Fermilab

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NEUTRINO DECAY PIPE TRIPLET

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Compatibility of Muon and Neutrino Beams: In the interest of finding a compatible mode for muon and neutrino beam operation, we propose a solution that could be implemented when the muon program runs slow spill while the neutrino program runs fast spill with the broad band horn beam. Our solution requires (a) the installation of three quadrupole enclosures in the decay pipe of the N0 line; (b) the design of laminated quadrupoles with 36" apertures and field gradients of 1 Kg./in (or 18 Kg at the pole tip); and (c) the development of trim magnets with a 36" gap.

To use the broad band neutrino focusing horns effectively, the proposed quadrupoles will have to match the aperture of the present decay pipe. This demands that they have an inner diameter of 36". For this aperture, our solution requires less than 18 Kg at the pole tip of the quadrupoles at 300 GeV/c operation - a requirement that could be met using conventional magnets. If one wishes to operate the line at higher energies, either more quadrupoles will be required than proposed or superconducting quadrupoles capable of fields of 40 Kg at the pole tip will have to be designed.

It is imagined that the quadrupoles will be energized for the slow spill cycle to be used to focus the muon beam into Enclosure 100. They will then be ramped down to zero field to be compatible with the neutrino beam requirements during fast spill. When the horn pulses to focus the neutrino beam pions and kaons, it is expected that the quadrupoles will be completely off. To allow this slow/fast operation, the quadrupoles will have to be laminated and their power supplies will have to be capable of driving them to zero field in times of the order of 0.1 seconds.

The method for the dumping of the proton beam involves the additional installation of a dipole of 36" aperture with a $\int B.d\ell$ of 50 Kg-ft in the last of the 3 quadrupole enclosures. This allows

the muon beam to be bent to the side port of the decay pipe, separating it from the higher energy protons. This method also allows the transport of hadrons into Enclosure 100, and subsequently down the muon line. Since trim magnets of 36" aperture of $\int B.d\ell$ of 20 Kg-ft will be required to center the muon beam both vertically and horizontally on the N1 line, the larger bend horizontally is not a major additional requirement. The trim magnets will have to be ramped as well, of course.

Optics of the Decay Pipe Triplet: The muon line up to Enclosure 100 will consist of the following elements (the field gradients are for a 300 GeV/c muon beam):

12" target on the neutrino horn train
200' drift space (target tube and horn train)
0Q1 - 4 36Q5's at 0.86451 Kg/in (focusing horizontally)
150' drift space
0Q2 - 4 36Q5's at -0.93316 Kg/in (focusing vertically)
150' drift space
0Q3 - 3 36Q5's at .73459 Kg/in (focusing horizontally)
0H0 horizontal trim
0V0 vertical trim

The optics and the beam envelopes are illustrated in Fig. 1 and Fig. 2. Fig. 3 illustrates the proposed physical layout of the enclosures.

The acceptance for pions by the system is 5 mr x 2.5 mr. This should be compared to the present triplet train acceptance - 2. mr x 2. mr at 150-300 GeV/c operation; and 3. mr x 3. mr at 50 GeV/c operation. The magnification obtained at the end of the decay pipe is $|M_x| \approx |M_y| \approx 2.5$. Again this should be compared to the present triplet train which has magnifications $|M_x| \approx |M_y| \approx .5$. Thus, the set of proposed quadrupole enclosures eliminates the necessity of the triplet train entirely.

