Electronics validation analysis
Updates from Genoa

A. Caminata, L. Di Noto, S. Repetto

GRAIN Meeting

19 July 2024

Our goals

- **Simulated data**: we simulated photon scintillation emission events in both LAr and in Xenon-doped Argon. Each ROOT output file contains 120 spill events

(**/storage/gpfs_data/neutrino/users/ldn/Samples/Spill_Xe/Spill_opt3_STT1_*/output/sensor_all_*.root**)

(/storage/gpfs_data/neutrino/users/ldn/Samples/Spill_**Ar**/Spill_opt3_STT1_*/output/sensor_all_*.root)

- **Goal**: we want to select most critical and significative samples and validate the architecture on those samples

Selected samples	Electronics validation
1. Events that need a high number of integration windows for some channels	1. For validating the architecture with 2 Wilkinson and conversion time of 40-50 ns
2. Events with the highest number of photons within an integration window	2. For optimizing/validating the dynamic range

Criterion applied: Number of integrators needed

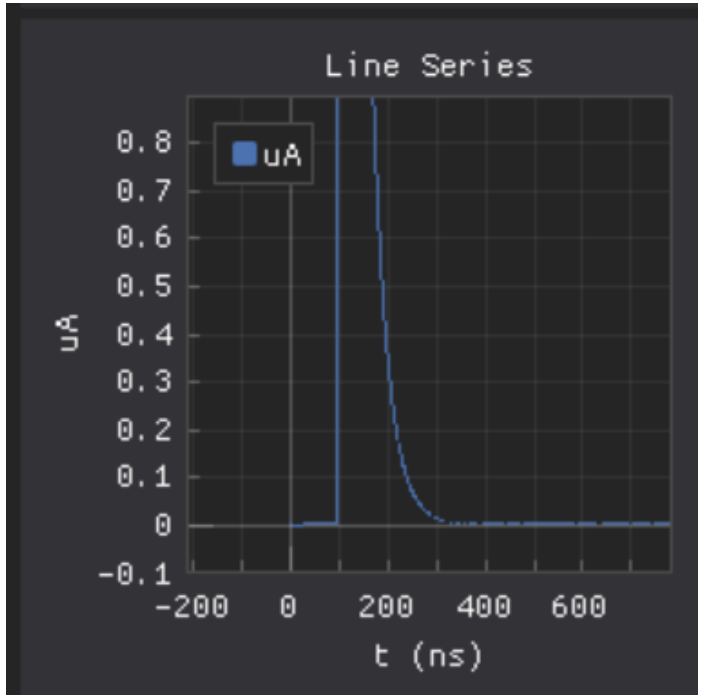
Events that need a high number of integration windows for some channels

Selected samples: Events that need a high number of integration windows for some channels

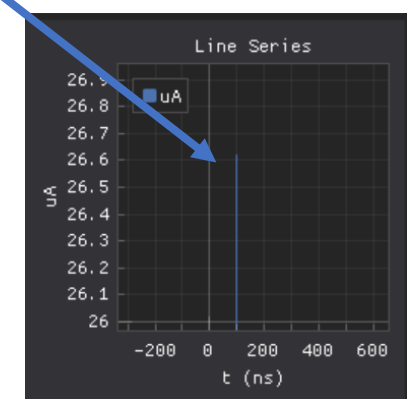
Rq for 2x2 SiPM: 300 kOhm (info from HAMAMATSU)

