

SSD online calibration

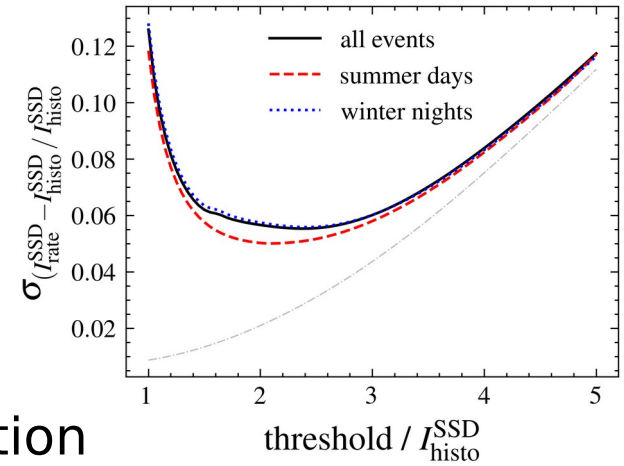
Paul Filip*, David Schmidt, Ricardo Sato

Outline

- Review + Motivation
- MuonAcquisition in Malargue
 - Sanity checks on data
 - WCD independent calib.
- Summary and outlook

Motivation + Review

- Require SSD online calibration for Phase II
- Enable monitoring + triggering on scintillators
- Propose rate-based algorithm for SSD online calibration
- First results on expected performances in [GAP2024-023](#)
 - Build algorithm from rate/threshold-relationship in muon histos
 - Bias resolution on online MIP peak of $\sim 6\%$ for **all** SD-1500 stations
- **But!** Muon histos acquired from triggers in WCD
 - Only have fraction of data measured by SSD (coincidences with WCD)
 - Hidden problems from adopting WCD systematics/calibration?

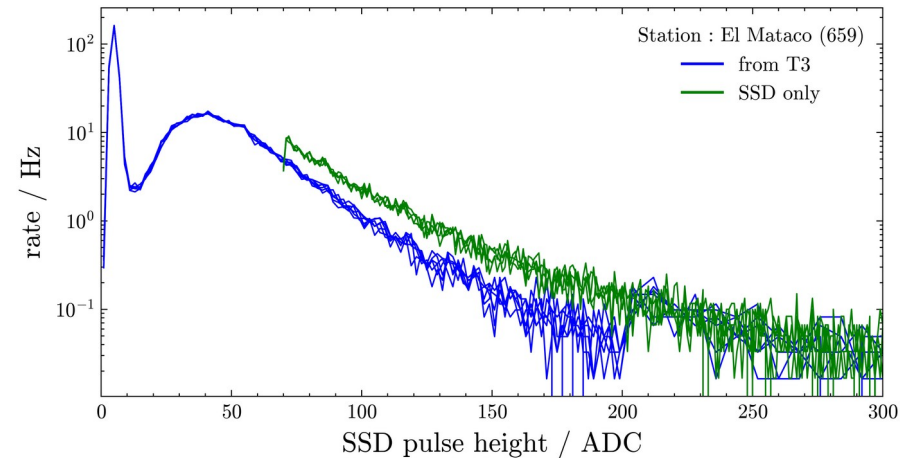


WCD independent online calibration of the SSD

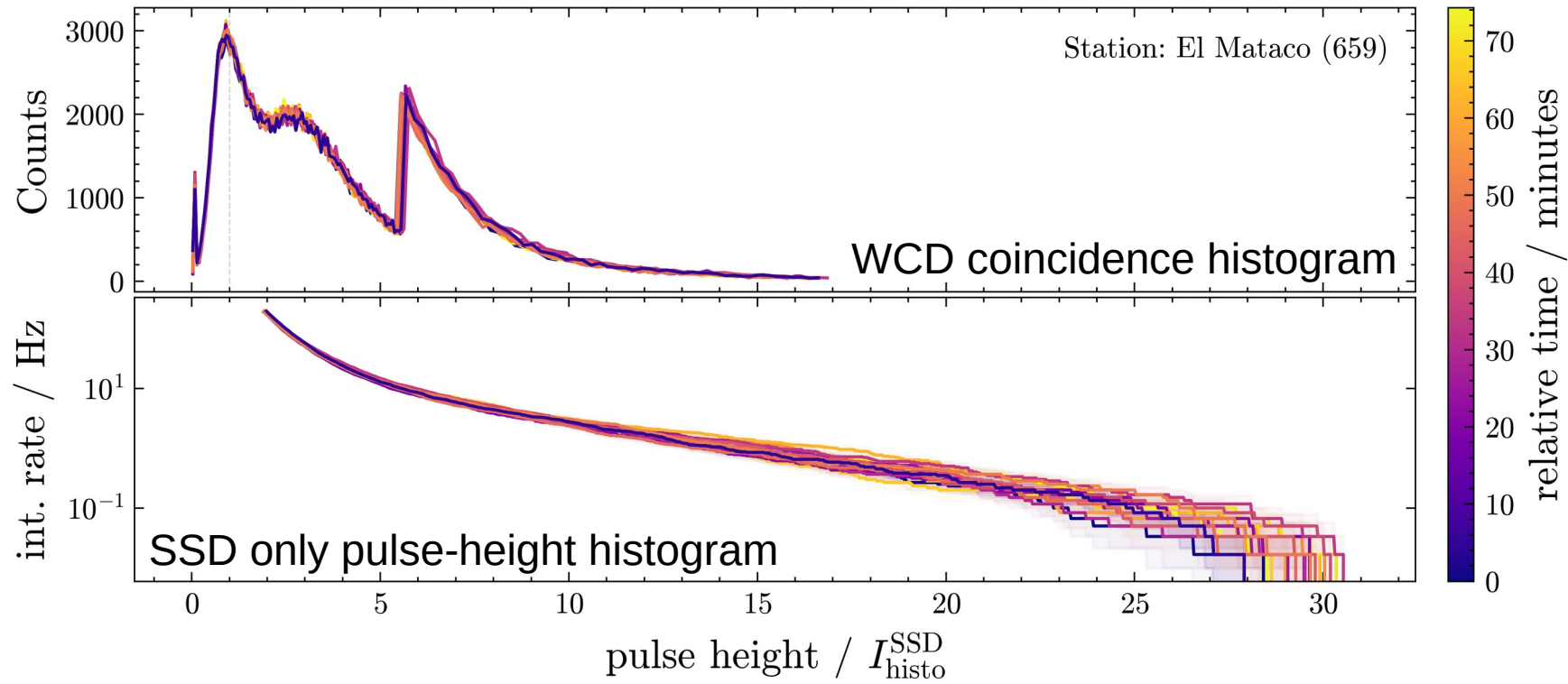
- Different detectors! MIP peak shouldn't rely on WCD
 - Calibration events currently selected from triggers in WCD
 - Headaches from dealing with masked WCD PMTs?
- MIP peak more variable than VEM peak
 - SSD more sensitive to EM component
 - Fluctuations too large to allow reliable calibration?
 - Only option to rely on WCD calibration?

