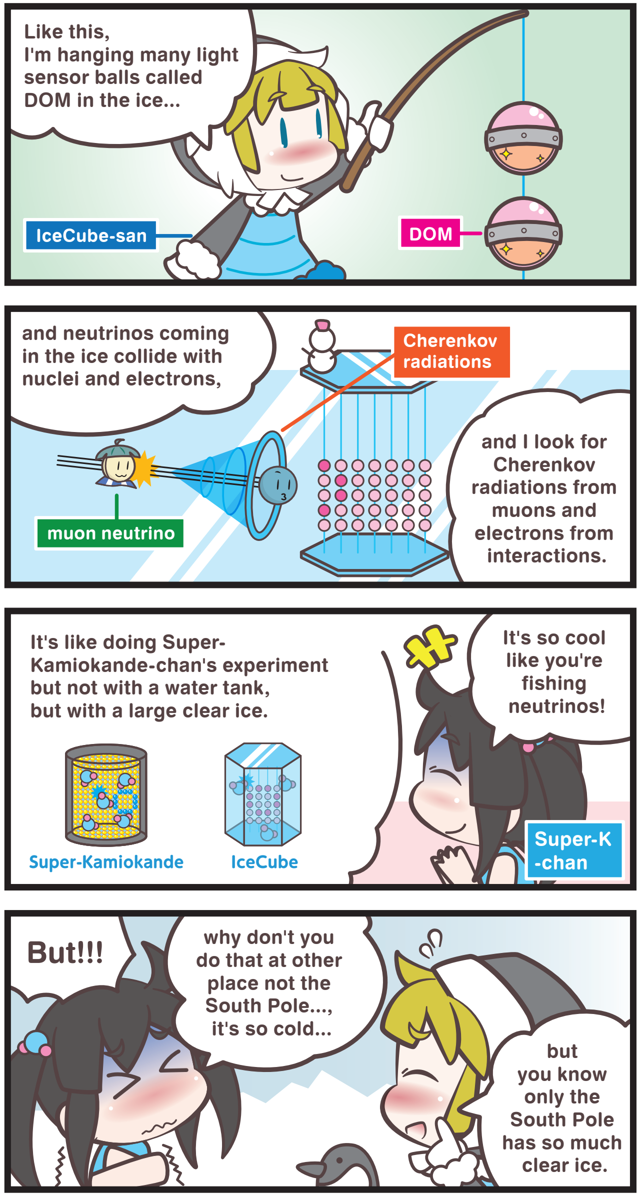
quick fire
by Poster Presenters

4koma-mangas of "the Neutrino Science Frontier"

higgstan.com
Yuki Akimoto

Neutrino Hunter!

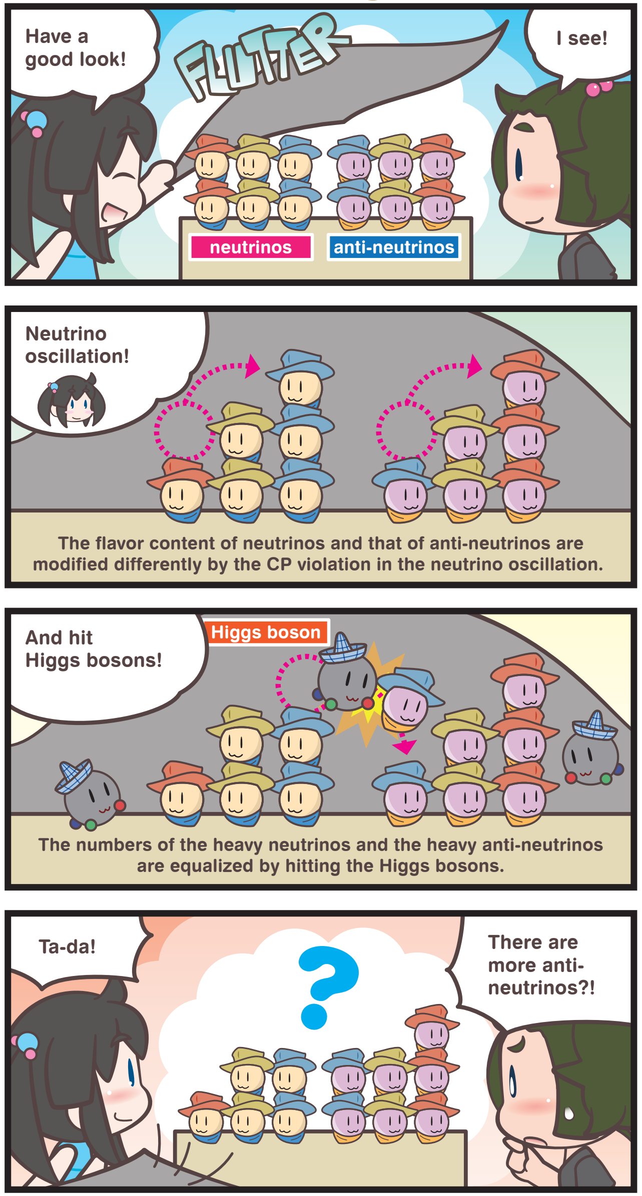


IceCube-san:
is observing neutrinos using Antarctic glacier ice.
These experimentalists are incredible as they go to such remote places to hunt for neutrinos.

DOM:
It stands for Digital Optical Module. About 5,000 pcs of them have been deployed in the deep ice, waiting for a signal from a cosmic neutrino.

High Energy Cosmic Neutrino
IceCube Experiment

Neutrino Magic!



More anti-neutrinos than neutrinos?:
Starting with the same numbers of neutrinos and anti-neutrinos, some magic under the cloth created an imbalance between them. This CP violating phenomenon, if it has really happened in the early Universe, give the reason for the Universe being made of matter rather than anti-matter.

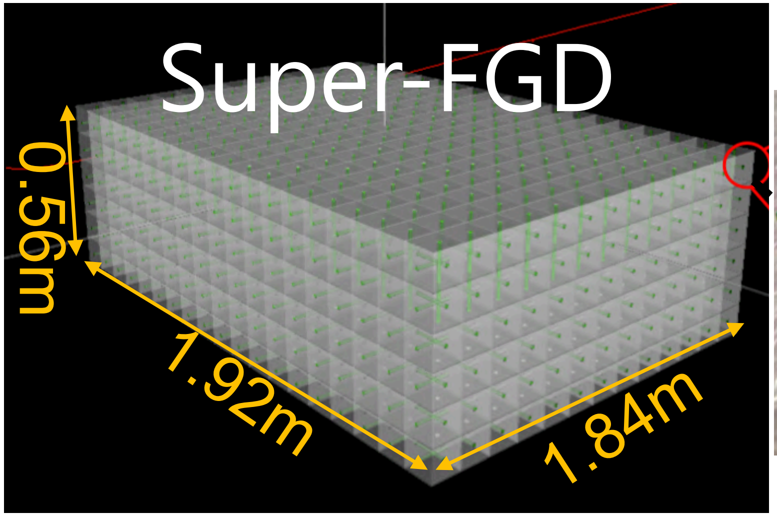
Neutrino physics and
the origin of the Universe

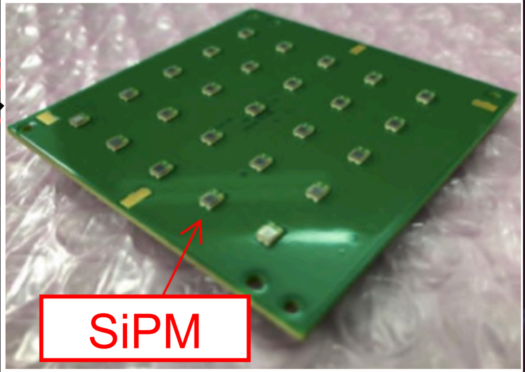
Development of LED Calibration System with Light Guide Plate for ND280 Upgrade

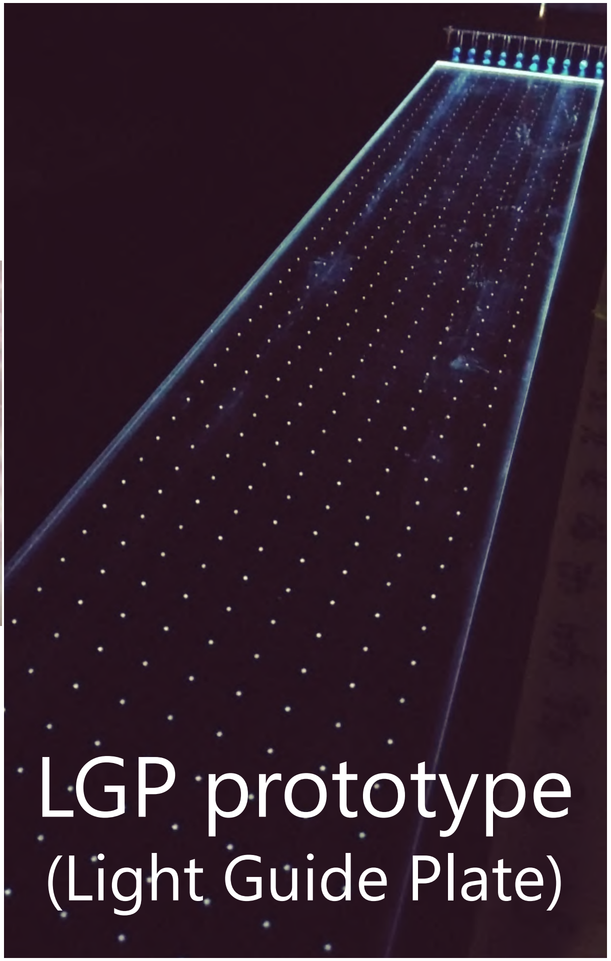
Presenter:
M1 Takuji Arihara
TOKYO METROPOLITAN UNIVERSITY

ND280 is one of the T2K near detectors and R&D for its upgrade in 2021 is ongoing.

Target & tracker for ND280 upgrade.
About sixty thousand SiPMs are to be equipped.







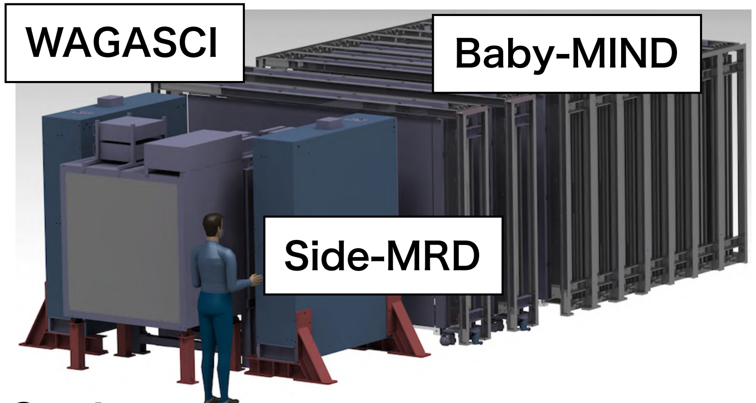
- R&D of the LED Calibration System with Light Guide Plate for Super-FGD is in progress.
- I will show evaluation results of light uniformity and optical crosstalk rate.

the Exploration of Particle Physics and Cosmology with Neutrinos Workshop2019
13/6/2019

The preparation for the neutrino beam measurement with full set up in T2K-WAGASCI experiment

Yokohama National University
Yuki Asada(淺田祐希)

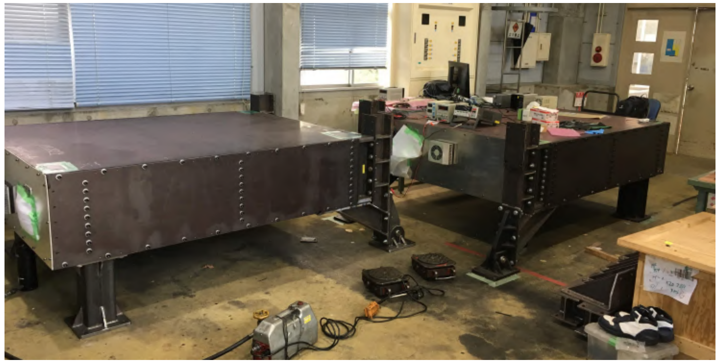
T2K-WAGASCI experiment



Goals : Measurement of neutrino cross sections with water and hydrocarbon targets with large angular acceptance for charged particles

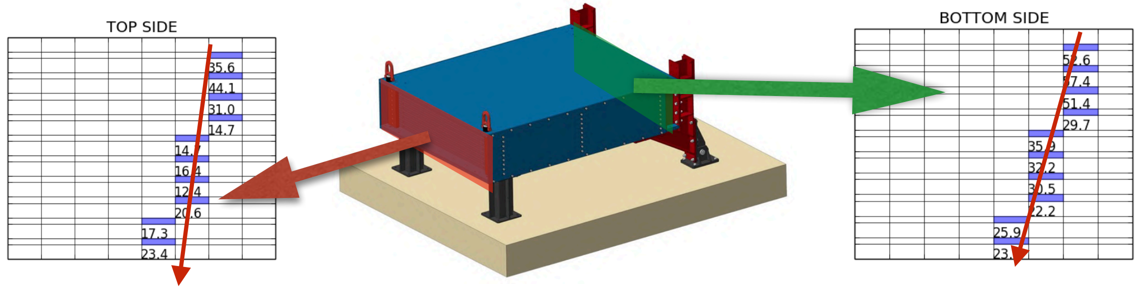
The construction of Side-MRDs

①scintillator mass test @YNU (2017/7)
②The Construction of Side-MRD @YNU (2017/11 ~ 2018/5)



We constructed <u>2 Side-MRDs</u>

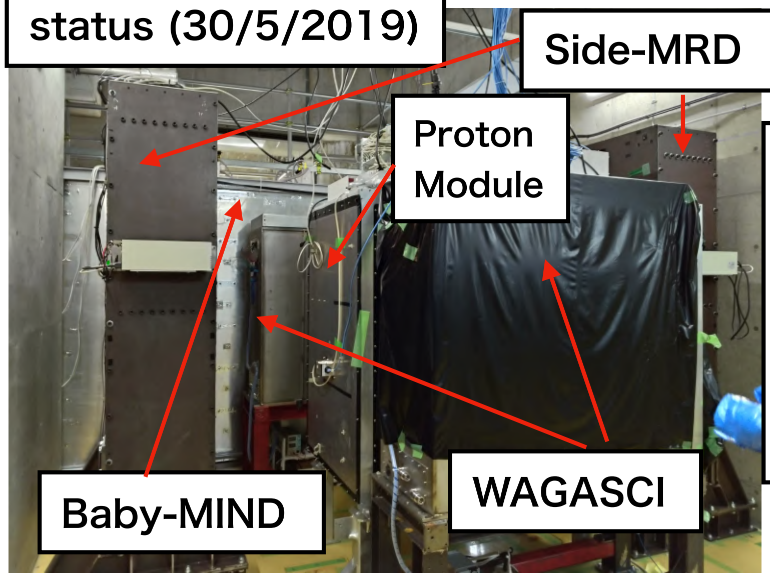
③performance evaluation of Side-MRD with cosmic ray @YNU and J-PARC (2018/6,7)



succeeded describing the trajectories of cosmic rays on both sides displays

The commissioning for T2K-WAGASCI experiment

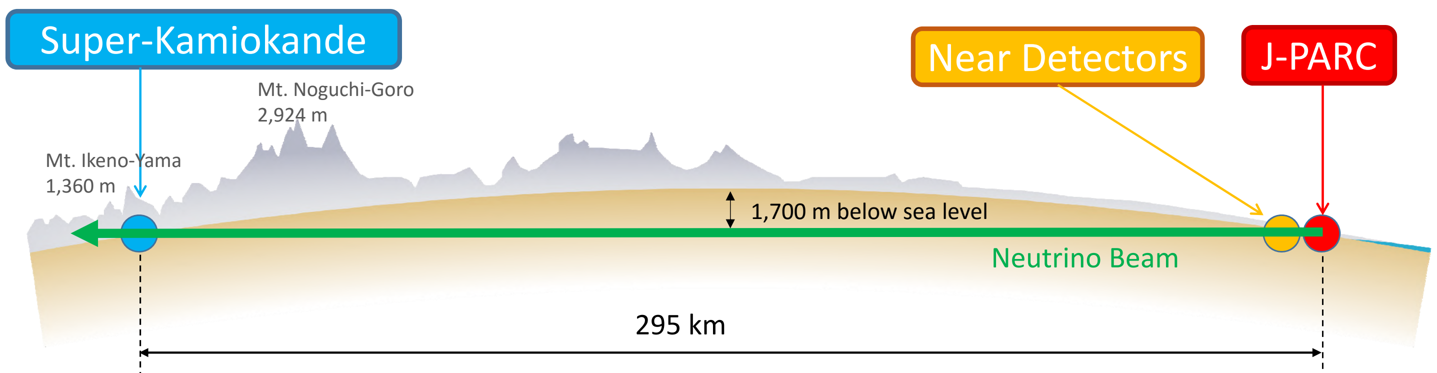
status (30/5/2019)

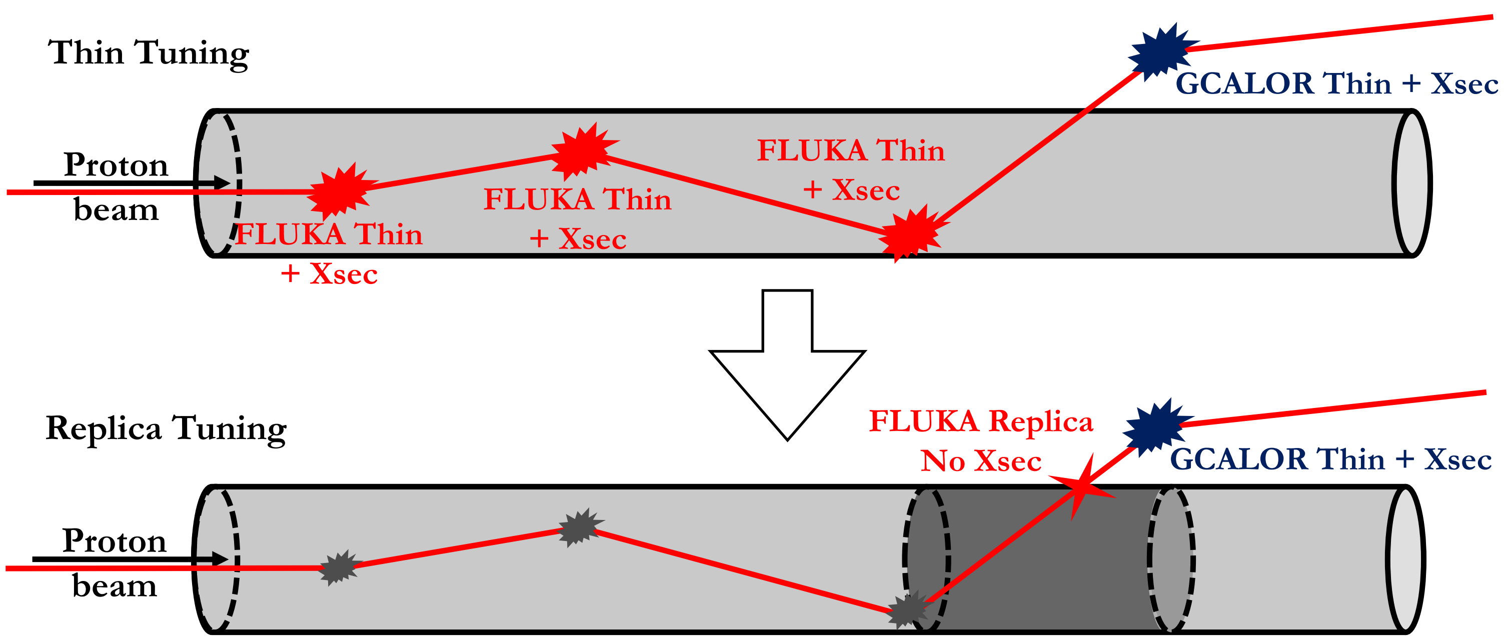


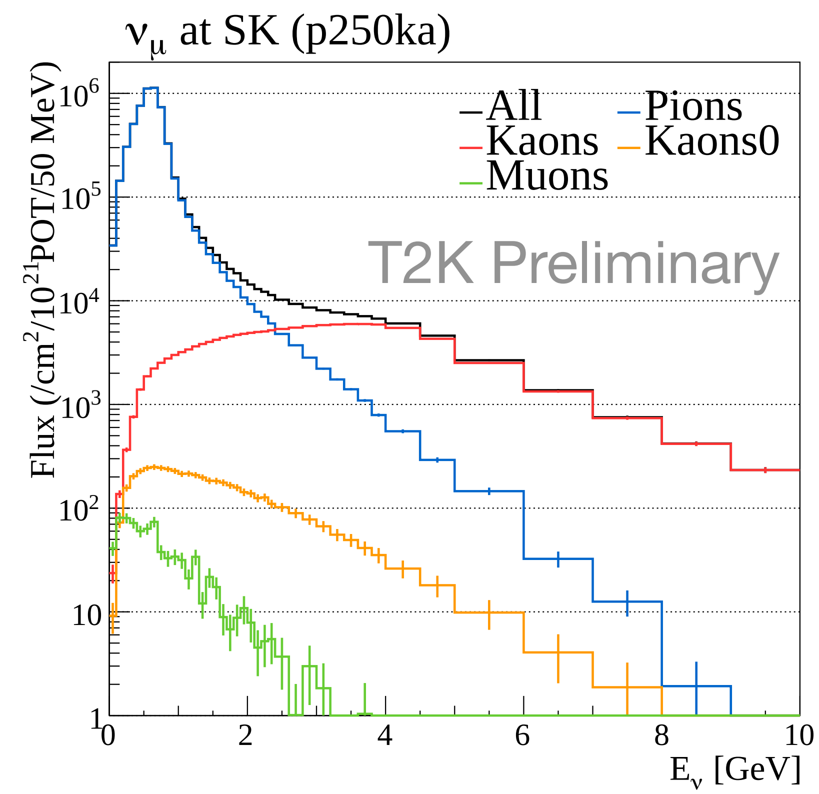
we are working for the neutrino beam measurement in winter 2019

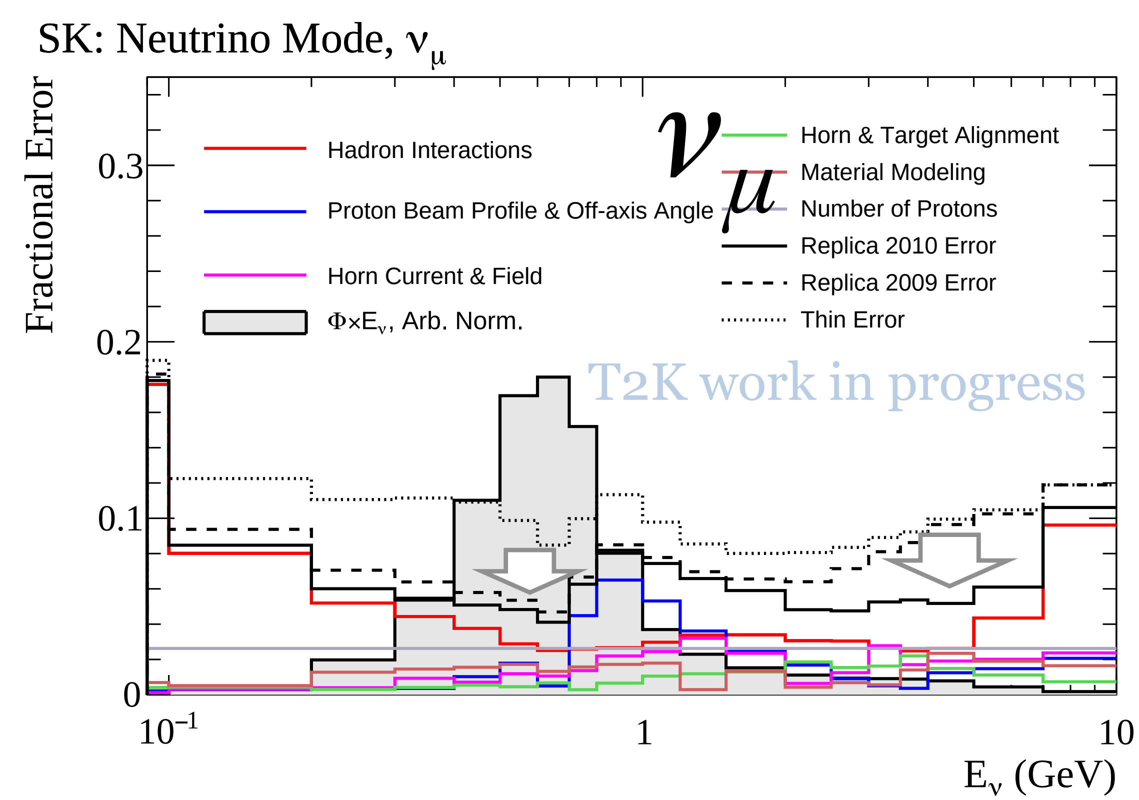
Systematic uncertainties of the **T2K neutrino beam flux** with improved MC tuning using NA61/SHINE replica target data