We use single PE waveform:
`2x2_I2in_interactive5523_300k.csv`

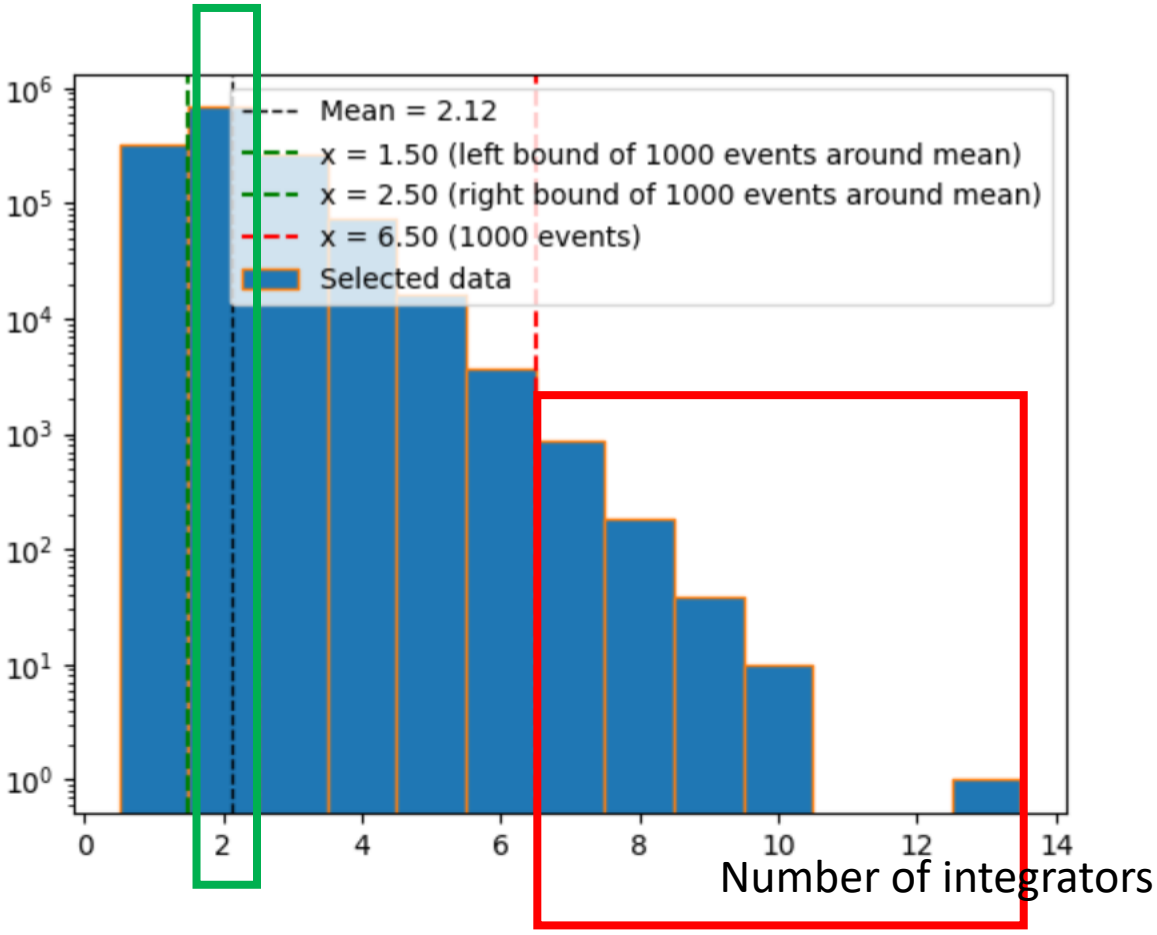
Rq = 300 kOhm



Imax= 26.62 uA

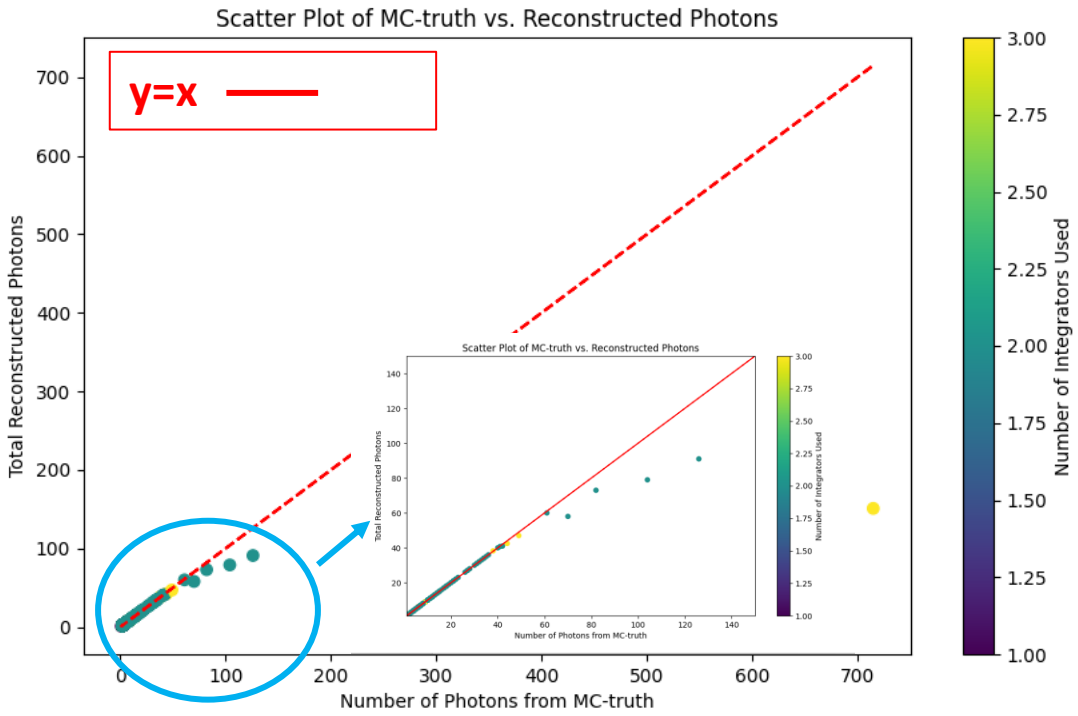


Xenon-doped Ar
720 spill

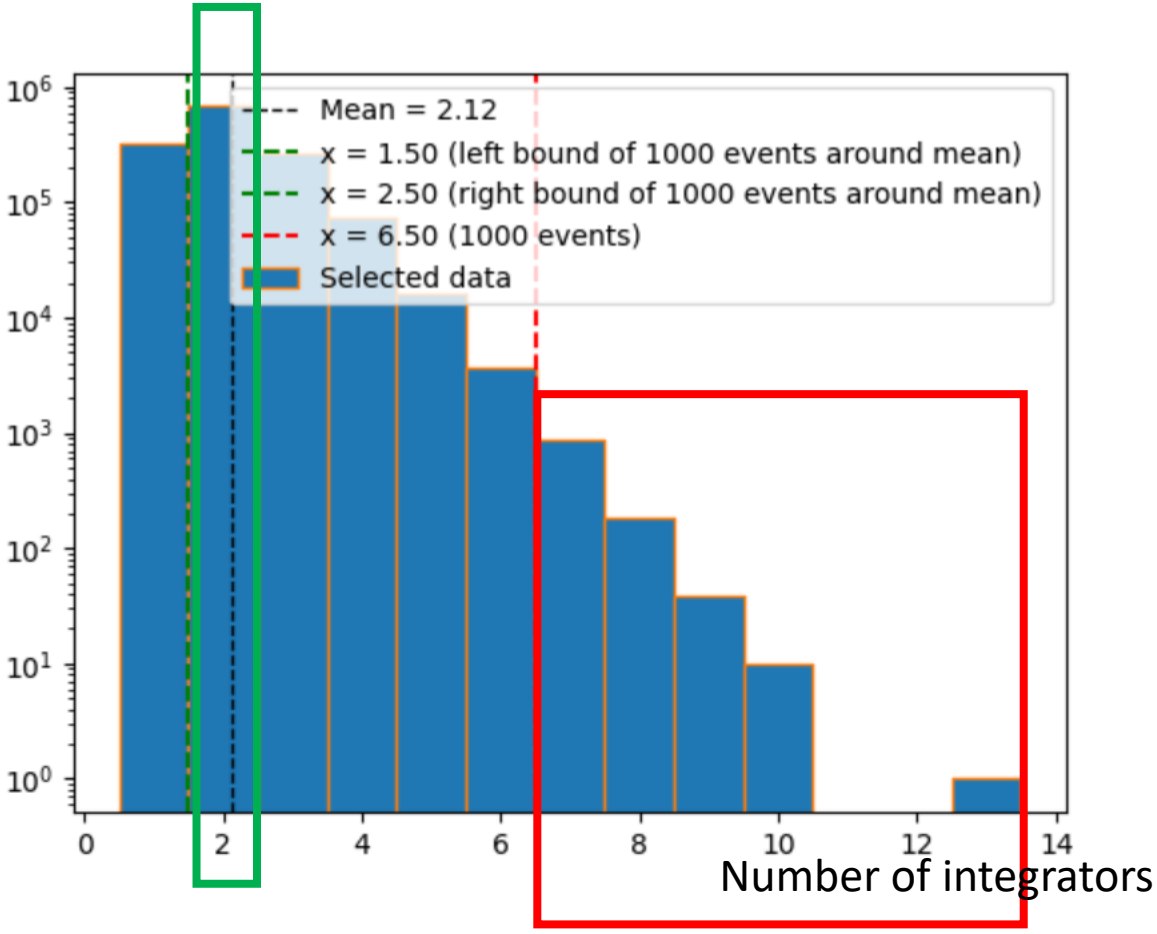


Selected samples: Events that need a high number of integration windows for some channels

Nintegrators = 2

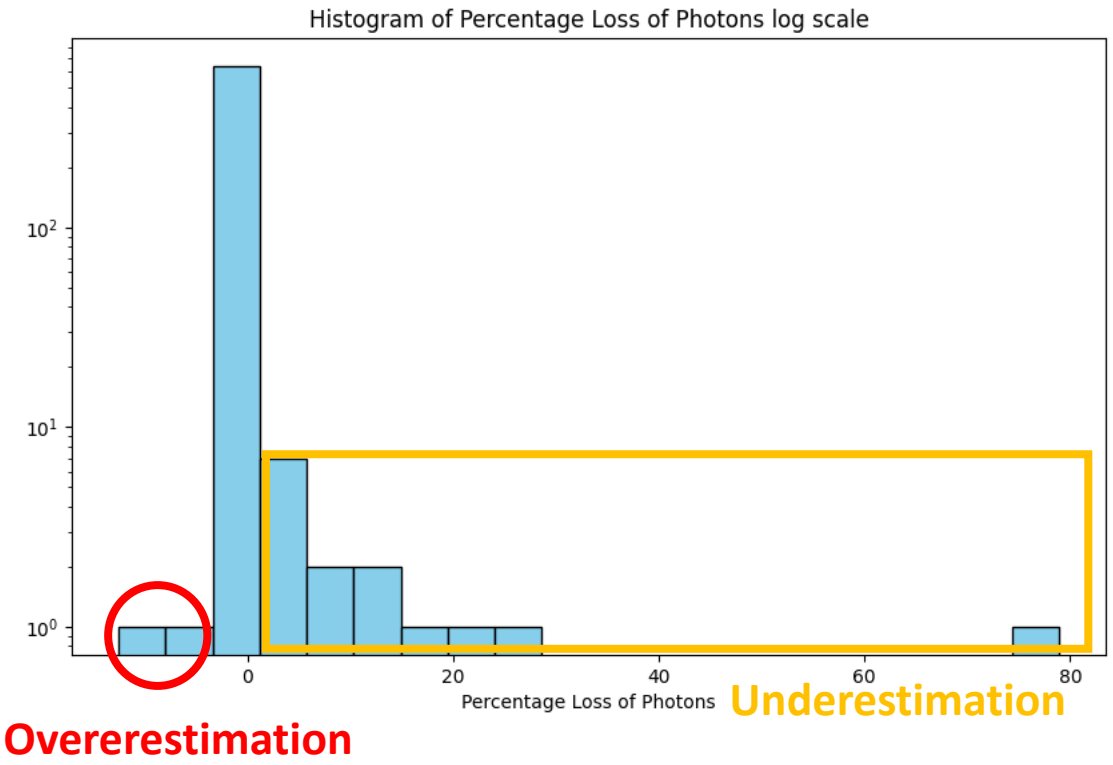


Xenon-doed Ar
720 spill



Selected samples: Events that need a high number of integration windows for some channels

