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abstract

The hypothesis of isomers of form of heavy nuclei can be checked in principle by radiospectroscopic measurement of the hyperfine structure of atomic levels of isomers.

The hypothesis of isomers of form explains successfully some properties of spontaneously fissioning isomers of heavy nuclei (see, e.g., [1]). Nevertheless, it surely needs further experimental check. In the ref.[2] it was noted that the measurement of isomeric shift of atomic levels could serve as such a test. This shift is caused by the change of the nuclear form at the increase of the deformation parameter β from the values $0.22 \div 0.29$ usual for uranium and transuraniums to the magnitude ~ 0.6 predicted by the hypothesis of isomers of form. (The change of the form influences the nuclear volume effect which is known to cause the isotopic shift of levels in heavy atoms.) According to the estimates[2], the isomeric shift of levels from Am^{242} to Am^{242m} can reach 20 cm^{-1}. One of the difficulties for the observation of this effect is that a weak line of Am^{242m} (its yield in nuclear reaction is $(2 \div 4) \cdot 10^{-4}$) will be covered by Doppler shifted line of Am^{242} [2].

I wish to call attention here to the crucial test of the hypothesis of isomers of form, radiospectroscopic measurement of the hyperfine structure (hfs) of atomic levels of isomers is meant. Its deviation from the hfs of a usual nucleus (for Am^{242}, I=1, K=0, in the atomic ground state $5f^7 7s^2$ J=7/2 hyperfine constants are A=±10.1282(14) MHz, B=±69.6339(13) MHz[3]) should be of relative order of magnitude about unity. Indeed, the quadrupole moment of nucleus Q increases, roughly speaking, by a factor of two at the transition from the usual nucleus to the isomer of form at the same total nuclear angular

momentum I and the same projection K of the nucleon angular momentum on the axis of nucleus. The calculation of the dependence of Q on β is presented, e.g., in the ref.[2]. Note also that as it is known the nuclear spin I can be determined as well through the number of hyperfine components to which the atomic level is splitted. It could serve in its turn as a test of alternative hypothesis according to which an isomeric nucleus differs from the usual one by high spin. Since at the transition to the suspected isomer of form the change of hfs should be of order of unity, the problem of background due to the spectrum of atoms with usual nucleus is not so sharp here as in the case of isomeric shift.

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