MuonAcquisition in Malargue

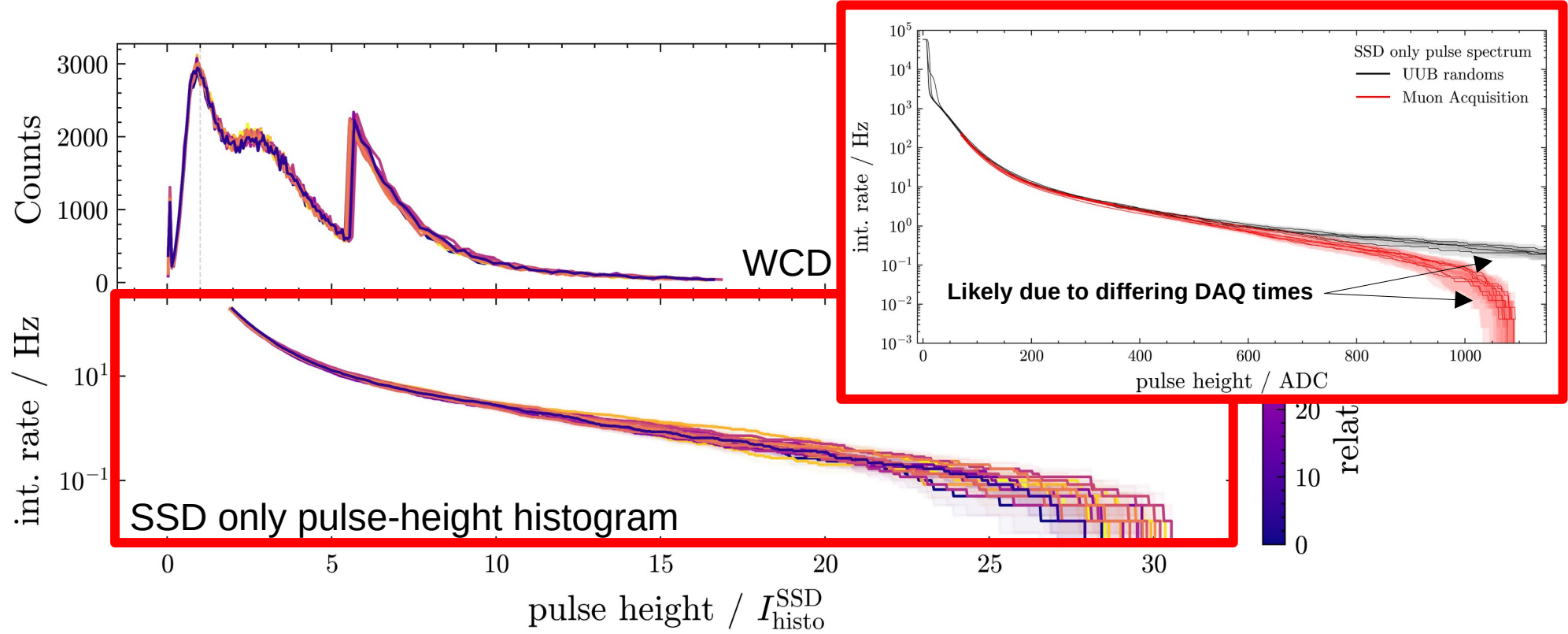
- Connect 8 Infill stations to separate CDAS instance
- Raise some standard muon histograms via forced T3
- Run special program on individual stations
 - Enable 2nd trigger mode (SSD only) on FPGA
 - Read out **muon histogram**
 - Save **SSD pulse-heights**
- Use **SSD only pulse-height histogram** for rate/threshold relationship and online MIP



