Comments

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g factor of the 2_1^+ state in ^{140}Ba and ^{142}Ba

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A simple calculation on the basis of the revolving cluster model leads to the value 0.495 for the g factor of $^{142}_{56}\mathrm{Ba}_{86}$, in agreement with the experimental value 0.48 ± 0.14. The same value is predicted for ^{140}Ba.

Gill *et al.*[1] have reported the experimental g value 0.48 ± 0.14 for ^{142}Ba, and have pointed out that it does not distinguish clearly between the values calculated by the hydrodynamic model with Greiner's correction (0.33) and by the interacting boson approximation interacting boson-fermion model (0.40). I have assigned to this nucleus in the 2_1^+ state a structure with 2α as the revolving cluster.[2,3] With this structure the value of q is 0.50, which becomes 0.495 with correction for the contribution of the spherical part of the nucleus.

This treatment is a rather simple form of the other two, the hydrodynamic model and the interacting boson model, and also of the alpha-particle model that was discussed by Bethe and others fifty years ago. It is based on hybridization of the shell-model orbitals to form a set of localized $1s$ orbitals, each of which is usually occupied by two neutrons and either one or two protons.[4–6] In ^{142}Ba there are four neutrons beyond the magic value $N = 82$, and they add four protons to achieve a Z/N ratio close to that of the spherical part of the nucleus; the revolving cluster thus consists of two alpha particles, as was concluded earlier[2,3] from the analysis of the rotational energy levels.

This treatment is similar to the one I used in discussing the g values of ^{7}Li, ^{19}F, ^{19}F*, ^{23}Na, ^{27}Al, ^{31}P, and ^{43}Sc on the assumption that the revolving cluster is a triton.[7] The calculated values agree closely with the observed values, which are far from the revolving-proton (Schmidt) values.

I predict the same value, 0.495, for g for the 2_1^+ state of $^{140}_{56}\mathrm{Ba}_{84}$. With two neutrons beyond the magic 82 and two protons to give a good Z/N ratio, the revolving cluster is one alpha particle, as for many other nuclei with Z or N differing by ± 2 from a magic number.[2,3,8]

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