KamLAND

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Supernova neutrino workshop, 2018/1/8-9

Contents

- *Status of SN monitor@KL*
- *New electronics for KL2*
- *Search for ν from GW event*

Next talk

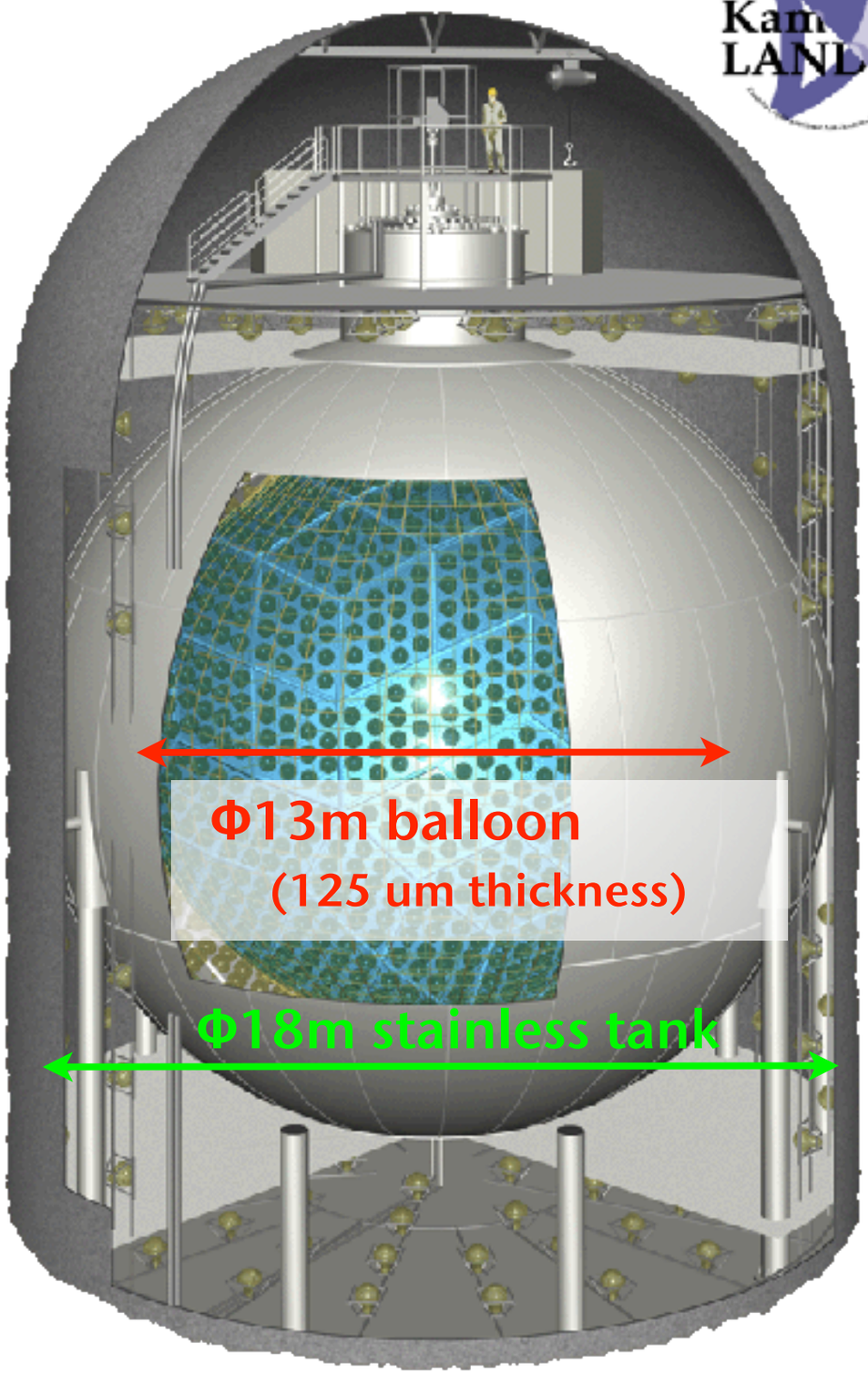
KamLAND detector

Kamioka Liquid scintillator
Anti-Neutrino Detector (since 2002)

- **1,000 m depth (Kamioka mine)**
- **1,000 t liquid scintillator**

  Dodecane (80%), Psedocumene (20%), PPO (1.36g/l)

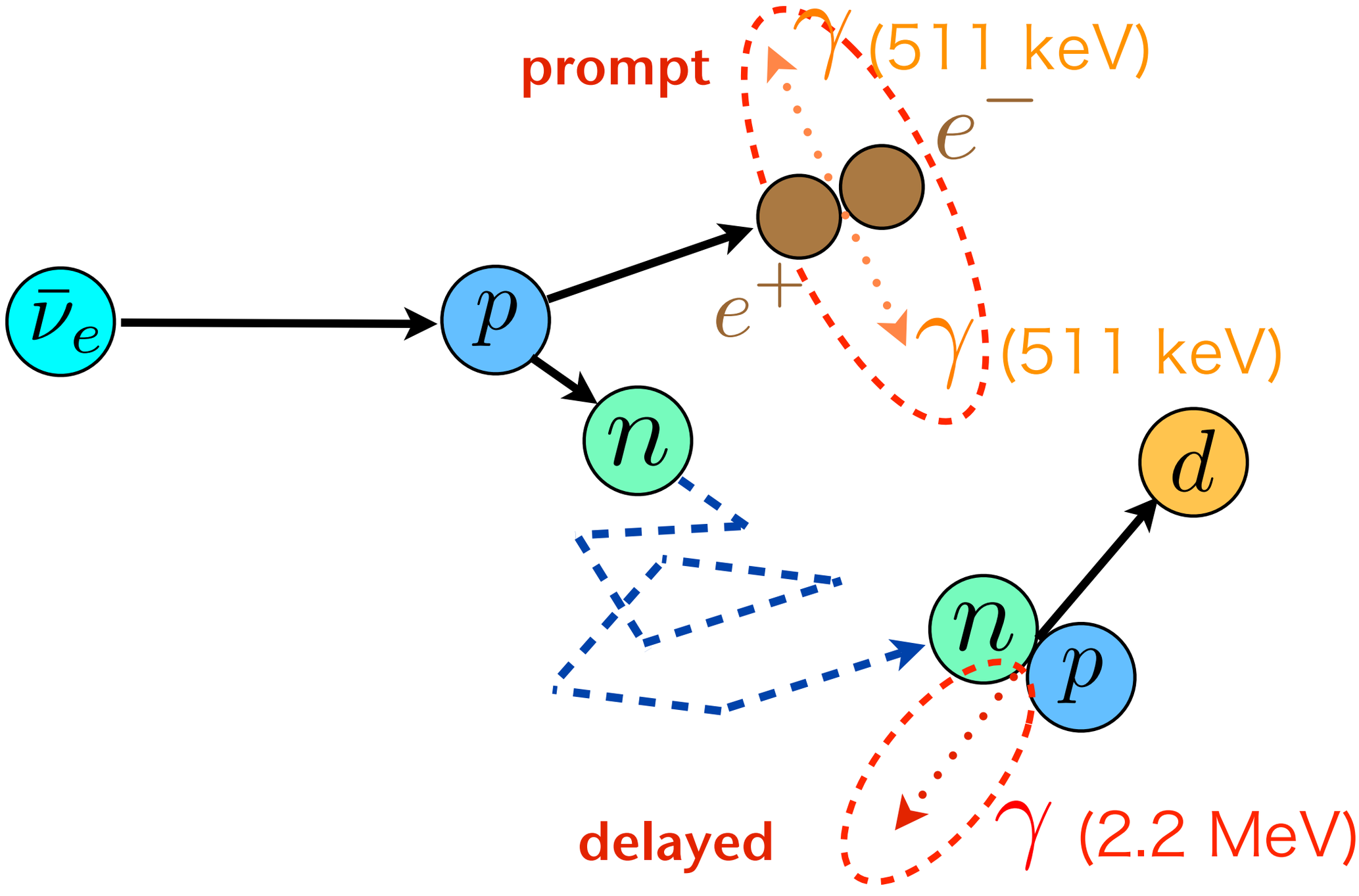
- **1,325 17inch + 554 20inch PMTs**



Outer detector (for muon veto)
- 3.2kton water cherenkov detector
- ~100 20inch PMTs

