The Time Projection Chamber for the MicroBooNE Experiment at Fermilab

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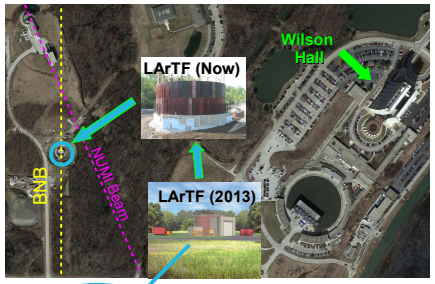
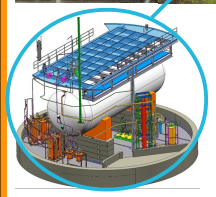
on behalf of the MicroBooNE Collaboration

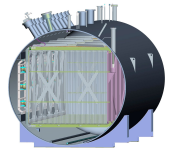
Overview of MicroBooNE

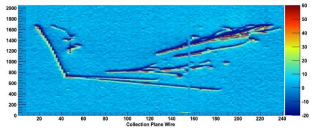


The MicroBooNE experiment will be housed in the new Liquid Argon Test Facility (LArTF) at Fermilab located in the Booster Neutrino Beam (BNB). LArTF construction is ongoing with an expected completion date of ~March 2013

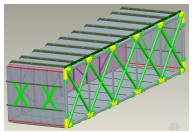


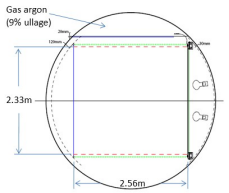
MicroBooNE will employ a ~70 t active mass (170 t total mass) Liquid Argon Time Projection Chamber (LArTPC) contained within a conventional cryostat. The high purity liquid argon in the LArTPC serves as the neutrino target and tracking medium for the particles produced in neutrino interactions





MicroBooNE will detect neutrino interactions through the observation of outgoing charged particles that ionize in the liquid argon. Ionization electrons drift though an electric field to three wire planes on the detector. The wire positions and the arrival times of the electrons on the wires enables sub-millimeter position resolutions.





Nominal Wire Length:
Y: 2.5m
U, V: 5m

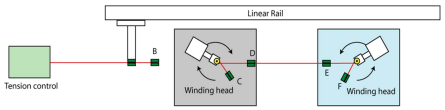
Number of Wires:
Y: 3456
U, V: 2400 each
Total: 8256

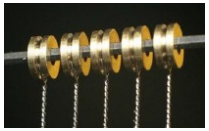
Three readout planes, spaced by 3 mm, form the beam-right side of the detector, with the 3456 Y wires arrayed vertically and the 2400 U and 2400 V wires oriented at ± 60 degrees with respect to the Y wires.

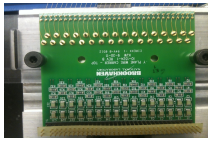
Abstract

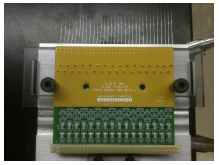
The MicroBooNE experiment at Fermilab will use a 170 ton, liquid argon time projection chamber (TPC) to investigate neutrino interactions coming from Fermilab's Booster Neutrino Beam (BNB) as well as an off axis component of the NUMI neutrino beam. MicroBooNE studies neutrino interactions through the observation of outgoing charged particles that ionize in the liquid argon as well as neutral particles that convert in the argon. These ionization electrons then drift through a uniform electric field to three wire planes allowing sub-millimeter position resolution in the reconstructed interaction. In this poster we present the details of the fabrication, assembly, and testing of the MicroBooNE TPC.

Wire Plane Production









All readout planes use 150 μm stainless steel wire with 2 μm thick copper plating covered with a thin flash of gold to prevent copper oxidization and increase conductivity.

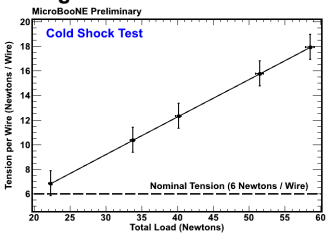
An automated wire winding machine terminates wires via several twists around a small brass ring. The winding machine sets the length of each wire at the nominal 1.0 kg (9.8N) tension with a precision ± 0.25 mm

Specially designed wire holder modules hold the wires. Each wire holder module holds 32 wires in Y, and 16 wires in U and V. A wire holder module consists of a stack of two printed circuit boards with the wire terminations encapsulated in rows of circular cavities. Each wire is placed by hand on the wire holder board before being riveted with a mounting plate (shown in yellow)

Strength Tests Performed

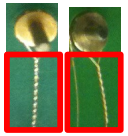
Breaking Load Cold Test

Assembled boards were tensioned > 2 times the nominal tension and then dunked (shocked) in liquid nitrogen

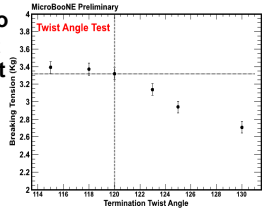


NO WIRES BROKE DURING TEST

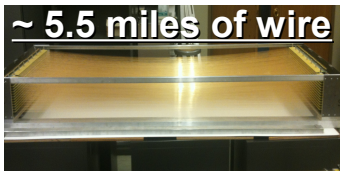
Twist Angle vs Breaking Load



Performed test to find the tightest termination twist angle without compromising maximum breaking load



Y-Plane Production



3840 Y-wires (120 boards) completely assembled in May 2012. U and V planes currently under construction and expect to be completed them this summer.