SiGe self-assembled nanostructures for quantum spintronics

N. Ares,[1] V. N. Golovach,[1, 2] G. Katsaros,[1, 2] M. Stoffel,[3] F. Fournel,[4] L. I. Glazman,[5] O. G. Schmidt,[2] and S. De Franceschi[1]

[1] SPSMS, CEA-INAC/UJF-Grenoble 1, 17 Rue des Martyrs, F-38054 Grenoble Cedex 9, France
[2] Institute for Integrative Nanosciences, IFW Dresden, Helmholtzstr. 20, D-01069 Dresden, Germany
[3] Universit´e de Lorraine, Institut Jean Lamour, UMR CNRS 7198, Nancy-Universit´e, BP 239, F-54506 Vandoeuvre-les-Nancy, France
[4] CEA, LETI, MINATEC, 17 Rue des Martyrs, F-38054 Grenoble Cedex 9, France
[5] Department of Physics, Yale University, New Haven, Connecticut 06520, USA

Quantum spintronics aims at utilizing the quantum nature of individual spins to bring new functionalities into logic circuits. Here we investigate a new route to quantum spintronics based on p-type SiGe nanostructures. This system combines weak hyperfine interaction, which is a favourable property for long spin coherence, with strong spin-orbit coupling, which can enable fast spin manipulation. We shall present tunneling and co-tunneling spectroscopy experiments on single quantum-dot devices. Our measurements reveal a variety of spin-related properties of the confined hole states. In particular, we find large g-factor anisotropies as well as pronounced spin-orbit related asymmetries in the non-linear transport characteristics [1,2]. In addition, we report a giant non-monotonic modulation of the hole g-factors induced by an external electric field [3]. Implications and schemes for electrically-driven spin coherent manipulation and readout are discussed.

[1] G. Katsaros, P. Spathis, M. Stoffel, F. Fournel, M. Mongillo, V. Bouchiat, F. Lefloch, A. Rastelli, O. G. Schmidt, and S. De Franceschi, *Nature Nanotechnology* **5**, 458 (2010).
[2] G. Katsaros, V.N. Golovach, P. Spathis, N. Ares, M. Stoffel, F. Fournel, O.G. Schmidt, L.I. Glazman, and S. De Franceschi, *Phys. Rev. Lett*. **107**, 246601 (2011).
[3] N. Ares, V.N. Golovach, G. Katsaros, M. Stoffel, F. Fournel, L.I. Glazman, O.G. Schmidt and S. De Franceschi, Phys. Rev. Lett. **110**, 046602 (2013).