

Pileup analysis for liquid xenon photon detector in MEG II experiment

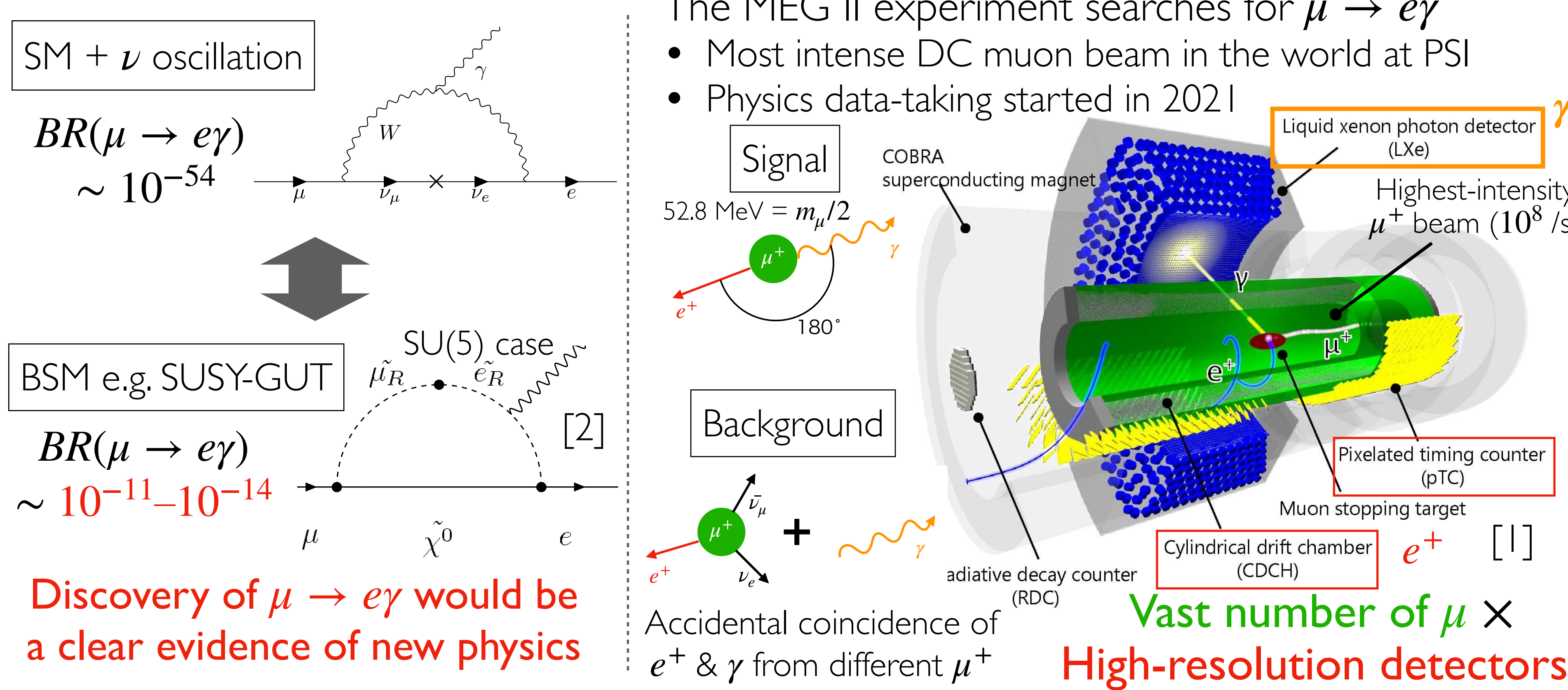


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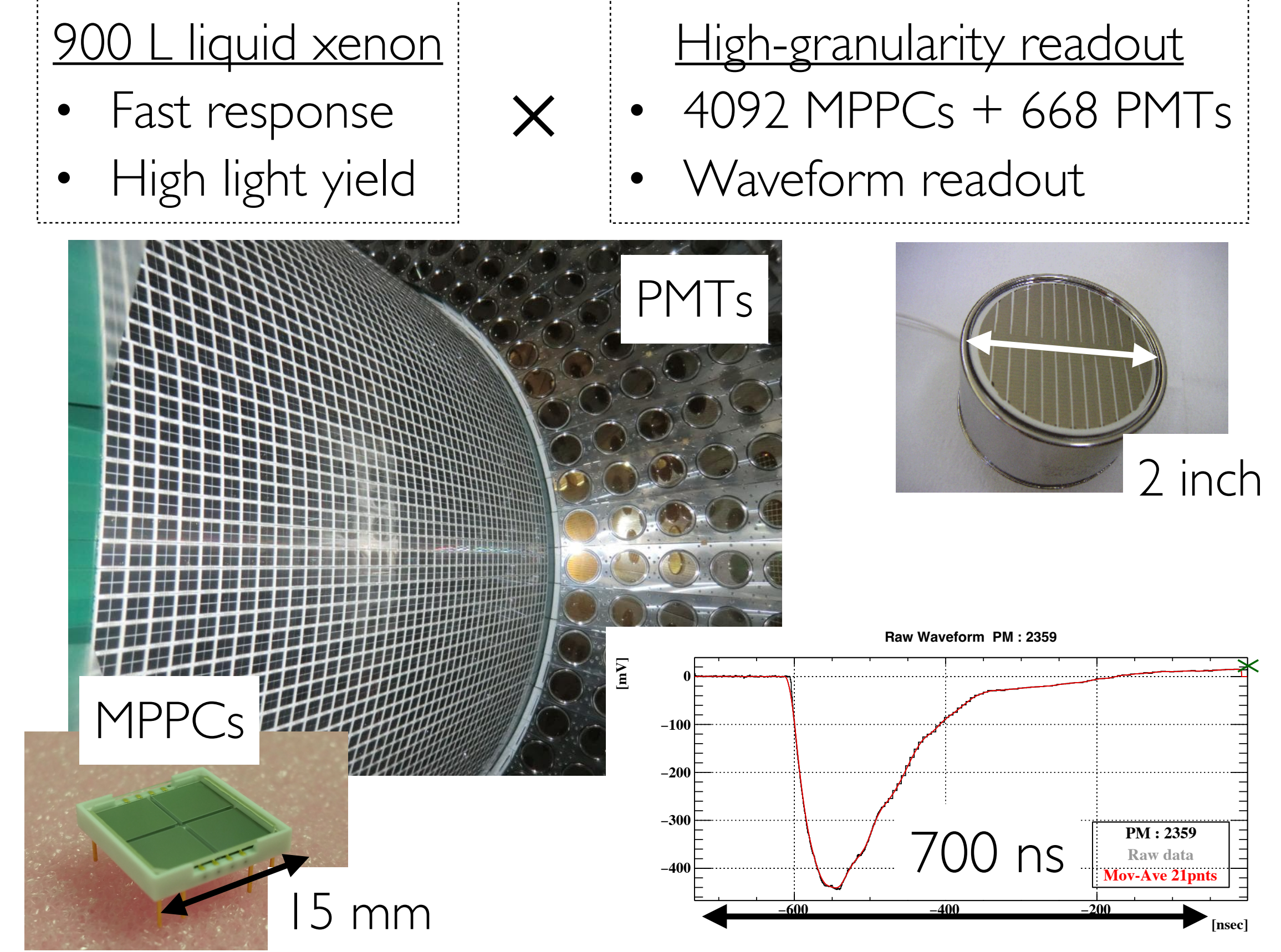
Abstract

The MEG II experiment at Paul Scherrer Institut searches for $\mu \rightarrow e\gamma$ with a target sensitivity of $\mathcal{O}(10^{-14})$ [1]. Due to the high rate of $\mathcal{O}(10^7)$ muon decays per second, photon pileup is observed in the liquid xenon detector. The pileup analysis has been developed to mitigate the effect on the energy reconstruction. Peak search in the light distribution is utilised to identify on-time two-photon events coming from positron annihilation. A template fit of waveform sums is also developed to extract the signal of individual photons in case of accidental pileup. A background photon reduction of 35% is achieved in the 2021 dataset.

