LOW-COST HIGH-QUALITY $\nu$ BEAM

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We are proposing that rather than using a large block of steel to stop the $\mu$'s in a $\nu$ beam another approach should be used. The essential points of this technique are:

1. Use a pair of quads ($Q_1, Q_2$), a collimator, and a plug to stop all pions except in the range $30 \pm 8 \text{ GeV/c}$ (or $60 \pm 15 \text{ GeV/c}$).

2. Use a pair of quads ($Q_3, Q_4$) to focus these $\pi$'s so that they remain in a 1-ft by 1-ft pipe. (38 GeV/c are parallel, 30 GeV/c focus at $\pi$-stop, 22 GeV/c focus at 1/2 way to $\pi$-stop)

3. Use two bending magnets (#1 and #2) to put a 3-ft transverse displacement in the beam. This sets the polarity of the $\pi$ beam. It also removes any 150 GeV/c $\mu$'s made before the high-momentum $\pi$'s stop in the plug.

4. The $\pi$'s decay in a 600-m pipe which is very narrow (2 ft by 1 ft).

5. The $\mu$'s from these decays are either:
   a) stopped in the 600 m of earth surrounding the pipe
   b) deflected past the detector by the small-aperture bending magnet which has a larger aperture than the decay pipe.

This has somewhat less intensity than a "steel-block" beam, but has the following advantages:
(1) low cost (less than $2 million).

(2) monochromatic.

(3) high quality--the transverse position of the origin of the $v$ is known to ±1 ft. Therefore, the angle of the $v$ is known to ±0.001 rad at worst.

(4) more flexibility--easier to change if unexpected problems occur.

(5) the smaller transverse position of the $v$ origin allows a smaller transverse area of the detector. This gives more interactions for the same detector weight.
Fig. 1. Low-cost high-quality neutrino beam: pions of one sign at 30±8 GeV/c decay in a small buried pipe. The central energy can be varied.