Working status & Introduction to NU short course

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KEK

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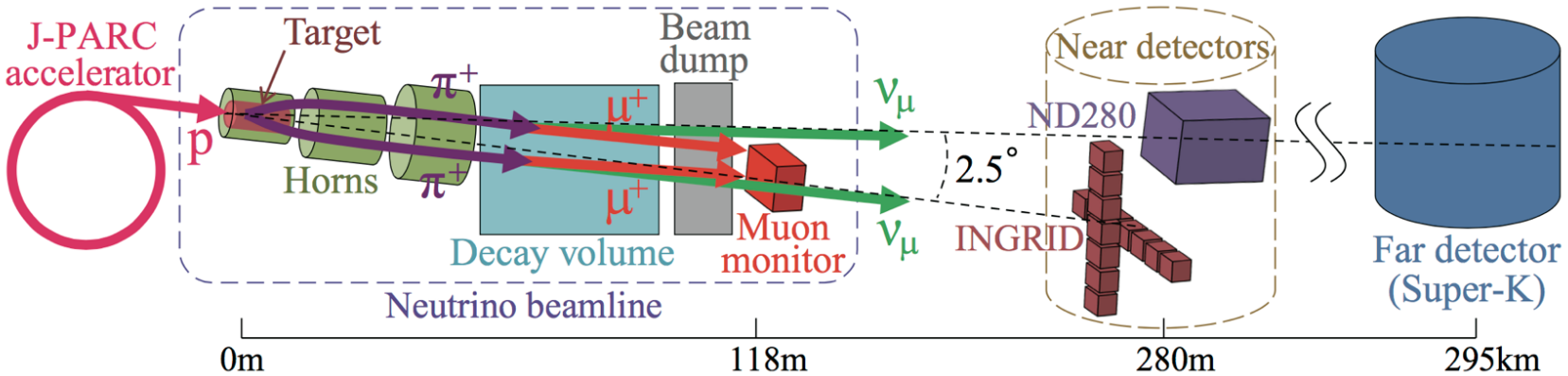
Introduction to T2K experiment

Main goal: precision measurement of neutrino oscillations



Achievements

- Discovery of $\nu_\mu \rightarrow \nu_e$
- Precision measurement of $\nu_\mu \rightarrow \nu_\mu$
- Precision measurement of $\bar{\nu}_\mu \rightarrow \bar{\nu}_\mu$
- 2sigma exclude CP invariance

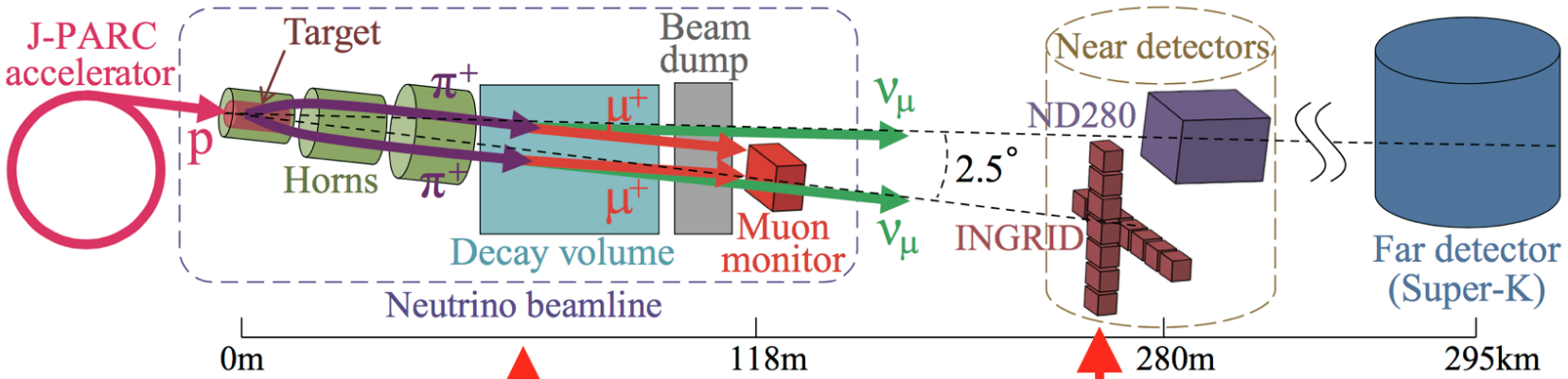
Future goals

- Discovery of $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$
- Explore CP violation
- Mass hierarchy constraint
- Some unknown…

→ World's leading results & more interesting results coming. Stay tuned!

