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ERICSON FLUCTUATION IN THE Si^{28} (n,α) Mg^{25} REACTION

by

L. COLLI - M. MILAZZO (UNIVERSITÀ DI MILANO)
I. IORI - M. G. MARCAZZAN (C.I.S.E.)

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Work done by Laboratori C.I.S.E., Milano,
in cooperation with the Physics Institute of the Milan University
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ERICSON FLUCTUATIONS IN THE $Si^{28}(n,\alpha)Mg^{25}$ REACTION *

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Laboratori C.I.S.E., Milano

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In a previous paper [1] the $Si^{28}(n,\alpha)Mg^{25}$ reaction has been studied with fast neutrons. As it is possible [2] to separate the transitions to the different final states of the residual nucleus Mg^{25}, from these measurements one gets the cross section for each transition as a function of the incident neutron energy. It has been shown that the values of the cross sections as a function of the incident neutron energy present characteristic fluctuations. These have been studied in detail previously only in the energy interval from 13.5 to 14.7 MeV.

These fluctuations have been interpreted as due to interference effects among the different states of the compound nucleus, as has been foreseen by Ericson [3]. As the width of these fluctuations gives the lifetime of the compound nucleus, we have considered it to be of interest to extend the study of the $Si^{28}(n,\alpha)Mg^{25}$ reaction with good energy resolution to the energy interval from 12.15 to 18.4 MeV.

The neutron source used was the $d + t$ reaction,

* This work has been done in cooperation with the nuclear physics group of the Physics Institute of the Milan University working under the CNEN-EURATOM program.

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Table 1

Peak	Excitation energy (MeV)	j	n	$\int_{12.15}^{18.4} \sigma\, dE_n$ arbitrary units	Energy interval (MeV)	$\sqrt{\left(\frac{\sigma - \bar{\sigma}}{\bar{\sigma}}\right)^2}$	$\sqrt{\frac{2}{n}}$
A	0	5/2	6	4100	12.15 - 14.15 14.15 - 16.15 16.15 - 18.4	0.13 0.10 0.10	0.57
B	0.58	1/2	2	1300	12.15 - 14.15 14.15 - 16.15 16.15 - 18.4	0.23 0.14 0.14	1
C	0.98	3/2	4	1950	12.15 - 14.15 14.15 - 16.15 16.15 - 18.4	0.17 0.15 0.15	0.7
D	1.61	7/2	8	3090	12.15 - 14.15 14.15 - 16.15 16.15 - 18.4	0.17 0.15 0.15	0.5
E	1.96	5/2	6	2780	12.15 - 14.15 14.15 - 16.15 16.15 - 18.4	0.15 0.16 0.10	0.57
F	2.56 2.76 2.80	1/2 7/2 3/2	14	6850	12.15 - 14.15 14.15 - 16.15 16.15 - 18.4	0.09 0.1 0.05	0.38
G	3.40 3.41	9/2 3/2	14	6950	12.15 - 14.15 14.15 - 16.15 16.15 - 18.4	0.08 0.06 0.04	0.38