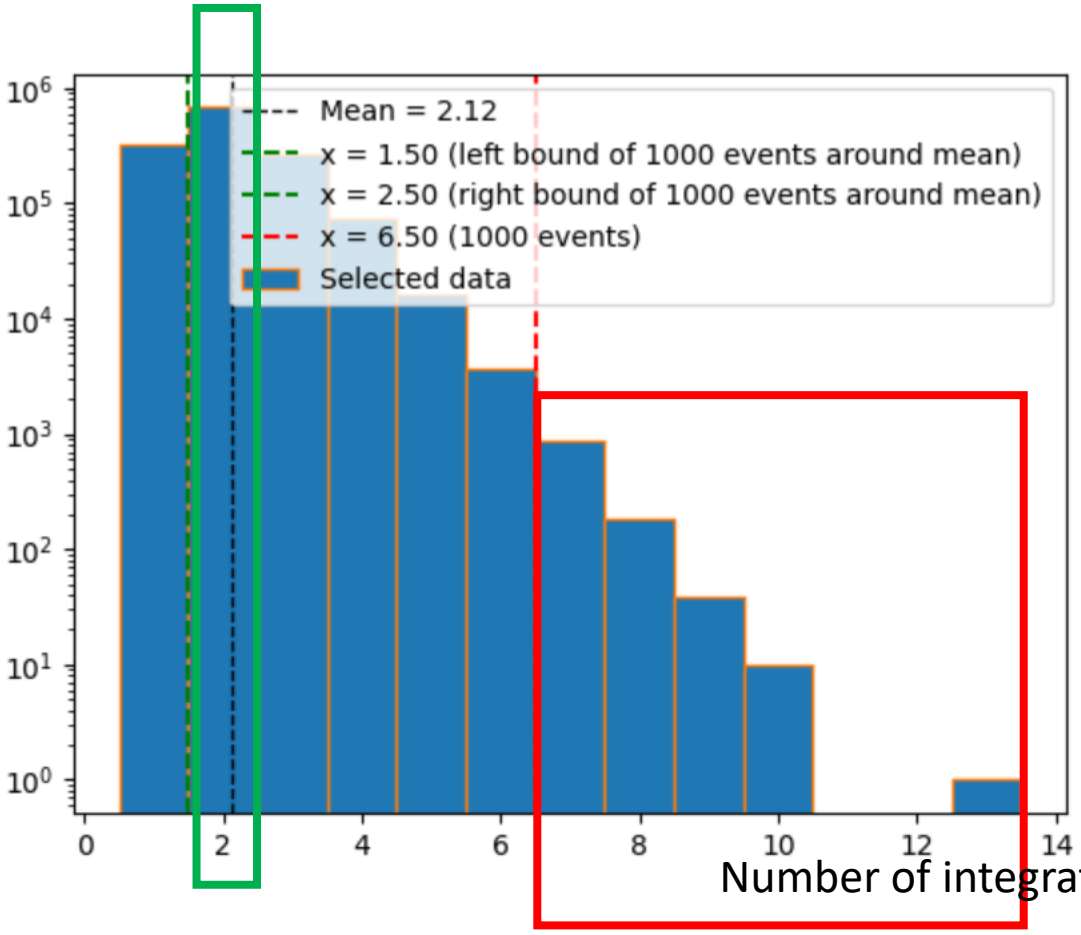
Nintegrators = 2



Overerestimation

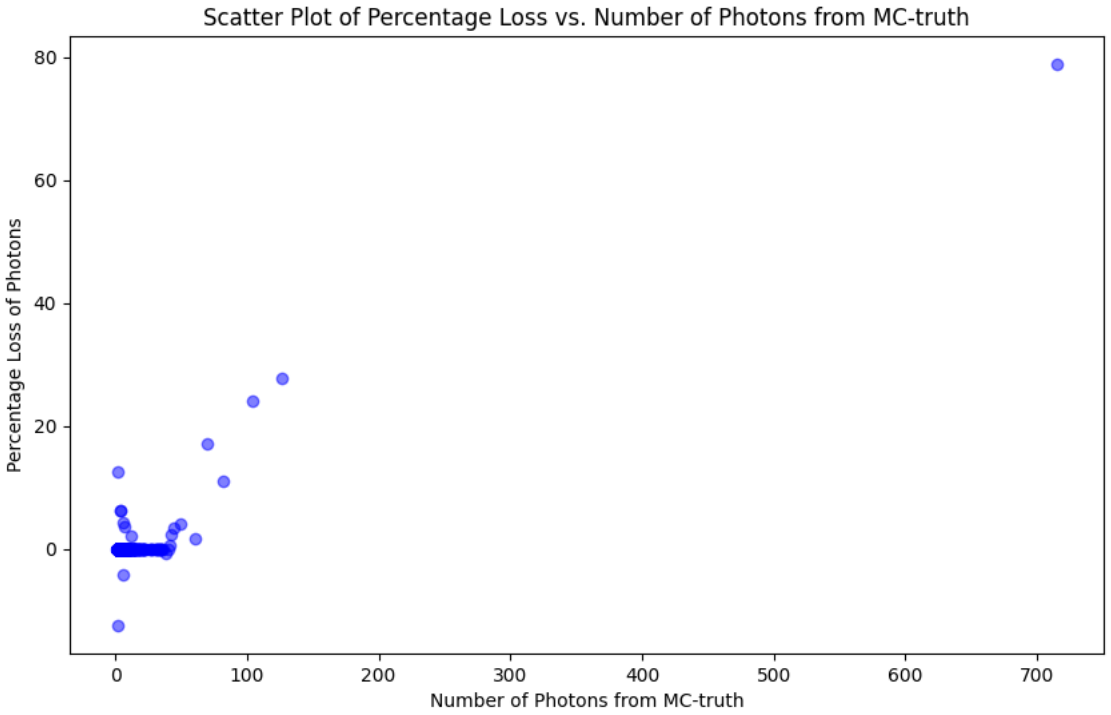
Underestimation

Xenon-doped Ar
720 spill

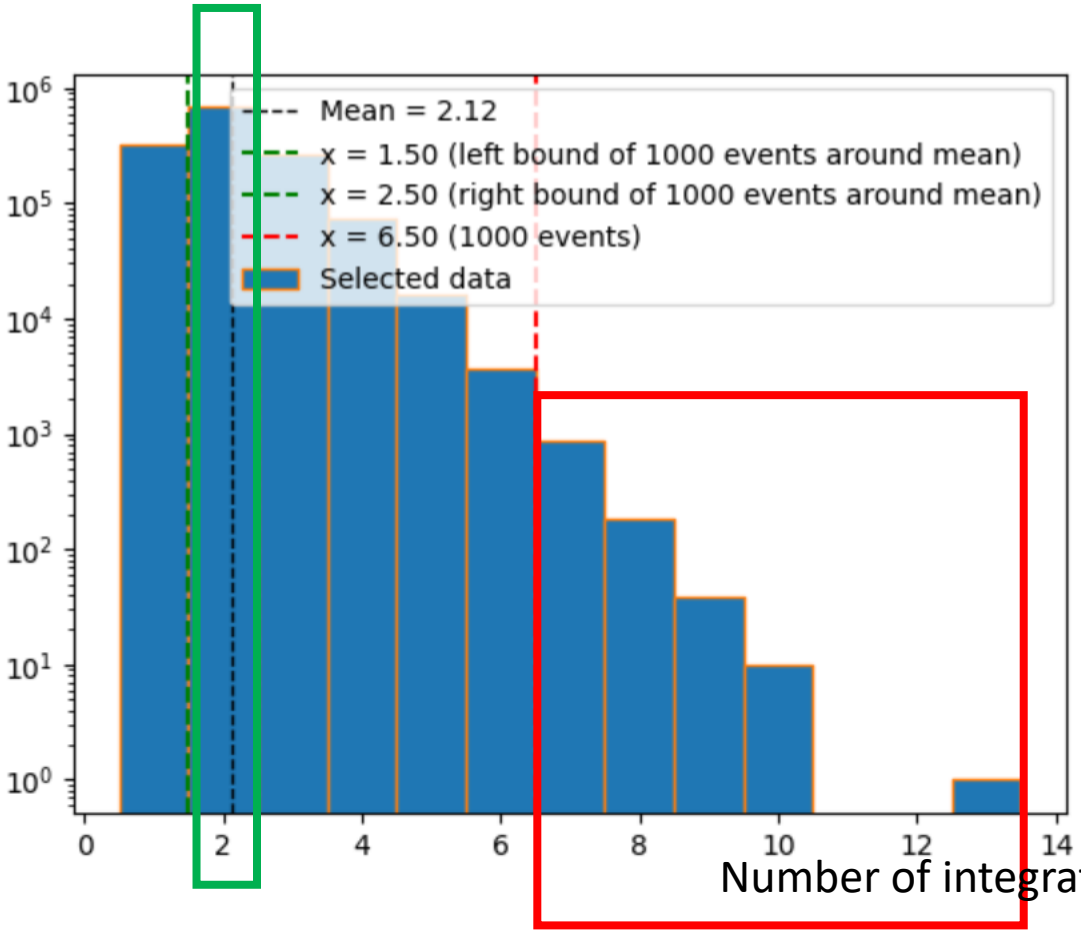


Selected samples: Events that need a high number of integration windows for some channels