Works at T2K

Main goal: precision measurement of neutrino oscillations

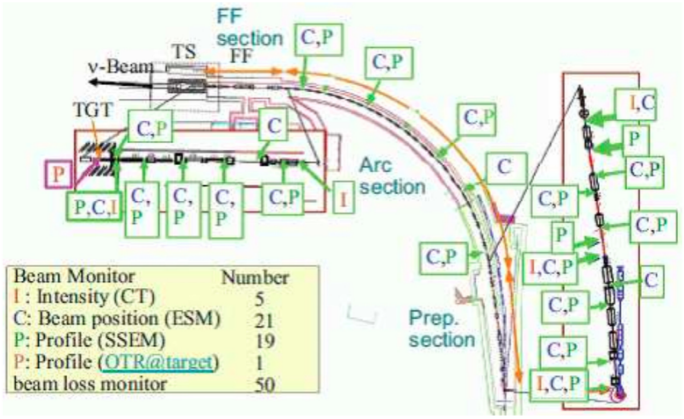


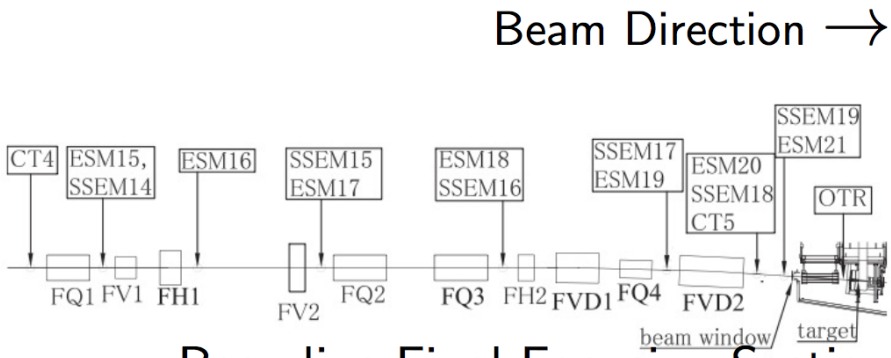
Now, major work

Now, responsibility as Convener and cross section analyzer

Also have performed neutrino oscillation analysis when proposing T2K-II (extend T2K run until 2026)

T2K beamline monitors





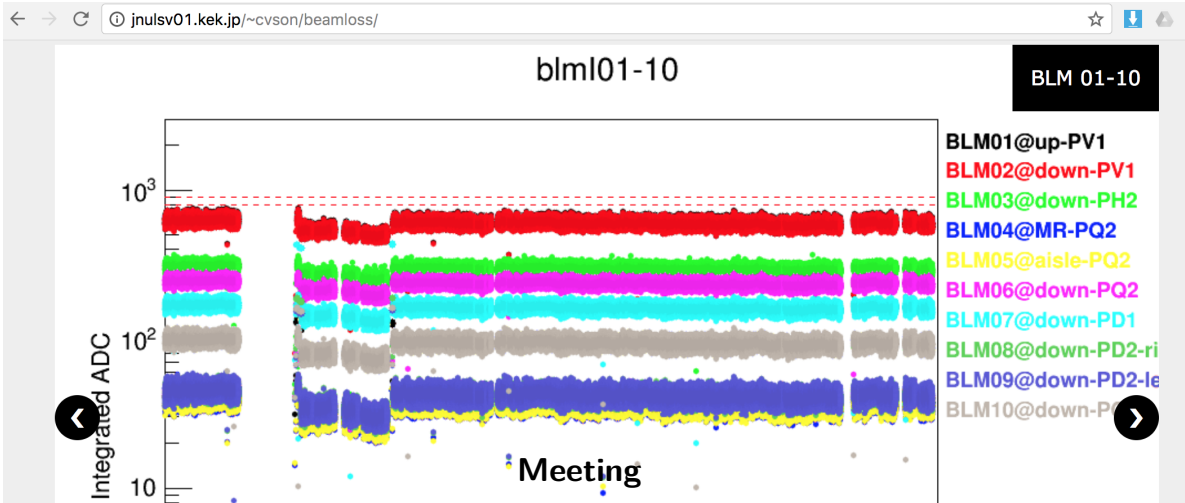
Beamline Final Focusing Section

- Beam monitors are essential for protecting beamline equipment and understanding proton beam parameters for flux MC

- 5 CTs (Current Transformers) – monitor beam intensity
- 50 BLMs (Beam Loss Monitors) ◀- - - BLM expert, monitor, R&D
- 21 ESMs (Electrostatic Monitors) – monitor beam position
- 19 SSEMs (Segmented Secondary Emission Monitors) – non-continuously monitor beam profile ◀- - - R&D
- 1 OTR (Optical Transition Radiation) Monitor – continuously monitors beam at target
- 1 MUMON (Muon Monitor) – monitors secondary muon beam

