Detection of nuclear recoil events with SF6 gas

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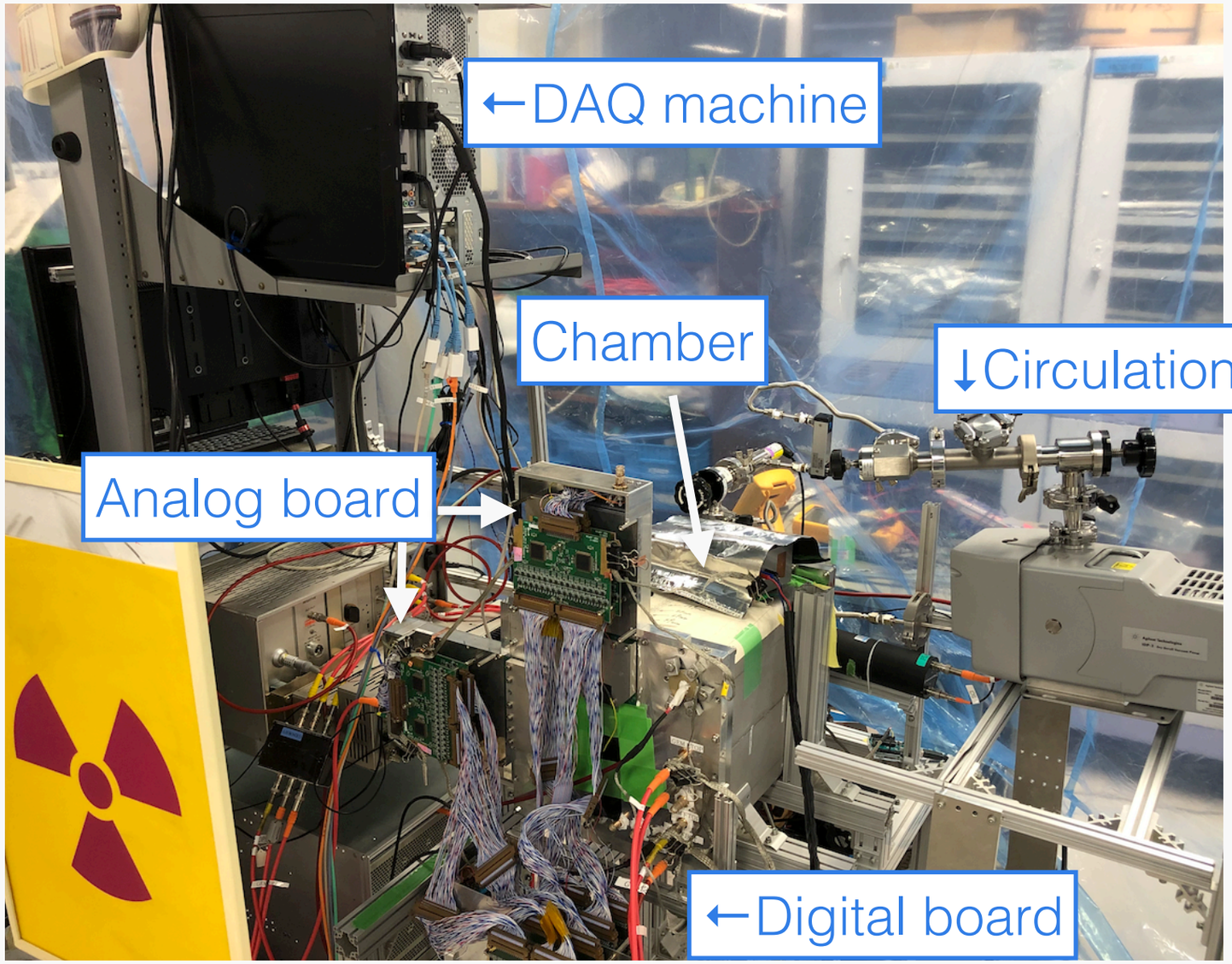
Introduction

- We had developed a test chamber to test SF6 gas as the target of DM
  - ➡ short-term experiment was carried out (3 days) last month
  - ➡ we will report current status of the analysis

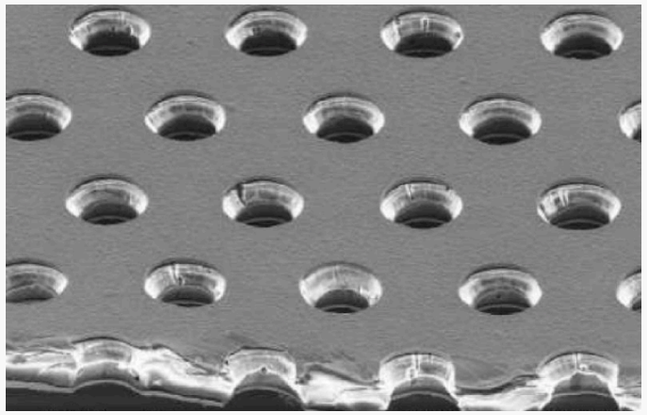


Gas: **pure SF6 (20 Torr)**

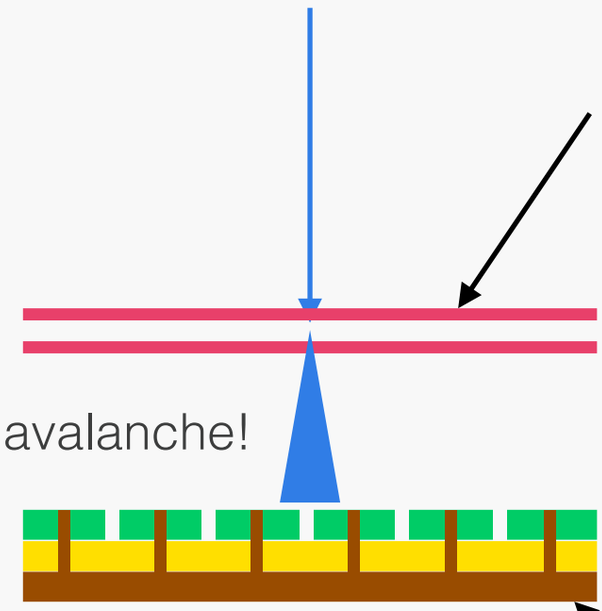
Detector

- 400 um pitch 2D strip readout (μ-PIC) with double GEM amplification
- ~100 × 100 × 150 mm^3 drift volume
  - ➡ only 64 ch × 32 ch (25.4 mm × 12.8 mm) readout is used in this test

