On modeling and visualizing single-electron spin motion

Ciann-Dong Yang

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Abstract

In this paper quantum Hamilton–Jacobi theory are exploited to model and visualize single-electron spin motion at zero-point energy state. Quantum Hamilton equations of motion are derived and solved analytically for an electron moving in a constant magnetic field. The resulting electron's trajectories explain explicitly why the electron has quantized spin and orbital angular momenta and why the electron has an intrinsic spin $\hbar/2$ with a g factor of 2. This quantum spin model, unlike the usual one expressed by the abstract spin matrices, is fully based on the measurable motion trajectory of electron and may hopefully provide us a succinct guideline to visualize single-electron spin motion in laboratory.