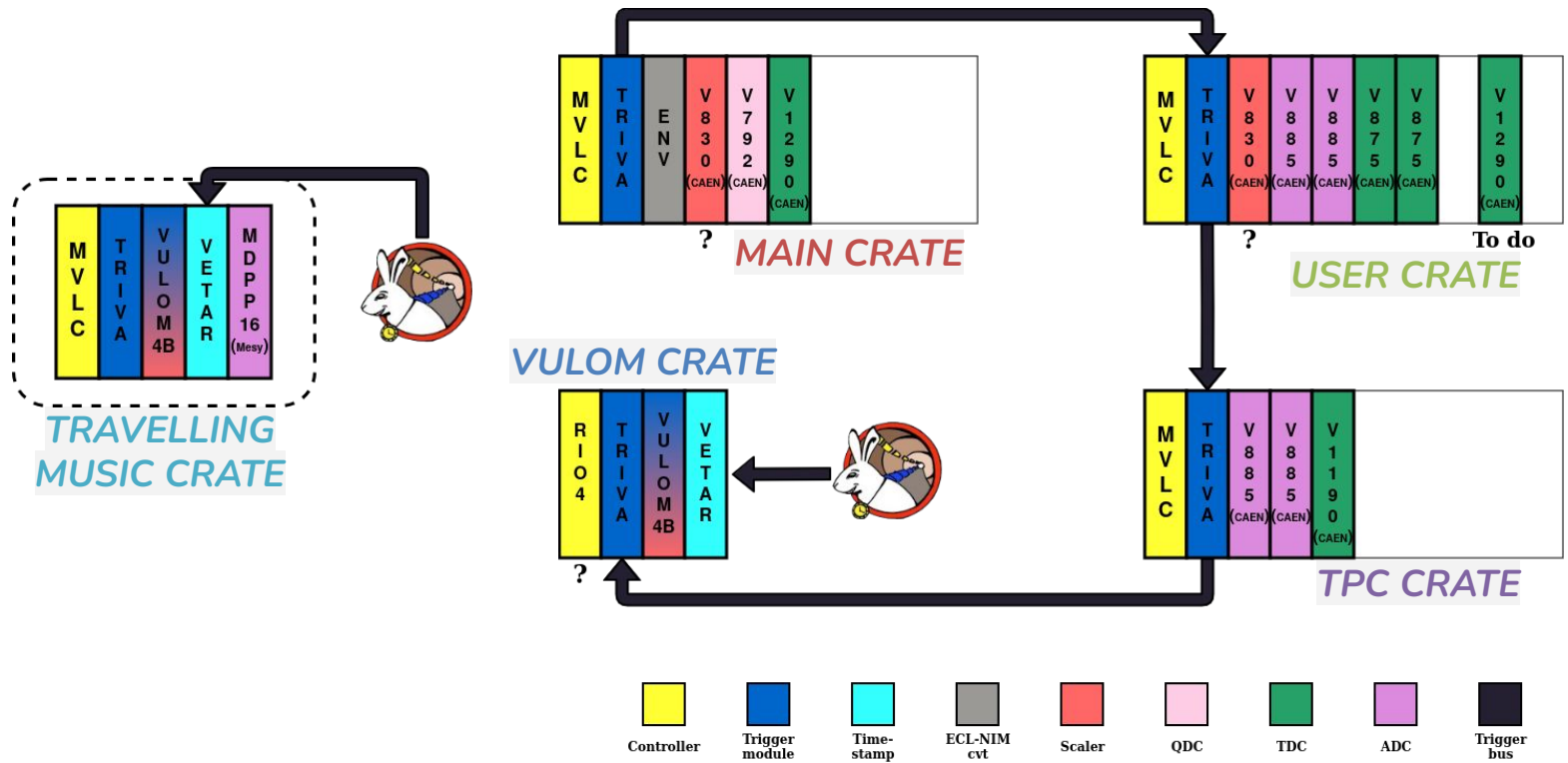
Martin Bajzek

Walldorf, October 31th, 2024

DAQ setup in S160

- Four VME crate system MBS
  - All crates in Messhütte
- Objective: precise benchmarking of DAQ performance (max rate, efficiency)
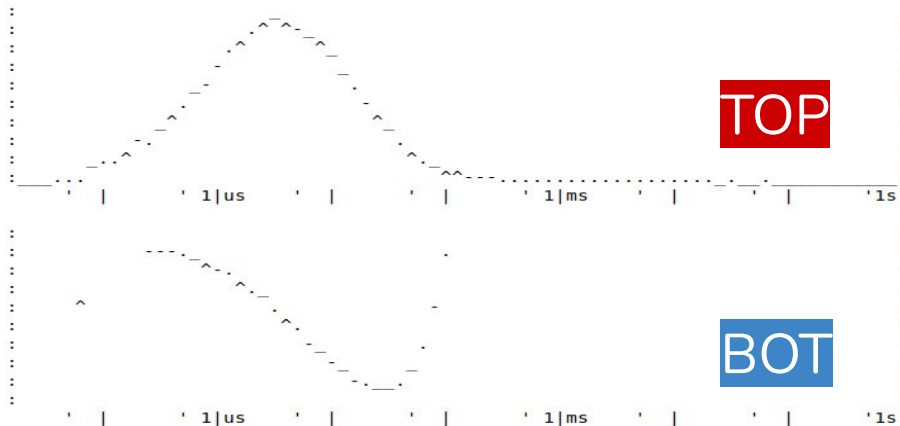
FRS microspill structure

- Top drawing : Δt between two consecutive SCI 21L hits (log - log)
- Bottom drawing : ratio between measured and true Poisson distribution (log-log)
  - A true Poisson distribution would be flat
