

Self-introduction

Son Cao

KEK

September 14, 2017

My little story

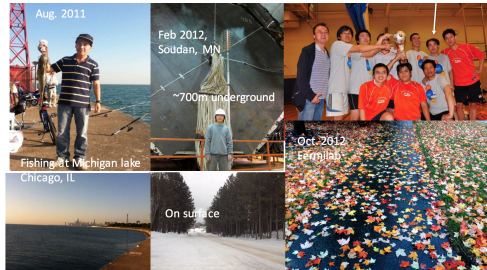


- ▶ Born in small village of Quang Binh province
- ▶ Went to College of Natural Science, Hanoi (2004-2008)
 - ▶ B.Sc Thesis: “Absolute mass of neutrinos”, Advisor: Dr. Nguyen Anh Ky
- ▶ Went to Univ. of Texas at Austin for Ph.D (Sept. 2009-May. 2014), VEF fellowship
 - ▶ Ph.D Thesis: “Study of antineutrino oscillations using accelerator and atmospheric data in MINOS”
- ▶ Went to Japan June 2014 until now
 - ▶ Okayama Univ.: July 2014 - Nov. 2014, EGADS (R&D project for insert Gadolinium into Super-K)
 - ▶ Kyoto Univ.: Nov. 2014 - Nov. 2016 (JSPS fellowship), work mainly for T2K
 - ▶ IPNS, KEK: Dec. 2016 up to now (ending term Mar. 2021): for neutrino beam monitor & T2K near detector



My little story (cont'd)

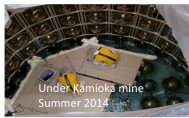
- ▶ Went to Univ. of Texas at Austin for Ph.D (Sept. 2009-May. 2014), VEF fellowship
 - ▶ Ph.D Thesis: “Study of antineutrino oscillations using accelerator and atmospheric data in MINOS”
 - ▶ use auxiliary detector to measure electronic latency, which helps for measuring neutrino speed at MINOS (ref. OPERA’s fault claim for faster-than-speed-of-light)





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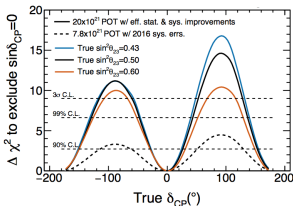




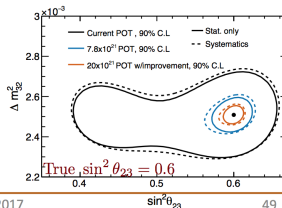
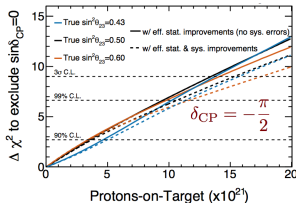
- Explore physics potential of T2K-II (extend T2K up to 2026,)



Medium term: T2K-II proposal



- ✧ $> 3\sigma$ significance sensitivity to CP violation if $\delta_{CP} = -\pi/2$
- ✧ 99% C.L. significance for more than 45% of the possible true values of δ_{CP}
- ✧ 1% precision of Δm_{23}^2 , $0.5^\circ - 1.7^\circ$ precision of θ_{23} depending on its true value, $\sim 3\sigma$ significance for resolving θ_{23} octant if $\sin^2 \theta_{23} > 0.6$ or $\sin^2 \theta_{23} < 0.43$

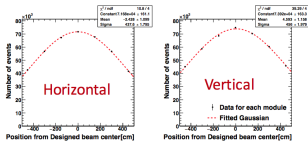




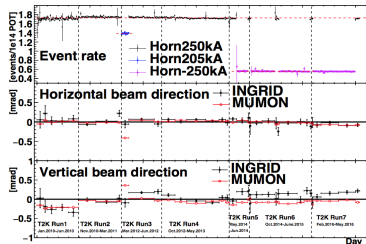
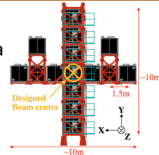
Recent contribution & work-in-progress (cont'd)