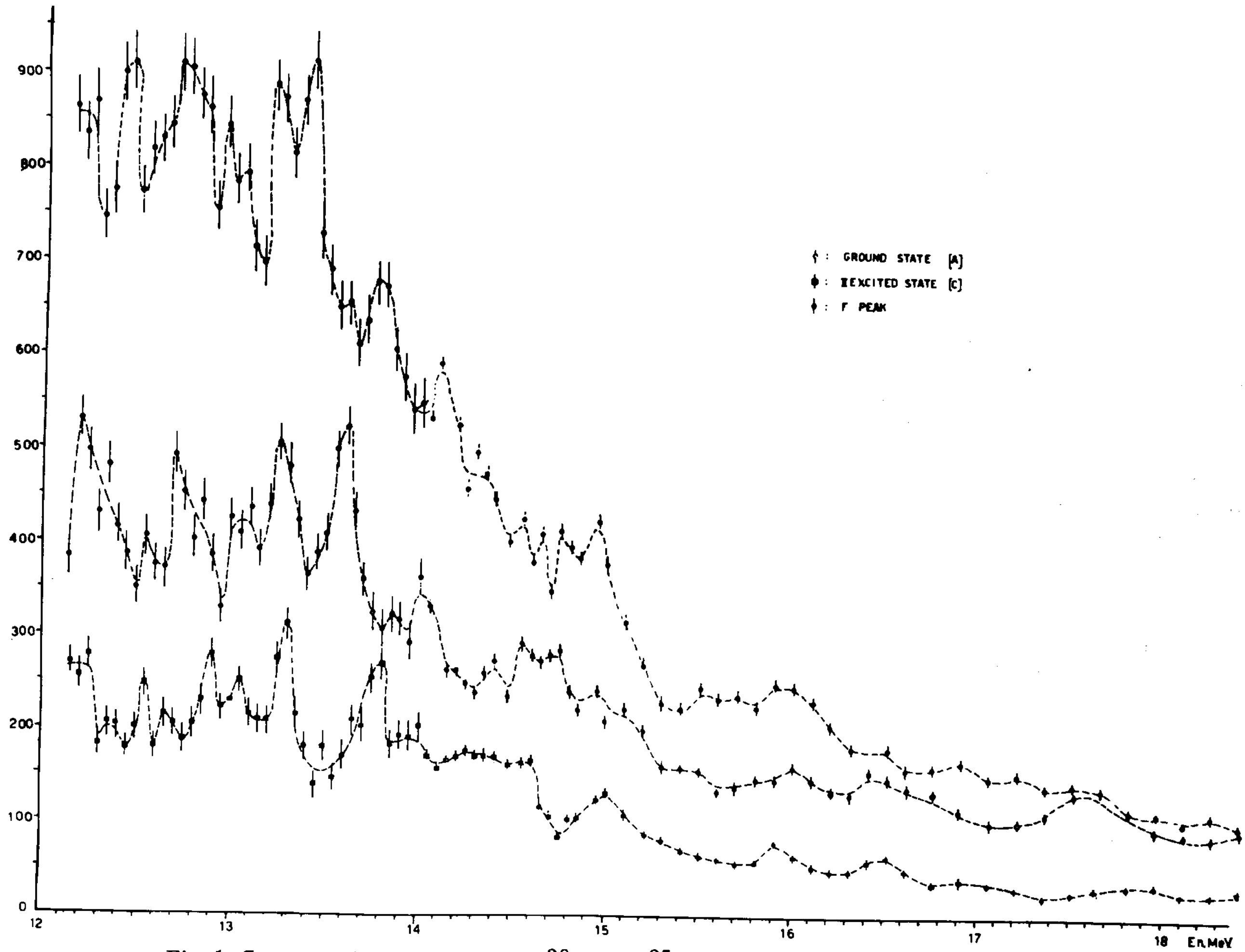

Fig. 1. Cross section vs. energy of $Si^{28}(n,\alpha)Mg^{25}$ in arbitrary units for the A, C, F peaks.

