ON THE ISOBARIC ANALOGIE BETWEEN LIGHTER NUCLEI

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ABSTRACT

The experimental asymmetry observed in the $^{3}He(t,d)^{4}He$ reaction is explain as a breakdown of the mirror relationship between the incoming pair of nuclei.

The Barshay-Temmer theorem[1] provide a experimental test of the isobaric analogie between light nuclei. Briefly the theorem states that in a nuclear reaction

$$A + B \rightleftarrows C + C'$$

in which the initial system is prepared in a pure isobaric spin state and in which the nuclei C and C' are members of the same isobaric-spin multiplet, the differential cross section of the reaction products will exhibit symmetry about 90º in the center-of-mass system. The theorem is strictly true only if isobaric spin is conserved in the interaction and the particles involved have the same spatial configuration.

Experimental test[2] [3] [4] [5] have been published in recent years for $^{12}C(^{14}N,^{13}N)^{13}C$, $^{10}B(^{4}He,^{7}Li)^{7}Be$ $^{9}Be(t,^{6}He)^{6}Li$ and $^{3}He(t,d)^{4}He$. While the first three reactions confirm to predictions, a marked desviation of up to 20% is found in $^{3}He(t,d)^{4}He$.

In order to explain this asymmetry we have performed a microscopic cluster model calculation with full antisimetrization of the $^{3}He(t,d)^{4}He$ reaction with a charge independent potential[6] which enables us to study the influence of the breakdown of the exact mirror relationship between ^{3}He and t nuclei. The wave function for both nuclei are assumed to have Gaussian form, which provide a simple relation-ship between the width of the wave function and the spatial correlation of the nuclei.

TABLE I Nuclear rms-radius

	^{4}He	^{3}He	d	t
Set I	1.66	1.66	1.86	1.59
Set II	1.66	2.23	1.86	2.07
Set III	1.66	2.23	2.32	2.07

The results shown (fig.1) that the calculated asymmetry is very sensitive to the nuclear rms radius. The best fits are obtained for rms-radius rather larger than the experimental ones which suggest that, in the interaction region, the nuclei are strongly distorted and the isobaric analogie between them break down.

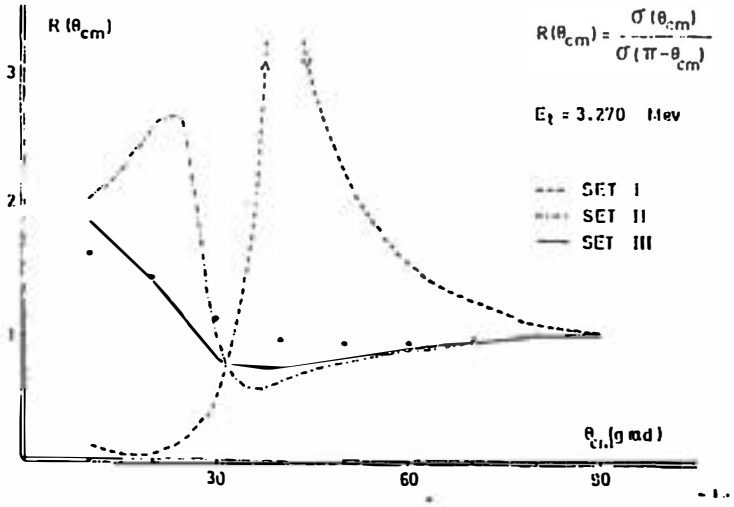

Fig. 1. Data points are taken from Ref. 5

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