Lukas Berns for T2K collaboration   Tokyo Institute of Technology





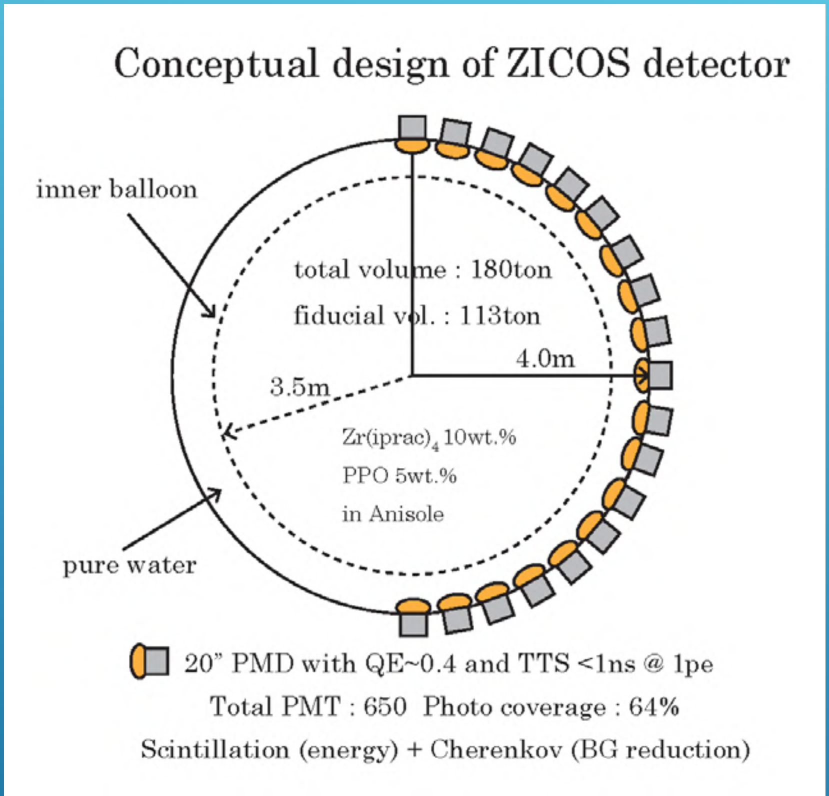


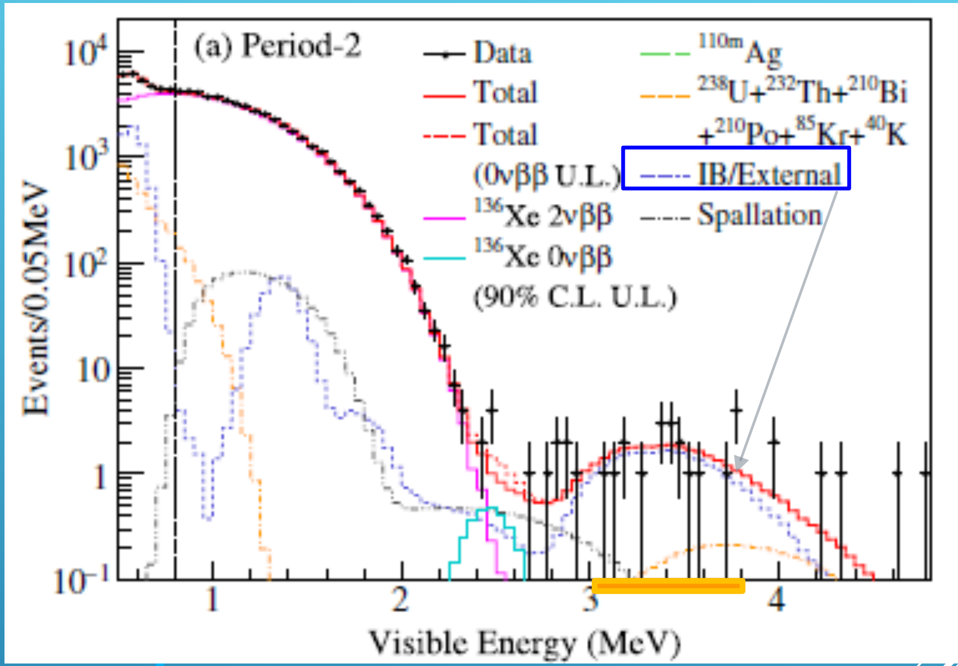


1. Total flux uncertainty goes down from 9–12% with thin tuning to 5–7% with replica tuning.
2. Consistency check of tuning methods.

ZICOS – Neutrinoless double beta decay experiment using ^{96}Zr

Phys.Rev.Lett. 117 (2016) 082503



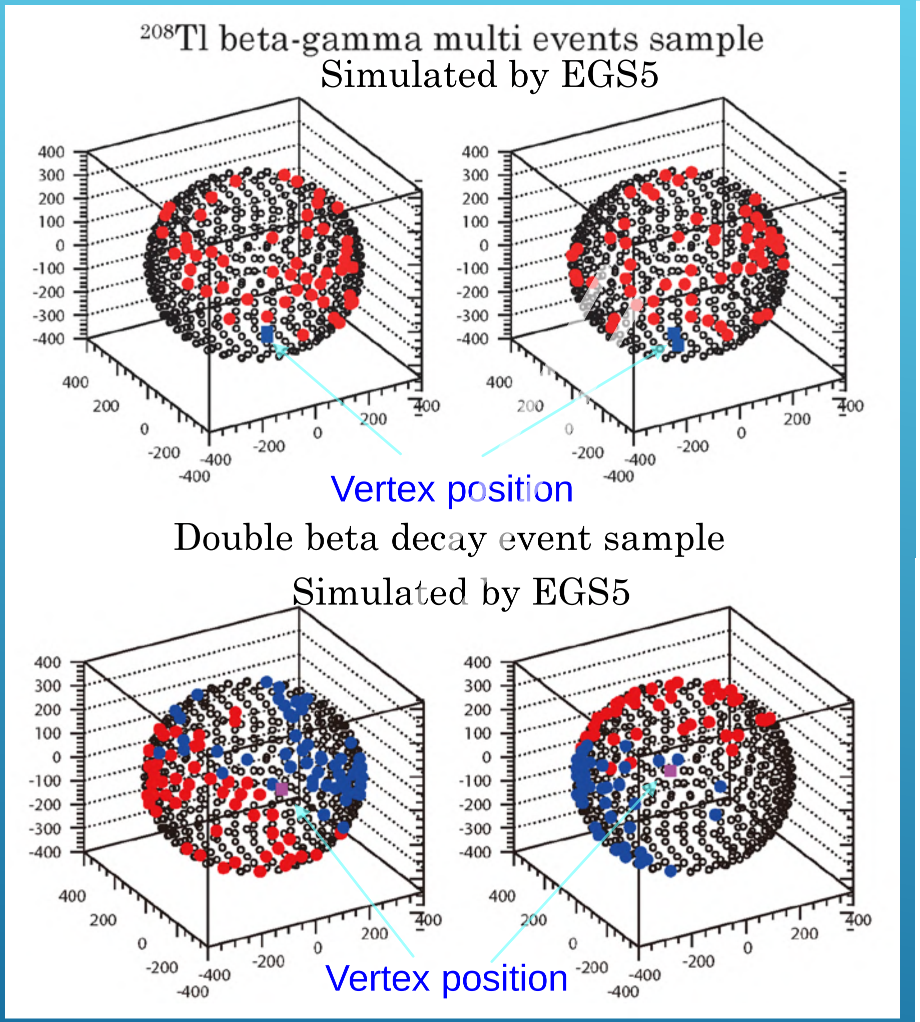


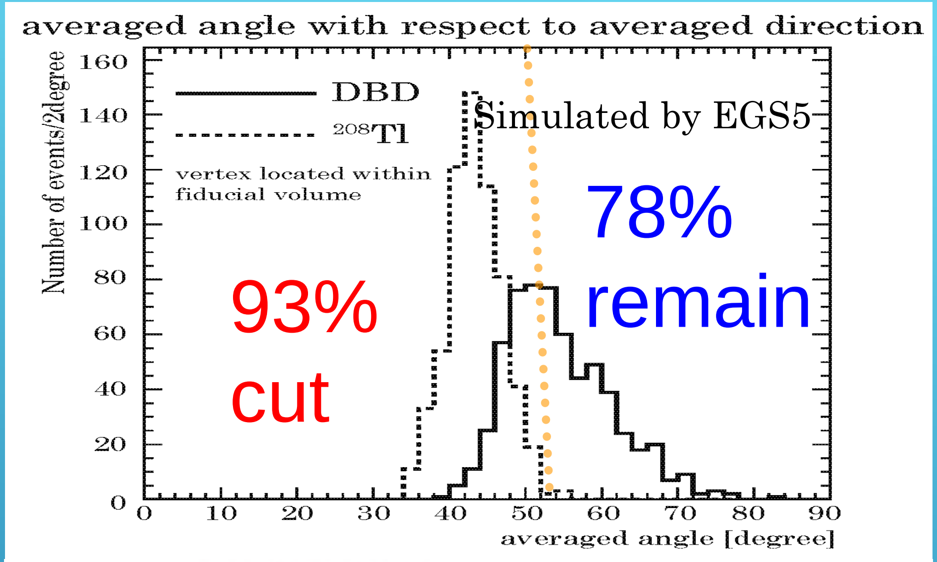
NEMO3 : $T^{0\nu}_{1/2} > 9.1 \times 10^{21}$ yrs

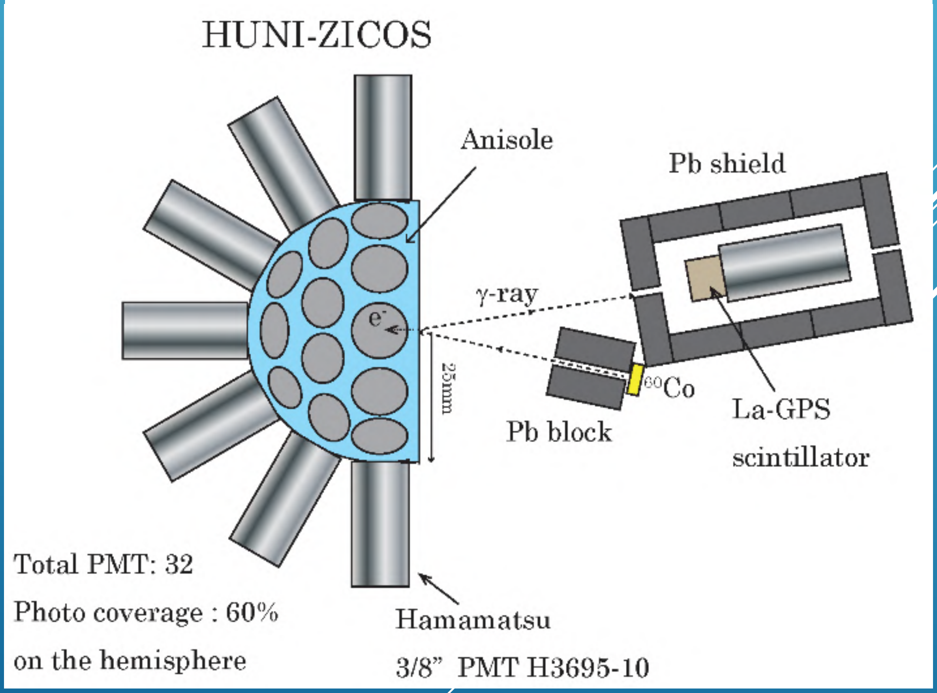
^{96}Zr : 45kg (nat.) → 865kg(50% enrich)→1/20 BG

$T^{0\nu}_{1/2} > 4 \times 10^{25}$ yrs → 2×10^{26}yrs → ~1 × 10^{27}yrs

Reduction of ^{208}Tl events using averaged angles





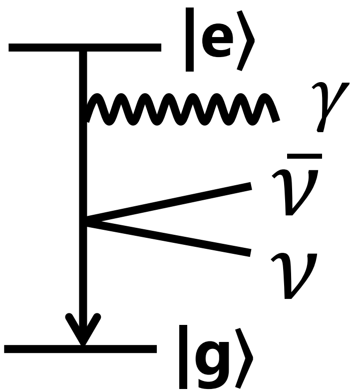


Measurement of the averaged angle for this KAKENHI

Rate amplification of higher-order QED process: toward neutrino mass spectroscopy

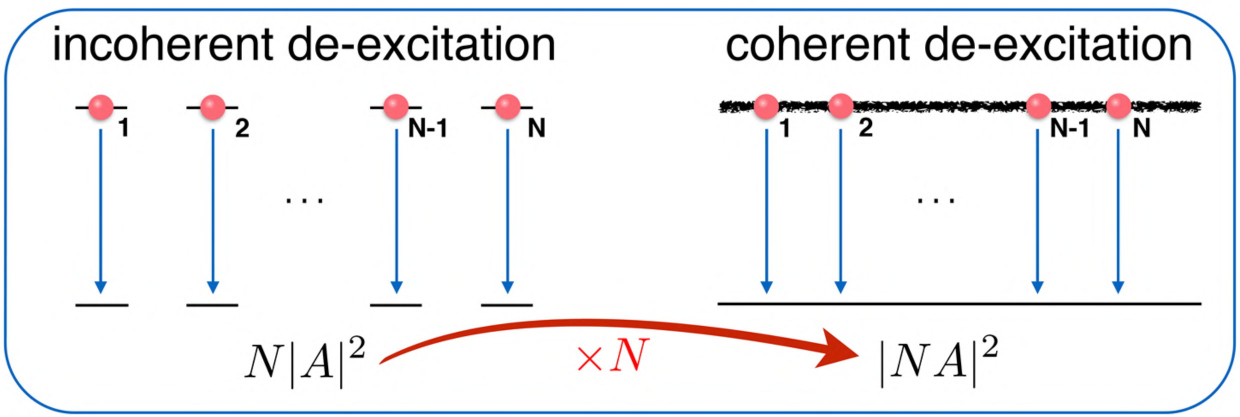
Takahiro Hiraki, RIIS, Okayama University

SPectroscopy with Atomic Neutrino (SPAN)



Final goal: Measure neutrino absolute masses by using atomic de-excitation process with techniques of laser spectroscopy

Rate amplification using atomic coherence



In this poster, previous results and current status of the principle verification experiments will be presented.

Realization of transparent water scintillator using fluorochemical surfactant

筑波大学
University of Tsukuba

Takashi Iida , Yukishige Kondo , Yoshiaki Kibe

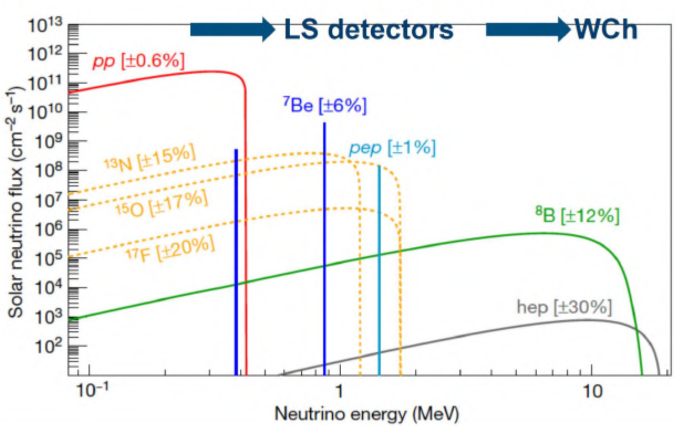
新学術領域研究 ニュートリノで拓く素粒子と宇宙

“Exploration of Particle Physics and Cosmology with Neutrinos Workshop 2019”
June 12th – 14th, 2019, HH-Sunpia Iga, Mie

- Water scintillator is good candidate for future neutrino experiment after SK-Gd.
- For that purpose, we are trying to develop transparent water scintillator using fluorochemical surfactant.

- Solar neutrino

✓ Lower the energy threshold makes it possible to detect lower energy solar neutrinos (e.g. ^{7}Be, pep, CNO etc.)
✓ Proof of MSW effect with large statistics.



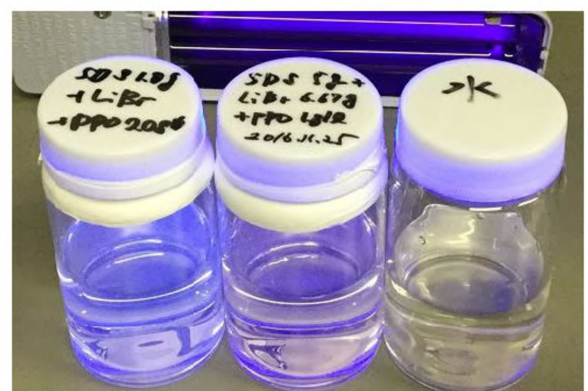
- Other applications:

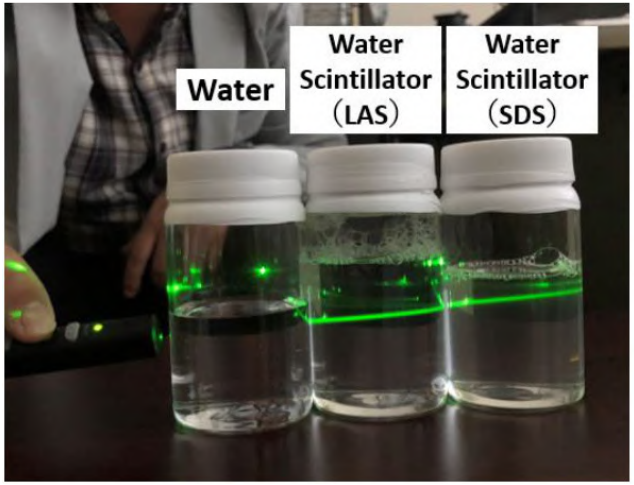
Suprenova neutrino, Geo neutrino,
Medical application, Reactor monitoring etc…

Our water scintillator was produced mixing the following solutes into the pure water.

- ☐ sodium dodecyl sulfate (SDS) as a surfactant
- ☐ 2,5-Diphenyloxazole (PPO) as a fluorescent agent
- ☐ 1,2,4-Trimethylbenzene (Pseudocumene: PC)
- ☐ Lithium Bromide (LiBr)

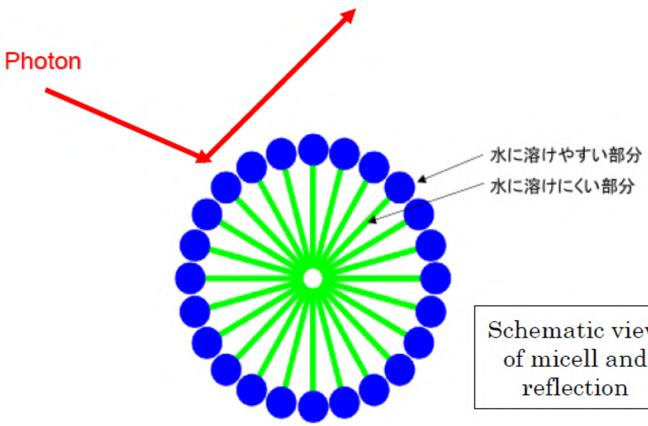
✓ Our water scintillator sample irradiated black light.





- In order to check transparency of our water scintillator, laser light was injected into the samples as shown in the picture.
- Clear green line is seen inside water scintillator, not seen in water.

- This indicate that reflection happens inside the water scintillator.
- We assumed this reflection happens on the surface of "micell" due to different refraction index between water and surfactant.



Schematic view of micell and reflection

	Refraction index
Water	1.33
Hydrocarbon system	1.5 ~ 1.6
Fluorine system	1.3 ~ 1.4

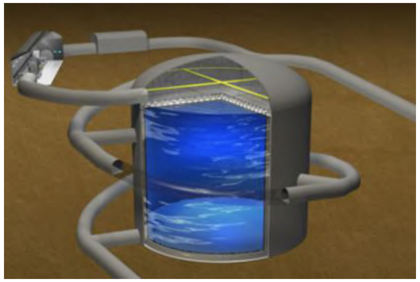
– ***Why fluorochemical surfactant?***

- We believe that the key to developing transparent water scintillator lies in surfactants.
- In general, fluorine resins have small refraction indices.
- Now, Iida and Kondo are developing a new surfactant based on fluorine for water scintillator at Tokyo university of science.

Basic studies of 3-inch PMT for multi PMT development

Inomoto Michitaka (Tokyo University of Science)

◆ Hyper-Kamiokande (HK)



HK is to be the next generation large-scale water Cherenkov detectors.
It is planned to be approximately an order of magnitude larger fiducial mass than its predecessor, Super-Kamiokande.

◆ Multi-PMT

In HK, use of multi-PMT, which is made by combination of 3-inch PMTs, is considered.

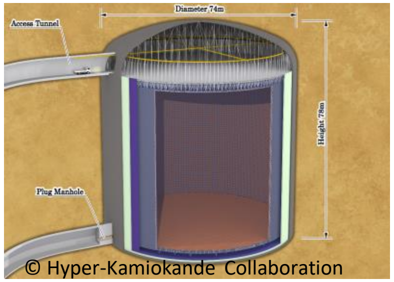
◆ Measurements

- We measured the characteristics of the 3-inch PMT including the temperature dependence of dark noise, which is one of the important characteristics.
- We confirmed the detection efficiency in the condition where the magnetic field was applied.

Evaluation of position dependent performance of 3-inch PMTs for Multi-PMT development

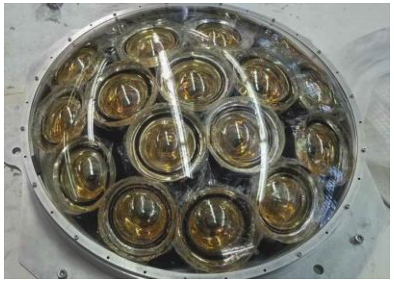
Nao Izumi (Tokyo University of Science)

Hyper Kamiokande



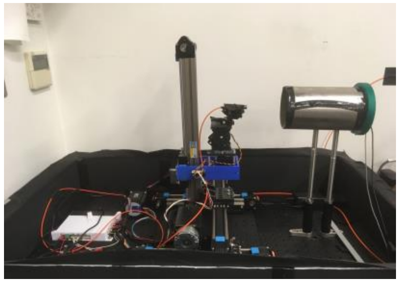
- Hyper Kamiokande is the next generation of Super Kamiokande experiment.
- It detects the Cherenkov light emitted by neutrino interaction using the PMTs on the wall.

Multi-PMT



- To improve the detector capabilities, the multi-PMT modules instrumented with multiple 3-inch PMTs are being developed.
- We studied the position dependent performance of 3-inch PMTs.

Measurement



- Using a moveable laser system, we illuminated a different position on the photocathode.
- I will present the characterization of efficiency, gain, and time response as a function of the position on the photocathode.

Development of Timing Synchronization System for Hyper-Kamiokande Electronics

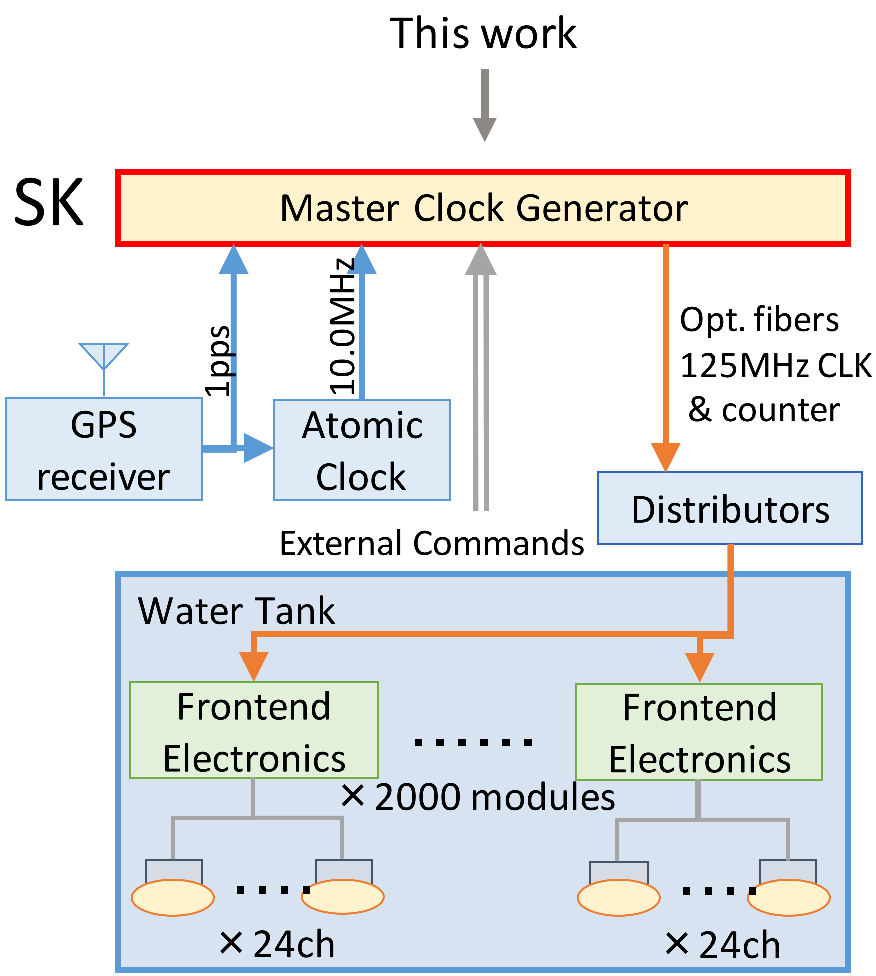
Tokyo Tech.
Shota Izumiyama

HK ～ 8 × SK : huge!

