PS/Int. EA 60-15
5th November 1960

THE PLANNING OF A SEARCH FOR NEUTRINO INTERACTIONS.

During recent months a practical experimental procedure has been developed for the 500 litre heavy liquid chamber to search for neutrino interactions near the C.P.S. Counter groups have also been active. This paper gives a detailed planning by which the first experiments can be performed in May 1961.

It is recalled that the only experimental results interpreted as evidence of neutrino interactions give a cross-section of about 6×10^{-44} cm^2 for pile neutrinos. An increase of cross section by a factor of between 10^5 and 10^7 has been variously predicted for the most useful component of the neutrino flux from the C.P.S.

The scientific justification for a preliminary search is that for the present position of our bubble chamber, a neutrino cross section of about 10^{-38} cm^2 and the most favourable operation of the C.P.S., an event rate of about one per 30,000 pulses would be anticipated.

It is expected that the first bubble chamber run would be about 100 hours and that many such runs would be accomplished before the search would be abandoned. If the search is successful a new field of experimental physics will be opened, a discussion of whose implications is not considered necessary at this juncture.

Brief outline of the proposal.

Detailed considerations and calculations which justify the experimental layout are given in the attached report, PS/Int. EA 60-16 and other documents. A résumé of the experimental procedure proposed by our group is as follows:

The bubble chamber will be operated in a region so well shielded that all known background from the secondary beams from the CERN-PS is excluded. Sufficient place for a simultaneous search by means of counters is foreseen.

Calculations show that in principle adequate shielding can be obtained and an engineering study reveals no serious problems, provided adequate attention is paid to the programming of the installation, and the manipulation of apparatus.

The detailed experimental layout is shown in the drawings of EA 60-16. The chamber will be filled with freon 1301 (CF_3Br) and will contain a mass of some 750 Kg. It will operate with a magnetic field of about 20 kG. To economise in film and scanning time by a factor of three each of the three cameras will advance only once per three pulses. The phasing will be cyclic and since the whole chamber will be visible in each picture any confusion from overlapping tracks can be excluded. The background rate is expected to be such as to make the probability of even one track in the chamber per two successive pulses very low.

The correct operation of the bubble chamber under conditions of no tracks will be monitored by two means.

1. On each machine pulse the chamber expansion cycle, the amplitude and timing of the pion flux for the experiment, and the timing of the flash, will be recorded on the film.
2. For a few pulses per thousand, charged particles will be allowed into the chamber by means of a quick opening particle channel, built into the shielding. This channel could consist of a stepped steel tube, which can be either emptied or filled with mercury in a few seconds.

Such a device is also of great importance for the testing of the bubble chamber during the preliminary study of its operating characteristics.

Due to the triple overlap of the bubble chamber pictures, developing and scanning do not present serious problems. Our developing machine can make rolls of film available for scanning in about 1 hour after exposure of the last frame. By May 1961 we shall have four scanning tables in operation. To keep pace with the operation of the bubble chamber it will be necessary to scan at an average rate of about one picture per 40 seconds per table. A frequency below one per thousand of frames with tracks worth examining should be obtained.

We have taken the liberty of imagining that, if approached many of our colleagues both in CERN and in other presently collaborating establishments would help to keep the four scanning tables in continuous operation during an experimental run. By keeping pace with the bubble chamber output, it will be possible to be convinced of the correct functioning of the whole experiment, and if necessary to make minor modifications during the course of the run.

Within four hours of the completion of the first run it will be known whether the scanning has yielded any pictures which require further measurement. Therefore machine time for a second and subsequent runs at intervals of two weeks should be sought simultaneously with the first run.

The space occupied by the present layout does not interfere with the general experimental utilisation of the South Hall. Therefore the normal beam layout of the PS nuclear physics programme may be left in place. Other experiments will be able to resume operation quickly at the end of a neutrino run - or in the case of change of the neutrino programme. We hope that it will be possible to devise procedures for simultaneous machine utilisation with two targets flipping at different times.

F. Bisson
J.J. Bleeker
C.Germain
P.G. Innocenti
F. Krienen
G. Kuhn
B. Langeseth
S. van der Meer
D. Neet
G. Pluym
B. de Raad
C.A.Ramm
L. Resegotti
R. Salmeron
R. Tinguely
R.G.P. Voss

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PS/2052