Nintegrators = 2



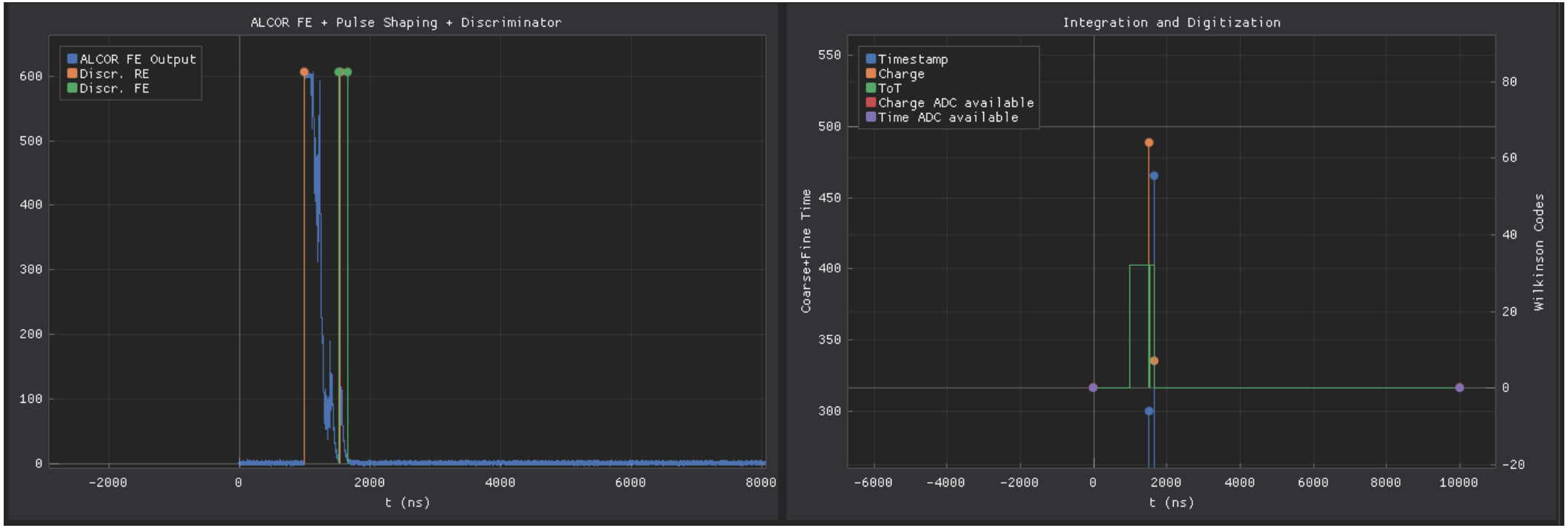
Xenon-doped Ar
720 spill



Example of a problematic case - underestimation

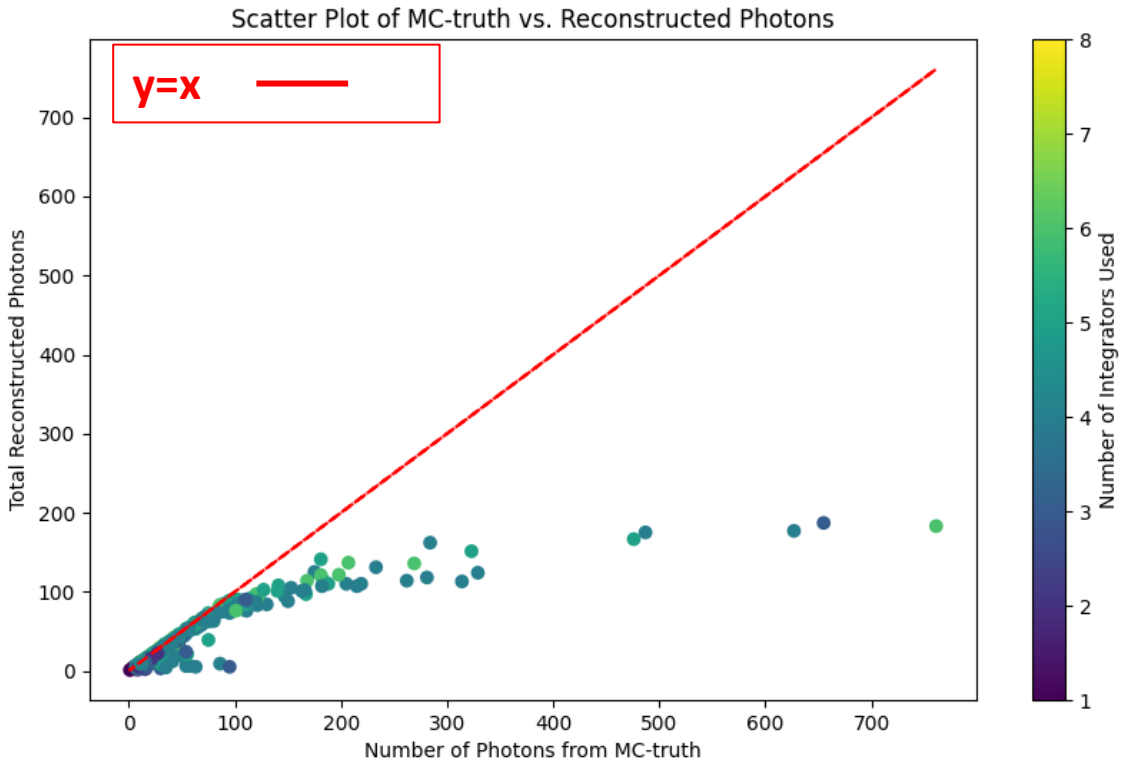
Number of MC photons: 126

Reconstructed photons: 91

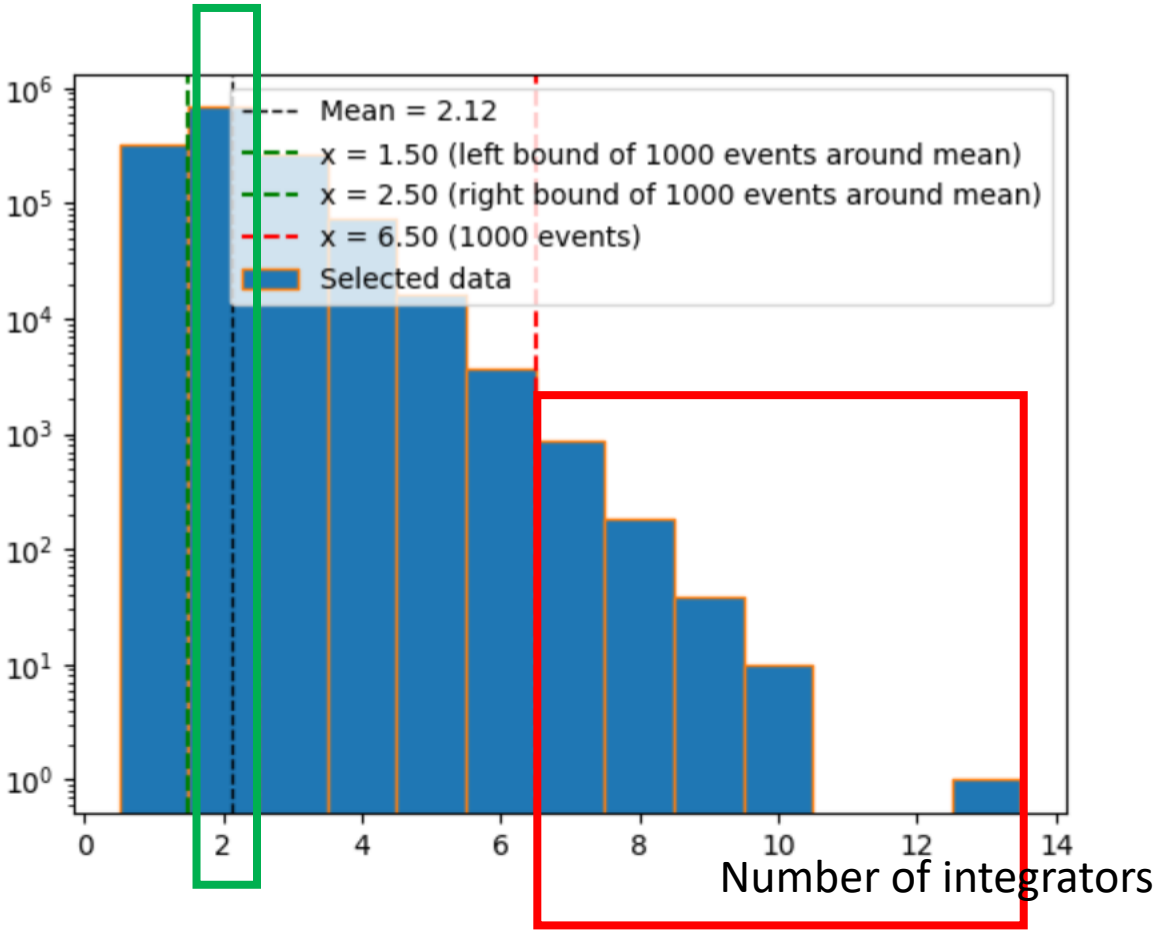


Selected samples: Events that need a high number of integration windows for some channels

