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Hyperfine Structure of Trapped $^{137}Ba^{+}$ Ions as a Probe of the Nuclear Magnetic Octupole Moment GARY HOWELL, BORIS BLINOV, NORVAL FORTSON, University of Washington — We present calculations of the 1^{st} order hyperfine splittings in the $^{137}Ba^{+}$ ion in terms of the 3 hyperfine constants a, b, and c, and also two 2^{nd}-order energy effects, for the metastable states $D_{3/2}$ and $D_{5/2}$. It is shown that up to 2^{nd}-order, only one of these 2^{nd} order effects (the dipole-quadrupole term) contributes to the measured value of the magnetic octupole constant c; the dipole-squared term does not contribute. Thus c can be determined purely from the measured energy splittings, with a small correction due to the dipole-quadrupole term. Using the octupole constants $c_{3/2}$ and $c_{5/2}$ of the two sets of levels, a particular linear combination of $c_{3/2}$ and $c_{5/2}$ will be completely independent of the 2^{nd} order dipole-quadrupole correction as well, and expressed purely in terms of the measured energy level splittings. Together with atomic theory calculations of the electronic wavefunctions, this would provide a precise value of the nuclear magnetic octupole moment, which could be used as a test of nuclear models.

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