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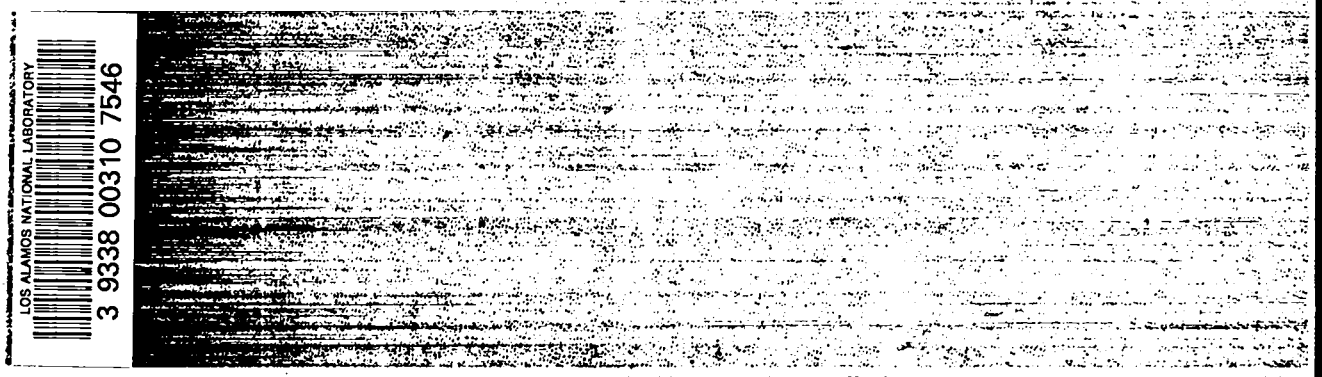

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(n,2n) CROSS SECTION OF Be^9

by

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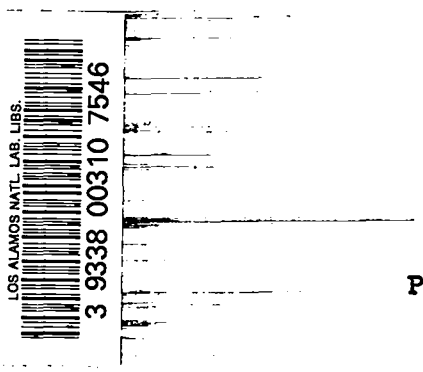

PHYSICS AND MATHEMATICS

ABSTRACT

The average difference between the (n,2n) and absorption cross section in Be for various neutron spectra was measured using a sphere multiplication method. A value for this difference of 0.20 ± .04 barn was obtained for a RaBe neutron spectrum, 0.24 ± .07 barn for a PoBe spectrum, and -0.16 ± .13 barn for a mock fission spectrum.

Because of the large variations in the reported values of the (n,2n) cross section in Be, it was considered worthwhile to conduct a quick experiment to supplement our information on the (n,2n) cross section in Be. An (n,2n) cross section of 3.5 barns had been reported.* However, since the total cross section is known and is of this magnitude or less, such a figure was not taken seriously.

A simple experiment was conducted which involved counting the neutrons from a small source when the source was bare and when surrounded by shells of Be of various thicknesses. The detector used was a long counter which had a flat response. The response of the detector was checked by comparing its response to Ra-Be, Po-Be, and mock fission sources of known strength, and by measuring the transmission of shells of graphite of various thicknesses. A series of shells having a diameter up to 9 in. all gave a transmission of unity.

The relatively large errors (average deviation from the mean) are due primarily to the misfit of the neutron sources and the cavities in the Be spheres, cracks in the Be, and too rapid change in size of the Be spheres. The Be in the outer layers of the thick shells was not as effective as inner material because of neutron energy degredation below the (n,2n) threshold by scattering processes.

The RaBe data were corrected for the neutrons produced by the (γ,n) reactions. This correction was obtained by measuring the

* See compilation obtained from A. H. Snell.

number of neutrons produced by a pure Ra source having the same Ra content as the RaBe neutron source.

The cross sections given in this report were computed using the relationship

$$I = I_o e^{+(\sigma_{n,2n} - \sigma_a)Nt}$$

where I is the number of neutrons per standard time interval detected by the long counter with the sphere of Be surrounding the neutron source. I_o is the number of neutrons detected under identical conditions except with source bare, $\sigma_{n,2n}$ is the average cross section of Be per atom for the (n,2n) reaction for the neutron spectrum involved, σ_a is the average absorption cross section of Be per atom for the neutron spectrum involved, N is the number of atoms of Be per cc., and t is the wall thickness in cm of the Be shells surrounding the source.

In the experiment reported here the source was 80 cm from the face of the long counter and the statistical errors involved were less than 1%. The geometry used was such as to minimize the effects due to room scattering.

The data and results obtained are as follows:

SOURCE	BARE	Be SHELL 1.3 cm WALL	Be SHELL 3.55 cm WALL	Be SHELL 4.65 cm WALL	$\sigma_{n,2n}-\sigma_a$ (barns)
PoBe (50sec runs)	4189	4269	4829	4848	
Be/Bare		1.02	1.15	1.155	0.24±.07
Mock Fission (100sec runs)	2472	2338	2377	2415	
Be/Bare		0.945	0.96	0.98	0.16±.13
RaBe(100sec runs)	1820	2013	2441	2479	
Ra(100sec runs)		149	404	524	
Be(corrected)/ Bare		1.03	1.12	1.08	0.20±.04

The following compilation of results was supplied to the author by A. H. Snell of ORNL.

Author	Primary Source	Method of Measurement	Average (n,2n) Cross section (barns)
Bernstein, et al	Ra - α - Be	Indium foils in paraffin	.1 (Upper limit)
Bernstein, et al	Ra - α - B	" " " "	.04 (Upper limit)
Funfer and Bothe	Ra - α - Be	Foils in diffusing media	.3
Funfer and Bothe	Ra - α - F	" " " "	.1
Ollano	Em - α - Be	" " " "	3.0
Houtermans	Em - α - Be	" " " "	4.1
"	Ra - α - Be	" " " "	3.1
"	Po - α - Be	Gold foil	3.1
Teucher	Ra - α - Be	Uranium fission chamber surrounding sphere	.32
"	Ra - α - Be	Thorium fission chamber surrounding sphere	.47
Martin	Po - α - B	Sphere multiplication, long counter	.15 (Upper limit)
"	Po - α - Be	" "	.43 " "
"	Po - α - Be	" "	.21 (Lower limit)

The equipment and facilities used in this experiment were made available to the author by George A. Jarvis and his assistance greatly facilitated finishing the experiment in a minimum of time.

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