Nintegrators > 6

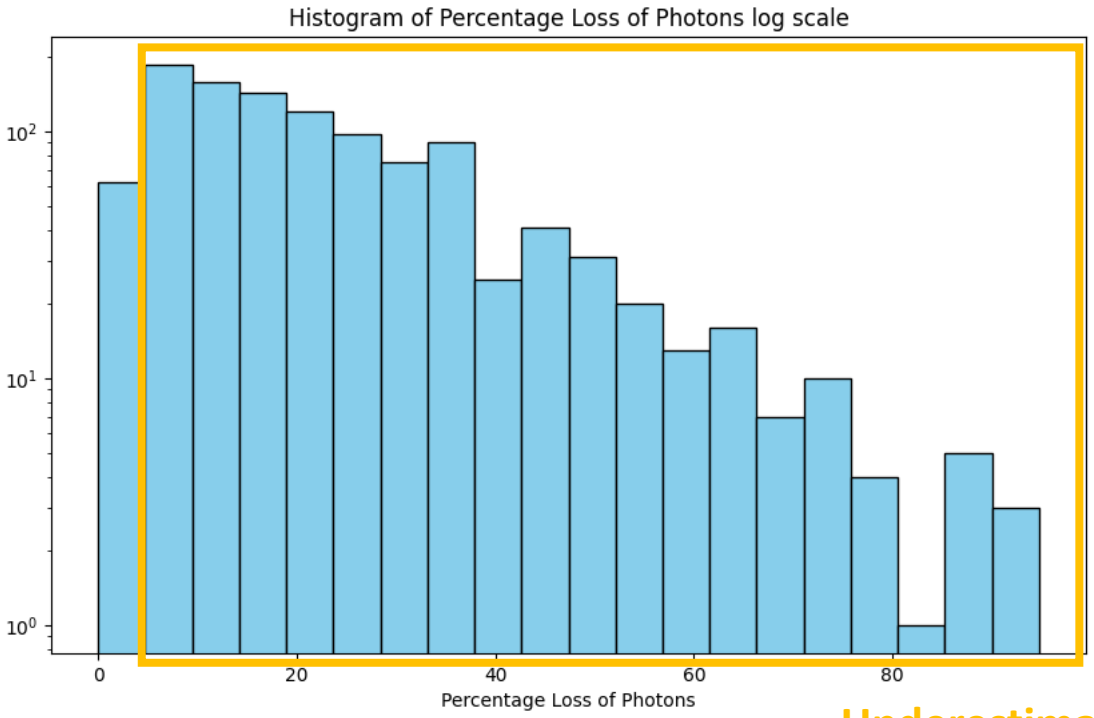


Xenon-doped Ar
720 spill



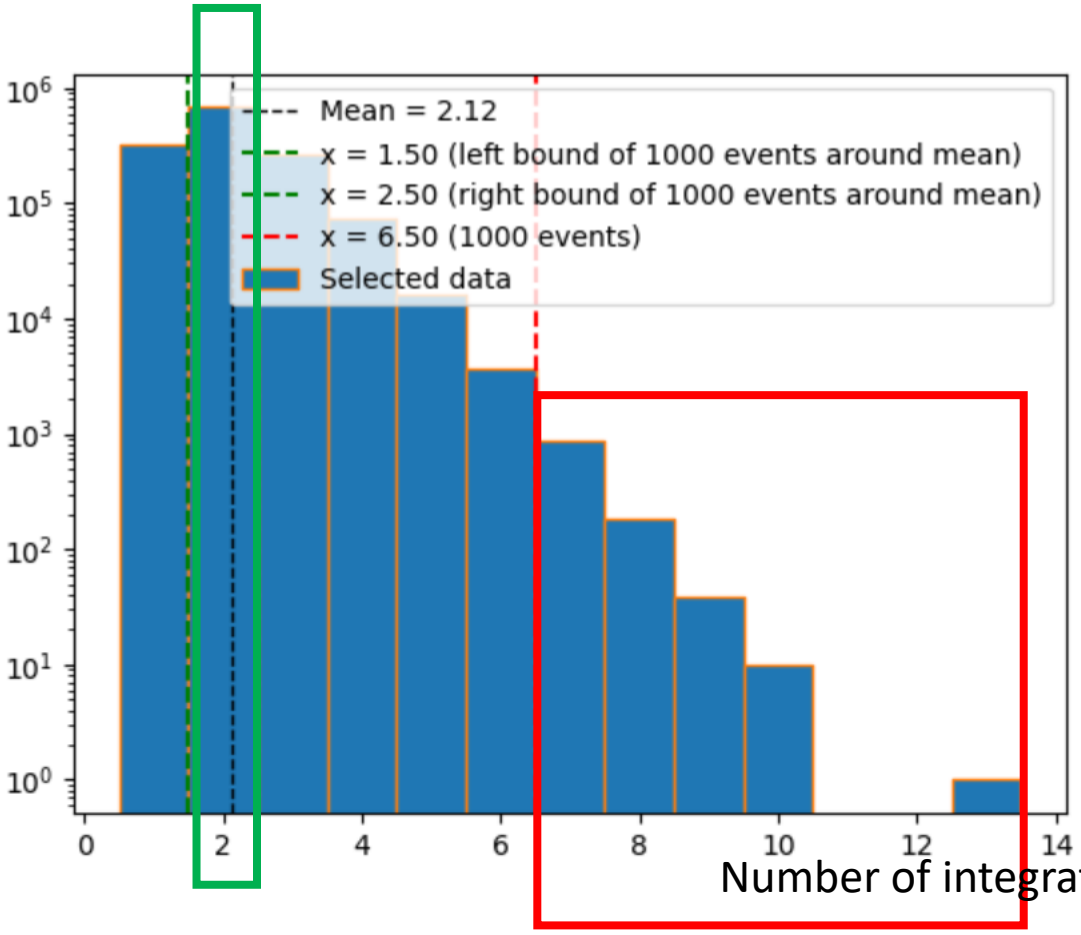
Selected samples: Events that need a high number of integration windows for some channels

