The Performance of the RENE Prototype Detector.

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The Reactor Experiment for Neutrinos and Exotics (RENE) aims to search for the sterile neutrino at $\Delta m_{41}^2 \sim 2$ eV^2 region by measuring reactor neutrino oscillation. The RENE experiment will be conducted at Hanbit nuclear power plant in Yeonggwang, Korea. The RENE prototype detector consists of a 350 L target with liquid scintillator (LS) containing 0.5% gadolinium and a box-shaped gamma catcher filled with LS. Two 20-inch PMTs will be used to detect the inverse beta decay events from the target. The detector will be covered by plastic scintillators to discriminate IBD events from the cosmic-ray background. In this presentation, we will report the performance and latest status of the RENE prototype detector.

Wonjun Lee (Seoul National University)
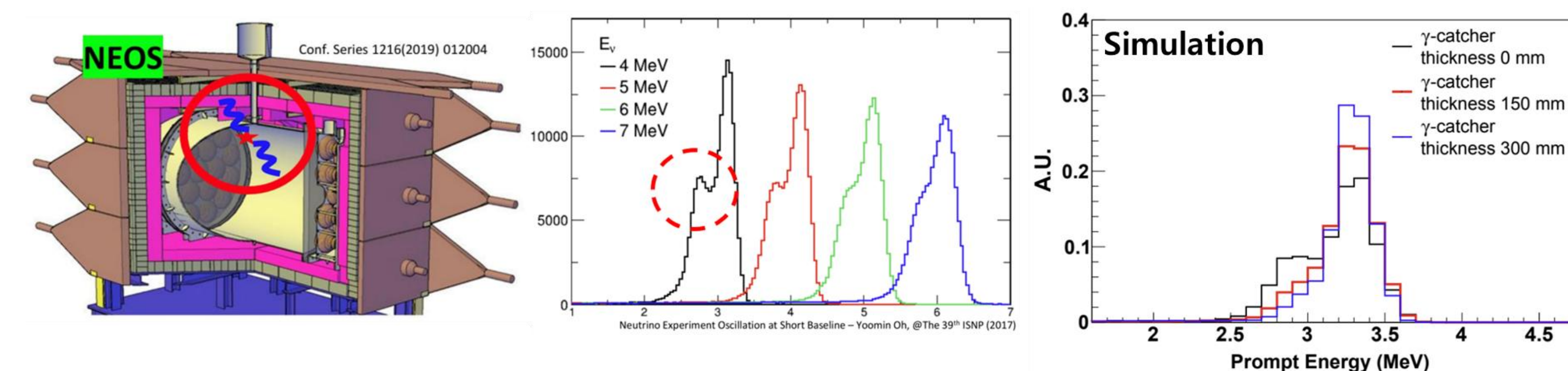on behalf of RENE Collaboration