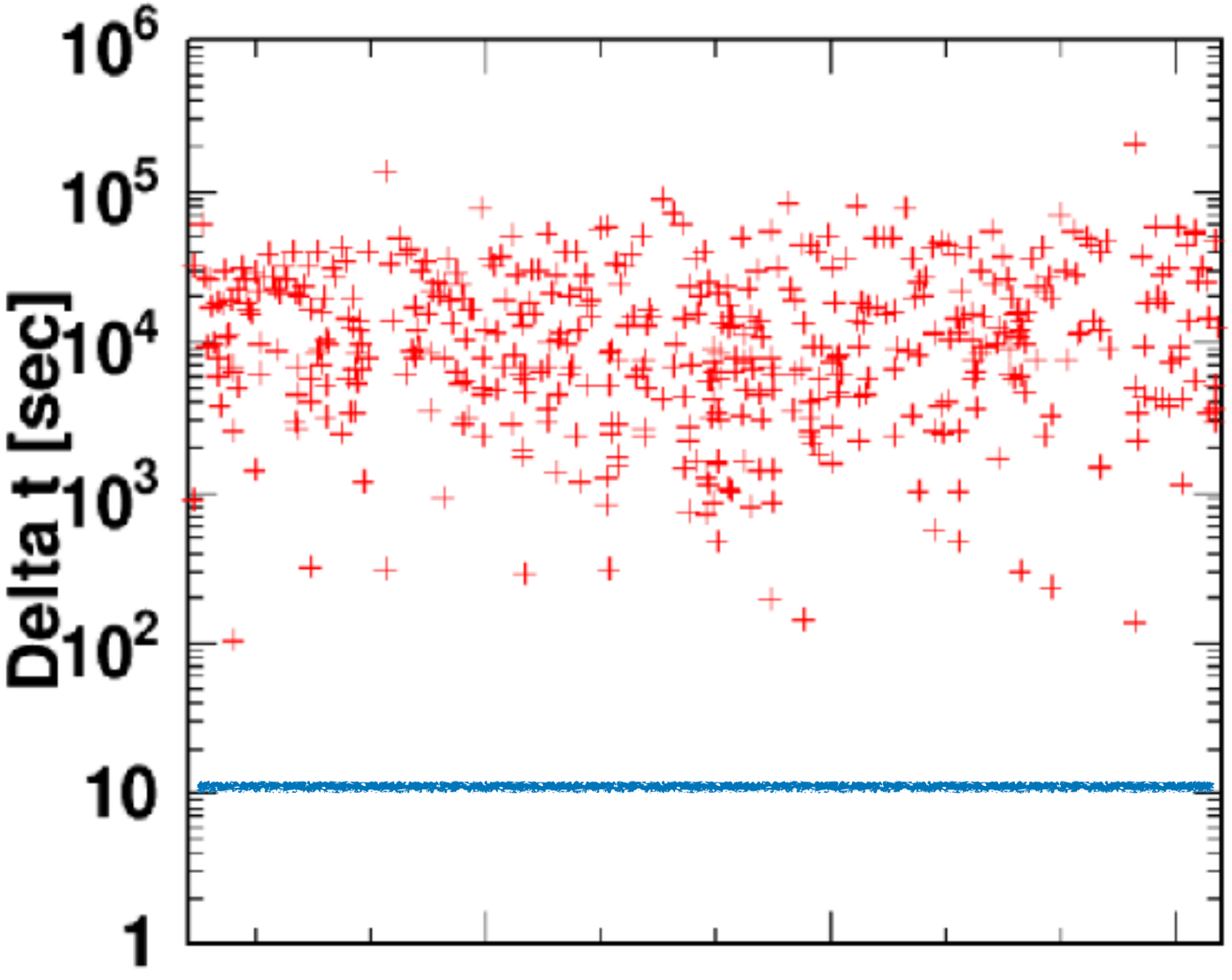
SN monitor@KL

Inverse-beta decay -> DC event



SN monitor@KL

Monitor of Δt

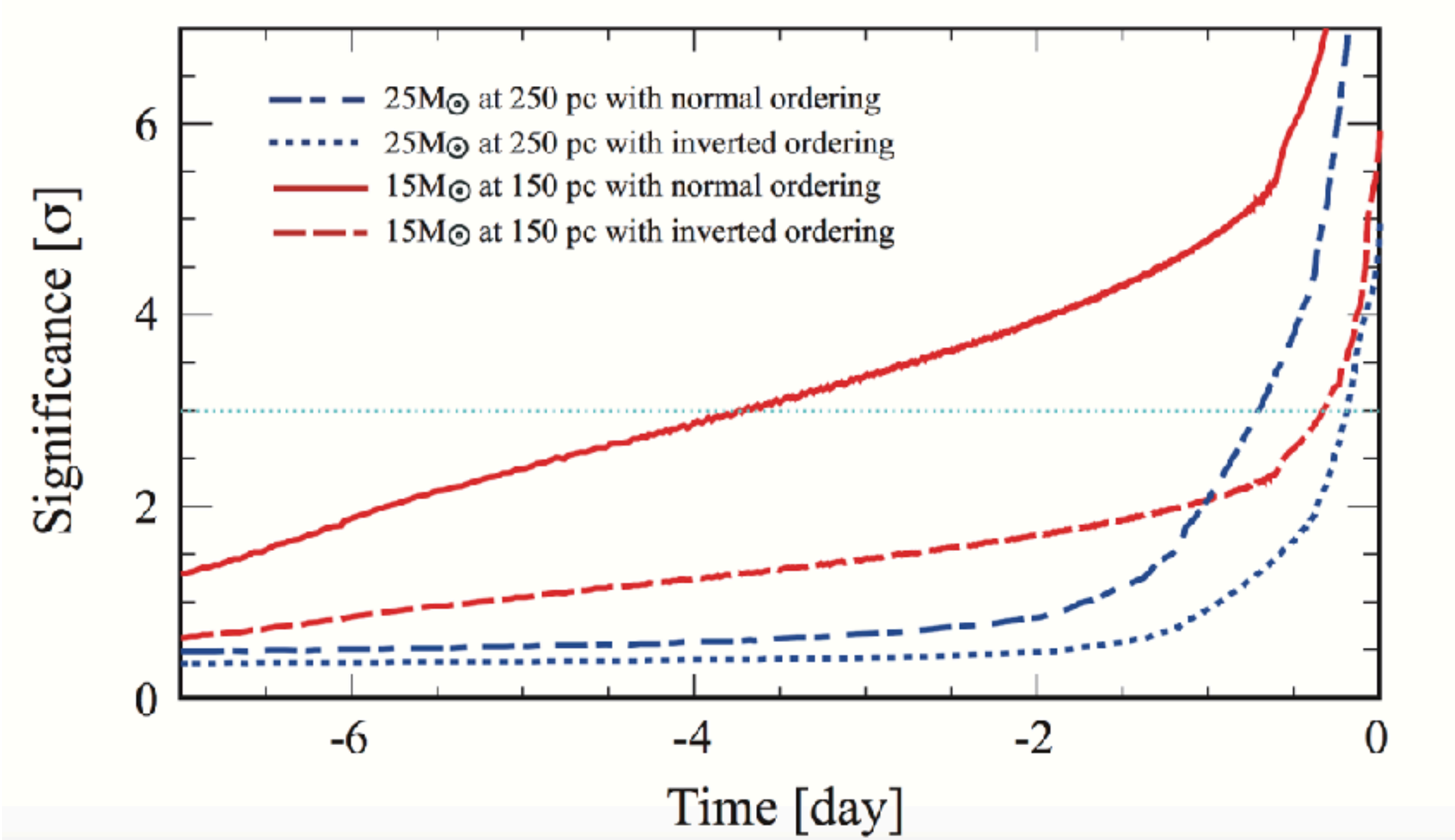


- 2.5 < Ep < 30MeV
- 1.8 < Ed < 2.6 MeV
  or 4.4 < Ed < 5.6MeV
- R < 650cm
- dR < 200cm
- 0.5 < dt < 1000us