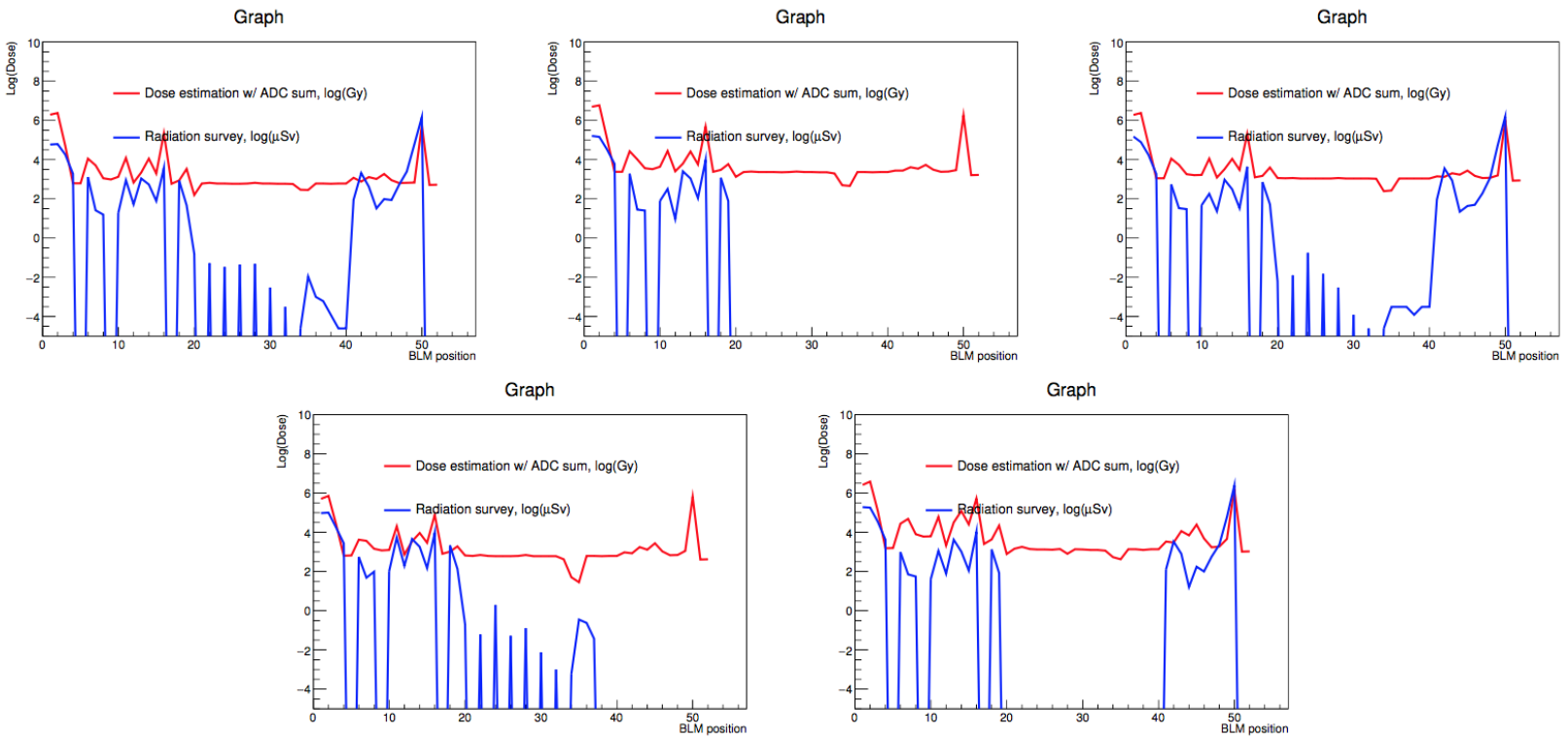
Working status: Beam loss monitor

- Why important?
  - High intensity proton beam is dangerous! $\rightarrow$ damage equipment if proton beam mis-steered
  - If proton beam mis-steered, caused a lot of radiation $\leftarrow$ BLM monitor this to protect machine (ex. stop beam if their radiation record is high)
- Responsibility
  - Monitor the beam loss (BLM) on few-day basic
  - Predict residual dose from data recorded by BLM & compare with handy measurement during maintenance



Working status: Beam loss monitor (cont'd)

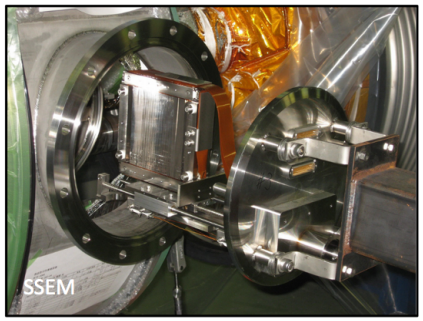
- T2K neutrino beam is running in anti-neutrino mode
  - Monitor the beam loss (BLM) on few-day basic
  - Predict residual dose from data recorded by BLM & compare with handy measurement during maintenance

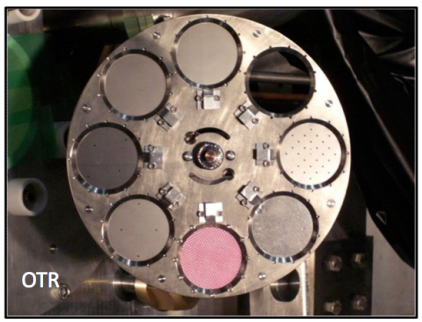


Working status: Beam induced Fluorescence Monitor R&D

- Motivation?
  - To measure neutrino oscillation $\rightarrow$ need to know the source (flux, energy & composition)
  - Conventional neutrino beam: proton hit on carbon target to create pion/Kaon which is decayed into ν_μ (and small amout of ν_e)
  - $\rightarrow$ knowing proton beam profile (center position, angle, width) is important to predict neutrino source
- How to measure proton beam profile
  - Destructive method: put something in the passage of proton, and get information
  - Non-destructive method: put nothing or very small amount of material in the passage of proton