Timing resolution of PMT ～ 2 × SK
Electronics must be designed to *maximize PMT's performance*

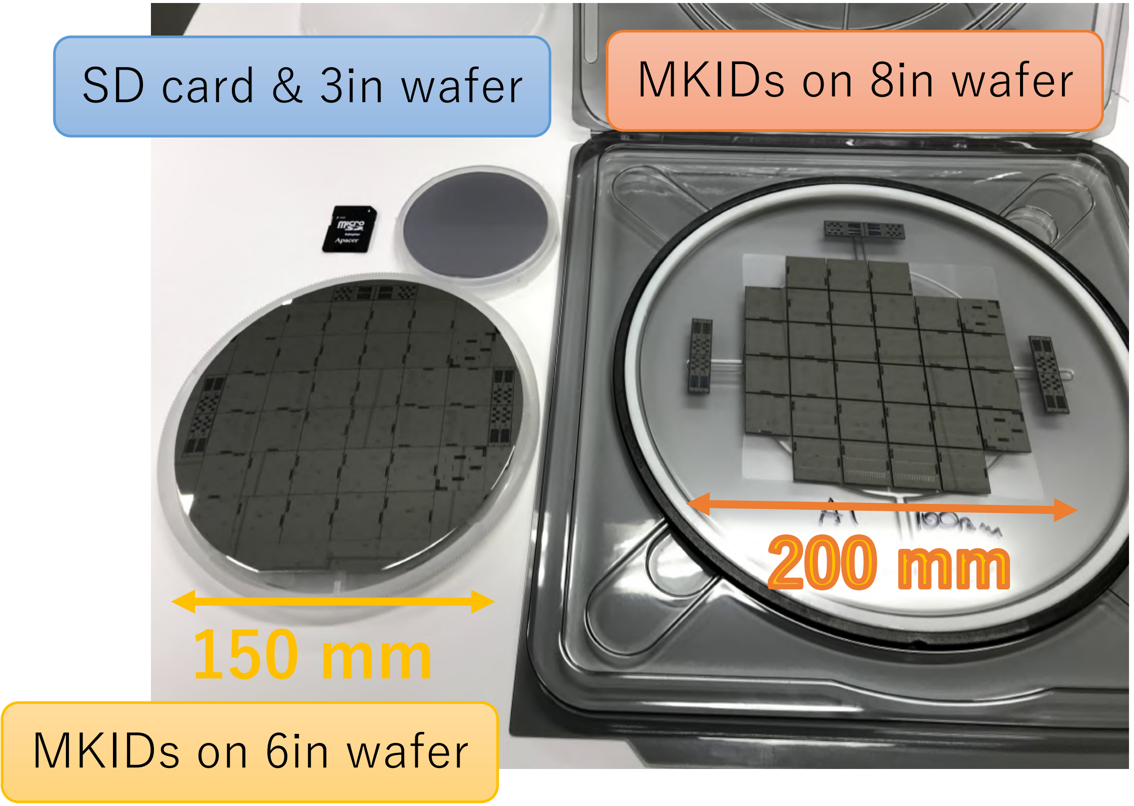
→ Frontend electronics are put next to PMTs (*in water*)

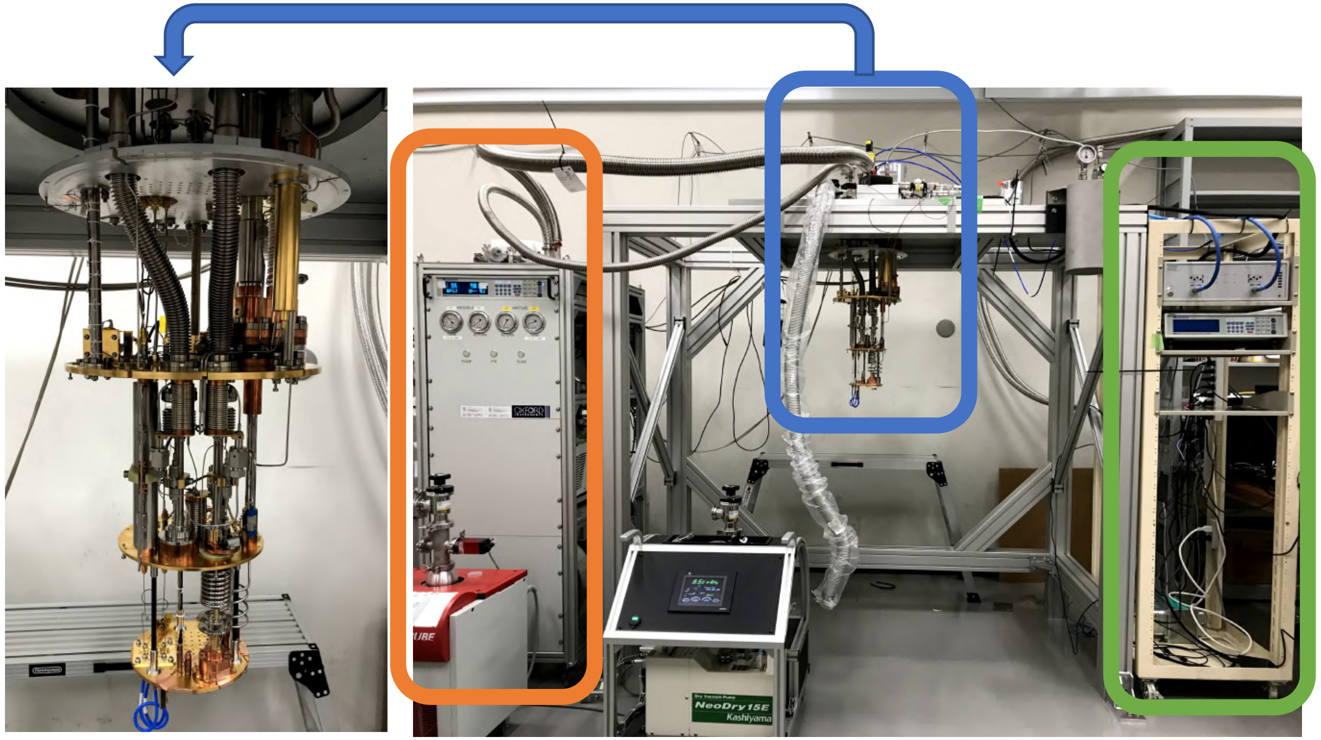
Timing synchronization system should be re-designed
→ Developed first prototype



Development of SUPERconducting DETECTOR and its measurement setup

Kenji Kiuchi, UTokyo





Can we start NEW experiments with superconducting detectors

Basic studies on the search for double beta decay with silicon detectors

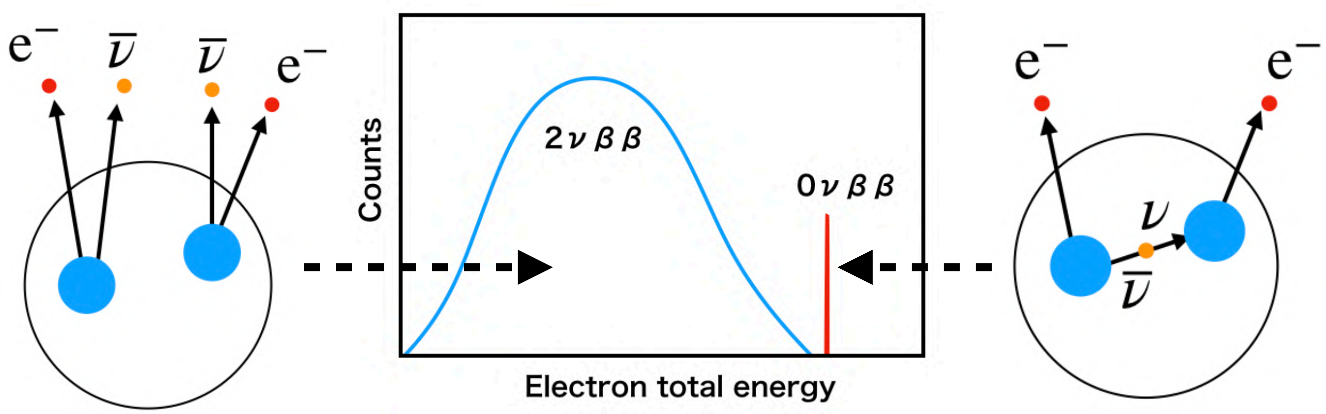
Tokyo University of Science Ryuji Kobayashi

Present status of neutrino physics

A neutrino is known to have mass by neutrino oscillations.

However, the absolute value of neutrino's mass has not been determined, and it is unknown whether a neutrino is a Dirac fermion or a Majorana particle.

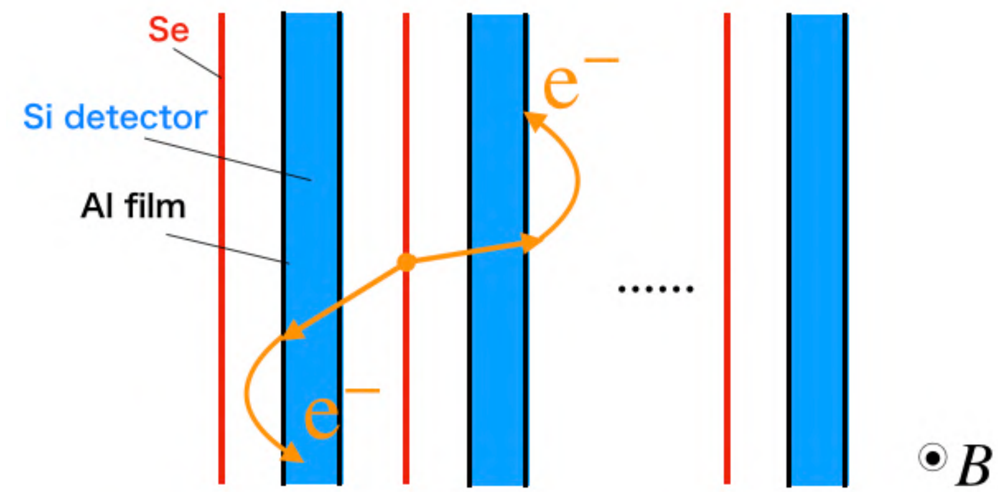
Neutrinoless double beta decay



$$(T^{0\nu}_{1/2})^{-1} \sim \langle m_\nu \rangle^2$$

Experiments such as NEMO-3 and KamLAND-Zen have been conducted, but neutrinoless double beta decay have not been observed yet.

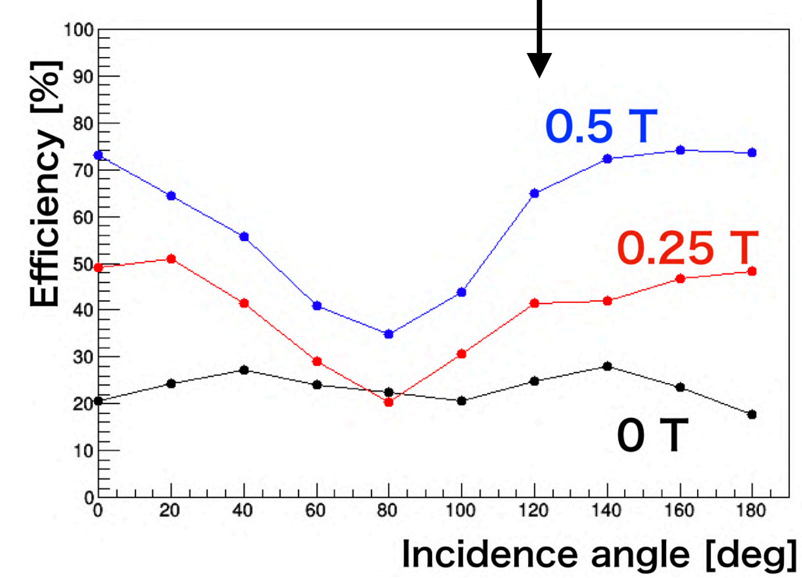
A new idea of the detector



→ Even with thin Si layer, electron detection efficiency can be increased by applying a magnetic field.

Testing of principle by simulation

- Incident angle dependency
- Si (Se) layer thickness dependence



Performance evaluation of gamma-ray detectors at observation altitudes for GRAINE experiment in 2018

Masahiro Komiyama
for GRAINE collaboration

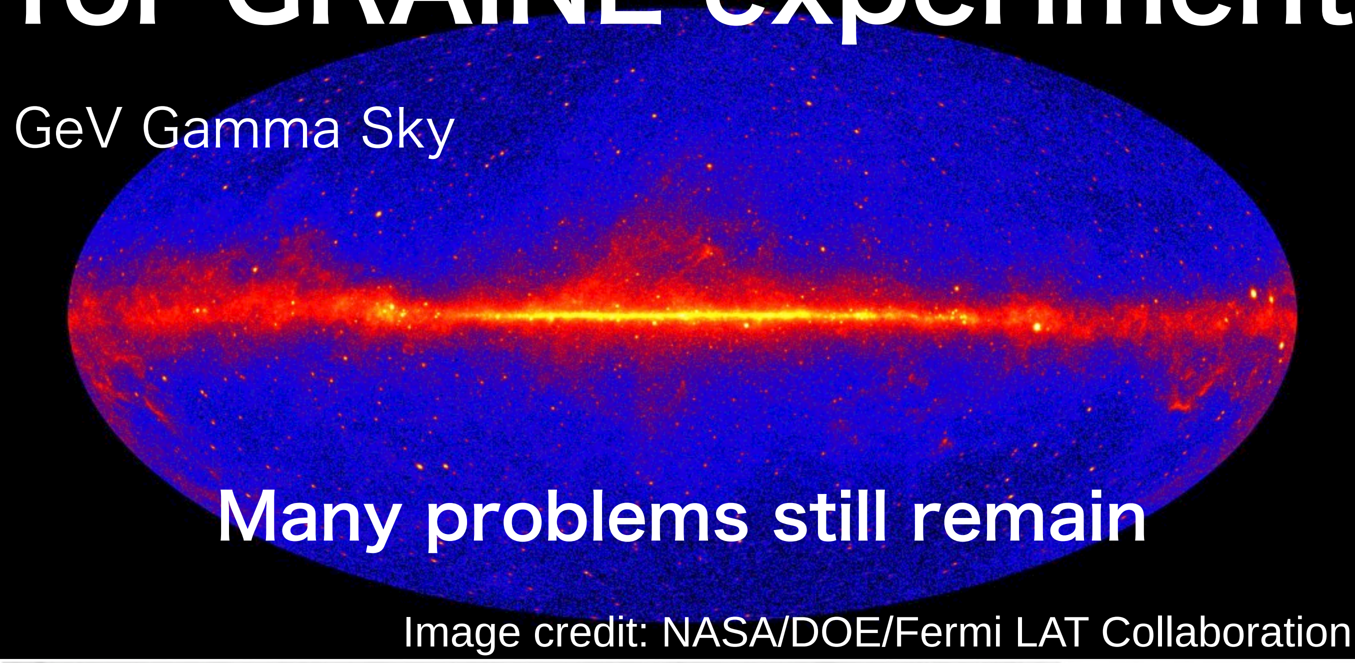
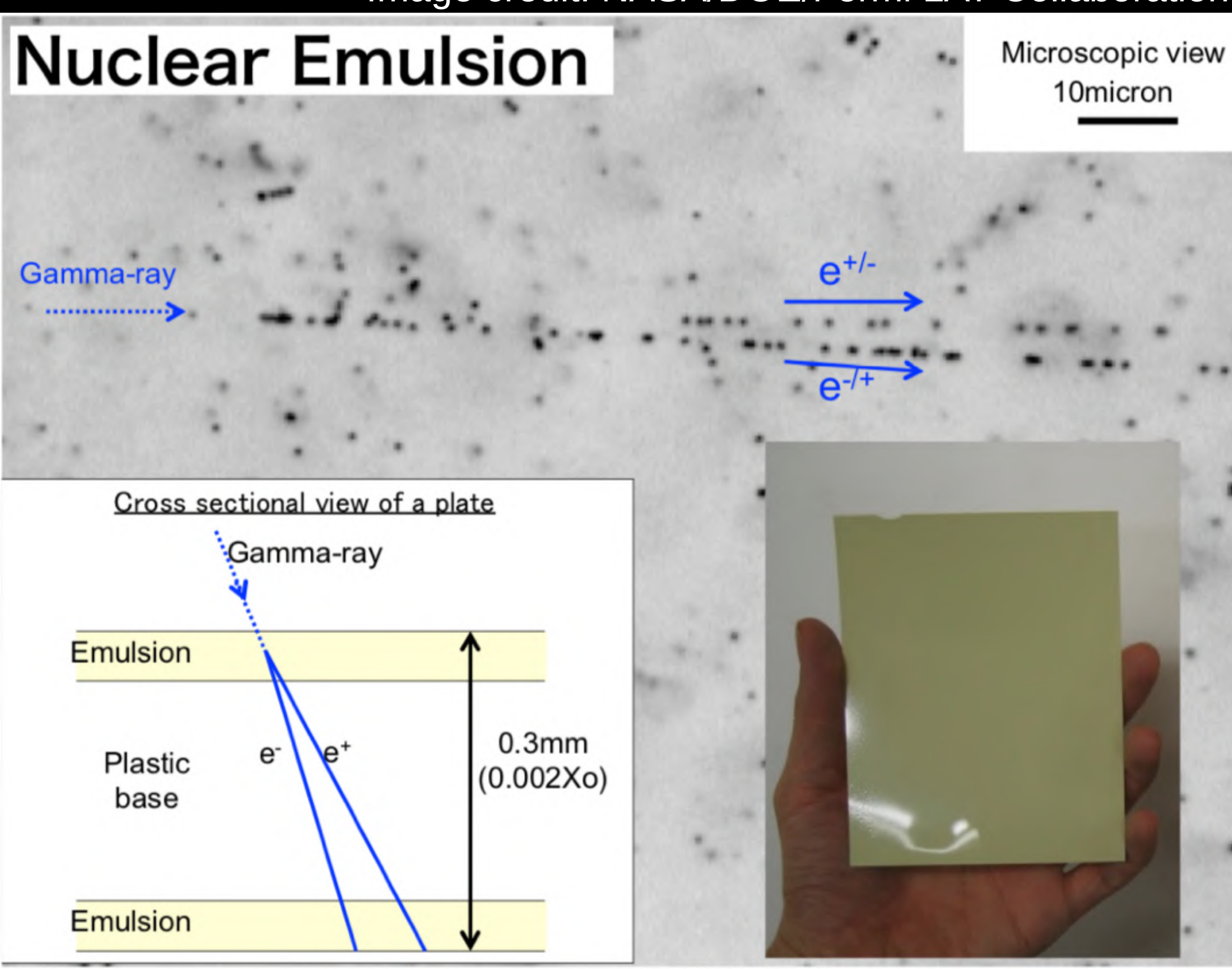
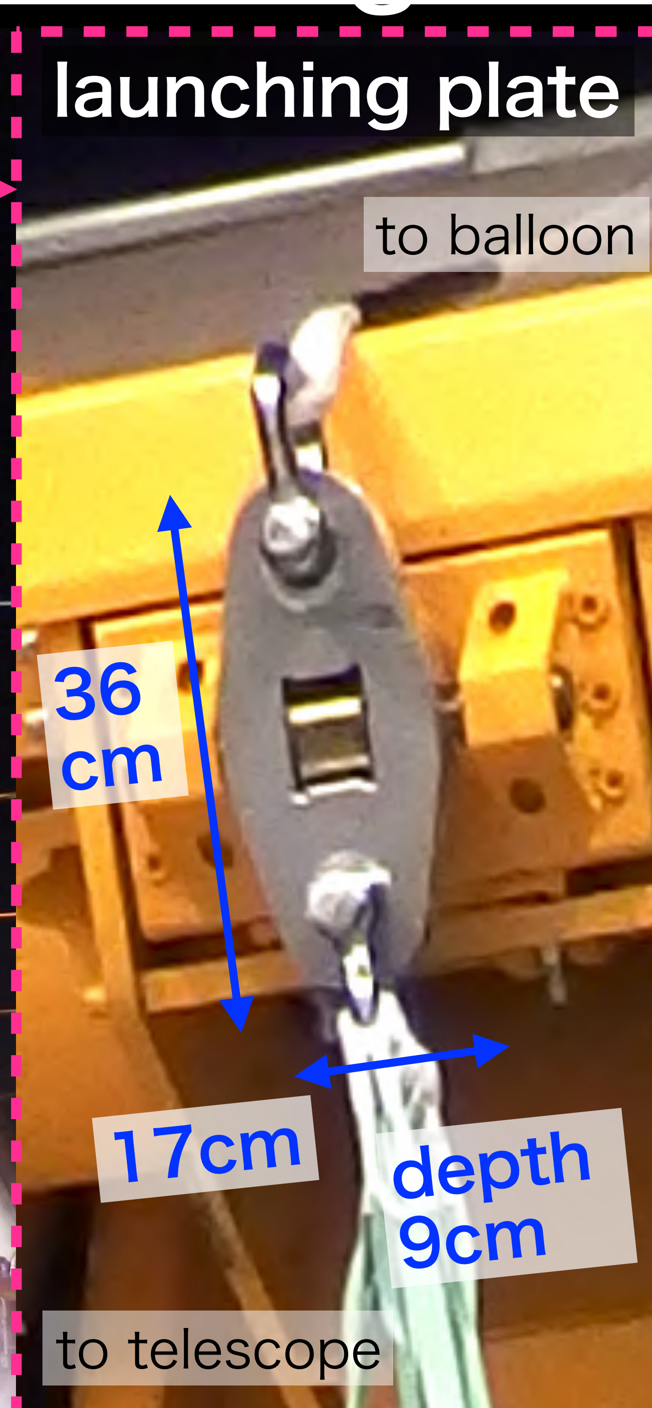
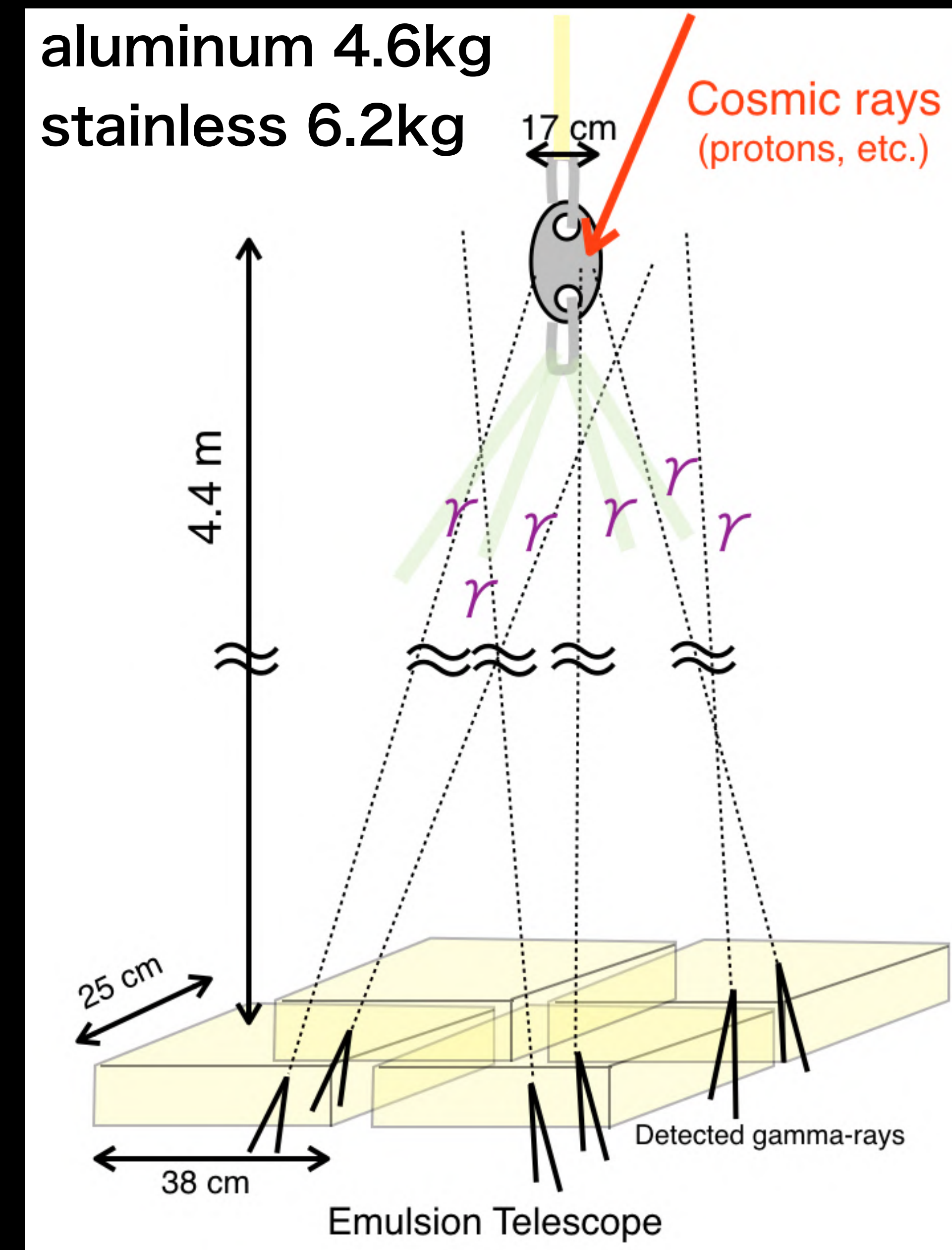


Image credit: NASA/DOE/Fermi LAT Collaboration



Imaging of <u>external gamma-ray source</u> (launching plate)



