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Harmonically trapped two-atom systems: Interplay of short-range s-wave interaction and spin-orbit coupling[1] X.Y. YIN, Washington State University, S. GOPALAKRISHNAN, Harvard University, D. BLUME, Washington State University — We investigate the interplay between the single-particle spin-orbit coupling term of Rashba type and the short-range two-body s-wave interaction for cold atoms under external confinement. Treating the spin-orbit term with strength k_{so} perturbatively, we determine the correction to the ground state energy for various parameter combinations. We find that the interplay between the spin-orbit coupling term and the s-wave interaction enters, depending on the exact parameter combinations of the s-wave scattering lengths, at order k_{so}^2 or k_{so}^4 for the ground state and leads to a shift of the energy of either sign. Additionally, we find that, for certain parameter combinations, the spin-orbit coupling term turns sharp crossings into avoided crossings with an energy splitting proportional to k_{so}. Our perturbative results are confirmed by numerical calculations that expand the eigenfunctions of the two-particle Hamiltonian in terms of basis functions that contain explicitly correlated Gaussians.

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