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THE MiniBooNE EXPERIMENT

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ABSTRACT

MiniBooNE is an experiment designed to provide a definitive test for the $\overline{\nu}_\mu \rightarrow \overline{\nu}_e$ oscillations signal seen by LSND. Here, a brief summary of the MiniBooNE goals and strategies is presented, as well as some highlights of its current status.

1 Introduction

The LSND oscillations signal [1] (event excess of 3.8 σ significance) requires a squared neutrino mass difference of the order of 0.3 - 3 eV^2. This is inconsistent with the three neutrino picture of the Standard Model (SM) when the oscillation evidence from solar and atmospheric neutrinos [4] is taken into account. MiniBooNE's primary goal is to confirm or refute the oscillations interpretation of the LSND $\overline{\nu}_e$ excess.

2 MiniBooNE neutrinos and detector overview

The neutrino beam [1] is produced from the decay of charged mesons that are created when protons from the Fermilab Booster (8.0 GeV kinetic energy) impact a 1.7 interaction length Be target. The target is placed inside a focusing horn whose polarity can be set to run in either ν or $\overline{\nu}$ mode. Currently the experiment runs in

[1] For more details see Ref.[2] and references therein

ν mode, and the horn increases the neutrino flux at the detector by a factor of ~ 5. The detector is a 12 m diameter sphere filled with mineral oil (hydrocarbon chain). Its interior is covered [2] by 1280 PMT's that gather the light produced by processes inside the tank. It is surrounded by an optically isolated veto region designed to tag cosmic rays with 240 PMT's . The transparent medium of the oil makes it primarily a Cerenkov detector, although an important component of scintillation light is present in any occuring process. The charge and time response of the tank PMT's is monitored continuously with a laser system. The energy scale of electron-type events is calibrated using the spectrum of Michel electrons. We use cosmic ray muons to determine the energy scale for muon-type events. The positions and angles of the incoming cosmic rays are measured with a tracking hodoscope situated above the detector and the stopping point is determined with a system of 7 scintillating cubes located throughout the detector.

3 Analysis status

MiniBooNE is presently studying [3] three processes that will be used to tune the detector Monte Carlo and the reconstruction algorithms: ν_μ charged current quasi-elastic (CCQE) events which will be used to determine the incoming neutrino flux; neutral current (NC) π^0 production which will account for the largest ν_μ misidentification background to the oscillation signal; and NC ν_μ elastic scattering which can be used to study the optical properties of the oil. The $\nu_\mu \to \nu_e$ oscillation analysis is a blind analysis and, as such, we have not yet looked for ν_e events. However, recent studies [2] show that with 1×10^{21} protons on target (P.O.T.) approximately 300 signal events are expected for LSND-like oscillations, as well as about 434 misidentified ν_μ interactions (dominated by $\sim$ 294 NC π^0 production), and about 346 intrinsic ν_e background events. Figure 1 shows the updated sensitivity and measurement capability for this number of protons.

4 Conclusion

The MiniBooNE experiment can definitively confirm or refute the LSND oscillation signal with 1×10^{21} P.O.T. Currently, 30% of this amount has been collected. The collaboration is presently working on the analysis of ν_μ CCQE, NC π^0's and NC elastic scattering. The $\nu_\mu \to \nu_e$ analysis is expected to produce first results in 2005.

[2] 10% photocathode coverage.

[3] For a detailed analysis update see Ref.[3]. Plots shown in the poster are included therein.

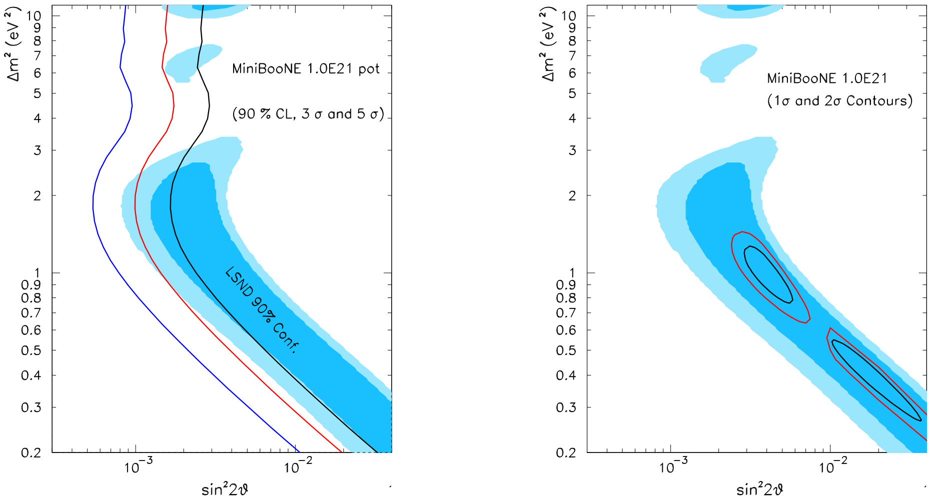

Figure 1: *Left: MiniBooNE* $\nu_\mu \to \nu_e$ *oscillation sensitiviy at 90% C.L., 3*σ*, and 5*σ *compared to the LSND allowed region. Right: MiniBooNE* $\nu_\mu \to \nu_e$ *parameter measurement capability at 1*σ *and 2*σ *for high and low* Δm^2*.*

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