E362 (K2K) Long baseline neutrino oscillation experiment

The observation of atmospheric neutrino oscillations by Super-Kamiokande offers the most convincing evidence of non-zero mass of neutrinos, which indicates new physics beyond the Standard Model. The goal of K2K experiment is to establish neutrino oscillation in the $\Delta m^2 > 2x10^{-3}\ eV^2$ region using a laboratory produced neutrino beam.

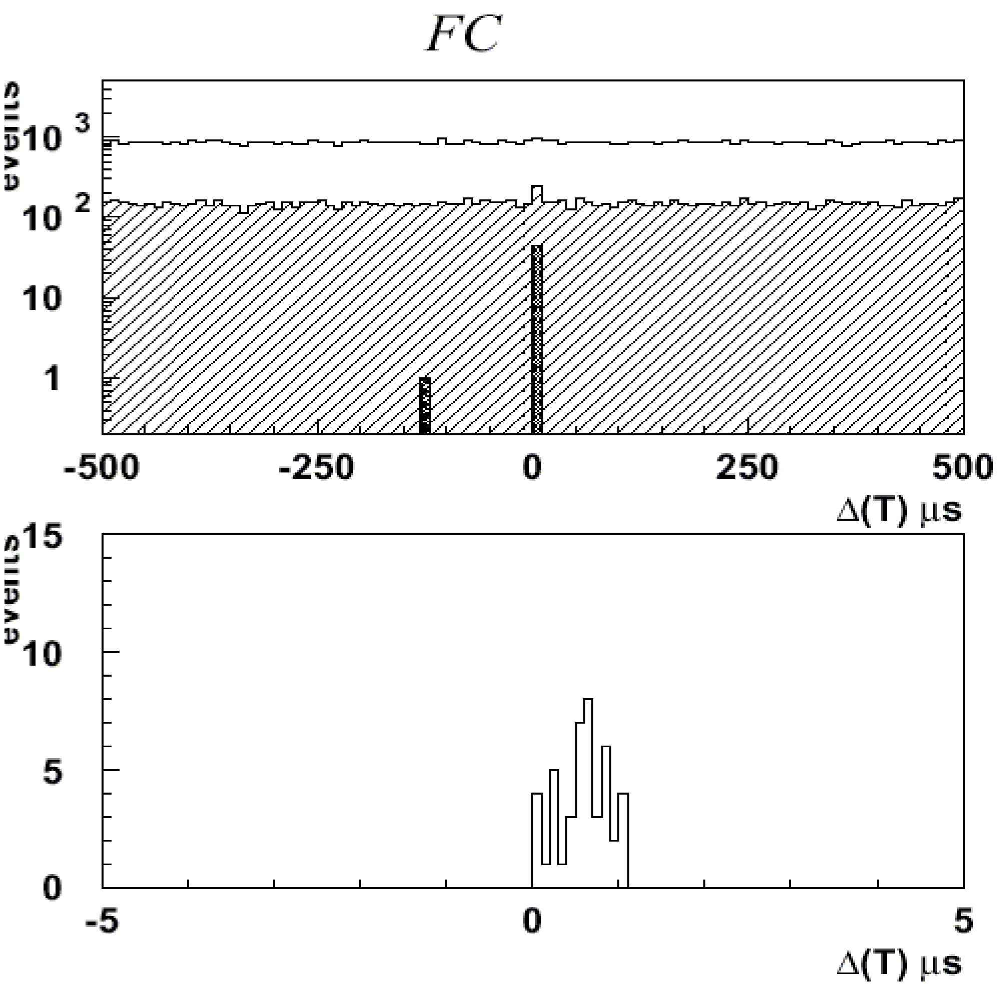
Usage of a neutrino beam from accelerator has advantage over atmospheric neutrino experiment for the predictability of the neutrino beam, by measuring neutrinos just after their birth by near detectors.

The experiment has start taking data in Nov. 1999 to June 2001 for 6 months per year. At this moment the data upto April 2001 has been analyzed that corresponds to about $4x10^{19}$ protons on target.

