

NuFact 2026 - The 27th International Workshop on Neutrinos from Accelerators



Contribution ID: 22

Type: **Oral contribution**

The NINJA neutrino experiment at J-PARC

The NINJA experiment in the T2K beam employs nuclear emulsion detectors to study neutrino interactions. A key advantage of nuclear emulsion technology is its extremely high spatial granularity allowing for sub-micron spatial resolution. This feature enables the reconstruction of short particle tracks originating in the vicinity of the neutrino interaction vertex, allowing for detailed characterization of low-energy final-state particles, e.g. protons with a momentum threshold of approximately 200 MeV/c.

The NINJA detector was installed in the B2 floor of the near detector complex of the T2K neutrino experiment and utilizes the neutrino beam produced at J-PARC. It comprises emulsion detectors and a scintillator detector to provide timing information. To date, the experiment has conducted three physics runs (November 2019-February 2020, November 2023-February 2024, and November 2025-March 2026). The first two runs were performed with a 75 kg water target, while the most recent run consisted of a larger 100 kg water target, providing increased statistics.

The capability to detect low-momentum protons makes NINJA particularly well suited to study nuclear effects such as multi-nucleon correlations and final-state interactions, which are critical for reducing systematic uncertainties in neutrino energy reconstruction. In this contribution, an overview of the NINJA experiment will be presented, along with the current status of the data analysis.

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Track Classification: WG2: Neutrino Scattering Physics