Erratum: High-precision measurements of the ^{87}Rb D-line tune-out wavelength [Phys. Rev. A 92, 052501 (2015)]

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Our paper referenced above presented a precise measurement of the scalar tune-out wavelength near 790 nm in ^{87}Rb. We have discovered a few errors in the analysis of our results, one of which is significant compared to our estimated uncertainty.

The most important error was in the correction of our experimental data for the Zeeman effect. The measurements were made in a magnetic trap with a bias field of $B = 20.0$ G. We accounted for the resulting Zeeman shift and subtracted it from our measured value. Unfortunately, a calculation error caused this adjustment to be incorrect. We take this opportunity to explain in more detail how the correction was made.

The Zeeman shift cannot be calculated using Eq. (5) of our paper since different m levels will no longer be degenerate. Instead we use Eq. (1) for the $5P$ states in the form

$$\alpha_{5P}^{(0)}(\omega) = \frac{1}{3\hbar} \sum_{J'F'm'} \frac{2\omega'}{\omega'^2 - \omega^2} |d_{J'}|^2 C_{J'F'm'}, \tag{1}$$

where $d_{J'}$ is the reduced dipole matrix element $\langle 5P_{J'} \| d \| 5S_{1/2} \rangle$ and ω' is the transition frequency from our $F = 2$, $m = 2$ ground state to the excited state $|J'F'm'\rangle$, including Zeeman shifts. This is calculated as

$$\omega' = \omega_0' + (g'm' - gm)\mu_B B \tag{2}$$

for unshifted frequency ω_0', Landé g-factors g and g', and Bohr magneton μ_B. The sum is over all accessible excited states $m' = \{m-1, m, m+1\}$ with the factor of 1/3 in front of the sum accounting for an average over the possible light polarizations. The state coupling coefficients C_i are given in terms of Wigner symbols by [1]

$$C_{J'F'm'} = (2F+1)(2F'+1) \begin{pmatrix} F' & 1 & F \\ m' & m-m' & -m \end{pmatrix}^2 \begin{Bmatrix} F' & I & J' \\ J & 1 & F \end{Bmatrix}^2. \tag{3}$$

The nuclear spin is $I = 3/2$, and the ground-state angular momentum is $J = 1/2$.

Using this formalism we calculate the wavelength $\lambda^{(0)}$ where $\alpha^{(0)} = 0$. By comparing results for $B = 0$ and $B = 20.0$ G, we determine the Zeeman shift in $\lambda^{(0)}$ to be +26 fm. This is contrary to the result reported in our paper of −36 fm owing to an error in which the Zeeman shift of the ground state was not included in ω'. Because of this mistake the reported value for $\lambda^{(0)}$ is incorrect. The correct value is $\lambda^{(0)} = 790.032\,326(32)$ nm, an adjustment of about 2σ. This also requires a correction to the matrix element ratio that was determined from our result. We now obtain $R = |d_{3/2}|^2/|d_{1/2}|^2 = 1.992\,17(3)$.

We take this opportunity to correct two other errors as well. First, in our comparison to theory, it was necessary to incorporate hyperfine effects into the theoretical result. We originally used an approach similar to Eq. (1) above, but we performed the polarization averaging by calculating the tune-out wavelength for two orthogonal linear light polarizations and then performing an appropriately weighted average of the resulting λ_0 values. This approach is valid only if the derivative $d\alpha/d\lambda$ is independent of the polarization angle, which is not the case here due to the tensor contribution to α. The correct result can be obtained using either Eq. (1) above or Eq. (5) of the paper, both of which agree and give a theoretical value of 790.0315(7) nm. This is about 0.5σ different from our original paper, and agreement with the experimental value is improved.

Finally, we compared our results to a previous measurement by Lamporesi *et al.*, who obtained $\lambda^{(0)} = 790.018(2)$ nm [2]. We noted the considerable disagreement but did not realize this was because Lamporesi *et al.* made their measurement in the $F = 1$ ground state. Using the same method discussed in the previous paragraph, we calculate a theoretical estimate for the tune-out wavelength in $F = 1$ to be 790.0167(7) nm, and applying the calculated hyperfine shift to our measured value yields 790.017 496(32) nm. The result of Lamporesi *et al.* is thus in good agreement with both our calculation and our measurements.

We regret these errors, and appreciate the chance to correct them here.

[1] F. L. Kien, P. Schneeweiss, and A. Rauschenbeutel, Eur. Phys. J. D **67**, 92 (2013).
[2] G. Lamporesi, J. Catani, G. Barontini, Y. Nishida, M. Inguscio, and F. Minardi, Phys. Rev. Lett. **104**, 153202 (2010).

