MUON ATTENUATION IN THE NEW NEUTRINO FILTER

- Preliminary Results -

1. Introduction

An array of channels provided in the new neutrino filter (fig. 1) in which detectors of various types can be placed allows an indirect determination of the neutrino spectrum. This is achieved by measuring the longitudinal and radial muon flux distributions. This report presents the results of two pre-runs during which the muon attenuation has been measured with scintillation counters, the other detectors (Corenstrov detectors and ionization chambers) being under test. The aim of these measurements was the optimization of the neutrino filter length with respect to the complementary requirements of the H.L.B.C. and spark chamber neutrino experiments.

2. Detectors

Plastic scintillators of 2, 4, 40, 400 and 2400 cm$^2$ surface have been used in places of appropriate muon intensity. In addition the counting rates of scintillators of 2.4 cm$^2$ and 0.8 cm$^2$ (3, 12 resp., fig. 1) have been available from the spark chamber group, as well as the H.L.B.C. photographs obtained during parts of the runs.

3. Attenuation results

Measurements have been made with 5 ejected bunches. The proton intensity was measured with a beam current transformer placed immediately in front of the target. The average proton intensities per pulse were $1.3 \times 10^{11}$ and $1.6 \times 10^{11}$ in the 1 and 2 runs respectively. During both runs the magnetic horn was focusing positive particles. Fig. 2 shows the muon intensities on axis as a function of depth at 17.0, 19.2 and 20.3 GeV/c proton momentum, obtained with a copper target of 10 mm diameter and 64 cm length. Fig. 3 shows the corresponding results of the second run (at 16.0, 19.2, and 20.3 GeV/c proton momentum) obtained with a copper target of 4 mm diameter.
64 cm length. The relative efficiencies of the two targets have been determined at 19.2 GeV/c (cf. section 4). Fig. 4 shows the radial flux distribution at 19.2 GeV/c in channel ZE 50 and 52 under various conditions. The flux intensities on axis have been obtained by extrapolation from these distributions.

4. Target effects

Measurements have been made at 19.2 GeV/c with the following targets:

Cu 4 mm diameter 64 cm length
Cu 10 mm " " "
Cu 4 mm " " " +14 cm W
BeO 4 mm " 75 cm length
(in an aluminium tube of 0.5 mm wall thickness)

The results are included in fig. 4 from which one can see that:

1) The 4 mm copper target is more efficient than the 10 mm copper target; this indicates that the proton beam is essentially less than 4 /mu in diameter.

2) A tungsten stopper behind the target only slightly reduced the flux of high energy muons in the forward direction.

3) Using the BeO target a significant increase in muon intensity was observed in all detectors.

5. Conclusions

In order to meet the requirements for the spark chamber experiment the muon intensity in the AB counter has to be reduced by a factor of 3000 to 5000 for 20.3 GeV/c proton momentum. This can be achieved by adding about 2 m of iron in front of the filter.

The target tests suggest further studies of light target materials.
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Fig 1. Neutrino filter
MEASURED $\mu$ INTENSITY
RUN 2.2.67
FILTER THICKNESS 16.4 m
TARGET 10 mm Cu

Fig. 2
MUON FLUX MEASUREMENTS
RUN 20.257

FILTER THICKNESS 12.4 cm
TARGET: 4 mm Cu + W

\( \mu^- / \text{cm}^2 \text{ proton} \)

16 GeV 19.2 GeV 20.3 GeV
R2 on

0.3 pulse

Fig. 3
RADIAL FLUX DISTRIBUTION IN CHANNELS 30 AND 32