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Studies Concerning Nuclear Coexistence in ^{115}In*

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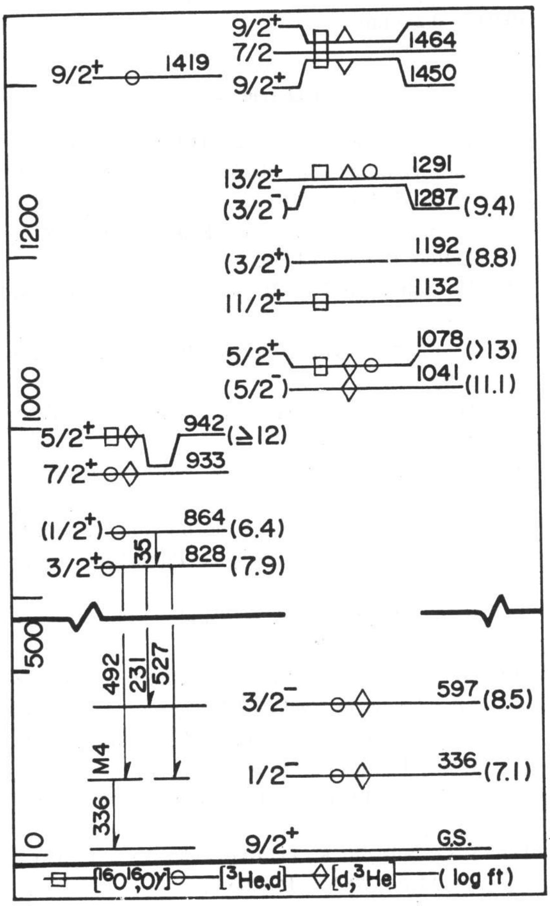
Recently Haas and Shirley[1] measured the static quadrupole moment of the 829 keV state ^{115}In and obtained 2.67 b implying the deformation parameter $\delta = 0.20$. This fact and the existence of the multiplet of positive parity levels shown in the figure strongly suggests the existence of a deformed intrinsic state coexisting with the lower energy levels described as single holes in a spherical ^{116}Sn core. If such a deformed intrinsic state in fact exists, then the B(E2) for the 35 keV transition between the 1/2 positive state at 864 keV and the 3/2 positive band head should be 104 spu. Bäcklin *et al.*[2] have measured the internal conversion electrons for this transition in the decay of ^{115}Cd and using the lifetime for this state measured by Graffe *et al.*[3] found a value of 83 spu.



We have measured the gamma rays from ^{115}Cd which was produced in the core of the Livermore pool type reactor by neutron capture upon isotopically enriched ^{114}Cd. After performing chemistry the sources were counted during their first half-life with a Compton suppression spectrometer and later with several Ge(Li) detectors. Precise energies and intensities have been determined (see Table I) which yield three new levels.

Since the 336 keV transition has been determined to be pure M4, we have used this transition to normalize the electron intensities of ref. 2 to our gamma intensities by using theoretical conversion coefficients. The B(E2)'s for the 35 keV transition were extracted by this method and are presented in Table II. They are clearly inconsistent with one another. Since the electron data are poorly resolved we have summed the L transition intensity to obtain a value of B(E2) $= 39 \pm 5$ spu.

Using the same technique we also calculated the

Table I. Partial list of transitions and intensities for ^{115}Cd decay.

$E_j(\Delta E_j)$ (in keV)	$I_j(\Delta I_j)$ (10,000 decays)	Assignment (From/To)
35.514(3)	42.1 (3)	864/828
231.443(10)	74 (1)	828/597
336.301(10)	4969 (22)*	336/G.S.
492.351(10)	803 (9)	828/336
527.901(15)	2745 (18)	864/336
705.180(250)	0.008(2)	1041/336
856.245(25)	0.22 (1)	1192/336
951.187(59)	0.028(3)	1287/336

*Transient equilibrium value.

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Table II.

Conversion coefficient used	B(E2)spu
α_{L_1}	0^{+10}_{-40}
α_{L_2}	63 ± 20
α_{L_3}	59 ± 11
α_M	95 ± 50
Total L	$39\pm\ 5$

B(M2) for the 231, 492 and 527 keV transitions and obtained 0.08, 0.13, and 0.17 spu respectively. This result, if true, would be very significant since B(M2)'s are normally retarded by several orders of magnitude. However, it is possible that the electron data was taken before the 336 keV transition reached transient equilibrium. Therefore we have also calculated the B(E2) by normalizing to the 231, 492 and 527 keV transition assuming that they are pure *E1*. These assumptions give $B(\mathrm{E2}) = 24 \pm 12$ spu. Therefore by taking Bäcklin's electron intensities, we find that 12 spu $< B(\mathrm{E2}) <$ 43 spu.

It is tempting to describe the band on the 828 keV level as arising from the 1/2 [431] Nilsson orbital, the more so because one of the $9/2^+$ states $\sim$ 1500 keV might then be attributed to the 9/2 [404] orbital. Nevertheless the inconsistency of the static and transition quadrupole moments and the fact that the spin 7/2 member of this "band" is strongly populated in the ^{114}Cd (^{3}He, d) ^{115}In reaction[4] argue against such a simple interpretation. If the large quadrupole moment of the 829 keV state arises from a second minimum in the potential surface, then it must be sufficiently shallow so that the strong coupling model fails.

References

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