

Erratum: Hyperfine-mediated effects in a Lu⁺ optical clock [Phys. Rev. A **102, 052834 (2020)]**

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In the original paper, higher-order Zeeman corrections were not considered. Upon reanalysis we find that the third-order corrections contribute at $1 - 2\sigma$ uncertainty in the reported ratios of Zeeman splittings. We provide corrected ratios and Landé g -factors accounting for this systematic. The analysis and hyperfine-mediated quadrupole moment results in the original paper are unaffected by these minor corrections.

The Zeeman shift, ν_{F,m_F} , on the $|F, m_F\rangle$ state is evaluated by perturbative expansion as

$$\nu_{F,m_F} = \frac{m_F g_F \mu_B}{h} B + \alpha_{F,m_F} B^2 + \lambda_{F,m_F} B^3 + O(4). \quad (1)$$

In the original paper, Zeeman splittings ν_F are measured as half of the measured frequency difference between $|F, +1\rangle$ and $|F, -1\rangle$ states. Only terms with odd parity in m_F contribute to the difference:

$$\nu_F = \frac{1}{2}(\nu_{F,+1} - \nu_{F,-1}) = \frac{\mu_B g_F}{h} B + \lambda_{F,1} B^3 + O(5). \quad (2)$$

We evaluate the third-order perturbation coefficients to be

$$\lambda_{F,1} = [0.224, -0.0719, -0.152] \text{ Hz/mT}^3$$

for $F = [6, 7, 8]$, respectively. The third-order terms are small and give rise to a fractional shift in Zeeman splittings $\frac{\delta \nu_F^{(3)}}{\nu_F} = \frac{h \lambda_{F,1}}{\mu_B g_F} B^2$.

Ratios of Lu⁺ and Ba⁺ Zeeman splittings were measured at 1.573 mT magnetic field. The corrected ratios are

$$r_6 = \frac{g_{\text{Ba}}}{g_6} = 5.596\,540\,2(20), \quad (3a)$$

$$r_8 = \frac{g_{\text{Ba}}}{g_8} = -6.477\,020\,8(30). \quad (3b)$$

Ratios of Zeeman splittings within Lu⁺ were measured at 1.107 mT magnetic field. The corrected ratios are

$$r_{68} = \frac{g_6}{g_8} = -1.157\,326\,675(88), \quad (4a)$$

$$r_{67} = \frac{g_6}{g_7} = -8.502\,639\,7(24), \quad (4b)$$

$$r_{87} = \frac{g_8}{g_7} = 7.346\,793\,1(20), \quad (4c)$$

$$r_{8s} = \frac{g_8}{g_I} = -254.289\,8(17). \quad (4d)$$

The g -factors are determined to

$$g_6 = \frac{g_{\text{Ba}}}{r_6} = -0.071\,662\,546(33), \quad (5a)$$

$$g_7 = \frac{g_{\text{Ba}}}{r_6 r_{68} r_{87}} = 0.008\,428\,270\,4(46), \quad (5b)$$

$$g_8 = \frac{g_{\text{Ba}}}{r_6 r_{68}} = 0.061\,920\,759(29), \quad (5c)$$

$$g_I = \frac{g_{\text{Ba}}}{r_6 r_{68} r_{8s}} = -0.000\,243\,504\,7(16). \quad (5d)$$

We evaluate g_J , $\sum_{J'} \beta_{1,J'}^1$, and $\sum_{J'} \beta_{1,J'}^2$ by solving the linear equations given in the original paper, including the $\delta g_F^{(2)}$ corrections as given in Appendix A2 of the original paper, which yields

$$g_J = 0.498\,237\,47(31), \quad (6a)$$

$$\sum_{J'} \beta_{1,J'}^1 = -8.658\,72(41) \times 10^{-4}, \quad (6b)$$

$$\sum_{J'} \beta_{1,J'}^2 = 3.088(12) \times 10^{-5}. \quad (6c)$$

Uncertainties have been updated to account for correlation arising from the common dependence on g_{Ba} .

The fractional correction to $\sum_{J'} \beta_{1,J'}^1$ is 1.5×10^{-4} relative to the value in the original paper, and has no effect on hyperfine-mediated quadrupole results at the level of precision given in the original paper.