Introduction

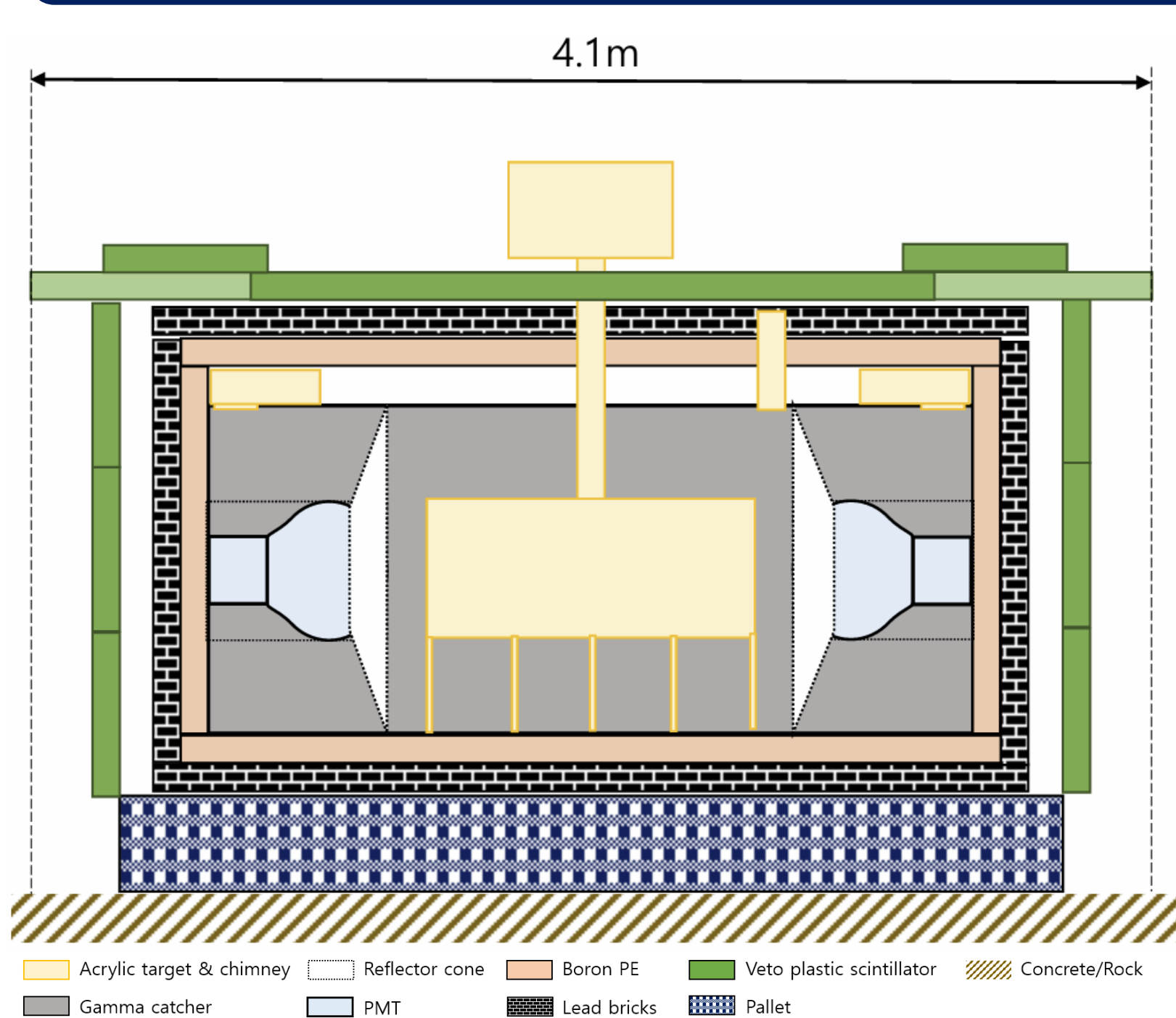### Motivation

- **RENO-NEOS joint analysis Hint** for the sterile neutrino at $\Delta m_{41}^2 \sim 2$ eV^2.

