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# Use of molecules to extract fundamental properties of nuclei

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Recently a strong disagreement between the theoretical prediction [1] of the specific difference of hyperfine splittings in H-like and Li-like $^{209}$Bi ions and the experiment was found [1]. This problem was called the "hyperfine puzzle". We have shown [3] that the reason of the discrepancy was caused by the inaccurate "standard" value of the magnetic moment of the $^{209}$Bi nucleus, which is given in reference books. This magnetic moment was obtained from the nuclear magnetic resonance experiment on the bismuth nitrate solution. We show that in the previous interpretation of the experiment the uncertainty of the shielding constant required to extract the nuclear magnetic moment was strongly underestimated. For this we have adapted the relativistic 4-component coupled cluster method to calculate the shielding constant in molecules at a new level of accuracy [3]. Using this method, the interpretation of the new nuclear magnetic resonance experiment on $[BiF_6]^-$ was performed [3]. In the present report we will outline the approach as well as the results of its application to other systems. In particular, the refined value of the magnetic moment of the $^{207}$Pb nucleus will be presented.

Also, we will briefly mention related problems to search for other nuclear properties such as the quadrupole distribution of neutrons inside the nucleus in the $^{177}$HfF+ cation [4]. This can be done by studying the parity violation effects.

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