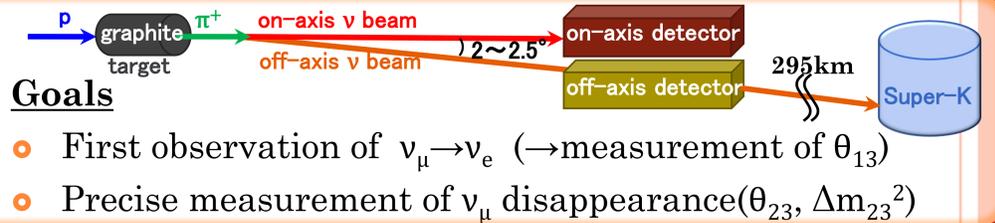


Tatsuya Kikawa (Kyoto University) for the T2K collaboration

The T2K (Tokai to Kamioka) experiment

- Long-baseline (295km) neutrino oscillation experiment
- Generate ν_μ beam at J-PARC in Tokai
- Detect the neutrinos with Super-K in Kamioka
- First application of off-axis beam

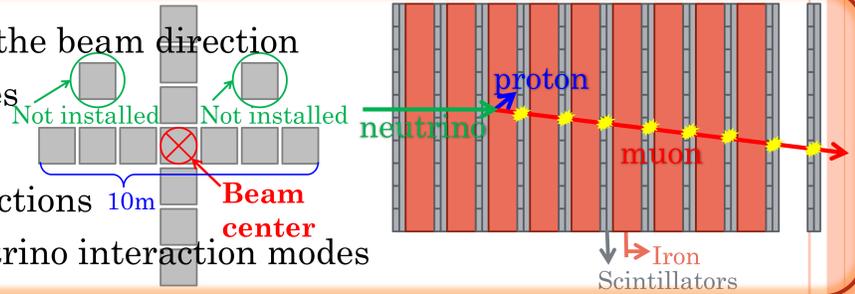


Goals

- First observation of $\nu_\mu \rightarrow \nu_e$ (\rightarrow measurement of θ_{13})
- Precise measurement of ν_μ disappearance ($\theta_{23}, \Delta m_{23}^2$)

INGRID (Interactive Neutrino GRID)

- On-axis neutrino detector (14(+2) identical modules) to monitor the beam direction
- Sandwich structure of iron target and scintillator tracking planes
- High statistics because of large target mass (116 tons)
- Unable to detect particles other than muon from neutrino interactions (i.e. protons & pions stop in iron layers) \rightarrow Unable to identify neutrino interaction modes



INGRID proton module

- New additional on-axis neutrino detector in front of the central INGRID module

Motivations

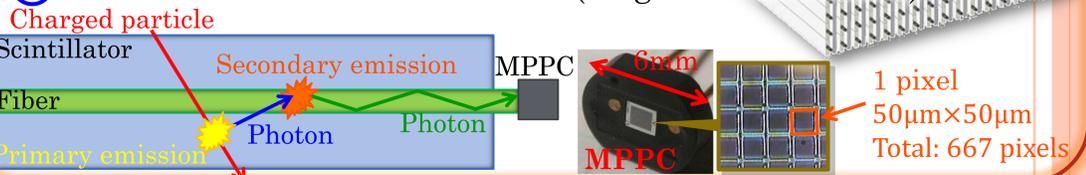
- Better understand neutrino interactions in INGRID by detecting particles such as hadrons and low-energy muons that INGRID is unable to detect
- Estimate signal & background in INGRID
- Measure on-axis neutrino energy spectrum via Charged Current Quasi-Elastic (CCQE) mode (Identify neutrino interaction modes by protons & pions from neutrino interactions)
- Guarantee beam quality and beam MC

Requirement

- Reconstruct tracks of all kinds of charged particles from neutrino interactions

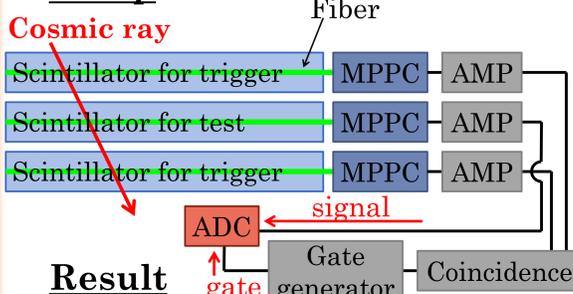
Design of INGRID proton module

- 34 scintillator tracking planes (without iron)
- One tracking plane consists of 32 scintillator bars
- Scintillator bars (10mmx50mmx1203m & 13mmx25mmx1203m) are lined up alternatively in horizontal and vertical planes
- Tracking planes are covered by 2 front veto planes and 4 side veto planes
- Fiber-MPPC (multi-pixel photon counter) readout
- Total channel: 1204, total mass: 1.4 t size: 1.4m x 1.4m x 0.9m
- Able to reconstruct 3D tracks of all kinds of charged particles from neutrino interaction
- Lower statistics than INGRID (target is scintillator)



