

FERMILAB TEVATRON MUON-NEUTRINO WORKSHOP

T. B. Kirk and J. Peoples

Ideas! Big fat fuzzy ones! Long skinny shiny ones! Ideas of every kind flew through the air of the Fermilab auditorium (cafeteria, atrium, etc.) for the four-day period of the Fermilab Muon-Neutrino Workshop, held in January in the auditorium. The occasion was the first public discussion of the plans of Fermilab scientific users and staff for the physics and facilities that could happen with the advent of the Tevatron project.

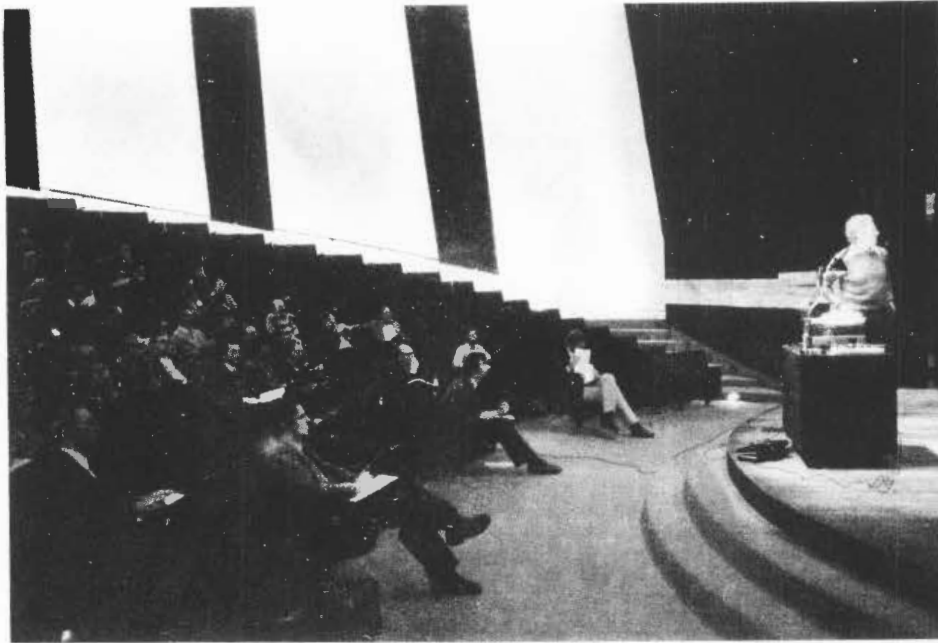
Tom Kirk, currently on leave from his position as head of the Neutrino Department, organized the workshop and will assemble materials to sort out what happened there. He reports that it was a very successful enterprise. More than 200 scientists attended, many journeying from as far away as Europe, Russia, and Japan to discuss the coming era of 1 TeV lepton physics.

Many of the scientists attending the workshop also spoke to the assembly. Each had ideas for making Fermilab's new high-energy frontier a source for exciting new experiments. On the first day of the workshop Horst Wachsmuth, on leave from CERN and presently in residence at the University of Wisconsin at Madison, unveiled ideas for a new bubble chamber optimized for neutrino physics at Tevatron energies. The proposed new chamber would be smaller than Fermilab's existing 15-foot bubble chamber, having a volume of only  $10 \text{ m}^3$ . It would be nearly completely surrounded by electronic detectors for particle type and momentum measurement. The new chamber would be optimized for neutrino physics but could also function as a visible target spectrometer for hadron physics.

Vincent Peterson (University of Hawaii), who organized the bubble-chamber presentations, praised Wachsmuth's ideas and reported enthusiastic support among his fellow bubble-chamber colleagues. Among these we found Toshio Kitagaki (Tohoku University), head of a large experimental group in Japan, who also spoke to the workshop attendees on neutrino physics with a bubble-chamber detector.

On the second day, Neutrino Department physicists Tom Kirk, Ray Stefanski, Dennis Theriot, and Jim Walker presented construction plans and beam designs developed in their department which will make the new experiments possible. These presentations followed a welcome to the workshop by Leon Lederman, who brought to the workshop the welcome news that the U. S. Department of Energy has indicated that they will support the second phase of the Tevatron program, the part that would support the beams and experiments under discussion at the workshop.

After Lederman's comment, John Peoples, Research Division Head, outlined the time schedule for bringing on the Tevatron



Leon Lederman speaking at the Tevatron Muon-Neutrino Workshop.

(Photograph by Fermilab Photo Unit)

program. His schedule called for extraction of the Tevatron beam to the first experiments in 1982 with the program hitting its full stride in 1983-84 with completion of a new 750-GeV muon beam and other large-scale projects.

Then the experiments took over! First came a pair of talks devoted to new ways of detecting particle collisions and showers. William Carithers (LBL) explained his recent very interesting experiments on limited Geiger mode gas discharges and Mikhail Kubantsev (ITEP Moscow) described a design effort and preliminary tests for a 100-ton high-pressure argon gas detector for neutrino physics.

Enthusiasm for the new high energy-high intensity muon beam was very marked as eleven speakers extolled the virtues of high-precision experiments, experiments that may have the best chance to measure accurately parameters of the leading candidate theory of strong interactions (QCD) and the best weak-interaction theory (Weinberg-Salam). The gains to be made at Fermilab with the new muon beam are probably the most dramatic that we will see, because it is here that the improvement over existing facilities is greatest.

