A test experiment to develop a neutrino detector with emulsions for neutrino-nucleus cross section measurements at J-PARC

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We would like to perform a test experiment to develop a new neutrino detector with nuclear emulsions at the near detector hall of the J-PARC neutrino beam line. The aim is to detect all the three neutrino species with high efficiency and measure the cross sections of neutrino-nucleus interactions at a low energy region. The original neutrino detector is so called Emulsion Cloud Chamber (ECC) [1-2] and consists of nuclear emulsion films, acting as high precision tracking detectors, interleaved with various material plates providing a massive target for neutrino interactions. The ECC has the unique capability to observe tau neutrino interactions [1-2]. Thanks to its high spatial resolution, it can also identify an electron neutrino, with small background from π^0 misidentified as electron, by observing the electromagnetic shower or by studying the scattering behavior of the electron [3]. We will use iron and carbon plates as target material so that we can study neutrino-iron and neutrino-carbon interactions. We also intend to insert the packed emulsion films in water to study neutrino-water interactions [4]. If we use low density material plates as spacers between emulsion films and put the detector in a magnetic field, we will be able to measure the charge sign and the momentum of charged particles emitted from neutrino interactions [5].

First, we will check the quality of new high sensitivity emulsion gel and films. Then we will optimize the thickness of material plates and other conditions. Assuming 10^{21} p.o.t. data taking with a 100kg detector (corresponding to 12 standard ECC bricks), 17,000 neutrino interactions are expected to be accumulated in the target. We will study the performance of the detector by analyzing real data. Since the experiment can run with T2K, we do not request any dedicated beam time.

References

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