Test of scintillators and fibers

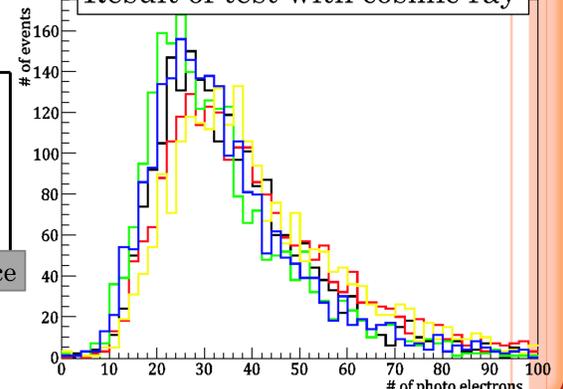
Setup



Result

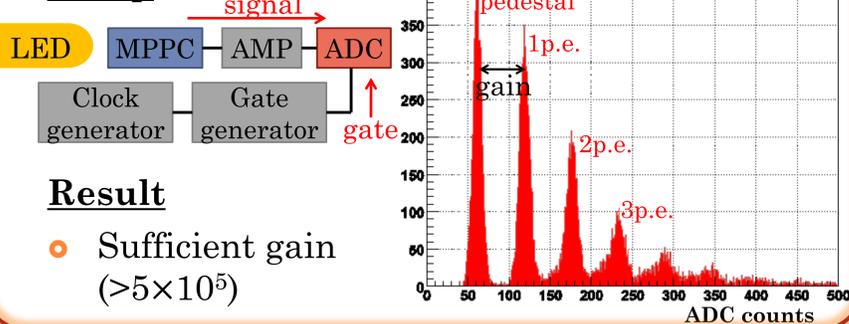
- Sufficient light yield (>10 photo electrons)

Result of test with cosmic ray



Test of MPPCs

Setup



Result

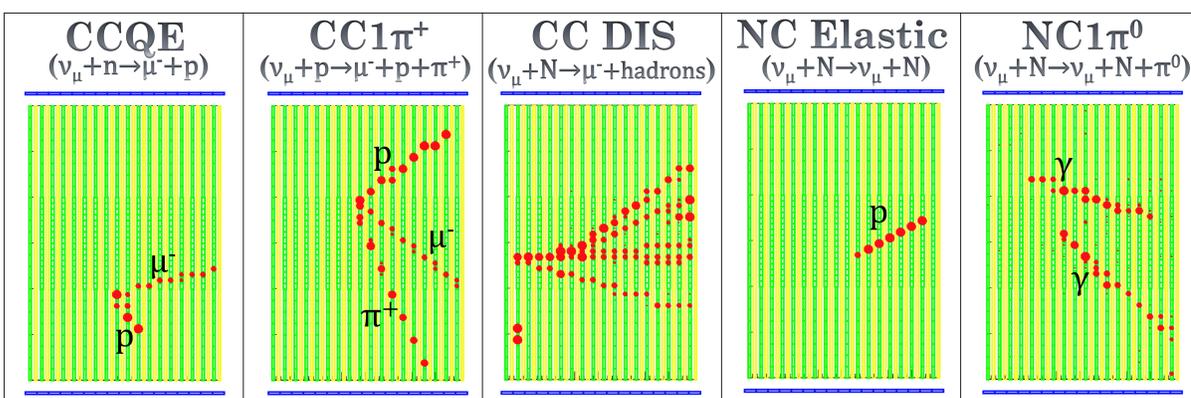
- Sufficient gain ($>5 \times 10^5$)

Monte Carlo simulation

Tool kit: Geant3(neutrino beam) \rightarrow NEUT(neutrino interaction) \rightarrow Geant4(detector simulation)

Result

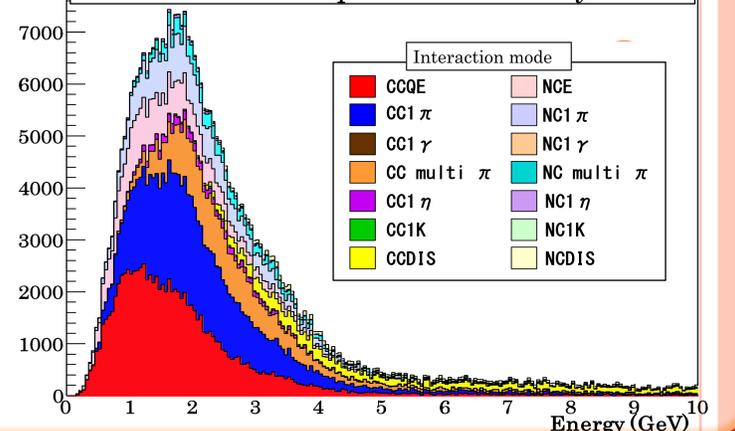
- Statistically sufficient number of events for reconstruction of neutrino energy spectrum
- Able to identify neutrino interaction modes



Expected number of neutrino interactions in proton module with 750kW beam power

Total	3.6×10^5 / year
CCQE mode	9.4×10^4 / year

Expected energy distribution of neutrinos which interact in proton module / year



Proton module is now under construction, and will be installed in September, 2010.