Nintegrators > 6



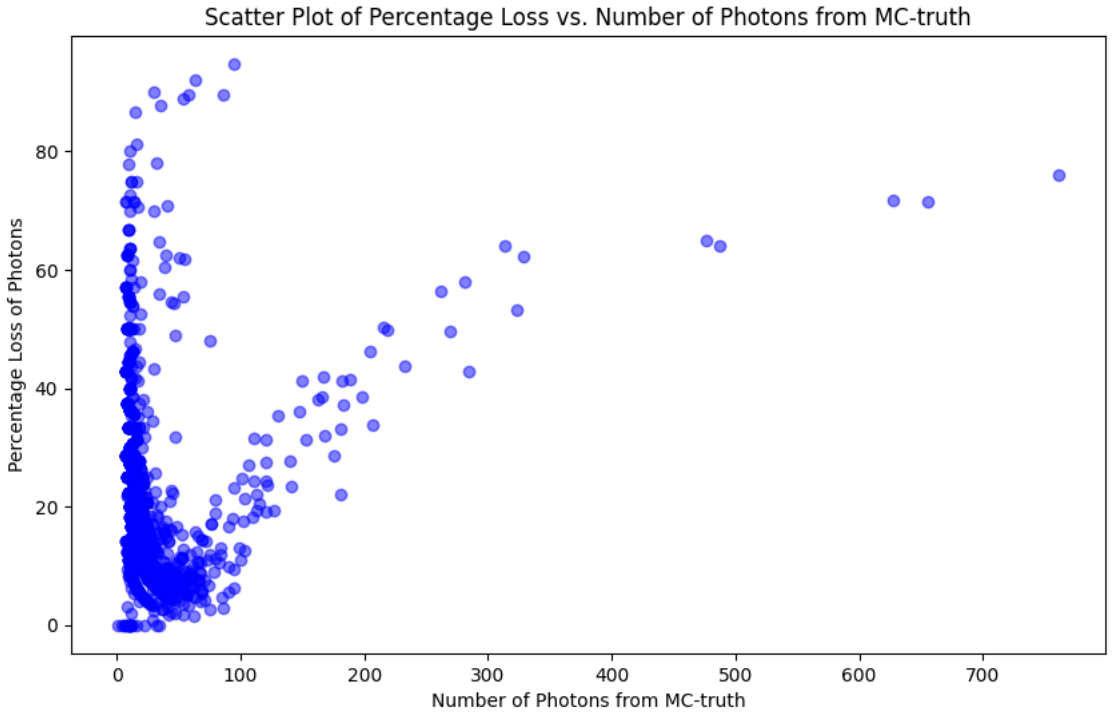
Underestimation

Xenon-doped Ar
720 spill

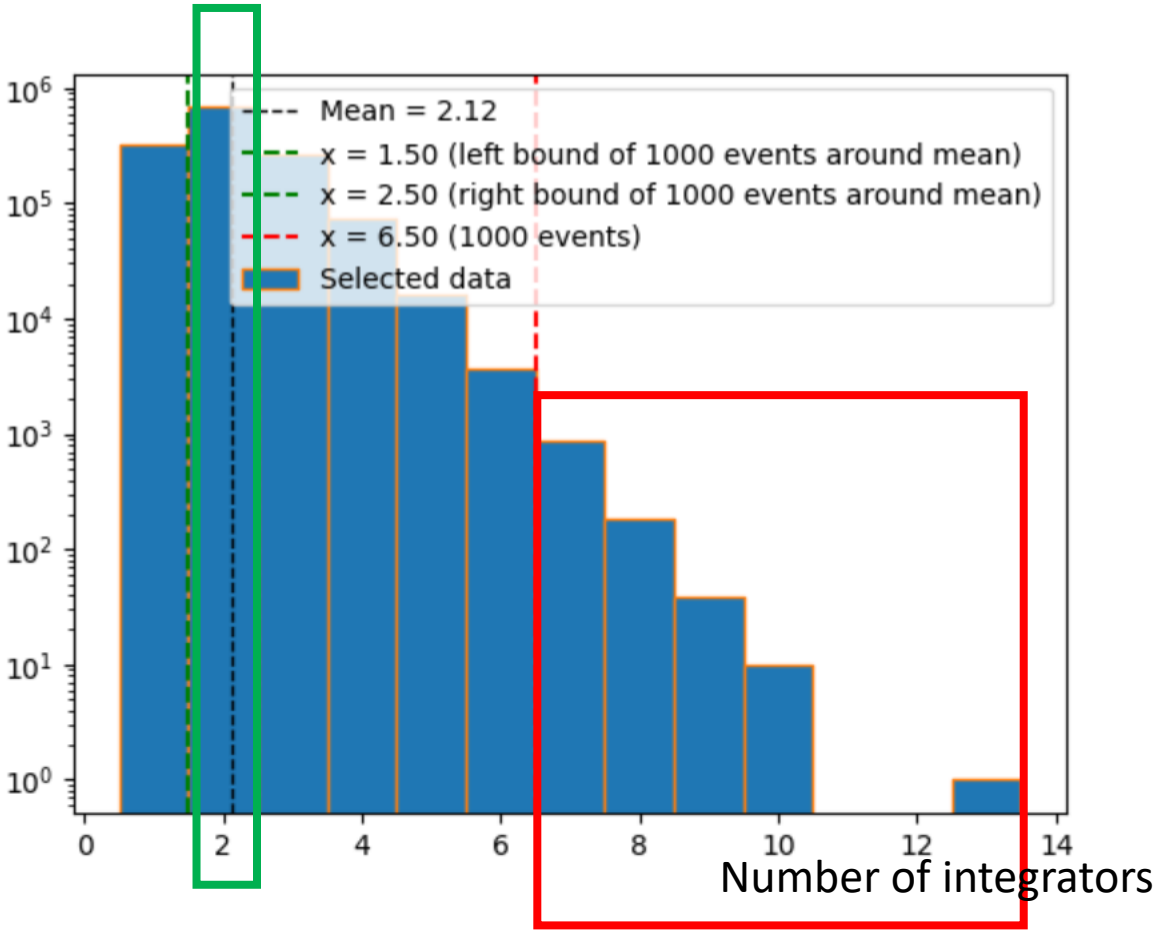


Selected samples: Events that need a high number of integration windows for some channels

Nintegrators > 6



Xenon-doped Ar
720 spill

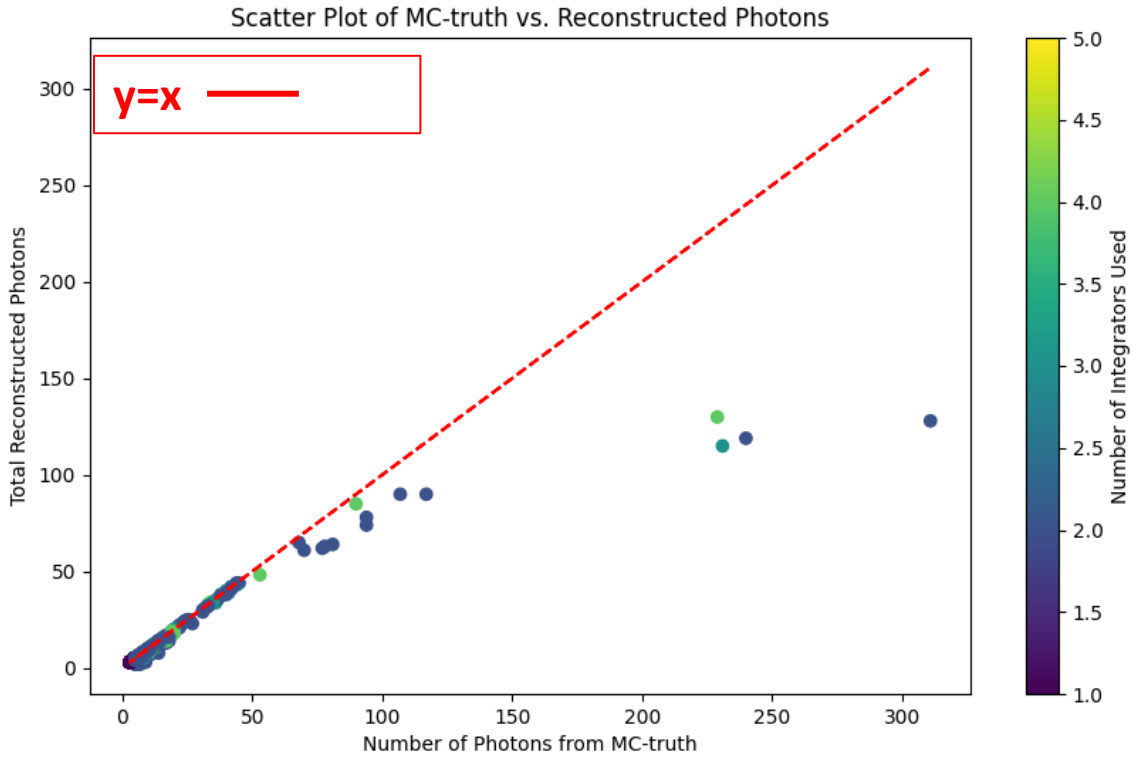


Criterion applied: Number of photons

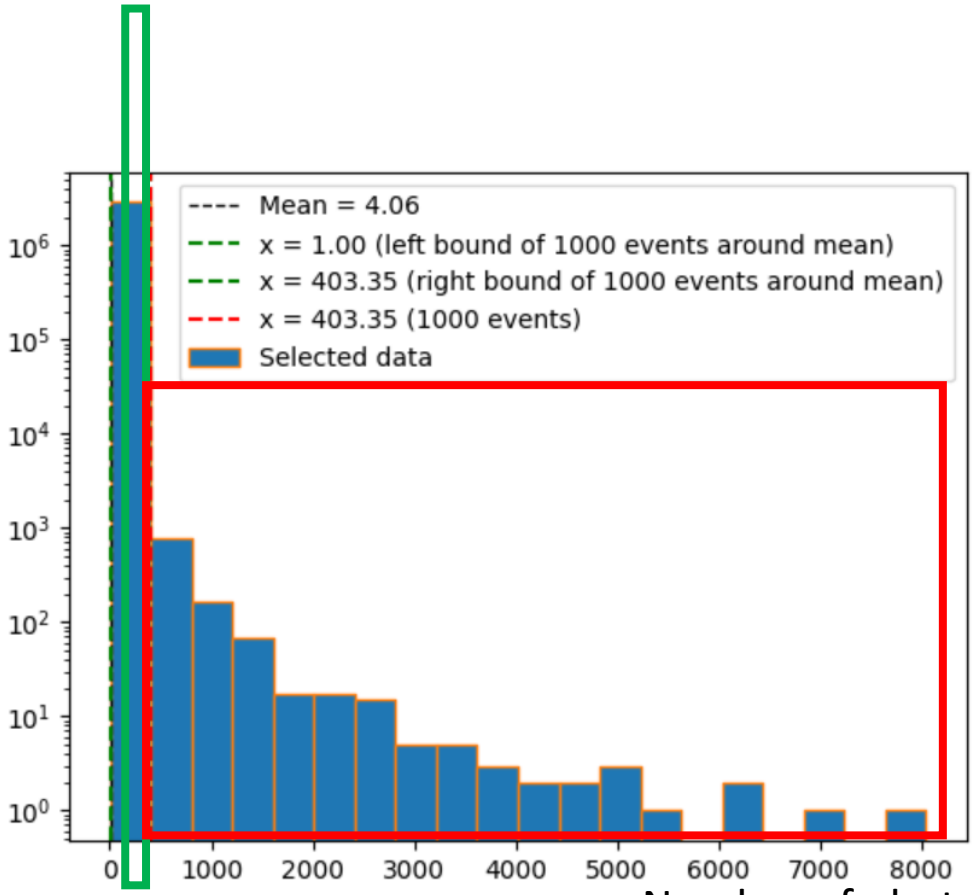
Events with the highest number of photons within an integration window