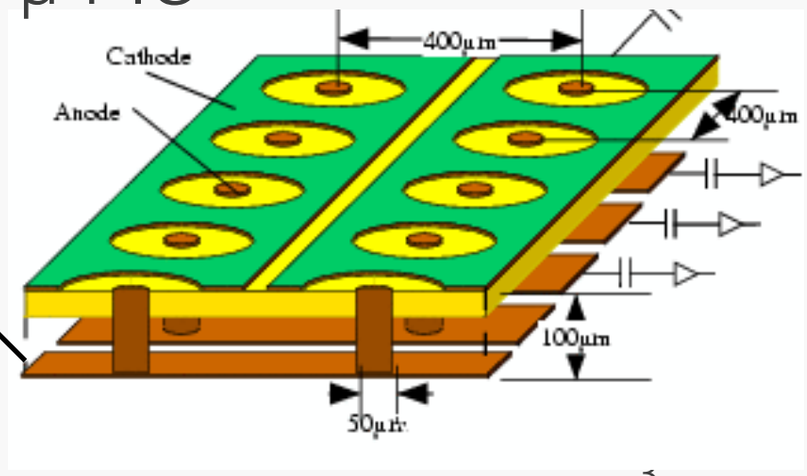
GEM × 2



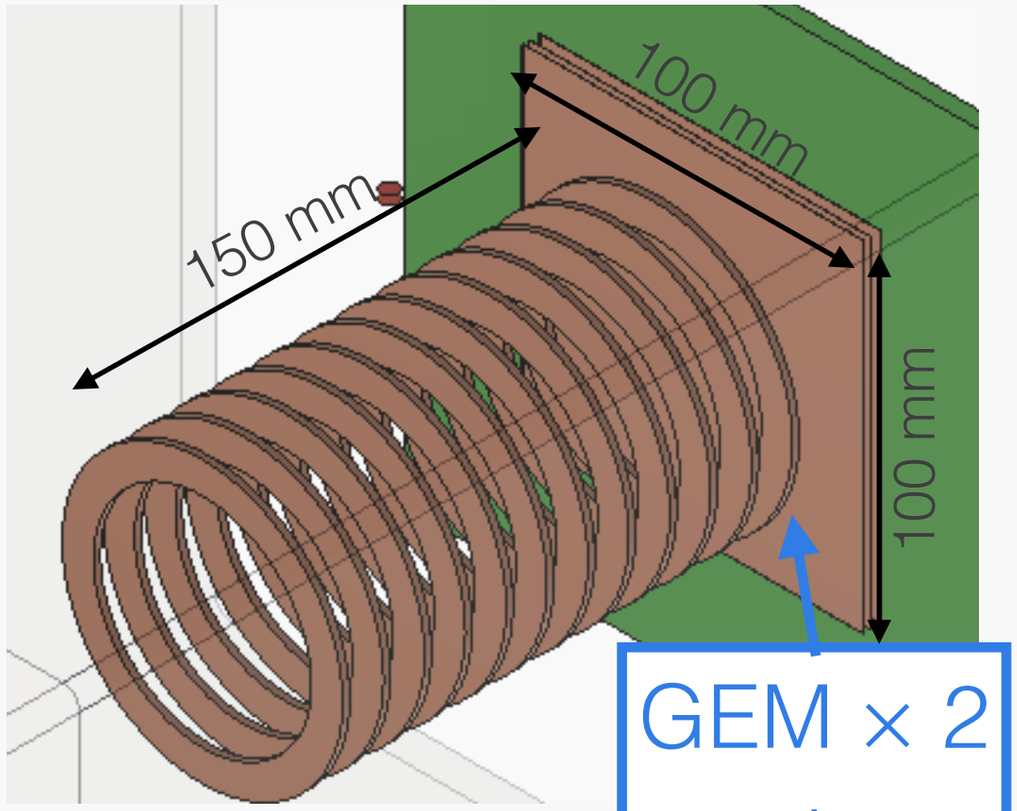
drift electron



μ-PIC



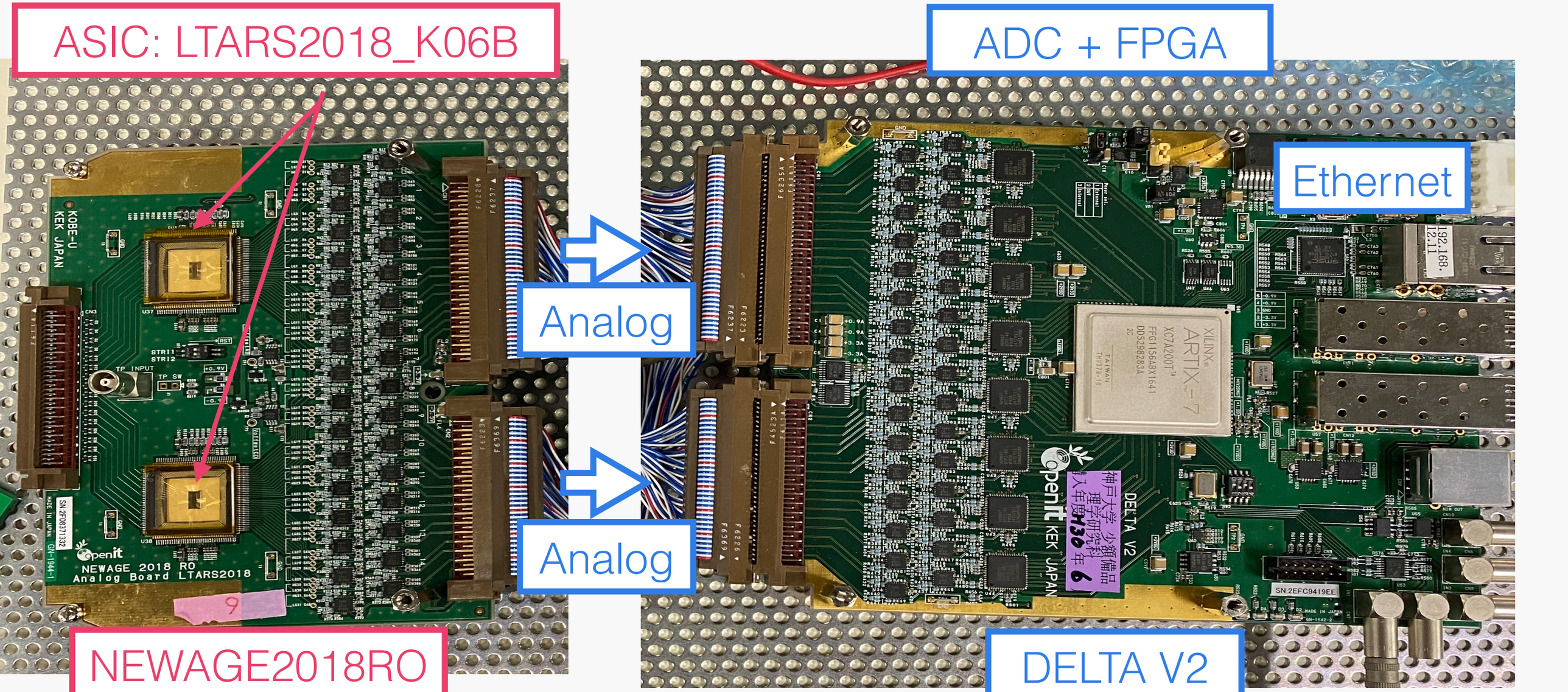
Field cage



GEM × 2
+
u-PIC

DAQ

- “LTARS2018” ASIC’s (amplifier) are used
  - ➡ ~ 4 us peaking time, good S/N and wide dynamic range
- 4000 sampling flash ADC with 2.5 MHz clock