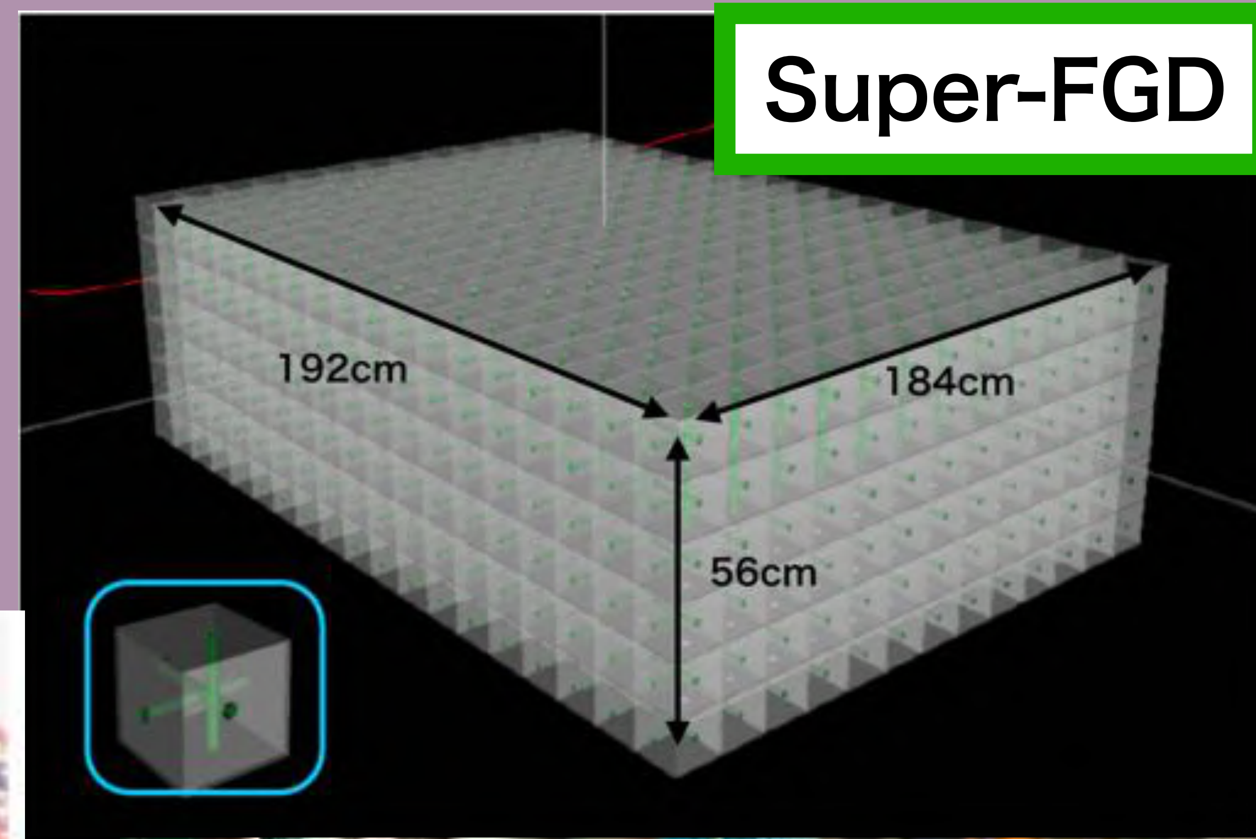


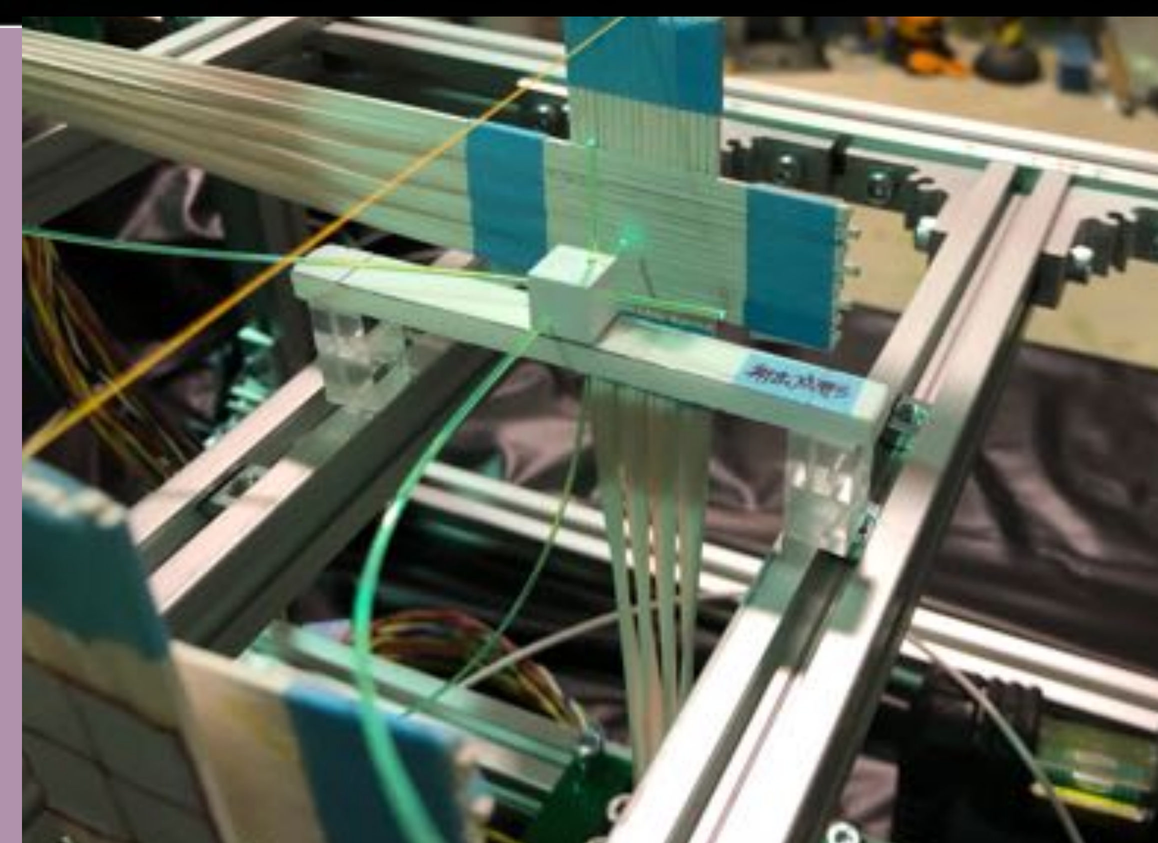
- **Check detected position**
  →Confirm alignment of detector coordinates and external space.
- **Check number of detection events**
  →Confirmation of telescope sensitivity at observation altitudes.

The imaging result is in my poster!

Performance test of prototype for the Super-FGD in the T2K experiment

- Prototype of the optical interface
- Scintillator cube response

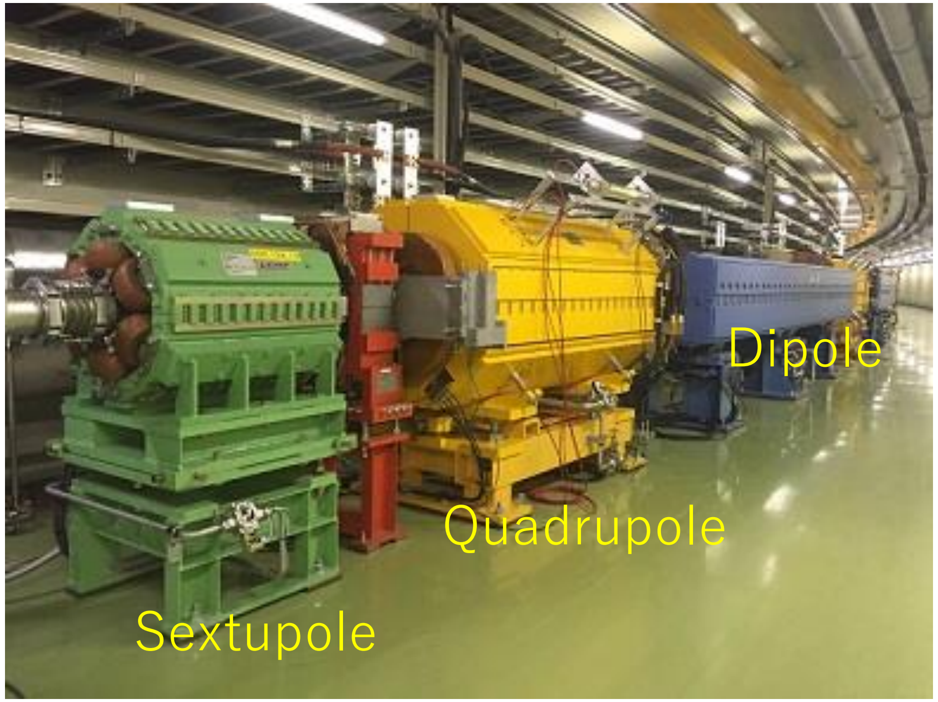




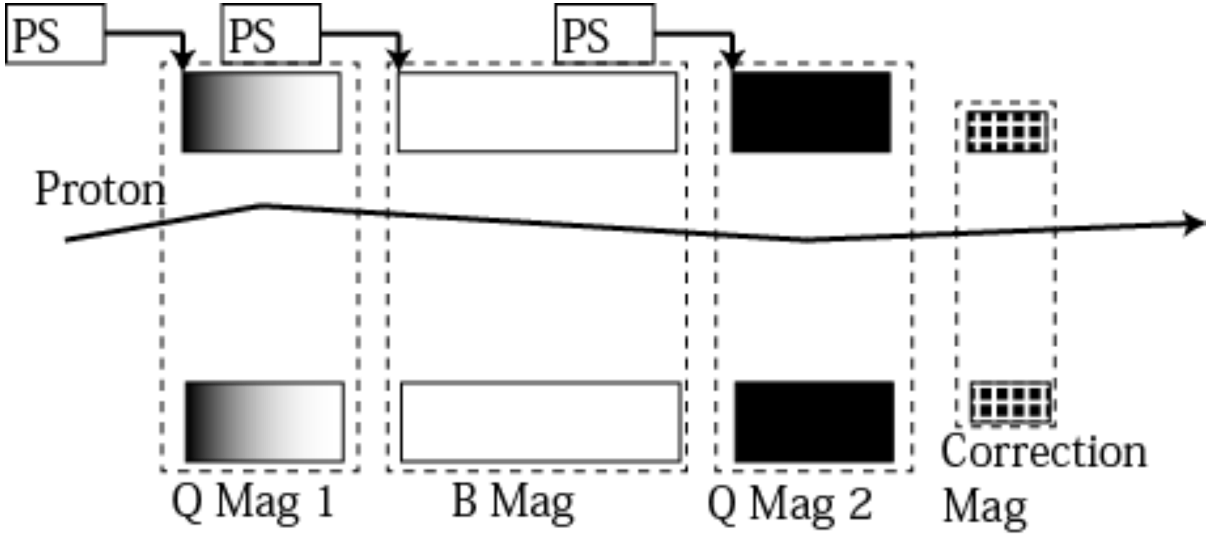
Real-Time Beam Optics Correction using Measured Magnet Current

Yoshi Kurimoto

Magnets in Accelerator Tunnel



How to control the transverse motion

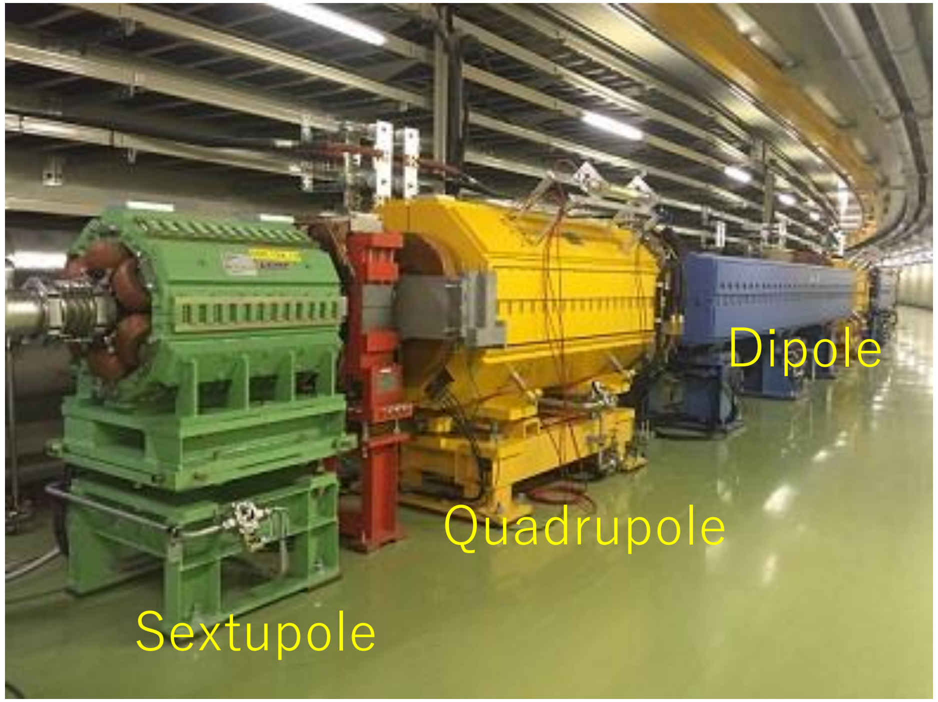


PS : Power Supplies for the magnets

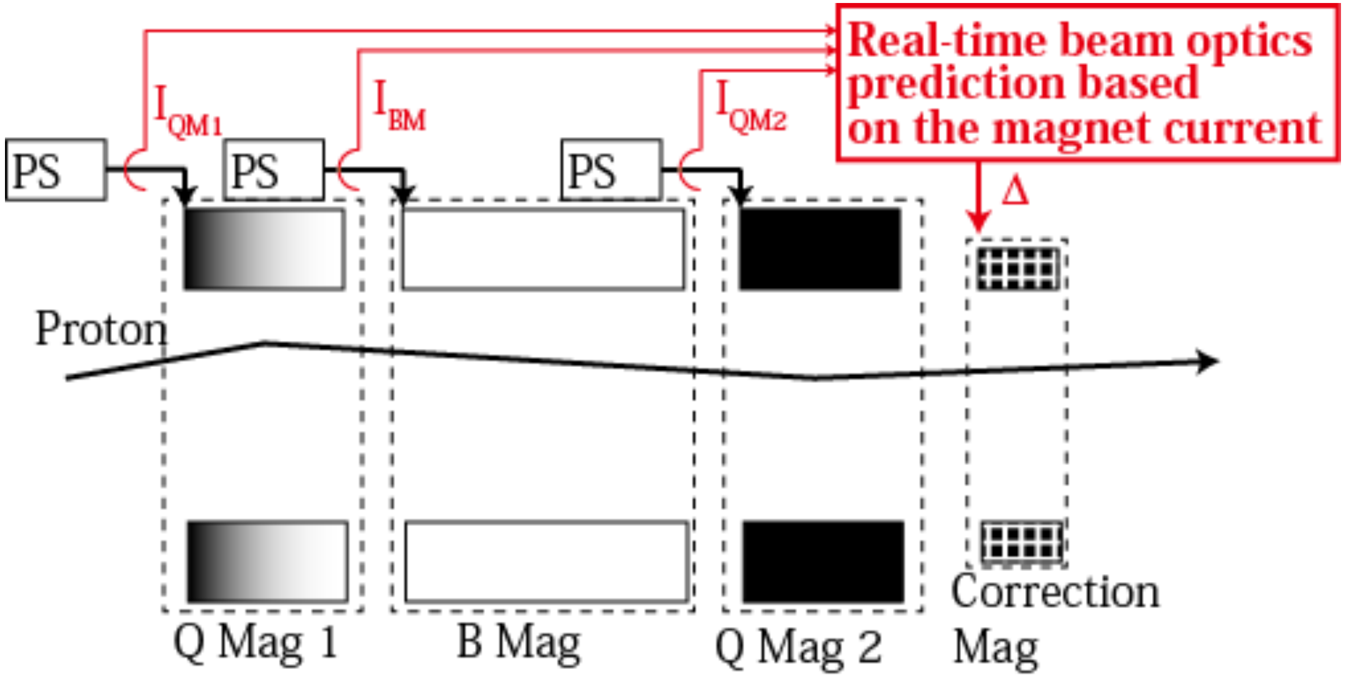
Real-Time Beam Optics Correction using Measured Magnet Current

Yoshi Kurimoto

Magnets in Accelerator Tunnel



How to control the transverse motion

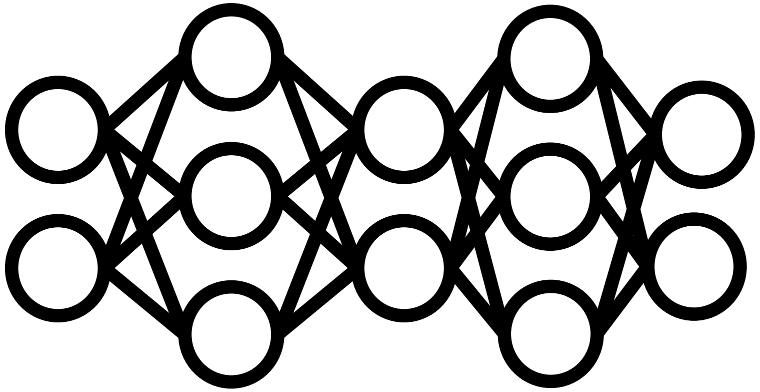


PS : Power Supplies for the magnets

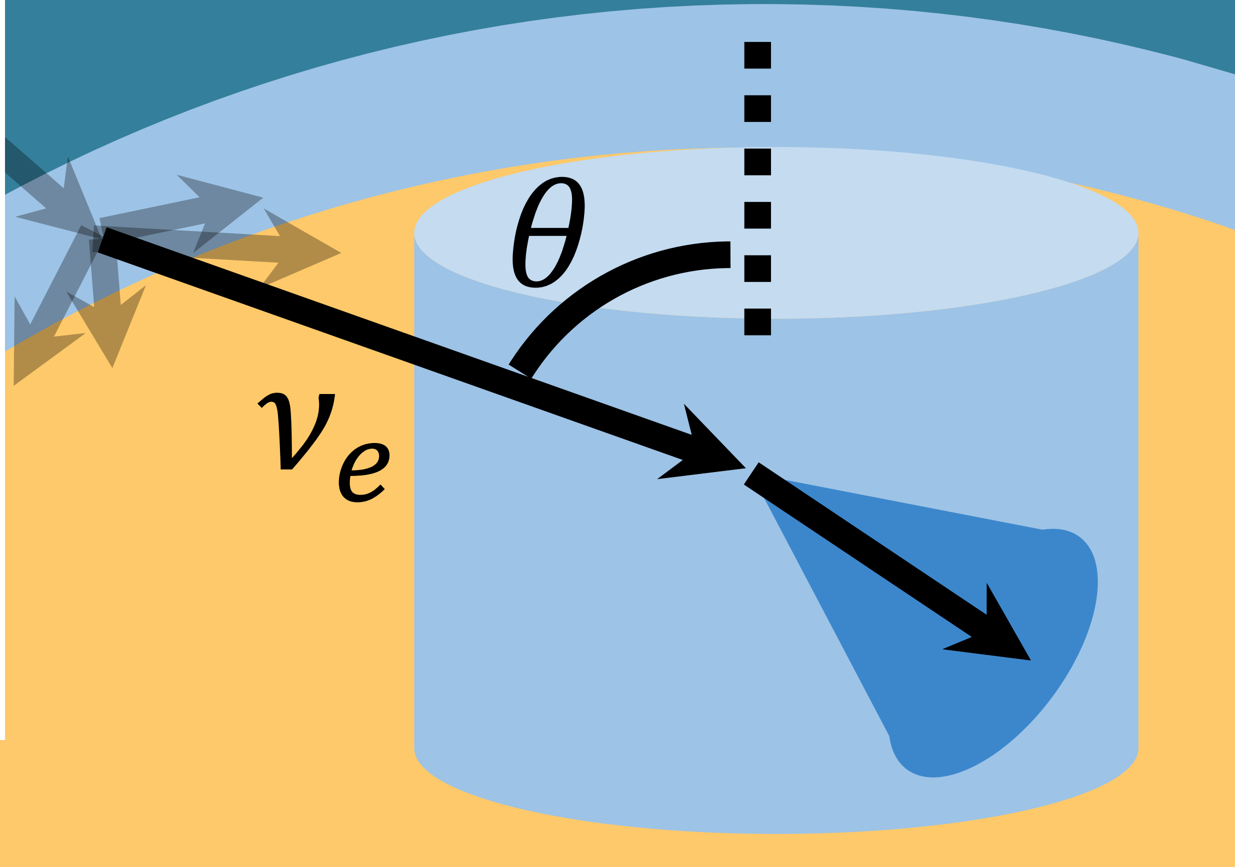
Event classification of atmospheric neutrino by neural network in SK

Tokyo University of Science   Ryo Matsumoto, Masaki Ishitsuka   for the Super-Kamiokande Collaboration

Atmospheric neutrino event classification for Multi-GeV Multi-Ring events using neural network



→ sensitivity to neutrino mass hierarchy



Detectable Dimension-6 Proton Decay in SUSY SO(10) GUT at Hyper-Kamiokande

Naoyuki Haba, Yukihiro Mimura* and Toshifumi Yamada (Shimane University)

Based on arXiv:1904.11697 [hep-ph]

Current Super-K bound: $\tau(p \to \pi^0 e^+) > 1.7 \times 10^{34}$ years (90% CL)

3σ discovery potential at Hyper-K 6.3×10^{34} years (10-year exposure)

Prediction in Minimal SU(5) GUT: $\tau(p \to \pi^0 e^+) \sim 5 \times 10^{35}$ years (for $m_{\tilde{g}} \sim 2$ TeV)

$$\left[\tau(p \to \pi^0 e^+) \propto (m_{\tilde{g}} m_{\tilde{w}})^{-\frac{4}{9}} \right]$$

Fixed mass ratios in GUT spectrum → Predictivity

How about SO(10) GUT?

We consider a simple SO(10) model in which GUT thresholds are predictive.