Δt < 10sec => SNEWS

preSN monitor

Number of DC events in the past 48 hr (with likelihood selection)



Accident in the last year

Large significance (>5σ) from calibration (contact form SNO)

Alarm system: process with normal data

Ishidoshiro:
We do not need stop the SN monitor.
Someone:
It is useful to process with normal process.
The monitor should be stopped. Let's use normal process with the calibration data

Accident in the last year

Large significance (>5σ) from calibration
(contact form SNO)

Updates of system

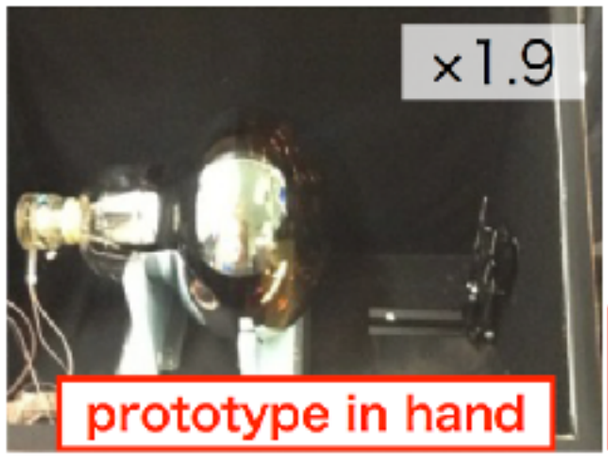
Stop of alarm system
Not use of normal process for calibration data

KamLAND2

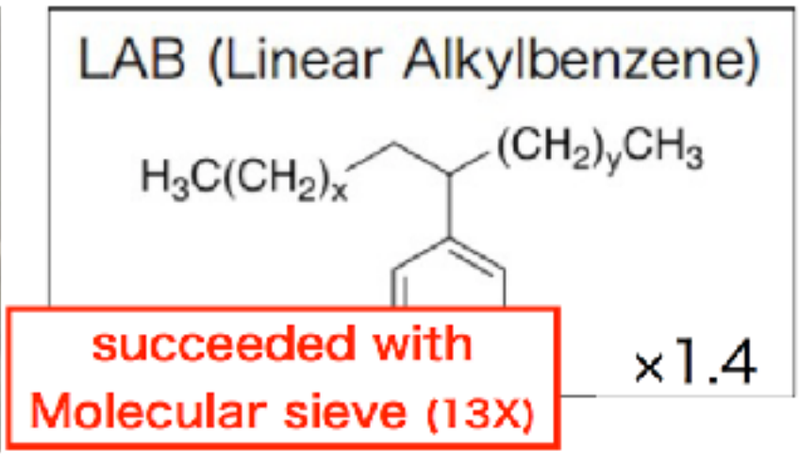
Improvements of energy resolution for KL-Zen

○ winston cone

○ HQE-PMT



○ New LAB-LS



Update of electronics and DAQ

Improvements for nearby SNe

Use of on-board memory and high speed readout

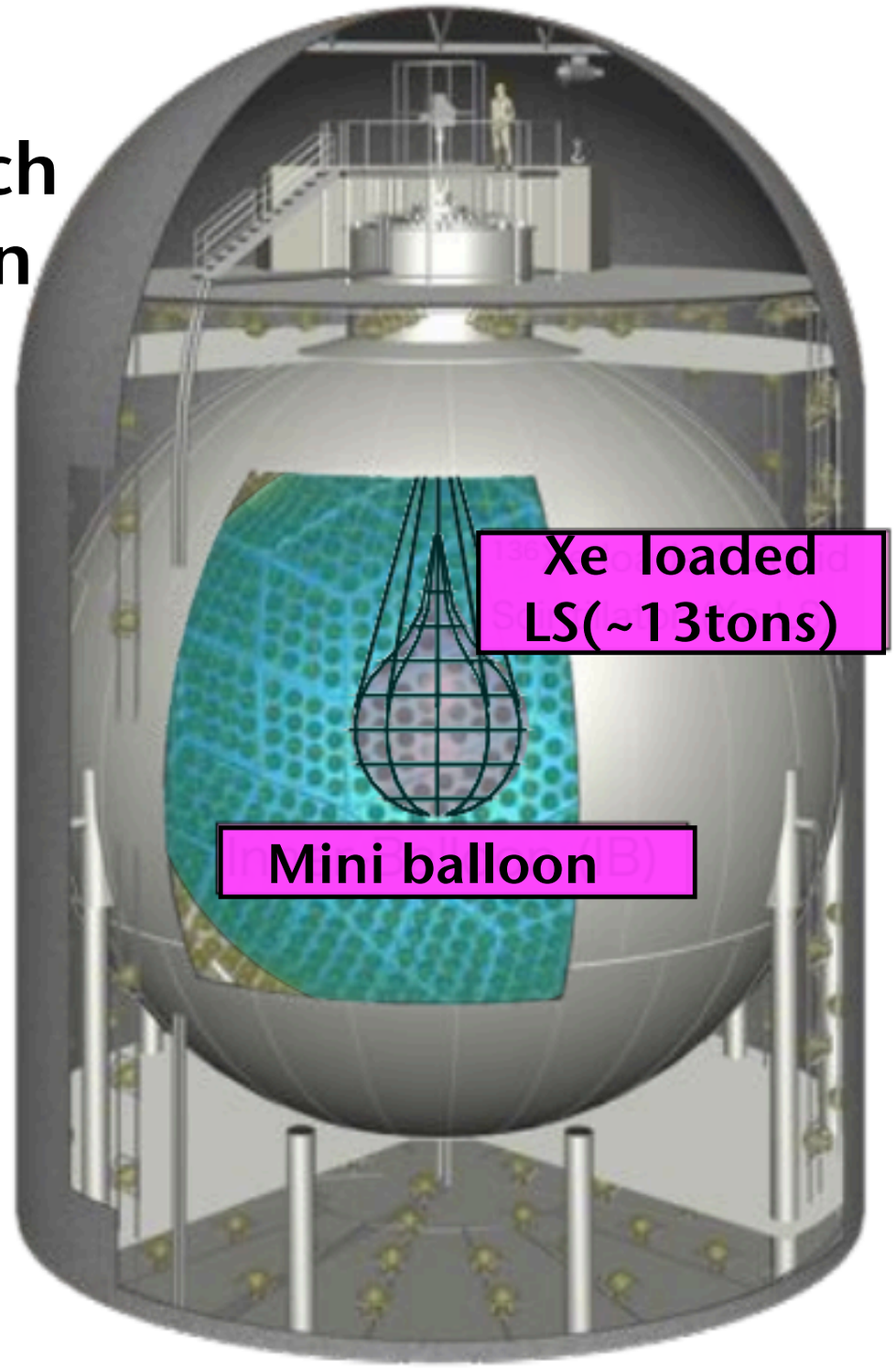
Improvements for n-tag efficiency due to muon

=> Reduction of 10C background for KL2-Zen

KamLAND-Zen

Neutrino-less Double-beta decay search using ^{136}Xe loaded LS in a mini balloon

decane 80.2%, pseudocumene 19.8%,
PPO 2.7g/l, Xe 2.4wt%



Detection

- Majorana neutrino
- Lepton number violation
- Heavy right-handed neutrino
  - ▲ Leptogenesis (Matter-dominated Universe)
  - ▲ Seesaw mechanism (light neutrino mass)

KamLAND-Zen

Neutrino-less Double-beta decay search using ^{136}Xe loaded LS in a mini balloon