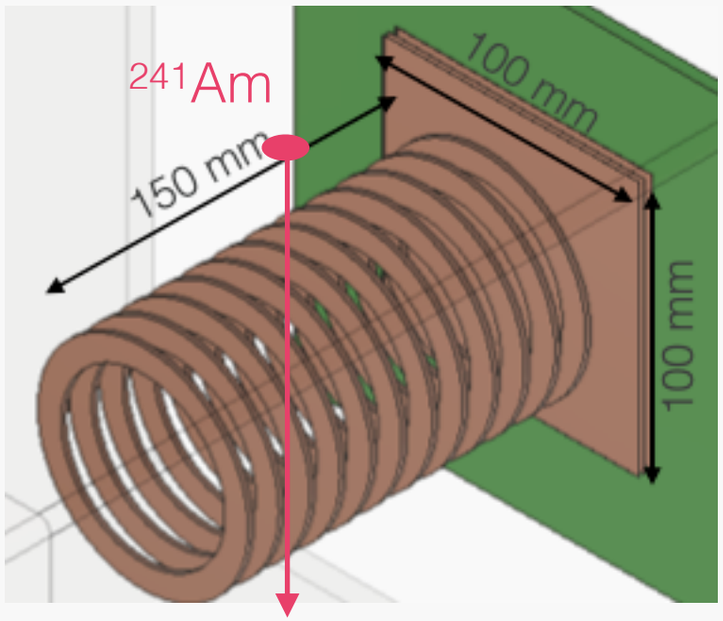


Measurement in April

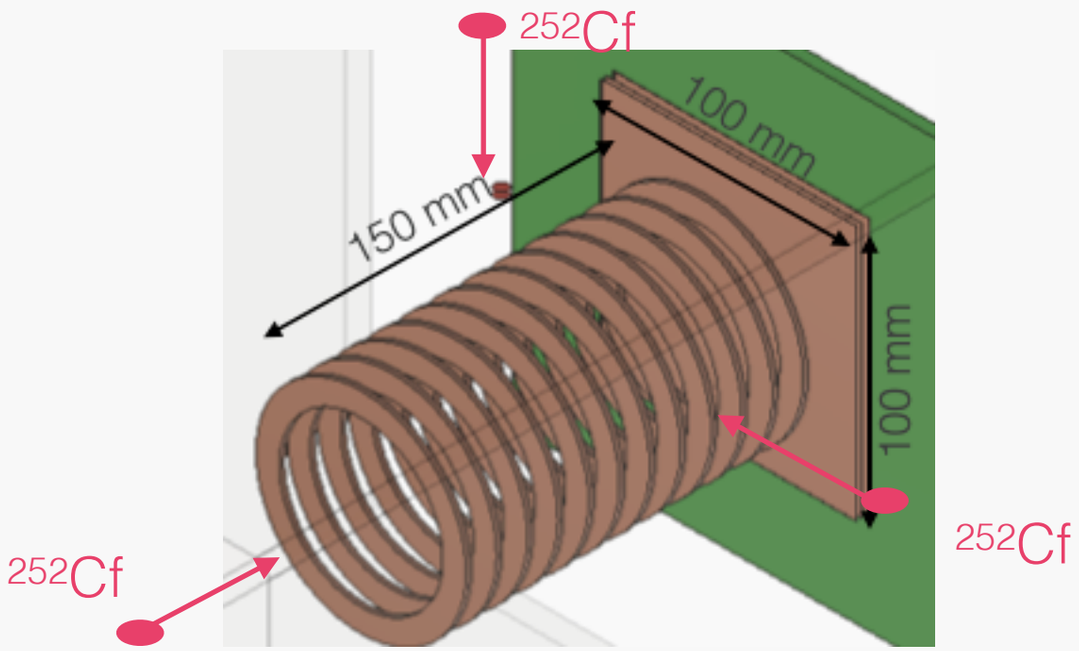
Two measurement

- Alpha run
  - ➡ Used ^{241}Am source for the energy calibration
- Neutron run
  - ➡ Used 252Cf source for the nuclear recoil detection

