Measurement of charged-current interactions on water using a nuclear emulsion detector in the NINJA experiment

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NINJA experiment

✧ NINJA: Neutrino Interaction research with Nuclear emulsion and J-PARC Accelerator
✧ Low momentum hadrons can be detected by nuclear emulsion
=> A powerful way to probe nuclear effects
Nuclear emulsion detector

- ECC (Emulsion Cloud Chamber):
  Alternating layers of emulsion films and targets (e.g. 2mm water)
  => Low momentum threshold
- Momentum measurement by multiple Coulomb scattering / range
Pilot runs

- Iron target run: 60-kg iron target ECC (2016)
- Water target run: 3-kg water target ECC (2017-2018)

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accepted by PTEP
Iron target result

- 60-kg iron target, neutrino mode
- Flux-averaged charged-current inclusive cross section
- Kinematics results paper is in preparation
Water target results

- 3-kg water target
- Antineutrino mode
- Backgrounds (mainly cosmic rays) are subtracted

Muon angle

Muon momentum
### Charged pion angle

- **Events**
  - CCQE
  - 2p2h
  - CC1pi
  - CC Multi-pi
  - CC Other
  - $\nu_e$ events
  - Data w/ stat.
  - + syst. (detector+bkg+flux) error
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Physics run & other activities

✧ 2019/2020:
First physics run, analysis ongoing

✧ 2022:
Second physics run
=> ×30 stat data in total !!

Other activities
✧ Heavy water run
(Pilot run in ongoing)
✧ Developments of new time stampers
✧ Studies for $\nu_e$ detection (for a sterile search)
The NINJA experiment measures neutrino interactions (especially on water) using nuclear emulsion.

We can achieve a 200 MeV/c proton momentum threshold to probe nuclear effects.

The pilot run results demonstrated the capability of our detectors.

Results from the physics run and other activities are coming soon!!