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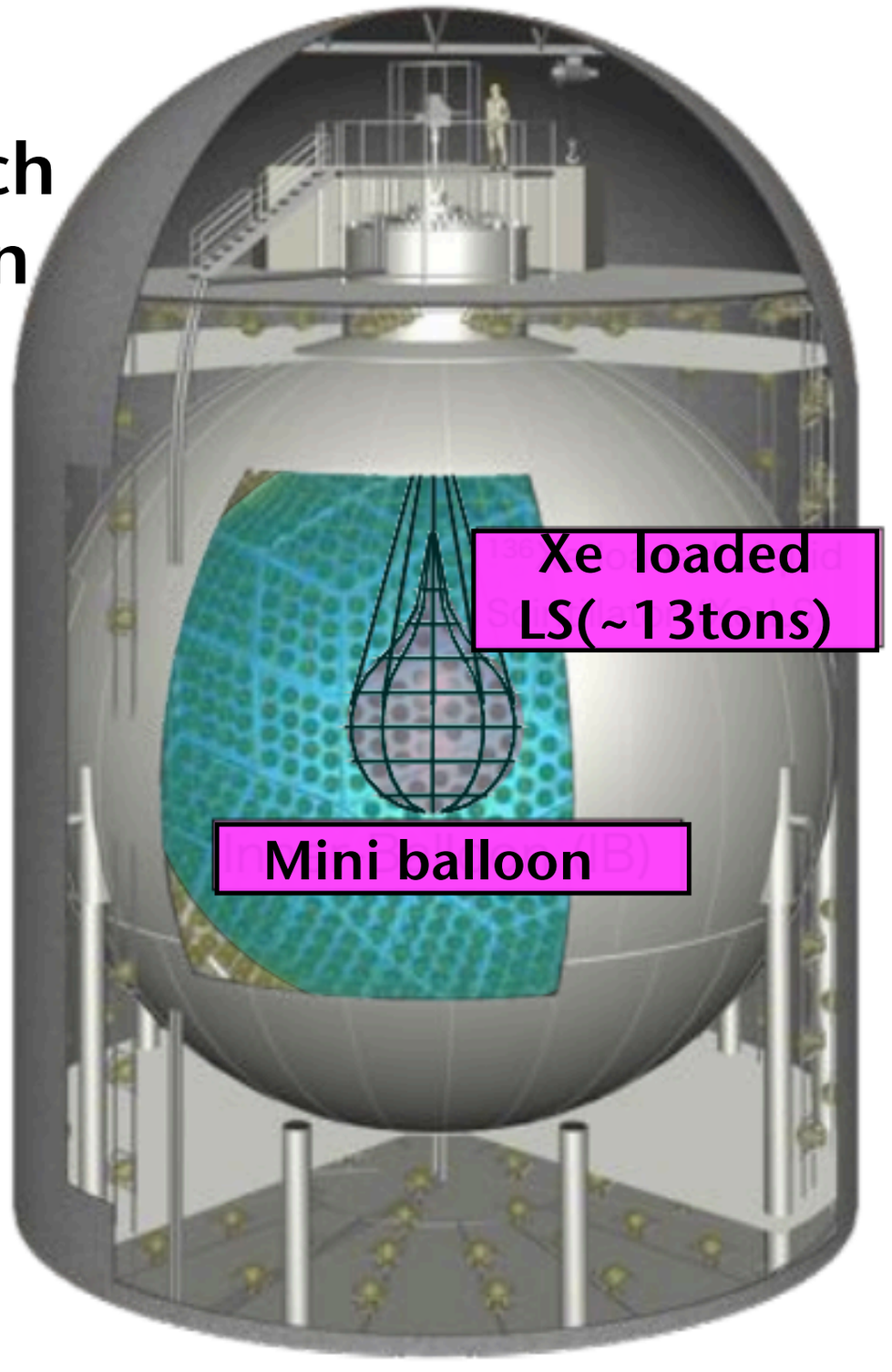


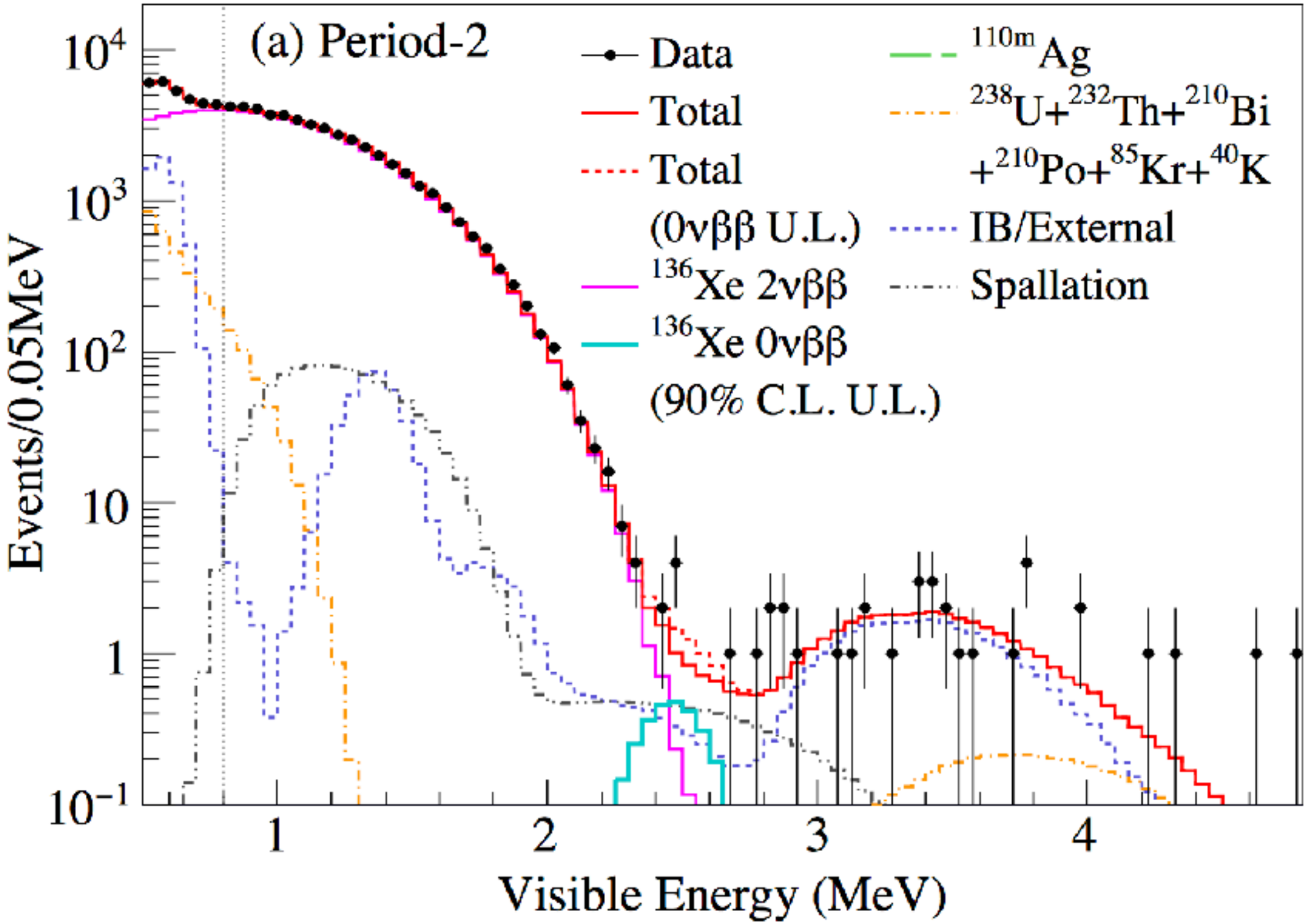
Advantages of KamLAND-Zen

- running detector: start quickly
- pure LS & 9m radius active shield
  U < 3.5 x10^{-18} g/g, Th < 5.2x10^{-17} g/g
- high scalability
  replacement of a mini ballon
  off-measurement