Working status: Beam induced Fluorescence Monitor R&D (cont'd)





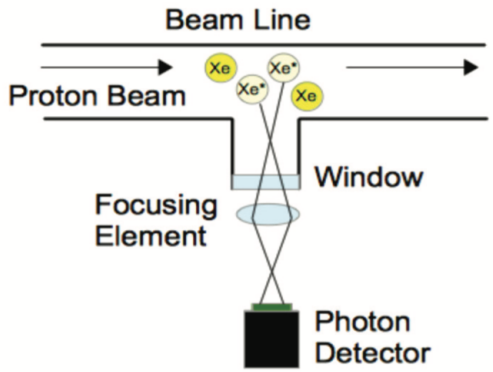
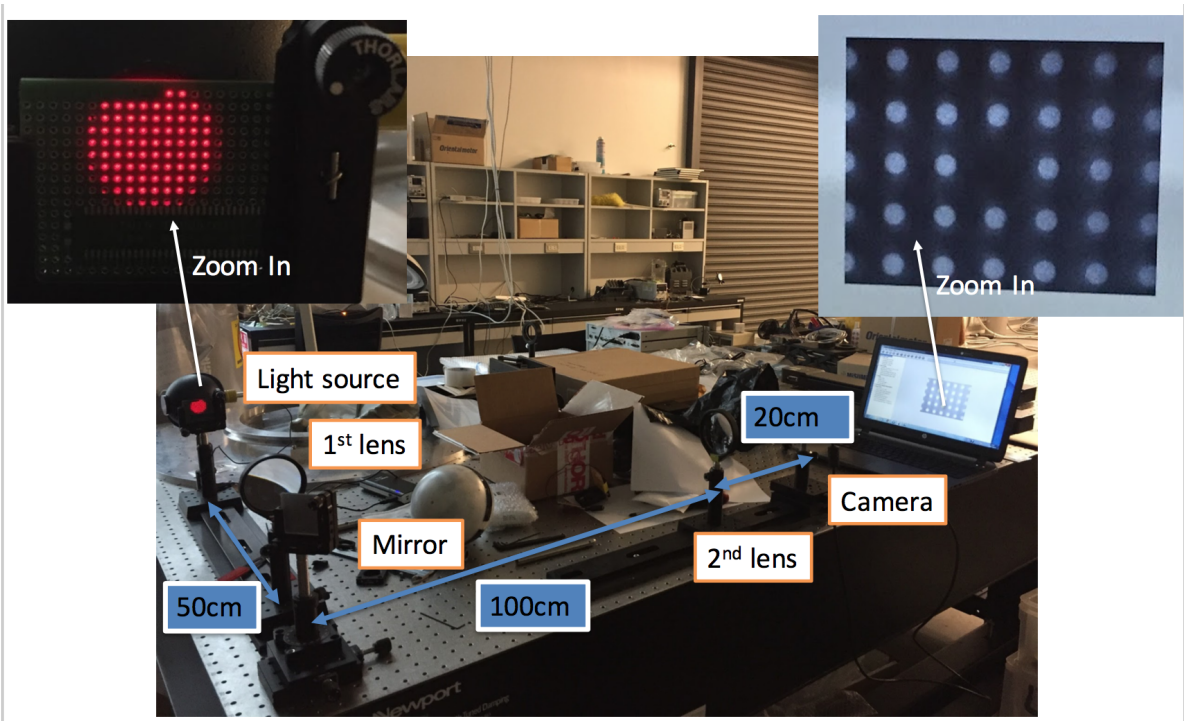
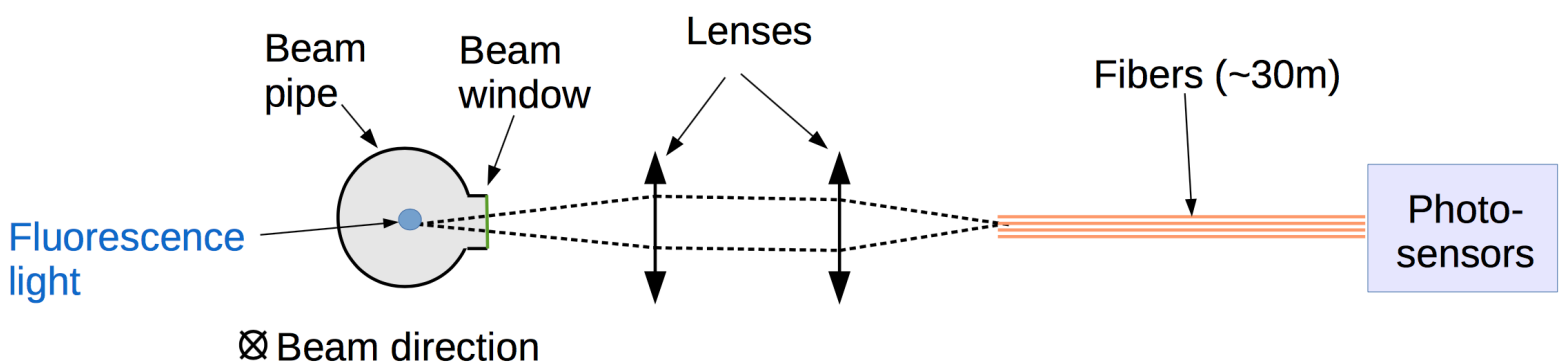


Figure 1: Schematic diagram of BIF monitor.

