Title: The effects of the spin-orbit coupling on the electronic spin state of quasi-one-dimensional nanowire quantum dot

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Abstract: In recent decade, the SOC in semiconductor nanowire structures plays an important role in exploring new physical mechanisms. However, in most cases, the SOC term is always regarded as a perturbation term to facilitate the calculation process, such that the strong SOC effects are always overlooked. Here we study the effects of the strong SOC on the electric-dipole spin resonance (EDSR) in a nanowire DQD. We find that there are two mechanisms leading to the EDSR in the DQD: the intradot orbital states mixing and the interdot spin-flipped tunneling. Moreover, in the nanostructures with large g-factor and strong SOC, the phonon-induced relaxations can be effectively suppressed even at relatively small magnetic fields because of the phonon bottleneck effect. Finally, we study the two-electron exchange interaction in a nanowire DQD under the influence of the strong SOC and the magnetic field, and reveal the controlliablity of the two-electron exchange interaction.