Selected samples: Events with the highest number of photons within an integration window

2 < Nphotons < 6

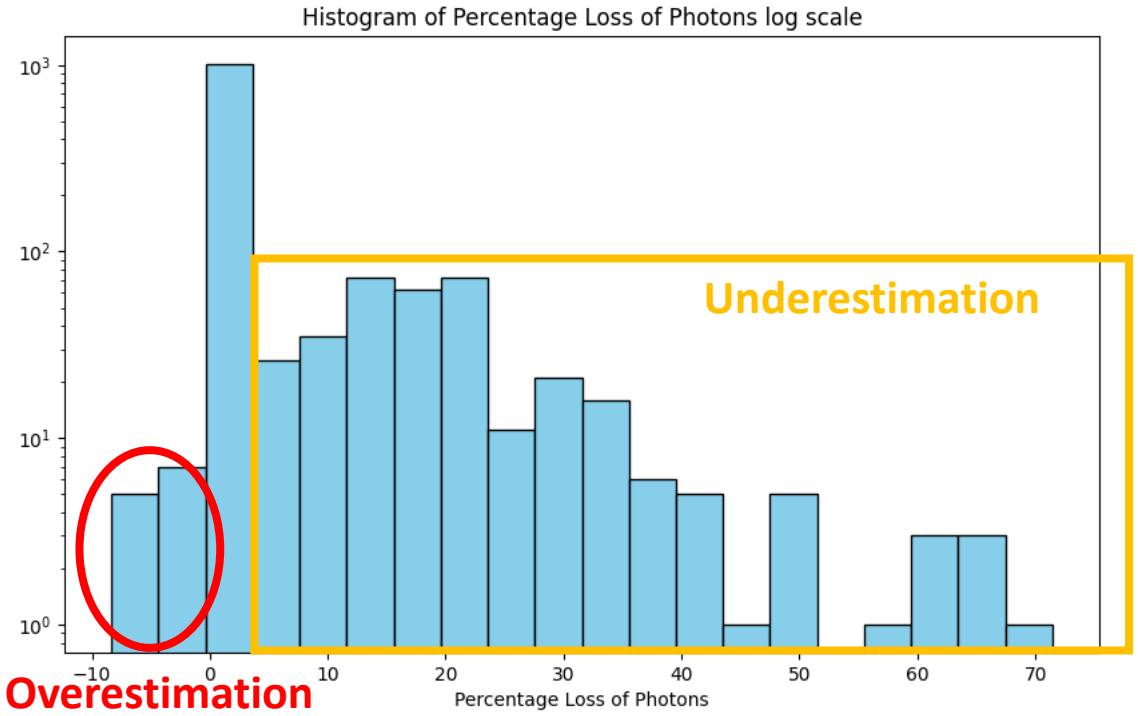


Xenon-doped Ar
720 spill

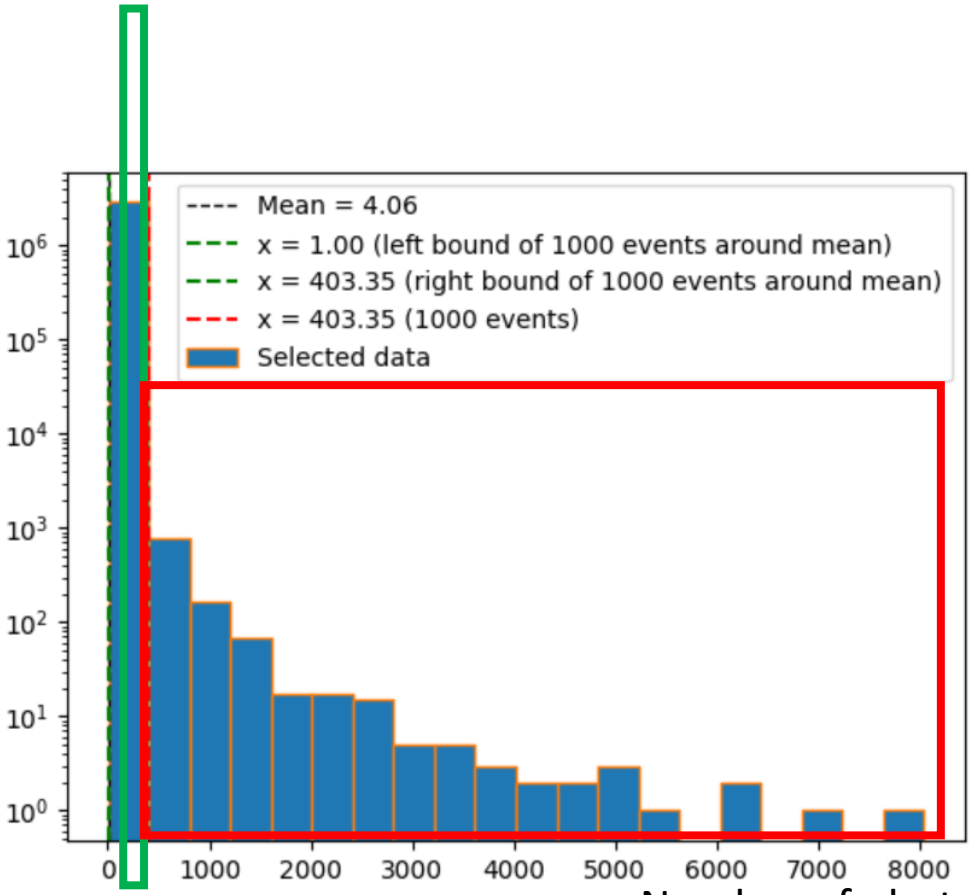


Selected samples: Events with the highest number of photons within an integration window