- Current, we are using SSEM (Segmented Secondary Emission Monitor) & OTR (Optical Transition Radiation)
- My work related to a $R\&D$, so called Beam Induced Fluorescence Monitor
  - Inject gas in the beamline, and measure the fluorescence light when passing through the gas

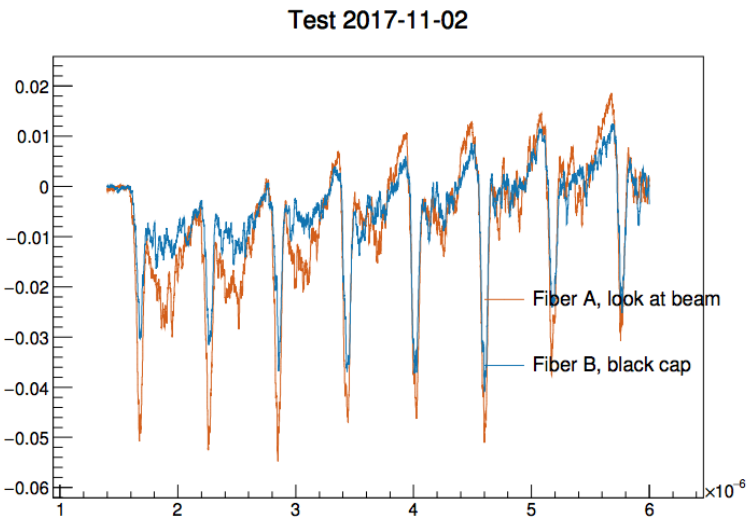
Working status: Beam induced Fluorescence Monitor R&D (cont'd)

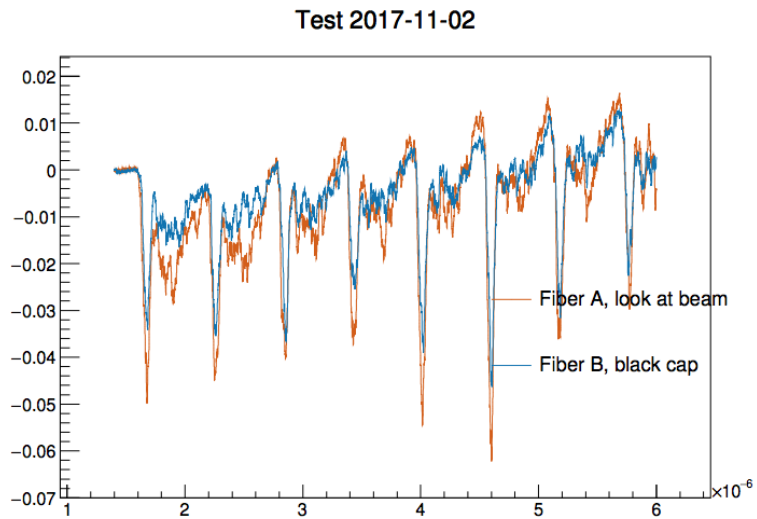




Working status: Beam induced Fluorescence Monitor R&D (cont'd)

- Taking data with oscilloscope and do offline analysis
  - 1 photoelectron charge recorded by MPPC
  - Integrated the charge during the beam, then divide to get number of photons.
- Next step: install more optical fibers (now only 2) and working w/ MPPC array to readout





