

**Erratum: Spin versus position conjugation in quantum simulations with atoms:
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In Appendix A, Eq. (A14) contains an incorrect sign in its last line. As a consequence, we withdraw Eq. (A15) and correct the related equations (B5) as

$$\rho^{(\text{int})}(1, 2, 3) = -\frac{\sqrt{3}}{2} \sum_{\odot} [\Phi^{(0;1/2)}(i; j, k) \cdot \Phi^{(1;1/2)*}(k; i, j) - \Phi^{(0;1/2)}(k; i, j) \cdot \Phi^{(1;1/2)*}(i; j, k)] \quad (\text{B5})$$

and (B10) as

$$\rho^{(\text{int})}(1, 2, 3, 4) = -\frac{\sqrt{3}}{2} \sum_{\odot} [\Phi^{(0,0;0)}(i, j; k, 4) \cdot \Phi^{(1,1;0)*}(k, i; j, 4) - \Phi^{(0,0;0)}(k, i; j, 4) \cdot \Phi^{(1,1;0)*}(i, j; k, 4)], \quad (\text{B10})$$

where $\odot$ denotes the sum over three possible cyclic permutations $(1, 2, 3) \rightarrow (i, j, k)$.

Being set by the products of mutually orthogonal single-particle orbitals, the complete spin-position wave functions, belonging to different spin coupling schemes, are orthogonal if the particles occupy different orbitals. Otherwise, both the considered coupling schemes lead to identical wave functions and coincidence in the spatial distributions in accordance with the calculations presented in the main text.

This correction does not affect our principle results, discussed in the main text.