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The $^{36}S(n,\gamma)^{37}S$ reaction with thermal neutrons

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Abstract: The $^{36}S(n,\gamma)^{37}S$ reaction has been studied for the first time. Four primary transitions account for >95% of the thermal neutron capture cross section of 230 ± 20 mb.

Since ^{36}S has an extremely low natural abundance (0.017%) and small thermal neutron capture cross section (≈150 mb), the ^{36}S (thermal n,γ) reaction has not been investigated till now. We have studied this reaction utilizing a 100 mg target enriched to 81% in ^{36}S placed in the Los Alamos Omega West Reactor thermal column at a distance of 1.7 m from the reactor core. A 26 cm³ Ge(Li) detector with a NaI(Tl) annulus was located approximately 6 m from the target and was operated in either a Compton-suppressed or a pair spectrometer mode. Eighteen γ rays in ^{37}S were identified in the 0.6-3.7 MeV region, several with intensities as low as ≈0.5 photons/100 n-captures. Ten strong γ rays have been incorporated into a level scheme as shown in Fig. 1. The 4 primary γ rays placed in this scheme account for >95% of the thermal neutron capture cross section. The energy levels at 646, 2023 and 3062 keV have been previously excited in the $^{37}S(t,^3He)^{37}S$ reaction (Ajzenberg-Selove and Lauritzen). The levels at 2317 and 2968 keV are ambiguous because reverse ordering of γ rays would lead to levels at 2671 and 1992 keV, respectively. A planned $^{36}S(d,p)^{37}S$ study should remove these ambiguities. The neutron separation energy was deduced as 4304 ± 2 keV.

We had earlier measured the thermal neutron capture cross section of ^{33}S to be 518 ± 14 mb. This value was subsequently employed to determine the thermal neutron capture cross section of ^{34}S as 244 ± 15 mb. Since the present enriched ^{36}S target material contained 18.8% ^{34}S, the use of the above cross section for ^{34}S resulted in a value of 230 ± 20 mb for the thermal neutron capture cross section of ^{36}S.

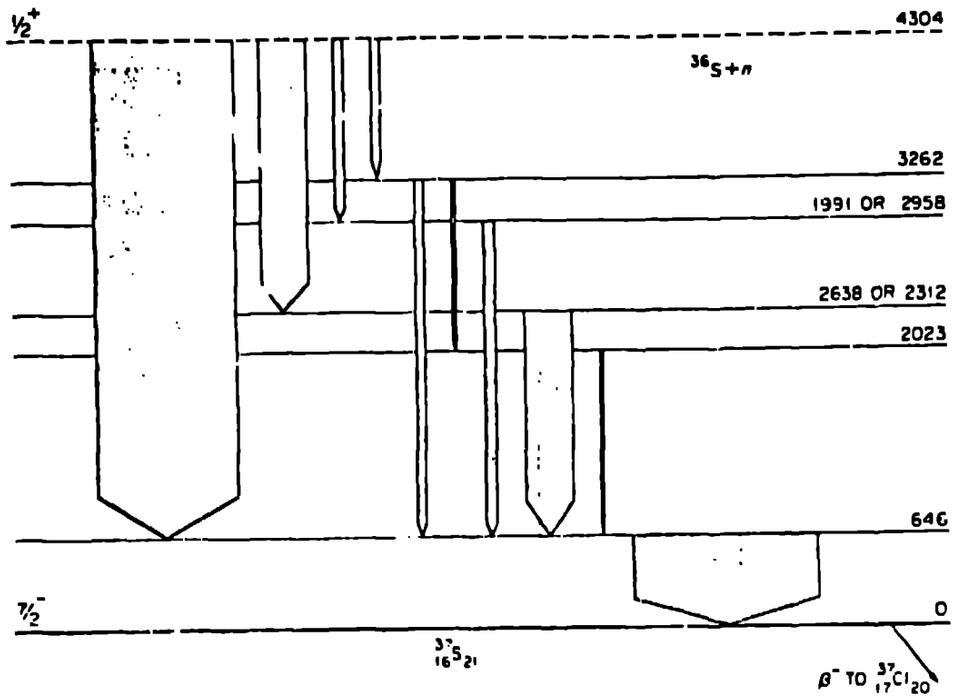

Fig. 1. Main decay modes in the $^{36}S(n,\gamma)^{37}S$ reaction

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Ajzenberg-Selove F and Ivo G 1970 Nucl. Phys. A142 601