Alpha run

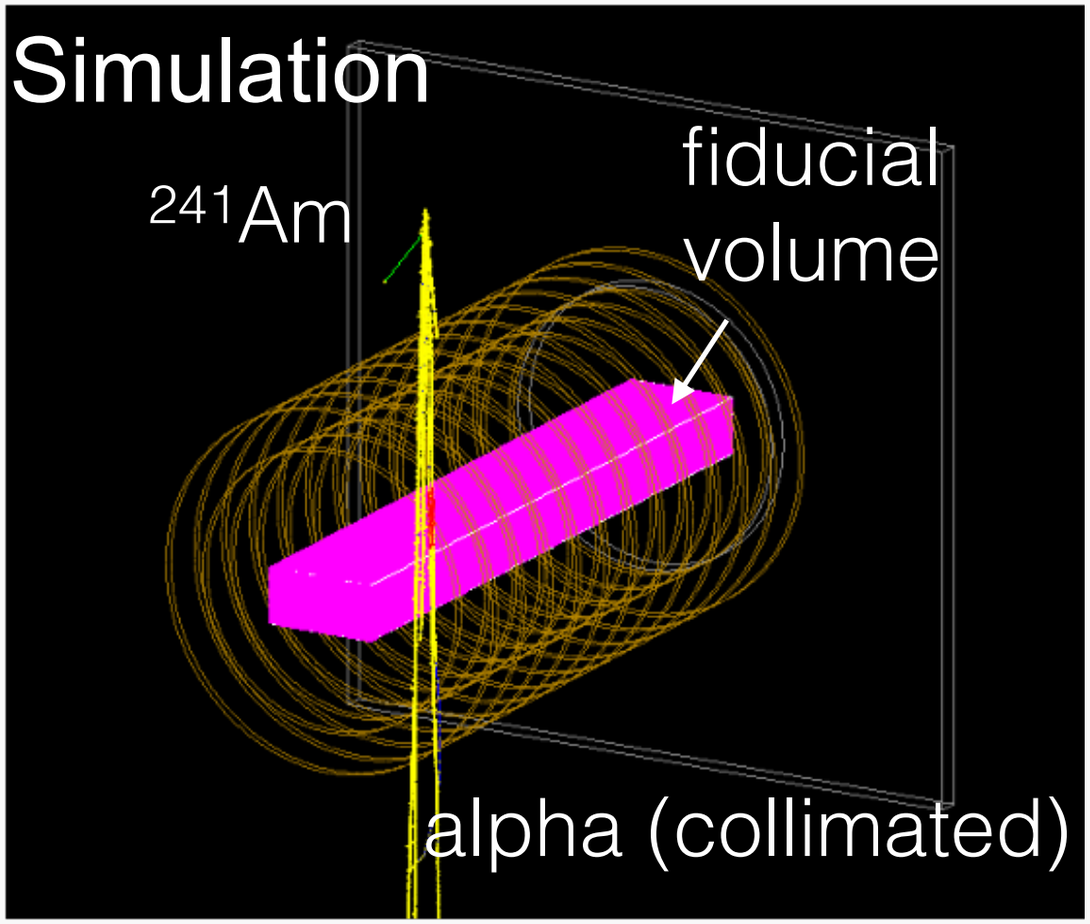


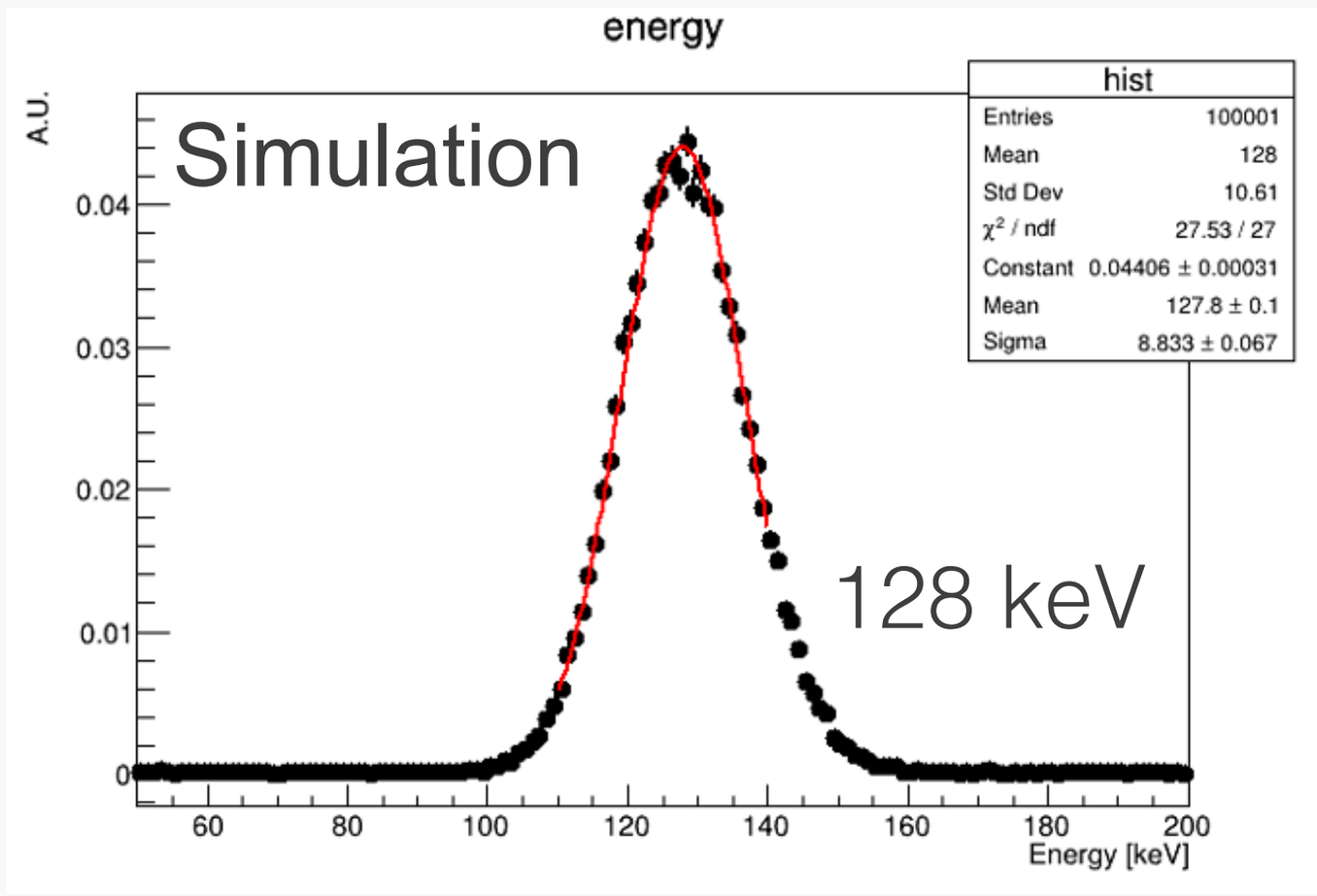
Neutron run



Energy calibration with alpha source

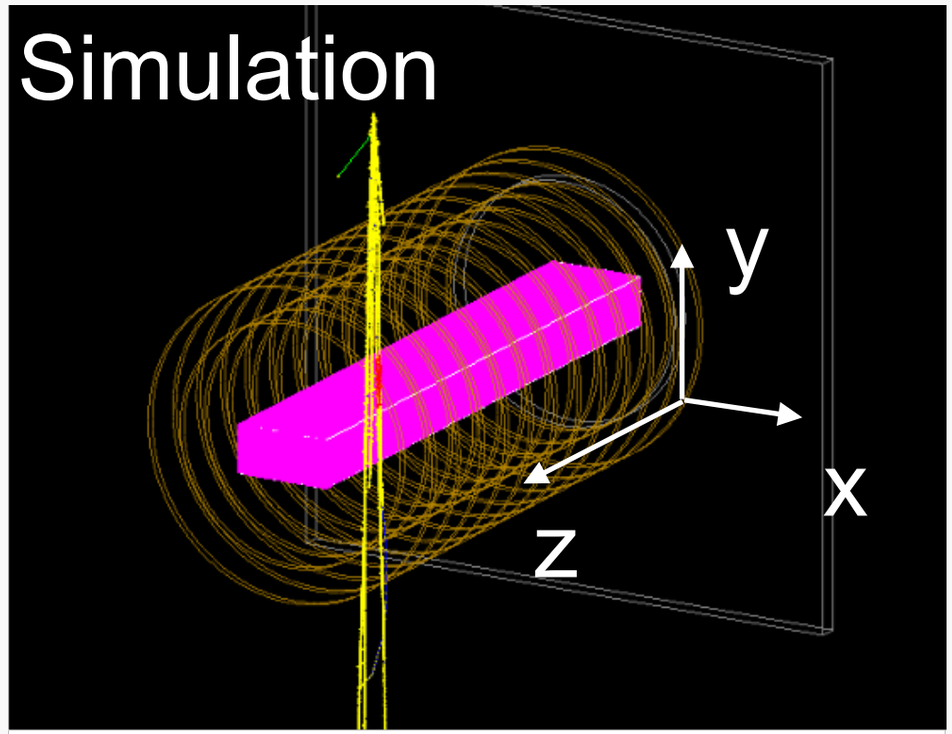
- ^{241}Am source is put in the chamber for energy calibration
  - ➡ Alpha-rays are collimated to path through the fiducial volume vertically
- Energy deposit in the fiducial volume is estimated using Geant4 simulation