Why ^{136}Xe

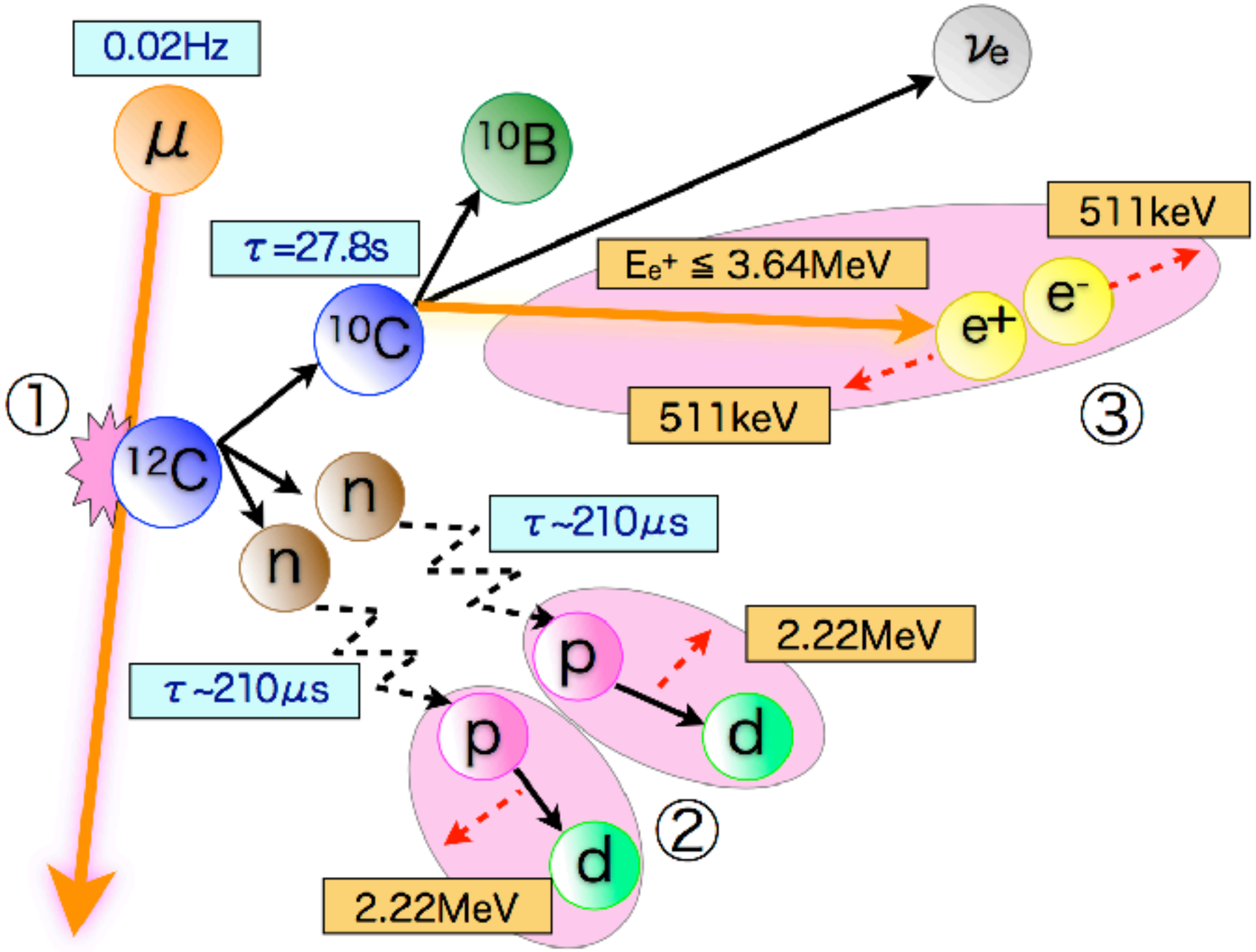
- Good solubility to LS (3wt%)
- Chemically stable (easy to handle)
- Establishment of enrichment method
- Q-value is 2.46MeV -> Low BG region in KamLAND

