SHORT COMMUNICATIONS

A SEARCH FOR A 5·5 MeV LEVEL IN ^{7}Li†

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A level at about 5·5 MeV excitation energy in ^{7}Li has been predicted theoretically on the basis of a number of models (Balashov 1959; Clegg 1962; Chesterfield and Spicer 1963) but the only one of these that also accounts for the other levels below 8 MeV, with correct spin and parity, is a rotational model put forward by Chesterfield and Spicer.

The experimental evidence for this 5·5 MeV level comes from electron scattering, proton scattering, and photonuclear studies. Inelastic electron scattering from ^{7}Li has been performed by Bernheim and Bishop (1963) using an incident energy range of 100–180 MeV. They report a level at 5·7 MeV of spin and parity $\frac{5}{2}^-$ or $\frac{3}{2}^-$, with slight preference for $\frac{5}{2}^-$. Chesterfield and Spicer predicted spin and parity $\frac{3}{2}^-$ for their 5·5 MeV level. In a later paper, Bernheim and Bishop (1964) refer to the difficulty of accounting for a second $\frac{5}{2}^-$ state in this region, and suggest that their 5·7 MeV level may be due to direct disintegration into triton and an α-particle.

In high energy (185 MeV) inelastic proton scattering, Hasselgren *et al.* (1965) have reported a small peak at 5·5 MeV in ^{7}Li, but say that its existence is uncertain because it was not clearly resolved.

Erdos *et al.* (1954) used the reaction ^{7}Li(γ, α)^{3}H to study energy levels in ^{7}Li and reported a clear level at 5·5 MeV. Shevchenko and Yur'ev (1961) performed a similar experiment and reported a level at 5·3 MeV.

The present experiment was undertaken firstly in an attempt to observe this level in the ^{7}Li(n, n′) reaction and, secondly, to verify the results of Regis *et al.* (1966), who report a level at 5·7 MeV in a similar experiment.

Neutrons from the T(d, n)^{4}He reaction were scattered from ^{7}Li and their energies measured by a time-of-flight spectrometer. The associated α-particle was used for the time reference of the spectrometer, which had a flight path of 6 m and a time resolution of 2·5 nsec under experimental conditions.

In the spectrum obtained (Fig. 1) the unresolved ground and 0·48 MeV states and the 4·63 MeV state stand out clearly, but there is no evidence for any level at higher energies. This conflicts with the results of Regis *et al.*, who report levels in this region.

The two spectra were taken under similar conditions; 14 MeV neutrons were used in both experiments and the ratios of flight path to time resolution were comparable. The main difference in the conditions for the spectra was the scattering

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angle, which was 12° lab. (13·4° c.m.) for Regis *et al.* and 20° lab. (22·3° c.m.) for the results in Figure 1. Little difference in cross section would be expected between these angles, and this is supported by examination of a compilation of neutron angular distributions (Brookhaven National Laboratory 1962). (Where angular distributions for inelastic scattering of 14 MeV neutrons were included, the differential cross sections did not vary by more than 7% between the angles of interest.) Thus it was considered that valid comparisons could be made between the spectra.

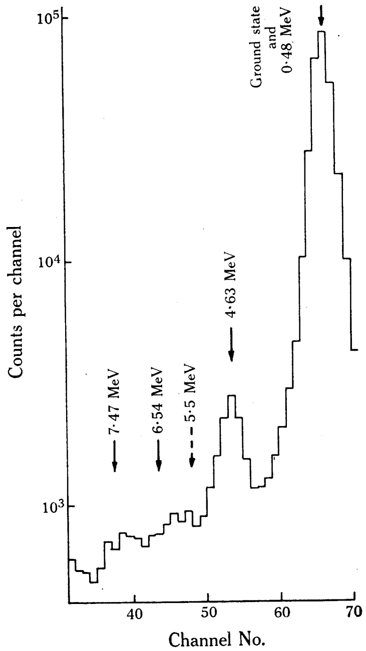

Fig. 1.—Inelastically scattered neutron spectrum from the reaction ^{7}Li(n, n′) at a laboratory scattering angle of 20° and an incident neutron energy of 14 MeV. The solid arrows indicate the expected positions of peaks due to levels in ^{7}Li for which adequate experimental evidence exists. The broken arrow indicates where a peak would appear due to a level at 5·5 MeV.

There is some evidence in the spectrum of Regis *et al.* for peaks at 5·7, 6·3, and 7·47 MeV excitation, but the number of counts in this region is small and the error bars are comparatively large. The 6·3 MeV level is assigned a spin and parity of $\frac{3}{2}^+$, which means it is not the generally accepted level at 6·54 MeV ($\frac{5}{2}^-$). This $\frac{5}{2}^-$ level was said to be weakly excited at 120°.

There is no evidence in Figure 1 for any levels higher than the 4·63 MeV level, despite extended experimental running time. (The 4·63 MeV peak in Figure 1 contains three times the number of counts in the corresponding peak of Regis *et al.*) This indicates that the levels of excitation higher than 4·63 MeV in the spectrum of Regis *et al.* may well be caused by statistical fluctuations and should not be regarded as firm evidence for the less generally accepted levels.

As no 5·5 MeV level was observed in the present work (Fig. 1), its cross section for inelastic scattering of 14 MeV neutrons must be markedly less than the value of $1\cdot9\pm0\cdot5$ mbn/sr estimated by Regis *et al.*, but this does not provide evidence against its existence, since the known higher energy levels were not seen.

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