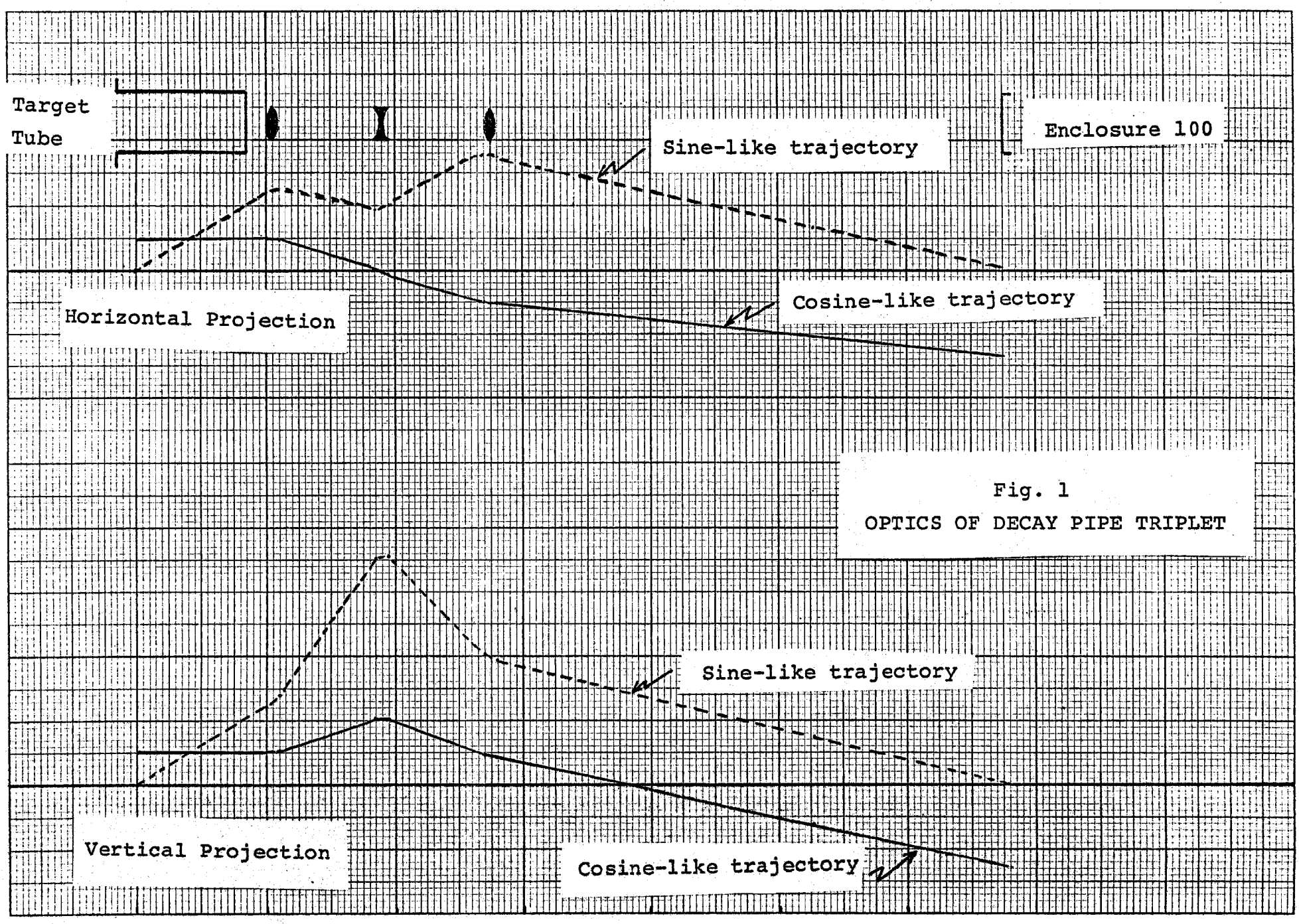


Fig. 1
OPTICS OF DECAY PIPE TRIPLET

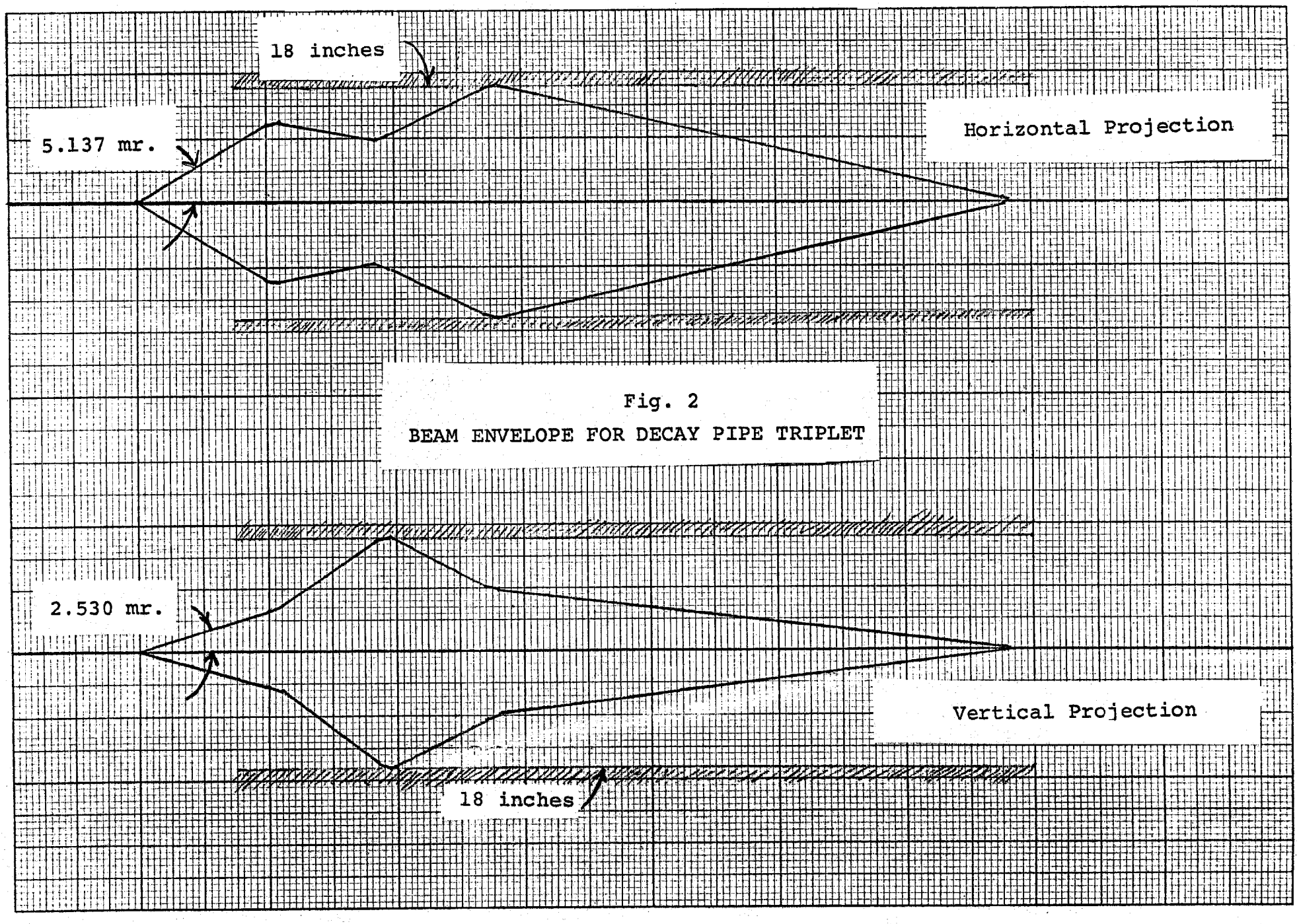