(PRD 105, 111101)
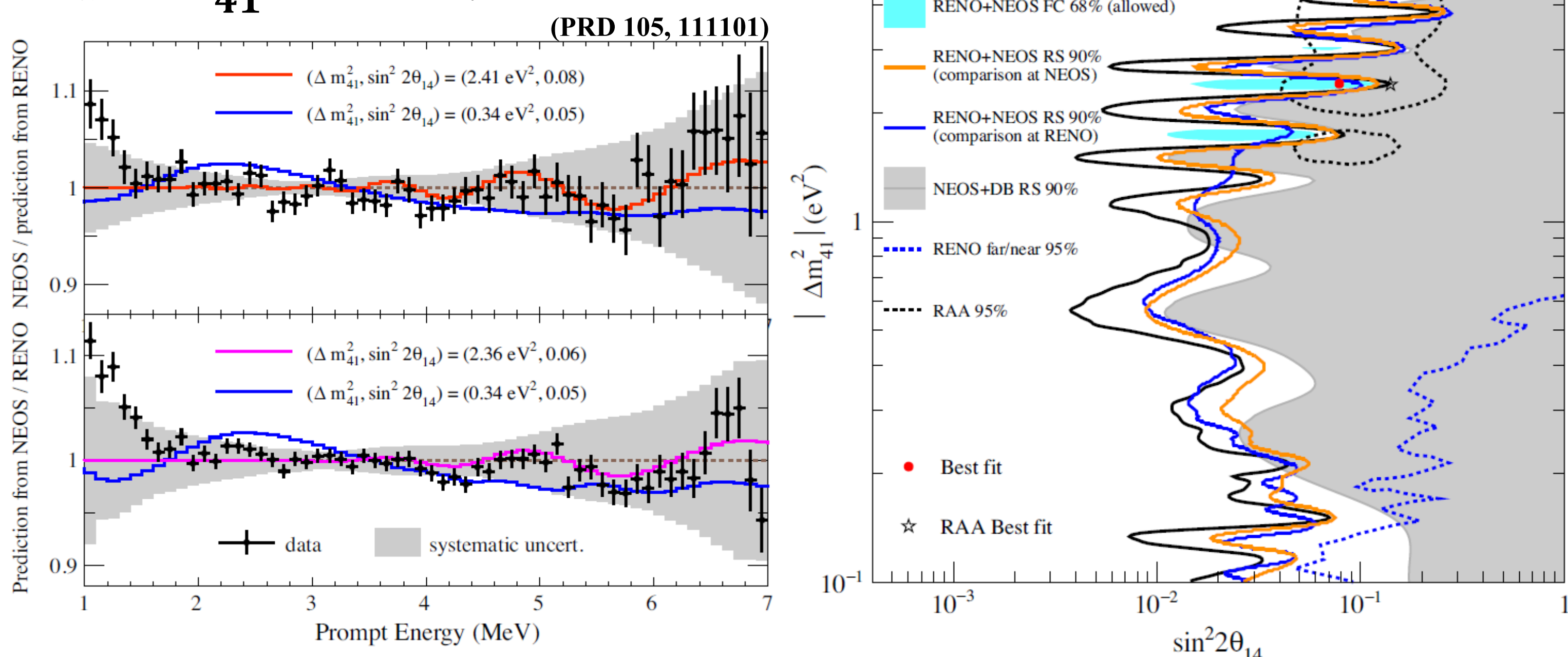
- NEOS's **low energy 2nd peak** is originated by **escaping gammas** from the target.
- **Gamma catcher** is needed to improve systematics.

RENE Detector Structure

Detector
- **2 20-inch PMTs**
- **0.5% Gd-LS target**
- **Box-shaped LS gamma catcher**

VETO
- **Plastic scintillator** from NEOS
- **32 2-inch PMTs**

Background shielding
- 100 mm thick **borated PE**
- 100 mm thick **high-density PE**
- 100 mm thick **lead bricks**

Acrylic target & chimney / Reflector cone / Boron PE / Veto plastic scintillator / Concrete/Rock / Gamma catcher / PMT / Lead bricks / Pallet

Commissioning
- **0.1 % RENO Gd-LS for the target**
- **RENO LS for the gamma catcher**

