MEGA

J.E. Knott, K.M. Stantz, and J.J. Szymanski
Indiana University Cyclotron Facility, Bloomington, Indiana 47408

We have continued a strong commitment to the MEGA experiment at LAMPF. In previous years, the IUCF group has built substantial portions of the hardware for the first- and second-level trigger systems. The hardware was installed in spring, 1992 and successfully ran during the late June through mid-October data-taking run. During the run our group not only maintained the hardware we built, but installed and debugged all of the other trigger hardware as well. In addition, we played a large role in the day-to-day running of the experiment.

Our hardware obligations now consist of simply maintaining the trigger system, so we have moved into other areas of responsibilities on the experiment. We have responsibility for analysis tasks (target location, scalers and inner-bremstrahlung data) and one of us (KMS) has taken over the modifications, installation and debugging of the positron chamber readout electronics.

We are also now playing a role in the third-level (software) trigger. We submitted a proposal to the NSF in March, 1992 for funding to upgrade the computing power available for the third-level trigger. This proposal was accepted, and we have been purchasing upgrades to our existing DECstation 5000-200 workstation farm. The farm will consist of 7 DECstation 5000-200 workstations and a single 5000-200. All of the parts for this farm are on order, and we expect the fully configured workstation farm up and working by the July, 1993 run.

The summer, 1992 data-taking run marked the first time that enough of the MEGA detector was installed so that physics data could be taken. All of the positron detectors were in place and, except for a broken wire in one of the eight MWPC's, worked well. Two of the three photon-pair spectrometers were in place. Many different calibration and test runs were taken to commission the detector. For example, extensive cosmic-ray events were taken to calibrate and debug the detector. A sample event is shown in Fig. 1.

Most of the summer's run was dedicated to the $\mu \rightarrow e\gamma$ search. A combination of factors limited the data rates below the design values. We were limited by computing power in the third-level trigger, no second-level trigger hardware and rate capability in the positron MWPC readout electronics. All of these systems are being improved for 1993, when we expect to take data that will improve the world limit for the decay $\mu \rightarrow e\gamma$.

A portion of the summer's run was used to measure the Michel ρ parameter, which describes the energy spectrum of positrons emitted in muon decay. Our present data set should improve the measurement precision of this parameter by a factor of 3. The ρ parameter is sensitive to non-V-A terms in the weak interaction; for the left-right symmetric model, the ρ parameter sets a limit on the mixing angle between left- and right-handed W bosons.

The ρ-parameter measurement is done by precisely measuring the shape of the positron energy spectrum from muon decay. Events of the type shown in Fig. 2 are used to measure the positron energy. The positrons make helical tracks through cylindrical

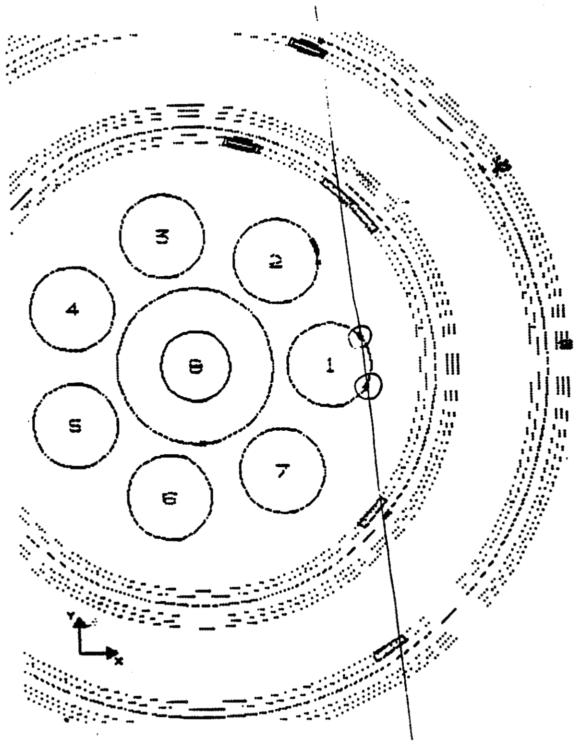

Figure 1. A sample cosmic ray event. The rectangles are hit scintillators and the x's mark MWPC hits on the inner, cylindrical chambers. This is an end view.

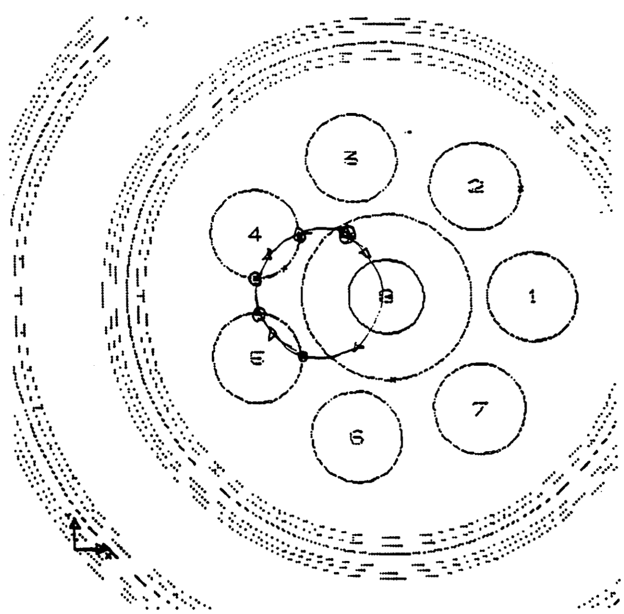

Figure 2. An event where a muon decayed into a positron and two neutrinos. This is the end view of a helical track produced by a positron passing through cylindrical MWPC's contained within a magnetic field.