2 < Nphotons < 6

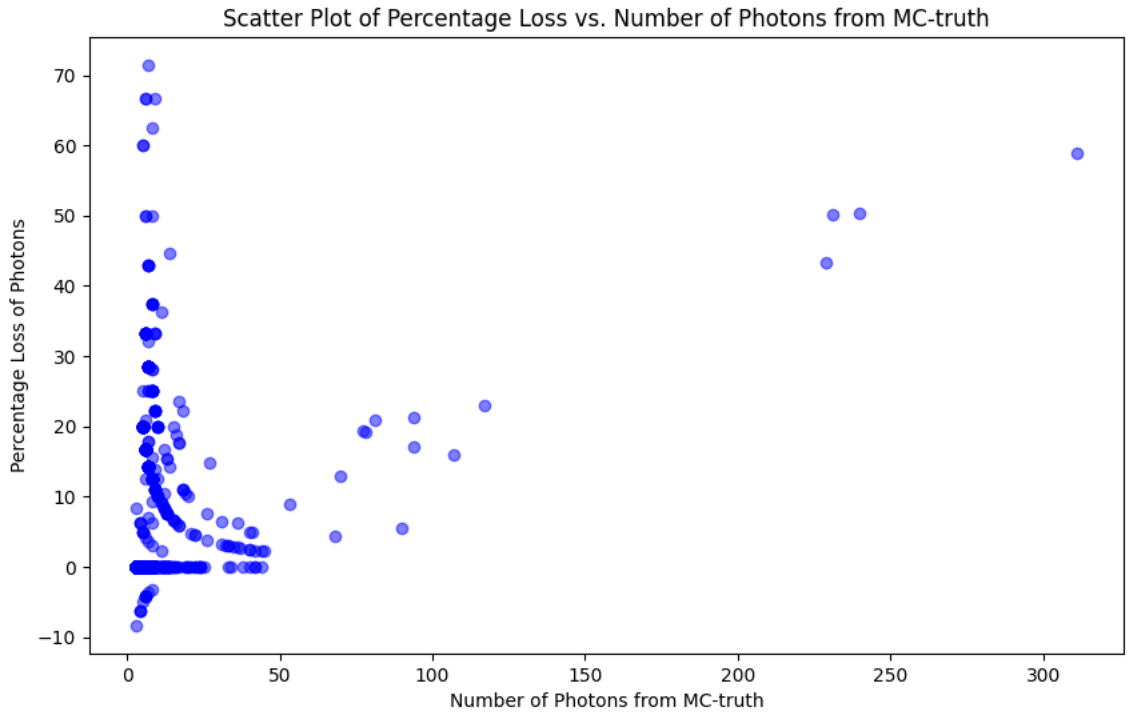


Xenon-doped Ar
720 spill

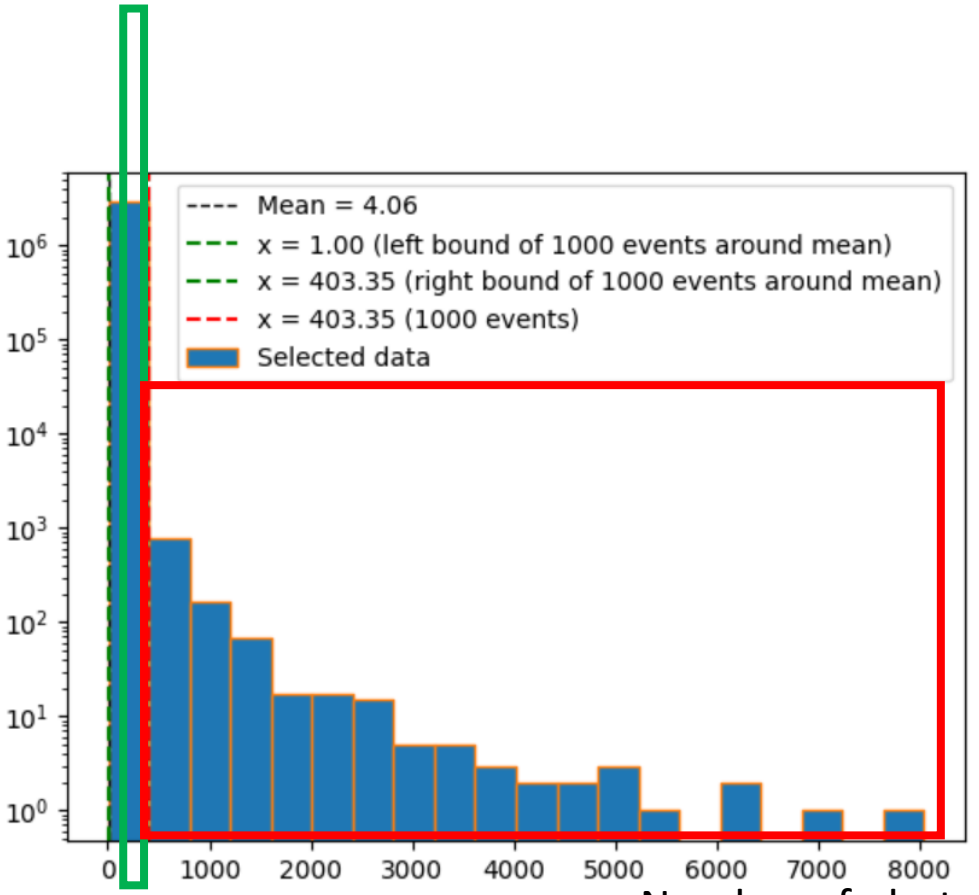


Selected samples: Events with the highest number of photons within an integration window

2 < Nphotons < 6

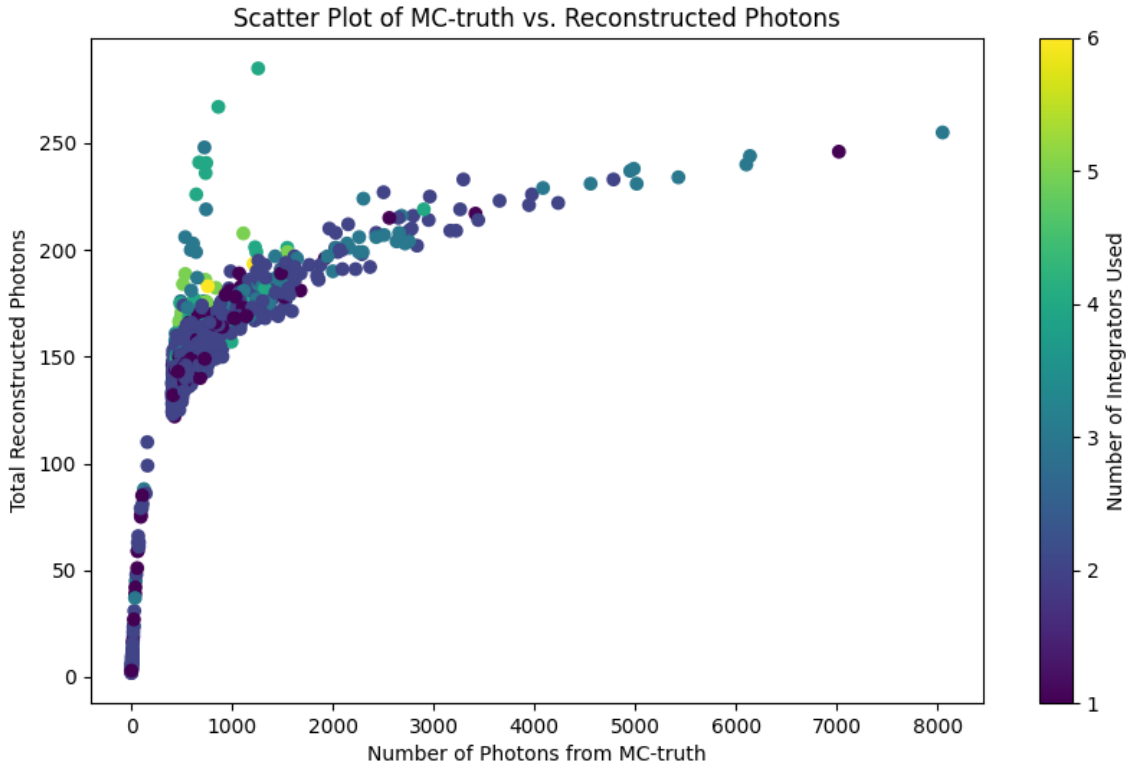


Xenon-doped Ar
720 spill

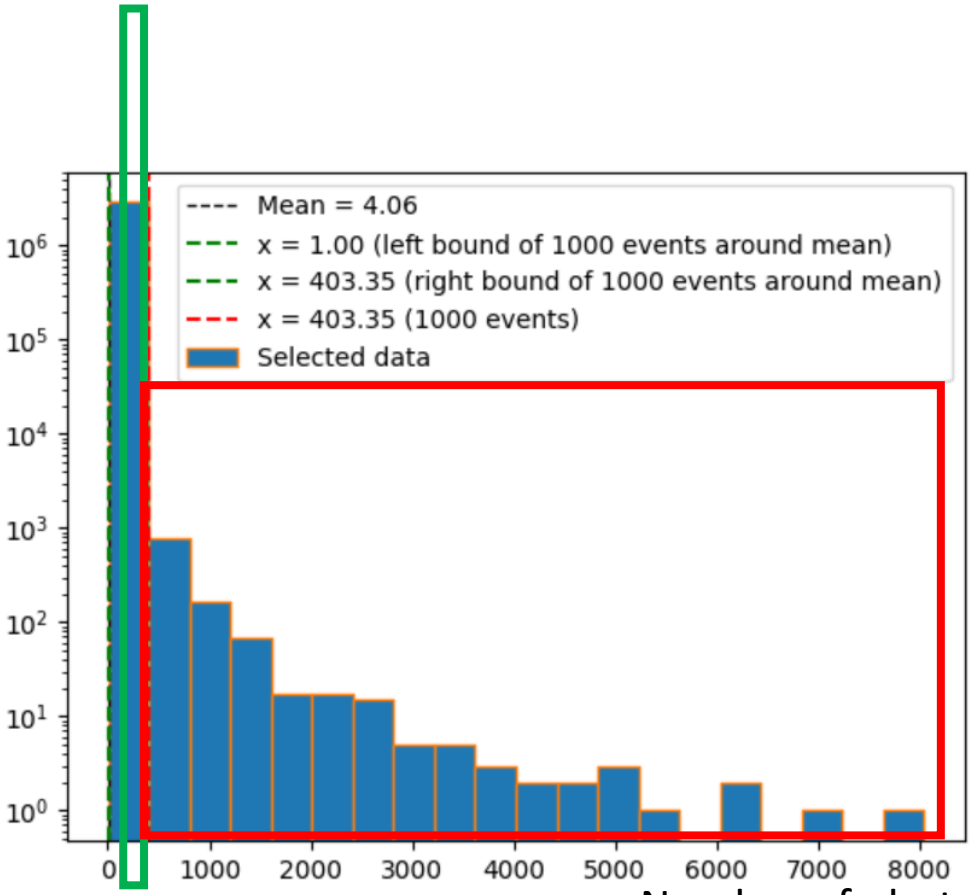


Selected samples: Events with the highest number of photons within an integration window

Nphotons > 403



Xenon-doped Ar
720 spill



Conclusions and open questions

- Can the number of integration windows we require for the most critical cases (with respect to the tail of the distribution) be satisfied?
- There is an important underestimation of the photon number reconstruction, even for a relatively low photon number
- Is there a way to tell when saturation occurs?
- Understanding from which photon threshold we need gain 1 instead of gain 0 and the root causes of the underestimation