Gain Selection
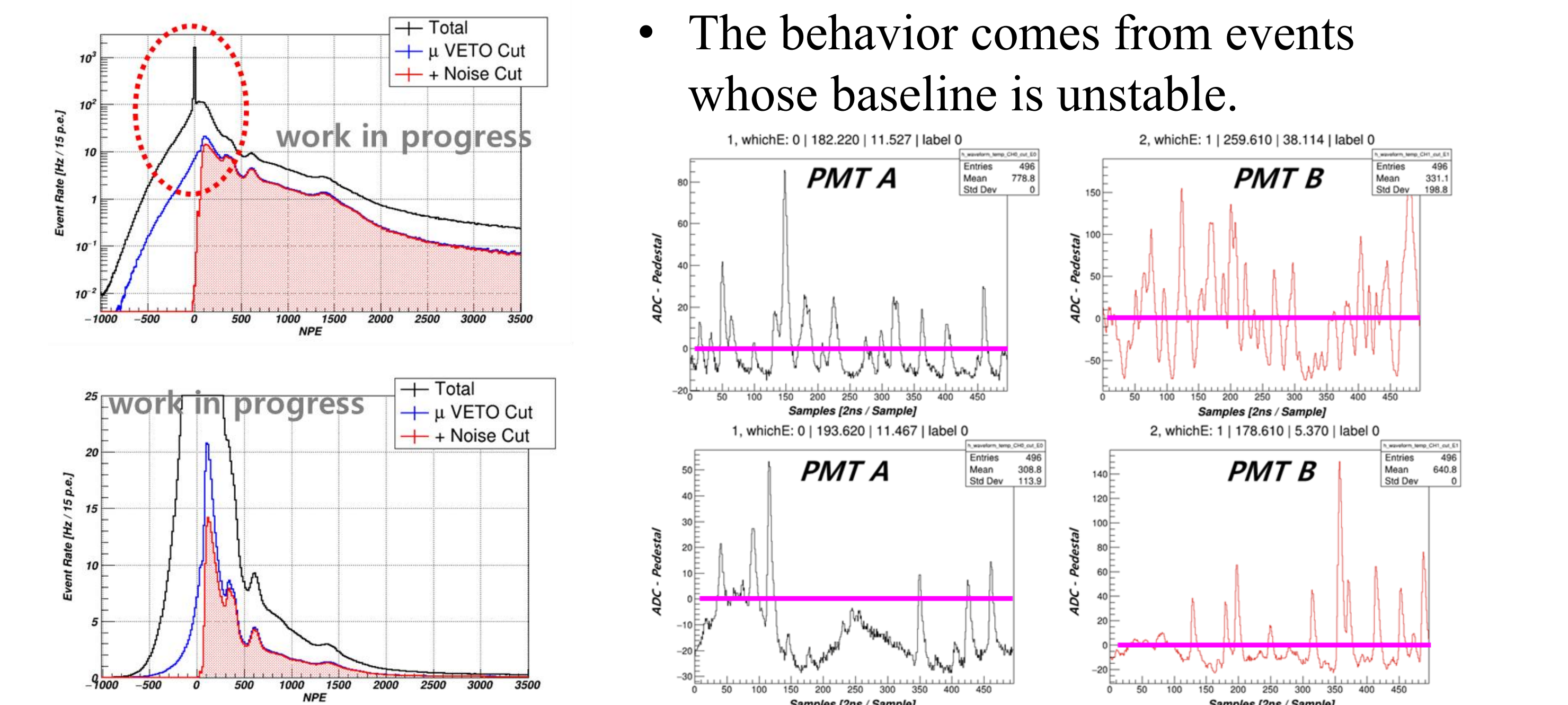
Conditions.
- DAQ saturation in n-Gd peak: **≤ 0.1 % events** compared to the peak when the Cf source is placed at the center of the target.
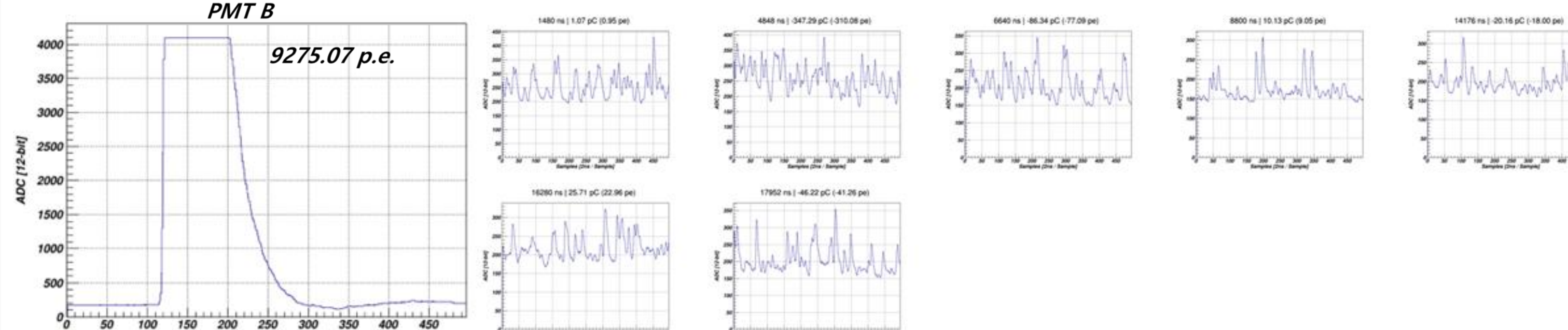- **Stable for two days.**

