Event Selection for Neutrino Energy Spectrum Analysis

Events are selected for inclusion in the analysis if there is at least one scifi track which

- Matches to the downstream veto within $\Delta x < 50$ cm and $\Delta y < 15$ cm
- Does not match an upstream veto hit to within 2 paddles

Either

- Matches with a 3D MRD track. The matching parameter takes the energy of the particle (assuming it is a muon) into account and constructs a selection window in angle and position of the MRD track which is consistent with multiple scattering of a muon with that energy. These are the MRD3d events.

Or

- Matches to a hit in the first layer of the MRD within $\Delta x<65$cm or $\Delta y<65$ cm. The track should not match to any hit in the second MRD layer and the time of the MRD hit should be correlated with the time of the hit in the downstream veto. These are the MRD First layer events.

Events are selected for QE event candidates if

- There is only one track matching the above criteria OR
- There are two tracks from the same vertex with the direction of the second track being within 30 degrees of the direction expected for a proton in a quasielastic event where the first track is assumed to be the muon ($\Delta\theta<30$ degrees).

Event Numbers

MRD3d 1 track	2190
MRD3d 2 track ($\Delta\theta$ < 30 degrees)	284
First Layer 1 track	344
First Layer 2 Track ($\Delta\theta$ < 30 degrees)	46
Total	2864

All event samples used in the flux analysis
Inelastic background shape verification and background normalisation uncertainty derived from MRD3d 2 track ($\Delta\theta$>30 degrees) sample.

Efficiency for selecting MRD (all types) events