The fact that (1) is a necessary condition for charge independence, no matter what else is assumed about the nucleon-nucleon interaction, suggests the importance of collecting accurate 90° scattering data at the highest possible energies. However, it should be emphasized that (1) is only a necessary condition; indeed, it is known[3] to be difficult to derive charge independent phase shifts which fit the high energy angular distributions if one uses only the customary velocity independent potentials.

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## Nuclear Stars in Emulsions*

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FOR the study of nuclear stars in photographic emulsions, it is highly desirable to have the incoming beam as monoenergetic as possible. In the case of neutrons it is very difficult to meet this requirement. There are a few ways of obtaining neutron beams with a fairly narrow energy spectrum. Namely, degradation of the beam by inserting a hydrogenous absorber or by utilizing the deuteron stripping process. The method we employed in our investigation may be called a "subtraction method." It is based on the following fact: When a beryllium target is bombarded with high energy protons, the emitted neutrons have different spectral distributions at different angles (Fig. 1).[1]

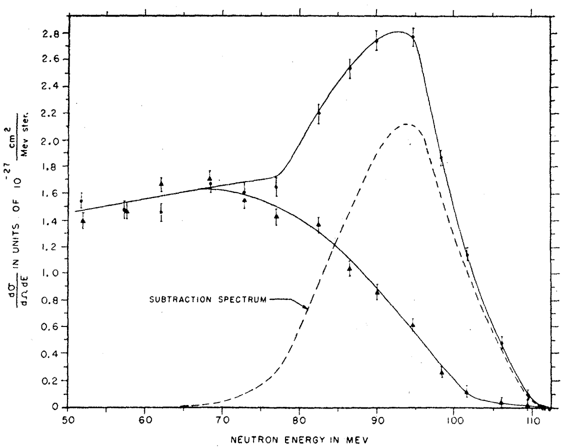


FIG. 1. Neutron spectra from Be. 0°—●; 16°—▲.

From the figure it is evident that the subtraction spectrum exhibits a fairly narrow distribution peaked at about 95 Mev; thus, exposing simultaneously two plates at the two angles, the differences in the results can be attributed to this peak. The experimental set-up was as follows: A $\frac{1}{8}$-inch beryllium target was bombarded with the internal proton beam of the Harvard 95-in. FM-cyclotron. The outgoing neutrons in the 0° and the 14° directions were collimated, and two Ilford Nuclear Plates (G5-200 microns) were exposed simultaneously in "good geometry," subtending the same solid angle at the target. At the same time a three-crystal scintillation counter telescope was set in line with the zero-degree plate to roughly determine the neutron flux (Fig. 2).

About 400 stars were scanned for each plate determining the actual range and the spatial angle for each prong.

Differences in certain features were noticed upon comparison of the results obtained from the two plates. For example, by plotting

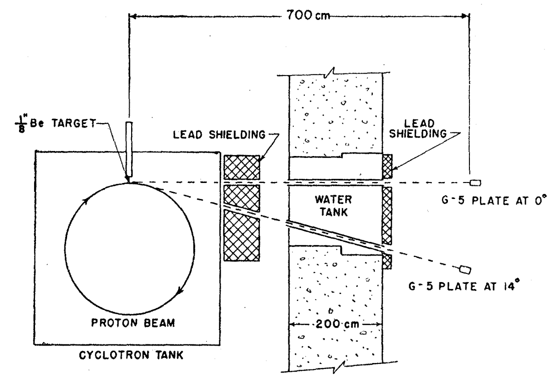


FIG. 2. Exposure of nuclear track plates to neutron beam.

the "asymmetry factor" (ratio of the number of prongs in the forward to the number of prongs in the backward hemisphere) *versus* the star type (indicated by the number of prongs) for each plate one obtains Fig. 3. For isotropic emission the asymmetry

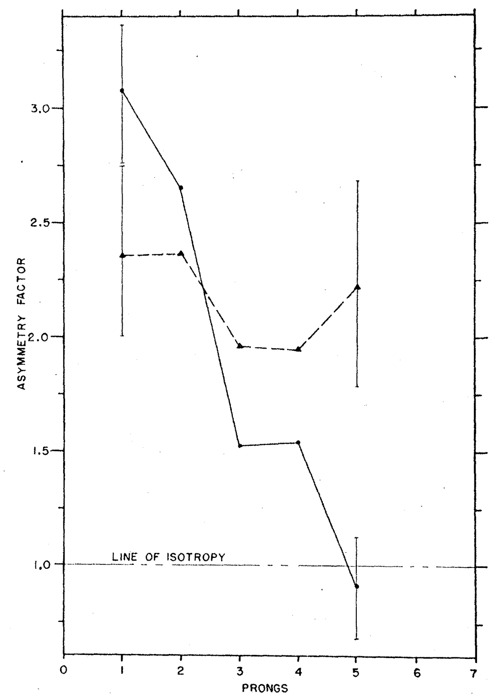


FIG. 3. Asymmetry *vs* prong number. - - - Plate 11, 0°; —— Plate 12, 14°.

factor is equal to 1. One can see from the figure that for the plate exposed at 14°, isotropy is reached much faster than for the plate at 0°. In other words, the larger stars in the 14° plate show practically an isotropic angular distribution, whereas in the 0° plate the prongs are still emitted to an appreciable fraction in the forward direction.

Further differences were detected in the angular distributions and in the number of stars *versus* prong number; thus, the method seems to be discriminative enough to the two different incoming effective neutron energies.

The detailed analysis and discussion for the angular and energy distributions will be published shortly.

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† Society of Fellows.
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