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P- AND T-INVARIANCE VIOLATING NUCLEAR SCHIFF MOMENT, NEW CONSTRAINT ON THE PROTON ELECTRIC DIPOLE MOMENT

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The most precise limit on parity- and time-invariance violating nucleon-nucleon interaction has been obtained from the measurement of the atomic electric dipole moment of ^{199}Hg [1].

$$|d(^{199}\mathrm{Hg})| < 2.1 \times 10^{-28} \text{ e cm}.$$

The hadronic part of the atomic dipole moment associated with the electric dipole moment of the ^{199}Hg nucleus manifests itself through the Schiff moment which is the first nonzero term in the expansion of the nuclear electromagnetic potential after including the screening of the atomic electrons. The expression for the Schiff moment consist of two parts. The first of it is related to the parity- and time-invariance violating nucleon-nucleon interaction

$$\mathbf{S_1} = \frac{1}{10}\sum_N^A e_N \left(r_N^2 \mathbf{r}_N - \frac{5}{3}\langle r^2\rangle_{ch}\mathbf{r}_N\right),$$

where e_N equal $|e|$ for a proton and zero for a neutron. The second part of the Schiff moment operator connected with the internal dipole moments of the nucleons

$$\mathbf{S_2} = \frac{1}{6}\sum_N^A \mathbf{d_N}\left(r_N^2 - \langle r^2\rangle_{ch}\right) + \frac{1}{5}\sum_N^A \left(\mathbf{r}_N(\mathbf{r}_N \cdot \mathbf{d}_N) - \mathbf{d}_N r_N^2/3\right).$$

For ^{199}Hg the last unpaired nucleon is a neutron. Nevertheless, due to core polarization, via proton - neutron interaction the proton dipole moment contributes to the Schiff moment as well. We found that for ^{199}Hg the Schiff moment is

$$S(^{199}\mathrm{Hg}) = (0.2d_p + 1.9d_n)\ e \cdot \mathrm{fm}^3.$$

Combining it with the result of experiment we obtained a new constraint for the proton electric dipole moment

$$d_p < 3.7\, 10^{-24} e \cdot \mathrm{cm},$$

which is one order of magnitude better than the existing boundary.

[1] M.V. Romalis, W.C. Griffith, E.N. Fortson, Phys. Rev. Lett. **86**, 2505 (2001).

NUCLEAR MAGNETIZATION DISTRIBUTION AND HYPERFINE SPLITTING IN Bi^{82+} ION

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High experimental precision attained in the laser spectroscopic measurement of the ground-state hyper-fine splitting (hfs) in hydrogen-like ion $^{209}Bi^{82+}$ [1]

$$\Delta E_{hfs}^{exper.} = 5.0840(8)\,\mathrm{eV}$$

stimulates considerable theoretical activity in this field.
In the present work we consider a contribution of the magnetic moment distribution within the nucleus to the hydrogen-like ion hfs. Our approach is close to the one used in [2]. This microscopic approach is based mainly on the Migdal's theory of finite Fermi systems (FFST) [3]. Hyperfine splitting in Bi^{82+} and Pb^{81+} ions was calculated using the continuum RPA approach with effective residual forces. To fix the parameters of the theory nuclear magnetic dipole moments of two one-particle and two one-hole nuclei around ^{208}Pb were calculated within the same approach. The contribution from a velocity dependent two-body spin-orbit residual interaction was calculated explicitly. Additionally, the octupole moment of ^{209}Bi and the hfs in muonic bismuth atom were calculated as well. All the calculated observables, except the electronic hfs in ^{209}Bi, are in good agreement with the data.

[1] I. Klaft, S. Borneis, T. Engel, B. Fricke, R. Grieser, G. Huber, T. Kühl, D. Marx, R. Neumann, S. Schröder, P. Seelig, and L. Völker, Phys. Rev. Lett. **73** (1994) 2425.

[2] V.F. Dmitriev and V.B. Telitsin, Nucl. Phys. A **402** (1983) 581.

[3] A.B. Migdal, *Theory of finite Fermi systems* (Wiley Interscience, New York, 1967).