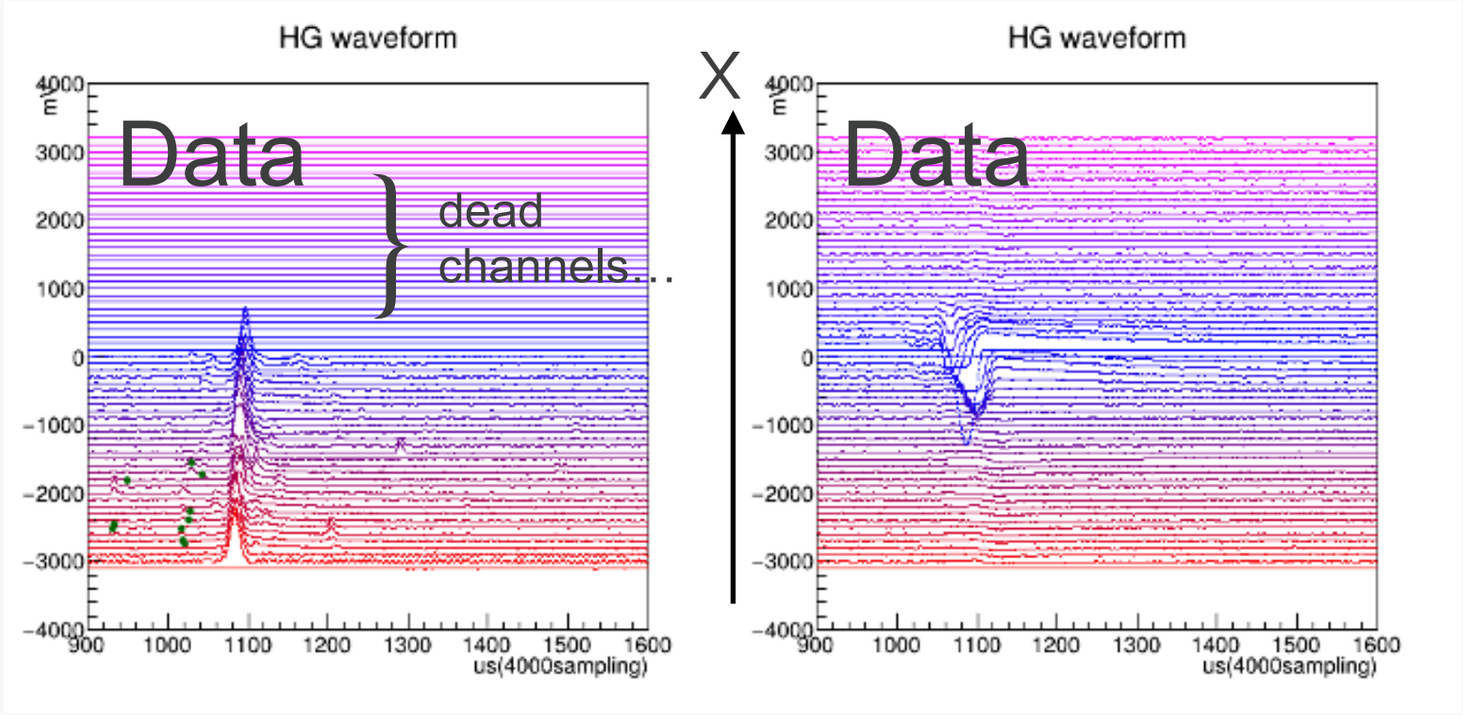


Alpha run

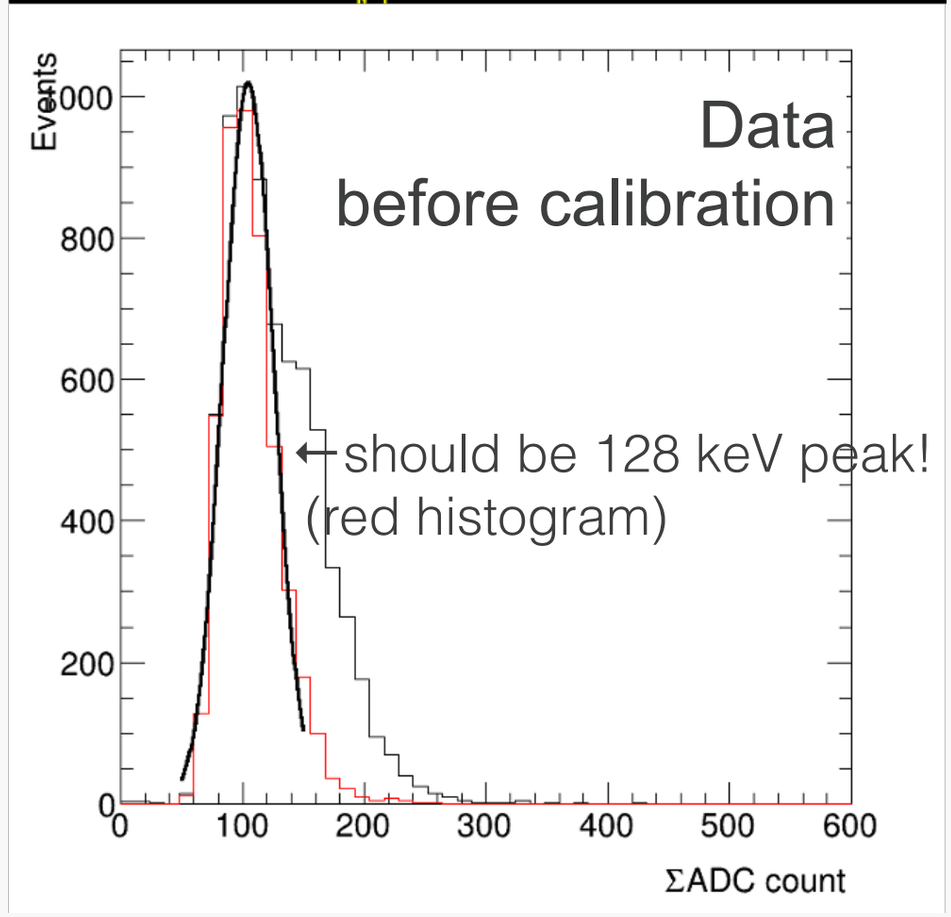
- Alpha tracks are successfully reconstructed form waveforms
  - ➡ Energy deposits are calculated by the integral of waveforms