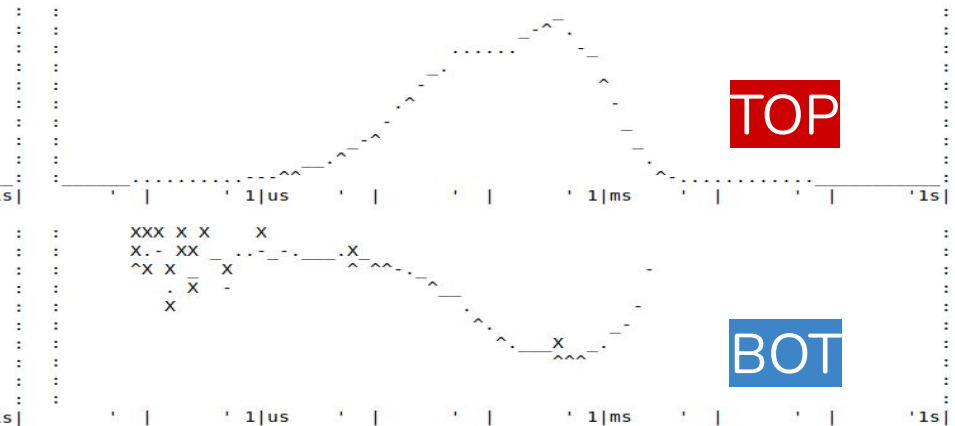
Measured during S160 SEC experiment in May, 2024

DAQ test results from S160 (I)

- ^{100}Mo particle rate: **250k/spill**, 2s spill duration

Free Trigger increment vs time-diff of consecutive readouts (us)

Free Trg Raw	
Entries	78968
Mean x	74.04
Mean y	6.279
Std Dev x	69.64
Std Dev y	4.681
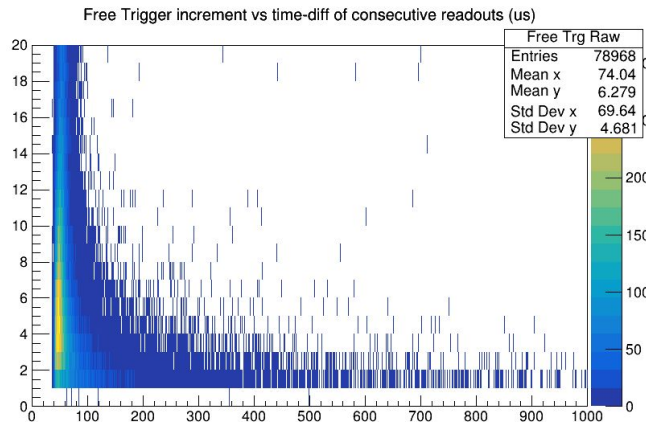
Top figure*: Multiple trigger requests (avg. 6.3)*
come for an accepted trigger