Sanity checks on measured data

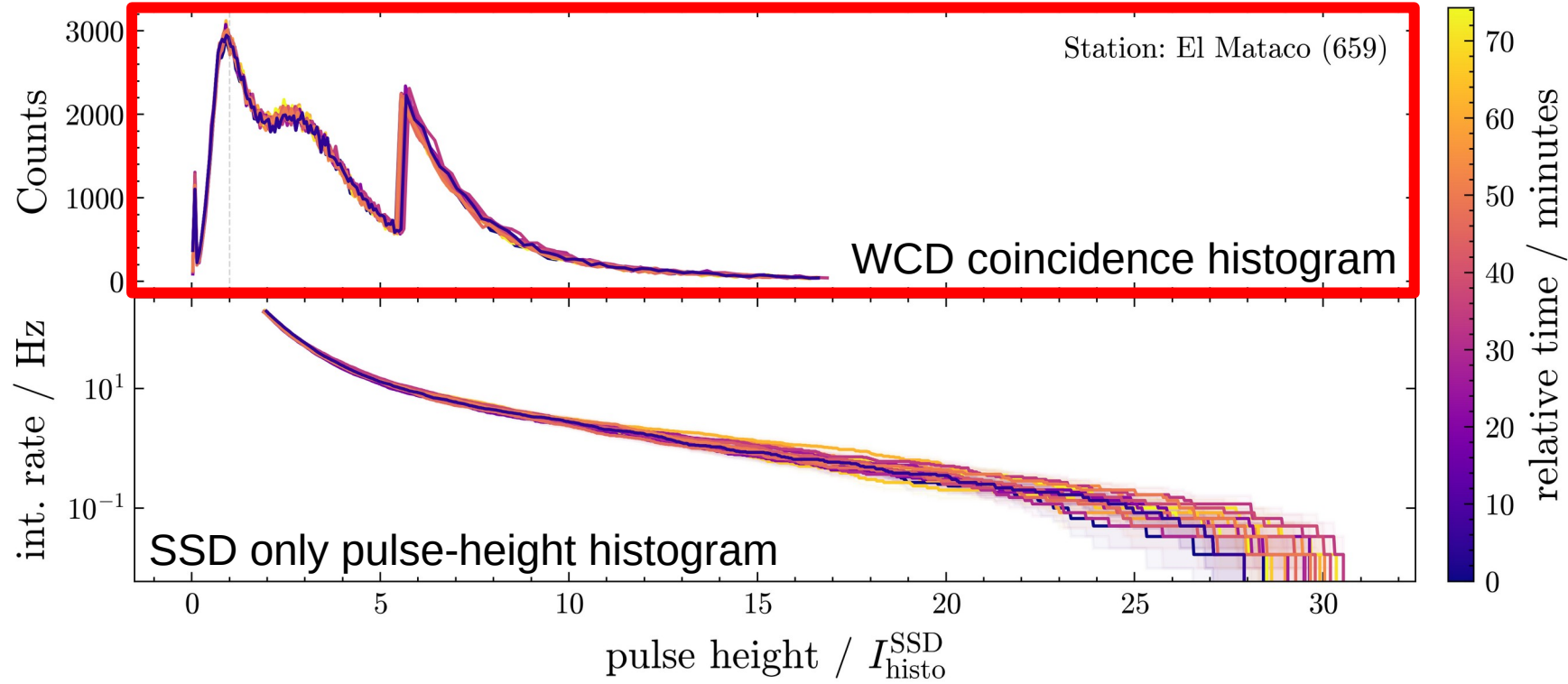


Sanity checks on measured data



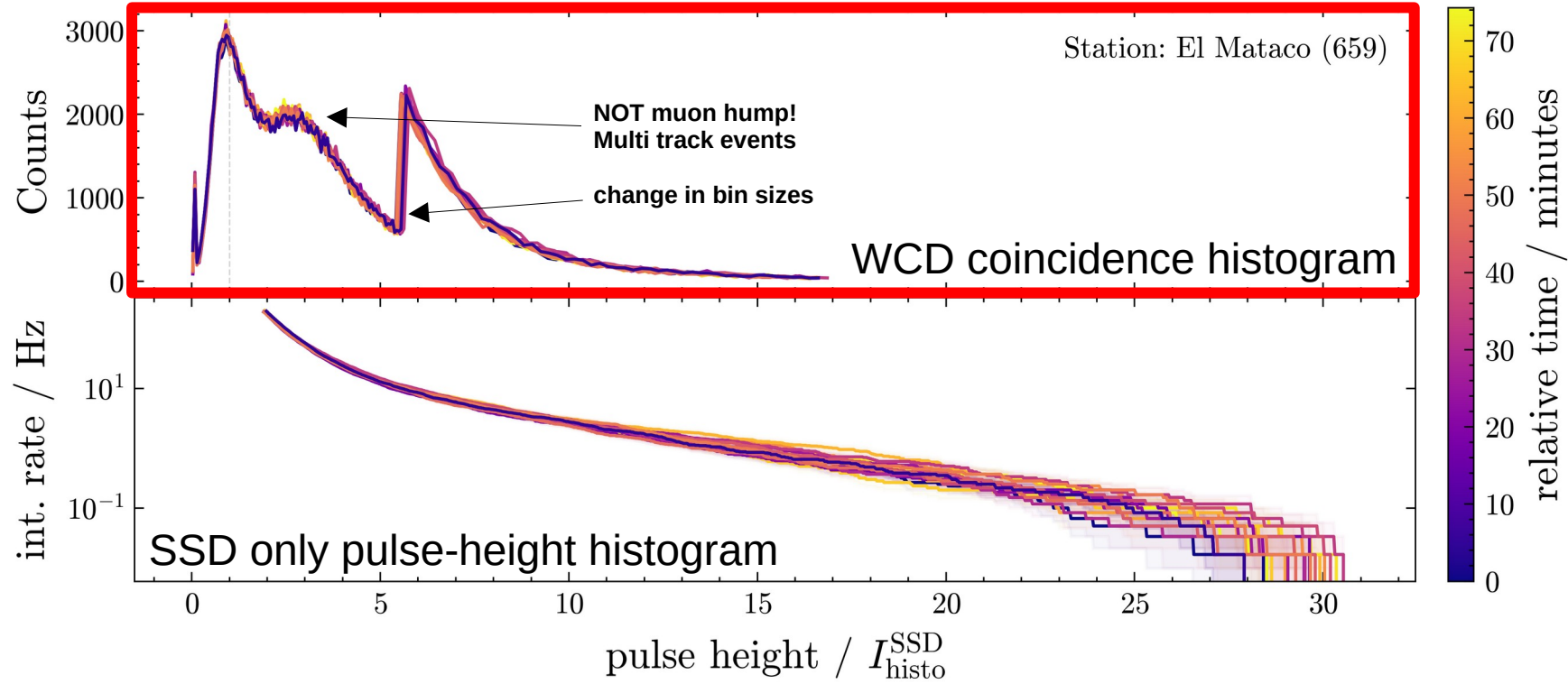
- SSD only histograms look as expected from UUB randoms

