Prediction of the spin triplet two-electron quantum dots in Si: towards controlled quantum simulations of magnetic systems

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Ground state of two-electron quantum dots in single-valley materials like GaAs is always a spin singlet regardless of what the potential and interactions are. This statement cannot be generalized to the multi-valley materials like n-doped Si. Here we calculate the spectrum of a two-electron Si quantum dot analytically and numerically and show that the dot with the lateral size of several nm can have the spin triplet ground state which is impossible in the single-valley materials. Predicted singlet-triplet level crossing in two-electron Si quantum dots can potentially establish the platform for quantum simulation of magnetic many-body systems based on the triplet quantum dots. We suggest several examples of such systems that open a way to controlled quantum simulations within the condensed matter setting.