Energy Dependence of the Cross Section for the Reaction $C^{12}(\alpha,\alpha n)C^{11}$†

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The cross section *vs* energy curve for the reaction $C^{12}(\alpha,\alpha n)C^{11}$ has been investigated from threshold to 380 Mev.

INTRODUCTION

THORNTON and Senseman[1] determined the energy dependence of the reaction $C^{12}(\alpha,\alpha n)C^{11}$ from threshold to 390 Mev on the 184-inch Berkeley cyclotron using the internal deflected alpha-particle beam. From the shape of the function these investigators concluded that the formation of C^{11} could be described by a single process. With a view to using carbon foils as an alpha-beam monitor, the experiments of these investigators were repeated, and the absolute cross section was established.

EXPERIMENTAL ARRANGEMENT

Polystyrene foils were spaced between aluminum absorbers, and bombarded on the 184-inch cyclotron.

TABLE I. Cross section for $C^{12}(\alpha,\alpha n)C^{11}$.

E	σ(mb)
380	51.0
380	45.0
307	54.0[a]
40	24.5
35	19.5
31	12.5
27	4.0
22	0.5

[a] This value was obtained by direct comparison with an aluminum monitor rather than from absolute electrical measurement.

The C^{11} thus formed was counted under conditions of known geometry on an end-window counter. For cross-section measurements, the absolute disintegration rate was determined on a proportional counter of 100 percent geometry. Two stack runs were made in the external deflected beam of the 184-inch cyclotron and the cross section at 380 Mev established by absolute electrical measurement of the beam intensity. A third stack run was made in the internal deflected helium ion beam of the 184-inch cyclotron. The cross section obtained in the latter case was compared with the previous runs by monitoring the beam with an aluminum foil placed in the stack, the cross section for the $Al^{27}(\alpha,\alpha 2pn)Na^{24}$ reaction being known.[2] A fourth run was made on the 60-inch Berkeley cyclotron to establish the cross section near the threshold and to minimize the uncertainty in energy inherent in the runs on the 184-inch cyclotron.

The cross sections obtained from electrical measurements of the 184-inch and 60-inch cyclotron beam intensities are given in Table I.

The values at 40 Mev and below were obtained in one bombardment on the 60-inch cyclotron. The energy

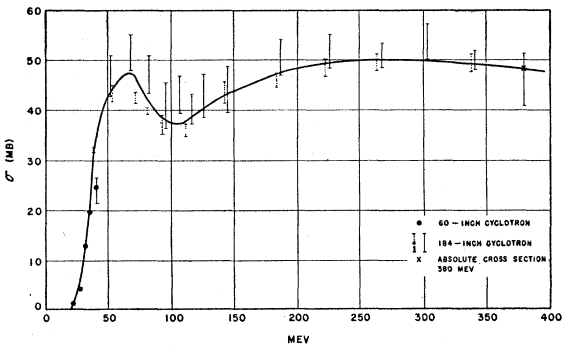

FIG. 1. Energy dependence of the cross section for the reaction $C^{12}(\alpha,\alpha n)C^{11}$.

dependence of the cross section as shown in Fig. 1 was obtained by combining the absolute cross sections (Table I) with the relative cross sections measured by the stacked foil technique. It will be noted that a peak occurs at about 60 Mev and a minimum at about 100 Mev. This observation appears to be in contrast with that of Thornton and Senseman[1] and indicates the formation of C^{11} by more than one energy-dependent reaction.

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[1] R. L. Thornton and R. W. Senseman, MDDC-1320 (unpublished). Manhattan District Declassified Report.

[2] M. Lindner and R. N. Osborne, U. S. Atomic Energy Commission Report MTA-13 (unpublished); Phys. Rev. **91**, 342 (1953).