Neutrino Group

IFIRSE

http://ifirse.icise.vn/nugroup/

ICISE
QUY NHON
VIETNAM

Who are we?

Core group members of Japan side

- **T.Nakaya (Kyoto Univ.): scientific group leader**
- Atsumu Suzuki (Kobe Univ.)
- Yuichi Oyama (KEK)
- Makoto Miura (Kamioka, ICRR, Tokyo)

International Advisory Committee

- M. Nakahata (Kamioka, ICRR, Tokyo, JP)
- T. Kobayashi (KEK, JP)
- Karol Lang (The Univ. of Texas at Austin, USA)
- Jacques Dumarchez (LPNHE- Univ. of Paris, FR)
- Boris Kayser (Fermilab, USA)

- Asso. Prof. **Van Nguyen** (IFIRSE & IOP)
- Dr. **Son Cao** (Affiliated member, postdoc in KEK/J-PARC)
- MSc. **Ngoc Tran** (IFIRSE, Ph.D student)
- BSc. **Thanh Nguyen (**IFIRSE, Researcher**)**
- BSc. **Ha Nguyen** (USTH. Master student)
- Other affiliated members
  - Dr. Le P. Trung (Tuft Univ., US, MinervA)
  - Dr. Tran Nam (Boston Univ., US, g-2)
  - Dr. Nguyen Truong (Univ. of California, Davis, mu2e)
  - Dr. Dien Nguyen (MIT)
  - Mr. Dung Phan, Ph.D student (The Univ. of Texas, Austin, MINOS(+)/NOvA)
  - Dr Hao Tran, Dr. Nguyen N. Le, Hue Univ. (on nuclear physics)

Dr. Van Nguyen

Recent activities

- T2K member since Oct 2017
- Participated in Neutrino beam group of T2K/ KEK: process beam data for T2K experiment; improve neutrino flux uncertainty with J-PARC neutrino beam monitors and T2K near detectors
- NEUT technical note for T2K (joint-work with Hayato-san (ICRR) and Son (KEK)) (
- Lectures on neutrino event generators in VSoN 2018
- Gave a talk of T2K latest results on behalf of T2K collaboration in "*Windows on Universe*"(August 2018, ICISE)
- Involving in T2K neutrino oscillation analysis

Tunnel to Kamioka mine:
Super-Kamiokande exp. and others

Past education and Experiences:

- Ph.D in France with ATLAS (2011)
- Physics analysis of precision measurements with ATLAS
- Neutrino phenomenology: flavor symmetry and other models of neutrino masses and mixing

Dr. Son Cao

Recent activities

- T2K member since Aug. 2014; also Super-K and Hyper-K collaborator
- Joining Neutrino group in KEK, IPNS,
  - Monitor neutrino beamline, particularly beam loss
  - R&D on non-destructive beam profile monitor for MW beam
- Some service tasks
  - Beam Run Coordinators
  - (past) Convener of a cross-section measurement
  - (past) Convener of T2K on-axis detector, i.e INGRID
- Others
  - Physic potential of T2K-II
  - Calibration and software for EGADS (R&D to insert Gd in Super-K detectors)
  - Lectures for VSoN school

J-PARC neutrino beamline

Past education and Experiences:

- Ph.D at Utexas at Austin on MINOS experiment
  - CPT test with full MINOS beam and atmospheric data
  - Auxiliary detector to reduce electronic latency in neutrino Time-Of-Flight measurement
- Researcher Associate at Okayama Univ. on EGADS R&D experiment
- JSPS fellow at Kyoto Univ. on T2K experiment

What do we care?

NEUTRINOS

Neutrino has been found to be a misfit and keep astonishing the human even now and at least for more a half century

- They have non-zero mass which is not fitted to Standard Model, a.k.a the most successful model to describe the world of elementary particle)

- Their mass is extremely small and the way they get mass may not same as other particles. Even its smallness (~$1/10^9$ of proton mass), neutrino is 2nd most abundant particle (~$330/cm^3$ in the whole Universe, 10^9 higher than proton). That means, total mass of neutrinos are at same level as the total mass of the starts in the whole Universe.