Sanity checks on measured data



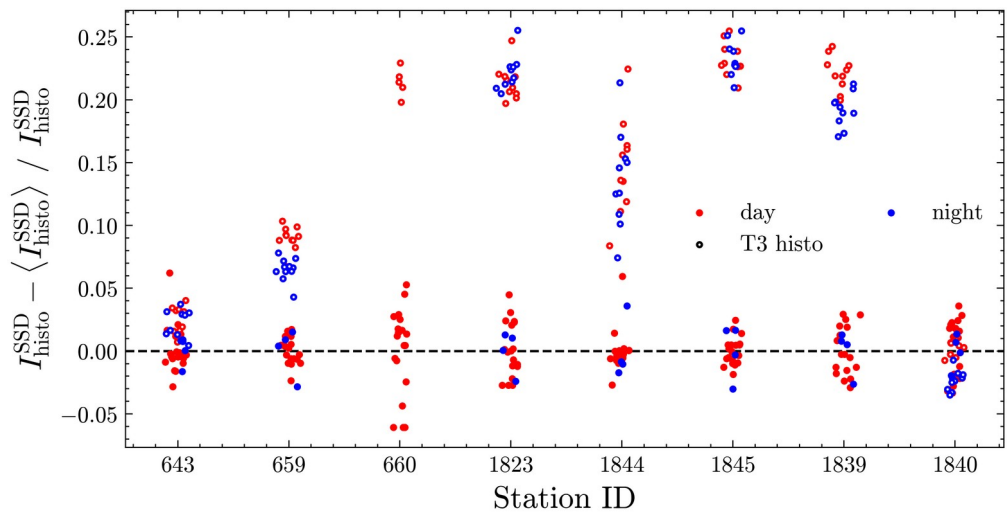
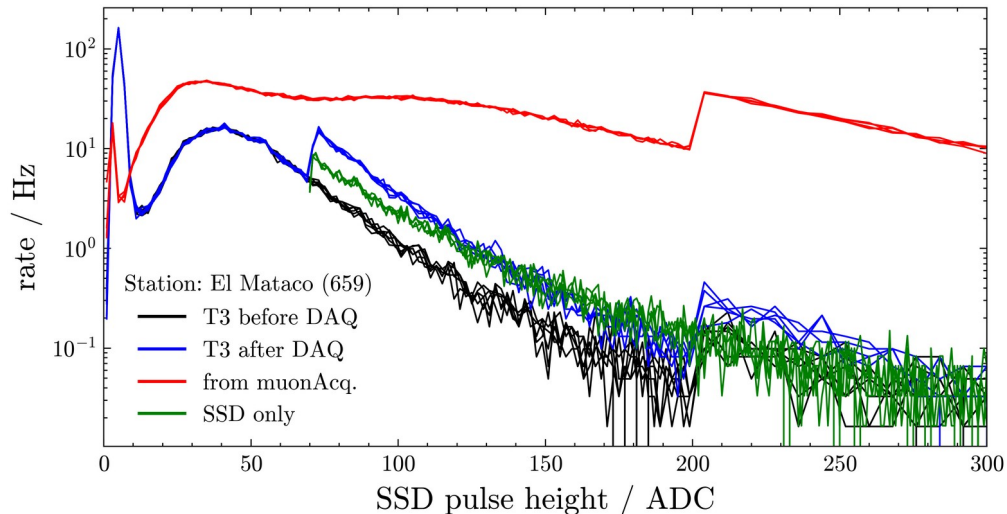
- WCD coincidence histogram differ from T3 histograms