Working status: Other works

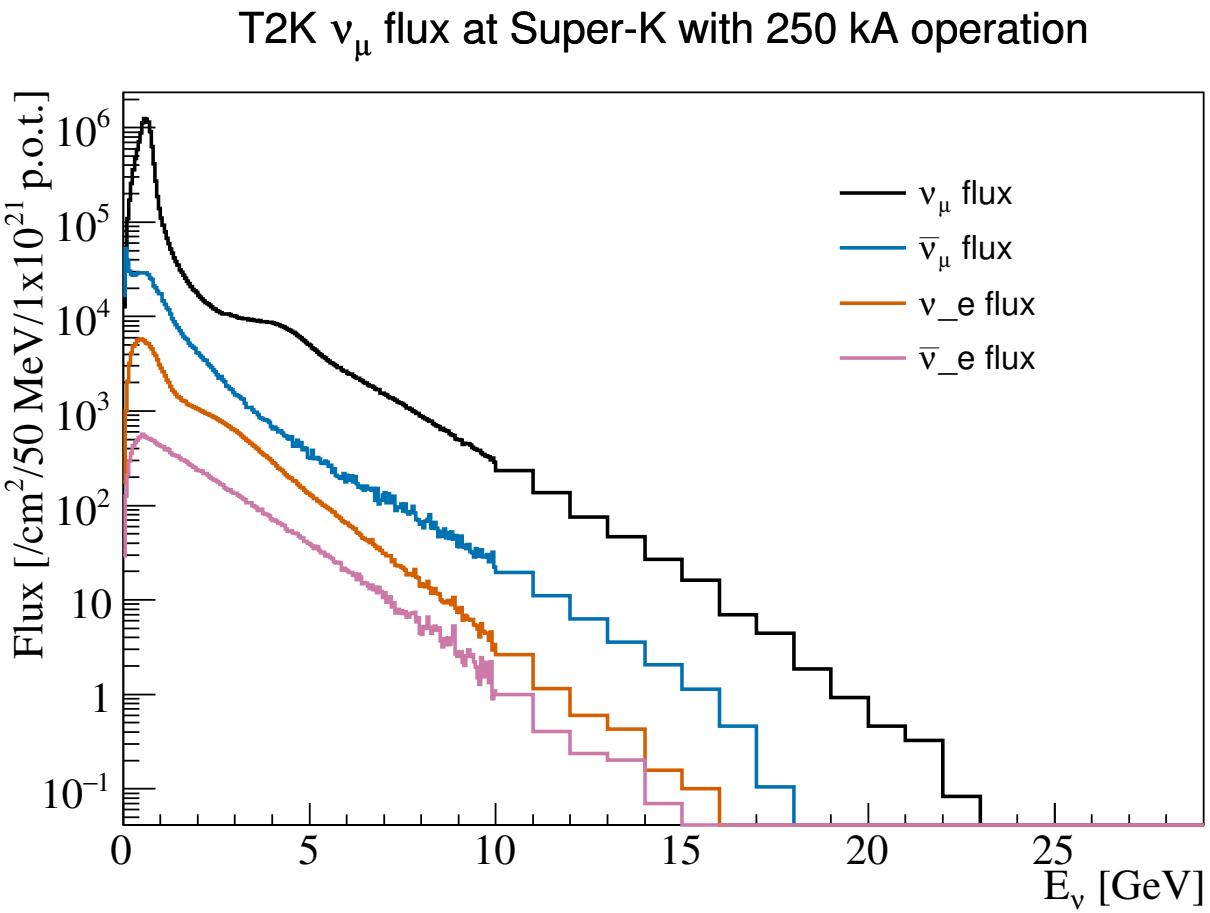
- Overall responsible person for INGRID (T2K on-axis near detector) operation as convener
- Take Neutrino beam leader shift some days (sharing duty among No. of physicists)
- Writing a technical note of measuring neutrino interactions, called charged-current pion coherent production with T2K on-axis detector
  - Will introduce later as specific topic
- Working on producing NEUT (neutrino event generator) manual (deadline for first draft by the end of this week)
  - Will introduce later as specific topic
  - (Joint working with Nguyen H. Van)

