

# Status report : KamLAND-Zen study

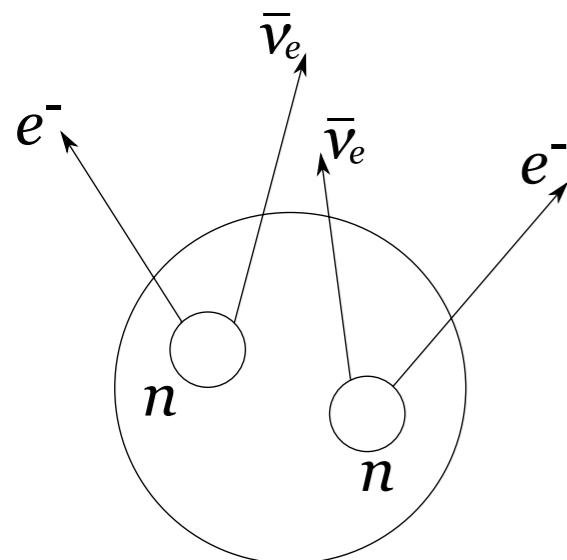
2020 fall GP-PU Progress Status Presentation

**B9SD2011 KAMEI Yuto, RCNS**

## *KamLAND-Zen 800 experiment*

- ▶ Neutrinoless double beta decay ( $0\nu\beta\beta$ ) search
- ▶ Decay target :  $^{136}\text{Xe}$  (Xe 745 kg,  $^{136}\text{Xe}$  91%,  $^{134}\text{Xe}$  9% enrichment)
- ▶ KamLAND is a large, ultrapure liquid scintillator (LS) detector.

Standard double beta decay ( $2\nu\beta\beta$ ) is interesting also.



$2\nu\beta\beta$

- ▶ It is second-order process of electroweak interaction in the standard model.
- ▶ High statistics : exposure 1.68 kton\*days
- ▶ BG :  $^{11}\text{C}$ ,  $^{86}\text{Kr}$ ,  $^{210}\text{Bi}$ ,  $^{210}\text{Po}$ ...

It's important to effort rejection of these BG.

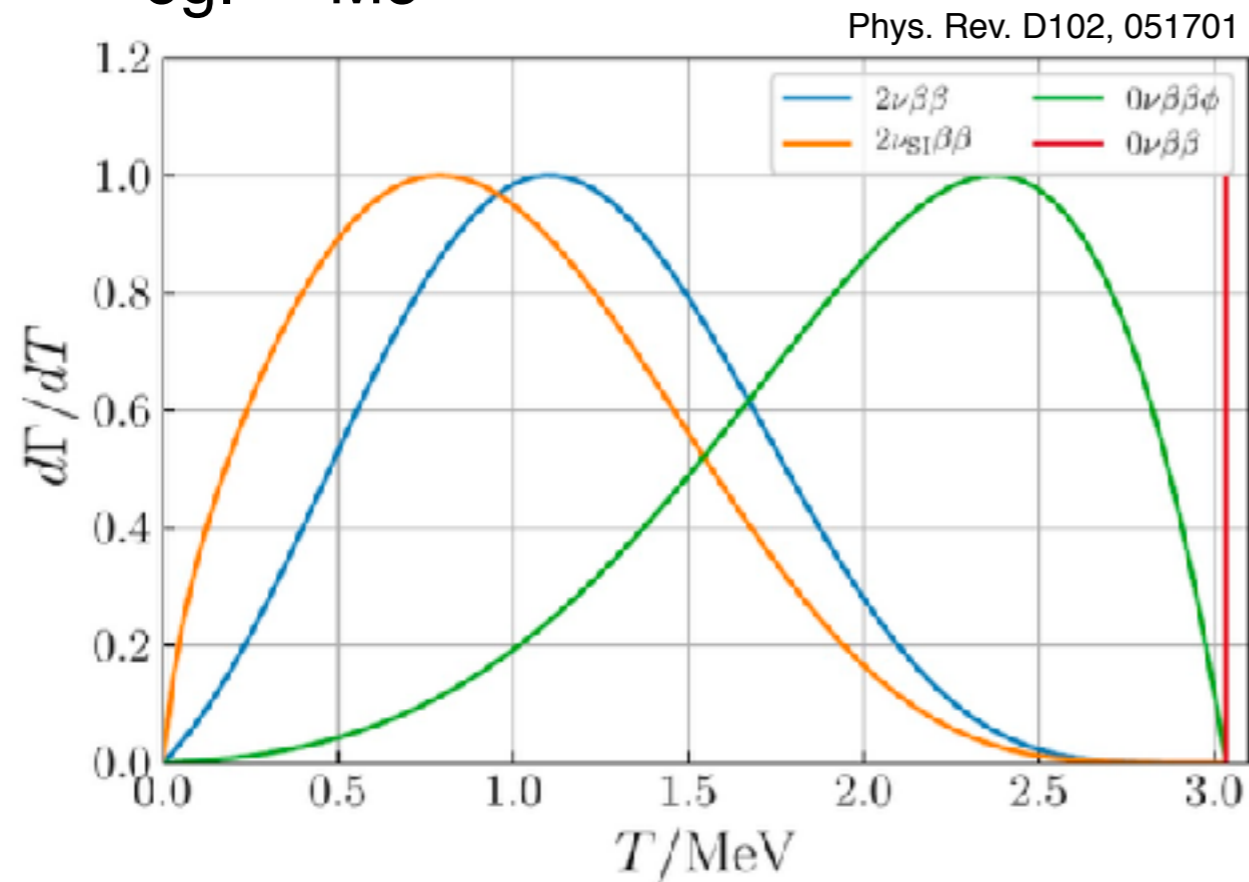
KamLAND-Zen has a potential to detect precise  $2\nu\beta\beta$  energy spectra.