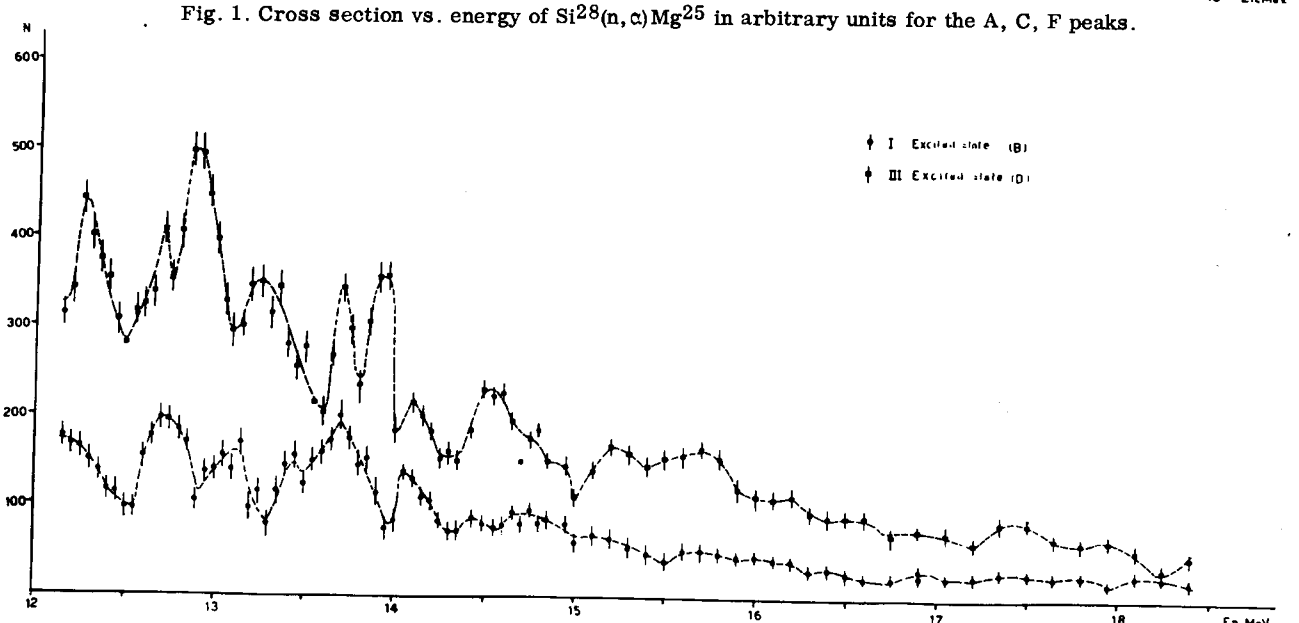

Fig. 2. Cross section vs. energy of $Si^{28}(n,\alpha)Mg^{25}$ in arbitrary units for the B, D peaks.