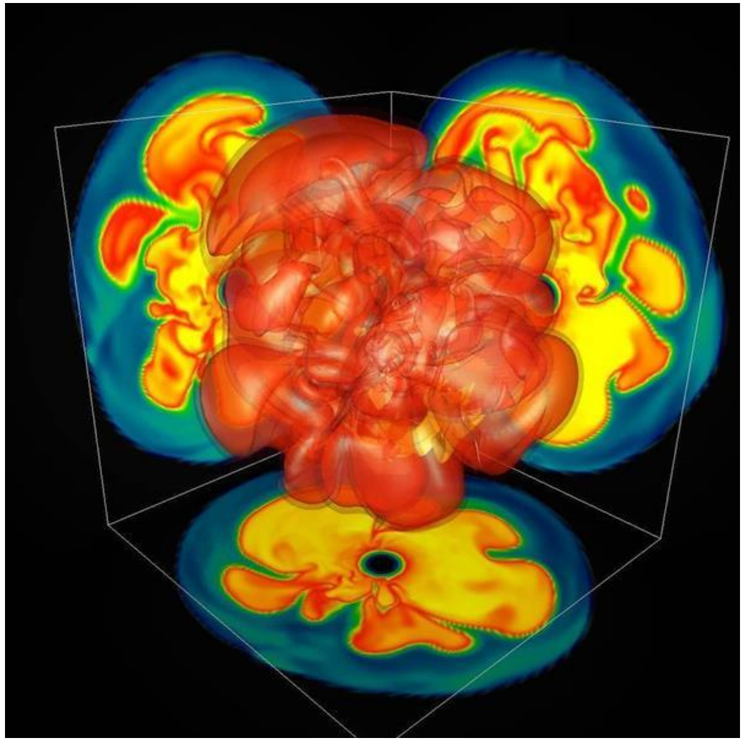
$$\tau(p \to \pi^0 e^+) \sim (3-5) \times 10^{34} \text{ years} \qquad (\text{for } m_{\tilde{g}} \sim 2 \text{ TeV})$$

Deveoloping a long time supernova simulator

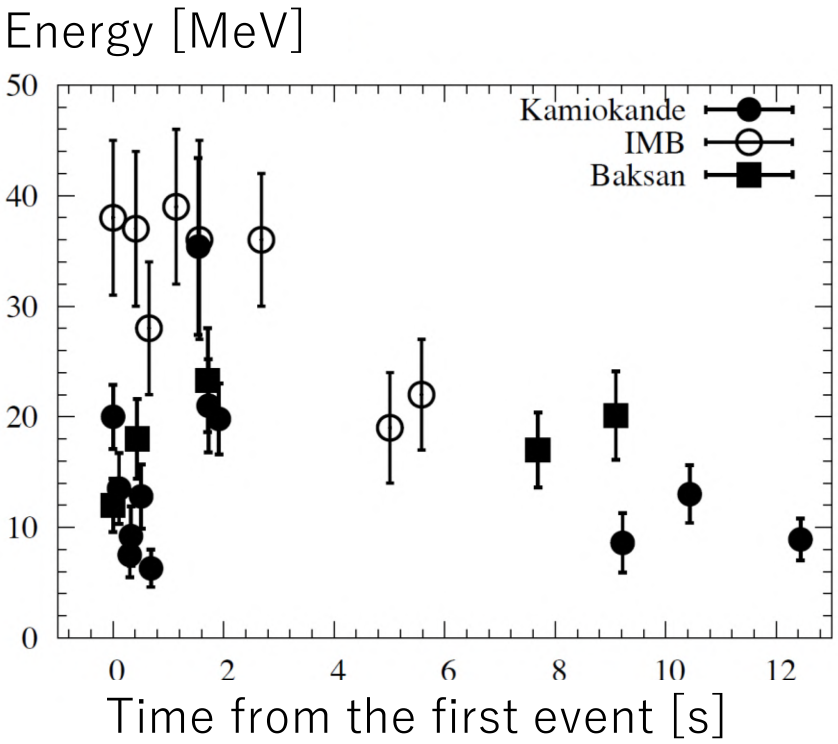
Masamitsu Mori, Roger Wendell, Yudai Suwa[A], Kenichiro Nakazato[B], Kosuke Sumiyoshi[C], Yusuke Koshio[D]
Kyoto univ., Kyoto Sangyo univ.[A], Kyushu univ.[B],Numazu col.[C], Okayama univ.[D]

Supernova

- Massive stars more than 8 times heavier than the sun cause huge explosion called supernova
- Releases a lot of neutrino



Takiwaki, Kotake, Suwa (2014)

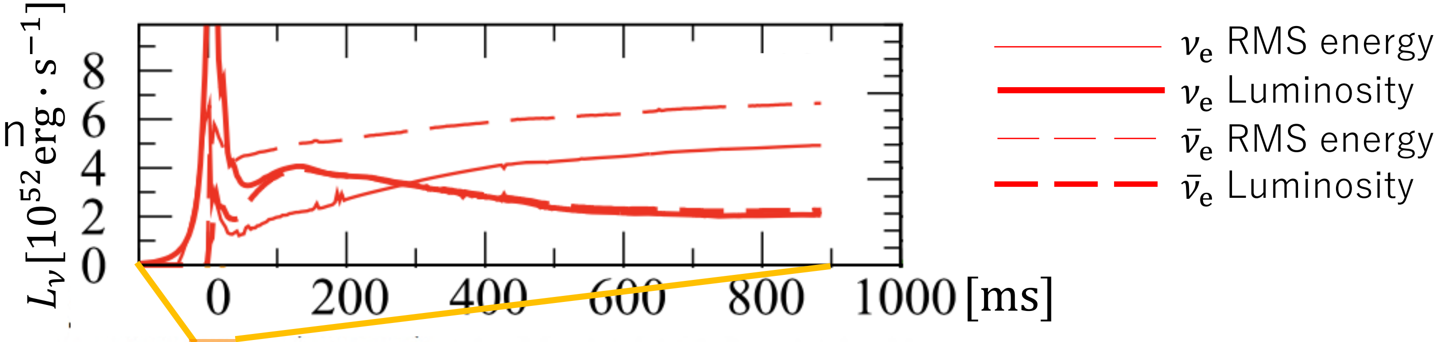


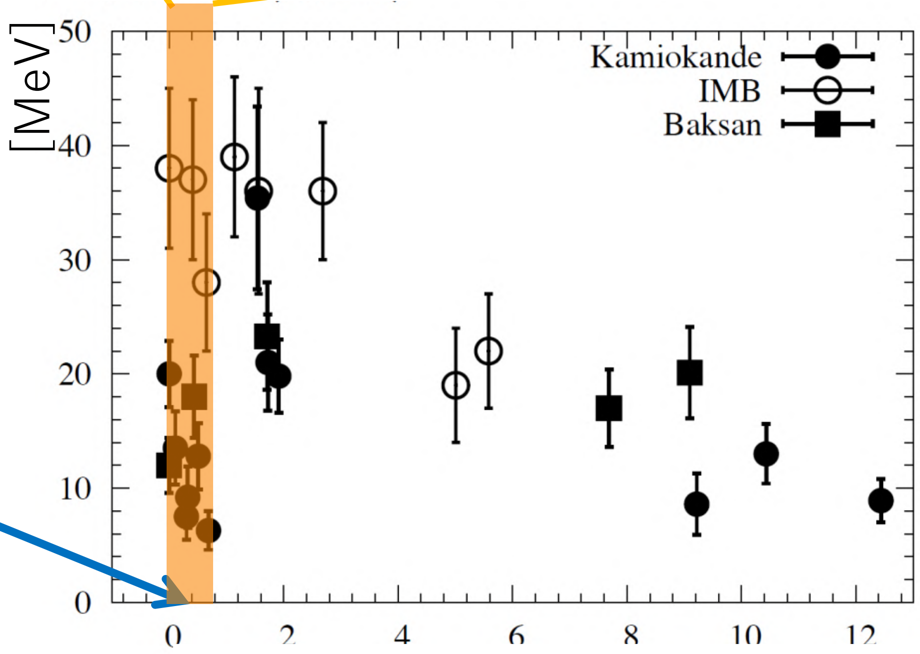
The neutrino events from SN1987a

Comparison of supernova simulation and real bursts

- Most simulations concentrate on the first 1 second, when decides whether explosion is successful.

Example of simulation
Suwa et al. (2016)





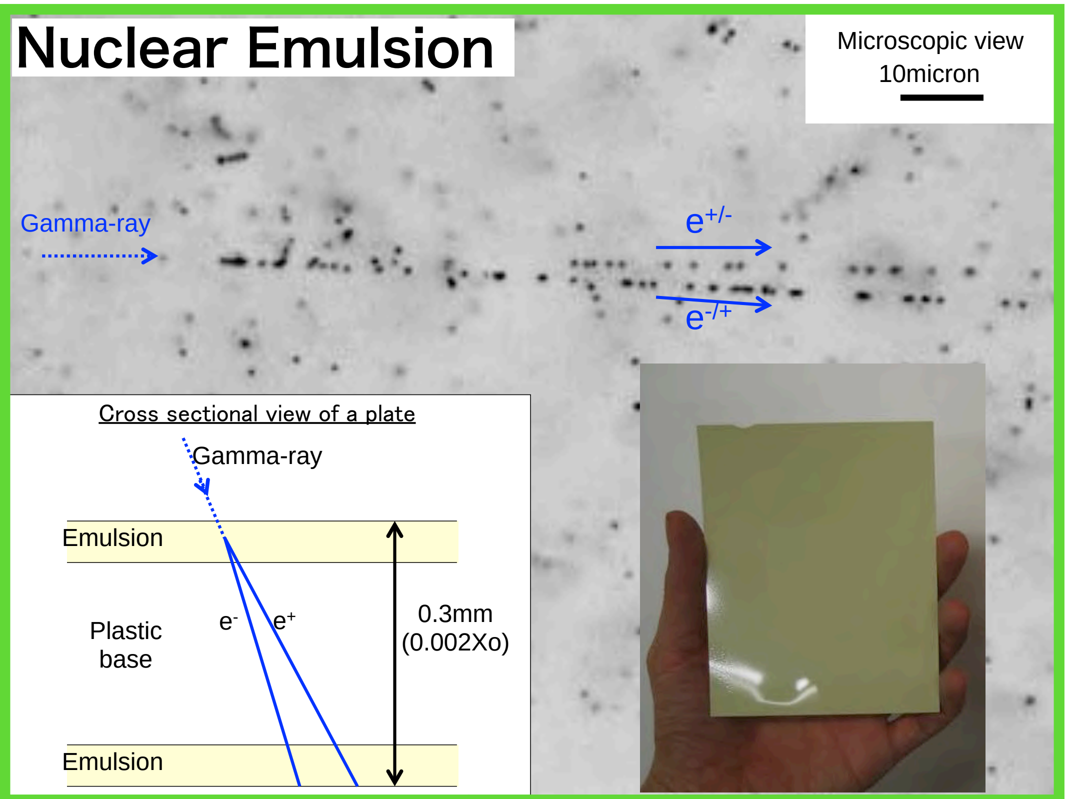
We can compare observation with theory during only this time

Note that there are a few simulations that treat only the evolution after explosion, but they are not enough

- **The long time supernova simulator is being developed for a future detection.**

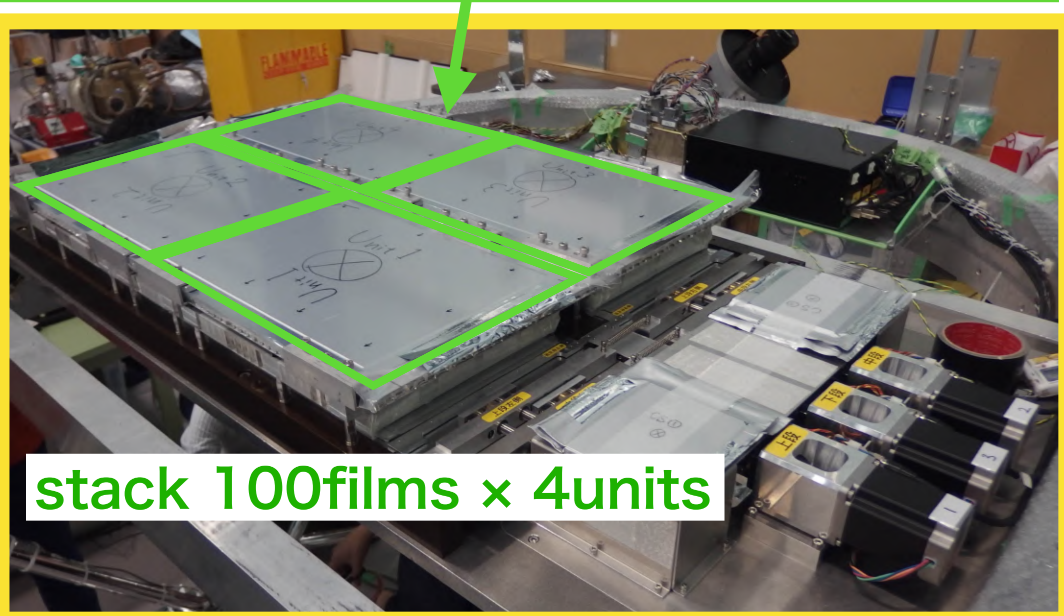
GRAINE project

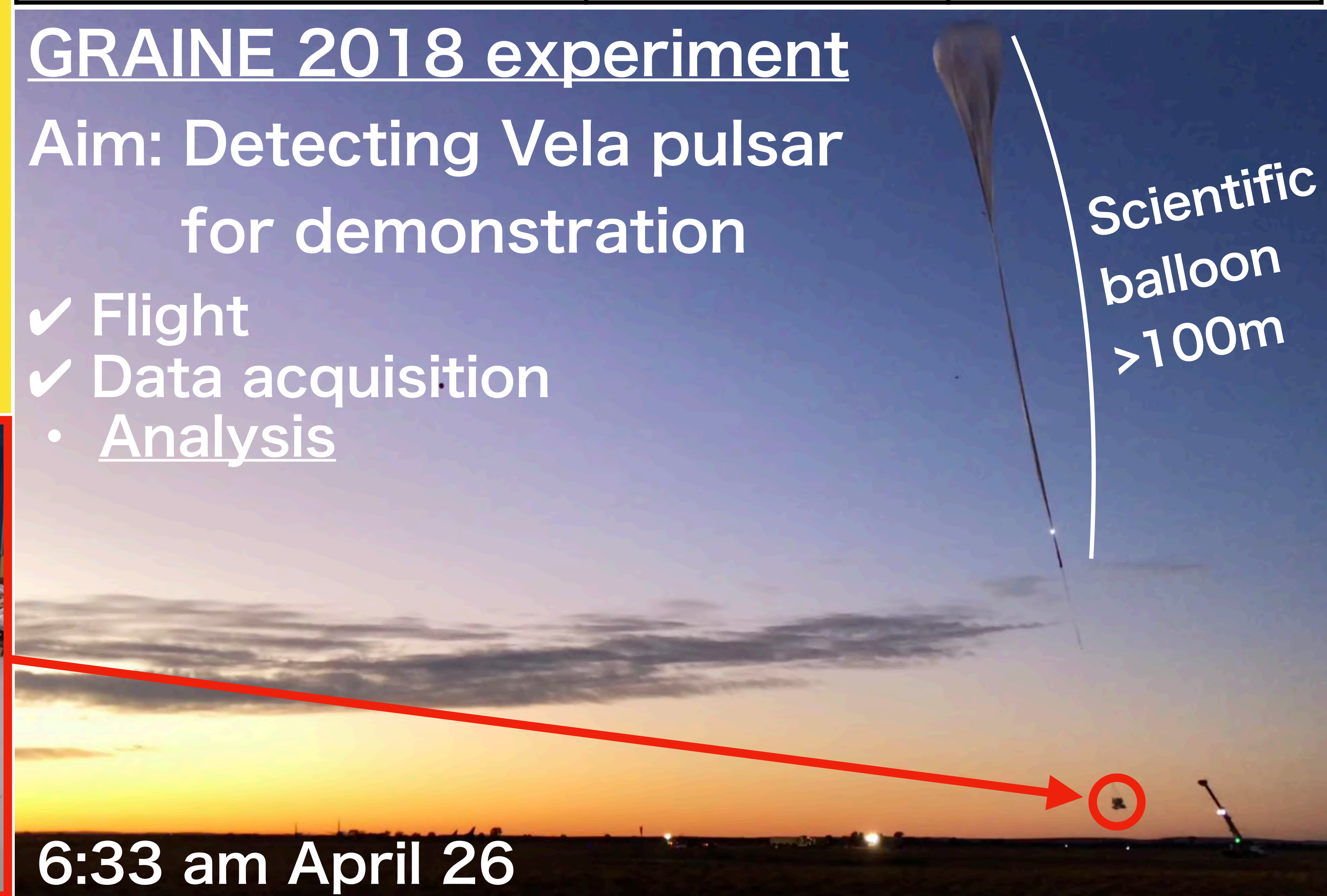
Precise observation of cosmic gamma ray Balloon borne gamma ray telescope utilizing nuclear emulsion



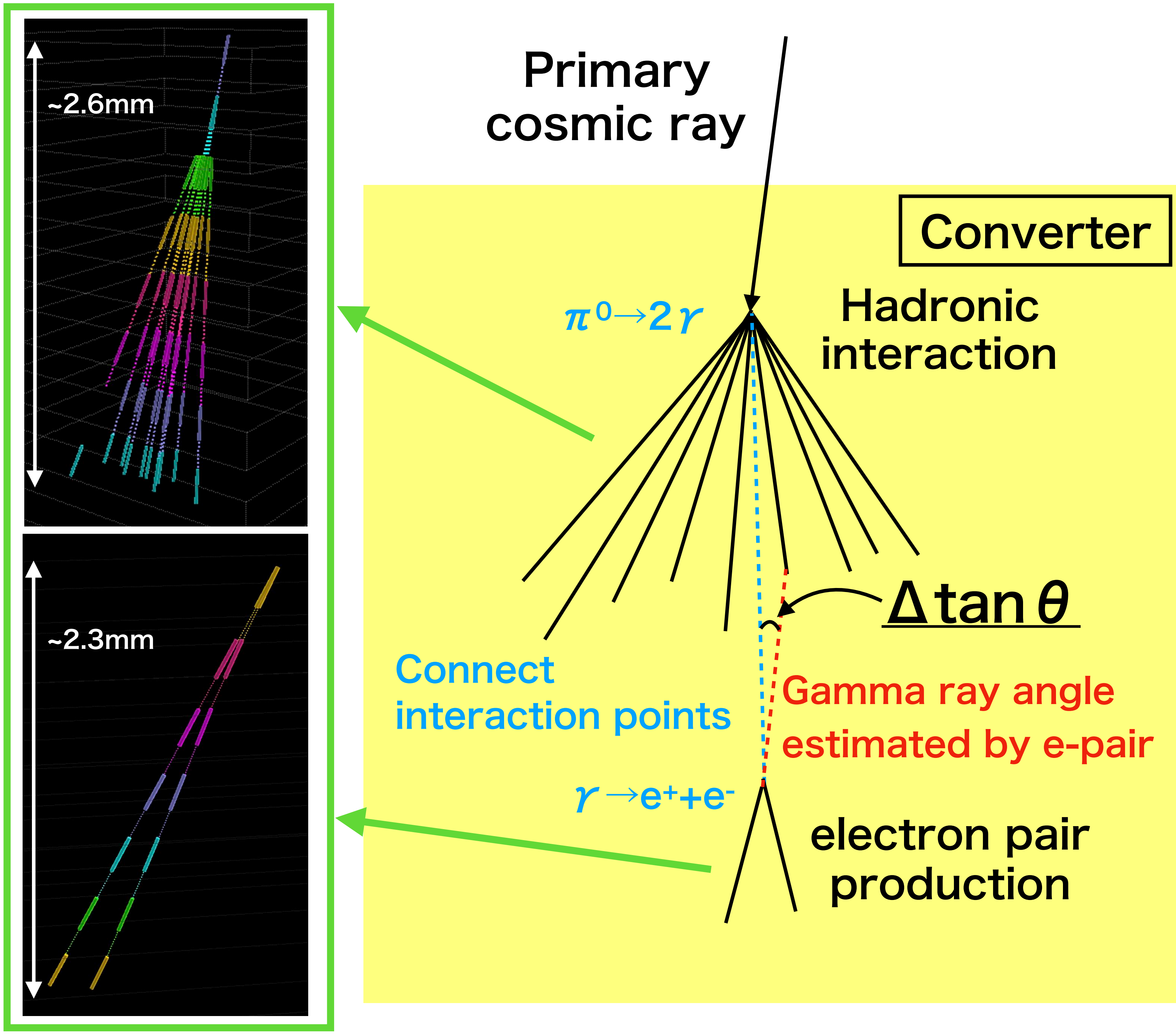
※10m² case

	Femir-LAT	GRAINE
Angular resolution @100MeV	6.0°	1.0°
@1GeV	0.90°	0.1°
Energy range	20MeV-300GeV	10MeV-100GeV
Polarization sensitivity	-	Yes
Effective area @100MeV	$0.25m^2$	$2.1m^{2*}$
@1GeV	$0.88m^2$	$2.8m^{2*}$
Dead time	26.5 μs(readout time)	dead time free





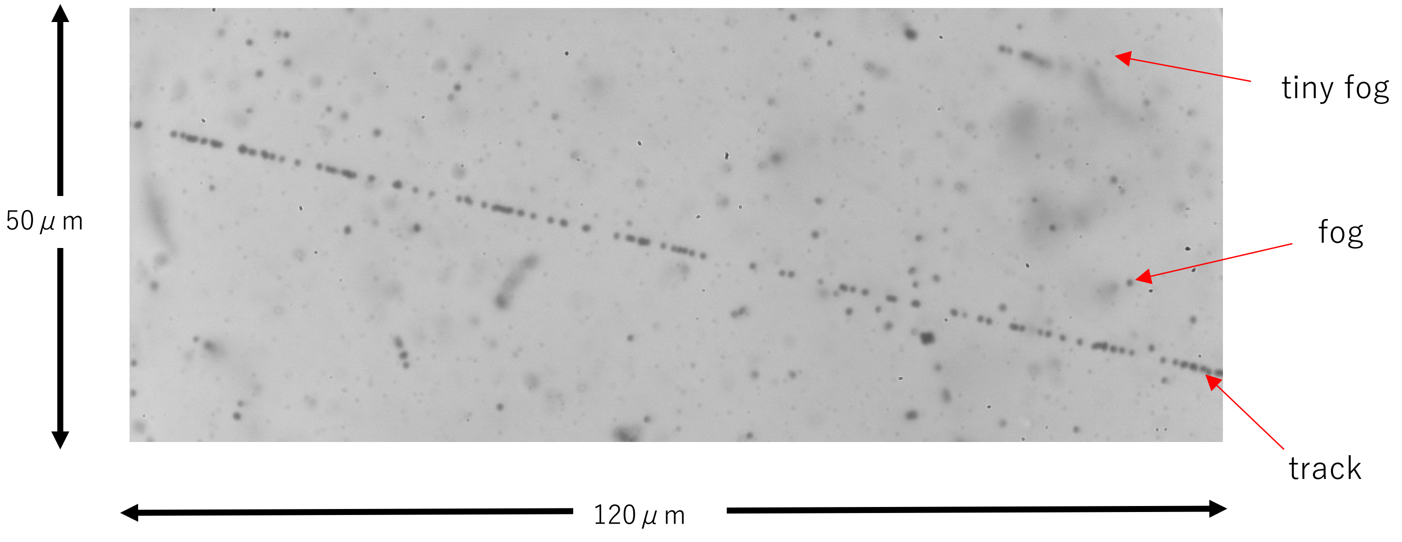
Evaluation for angular resolution



$\Delta \tan\theta$ is better than required performance?(1° @>100MeV)

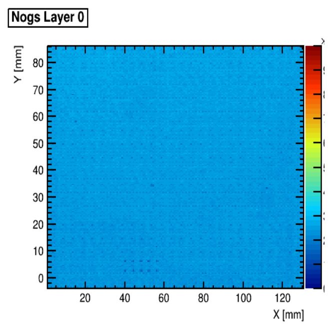
→Watch the more on my poster!!!

Noise evaluation of nuclear emulsion

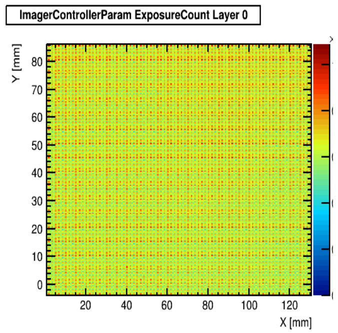


PL002

Number of grain

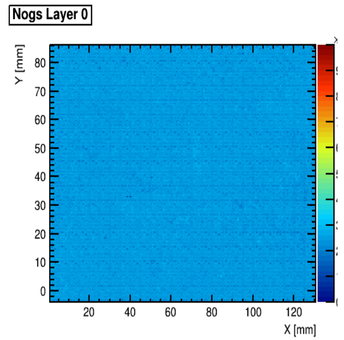


exposure

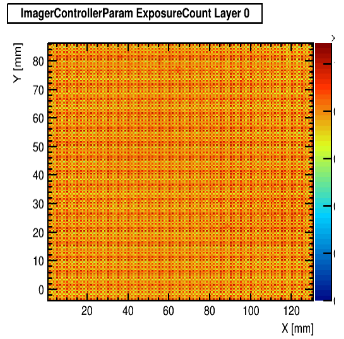


PL004

Number of grain



exposure



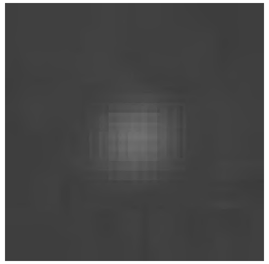
The cause may be tiny fog …?

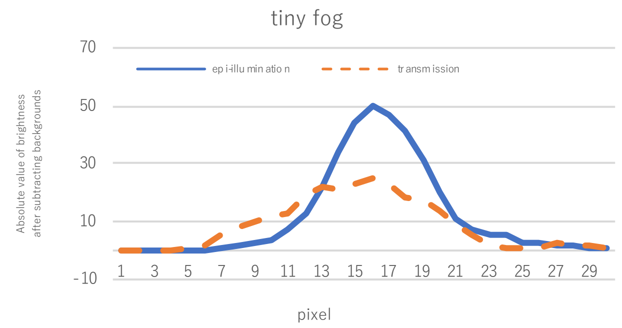
Automatic reader cannot evaluate noise accurately.

I want to evaluate various films with better accuracy than automatic reader by automatically measuring the amount of Tiny fog and fog.

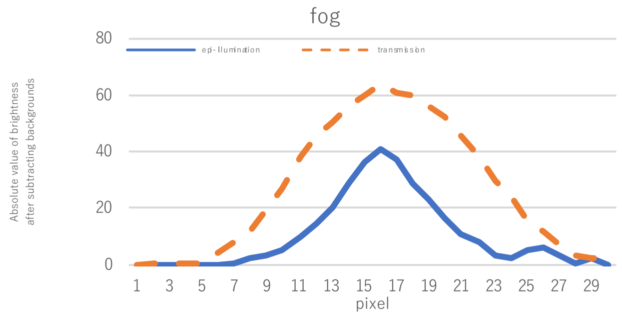
Micro

A typical fog

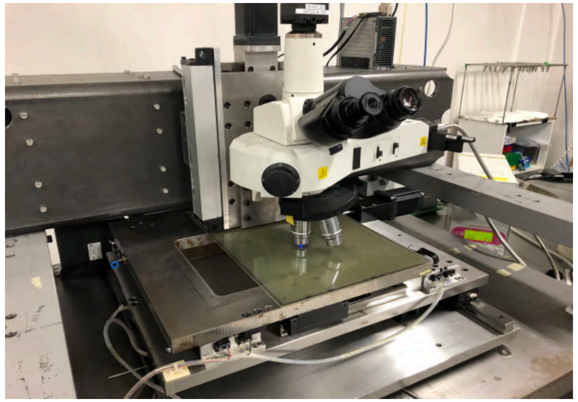




tiny fog

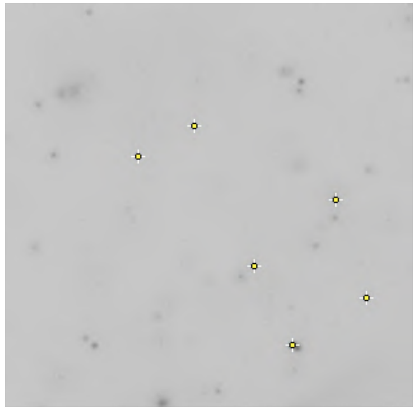


Macro



PTS

Measurement fog and tiny fog



The result is in my poster

Study for g-mode oscillations in the Sun using solar neutrino

Exploration of Particle Physics and Cosmology with Neutrinos Workshop2019

2019 June 13th (Thu)

Yuuki Nakano (Kobe university)

■ Introduction

- There are **several periodic variations** in the sun.
- They may affect the production of solar ν.