# Works from now

$2\nu\beta\beta$  search has probes to new physics also.

- the nuclear model
- Majoron
- Neutrino self-interaction
- $^{134}\text{Xe } 2\nu\beta\beta(0\nu\beta\beta)$
- Lorentz symmetry violation
- Bosonic neutrino
- Right-handed current
- Bound-state

eg.  $^{100}\text{Mo}$



Energy spectra shape changes depending on each models!

- Blue line:  $2\nu\beta\beta$
- Green line: Majoron emission model
- Orange line: Considering  $\nu$  self-interaction

There're many searching topics, however these are tested by comparing energy spectra shape!! It's important to measure precise  $2\nu\beta\beta$  shape.

# Background Study

Evaluating spallation background in KamLAND-Zen

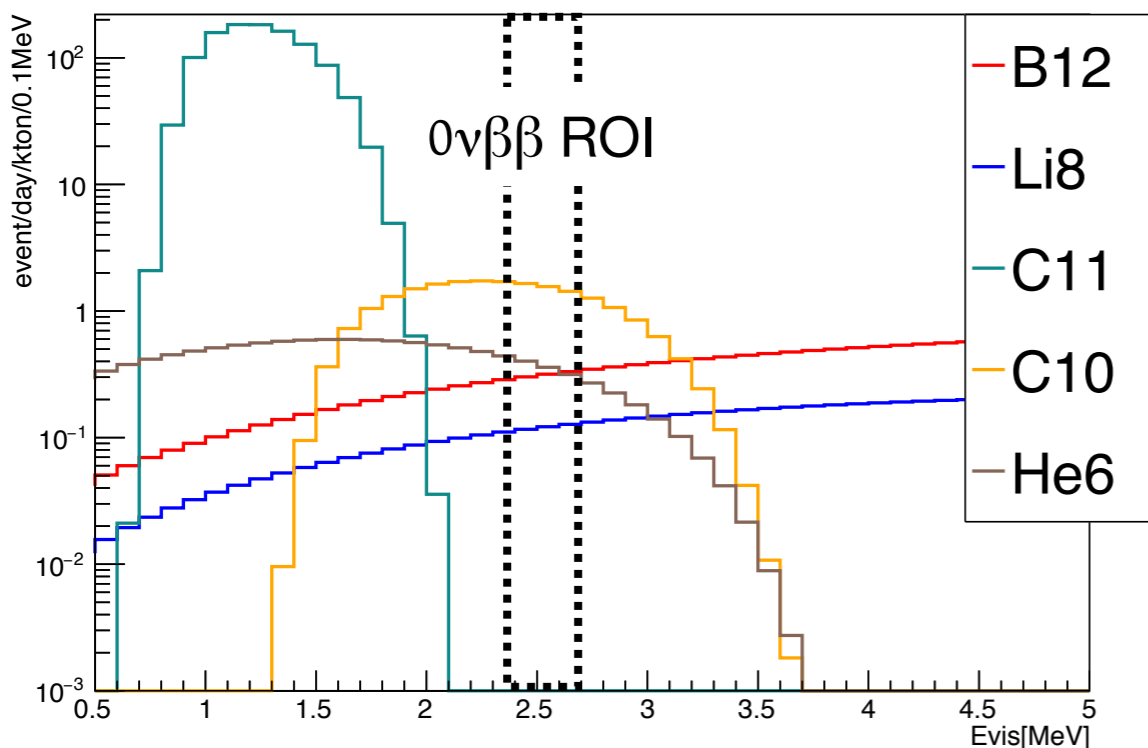
- ▶ Cosmic-ray produces spallation productions by breaking up nucleus.

Triple coincidence ( $\mu$ - $n$ -isotope decay) & Shower tagging are powerful rejection method for short-lived ( $\tau < 30$  s) spallation isotope.

$^{11}\text{C}$  is a main remaining spallation product in  $2\nu\beta\beta$  region.

