Erratum: Attractive Spin-Orbit Potential from the Skyrme Model [Phys. Rev. Lett. 125, 042501 (2020)]

Chris Halcrow and Derek Harland

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Since publication we have noticed two errors in our calculation. The first is in our calculation for the tensors $A_{ij;ab}$, etc., which was based on a calculation in [1]. In both our Letter and [1], an acceleration was incorrectly neglected. The correct expressions for these tensors are

$$A_{ij;ab} = \varepsilon_{ajc}\left[-\delta_{ib}\nabla_c\left(\frac{e^{-m_\pi X/\hbar}}{X}\right) - \nabla_{ibc}\left(\frac{\hbar e^{-m_\pi X/\hbar}}{2m_\pi}\right)\right], \quad B_{ij;ab} = -\varepsilon_{aic}\varepsilon_{bjd}\nabla_{cd}\left(\frac{\hbar e^{-m_\pi X/\hbar}}{m_\pi}\right),$$

$$C_{ij;ab} = \delta_{ij}\nabla_{ab}\left(\frac{e^{-m_\pi X/\hbar}}{2X}\right) - \nabla_{abij}\left(\frac{\hbar e^{-m_\pi X/\hbar}}{4m_\pi}\right) - (\delta_{jb}\nabla_{ia} + \delta_{ja}\nabla_{ib} + \delta_{ib}\nabla_{ja} + \delta_{ia}\nabla_{jb})\left(\frac{3e^{-m_\pi X/\hbar}}{8X}\right), \quad D_{ab} = \nabla_{ab}\left(\frac{e^{-m_\pi X/\hbar}}{X}\right).$$

There is also an error in the formula for the Hamiltonian $\mathcal{H}$ that precedes Eq. (5), but this does not affect the calculation of the spin-orbit potential. For more details on both errors, see Ref. [2].

As a result of the first error, Eq. (14) is incorrect. The correct formula for the spin-orbit potential is

$$H^2_{LS} = \frac{\rho^2 e^{-2s}}{972\hbar^3 M X^8 \Lambda^2}\boldsymbol{L}\cdot(\boldsymbol{\sigma}_1 + \boldsymbol{\sigma}_2)][64\Lambda^4(s^2+3s+3)^2 - 32\hbar^2X^2(s+1)(7s^2-6s-6) + \hbar^4X^4(s+1)(115s-101)].$$

This Hamiltonian still allows for a negative spin-orbit potential: for example, when $m_\pi = 0$ the leading large r behavior is $H^2_{LS} \sim -101\hbar\rho^2/972MX^4\Lambda^2$. However, with the calibration used in the Letter (originally proposed by Lau-Manton) the spin-orbit potential is positive at intermediate separations $r \sim 2$ fm, as shown in Fig. 1. In a forthcoming paper, we show that the correct sign is obtained at intermediate separations using a more sophisticated approximation based on instanton holonomies [3].

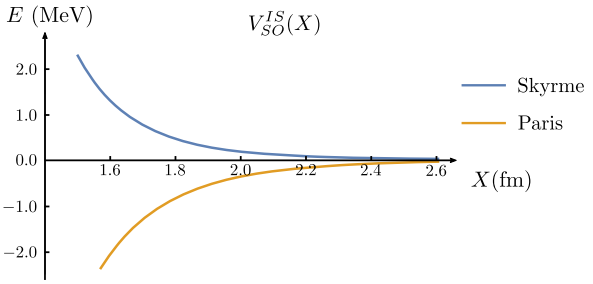

FIG. 1. A comparison between the isoscalar spin-orbit force from the Skyrme and phenomenological Paris potential. This replaces Fig. 2.

[1] B. J. Schroers, Z. Phys. C **61**, 479 (1994).
[2] D. G. Harland and C. J. Halcrow, Nucl. Phys. **B967**, 115430 (2021) (corrigendum arXiv:2101.02633).
[3] C. J. Halcrow and D. G. Harland, arXiv:2208.04863.