- They are strangers, can go through entire the earth without interact. It's really hard to catch them but they can provide extremely useful information

Neutrino can be "our ultimate Mother", can be a reason for the Universe existence by making imbalance between matter-antimatter

What do we care?

NEUTRINOS

Begin of Universe

1,000,000,001
Proton

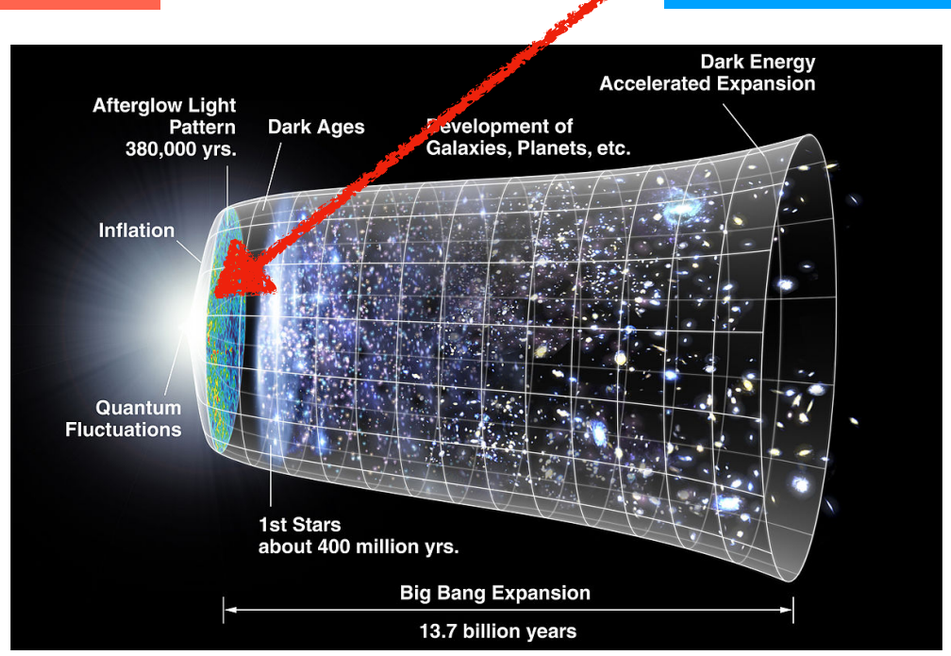
1,000,000,001
Anti-Proton

?

Shortly After

1,000,000,00
+2
Proton

1,000,000,000
+0
Anti-Proton



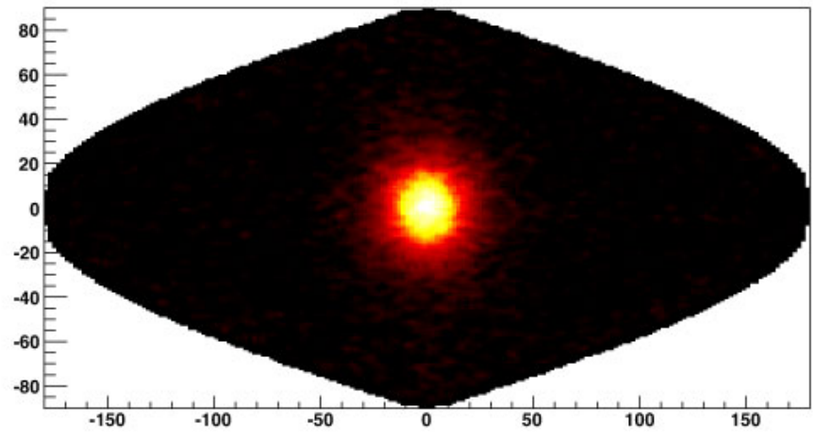
Neutrino can be “our ultimate Mother”, can be a reason for the Universe existence by making imbalance between matter-antimatter

What can neutrino offer?