Oscillation	Restoring force	Region	Frequency
p-mode	Pressure	Surface	A few mHz (~5 min)
g-mode	Gravity	Core	100-300 μHz (~a few hours)

■ ^{8}B solar neutrino

- Production rate depends on temperature.
  → $T^{24\text{-}25}$ (where $T_{core} \sim 10^{6\text{-}7}$ K).
- **Flux of ^{8}B ν may amplified by a factor of 170.**

■ Method to search for g-mode oscillation using ν

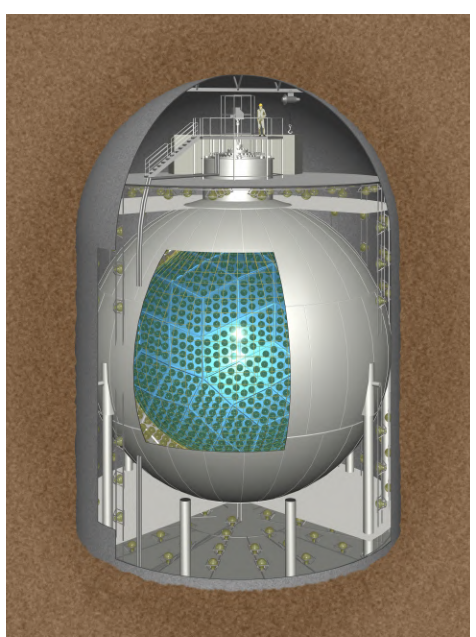
- **Lomb-Scargle method** (binned analysis)
- **Rayleigh test** (circular test, unbinned analysis)

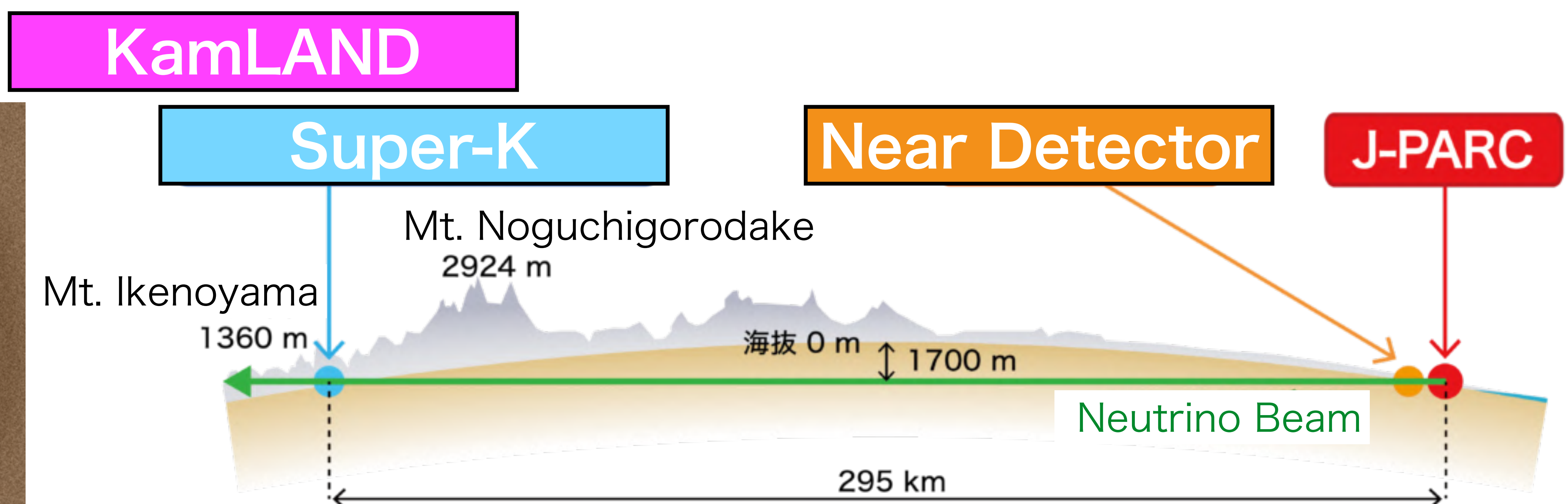
T2KamLAND and Neutral Current BG Estimation for Supernova Relic Neutrino Search

S.Obara for KL-collaboration

High Energy Phys. Lab. Kyoto-Univ.

- **KamLAND** is also a far detector for **T2K** –> Try analysis !!
- Evaluate **NC-reaction** ($\nu_\mu + {}^{12}C \rightarrow \nu_\mu + {}^{11}C^* + n$), which is **BG for SRN search**
- SRN search in KamLAND has advantage for low-energy SRNs ~ a few MeV





Development and Construction of the New Tracker for NINJA Physics Run

Odagawa Takahiro (Kyoto Univ.) for the NINJA Collaboration

- NINJA = (**N**eutrino **I**nteraction research with **N**uclear emulsion and **J**-PARC **A**ccelerator)
- Construction of a new tracker in J-PARC from last Feb. ->
- How the construction went and what is ongoing about this new tracker.

Right-handed neutrinos and the primordial gravitational wave

Hisashi Okui, Takehiko Asaka
Niigata University

Light right-handed neutrinos

- Tiny neutrino masses via seesaw mechanism
- Baryogenesis via RH ν oscillation
- Sterile neutrino DM

Asaka, Blanchet, Shaposhnikov, Phys.Lett.B631(2005)151-156
Asaka, Shaposhnikiv, Phys.Lett.B620(2005) 17-26

Primordial gravitational wave

- Produced by quantum fluctuation in inflation
- Imprinting the thermal history of the universe

Seto, Yokoyama, J.Phys.Soc.Jap. 72 (2003) 3082-3086
Watanabe, Komatsu, Phys.Rev. D73 (2006) 123515

- We revisit the entropy production by the decay of right-handed neutrinos that dilutes DM and baryon abundances.
- We estimate the modified history by right-handed neutrinos that is imprinted in the gravitational wave spectrum.

Quickfire

「Study of neutrino charged current interactions on iron in the NINJA experiment」

2016.5.30 @ J-PARC

Toho University
Hitoshi Oshima
for the NINJA collaborators

Study of neutrino charged current interactions on iron in the NINJA experiment

Exploration of Particle Physics and Cosmology with Neutrinos Workshop2019, 12-14 June. 2019, Iga, Mie, Japan

H. Oshima (Toho University)
on behalf of the NINJA collaboration

Poster highlights ① (NINJA iron target run in 2016)

ν CC interaction

- Quasi Elastic (QE)

$$\nu_\mu + n \rightarrow \mu^- + p$$

- Meson Exchange Current (2p2h)

$$\nu_\mu + n + N \rightarrow \mu^- + p + N$$

The low energy **p** can not be detected.
→ ν energy will be miss-reconstructed.

- Resonant Pion Production (RES)

$$\nu_\mu + N \rightarrow \mu^- + N' + \pi$$

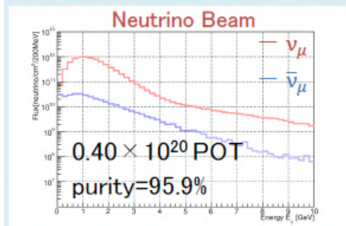
The $\pi^\pm$s were re-scattered in the nucleus.
→ difficult to distinguish the int. mode.

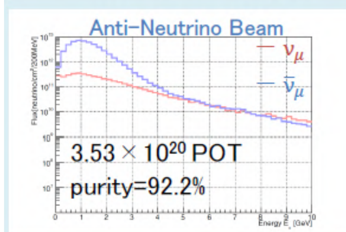
- The major systematic uncertainties in ν oscillation measurements.
- Understanding of ν-nucleus int. is very important.

NINJA Experiment : Iron target Run in 2016

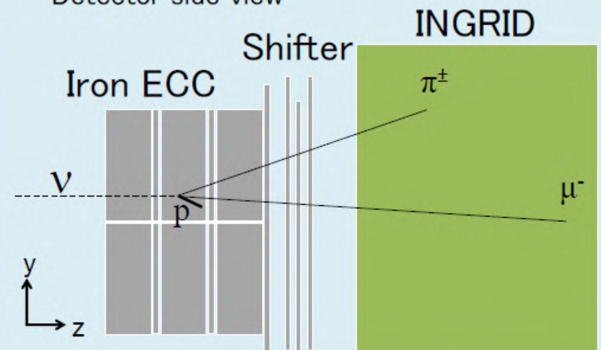
Detector construction & Analysis strategy

Beam information



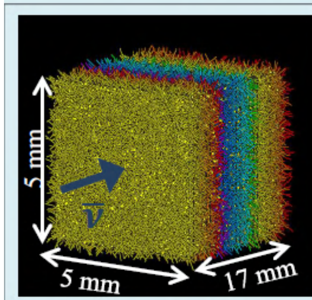


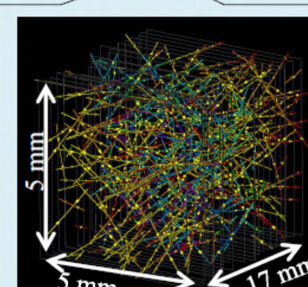
Detector side view



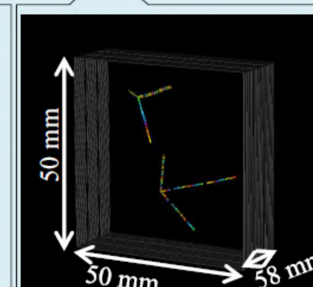
Precise vertex analysis

Timestamp + Muon ID → CC int. selection





ν beam int.(CC+NC) + $\bar{\nu}$ beam int.(CC+NC) + cosmic-ray + environmental radiation + ･･･



ν beam int.(CC) / $\bar{\nu}$ beam int.(CC)

Study of neutrino charged current interactions on iron in the NINJA experiment

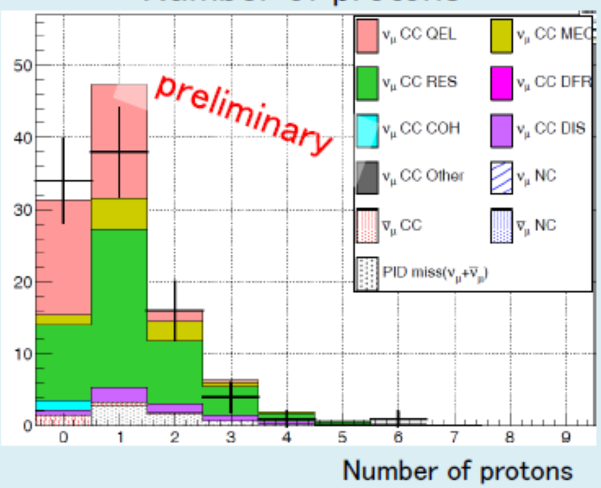
Exploration of Particle Physics and Cosmology with Neutrinos Workshop2019, 12-14 June. 2019, Iga, Mie, Japan

H. Oshima (Toho University)
on behalf of the NINJA collaboration

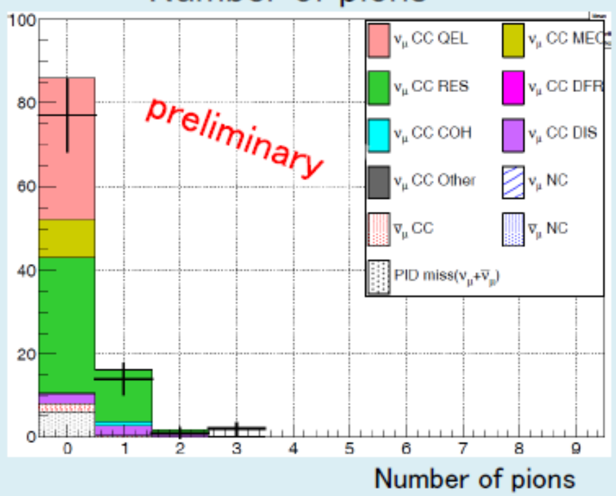
Poster highlights ② (NINJA iron target run in 2016)

The number of protons and $\pi^{\pm}$s

Number of protons



Number of pions



Analysis using emulsion film's high position resolution.

Number of protons vs. charged pions

Real Data

p \ $\pi^{\pm}$	0	1	2	3	4
0	27 ± 5	7 ± 3	0	0	0
1	32 ± 6	5 ± 2	0	1 ± 1	0
2	15 ± 4	1 ± 1	0	0	0
3	3 ± 2	1 ± 1	0	0	0
4	0	0	1 ± 1	1 ± 1	0

preliminary

MC(NEUT5.4.0)

p \ $\pi^{\pm}$	0	1	2	3	4
0	25.3	8.1	0.8	0.3	0
1	37.0	8.4	1.8	0.3	0.1
2	11.6	2.0	0.5	0.1	0
3	4.4	0.8	0.2	0.1	0
4	1.6	0.4	0.1	0	0

preliminary

Study of neutrino charged current interactions on iron in the NINJA experiment

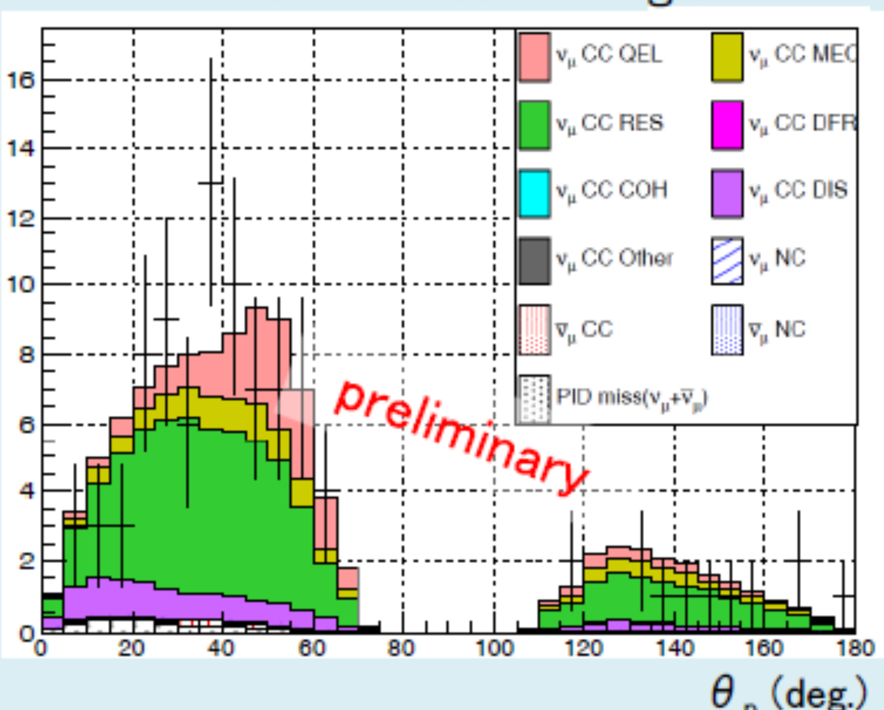
Exploration of Particle Physics and Cosmology with Neutrinos
Workshop2019, 12-14 June. 2019, Iga, Mie, Japan

H. Oshima (Toho University)
on behalf of the NINJA collaboration

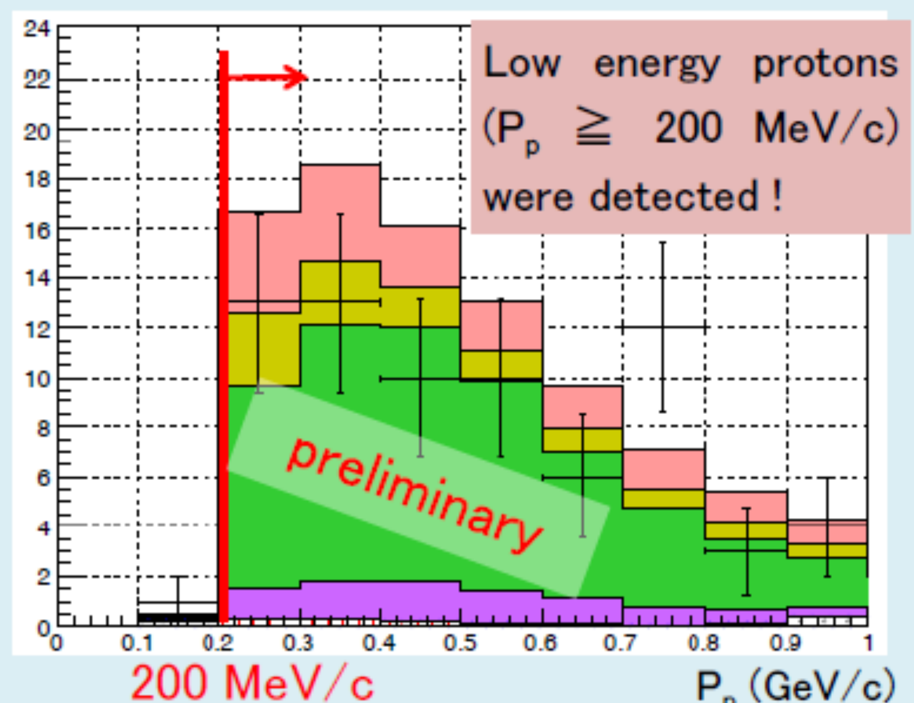
Poster highlights ③ (NINJA iron target run in 2016)

Proton kinematical measurements

Proton emission angle



Proton momentum



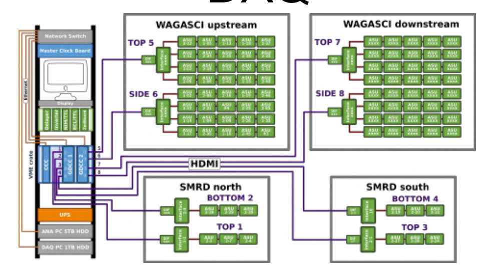
Low energy protons (～200 MeV/c) from ν interactions were detected !

T2K-WAGASCI:MIDAS-based DAQ software and online monitor for the readout of a large number of MPPCs

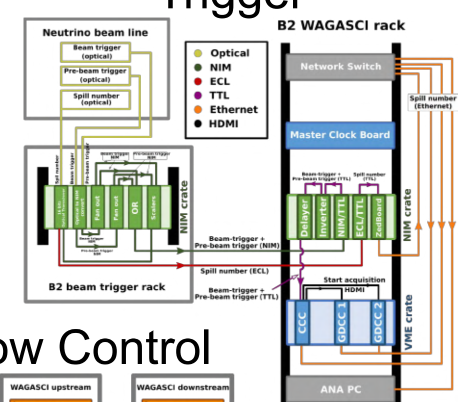
Pintaudi Giorgio
PhD student, YNU

Topic	My direct contribution
Slow control	Selected and prepared new electronics. Completely rewritten all the software.
Pyrame (frontend)	Directly contributed to the LLR GitLab repository. Added support for new devices.
MIDAS (backend)	Completely new Web interface for run control and testing.
Analysis (calibration)	Rewritten much of the code for automated calibration. State of art run control scripting and online monitor (still to test).
Backups	New code to perform automated backups. Database-based backups!

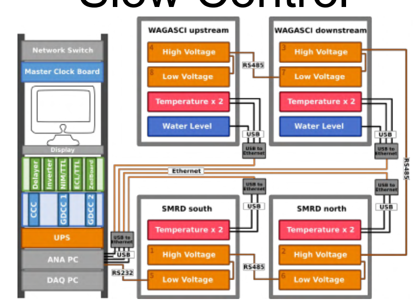
DAQ

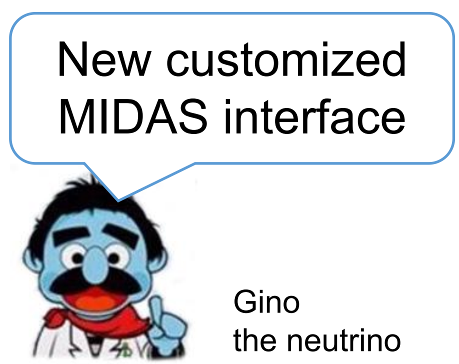


Trigger



Slow Control





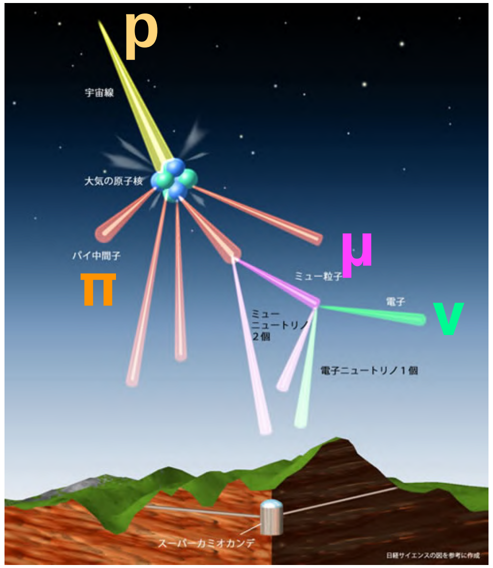
upgrade of ATMNC

K. Sato, Y. Itow, H. Menjo (ISEE, Nagoya), M. Honda (ICRR, Tokyo)

ATMNC by Honda: **simulation code** for atmospheric ν flux

[M. Honda *et. al.* PRD83:123001 (2011)]

- 3D & full simulation
- successfully used in SK analysis



For *future more sensitive detectors*,
more accurate simulation is desirable

air shower development
→ hadronic interactions dominated

source of uncertainty

↑

I want to reduce this

In this poster …

- review the treatment of had. int. in ATMNC
- discuss the strategy to reduce the uncertainty
- report current status (*no result yet*…)

$f_{|p|}$ & f_θ as 2D plot

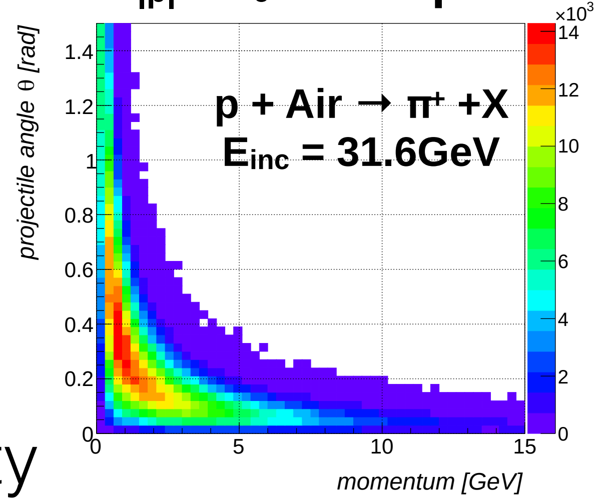
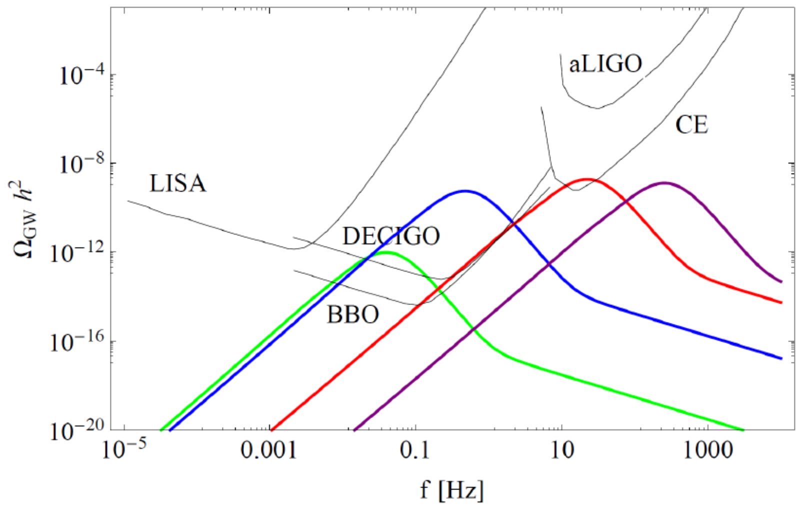


table of kinematics used in ATMNC

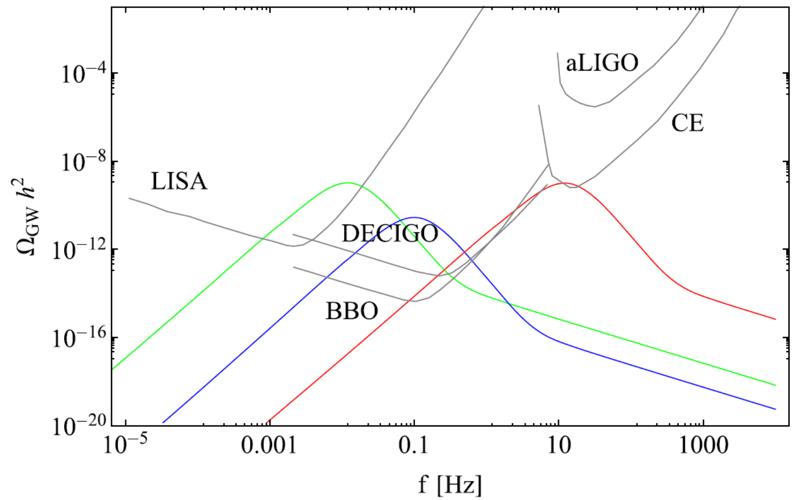
Gravitational waves from minimal and nonminimal B-L phase transition

Osamu Seto (Hokkaido University)
with Nobuchika Okada, RRD 98 063532 (2018)
with Taiki Hasegawa and NO, PRD 99, 095039 (2019)

- Open questions about neutrino masses
  - The origin of neutrino mass?
  - How many/heavy RH neutrinos?
  - …
- Gauged B-L symmetry is an attractive BSM addressing neutrino masses
- Gravitational waves from a 1st order phase transition in the early Universe
- Results Non-minimal (2018) Minimal (2019)



$v\ (=v_1=v_2) = 4,\ 10^2,\ 10^4,\ 10^5$ TeV



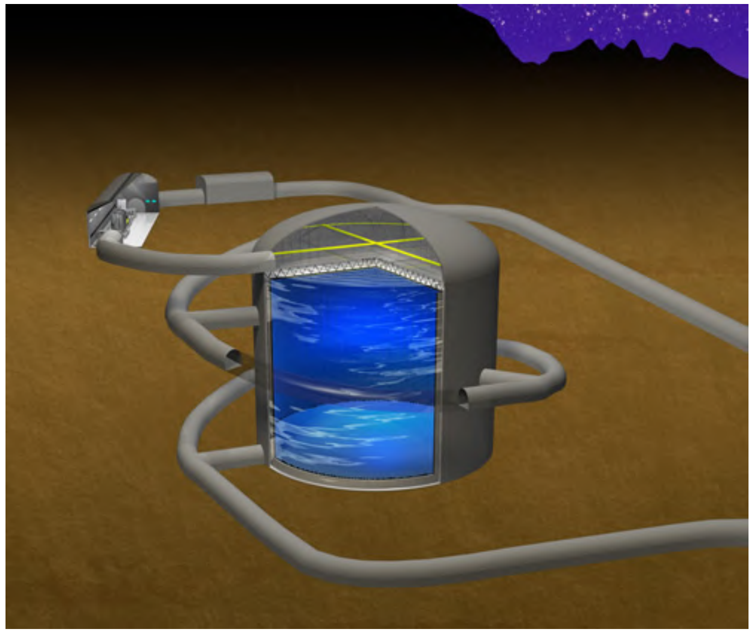
Low energy event reconstruction in Hyper-Kamiokande

Masataka Shinoki (Tokyo University of Science)

The Exploration of Particle Physics and Cosmology with Neutrinos Workshop 2019

□ Hyper-Kamiokande

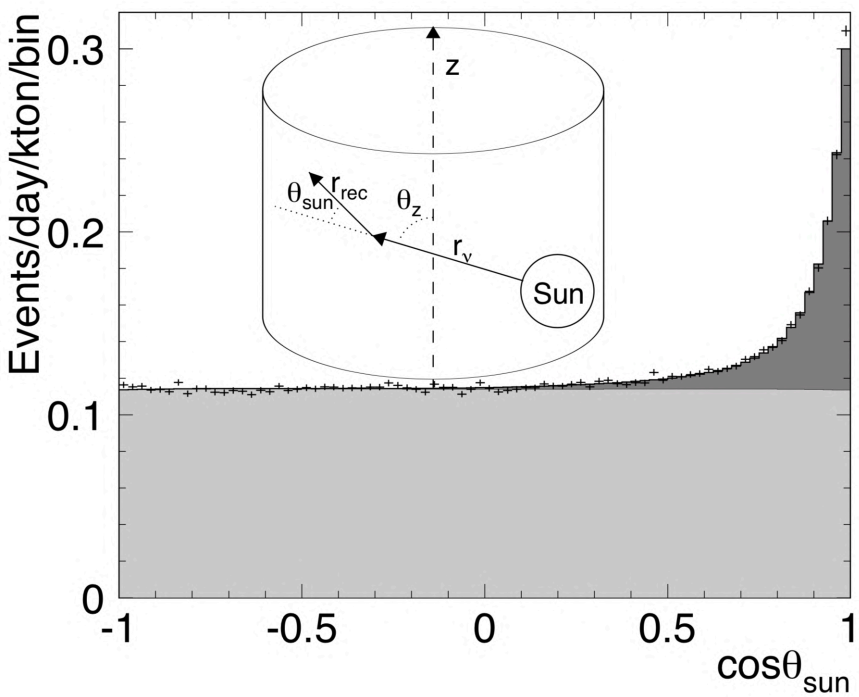
- The next generation, large-scale water Cherenkov detector.
- The main purpose
  - Nucleon decay, neutrino oscillations, neutrino astrophysics, CP-violation



(arXiv: 1805.04163)

□ Solar neutrino

Solar neutrino is a few MeV electron neutrino produced from fusion reactions in the Sun.