[n-Gd's ~8 MeV peak structure]

=> Select 0.7×10^7 gain.
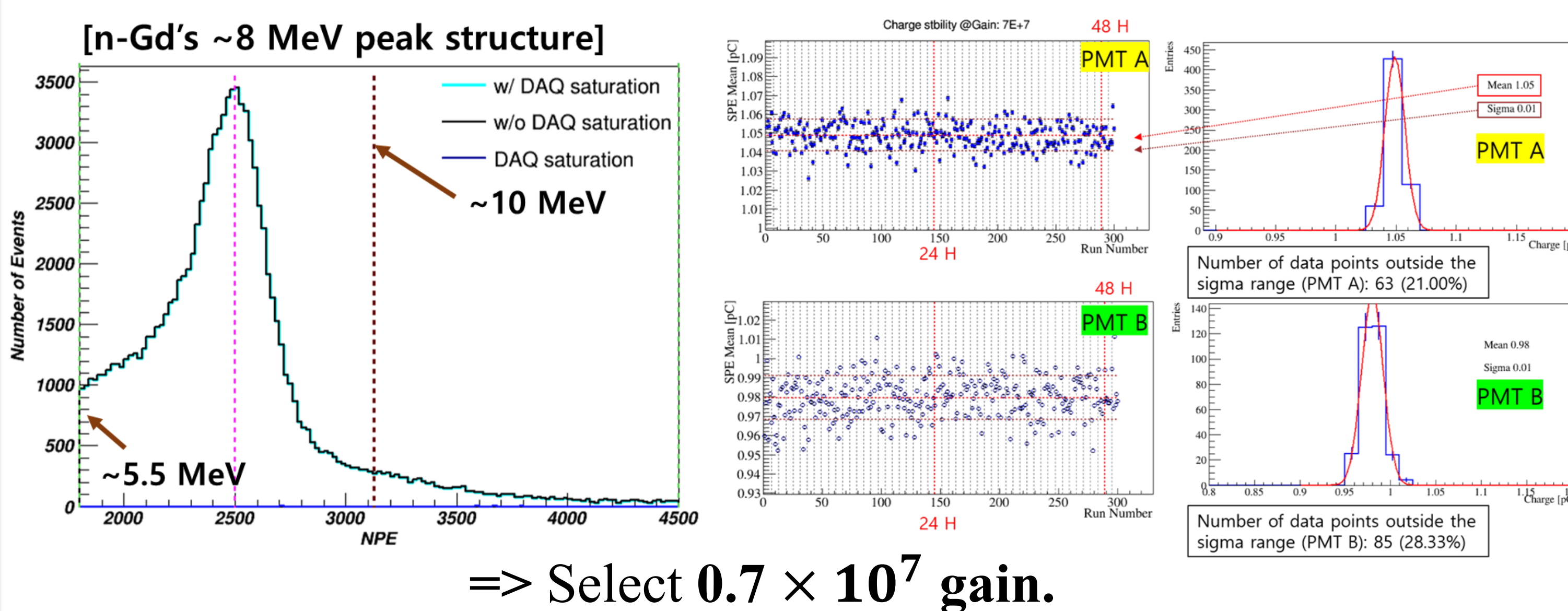
Performance

Background spectrum

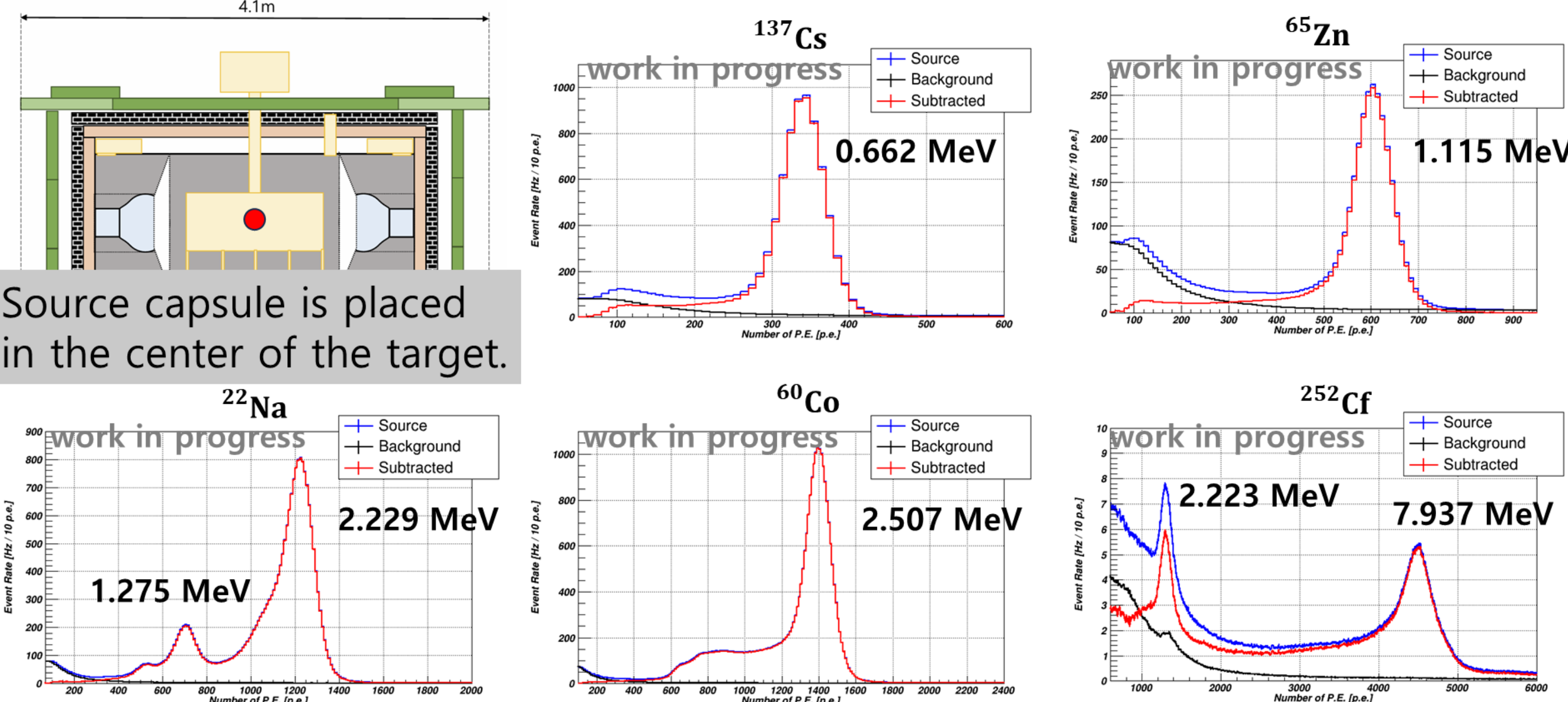- The behavior comes from events whose baseline is unstable.

- Baseline-unstable events occur after high-energy particles pass through the target.