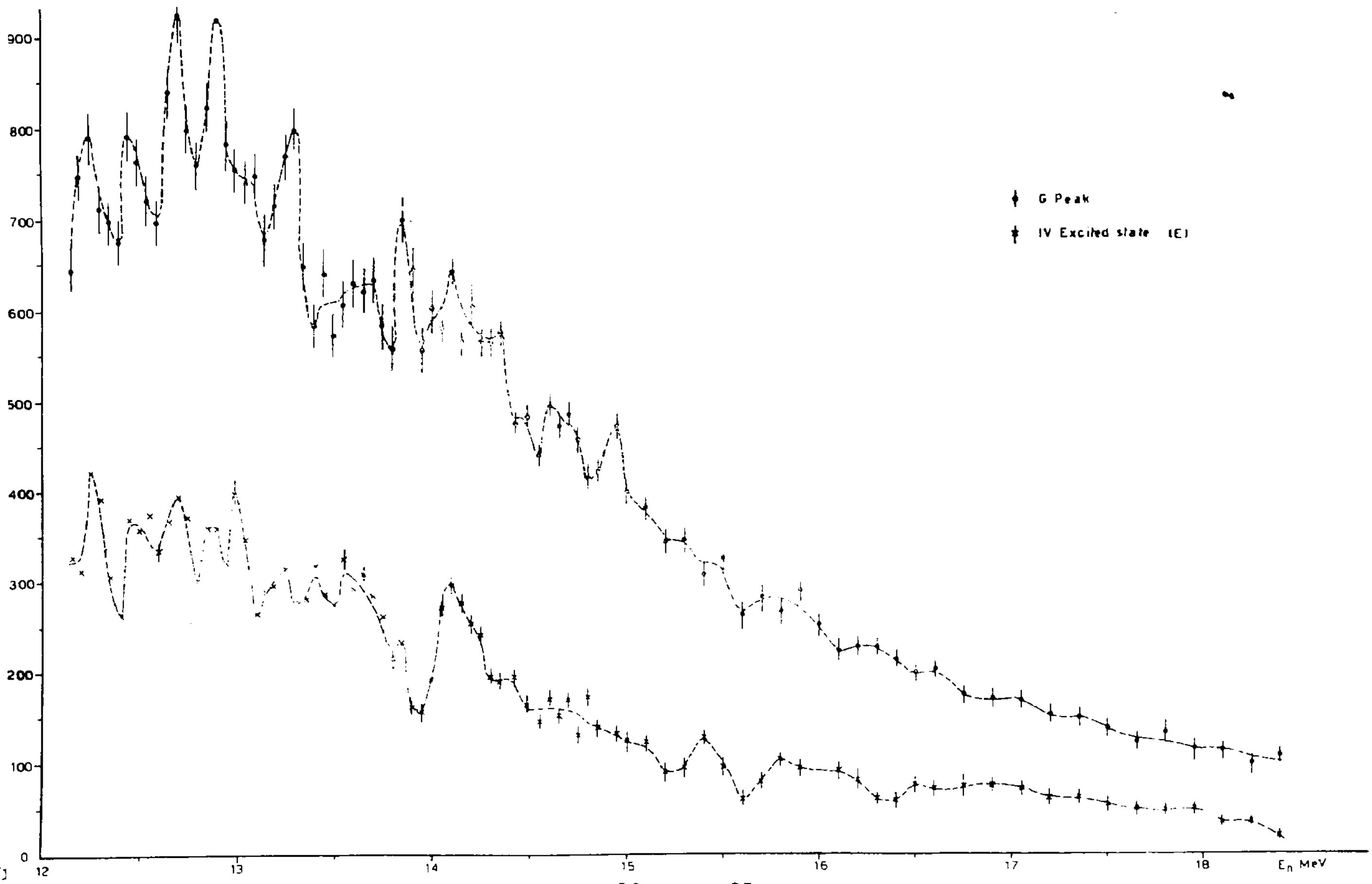

Fig. 3. Cross section vs. energy of $Si^{28}(n,\alpha)Mg^{25}$ in arbitrary units for the G, E peaks.

with deuterons of 2.2 MeV energy accelerated by the CISE 3.5 MeV Van de Graaff accelerator. The energy spread of the neutron beam is about 50 keV below 15 MeV and 100-150 keV over 15 MeV.

The measurements of the cross section for the transition to the ground state and to the first excited states of the residual nucleus, labelled A, B, C, D, E, F, G (see table 1) have been obtained through detecting the energy spectra of the products of the reaction at intervals of 50 keV - 15 MeV, 100 keV - 17 MeV and 150 - 18.4 MeV.

The experimental results are shown in figs. 1, 2 and 3. From the analysis of the experimental results one can deduce:

1. In the whole energy range studied the cross sections show characteristic fluctuations. The width and the amplitude of these fluctuations do not change strongly in the whole energy interval.
2. In a large energy region the average cross sections $\overline{\sigma}$ for the different transitions are decreasing functions of the incident neutron energy. In order to calculate the amplitude of the fluctuations we have first evaluated the average behaviour of the cross sections versus the energy and then calculated the relative mean square deviation $\sqrt{[(\sigma - \overline{\sigma})/\overline{\sigma}]^2}$ considering separately three energy intervals of ~ 2 MeV each. These values are given in table 1.
   Ericson [3] has estimated that the maximum value of these deviations should be of the order of $\sqrt{2/n}$. where n is the number of final states. We list in table 1 the values of $\sqrt{2/n}$ for the various levels. These values are roughly a factor of 4 larger than the experimental deviations.
   There is an indication that the experimental fluctuations have greater amplitude as n decreases.
3. The width of the fluctuations is of the order of 100-250 keV. The life-time of the compound nucleus, deduced from this value turns out to be $\tau = 0.2 - 0.6 \times 10^{-20}$ sec.

A more complete analysis of these measurements will appear in Energia Nucleare.

References

1) L. Colli et al., Physics Letters 1 (1962) 120.
2) M. G. Marcazzan, F. Merzari and F. Tonolini, Physics Letters 1 (1962) 21.
3) T. Ericson, Adv. in Phys. 9 (1960) 425.