(Phys. Rev. D 94 052010)

□ The purpose of the study

The purpose is to study reconstruction for low energy events in Hyper-K with simulation.

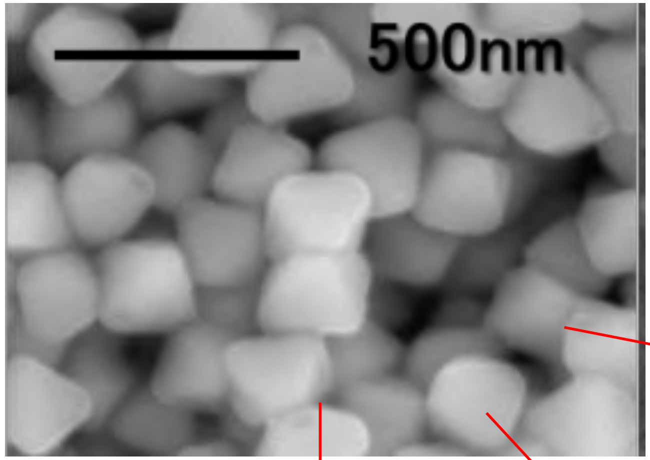
- By changing the detector configurations with WCSim, we compared the reconstruction performance.

Constructing of Emulsion Film Pouring System in Nagoya University

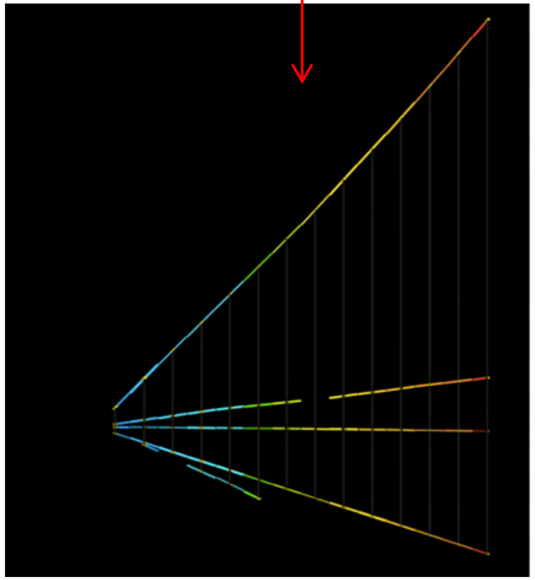
Nagoya university

Kou sugimura, Hiroki rokujo, Mitsuhiro nakamura, Naotaka naganawa

Lots needs for Nuclear Emulsion



Muon Radiography

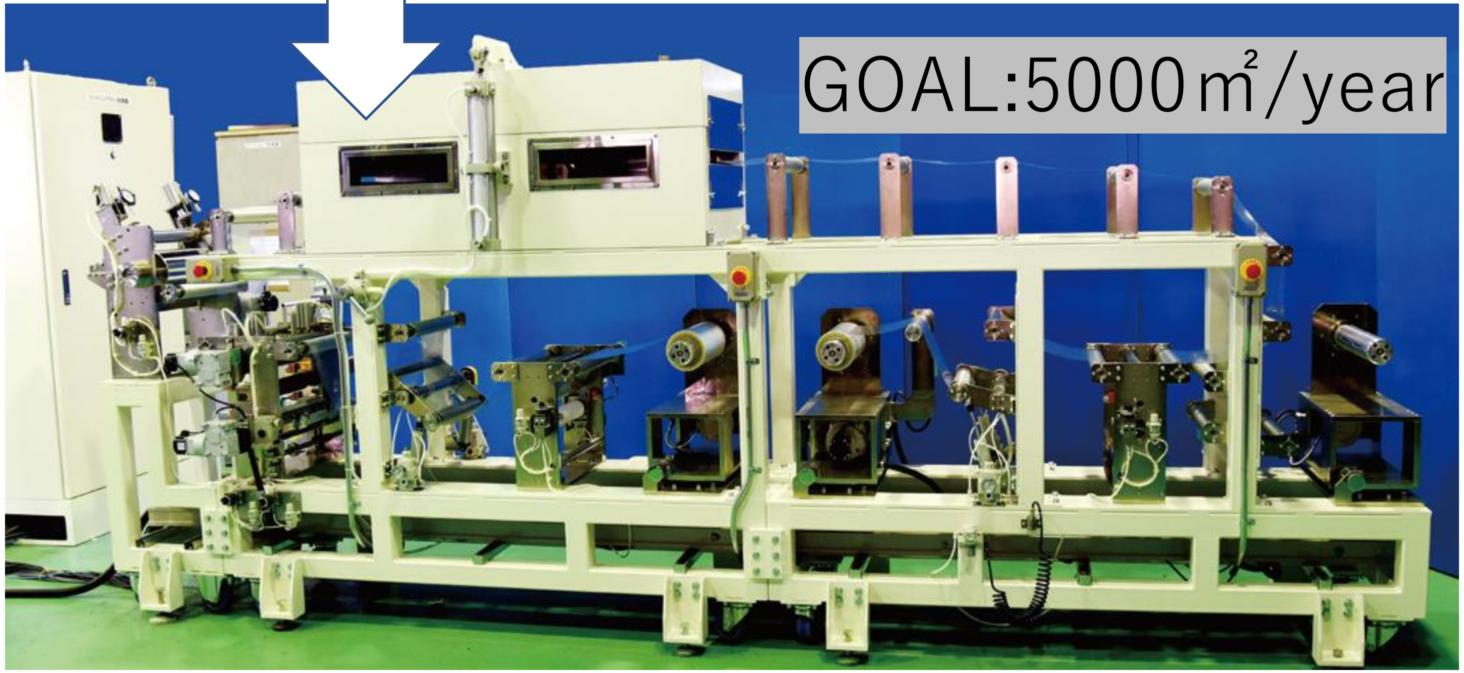


NANJA・Neutrino Experiment

GRAINE project

Producing Nuclear Emulsion today and future

Guarantee Flattness by
low viscous and **gravity**



Guarantee Flattness by
high viscous and **shaving**

In this poster…

- Determining for coating design
- Increasing viscous of emulsion liquid
- Trying to coat thick more than 70μm

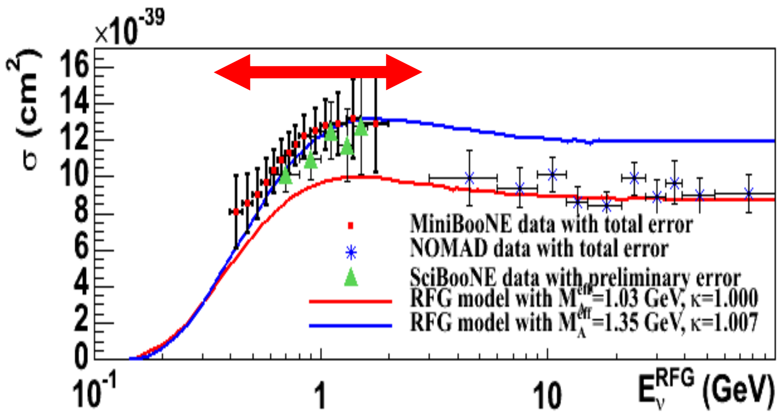
Track analysis of the water target ECC in NINJA experiment

Y. Suzuki(Nagoya Univ.)
on behalf of the NINJA collaboration

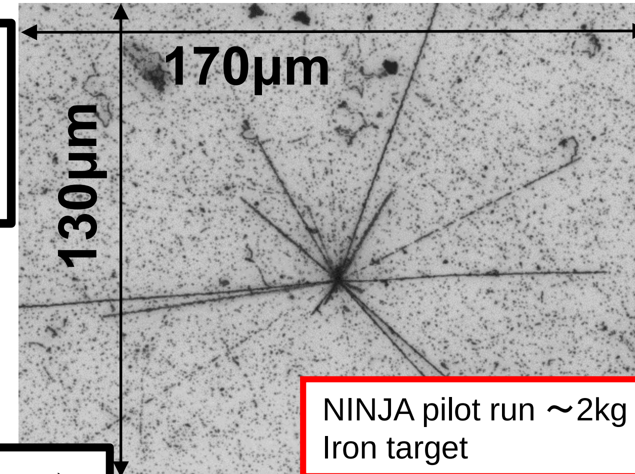
N I N J A Experiment

Neutrino Interaction research with Nuclear emulsion and J-PARC Accelerator

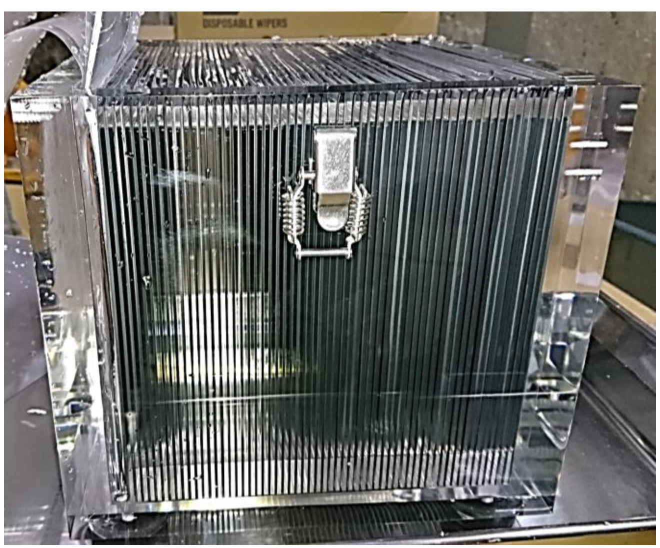
Precise measurement experiment of sub～multi GeV region neutrino interaction

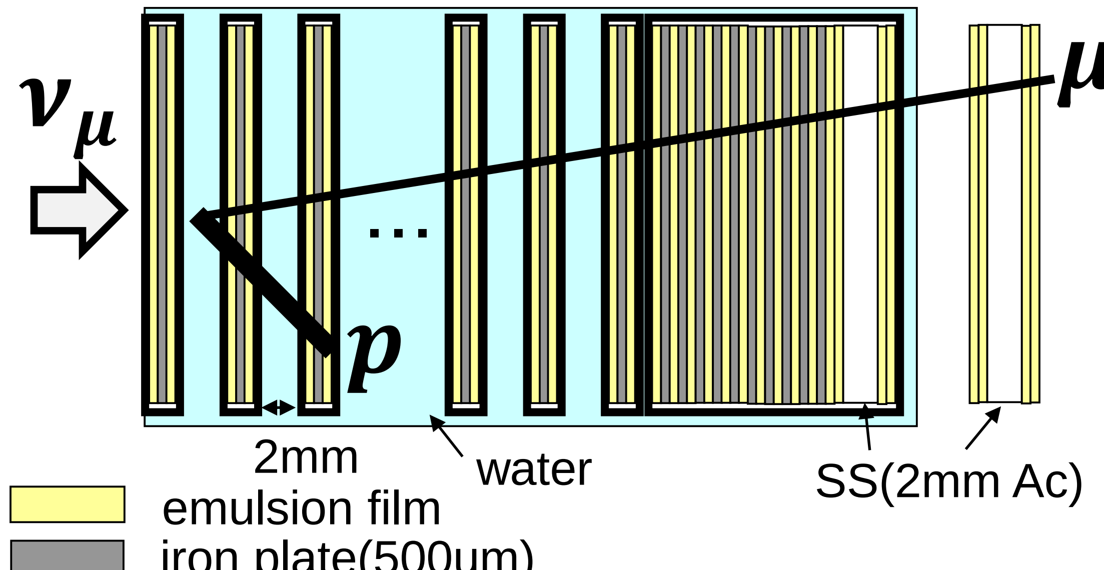


nuclear emulsion



Water target ECC(Emulsion Cloud Chamber)

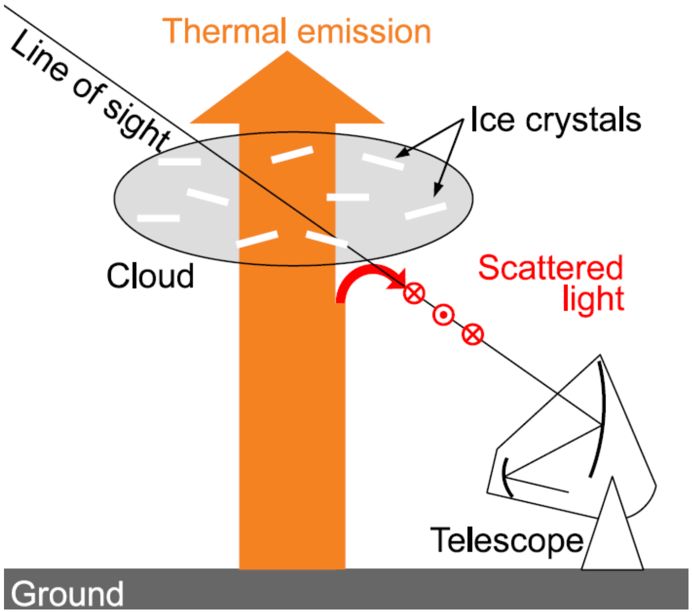


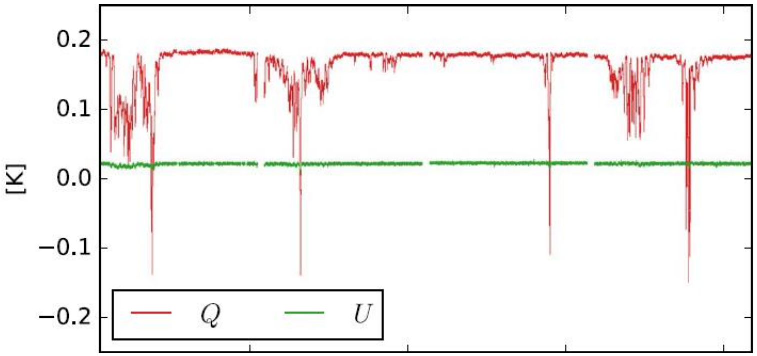


Cloud monitor with IR camera for Simons Array

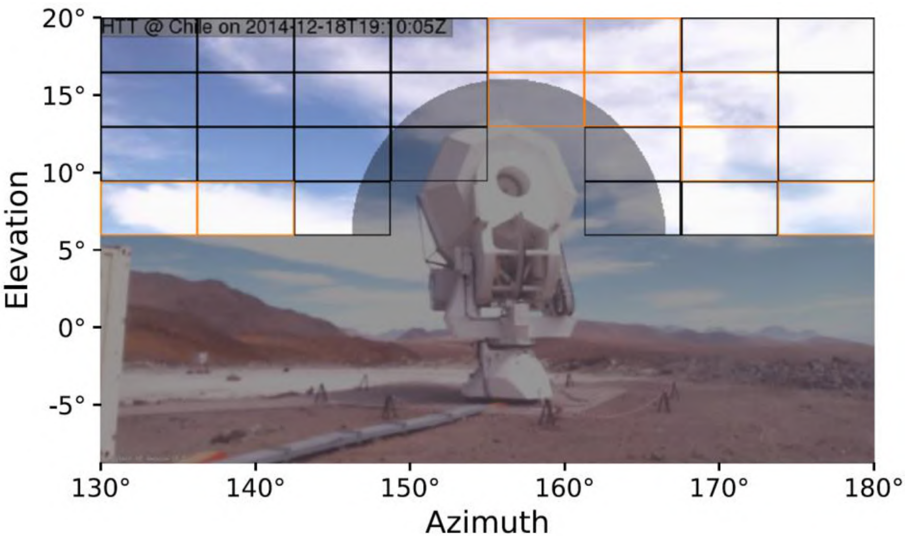
Satoru Takakura (Kavli IPMU)

Polarization of clouds





Results in POLARBEAR



Data	Webcam	Polarized Burst
Daytime	All	16.1% (295/ 1835)
	Cloud	46.3% (279/ 602)
	No cloud	1.3% (16/ 1233)
Night	N/A	9.7% (458/ 4735)

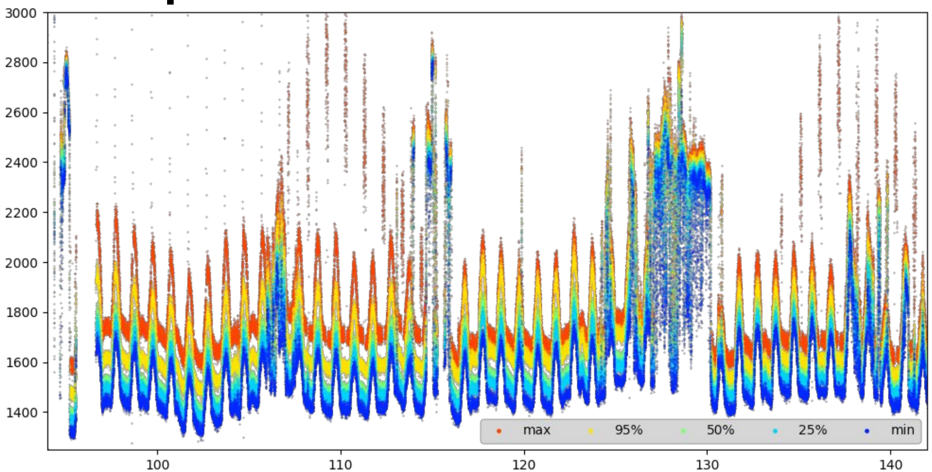
Cloud monitor with IR camera for Simons Array

Satoru Takakura (Kavli IPMU)

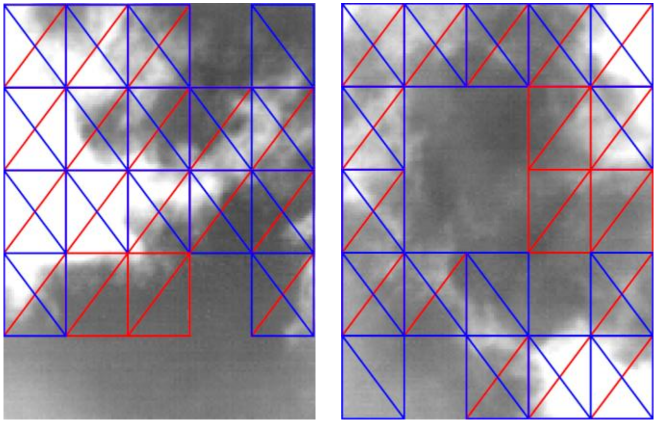
Cloud monitor with IR camera

Wavelength	8 – 14 μm
Field of view	55° × 43°
Pixel	160 × 120
Frame rate	8.7 Hz (max)
Thermal resolution	150 mK

Test operation for > 2 months



Cloud detection w/ AI?

