Study of hyperfine structure in ^{9,11}Be isotopes

Yu.L. Parfenova[1,2], Ch. Leclercq-Willain[1]
[1] Physique Nucléaire Théorique et Physique Mathématique, Universite Libre de Bruxelles, Brussels, Belgium.
[2] Skobeltsyn Institute of Nuclear Physics, Moscow State University, Moscow, Russia.

The study of the hyperfine anomaly of neutron rich nuclei, in particular, neutron halo nuclei, can give a very specific and unique way to measure their neutron distribution and confirm a halo structure. The hyperfine structure anomaly in Be^{+} ions is calculated with a realistic electronic wave function, obtained as a solution of the Dirac equation. In calculations, the Coulomb potential modified by the charge distribution of the clustered nucleus and three electrons in the configuration $1s^22s$ is used.

The nuclear wave function for the ^{11}Be nucleus is obtained in the core+nucleon model, and that for the ^{9}Be nucleus is calculated in the three-cluster (α+α+n) model. The aim of this study is to test whether the hyperfine structure anomaly reflects an extended spatial structure of ^{11}Be. The results of the calculations are listed in Table 1. ϵ_{BW} is the hyperfine anomaly in the Bohr-Weisskopf effect and δ is the charge structure correction [1], μ is the calculated magnetic moment, and μ_{exp} is the experimental value of the magnetic moment.

Isotope	ϵ_{BW}, %	δ, %	μ	μ_{exp}
^{11}Be	-0.0534	-0.0476	-1.784 μ_0	-1.6816(8) μ_0 [2]
^{9}Be (WF1)	-0.0228	-0.0419	-1.053 μ_0	-1.177432(3) μ_0 [3]
^{9}Be (WF2)	-0.0303	-0.0463	-1.316 μ_0	-1.177432(3) μ_0

The results for ^{9}Be are obtained with two different three-body wave functions (WF1 and WF2) showing the sensitivity of the calculations to input parameters. The value of the ϵ_{BW} is sensitive to the weights of states admixed in the nuclear ground state wave function. The total hyperfine anomaly value $\epsilon = \epsilon_{BW} + \delta$ in ^{11}Be differs from that in ^{9}Be by 25%. This gives a measure of the accuracy of the hyperfine anomaly measurements needed for studies of the neutron distribution in the Be isotopes.

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