Background in KL-Zen



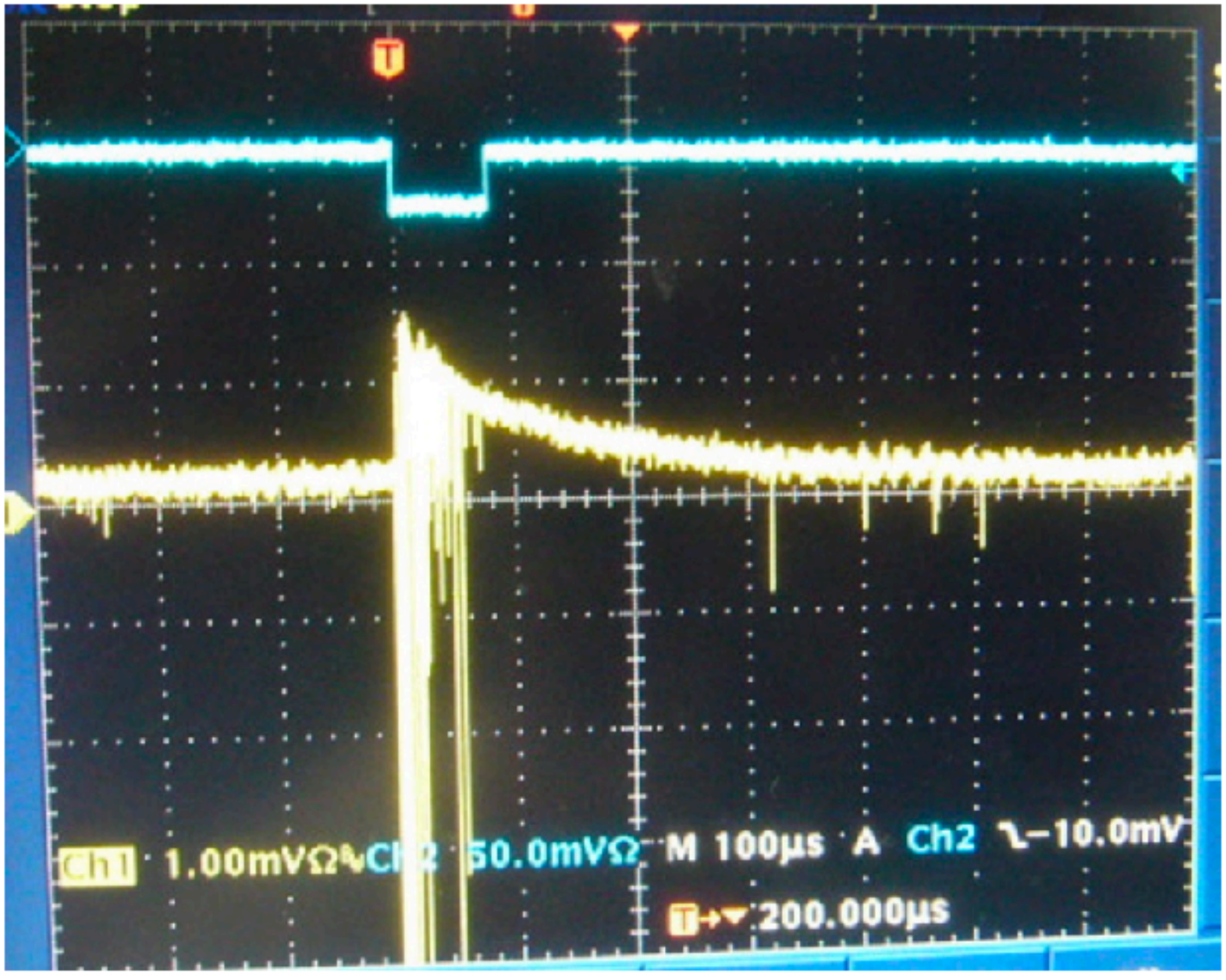
Spallation ^{10}C

^{10}C reduction: n-tag is a key



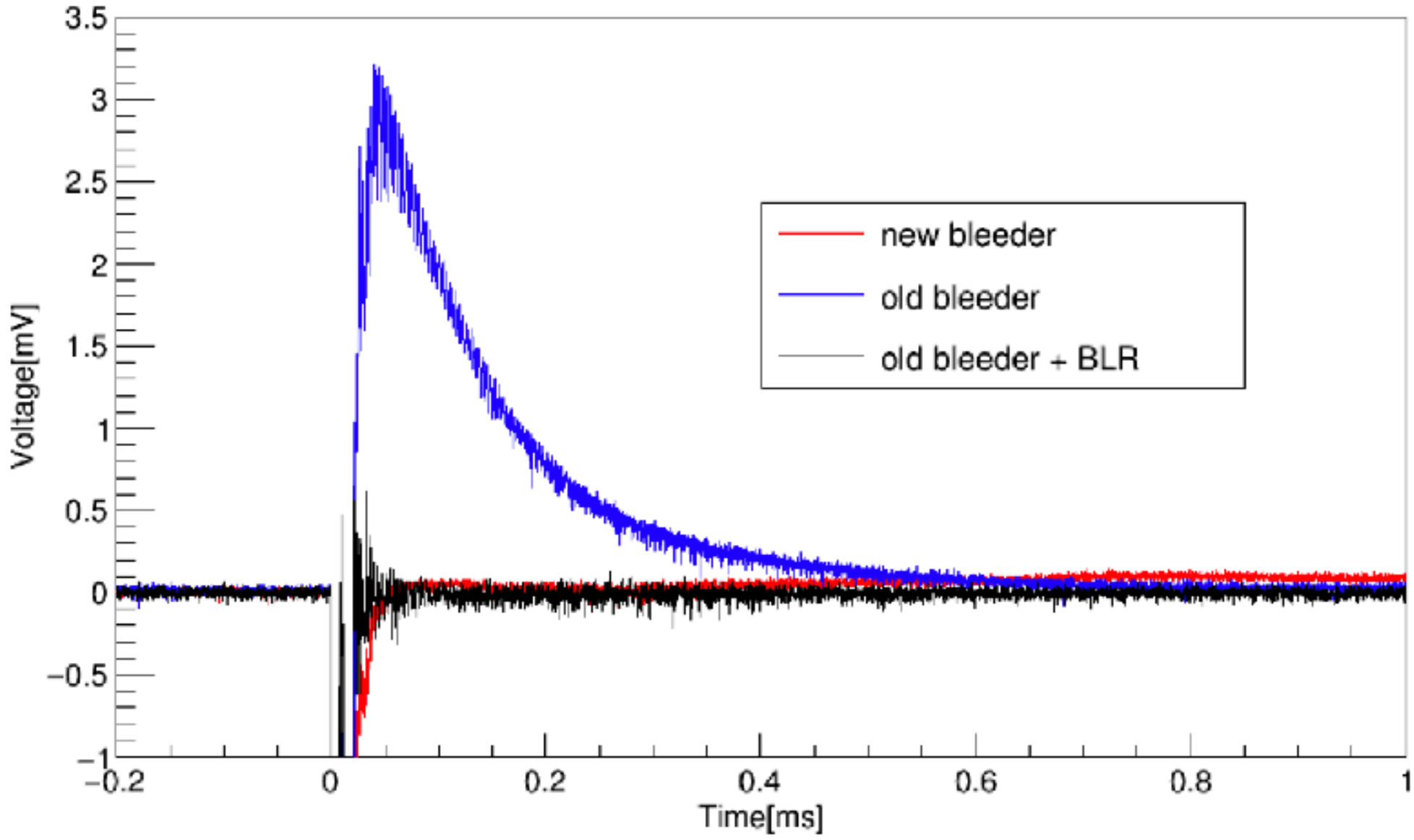
Behavior of PMT after muon

Overshoot and after pulse



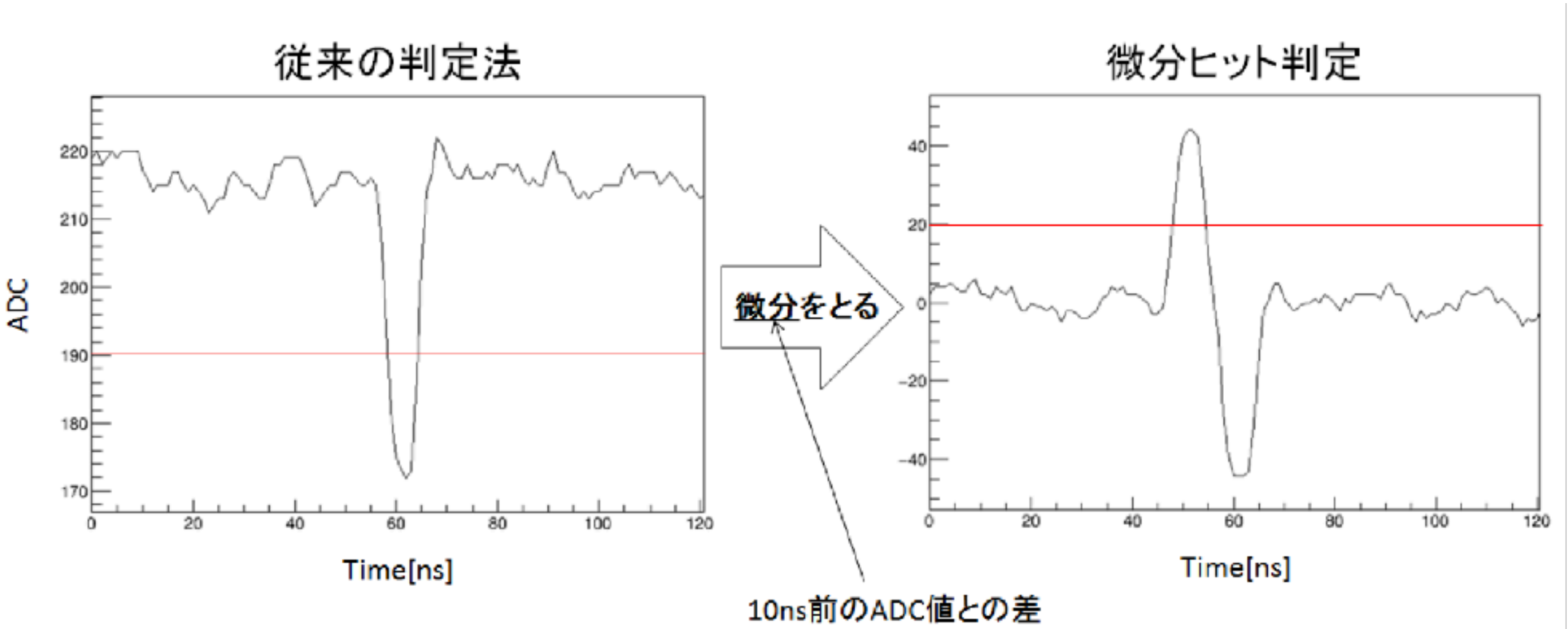
Approach

1. Update of PMT bleeder circuit



Approach

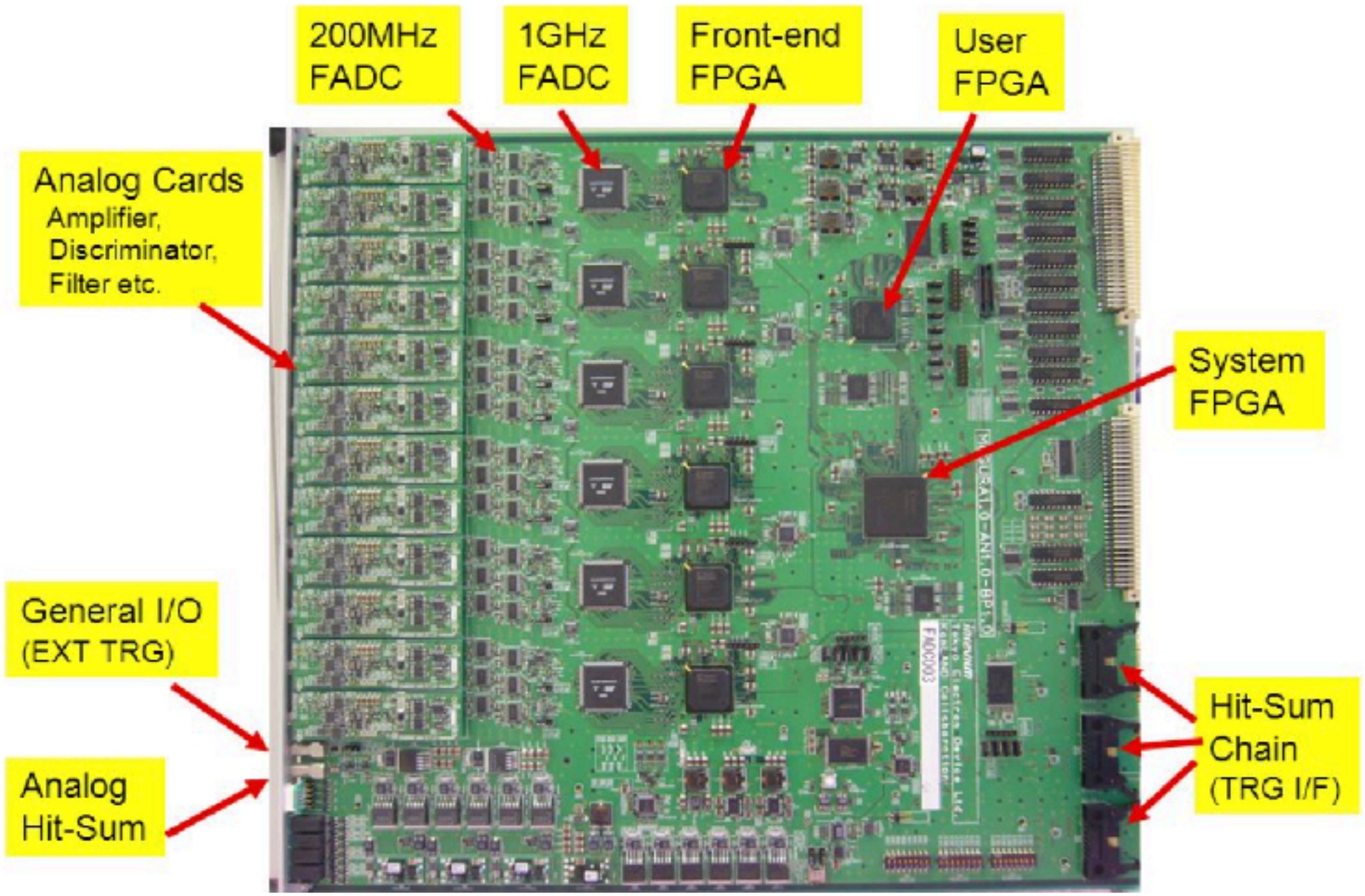
2. Differential hit detection



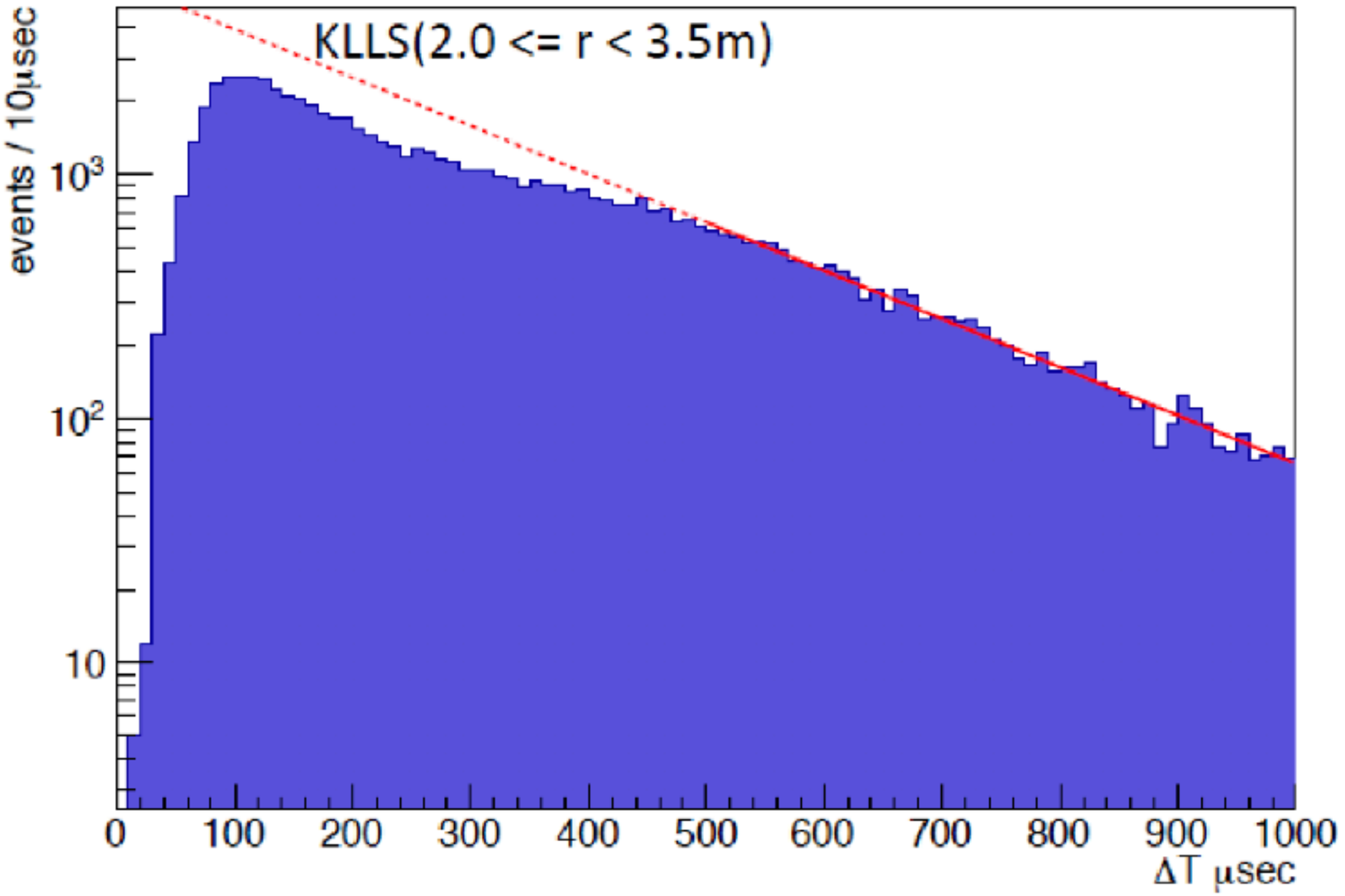
Approach

