Pseudospin resonances reveal synthetic spin-orbit interaction

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The interplay between interference and interaction produces several effects in degenerate quantum systems, including spin torques [1], dark states formation [2] and multilevel coherences [3]. In this context, a spin resonance without spin splitting has been first predicted for a single quantum dot spin valve [4]. We investigate a spinful double quantum dot coupled to leads in a pseudospin valve configuration. We predict in the stability diagram a rich variety of current resonances which are modulated by the system parameters [5]. In the presence of ferromagnetic leads and pseudospin anisotropy, those resonances split, turn into dips, and acquire a Fano shape, thus revealing a synthetic spin-orbit interaction induced on the double quantum dot. A set of rate equations derived for a minimal model captures those features. The model accurately matches the numerical results obtained for the full system in the framework of a generalized master equation and calculated within the next to leading order approximation.

References

[1] M. Braun et al., Phys. Rev. B 70 (2004), 195345
[2] A. Donarini et al., Nature Comm. 10 (2019), 381
[3] M. Maurer et al., Phys. Rev. Research 2 (2020), 033440
[4] M. Hell et al., Phys. Rev. B 91 (2015), 195404
[5] C. Rohrmeier et al., Phys. Rev. B 103 (2021), 205420

Figures

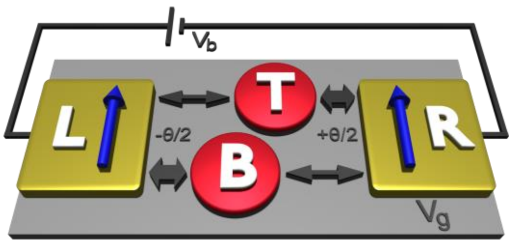

Figure 1: Schematic setup of a double quantum dot in a pseudospin valve configuration

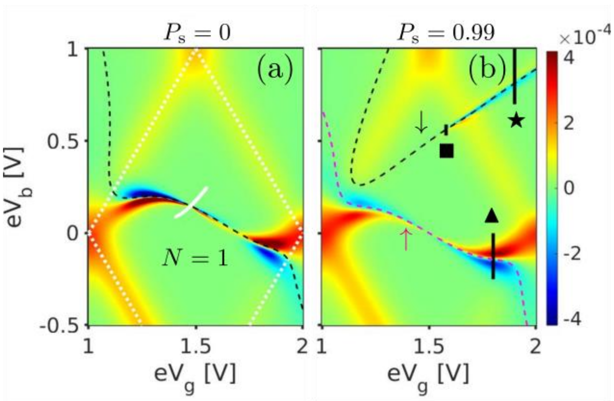

Figure 2: Differential conductance of a double quantum dot shows pseudospin resonances tuned by spin polarization P_s

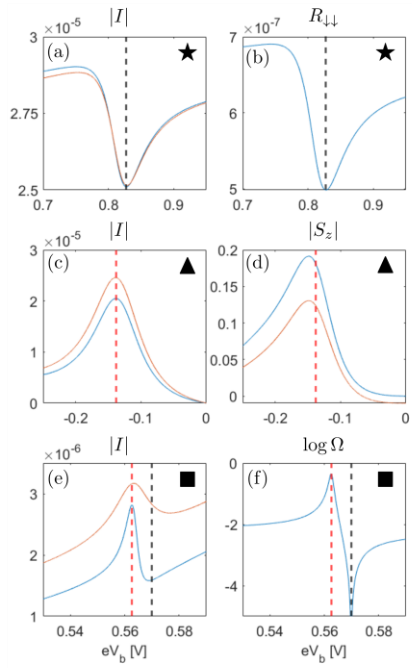

Figure 3: Bias traces from Fig. 2 b)