Erratum: $^{27}Al^+$ Quantum-Logic Clock with a Systematic Uncertainty below 10^{-18} [Phys. Rev. Lett. 123, 033201 (2019)]

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In this Letter, we reported an evaluation of the systematic uncertainty of the third-generation NIST $^{27}Al^+$ quantum-logic clock. Included in this evaluation was a new measurement of the differential polarizability of the $^1S_0 \leftrightarrow {}^3P_0$ transition of $^{27}Al^+$. At dc, the new measurement is a factor of 2.4 smaller than the previous measurement [1]. In addition to reducing the Stark shift due to blackbody radiation, this lower differential polarizability reduces the Stark shift due to the rf electric fields of the ion trap. This latter effect was not taken into account in Eq. (2) of this Letter, which should read

$$\frac{\Delta\nu}{\nu} = -\frac{\langle v_{\mathrm{EMM}}^2 \rangle}{2c^2}\left[1 + \left(\frac{\Omega_{\mathrm{rf}}/2\pi}{617\ \mathrm{MHz}}\right)^2\right]. \tag{1}$$

Here, $\Delta\nu/\nu$ is the fractional frequency shift of the clock transition, v_{EMM} is the component of the ion velocity due to excess micromotion along the probe beam k vector, c is the speed of light in vacuum, and $\Omega_{\mathrm{rf}}/2\pi = 40.72$ MHz is the trap rf drive frequency. The scaling parameter $\Omega_{\mathrm{rf},0}/2\pi = (617 \pm 42)$ MHz depends on the dc differential polarizability $\Delta\alpha$ of the clock states according to [2]

$$\Omega_{\mathrm{rf},0} = \frac{q_e}{mc}\sqrt{\frac{h\nu}{\Delta\alpha}}, \tag{2}$$

where h is Planck's constant, q_e is the elementary charge, and m the $^{27}Al^+$ ion mass. This updated value of the scaling parameter changes the reported micromotion time dilation shift by 2.7×10^{-20} from -45.8×10^{-19} to -45.5×10^{-19}. The effect on the total systematic uncertainty is negligible and all conclusions from this Letter as well as Ref. [3] in which the frequency ratio of this clock with other optical atomic clocks was reported remain valid.

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[1] T. Rosenband, W. M. Itano, P. O. Schmidt, D. B. Hume, J. C. J. Koelemeij, J. C. Bergquist, and D. J. Wineland, in Blackbody Radiation Shift of the $^{27}Al^+$ $^1S_0 \rightarrow {}^3P_0$ Transition (IEEE, Piscataway, NJ, 2006).
[2] P. Dubé, A. A. Madej, M. Tibbo, and J. E. Bernard, Phys. Rev. Lett. **112**, 173002 (2014).
[3] Boulder Atomic Clock Optical Network (BACON) Collaboration, Nature (London) **591**, 564 (2021).

