Recent status of neutrino interaction analysis in the first Physics Run in the NINJA experiment

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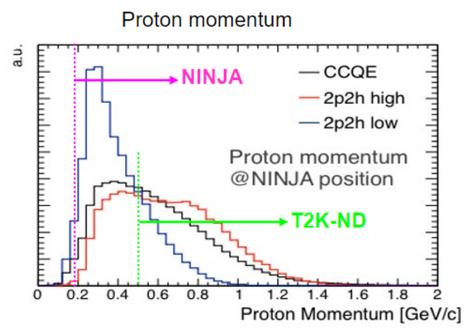
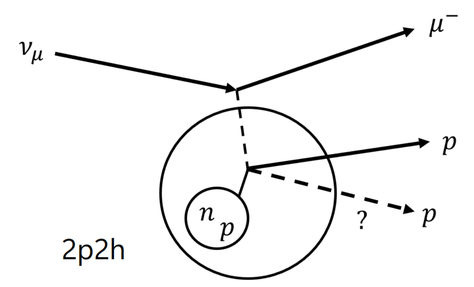
NINJA experiment : Neutrino Interaction research with Nuclear emulsion and J-PARC Accelerator

Motivation

- Precise measurement of neutrino-nucleus interaction interaction of sub- multi-GeV ν_μ
- Electoron neutrino closs section measurement
- Sterile neutrino search





The uncertainty of neutrino-nucleus interaction need to be reduced for the precise measurement of neutrino oscillations. To accurately understand the contribution of the 2-particle 2-hole(2p2h)to the CCQE like events, protons from neutrino interaction need to be detected down to low momentum.

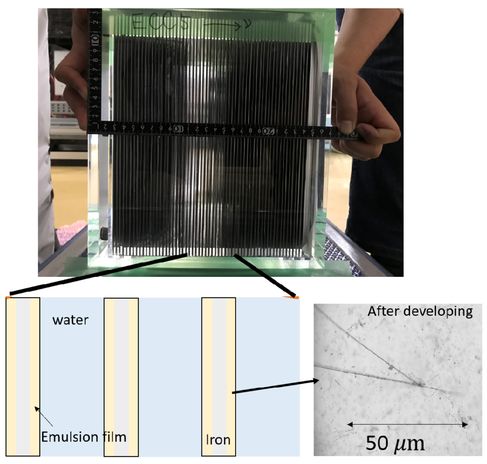
Physics Run a (E71a)

Neutrino beam: 4.8×10^{20}POT, Nov. 2019-Feb. 2020;
Cite: the J-PARC Neutrino monitor building
Analysis of neutrino interactions is being conducted for all ECCs, and the results will be reported in this July. This poster shows the results for about half of the statistics (45%statistics).

Detectors

Emulsion Cloud Chamber

- sandwich structure of emulsion film and water
- sub-micron position resolusion
- Target : H_2O 75kg, Iron 130kg



Time Stamper

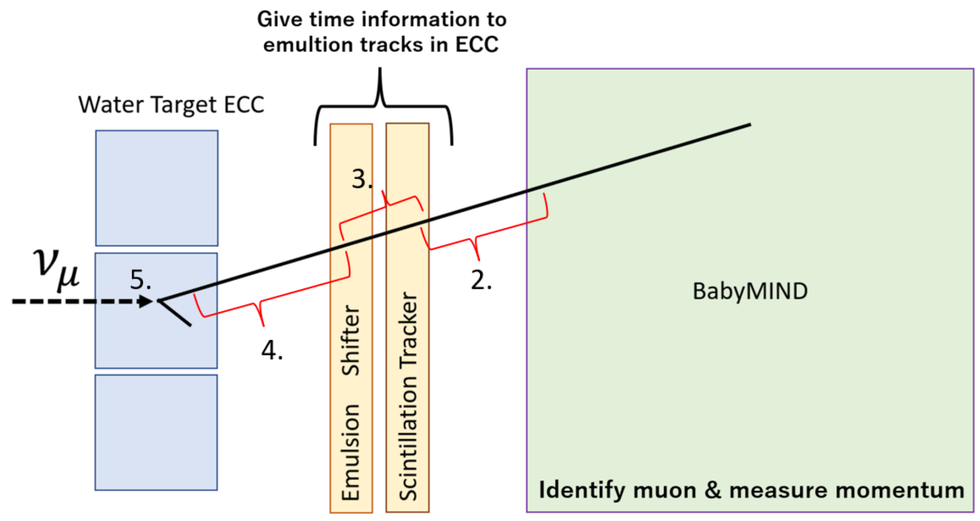
- To connect muon tracks in ECC and Baby MIND
- Two types of detector : emulsion shifter and scintillation tracker

Muon Range Detector (Baby MIND)

