Scibath proof-of-principle tests for FINeSSE performed at IUCF

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The FINeSSE experiment under development to measure the nucleon axial form factor using neutrino-nucleon neutral-current elastic scattering, as described above, uses a detector that employs the "scibath" technique. The recent development of this technique at IUCF was motivated by the desire to precisely reconstruct 100-1000 MeV proton tracks in a large-volume neutrino detector and has recently been shown to work in a small "proof-of-principle" device. This device consisted of a 15x15x30 cm^3 volume of liquid scintillator with an immersed array of 30 wavelength-shifting (WLS) fibers. The fibers were arranged in a 5x6 grid with 2-cm spacing between fibers. They were routed to 2 16-anode photomultipliers tubes to record the light produced by incident protons. This device was tested in the IUCF RERP facility, again, with 200-MeV protons. The results from these tests showed that there is adequate light collected with this method (17 photoelectrons for a proton track passing near a fiber). They also showed that the device is capable of good angular (6°) and position (6mm) resolution for reconstructed tracks. The results for a small sample of data are shown in Fig. 1.

This data was used as input for simulations of the full-sized (2.5x2.5x2.5 m^3) FINeSSE detector. Further tests to optimize the light output and tracking resolution are ongoing.

Figure 1*: Reconstructed track position (a) and angle (b) for a sample of 200 MeV protons in the scibath proof-of-principle detector. This data yielded 6mm position resolution and 6° angular resolution. The rectangle overlay in (a) shows the extent of the trigger scintillators.*