Time diff between consecutive readouts (us)
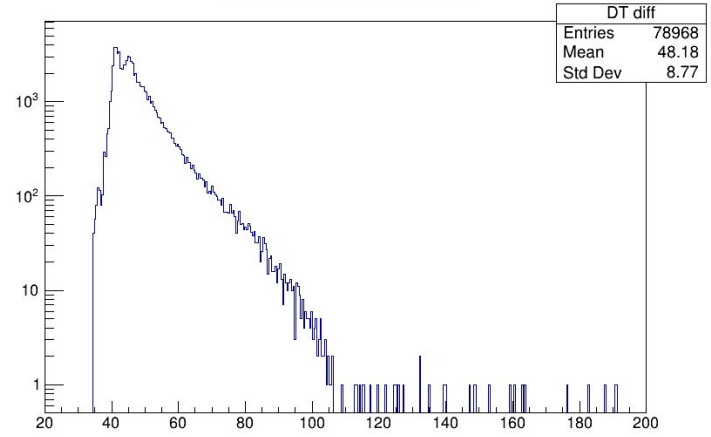
Time diff	
Entries	78968
Mean	73.88
Std Dev	71.22

blue: measured by Whiterabbit,
red: measured by a 1 MHz clock

Deadtime measured (us)

DT diff	
Entries	78968
Mean	48.18
Std Dev	8.77

Mean DAQ deadtime: 48 us

Microspill structure

Hits: 472423   Lost: 1048   Cut: 77 = 0.501 s   Total_t: 3.874 s   Rate: 121679.4 /s
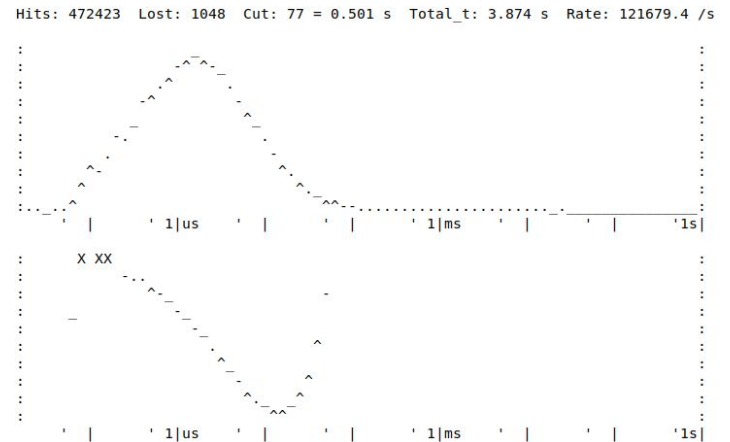
DAQ test results from S160 (II)

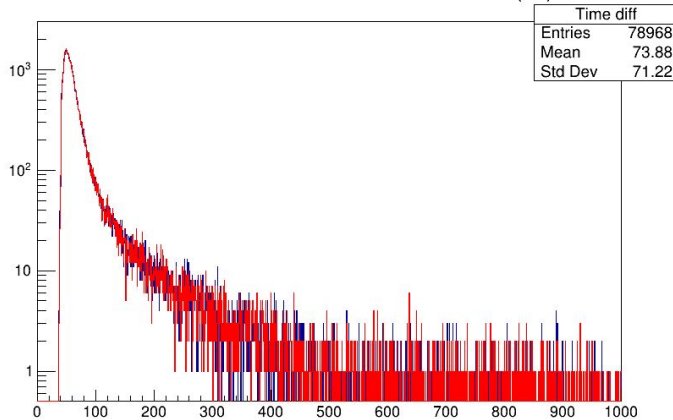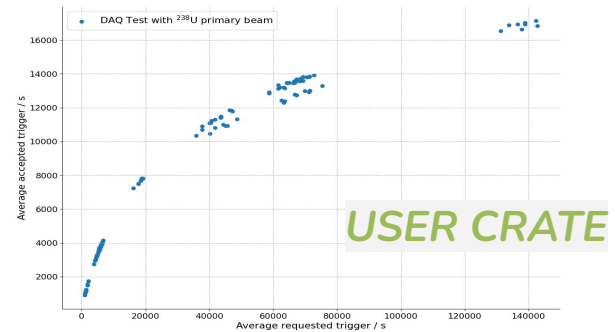- ^{100}Mo particle rate: **140k/spill**, 2s spill duration