Pamela Surko of Princeton University showed how the natural polarization of the beam muons can be exploited to make a critical test of the Weinberg-Salam theory. Her ideas would make use of an existing Fermilab apparatus, the multimoon spectrometer, in an effective new way.

The remaining experimenters explored the opportunities for neutrino physics as it will be extended with the Tevatron. Frank Taylor (NIU), Frank Sciulli (Cal Tech), and Jack Steinberger (CERN) led their groups in presenting neutrino scattering plans for the 1980's. The plans presented concentrated on capabilities of existing neutrino detectors for the new energy regime and on the rewards that higher energy will bring.

Among the topics that will benefit from Tevatron neutrino beams are continued study of nucleon structure functions with comparison to QCD and study of multimoon events as a probe of heavy quark production. A field of study that should benefit significantly from the higher energies is the study of neutrino-electron elastic scattering.

A special category of neutrino experiments discussed on the last day of the workshop involves the flux of prompt neutrinos that come streaming from a beam dump placed ahead of the experiments, in which the primary proton beam is buried. Unfortunately, a muon or electron is born with each neutrino and the muons must be eliminated before the neutrinos can be used for experiments. Mike Peters (Hawaii) gave a useful talk on the tools for calculating an appropriate muon shield and both he and Richard Fine (Columbia) explained how such a shield might be constructed using magnets from the retiring Argonne ZGS accelerator.

A highlight of the workshop was provided by Stephen Adler of Princeton University who spoke on his recent theoretical investigations into the dynamical interactions of subquark particles that might be the ultimate form of matter. Very interesting and helpful talks were given by two other theorists, Mike Barnett (SLAC) and Robert Shrock (SUNY at Stony Brook), who directed their attention to the practical details of comparison of theory to experiment. Barnett reviewed the impact that Tevatron experiments could have on QCD and Shrock analyzed methods for measuring the scattering of tau neutrinos.

Now that the workshop is over, we can draw some conclusions. First, we believe there is a high level of user interest in lepton physics with the Tevatron (more than 200 users were present at the workshop). Second, it appears that there are comparable levels of interest in both muon and neutrino experiments.

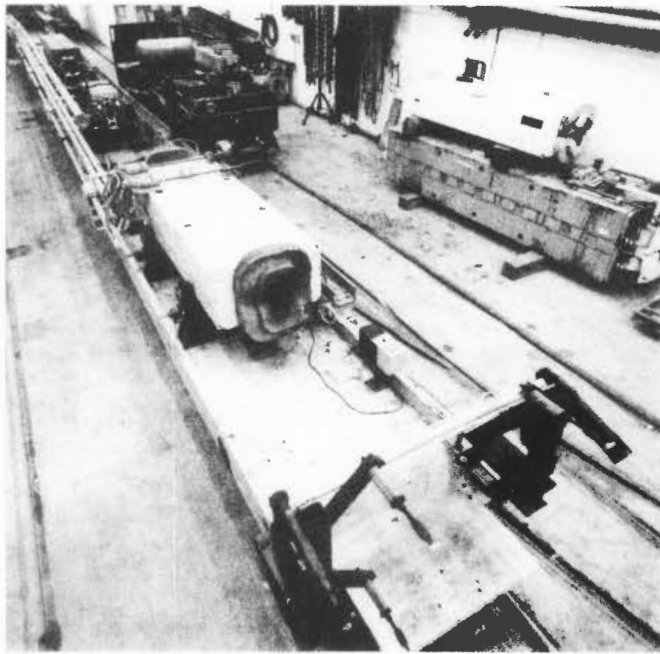
One of the main purposes of the workshop was to solicit reactions from users to the Laboratory plans for development of the areas. The discussions did result in useful feedback, most importantly in the interest shown in the beam-dump facility.

The request of the Laboratory to receive Tevatron neutrino and muon proposals by April 25, 1980, is sound, given the interest of physicists in these experiments as well as the likelihood of support for the program from the Department of Energy. The Physics Advisory Committee is scheduled to hear presentations of the proposals on May 15th and 16, 1980. The PAC will then discuss the proposals at its June meeting. Because of the expected complexity of the proposals the PAC is not likely to be able to reach a decision on all these proposals at this meeting. Leon Lederman is considering the appointment of **ad hoc** committees to study major proposals where that seems desirable. The Committee's reports would be available for consideration by the PAC at its meeting in the fall of 1980. Following that meeting, the Director expects to approve additional proposals. Fermilab will also welcome proposals for Tevatron neutrino and muon experiments that are not ready by the April 25 deadline. An inability to have a proposal ready by April 25 will not preclude doing a neutrino or muon experiment in the early days of Tevatron operation. But, real estate is limited and late proposals may meet delays or suffer the requirement of a higher level of originality.



Vincent Peterson, University of Hawaii, addresses a session at the Workshop (see page 1). (Photograph by Fermilab Photo Unit).

Users who are interested in preparing proposals for the Tevatron are encouraged to contact Shigeki Mori for the latest information on beams and facilities that are expected to be available at the Tevatron. Users who wish to comment on the plans of the Neutrino Department, as presented at the workshop, are also encouraged to contact Shigeki Mori.



Neutrino triplet train, partially disassembled.  
(Photograph by Fermilab Photo Unit)