Introduction to short course

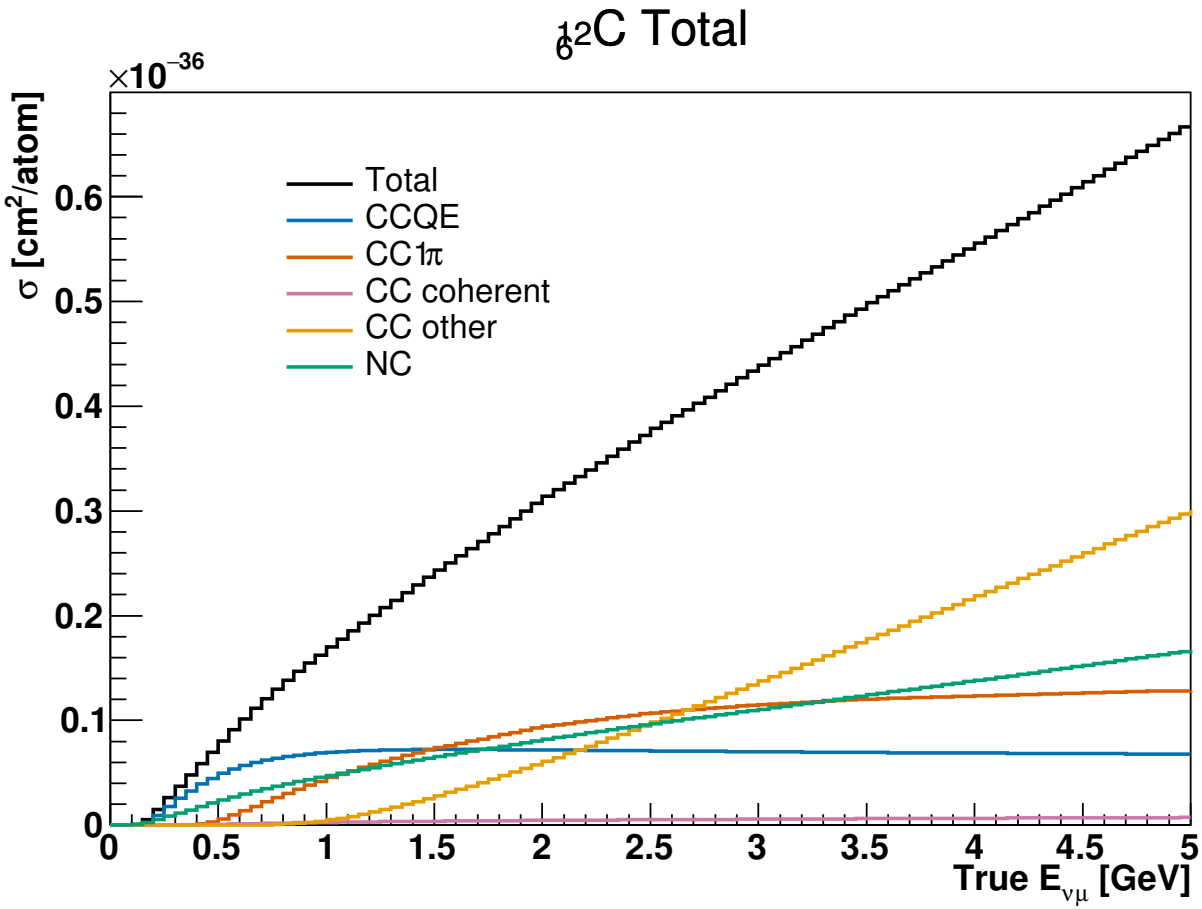
Goals & context

- Goals
  - Provide some ideas of neutrino experiments with simulation
  - It can be extended with signal processing
- Open code managed with github `https://github.com/cvson/nushortcourse`
- So far included
  - Framework for ν oscillation probability calculation (simple & complex)
  - Unitary matrix illustration
  - Off-axis experimental illustration
  - Monte Carlo toys: to calculate π and integral
  - Inputs: neutrino flux (T2K) and cross section
- If you want to contribute, please work together
- Below is some example. More is coming and instruction will come for each short sourse.

