Motivation

Fast neutrons represent a significant background for low-energy particle physics experiments. MITPC is a directional fast neutron detector currently installed at Fermilab, after having completed runs under the name DCTPC at the experiment Double Chooz. These detectors are being used to characterize MeV-scale neutron background relevant for low and high energy neutrino experiments.

Prototype and Full-size Detectors

The two detectors run complementary to each other. The prototype has better low-energy resolution, while the full-size detector has better resolution at higher energies.

<table>
<thead>
<tr>
<th>Detector</th>
<th>Active volume</th>
<th>Energy sensitivity in different gases</th>
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</thead>
<tbody>
<tr>
<td>Full-size</td>
<td>40 – 60 L</td>
<td>3He/CF4: DCTPC at Double Chooz, MITPC at Fermilab</td>
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<tr>
<td>Prototype</td>
<td>2.8 L</td>
<td>0.2 – 10 MeV</td>
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</tbody>
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Demonstrating Use of Neon

- Ne as fast neutron target
- To reconstruct more energetic recoils than possible with 3He
- Performed studies with prototype
- Showed sufficient gain and acceptable diffusion
- Lower spark rate in Ne than in 3He

Energy Reconstruction

SRIM calculations yield the recoil energy from reconstructed 3D track length.

DCTPC Results from Runs at Double Chooz

60 L detector, Double Chooz near hall, 7 months

40 L detector, Double Chooz far hall, 6 months

MITPC at Fermilab

- Installed at Fermilab, in SciBooNE hall
- 100 m downstream of Booster Neutrino Beamline (BNB) target
- To measure neutrino-induced, skyshine, radiogenic and cosmogenic neutrons
- Measurements to tune Monte Carlo prediction of neutron background
- Useful for neutrino experiments on BNB: MicroBooNE, ANNIIE, and SBND

CCD Images of Tracks in 3He/CF4

c. 1 MeV neutron-induced nuclear recoil
d. 210Po alpha
e. Double-alpha from 222Rn decay

MITPC Collaboration

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