- T2K near detector
- To identify muon tracks and measure their energy

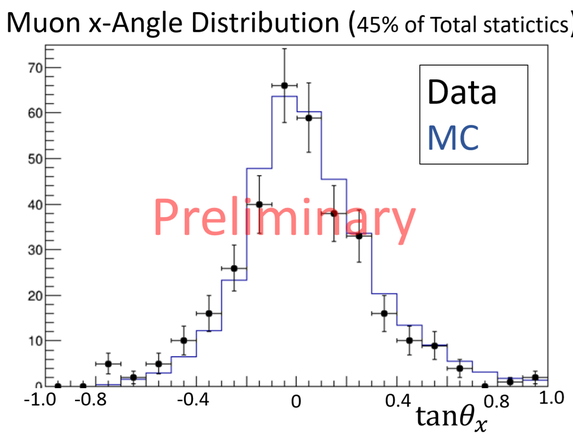
Analysis method

The analysis proceeds in the order of 1. to 5. shown in the figure below.

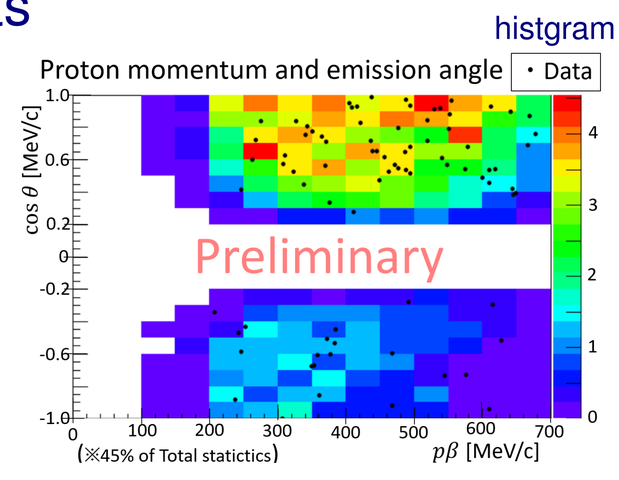


1. Muon identification and reconstructing the tracks
2. Matching scintillation trackers and BabyMIND tracks
3. Matching scintillation tracker and emulsion shifter tracks
4. Matching ECC tracks with shifter muon tracks
5. Select muons that are candidates for neutrino interaction events in ECC.Reconstruct the neutrino interaction.

Very Preliminary Results



histgram MC



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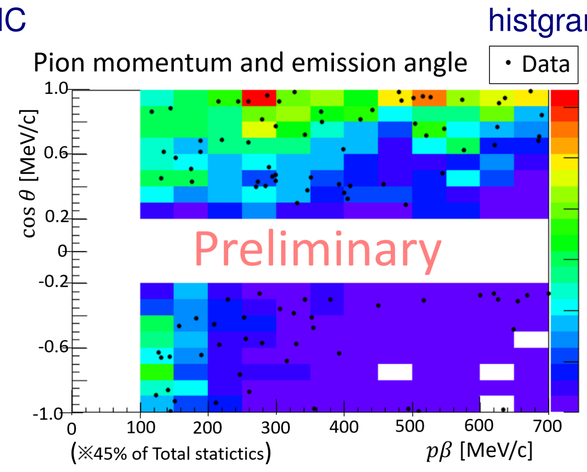

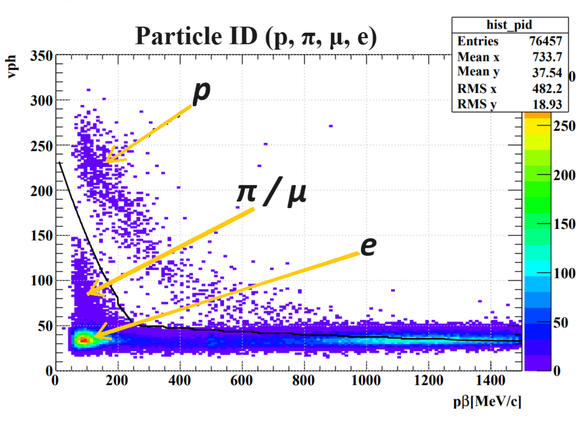

The plot on the left shows the angular distribution of muons in the simulation and data, and the two middle plots show the emission angles of pions and protons. Iit was confirmed that the distributions in the data and simulation are roughly the same. VPH is a value corresponding to dE/dx, and particle identification is performed using the momentum and VPH. As an example, the case of $0.4 \leq \tan\theta < 0.5$ is shown.

Conclusion

- Precise measurement of sub-multi GeV neutrino-water interactions is important for future neutrino oscillation analysis.
- The analysis was performed on approximately 45% of the total statistics. Compared with the simulation, the distribution of muons originating from neutrino reactions was found to be approximately good. The multiplicity will be analyzed and verified in more detail.
- All analysis results are expected to be completed by the end of the summer.

The XXXI International Conference on Neutrino Physics and Astrophysics (Neutrino 2024) in Milano, Italy, from June 16 to June 22.