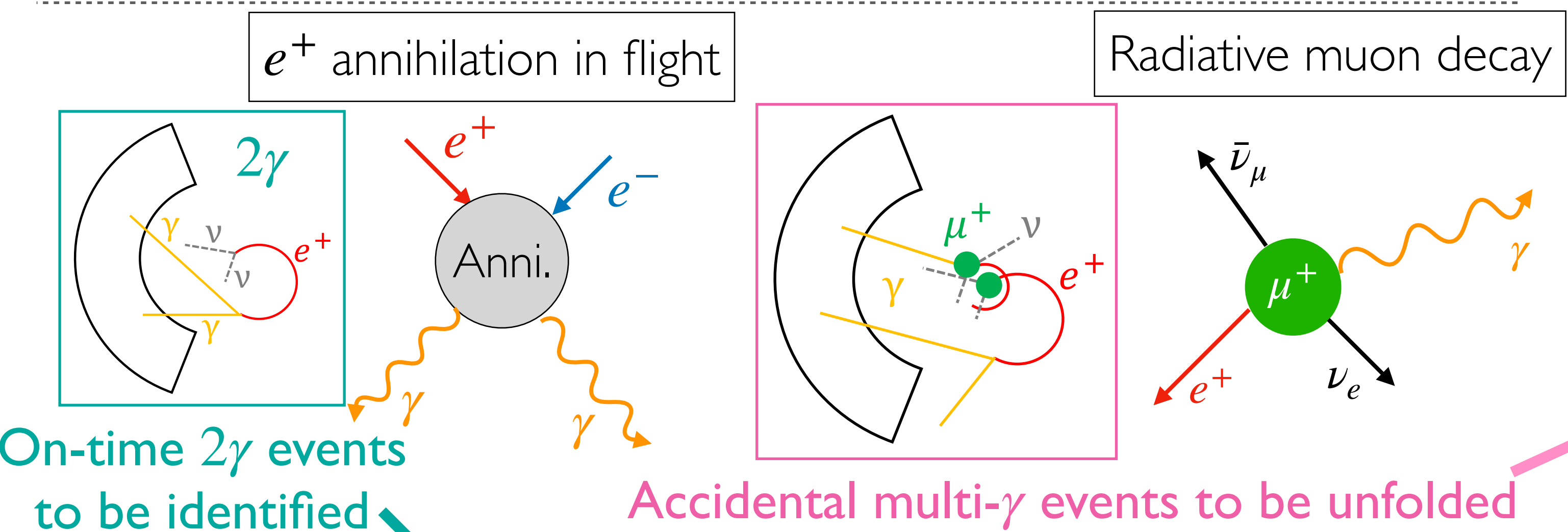
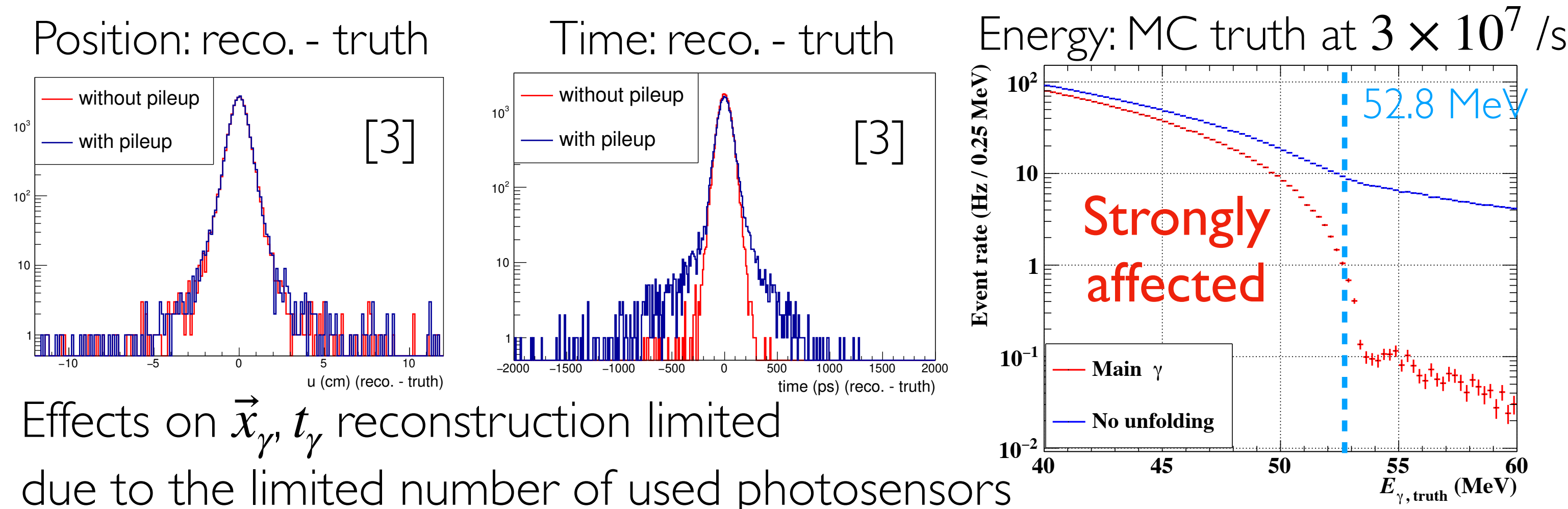
$\mu \rightarrow e\gamma$ search in MEG II experiment