3. Use of local trigger with δt

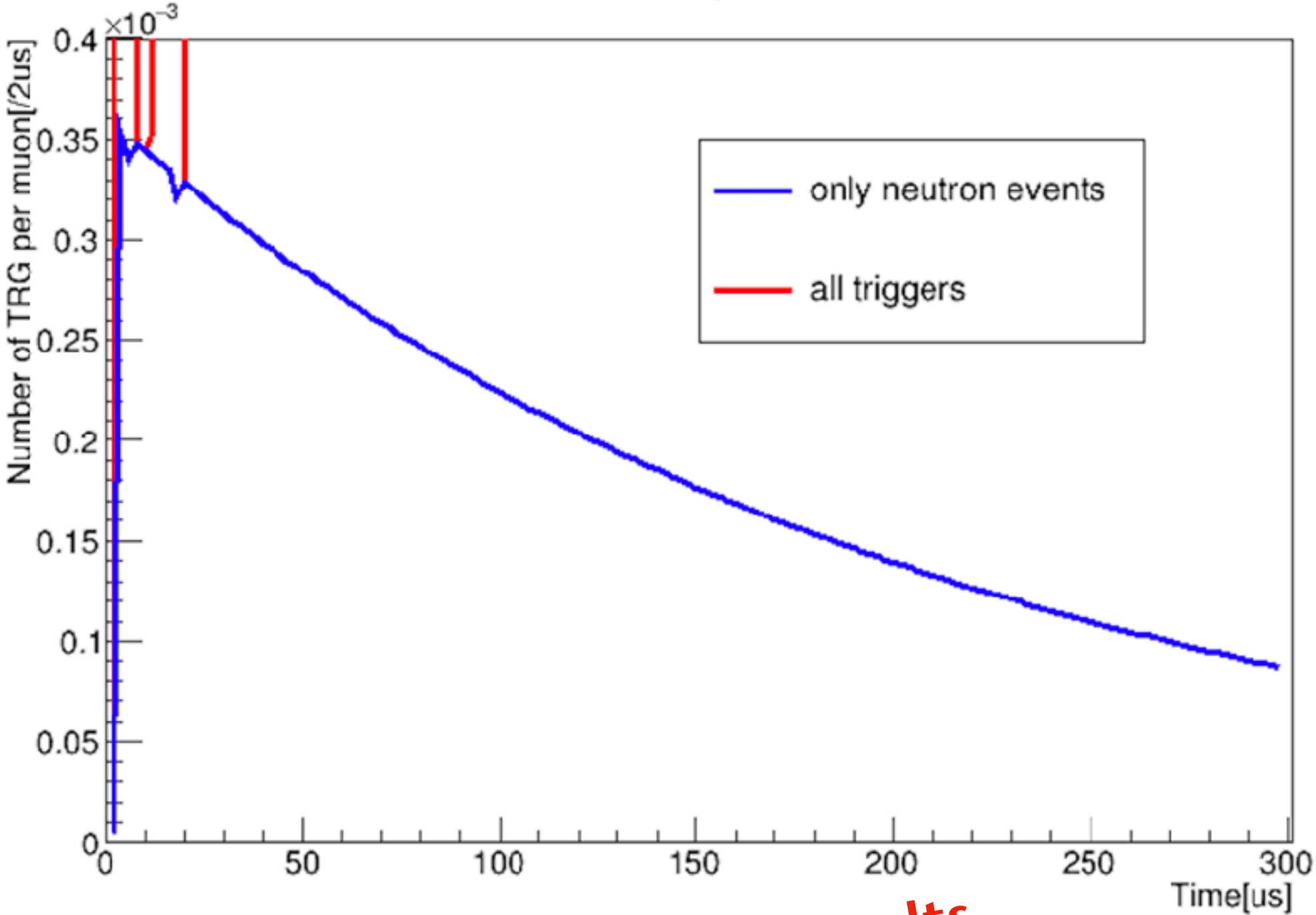
(δt < Δt; Δt is coincidence windows for global trigger)



Current n-tag efficiency



Improvement of efficiency



Efficiency: 95% **Preliminary results**

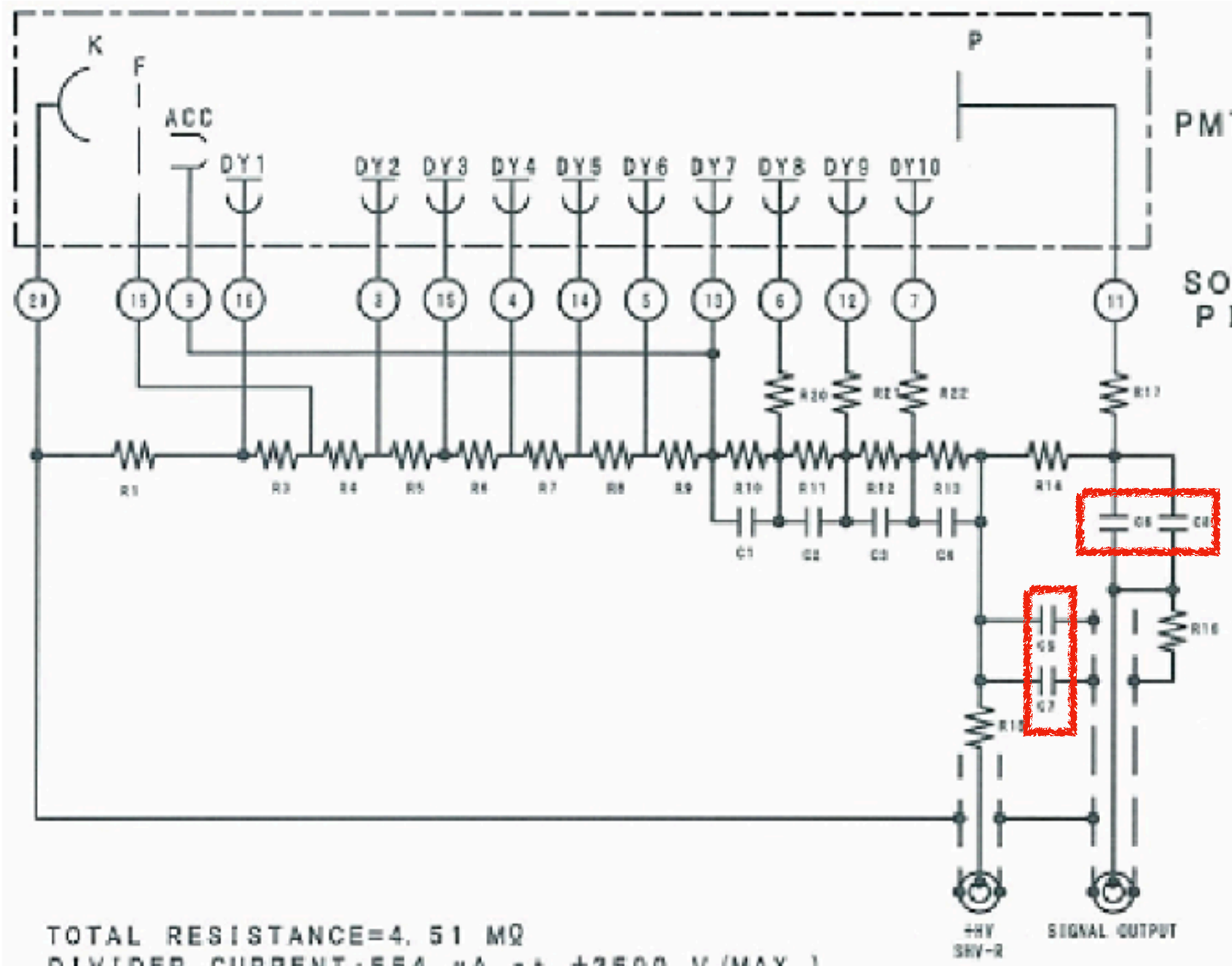
Summary

- SN monitor: working
- preSN monitor: update to reduce false

- New electronics for KL2
- Updates for nearby SNe
- Improvements for n-tag efficiency

Data taking will stop for the Zen balloon installation.

Data taking will continue during the SK tank open



R1 : 1. 72 MΩ
R3, R8−R13 : 150 kΩ
R4 : 523 kΩ
R5 : 600 kΩ
R6, R7 : 300 kΩ
R14 : 100 kΩ
R15 : 10 kΩ
R16, R17 : 49. 9 Ω
R20−R22 : 100 Ω
C1−C4 : 10 nF
C5, C6, C7, C8 : 47 nF

THE HOUSING IS INTERNALY CONNECTED TO THE GND.

TOTAL RESISTANCE=4. 51 MΩ
DIVIDER CURRENT : 554 μA at +2500 V (MAX.)
VOLTAGE DIVIDER RATIO: 11. 5−1−3. 5−4−2−2−1−1−1−1−1−1