Free Trigger increment vs time-diff of consecutive readouts (us)

Free Trg Raw	
Entries	343967
Mean x	77.67
Mean y	5.329
Std Dev x	74.34
Std Dev y	4.21

Deadtime measured (us)

DT diff	
Entries	343967
Mean	46.06
Std Dev	6.687

Mean DAQ deadtime: 46 us

Time diff between consecutive readouts (us)

Time diff	
Entries	343967
Mean	78.34
Std Dev	79.61

Hits: 583124   Lost: 866   Cut: 77 = 0.501 s   Total_t: 9.084 s   Rate: 64100.2 /s
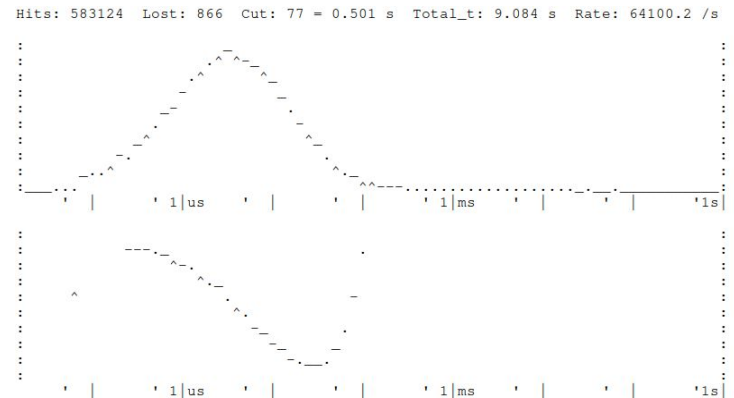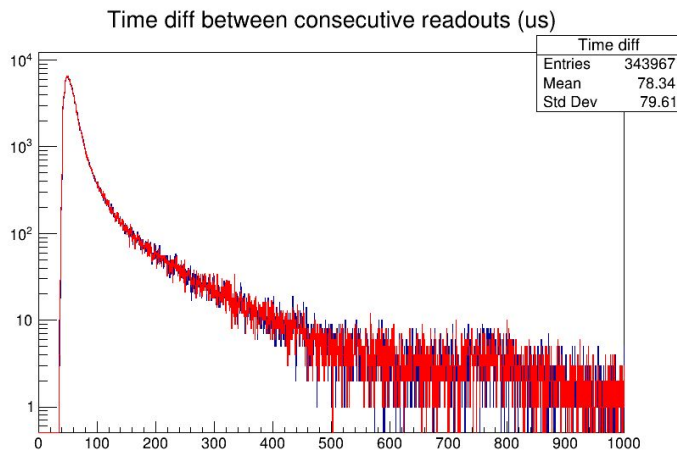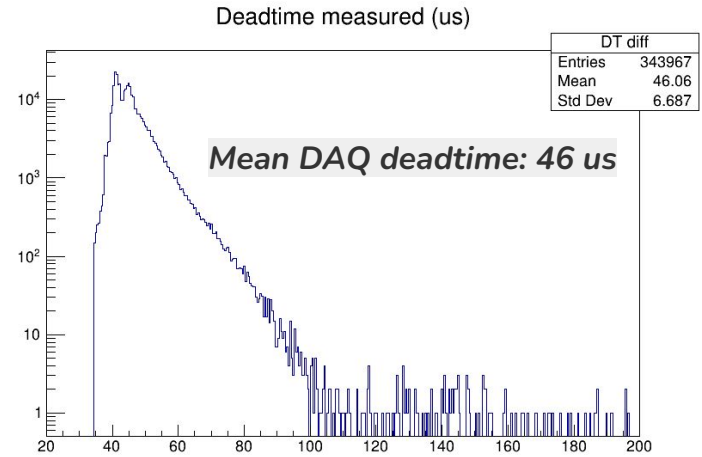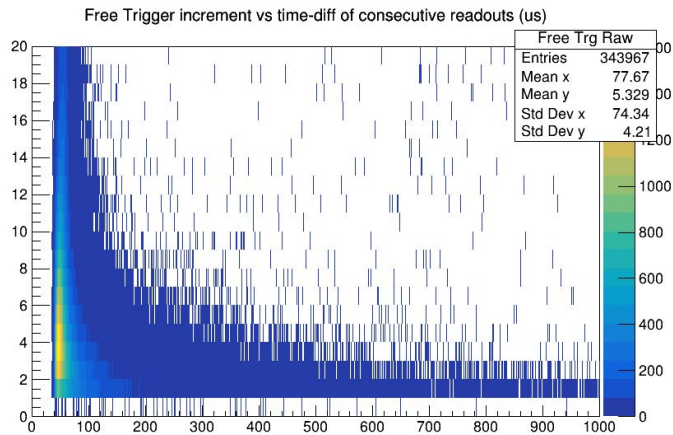
- A *point* is a measurement of **one spill**.
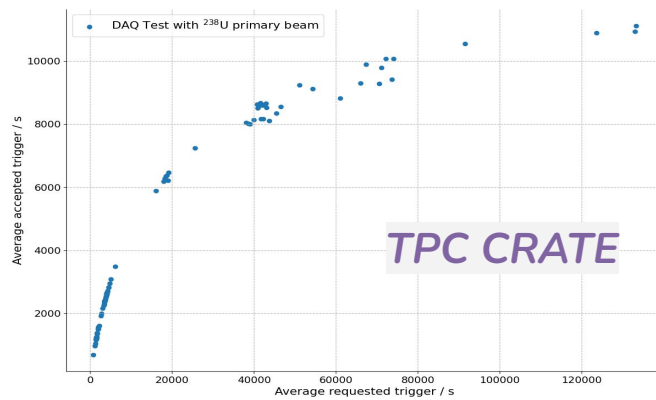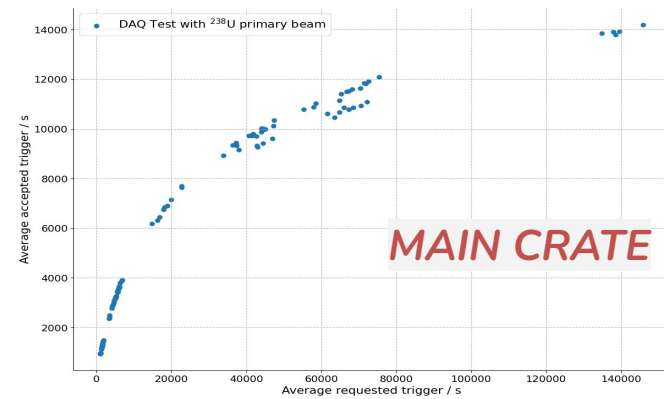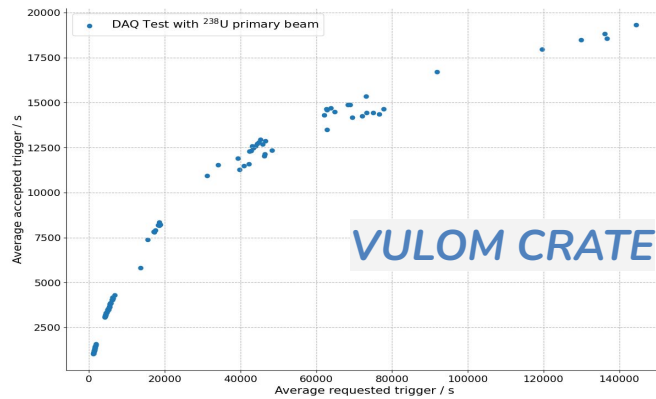
DAQ test results from S160 (IV)