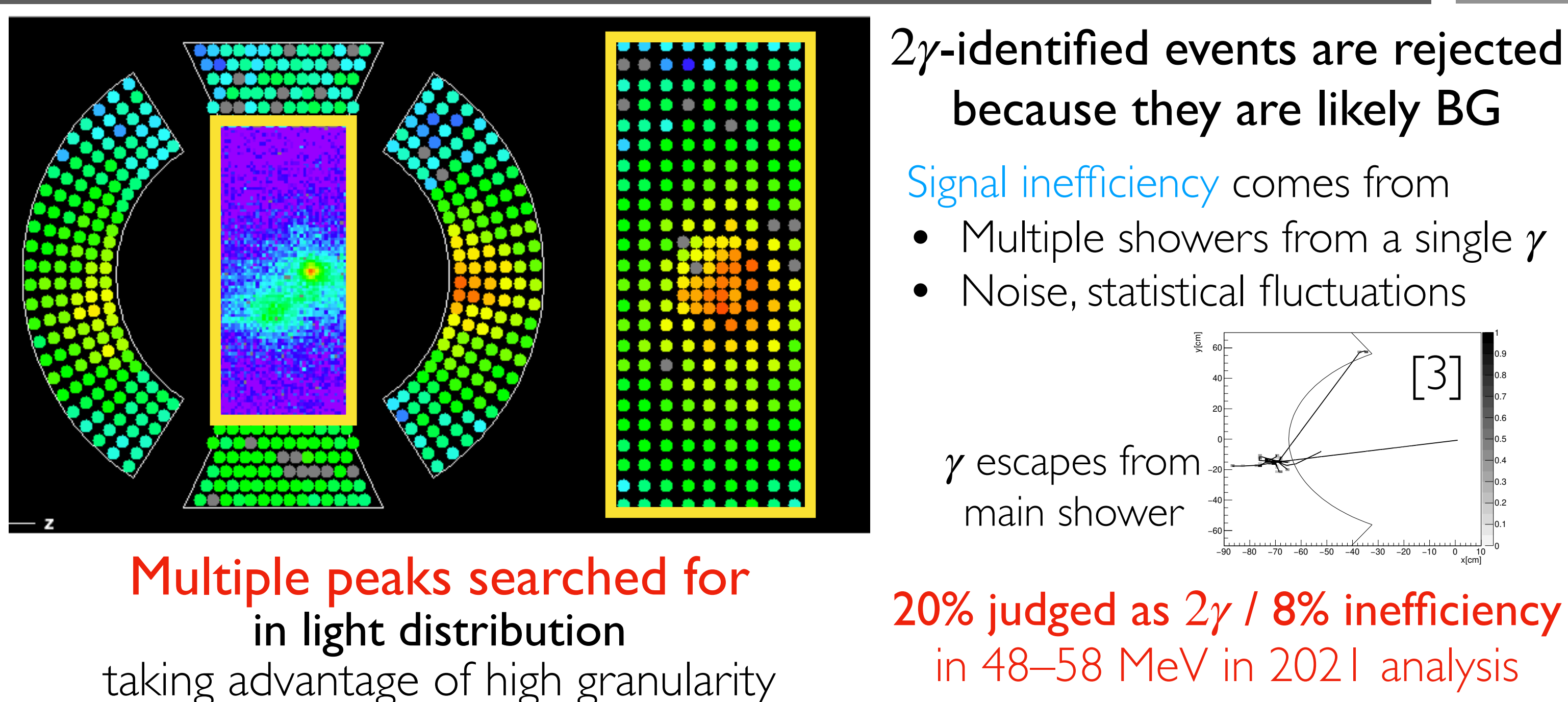
Liquid xenon photon detector



Pileup events in LXe detector

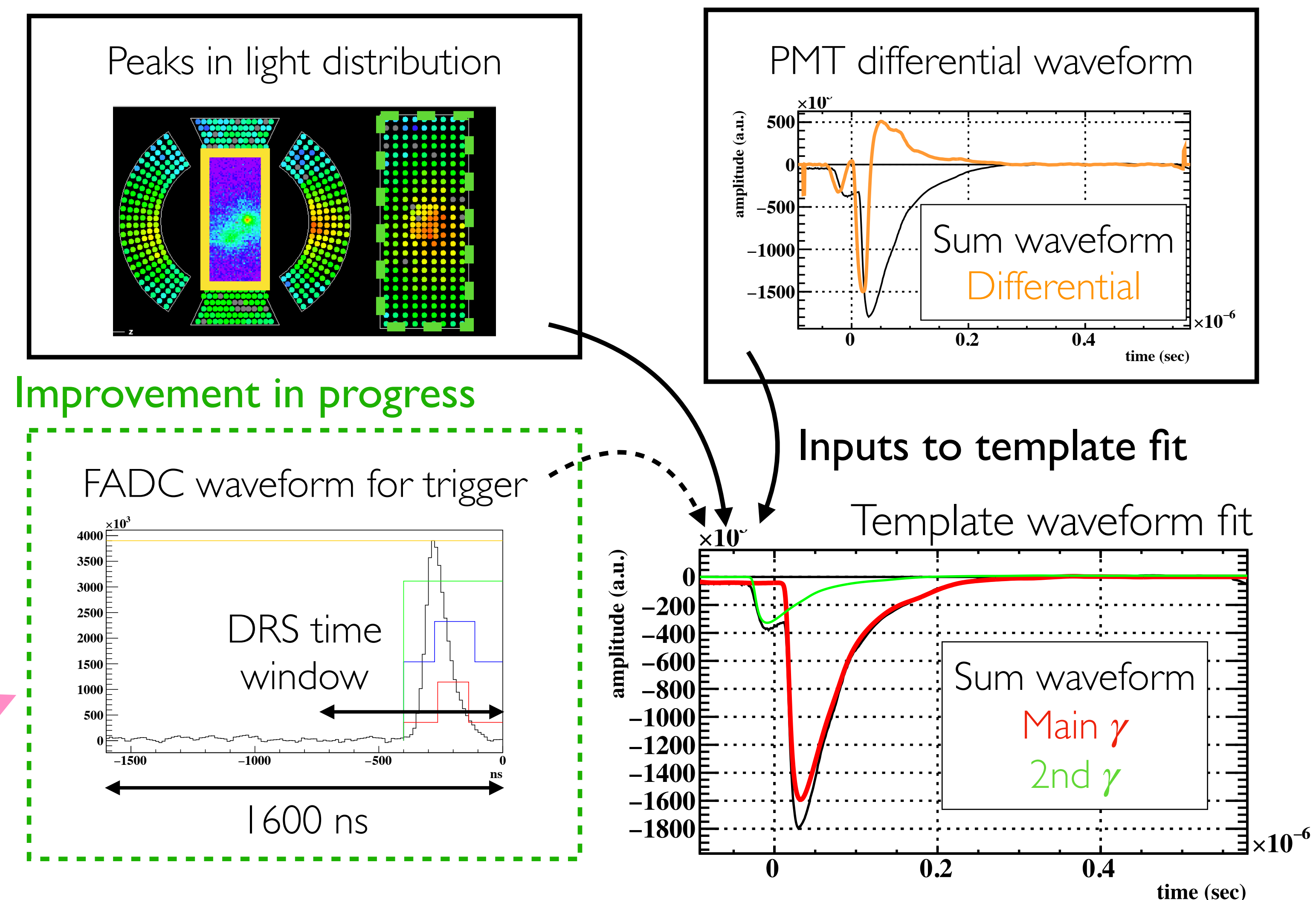


2γ event identification

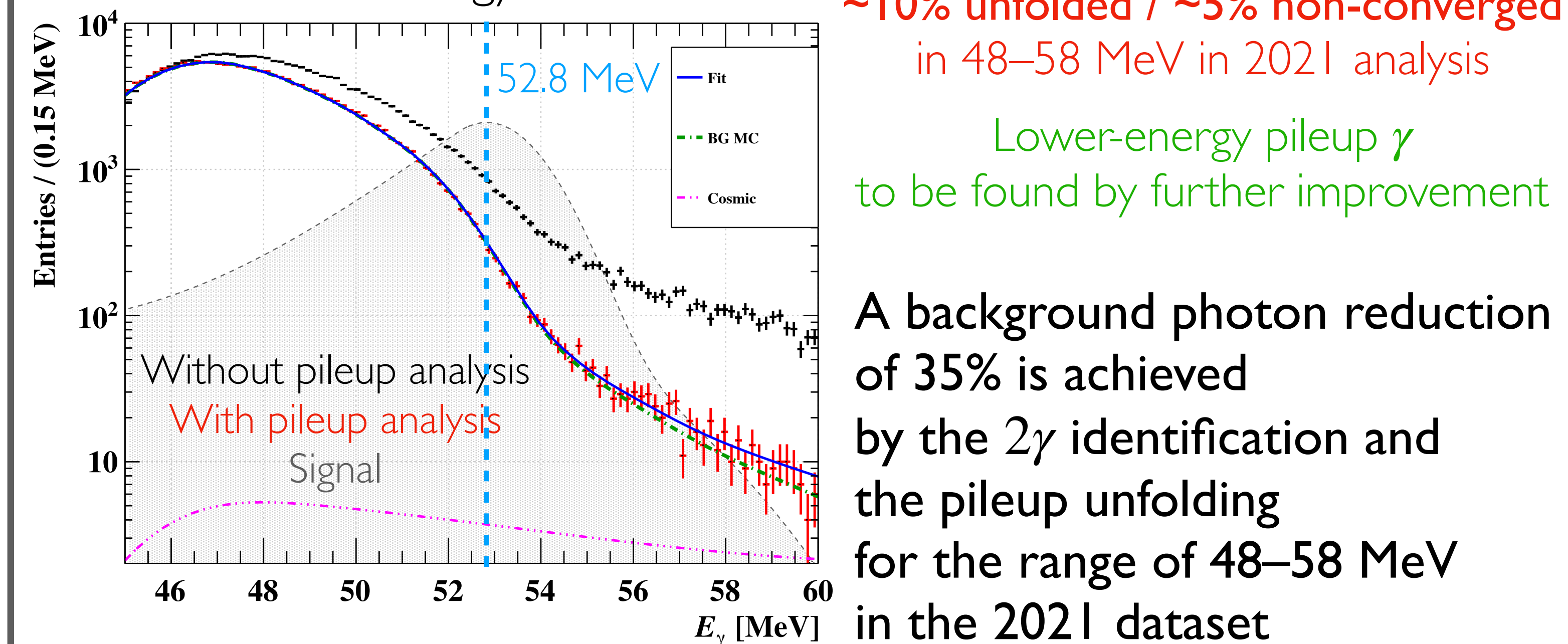


Pileup photon unfolding

Accidental pileup photons subtracted by template fit of waveform sums



Reconstructed energy of 2021 data



Reference

- [1] A. M. Baldini et al., "The design of MEG II experiment", Eur. Phys. J. C, 78, 380 (2018)
- [2] Y. Kuno and Y. Okada, "Muon decay and physics beyond the standard model", Reviews of Modern Physics, 73 (2001)
- [3] S. Ogawa, "Liquid xenon detector with highly granular scintillation readout to search for $\mu^+ \rightarrow e^+\gamma$ with sensitivity of 5×10^{-14} in MEG II experiment", PhD thesis, The University of Tokyo (2020)

Conclusion & prospects

- Pileup analysis is required to reconstruct one-photon energy in LXe detector.
- A background photon reduction of 35% is achieved by the 2γ identification and the pileup unfolding in the 2021 dataset.
- Further improvement is in progress and applied to the 2021+2022 analysis.