*"**I don't say that the neutrino is going to be a practical thing**, but it has been a time-honored pattern that science leads, and then technology comes along, and then, put together, **these things make an enormous difference in how we live**"*

——**Fredrick Reines**, Nobel prize winner, co-discover of the neutrino, NYT 1997

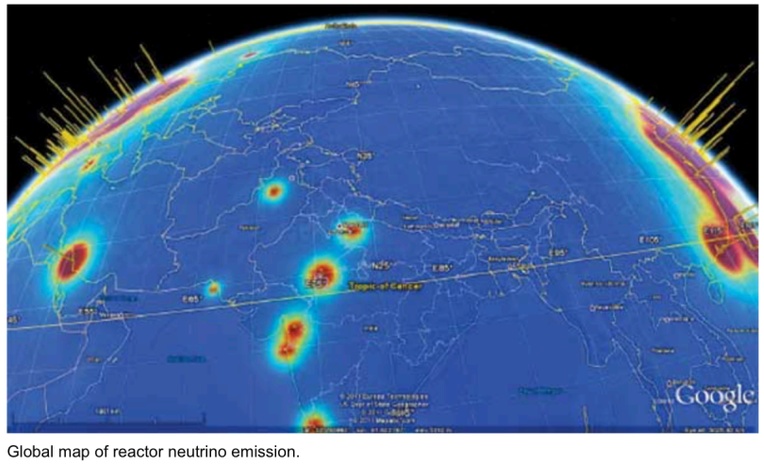
- Look inside of the Sun
- Tomography of the Earth
- **Monitor the reactors**
- Astrophysical messenger from the extragalactic
- (May less (?) practical at present) new clean energy source, non-destructive light-speed communication



Sun pictured with neutrino by Super-K

Neutrinos and National Security

By Michael Lucibella

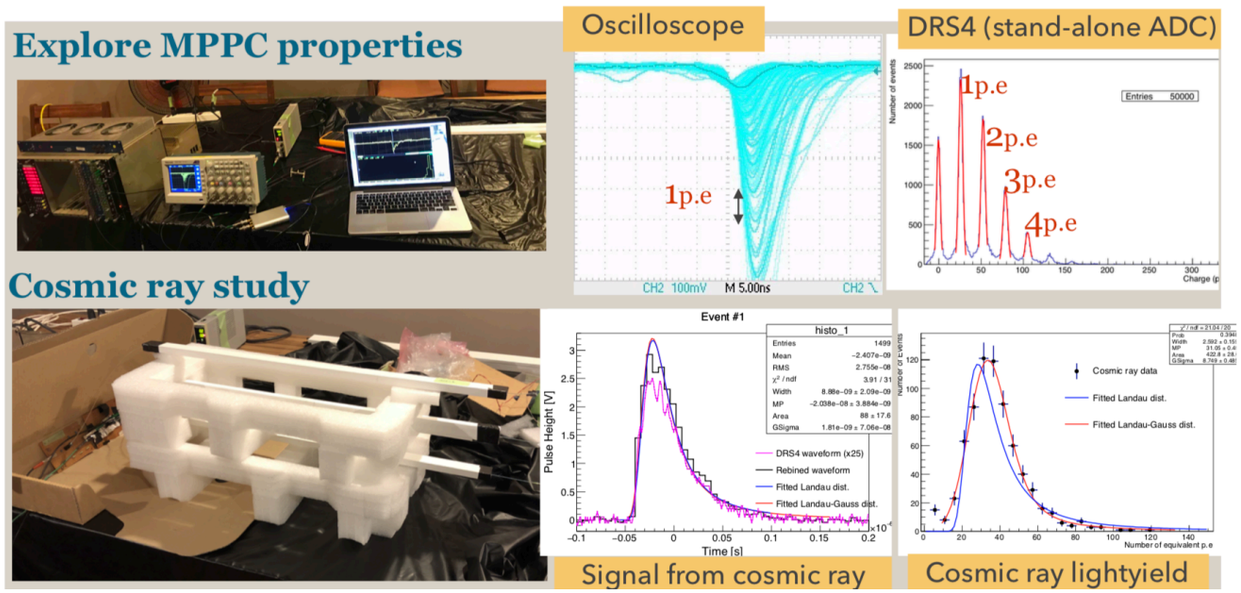


Global map of reactor neutrino emission.
Photo courtesy of Glenn Jocher and John Learned, University of Hawaii

What actually are we doing?