Sanity checks on measured data



- WCD coincidence histogram differ from T3 histograms

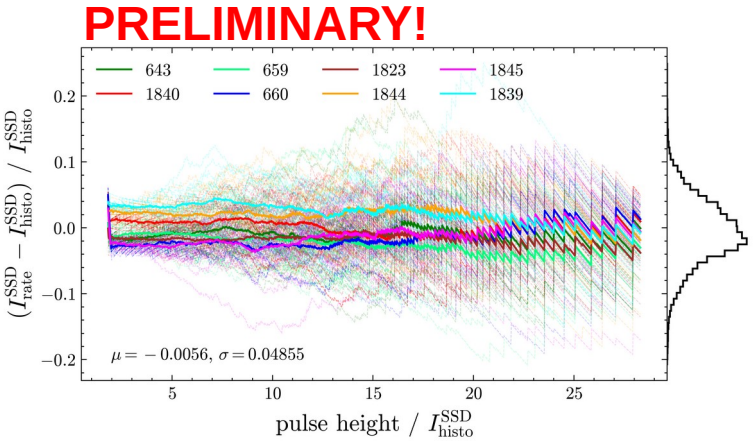
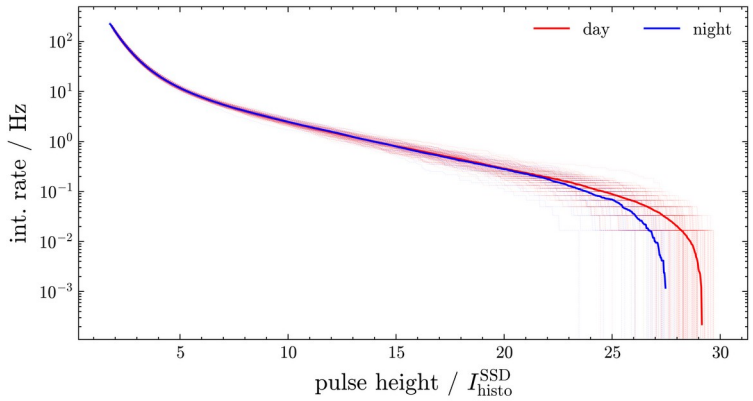
Sanity checks on measured data



- Significant difference between histograms from **muonAcquisition** and T3s **before/after** DAQ
 - Station dependent bias of location of MIP peak?
 - Ongoing investigation of what went wrong

WCD independent online MIP

- Little variation between day/night
 - Lower counts at high pulse-heights expected for lower temperatures
- Use relationship to estimate MIP
 - Unbiased estimator by definition
 - Very good resolution ($\sim 5\%$)
 - Aliasing effects at very high pulse-heights, no trustworthy resolution
 - Resolution below 5 MIP @ $\sim 2\%$



