EXPECTED NEUTRINO FLUX FROM "ENHANCED NEUTRINO BEAM"

Since the proposal for the enhanced neutrino beam (ref. 1,2) was made, various estimations of the neutrino flux to be expected were produced.

The present curves (fig. 1) show the most recent results of computations, based for the first time upon reasonably reliable production spectra for pions and K's.

The following points should be noted:

1. The curves give the flux per circulating proton, in the centre of the neutrino blockhouse, i.e. between the future positions of bubble chamber and spark chamber respectively.

   For the centre of the bubble chamber the flux will be about 20 o/o higher, in the spark chamber 20 o/o lower.

2. A decay length as existing at present was assumed. If (by the use of steel screening) the decay path will be increased by 10 m, the flux will go up by about 40 o/o.

3. The efficiency of ejection and transport of the proton beam was supposed to be 90 o/o.

4. Production spectra for pions were taken from the recent $N_4$- experiment (not yet published) and from the Brookhaven measurements (ref. 3). A good agreement between these two sources exists. For large production angles, some figures from ref. (5) were used. The data are based upon measurements with protons of 20 GeV/c and Be or Al targets, In the tungsten target of the horn the spectra may be somewhat different.

5. For establishing similar production spectra for $K^+$, the ratios $K^+/\pi^+$ found by various experimenters at different angles and momentum values were combined. Large discrepancies were found to exist between data of ref. (3), (4), (5) and (6). More weight was given to the most recent recent measurements and more or less smooth spectra were drawn. There is no obvious reason to believe that these are precise to better than 50 o/o.
It was supposed that 58 o/o of the $K^+$ decay into $\mu^+ + \nu$; other decay modes were disregarded.

6. The curves are given for various excitation currents of the focusing horn. The maximum current is 300 kA.

7. Through absorption of secondary particles in the target and in the material of the horn, a loss of 20 o/o was assumed. From some recent calculations it seems that this may be too optimistic. This factor can only be established in the proper way by writing a new computer programme, which will be done in the near future.

8. Multiple scattering in the walls of the horn was neglected. This is reasonable, because the scattering angles are still small compared with the half - angle of the neutrino beam.

9. All pions were supposed to decay in the middle of the decay path. For the K's, a suitable correction was made because of their small decay length.

In view of all approximations made, absolute flux values are believed not to be reliable to better than a factor 2.

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References

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2) S. van der Meer - B. de Raad - Proposal for an enhanced neutrino beam, NPA/Int. 61-3

3) W.F. Baker et al. - Particle production by 10 - 30 BeV protons incident on Al and Be, Phys. Rev. Letters 7, 101, 1961

4) W.A. Cooper et al. - Low energy particles from the CERN-PS, CERN 62-19.

5) G. Cocconi - Progress report on work with the 25 GeV proton synchrotron Proc. 1960 Rochester Conf., p. 799

Unfortunately, there is a mistake in the drawing belonging to this report. All intensities should be a factor 2.5 higher than shown.

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Fig. 1

Neutrinos from $\pi \rightarrow \mu + \nu$ and from $K^+ \rightarrow \mu^+ + \nu$. 

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