Work as an international collaboration

- Join T2K (Oc. 2017~) an international accelerator-based long-baseline neutrino experiment in Japan (~500 collaborators from 65 institutes of 12 countries)
  - **Neutrino Event Generator, Neutrino Oscillation Analysis**
- Join WAGASCI (now part of T2K) (Feb. 2018~) a neutrino-nuclei interaction-focused experiment in Japan,
  - **Detector construction (our students are working directly with Japanese and other colleague)**



Build the lab at ICISE:

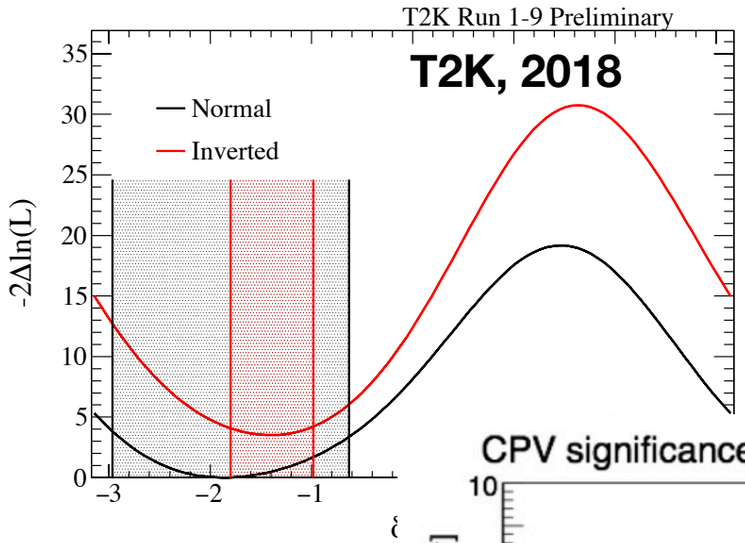
- Focus on Multi-pixel Photon Counting (MPPC) and properties of plastic scintillators
- Practice with cosmic ray measurements

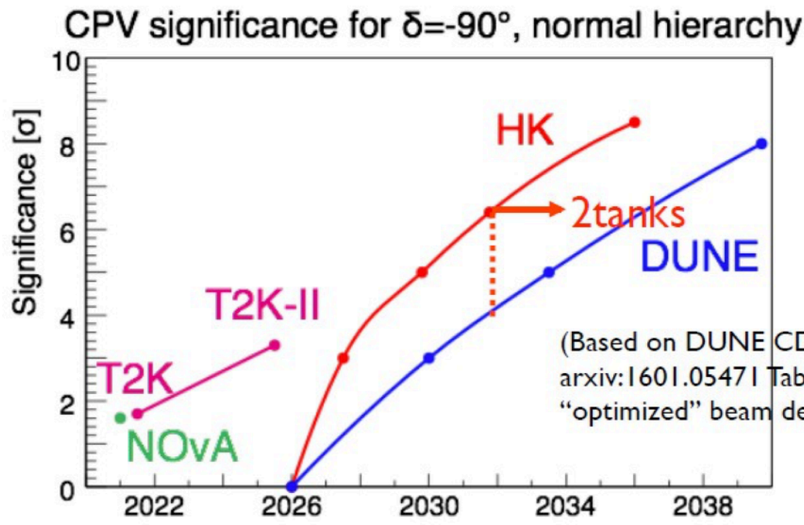
- Organize annually *Vietnam School on Neutrinos (2019 is the 3rd in the series, 12 Vietnamese, 8 Japanese, 5 from India, Pakistan and Thailand)* to **train and encourage students and young researchers working on neutrino physics**
- Host the *International Symposium on Neutrino Frontiers (2018)*