y

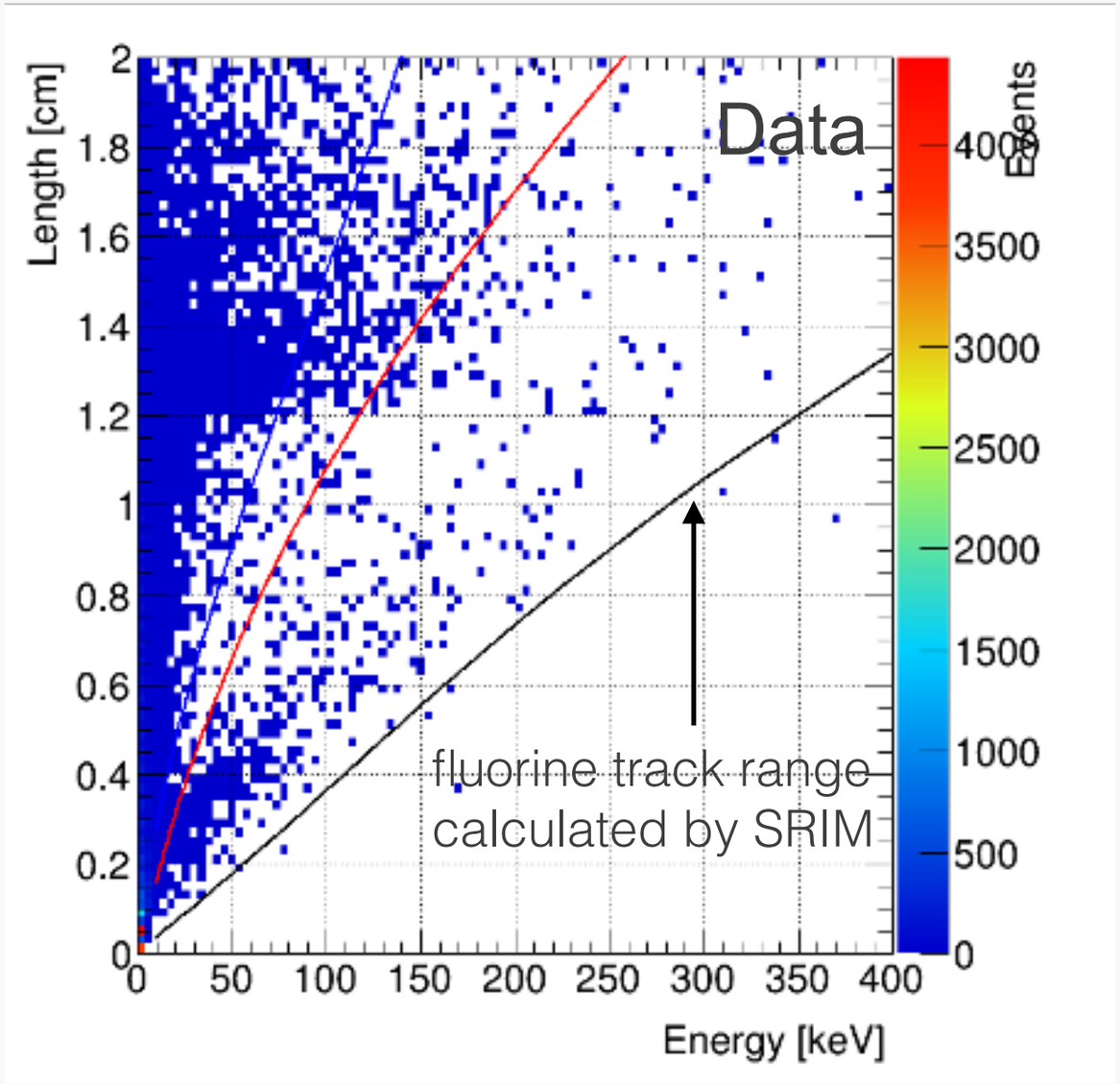


X



Neutron run

- Track length is calculated with waveforms
  - ➡ Nuclear recoil events are clearly seen in energy vs length plot