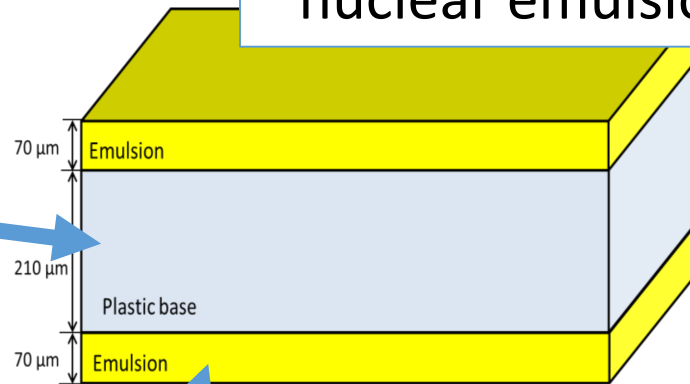


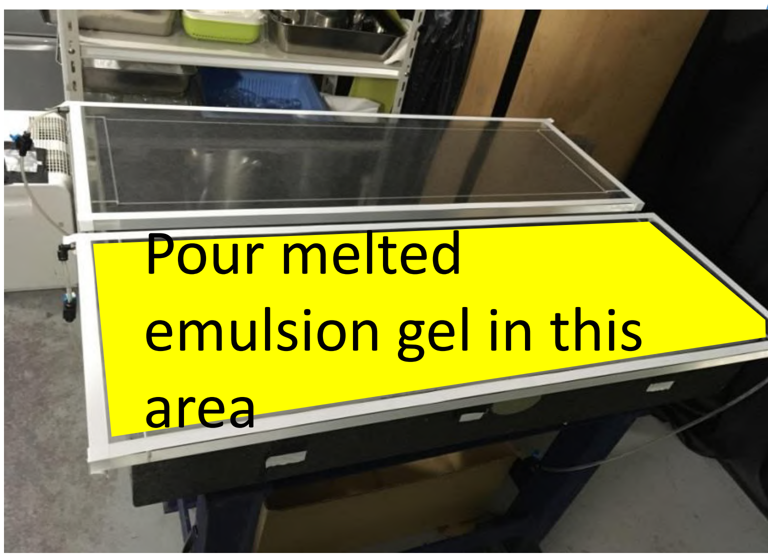
Performance and production of emulsion for NINJA experiment

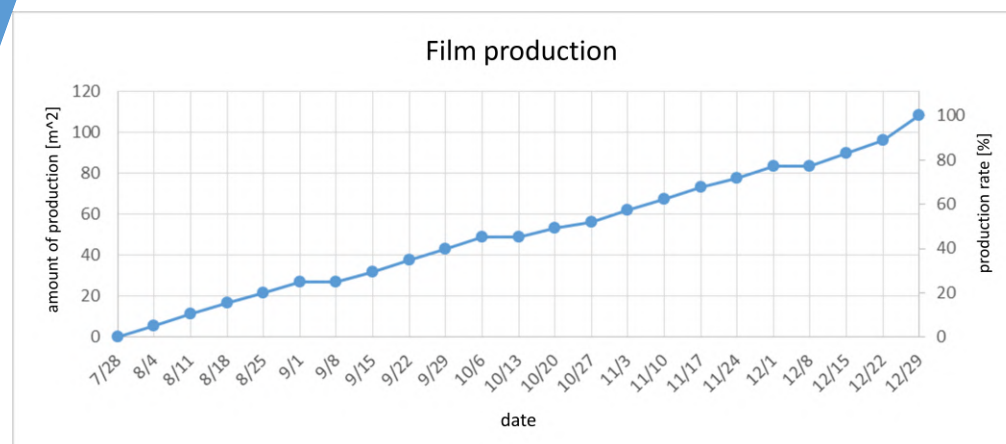
Nagoya Univ. Tomoki Takao
on behalf of NINJA collaboration

Film production

the structure of nuclear emulsion







25cm*25cm size film: 1398

34cm*102cm size film: 60

Performance test

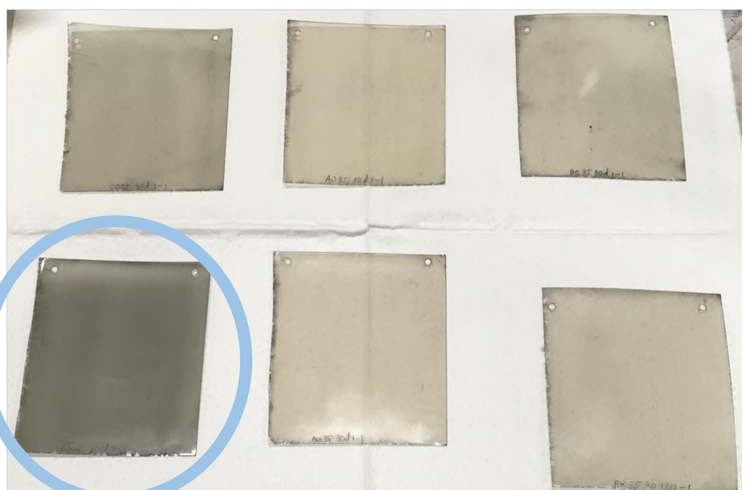
1. Accelerated fog up test
2. realistic condition fog up test
3. Fading characteristics test & Water proof test

35℃ 33days

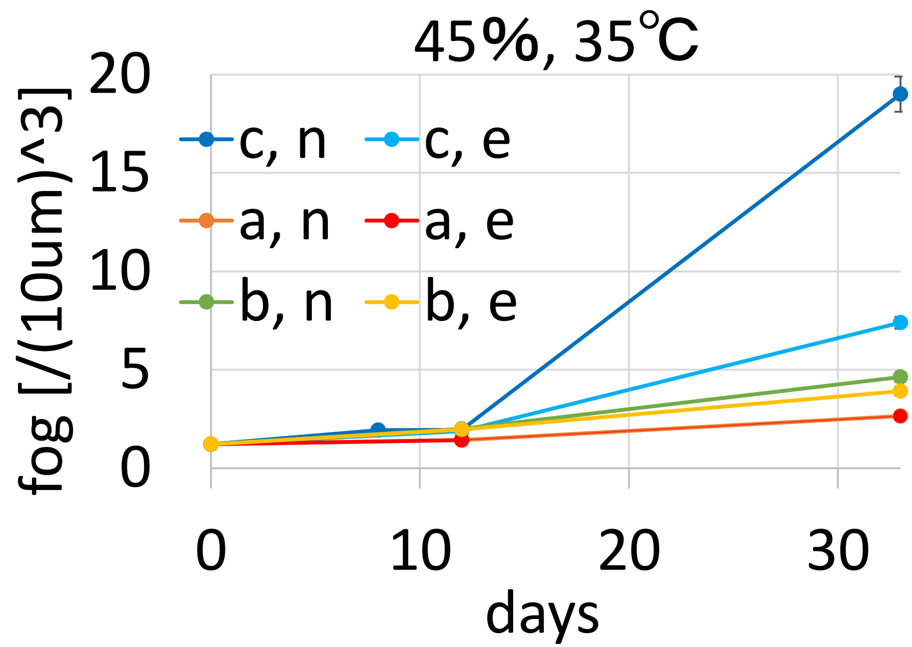
c a b

frame existence (e)

frame non-existence (n)

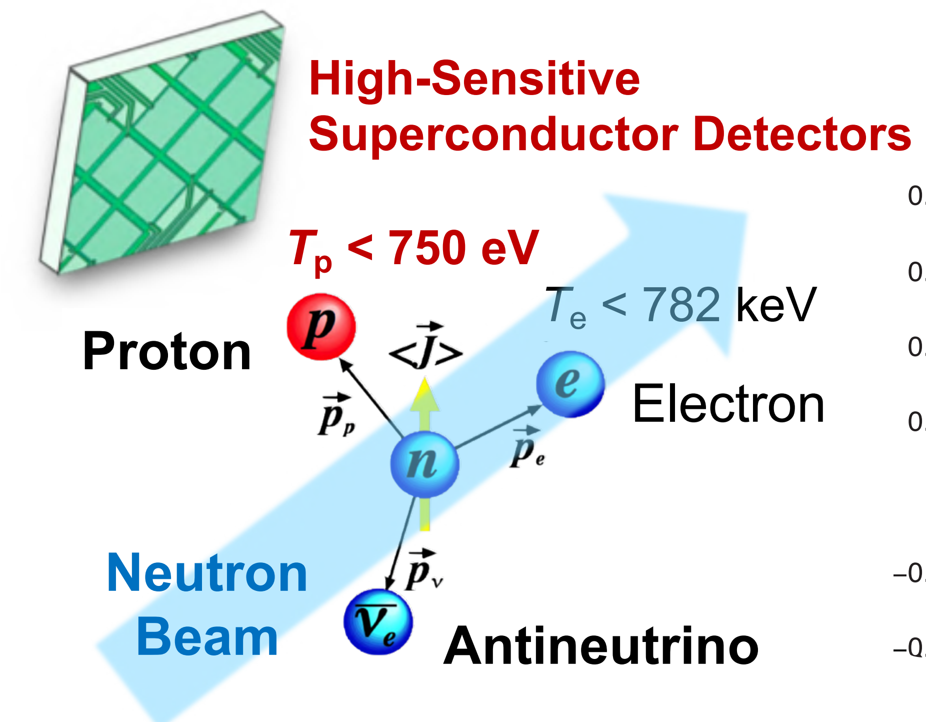


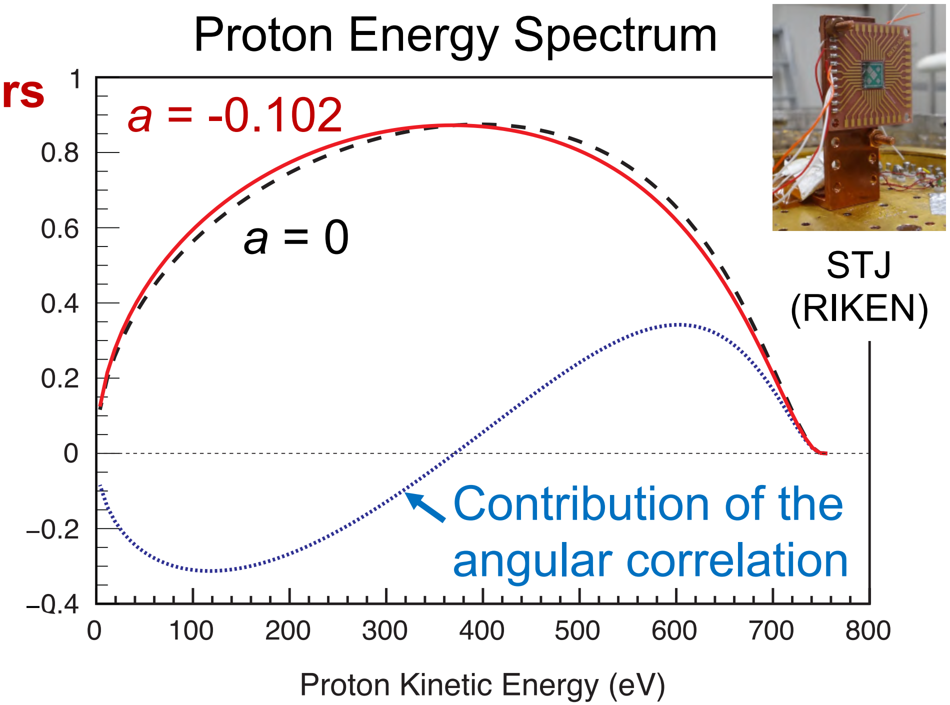
Traditional packing



Study on Superconductor Low-Energy Particle Detectors for Measurement of Angular Correlation between Neutrino and Electron in Beta Decay

M. Tanaka and M. Kitaguchi, *Nagoya Univ.*





Measurement of the angular correlation between neutrino and electron in beta decay is a good probe of the validity of the Standard Model.

Prediction on Neutrino Dirac CP Phase in SO(10) GUT with Suppressed Proton Decay

Toshifumi Yamada
(Shimane University)

in collaboration with
Naoyuki Haba and Yukihiro Mimura

Renormalizable SUSY **SO(10) GUT** with Realistic SM Yukawa couplings

$$W_{\text{Yukawa}} = (\tilde{Y}_{10})_{ij}\,\Psi_i H \Psi_j + (\tilde{Y}_{126})_{ij}\,\Psi_i \bar{\Delta} \Psi_j + (\tilde{Y}_{120})_{ij}\,\Psi_i \Sigma \Psi_j$$

- Ψ_i unifies SM fermions + right-handed neutrino
- SO(10) $\supset$ $U(1)_{B\text{-}L}$

➡ SM Yukawas and Seesaw Neutrino Mass are derived from restricted set of parameters

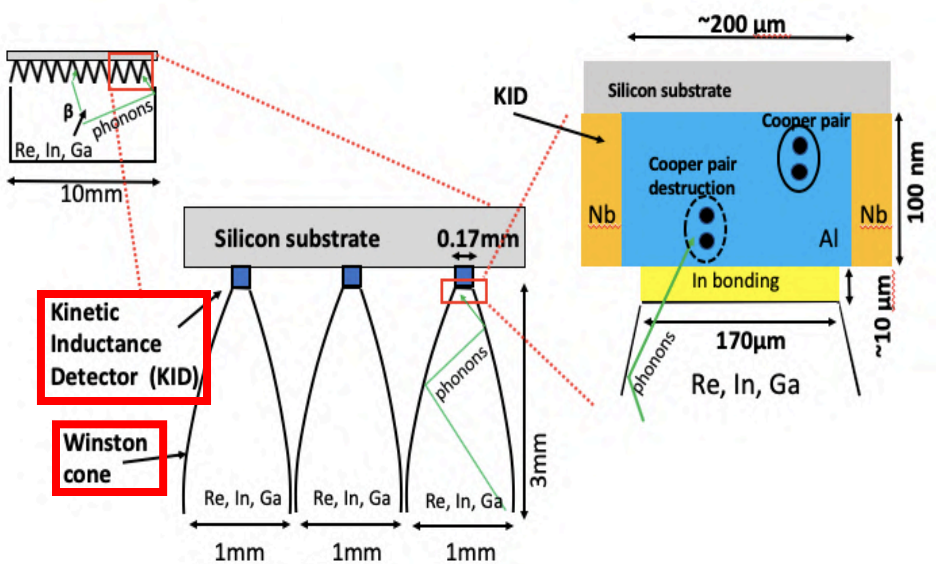
➡ **can predict Neutrino Dirac CP phase δ_{CP}**

With $\tilde{Y}_{10}, \tilde{Y}_{126}, \tilde{Y}_{120}$, we have **reproduced** SM Yukawas and neutrino mixing angles, and at the same time, realized **suppression of troublesome *RRRR*-proton decay**.

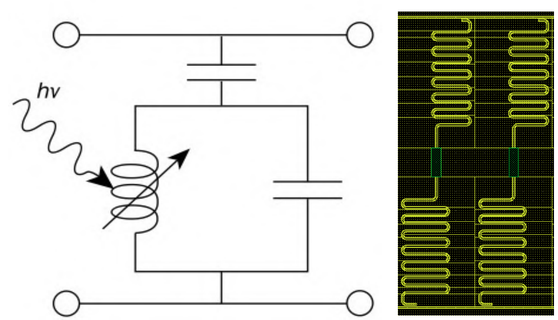
➡ **unique prediction on δ_{CP}**

Development of New Superconducting Detectors for Neutrino Researches

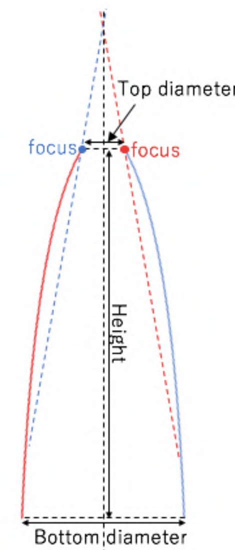
We are developing a new detector system to measure the absolute mass of neutrinos.
The detector system consist of the Rhenium target with the Winston cone structure in the surface formed by a laser system and the KID coupled to the cone for phonon detection.



measurement system



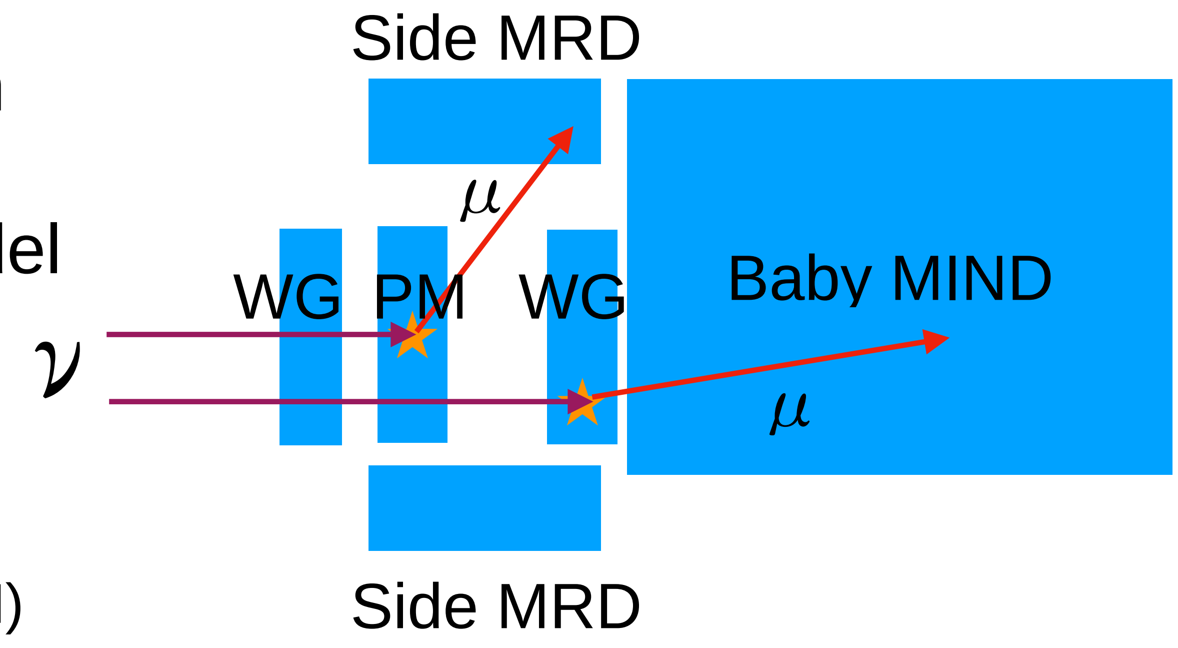
outline of KID



outline of Winston cone

Upgraded Baby MIND for the T2K-WAGASCI experiment

- Measure the neutrino differential cross-section
- Select an appropriate neutrino interaction model
- Aim to reduce the systematic error of T2K

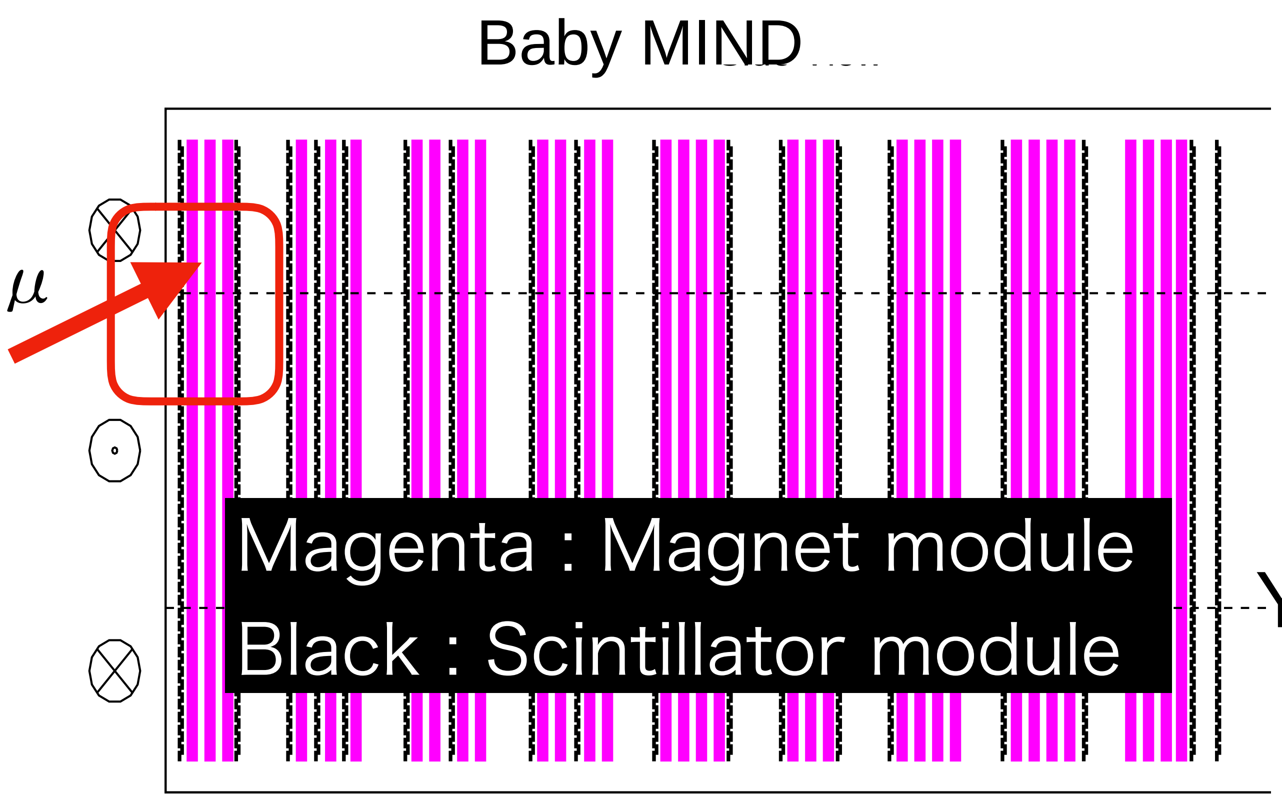


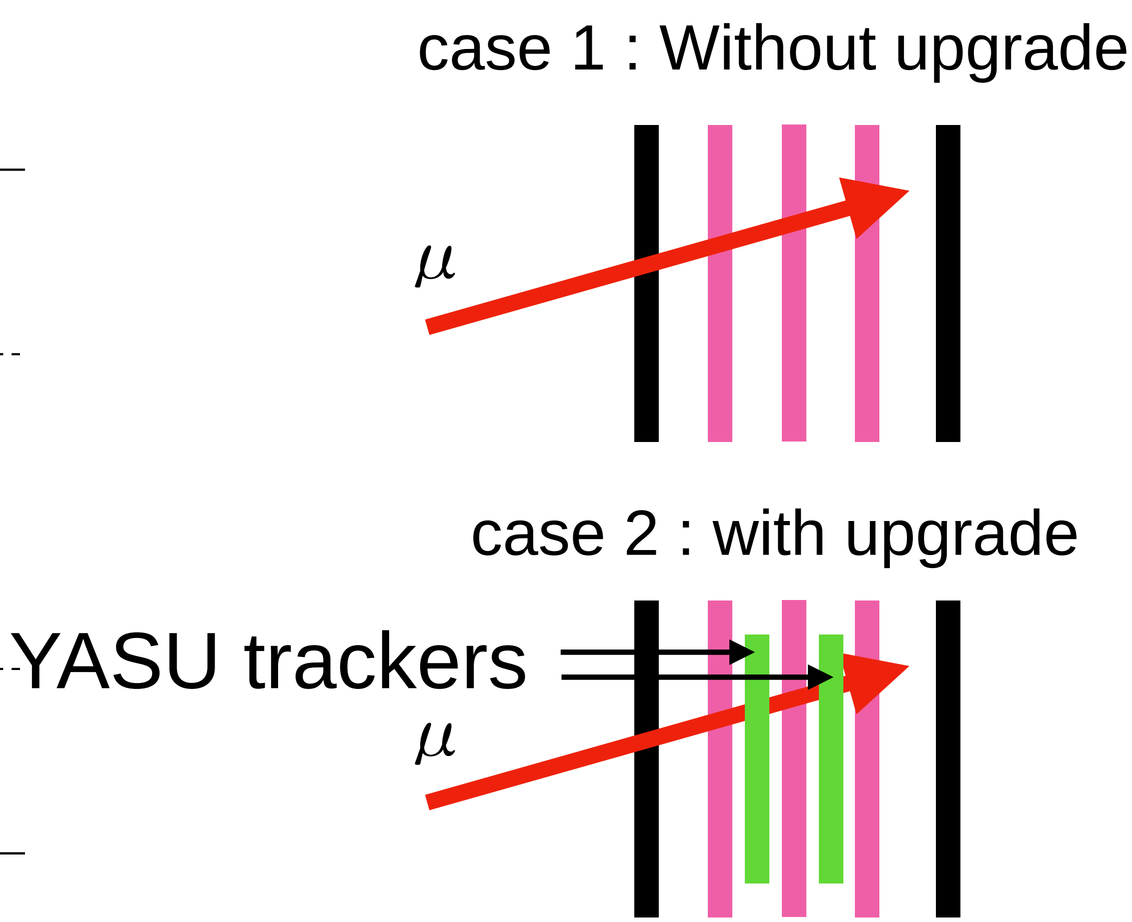
H_2O, CH CH

Neutrino detector : WAGASCI (WG), the Proton Module (PM)

Muon detector : Side MRD, Baby MIND

Each detector is a tracking detector using plastic scintillators, WLS fiber, and MPPC.





Cheap !

YASU

安

Name !

YASU tome

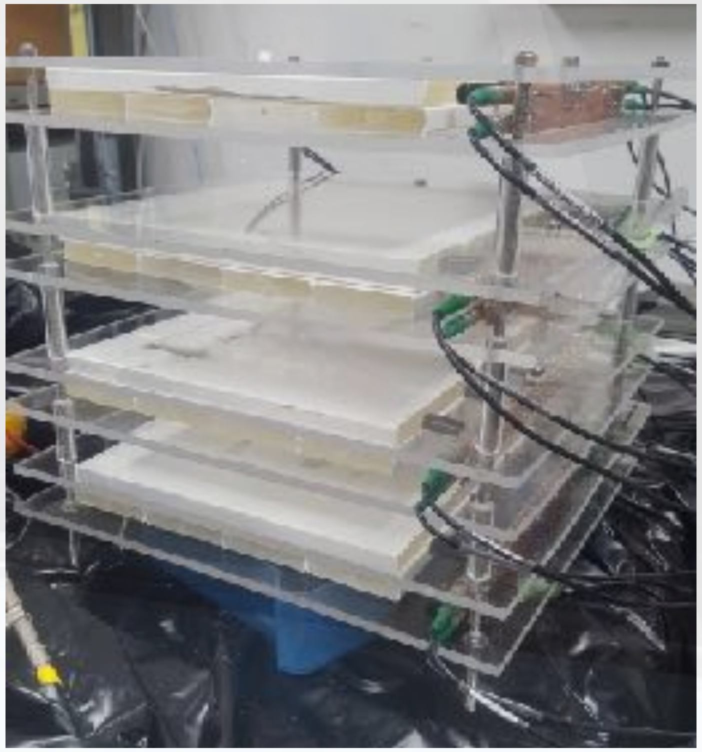
安留

“YASU” Tracker

Official !

Y11 And Scintillator Upgraded (Used)

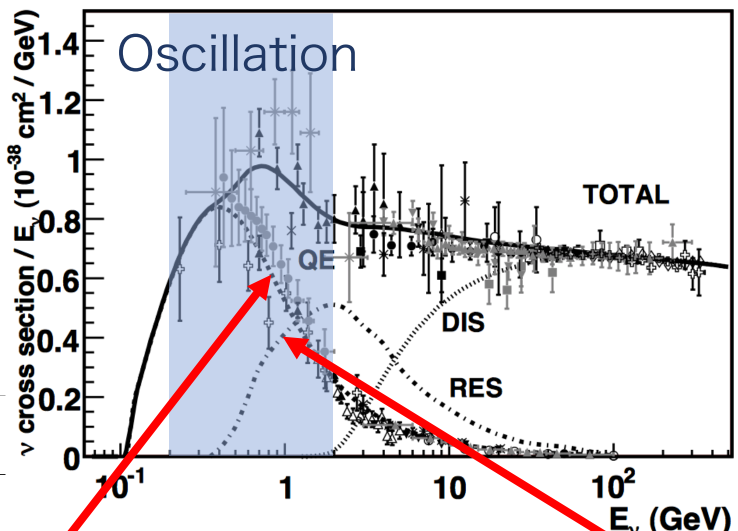
Hobby !



Development of the first multi-Cherenkov-ring samples for T2K neutrino oscillation analysis

Tomoyo Yoshida (Tokyo Tech.) for T2K collaboration

T2K has been focused on CCQE-like events for oscillation analyses.



Can we use the second dominant interaction to increase data statistics?