- Manage one T2K near detector as convener, used to measure neutrino beam profile

Near Detectors measurements



Measured data



Off-axis neutrino energy strongly depend on beam direction (1mrad ~ 2% shift of peak energy)

T2K controlled off-axis better than 1mrad



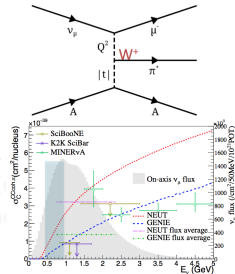
Recent contribution & work-in-progress (cont'd)

- ▶ Manage one T2K near detector as convener, used to measure neutrino beam profile
- ▶ Also analyzer for T2K near detector to measure neutrino interaction, focusing on coherent channel (work-in-progress)

- ◇ Interesting features

- ◇ Pion created from off-shell W boson despite small nucleus binding energy (~ 10 s MeV)
- ◇ Very small four-momentum transfer, $|t| \sim \hbar^2/R^2$ to leave nucleus in its ground state
- ◇ Small angle scattering of produced lepton

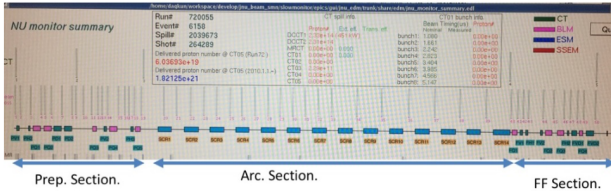
- ◇ **Puzzle:** K2K and SciBooNE found no evidence of CC coherent below 1.5 GeV but NC coherent signal was clearly observed at same energy





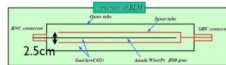
Recent contribution & work-in-progress (cont'd)

► Manage Beam loss monitor for neutrino beam line



- 50 BLM distributed along the beamline
- Proportional counter w/ Ar+CO₂ mixture
- Signal integrated for each beam spill and fire MPS interlock if over threshold

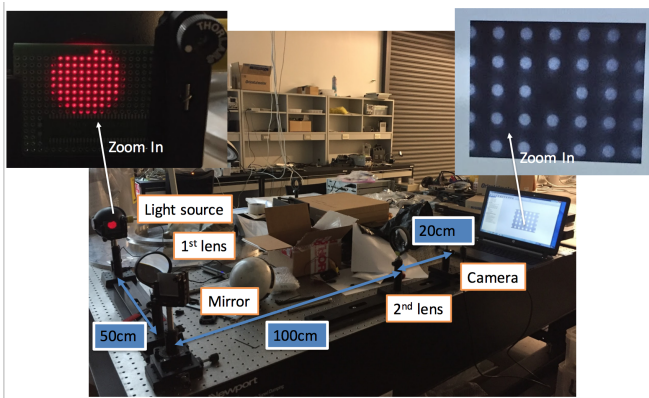
Item	Value	Unit	Min	Max	Warn	Alarm
Length	250	mm	0	250	0	0
Gas Inlet	Ar+CO ₂	mm	0	250	0	0
Outer Tube	Aluminum	mm	0	250	0	0
Inner Tube	Aluminum	mm	0	250	0	0
Gas Inlet	Ar+CO ₂	mm	0	250	0	0
Gas Out	Ar+CO ₂	mm	0	250	0	0
Signal Condition	Ar+CO ₂	mm	0	250	0	0
Manufacturer	Advanced Nuclear Systems	mm	0	250	0	0





Recent contribution & work-in-progress (cont'd)

- ▶ R&D project for Beam Induced Fluorescence (BIF) for non-destructive monitor of proton beam (before hitting on graphene target to produce neutrino) (work-in-progress)



Neutrino activities in Japan, T2K & our chance?