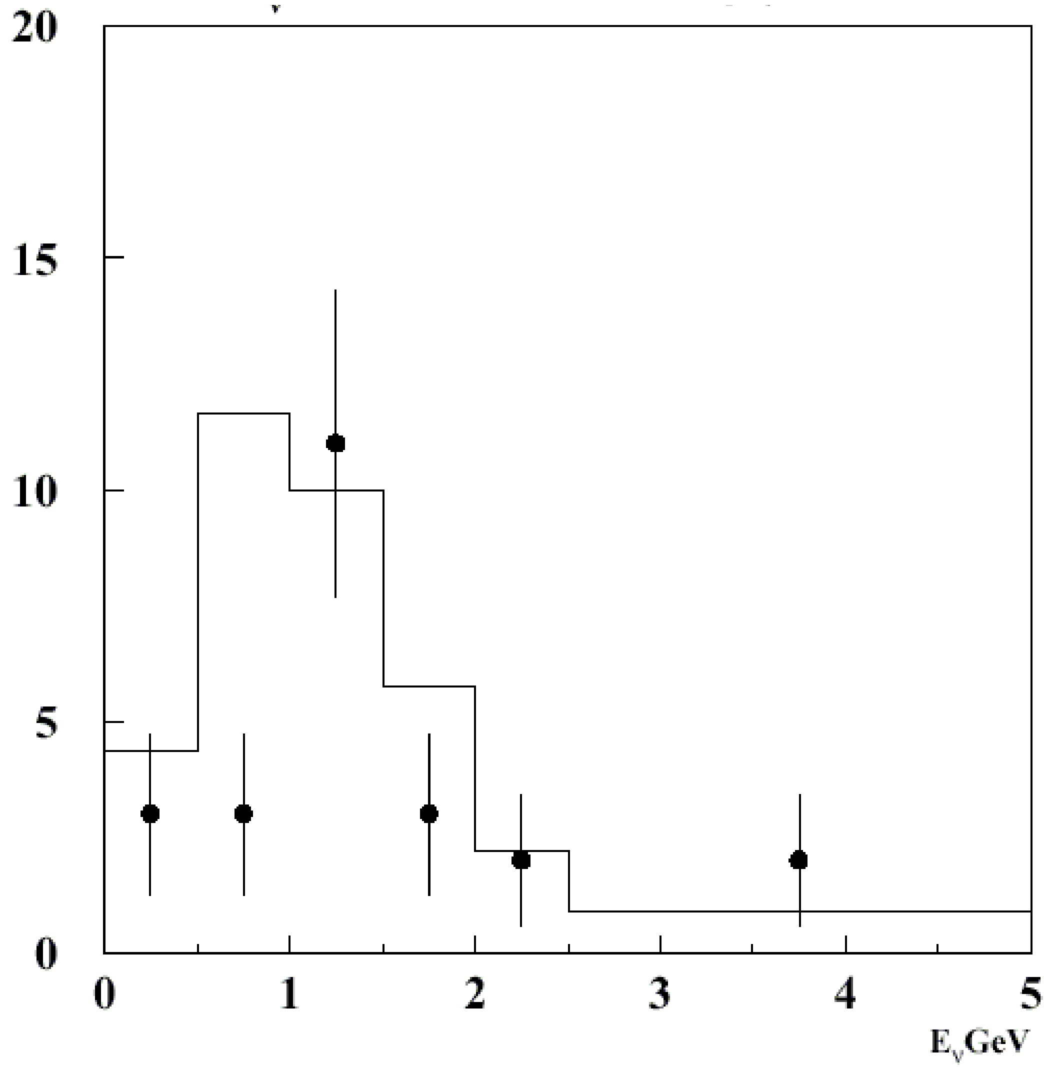
The directionality of the neutrino beam has been monitored and controlled within 1 mradian with respect to the Super-Kamiokande direction. The neutrino rate and spectrum stability in the near detectors has been shown to be stable for entire running period. The extrapolation of neutrino beam from near to far detector has been done with beam Monte-Carlo that has confirmed by in-situ measuremenst with the pion-monitor(gas Cherenkov detector). The Super-Kamiokande data has been selected with the accelerator spill time and event detection time, using GPS time signal as a common timing source. Fig. 1 shows the TSK-TSpill-TOF (time of Super-Kamiokande events minus the time of spill minus the time of flight). The upper figure is for the timing of the Super-Kamiokande events which detected in –500 micro-sec to 500 micro-sec relative to beam spill. After selecting the events which has no energy deposit in the outer layer of the Super-Kamiokande (selecting neutrino events which occurred in the inner 22.5 kton fiducial mass) the events shown by thick histgram remain. The lower histgram is the expanded view from -5 micro-sec to 5 micro-sec. The figureb show essentially no background due to atmospheric neutrino interactions.

The collaboration identified 44 events while expected 64 events in no oscillation case.

Figure 2 is the neutrino energy for single muon events and the expected neutrino spectrum. The prediction of the neutrino spectrum need further study, especially in the low energy region. However the results look promising to show spectrum distortion due to neutrino oscillation with more statistics and precise determination of low energy neutrino events.



FC
events
10 3
10 2
10
1
-500
-250
0
250
500
Δ(T) μs
events
15
10
5
0
-5
0
5
Δ(T) μs



20
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0
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2
3
4
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E_ν GeV