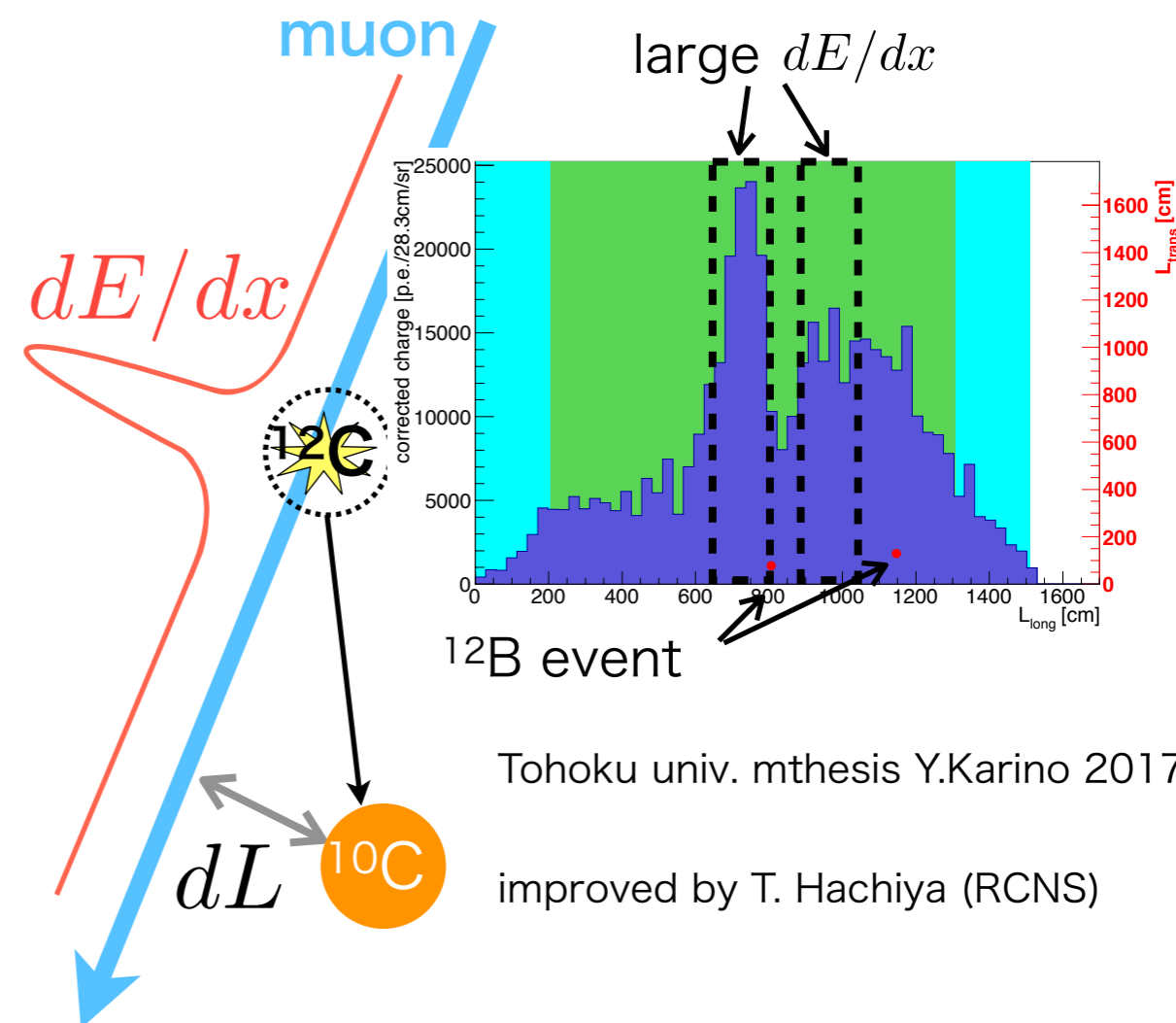
Examples of light isotope BG ;

$^{10}\text{C}$	$Q = 3.7 \text{ MeV}$	$\tau = 28 \text{ sec}$
$^{12}\text{B}$	$Q = 13 \text{ MeV}$	$\tau = 30 \text{ msec}$
$^{11}\text{C}$	$Q = 2.0 \text{ MeV}$	$\tau = 20 \text{ min}$



Shower tagging

(Rejection method using  $dE/dx$  and  $dL$ )



Tohoku univ. mthesis Y.Karino 2017

improved by T. Hachiya (RCNS)

# **GPPU program requirement**

GSP 5 / 10 pt

✓GEP 14 / 13 pt

I have better get GSPs as soon as possible.

## **Plan of study abroad (Domestic study)**

~~Study in Amsterdam (Xenon experiment work)~~

Instead of this, I get advices about my KamLAND-Zen work from professor of Amsterdam Univ. (KamLAND-Zen collaborator in overseas).

*contacts method :*

usually : e-mail

I have twice annual meeting by face to face.

I can have other online-meeting as needed.