Conclusion

FRS
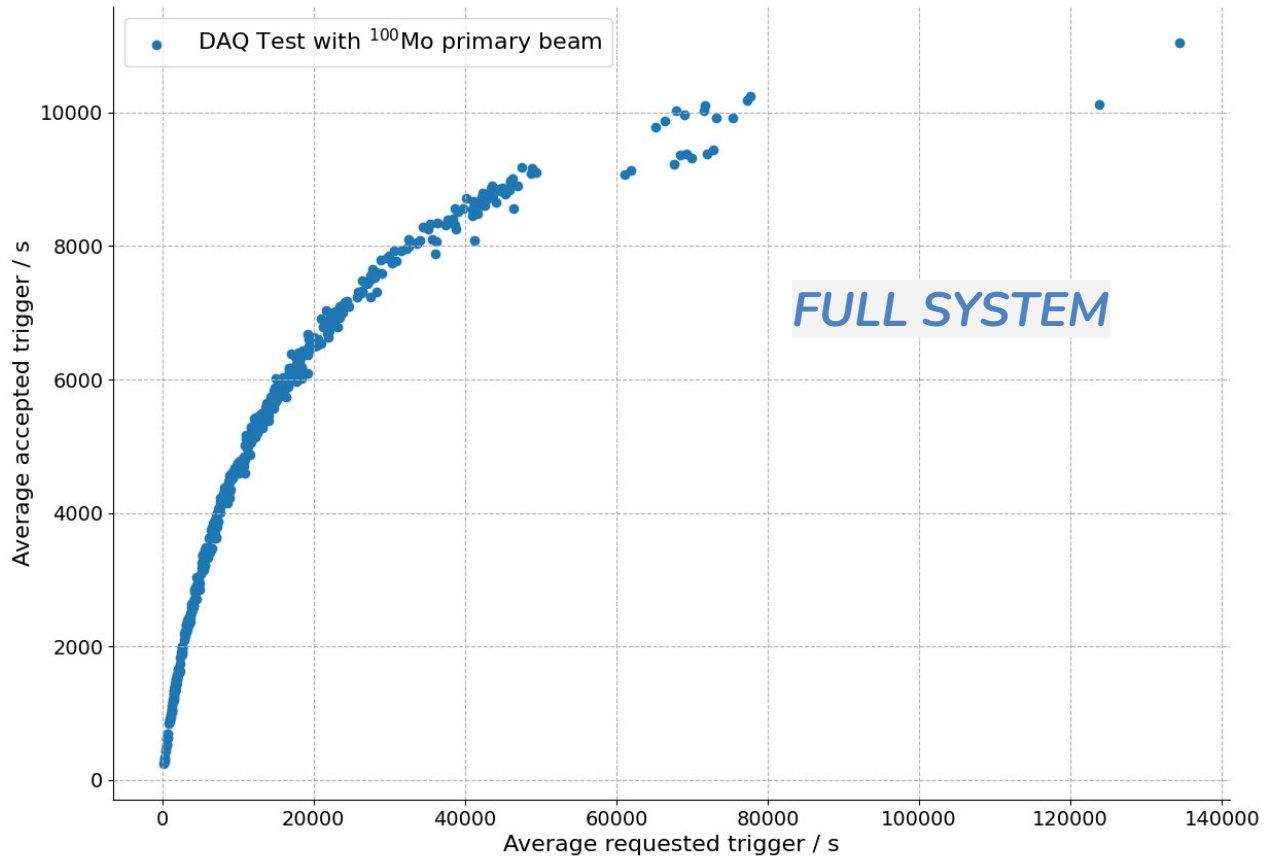
- DAQ deadtime <50 us (max rate above 20kHz)
    - Depends on multi-hit TDC payload

To do

- Optimizing conversion times
    - Can go down to 6-8 us from 10-18 us.
    - If too low, multihit TDC data can be segmented
- Consistent and more detailed measurements of microspill structure

Thanks to all the collaborators

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GSI Experiment Electronics

Yoshiki Tanaka, Stephane Pietri, Emma Haettner, Christine Hornung, Jianwei Zhao, Nic Hubbard

Super-FRS Experiment Collaboration

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