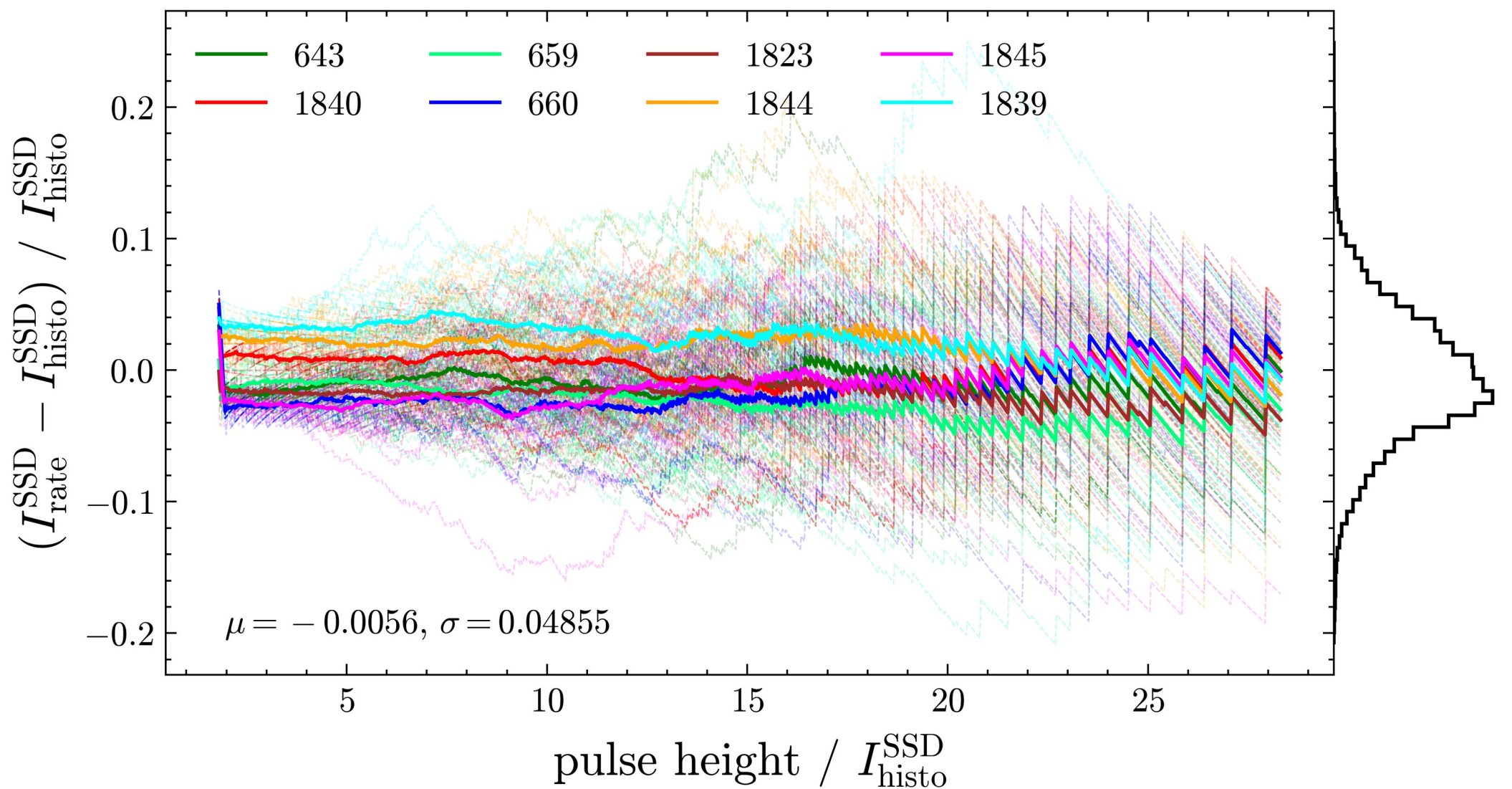
Summary

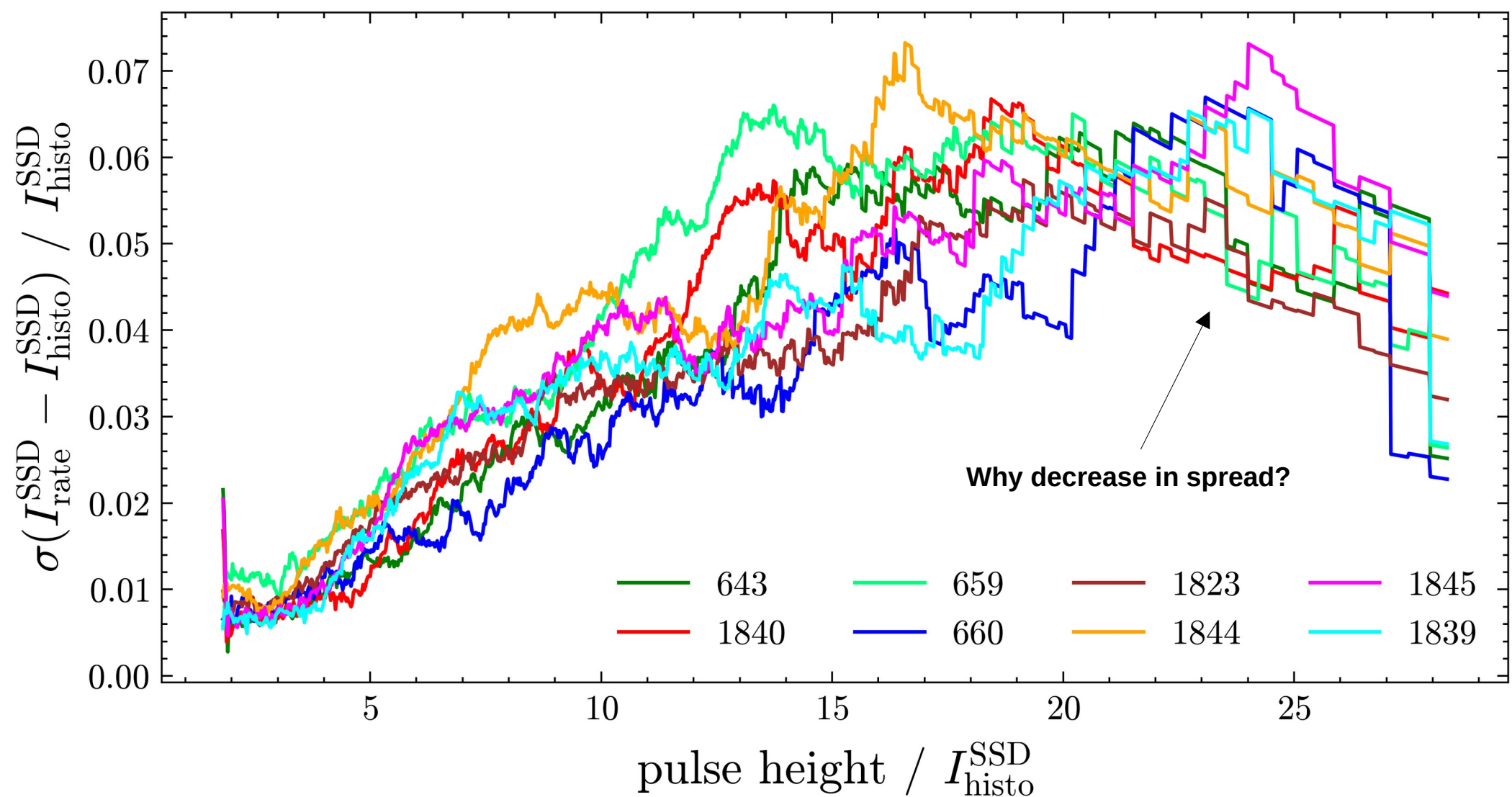
- Desire to decouple online calibration algorithms
 - Status now: everything relies on WCD triggers
 - Change in UUB DAQ software required
- WCD independent rate-based SSD calibration seems possible
 - Field tests show performances on par with WCD calibration
 - Bias resolution of $<5\%$ observed for selection of infill stations
 - Some phenomena not yet fully understood. Need further tests!

