STRAWMAN DETECTOR

The relatively low energy of the muon storge ring impacts the design of any near detector in two ways through event kinematics and beam structure.

Event kinematics of charged current neutrino interactions at tens of GeV produce low energy particles at large angles as seen in Fig.1. This dictates that the detector have a magnetic tracking system to measure the momentum of charged particles produced at almost any angle with respect to the beam.

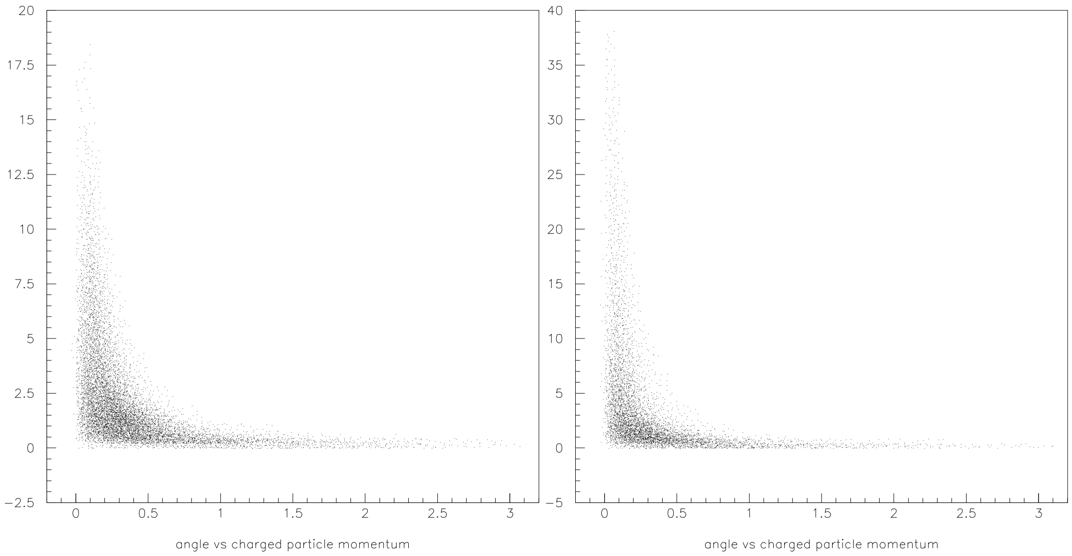

FIG. 1. Angle (in radians) vs. momentum of charged particles produced in charged current muon neutrino interactions at a 25 Gev (left) and a 50 GeV (right) neutrino factory.

The divergence of the neutrino beam at these energies is also an important factor in detector design. As seen in Fig.2, because of the width of the beam, even at 50m from the end of the storage ring any dense components of the detector near the center of the beam could be a source of background in the detector.

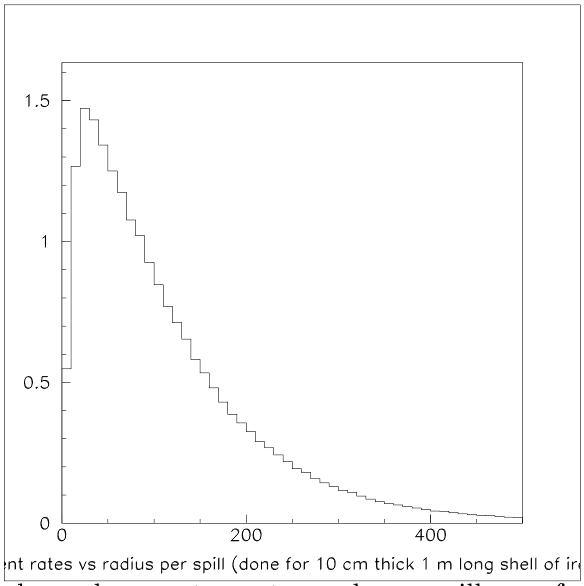

FIG. 2. The number of charged current events per beam spill as a function of radius in a 10cm thick cylidrical shell 1m long 50m from the end of a 600m long straight section.

In order to achieve a better resolution on the hadronic energy of the neutrino events detector systems such as calorimeters and magnet coils and return yolk should be several meters away from the beam axsis. However this presents another problem. Electromagnetic and hadronic calorimeters are the only way to measure the energy of the neutral particles produced in an event (see Fig. 3), so in order to detect all of the hadronic shower energy in an event, calorimeters will have to be used close to the beam axis.

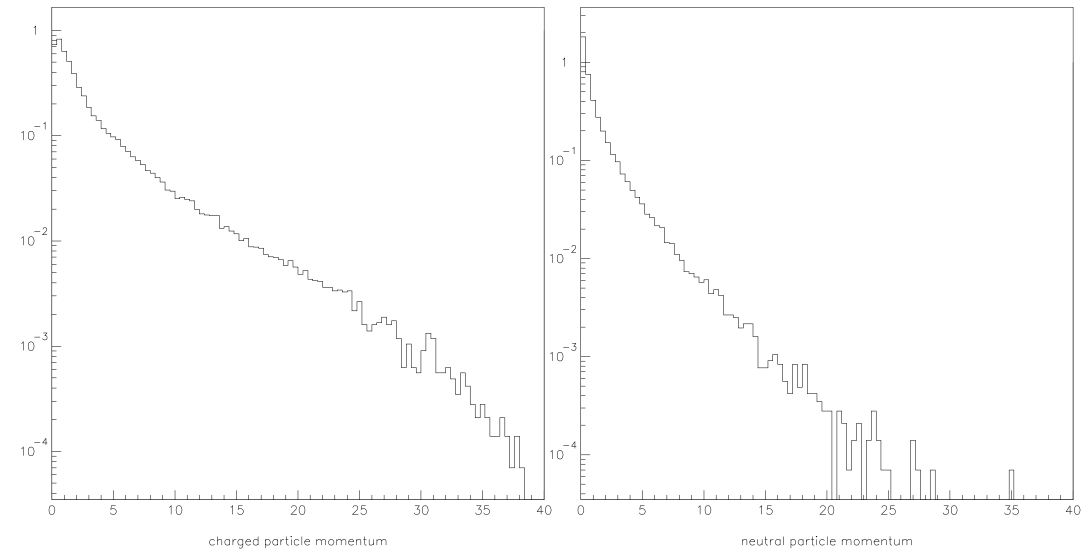

FIG. 3. Normalized momentum distribution of charged particles (left) and neutral particles (right) produced in charged current muon neutrino interactions at a 50 GeV neutrino factory.