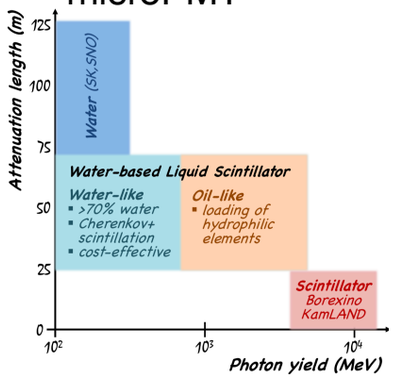
The path forward

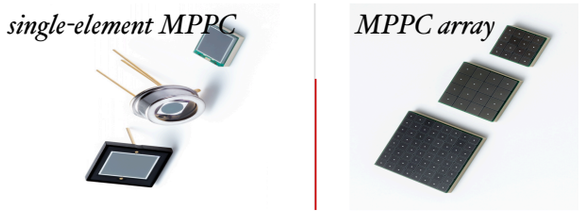
International collaboration work

- **Keep working with T2K experiment**
  - in 2018, T2K firstly presented that oscillation data exclude the CP conserving cases at 2 sigma
  - Contribute for other supporting program: neutrino flux, neutrino-nucleon/nucleus interactions
  - We are also interested in non-standard neutrino physics (CPT violation, sterile neutrino)
  - T2K is proposed to extend the run up to 2026 to achieve 3 sigma sensitivity on CP violation
- **Will join Hyper-Kamiokande experiment**
  - Effectively 8 times larger than Super-Kamiokande
  - This is the 3rd generation of neutrino experiments, tentative plan is to start operation from 2027
  - Along with data analysis, we may want to work on PMT or microPMT

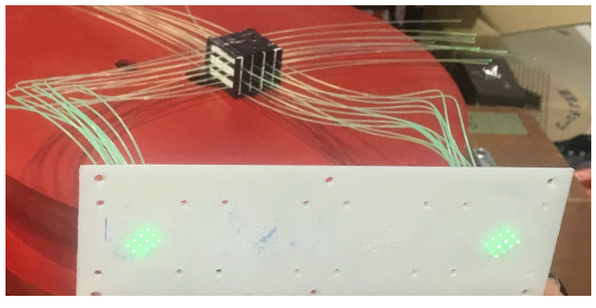


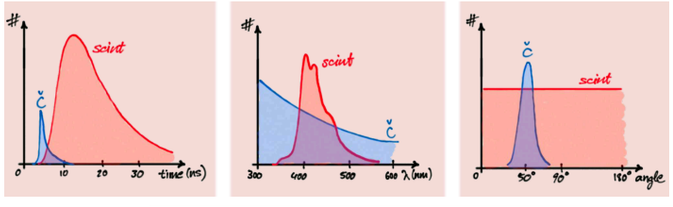






Portraits of MPPCs (taken from Hamamatsu)





Lab development

- Photon sensor
  - Multi-pixel Photon Counter
  - microPMT
- Scintillator materials
  - (Water-based) Liquid scintillator
- Lab test bench, detector prototype

The most important is to build local human source & attract young, ambitious physicists working now outside of Vietam

What do we need?

- We started quite late and we need to catch up
- **Set our hearts on the toys**, it means we need to ignore/forget other things
- The toy maybe expensive but probably affordable (relatively to other field) —> definitely we need the strong support from both inside and outside of Vietnam

Can we build this as a new world-class neutrino center?

A vigorous society is a society made up of people who set their hearts on toys, and who would work harder for superfluities than for necessities

Eric Hoffer, author of The True Believer

We are asking your support for developing neutrino science in Vietnam.

Thank you for coming!
We hope to work with you on this interesting particle.