VIII. Summary

We have presented a proposal for a multi-detector long baseline neutrino oscillation experiment at the BNL AGS. The experiment will search for oscillations in the ν_μ disappearance channel and the $\nu_\mu \leftrightarrow \nu_e$ appearance channel by means of four identical neutrino detectors located 1, 3, 24, and 68km from the AGS neutrino source. Observed depletion of the ν_μ flux in the far detectors not attended by an observed proportional increase of the ν_e flux in those detectors will be *prima facie* evidence for the oscillation channel $\nu_\mu \leftrightarrow \nu_\tau$. The experiment is directed toward exploration of the region of the neutrino oscillation parameters Δm^2 and $\sin^2 2\theta$, suggested by the Kamiokande and IMB deep underground detectors but it will also explore a region more than two orders of magnitude larger than that of previous accelerator experiments.

The experiment is designed to capitalize on the advantages of the AGS: high proton beam intensity (currently the AGS can provide 6×10^{13} per pulse every 1.6 sec) yielding a correspondingly high intensity, low energy, pure (ν_e/ν_μ flux ratio of 10^{-2}) muon neutrino beam, and the narrow time-structure (20-30 ns wide 8 bunches per pulse) of the fast extracted proton beam to permit the detectors to be located on the earth's surface.

A key aspect of the experimental design involves placing the detectors 1.5 degrees off the center line of the neutrino beam, which has the important advantage that the central value of the neutrino energy ($\approx$ 1 GeV) and the beam spectral shape are, to a good approximation, the same in all four detectors. Another significant advantage of the 1.5 degree beam is that the low energy ($\approx$ 1 GeV) flux is increased while the higher energy flux is decreased relative to the flux in the zero degree beam. This appreciably diminishes the rate of inelastic neutrino interactions with respect to the dominant quasielastic interactions that constitute the signals of the experiment.

The proposed detectors are massive, imaging, water Cherenkov detectors similar in large part to the Kamiokande and IMB detectors. Our design has profited from their decade-long experience, and from the detector designs of the forthcoming SNO and SuperKamiokande detectors.

An important principle in the design of the experiment has been to provide detailed, precise, and redundant control of possible systematic errors. This accounts for the requirement of four identical detectors, and their relative spacing, which yields data of high statistical quality in the upstream detectors with which to study the neutrino beam properties and the response of the massive, large volume detectors. This ensures proper understanding of the response of the far detectors and correct high precision predictions of the fluxes reaching the far detectors in the absence of oscillations. To this end, the ratio $QE(\mu)/NC(\pi^0)$ is also measured in each of the four detectors to provide an essentially independent search for oscillations in the ν_μ disappearance channel, as well as in the channel $\nu_\mu \leftrightarrow \nu_{(sterile)}$.

The experiment will run in a mode new to BNL. It will receive the fast extracted proton beam on the neutrino target approximately 20 hours per day when the AGS is not filling RHIC.

The experiment will evolve in a continuous fashion, dictated by the rates at which construction and funding are likely to proceed. The detectors will be built in the sequence D3, D24, D68, and the fourth detector at D1. this permits operation as soon as each detector is completed, and makes possible the extraction of significant oscillation results from D3 and D24 early in calendar 1999. All four tanks would be in operation one year later.

A cost and schedule document (CDR) has been submitted to the DOE which provides the basis for the total project cost and schedule. This schedule is funding driven and might be advanced by a half year with an improved funding profile.

The new neutrino beam facility necessary for the oscillation search would make possible other unique neutrino scattering experiments of fundamental importance. The motivation for one such experiment is briefly discussed.