This is a document explaining what each figure shows in the Scifi official plots. The word "combined" of each file name means that the figure contains both June and November data in 1999.

Selection criteria for neutrino events in Scifi

First of all, a description of selection criteria for neutrino events in Scifi is given.

(1) timing cut

In order to select on spill timing events, timing information of VETO counters is used. When at least one hit whose TMC count is in a time window ranging from 1000 to 2750 ($\sim$1.4μsec) exists, the event remains.

(2) Scifi track and Muon chamber hit matching

We require a track in Scifi matching with Muon chamber hits by extrapolating it to the first layer position of Muon chamber detector. The matching condition required for the selection is;

$$|\Delta x|, |\Delta y| \leq 65\text{cm} \quad (1)$$

where $|\Delta x(y)|$ is minimum distance between the extrapolated Scifi track position and Muon chamber hit positions in x(y) plane. The Muon chamber hits are required to be at least three hit coincidence, i.e. XXY or XYY ore XXYY hits. And further, when the Muon chamber hits are associated with a Muon chamber track, the event is selected.

(3) fiducial volume cut

Fiducial volume cuts are applied in this step. Cut criteria are as follows;

(a)$z_{str} > -5$cm (from 2nd layer of Scifi) and $|x(y)_{str}| < 110$cm (10cm from detector edge)

(b)$z_{stp} > 145$cm (19 or 20 layer)

(c)$|X(Y)_{stp}| < 360$cm (20cm from detector edge)

where the subscript of $str(stp)$ mean track start(end) position and the small(capital) letter of x(X) mean Scifi(Muon chamber) detector position. Purposes of the cuts are (a) eliminating induced muons from upstream side and comic ray muons, (b) rejecting muons missing Muon chamber detector, (c)removing muons escaping from Muon chamber detector. The cut (a) reduces target mass from 8.28tons of total volume to 5.94tons of fiducial volume.

(4)Scifi and Muon chamber track correlation

This cut rejects accidental coincidence matching events such like noise track in Scifi + induced muon track in Muon chamber detector.

(5)Veto cut

The final cut removes induced muons which do not hit first layer of Scifi due to inefficiency using veto timing and hit position information

Numbers of remaining events in June and November in 1999 are 315 and 367 and total efficiencies from whole Scifi mass are 14.7% and 17.6%, respectively. Neutral current interaction contamination in the final event sample is estimated to be <0.3%.

muon_energy_combined.ps

:The 1st page shows observed muon energy spectrum for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector. The cross points and boxes with statistical error are Data and MC, respectively. The 2nd page shows ratios of Data/MC as a function of measured muon energy.

muon_energy_double_combined.ps

:The 1st page shows observed muon energy spectrum for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and one short track associated with the muon long track ("two-track" events). The selection criteria to select those events are described later (see the explanation in "num_of_track_combined.ps"). The 2nd page shows ratios of Data/MC as a function of measured muon energy.

muon_energy_double_combined2.ps

:The figure shows observed muon energy spectrum for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and one short track associated with the muon long track ("two-track" events). The MC histogram is divided to Q.E.(quasi-elastic, blank) and non-Q.E. (hatched) events. The selection criteria to select those events are described later (see the explanation in "num_of_track_combined.ps").

muon_energy_qecand_combined.ps

:The 1st page shows observed muon energy spectrum for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and one short track associated with the muon long track ("two-track" events), which is a recoil proton candidate. The selection criteria to select those events are described later (see the explanation in "num_of_track_combined.ps" and "second_trk_deltatheta_combined.ps"). The 2nd page shows ratios of Data/MC as a function of measured muon energy.

muon_energy_qecand_combined2.ps

:The 1st page shows observed muon energy spectrum for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and one short track associated with the muon long track ("two-track" events), which is a recoil proton candidate. The MC histogram is divided to Q.E.(quasi-elastic, blank) and non-Q.E. (hatched) events. The selection criteria to select those events are described later (see the explanation in "num_of_track_combined.ps" and "second_trk_deltatheta_combined.ps").

muon_energy_single_combined.ps

:The 1st page shows observed muon energy spectrum for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber

detector and no short track associated with the muon long track ("single-track" events). The selection criteria to select those events are described later (see the explanation in "num_of_track_combined.ps"). The 2nd page shows ratios of Data/MC as a function of measured muon energy.

muon_energy_single_combined2.ps

:The figure shows observed muon energy spectrum for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and no short track associated with the muon long track ("single-track" events). The MC histogram is divided to Q.E.(quasi-elastic, blank) and non-Q.E. (hatched) events. The selection criteria to select those events are described later (see the explanation in "num_of_track_combined.ps").

muon_theta_combined.ps

:The 1st page shows observed angle between neutrino beam and muon for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector. The cross points with statistical error and histogram are Data and MC, respectively. The 2nd page shows ratios of Data/MC as a function of measured muon energy.

muon_theta_double_combined.ps

:The 1st page shows observed angle between neutrino beam and muon for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and one short track associated with the muon long track ("two-track" events). The cross points with statistical error and histogram are Data and MC, respectively. The 2nd page shows ratios of Data/MC as a function of measured muon energy.

muon_theta_qecand_combined.ps

:The 1st page shows observed angle between neutrino beam and muon for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and one short track associated with the muon long track ("two-track" events), which is a recoil proton candidate. The cross points with statistical error and histogram are Data and MC, respectively. The 2nd page shows ratios of Data/MC as a function of measured muon energy.

muon_theta_single_combined.ps

:The 1st page shows observed angle between neutrino beam and muon for Data and MC (MC histogram is normalized to DATA) events which have muon tracks in both Scifi and Muon chamber detector and no short track associated with the muon long track ("single-track" events), The cross points with statistical error and histogram are Data and MC,

Number of tracks	Number of events(Data) Jun+Nov,1999
1	541
2	123
3	16
4	2

respectively. The 2nd page shows ratios of Data/MC as a function of measured muon energy.

num_of_track_combined.ps

:This figure shows a distribution of number of tracks in a event (i.e. muon long track + associated short track). The cross points are data and, the blank and hatched histogram are Q.E. and non-Q.E. events in MC. The way to calculate number of tracks is as follow.

(a)At first, three variables are defined; d_{trk} : three dimensional distance between muon long track which was tagged by the Muon chamber detector and second track candidate, d_{str} : distance between the muon track and the second track candidate in a plane including the start point of the second track, which is perpendicular to the neutrino beam direction, d_{stp} : distance between the muon track and the second track in a plane including the end point of second track, which is also perpendicular to the neutrino beam direction.

(b)The second track candidate which satisfys following condition is selected;

$$d_{trk} < 5cm \tag{2}$$

$$d_{str} < 20cm \tag{3}$$

$$d_{stp} > 25cm \tag{4}$$

(c)If more than 2 tracks satisfy the condition (b), the track which has the most smallest d_{trk} is selected as the second track.

Table shows the number of events (Data) for each number of tracks.

second_trk_deltatheta_combined.ps

:This figure shows $\cos\Delta\theta$ distribution, where $\Delta\theta$ is angle between the observed second track and an expected proton track which can be predicted from observed muon kinematics (i.e. total energy and angle with respect to the neutrino beam direction) by assuming Q.E. scattering. The events that number of tracks equals 2 in the "num_of_track_combined.ps" are only used. The histogram of MC is divided to Q.E. and non-Q.E. events. The events used in the figures "muon_energy_qecand_combined.ps", "muon_energy_qecand_combined2.ps" and "muon_theta_qecand_combined.ps are those satisfying $\cos\Delta\theta >= 0.95$, and total number of events is 34.