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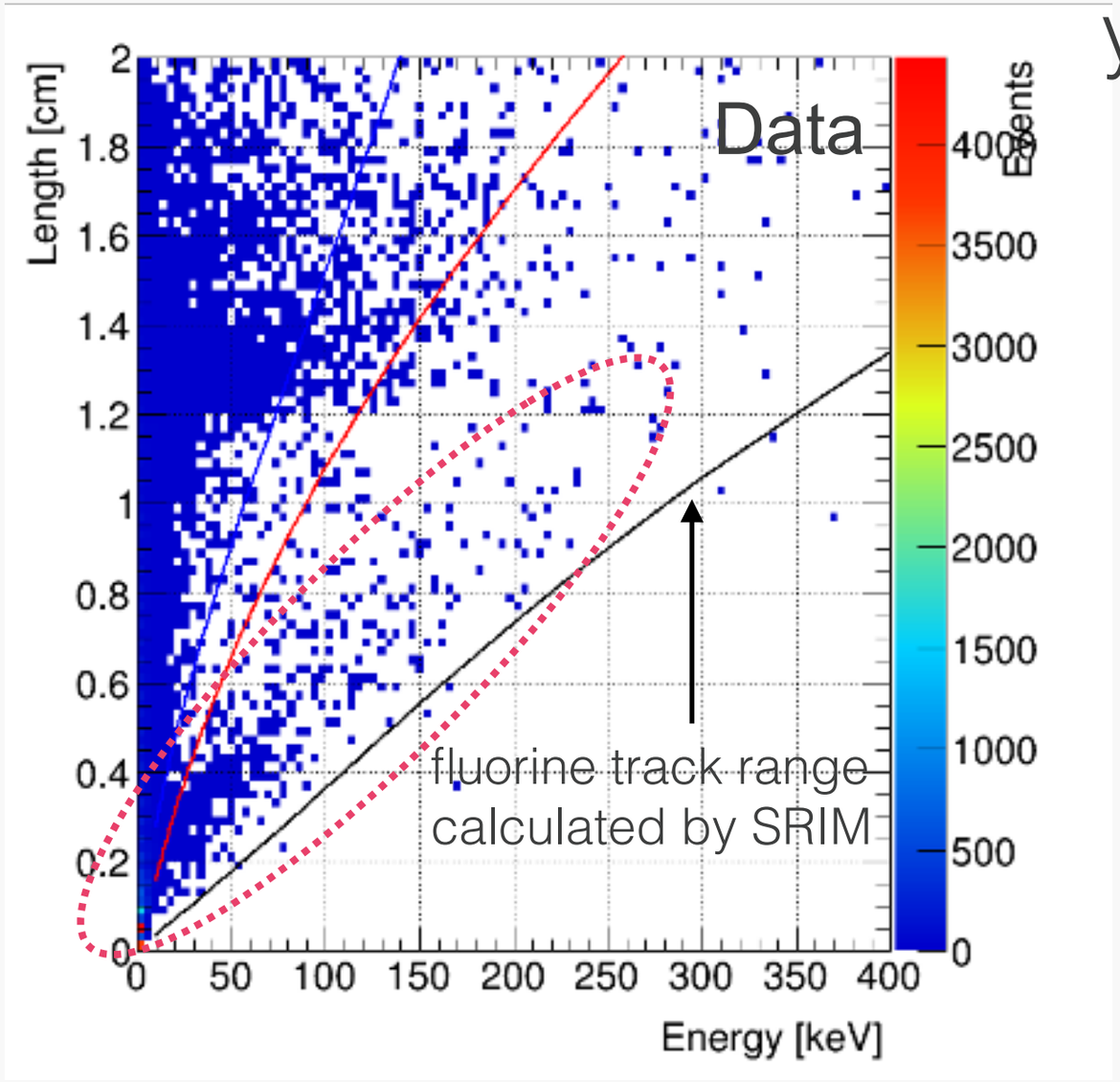
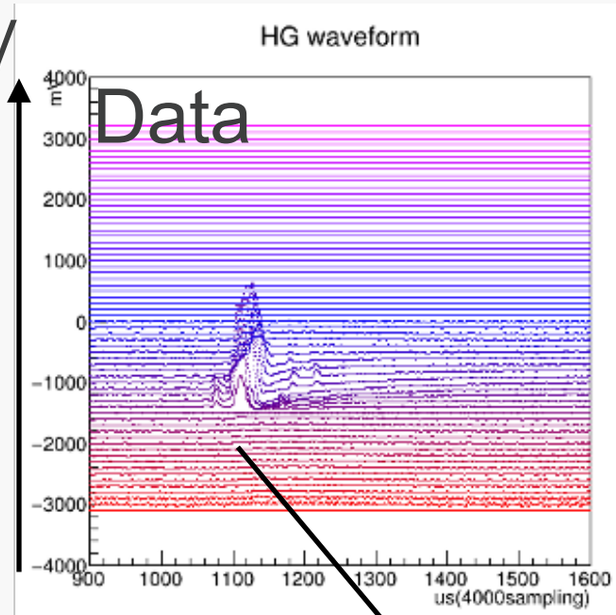
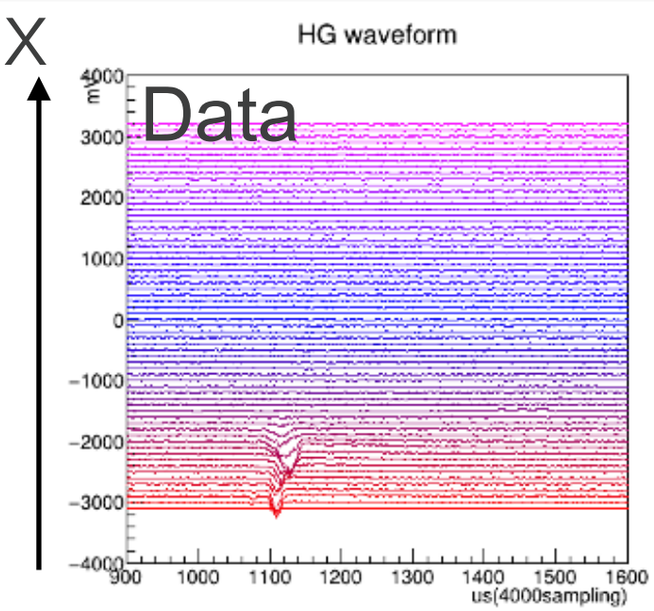


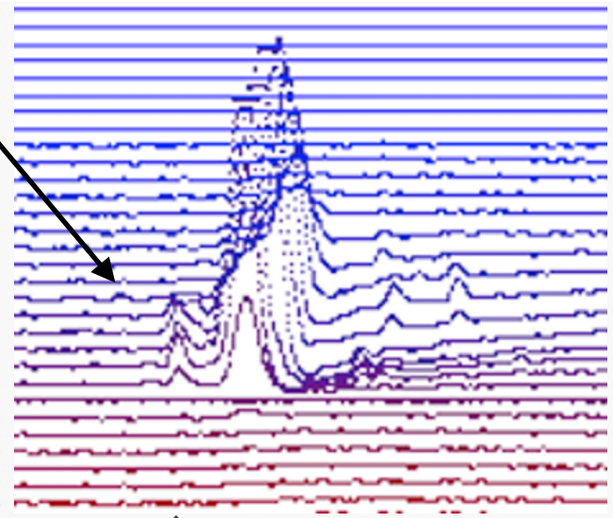
y



x



zoom



↑minority peak!

Future plan

- Efficiency of minority peak detection is one of the interest
  - ➡ Analysis is ongoing…
- Additional measurement is now preparing in parallel
  - ➡ Only 378 events are identified as nuclear recoil-like events in this experiment

➡ long-term measurement will be started at the beginning of June

Backup