Fermilab FERMILAB-Conf-01/451-E March 2003

Status of the MINOS Experiment

Elizabeth Buckley-Geer [1]

Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Il 60510, USA

Abstract

We report on the status of the MINOS long baseline neutrino experiment presently under construction at the Fermi National Accelerator Laboratory and the Soudan mine.

Key words: Neutrino oscillations
PACS: 14.60.Pq

1 Introduction

There is growing evidence that the solar neutrino and atmospheric neutrino anomalies [1] are the result of neutrino oscillations. The MINOS experiment is a long baseline neutrino oscillation experiment designed to study the region of parameter space indicated by the SuperKamiokande atmospheric neutrino results [2]. The experiment consists of two detectors, one with a mass of 980 tons located at Fermilab (the near detector) and the other of mass 5400 tons located 731 km away in the Soudan mine in northern Minnesota (the far detector). The third component is the neutrino beam which is currently under construction at Fermilab.

2 The Neutrino beam

A 120 GeV proton beam from the Fermilab Main Injector strikes a carbon target. The pions are focussed by two magnetic horns and allowed to decay in a 670 m evacuated pipe. A prototype of the first horn has been built and its

[1] Presented on behalf of the MINOS Collaboration at the NUFACT01 Workshop, Tsukuba, Japan, 24-30 May 2001.

Preprint submitted to Elsevier Science *11 September 2001*

measured magnetic properties agree very well with calculations. The target and second horn are moveable enabling three different neutrino beam spectra to be produced. The best fit from the SuperKamiokande data [2] for Δm^2 is $2.5 \times 10^{-3} eV^2$ which means that with a baseline of 731 km the first oscillation maximum occurs at about 2 GeV. This corresponds well to the low energy beam spectrum which has its maximum at about this energy. This option has been chosen for the startup of the experiment.

3 The far detector

The far detector is an 8 m diameter octagonal tracking calorimeter constructed of 486 layers of 2.54 cm steel with plastic scintillator planes sandwiched in between. There are 2 supermodules each 16m long. The scintillator planes are made from 4 cm wide solid scintillator strips with WLS fiber readout. They are readout by multichannel Hammamastu PMTs (16 channels per tube). The detector occupies a new cavern in the Soudan mine. Civil construction and outfitting is complete and the detector construction has begun. Figure 1 shows the first far dectector plane mounted on the steel support frame. Planes will be installed at the rate of ~ 5 per day and cosmic ray muon tracks have already been observed in the first few planes.

Fig. 1. The first steel plane of the MINOS far detector at Soudan.

4 The near detector

The near detector is designed to be as similar as possible to the far detector. It uses the same steel and scintillator and consists of 282 “squashed octagon” planes of steel. The scintillator is read out using multichannel Hammamatsu PMTs (64 channels per tube).

5 Physics Goals

MINOS has the following physics goals:

- Obtain firm evidence for neutrino oscillations by measuring the charged current interaction rate and energy distribution as well as the ratio of neutral current interaction rate to the total rate (neutral + charged current).
- Measure the oscillation parameters to better than 10%. Figure 2 shows the expected 68% C.L. errors for Δm^2 and $\sin^2 2\theta$ assuming a 10 kton-year exposure with the low energy beam option.
- Either observe $\nu_\mu \to \nu_e$ or improve the limit [3] to $U_{e3} < 0.013$ assuming a 10 kton-year exposure.

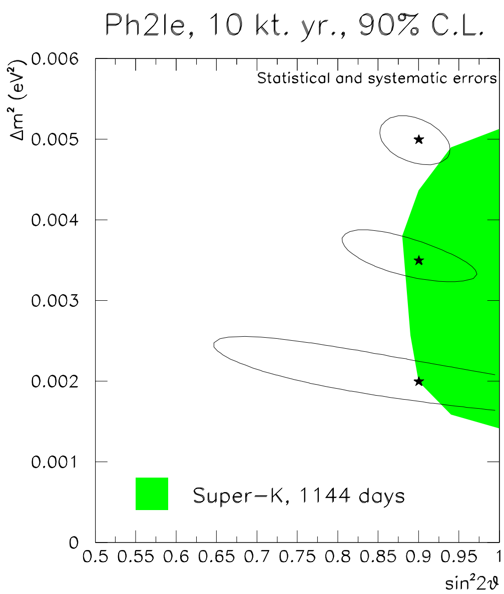

Fig. 2. Expected Δm^2 and $\sin^2 2\theta$ sensitivity for a 10 kton-year exposure with the low energy beam.

References

[1] Y. Fukuda et al., Phys. Rev. Lett. 81 1562 (1998).
S. Fukuda et al., Phys. Rev. Lett. 86 5656 (2001).
Q. R. Ahmad et al., Phys. Rev. Lett 87 071301 (2001).

[2] T. Toshito for the Super-K Collaboration, hep-ex/0103033.

[3] M. Apollonio et al., Phys. Lett. B466 415 (1999).