- A VETO cut which rejects events within 150 μs after an external event and a noise cut are applied.
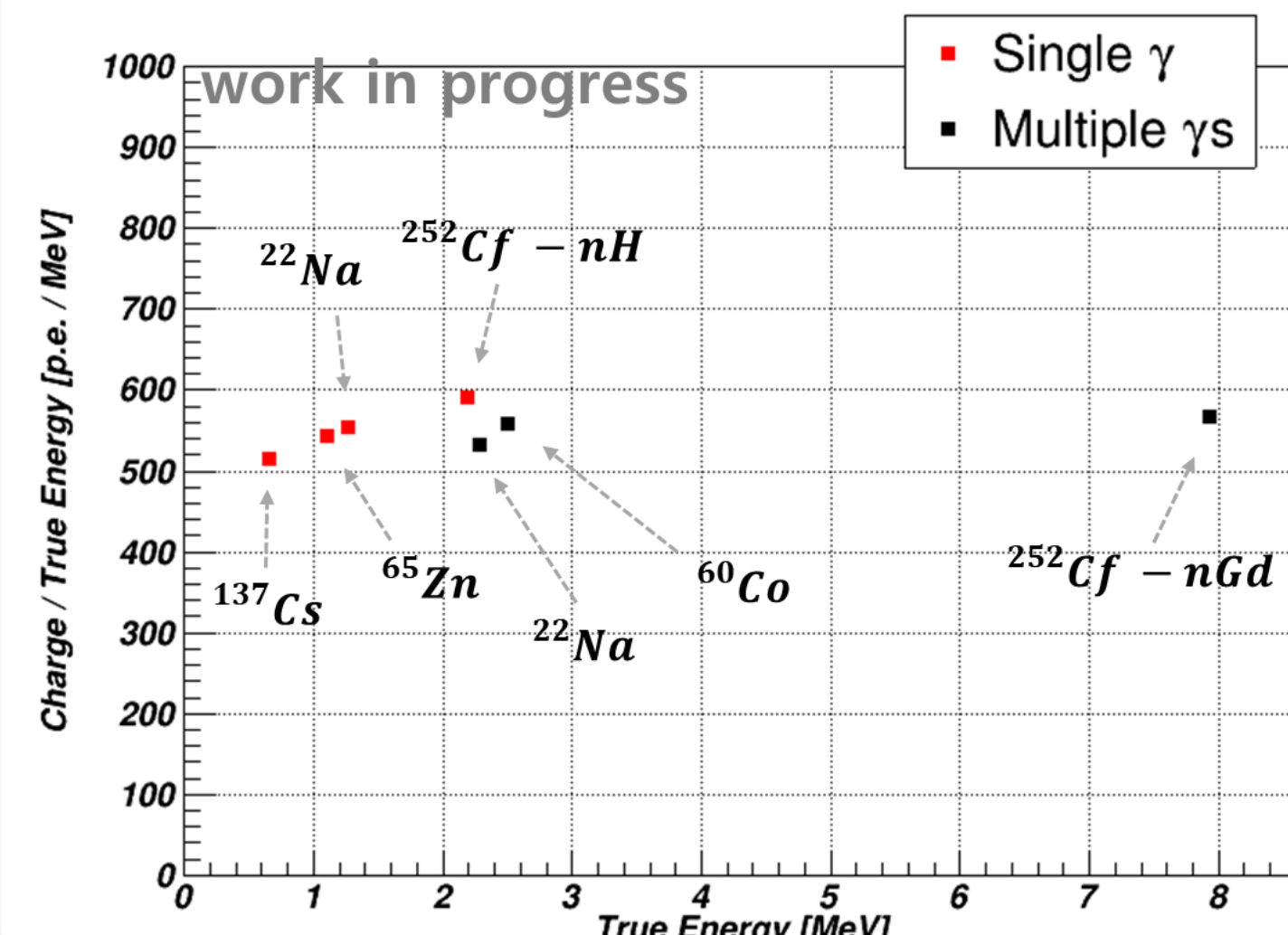
=> The cuts are currently under study.

NPE distribution

Source capsule is placed in the center of the target.

- NPE table using gaussian fitting functions for the peaks.

Source	^{137}Cs	^{65}Zn	^{22}Na		^{60}Co	^{252}Cf	
NPE	340.97 ± 0.02	604.59 ± 0.06	705.67 ± 0.12	1220.97 ± 0.06	1398.19 ± 0.07	1300.41 ± 0.65	4487.83 ± 0.77
True Energy [MeV]	0.662	1.115	1.275	2.229	2.507	2.223	7.937

True Energy vs NPE / True Energy

- **A non-linear response** to scintillation energy is observed when radioactive sources are placed at the center of the target.

- The conversion function will be constructed, and the spectrum reconstruction will be performed.

Summary

- The RENE experiment aims to search **for the sterile neutrino at $\Delta m_{41}^2 \sim 2$ eV^2.**
- Several cuts for event selection are currently under study with the background spectrum.
- The detector is being calibrated using several radioactive sources.
- **We plan to install and start taking data in tendon gallery this year.**

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