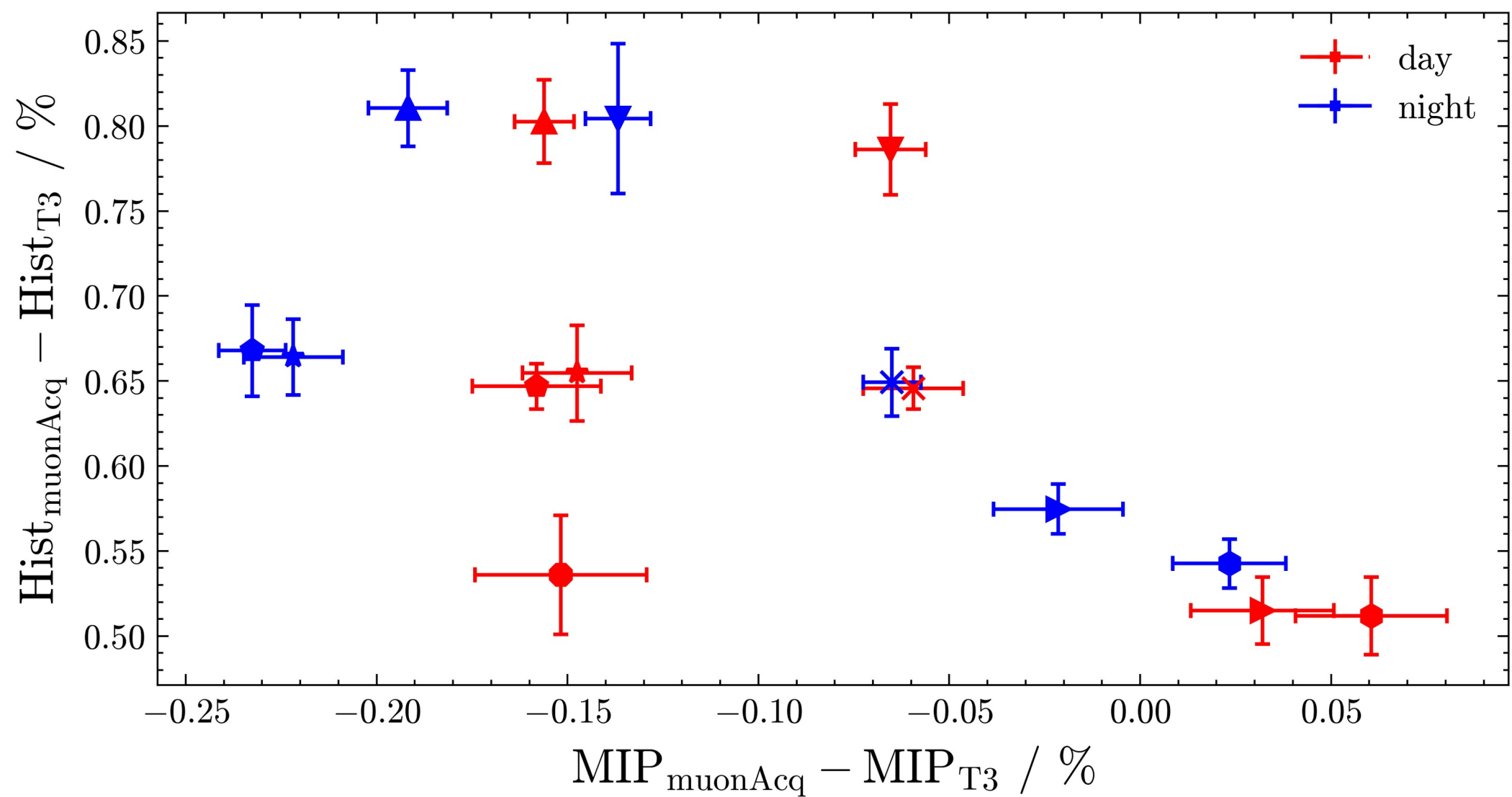
Outlook + Roadmap

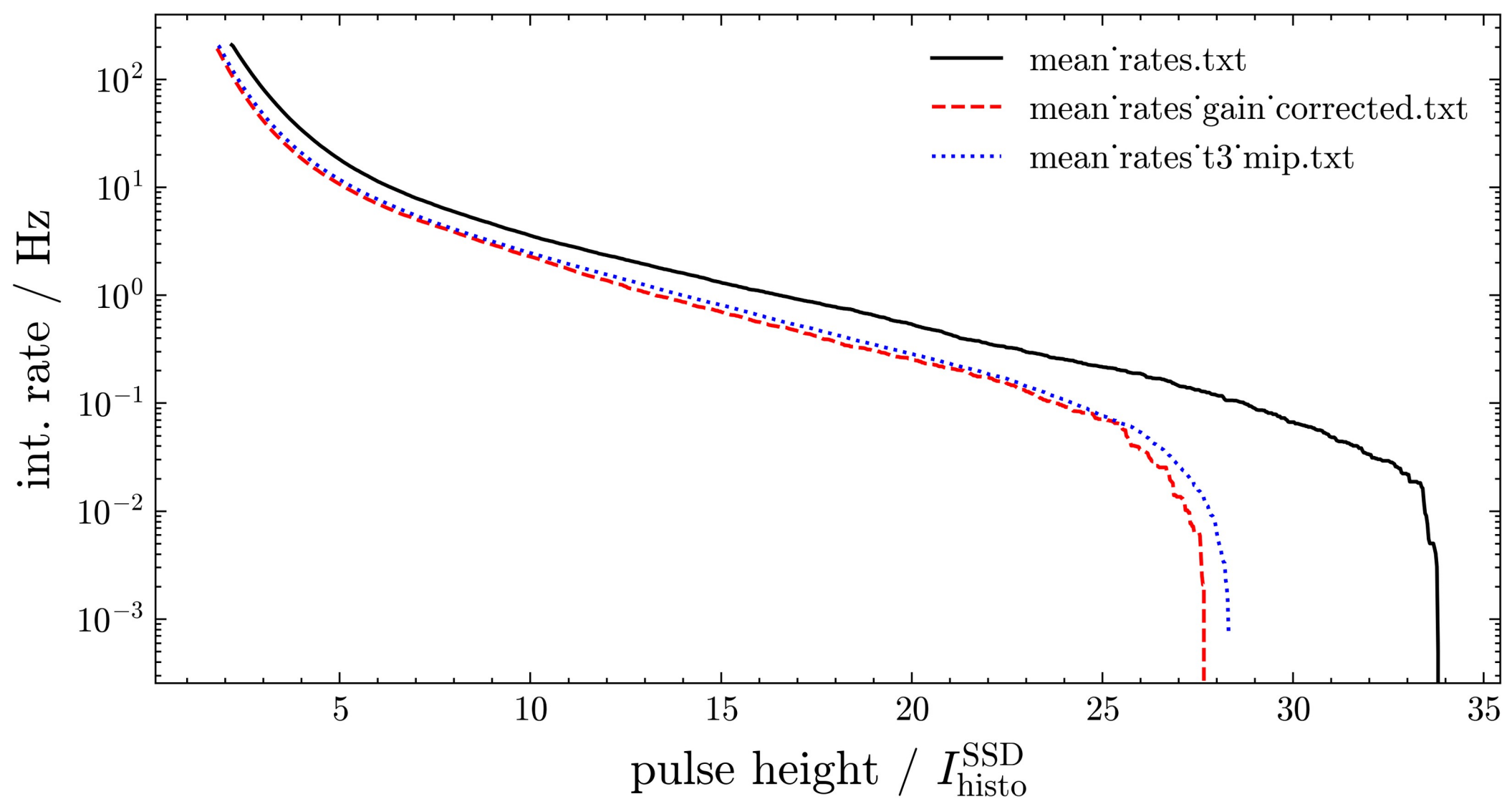
- Implement prototype SSD online calibration...
 - **... in UUB DAQ** → **~2 months (before Aug.)**
 - Add event counter in **MuonFill** process
 - Perform rate-based estimation of MIP peak
 - Add calculated online MIP peak to Events
 - Send calculated online MIP peak to FPGA