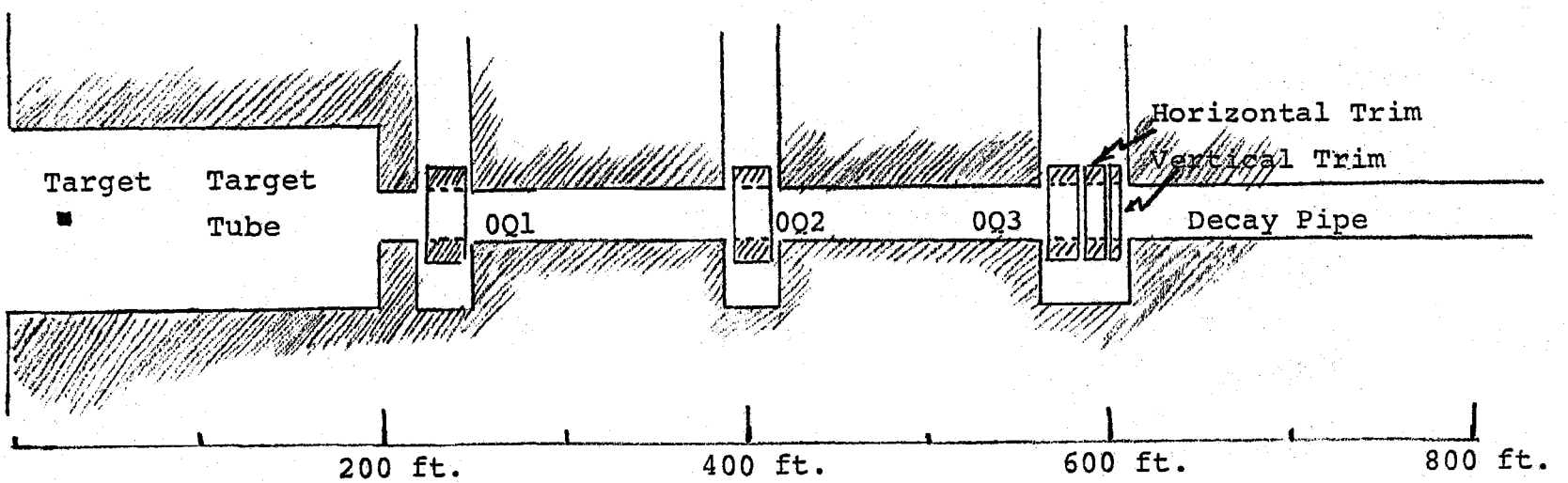


Fig. 2

BEAM ENVELOPE FOR DECAY PIPE TRIPLET



SCHEMATIC OF NEUTRINO DECAY PIPE TRIPLET

Fig. 3