Example: Flux



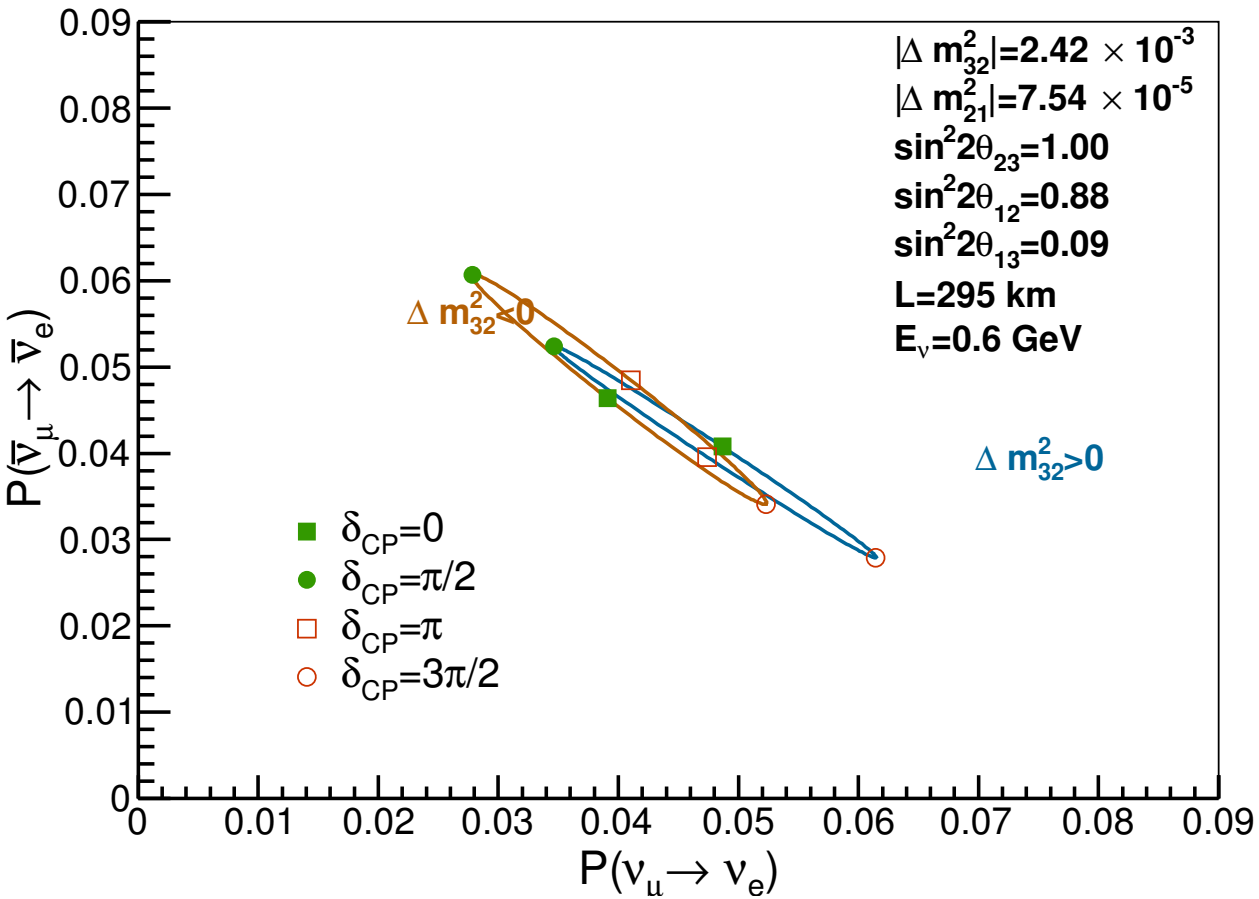
Example: cross section



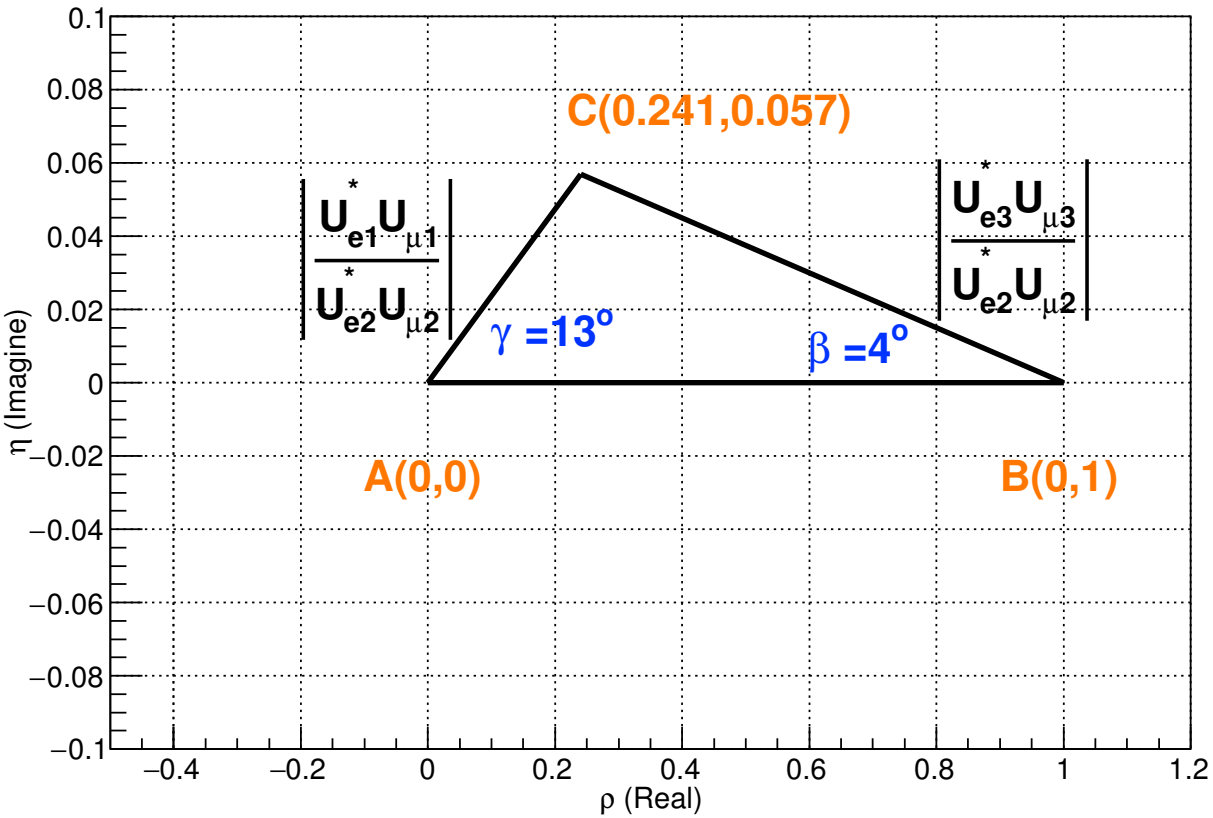
Simple Monte Carlo

https://vnnuphys.slack.com/files/U42100C78/F7PGWRFHN/hpianim.gif

Oscillation framework



Unitary triangle



School & symposium next summer

- Neutrino Summer School (2nd): July 9th - July 20th, 2018
  - 15-20 students (about 10 students from Vietnams, others from Japan and other Asia countries)
  - 1st school can be found at `http://ifirse.icise.vn/nugroup/vson/2017/`
  - Announcement is around Jan. 2018
- International Symposium on Neutrino Frontiers: July 16th - (July 19th or July 20th), 2018
  - Chaired by Prof. Nakaya
  - Forming International Advisory Committee
  - 50-70 physicists
  - Announcement is around Feb. 2018

Backup