Neutrino activities in Japan

- ▶ (focusing on long base-line experiment, atmospheric neutrino, not including reactor neutrino and neutrino-less double beta decay)
- ▶ T2K is now the main project, highest priority in taking data, may finish data around 2021, but seem extending up to 2026: first measurement on CP (main achievement is $\nu_\mu \rightarrow \nu_e$ observation, Breakthrough prize). T2K uses Super-K as far detector
- ▶ Super-K (50k tons of water Cherenkov det.) is still running and improving by adding Gadolinium into the detector, improve Supernova neutrino search
- ▶ Hyper-K (~ 10 of Super-K) is future: expectedly operate ~ 2026 (if approved in 2018, likely so).

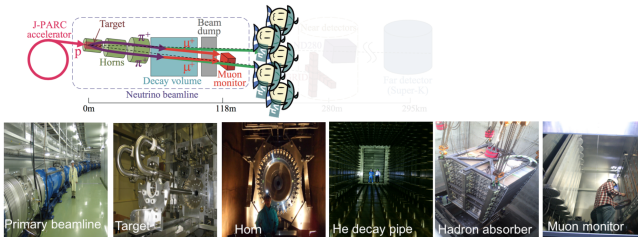


T2K & our chance

Neutrino Group leader, Prof. Nakaya - Kyoto Univ., is spokesperson of T2K. Neutrino Group will apply to join T2K this October.

What we can contribute:

- ▶ (software) Neutrino Interaction Simulation, a.k.a NEUT, used widely in JAPAN (used by T2K, Super-K and also Hyper-K)
- ▶ (software) Neutrino Interaction measurement with T2K Near Detector (also can be with T2K Far Detector, Super-K)
- ▶ (software) Neutrino oscillation measurement (in combination w/ Super-K atmospheric neutrino sample)
- ▶ (hardware) Monitor T2K Near Detector. (Also can join effort to upgrade detector, such as Muon Monitor, Using MPPC)



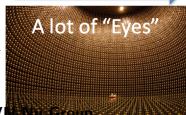
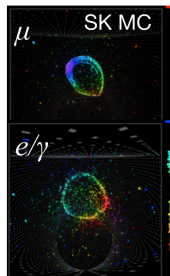
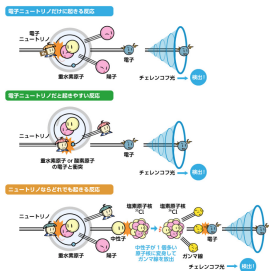


Super-K & our chance

Neutrino Group affiliated member, Prof. Miura - ICRR, Univ. of Tokyo, is convener of Super-K activity & recently measure proton decay.

What we can contribute:

- ▶ (software) Particle identity (or event classification) improvement when adding Gadolinium
- ▶ (software) Proton decay measurement with update data & improve event classification
- ▶ (software) Atmospheric neutrino analysis (in combine w/ T2K)
- ▶ (hardware) PMT re-install when Super-K opening tank to insert Gadolinium (Summer 2018)



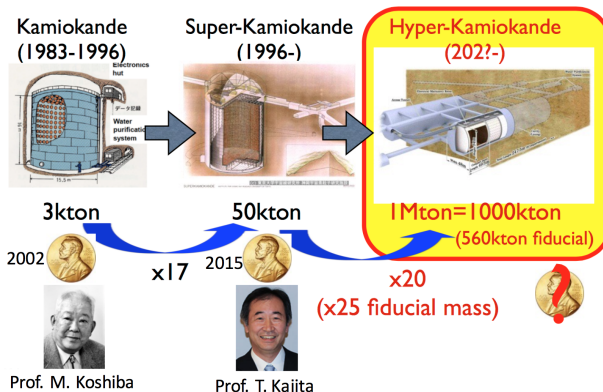


Hyper-K & our chance

Neutrino Group leader, Prof. Nakaya - Kyoto Univ., is chair of Hyper-K steering committee.

What we can contribute:

- ▶ (software) Explore potential physics of Hyper (many not just neutrino)
- ▶ (hardware) PMT development/ detector calibration



Backup