 - **... in CDAS** → **~4 months (before Nov.)**
 - Package online MIP peak in monitoring data
 - Handle change in sent data packages on CDAS side

Backup



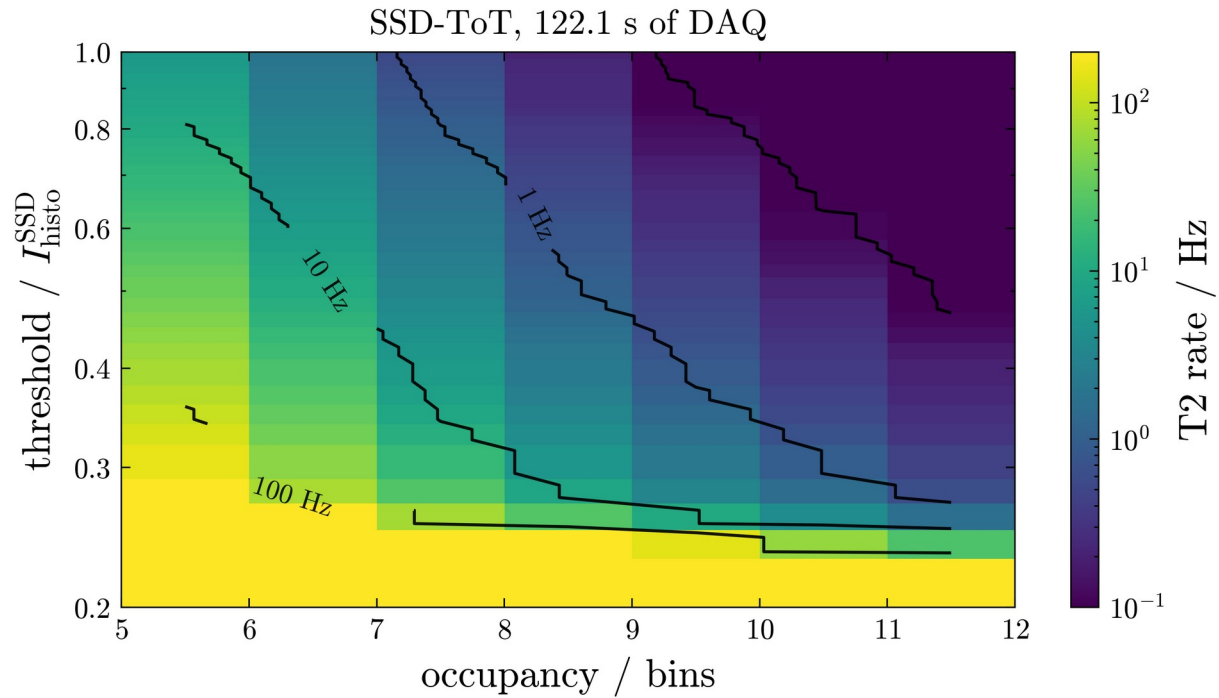






Plan for SSD triggers

- Implement SSD triggers → **November onwards**
 - ToT-like trigger, thresholds TBD from UUB randoms



WCD ToT+ToTd rates from UUB randoms