MWPC's contained within a 15-kG magnetic field. An end view of such a track is shown in Fig. 2. The positrons will make 0,1,2,3 or more 360° revolutions before striking a scintillator and stopping in a lead shield. The dip angle is the angle between the positron track and a plane perpendicular to the field direction. Fig. 3, which is a plot of positron energy versus the dip angle, shows the effect of this varying number of revolutions. The positron energy has a sharp cutoff at 52.8 MeV, as expected from the kinematics of the $\mu^+ \to e^+\nu_e\overline{\nu}_\mu$ decay. Tracks going through the fewest revolutions have the largest dip angles. There are more events seen at negative dip angles because the incoming muon beam is polarized; our field retains the muon polarization after the muon stops and the decay $\mu^+ \to e^+\nu_e\overline{\nu}_\mu$ is strongly parity-violating.

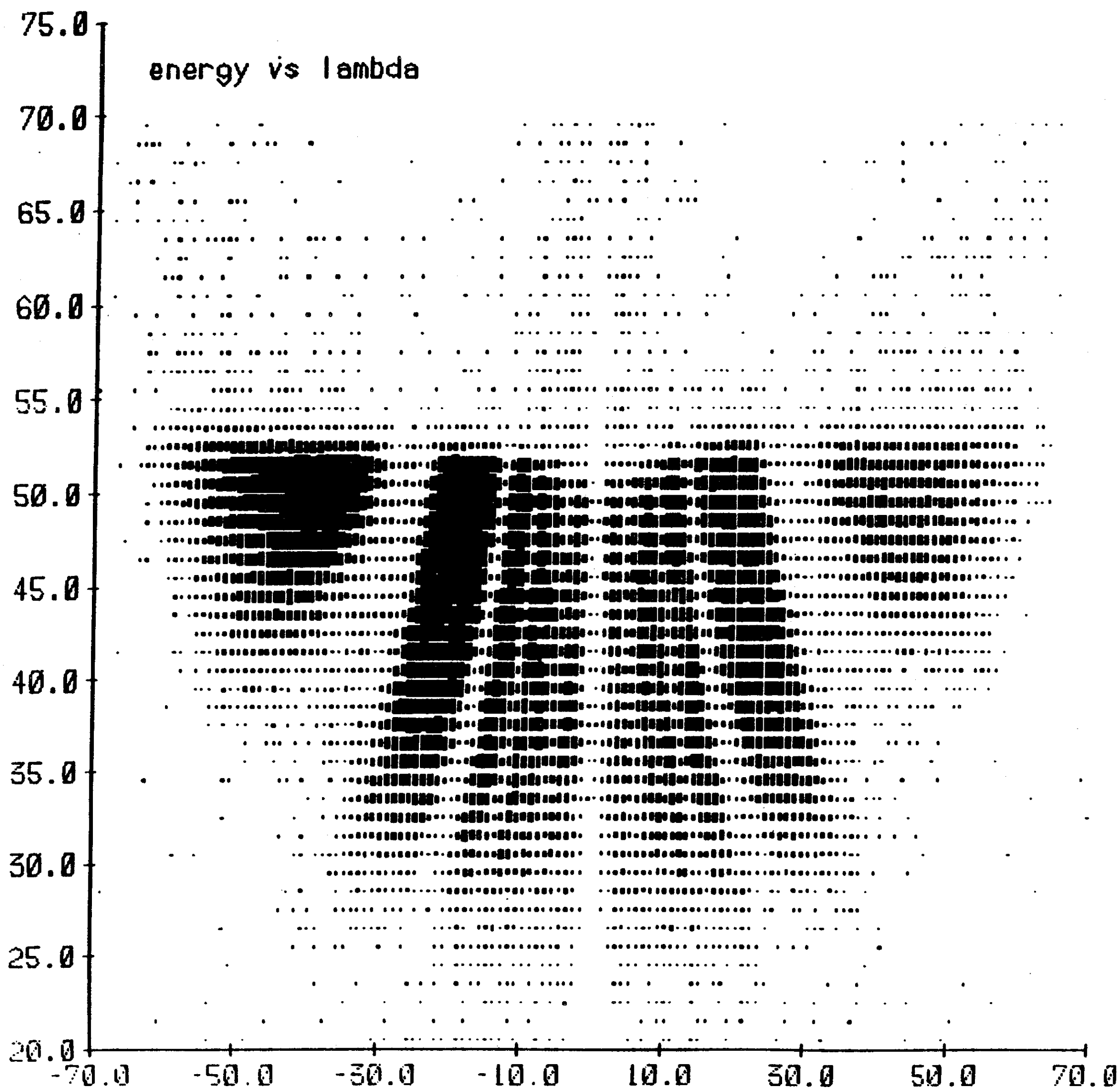

Figure 3. Plot of positron energy versus dip angle (lambda).

Analysis of the ρ-parameter data set and the $\mu \rightarrow e\gamma$ data set are proceeding. More $\mu \rightarrow e\gamma$ search data will be taken in 1993. The $\mu \rightarrow e\gamma$ search using the 1993 data will serve as a thesis for IUCF graduate student Keith Stantz.

The MEGA Collaboration consists of the following member institutions: UCLA, U. of Chicago, Fermilab, Hampton U., U. of Houston, Indiana U., Princeton, Los Alamos National Laboratory, Stanford U., Texas A&M U., U. of Virginia, Virginia Polytechnical Inst. and State U., U. of Wyoming, and Yale U.