

# Theory of Condensed Matter: Hard Condensed Matter

Feb. 6, 2015 at 10:30 a.m.  
Galileiraum, 01-128, Staudinger Weg 9

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## **Spin Filtering: how to write and read quantum information on mobile qubits**

Quantum computing requires the ability to write and read quantum information on the spinors of electrons. This work considers mobile electrons, which move through mesoscopic (or molecular) quantum networks (made of quantum wires or of arrays of quantum dots). Combining spin-orbit interactions, whose strength can be tuned by external gate voltages, and the Aharonov-Bohm flux, which can be tuned by an external magnetic field, one can manipulate the properties of such networks, so that the outgoing electrons are polarized along a desired direction. This amounts to 'writing' the desired information on the spinor of the electrons. Given a beam of polarized electrons, the charge conductance of the same network depends on their polarization, allowing 'reading' the qubit information. Specific results will be presented for a simple closed interferometer. [1] The talk will also report on more recent work:

(a) The above filtering is robust against leaking of electrons, in an open interferometer. [2] (b) Filtering can also be achieved for a single one dimensional chain which has spin-orbit interactions, when the chain vibrates in the transverse direction. [3] (c) Real time evolution of the polarizations in the filter. [4]

[1] A. Aharony, Y. Tokura, G. Z. Cohen, O. Entin-Wohlman, and S. Katsumoto, Filtering and analyzing mobile qubit information via Rashba-Dresselhaus-Aharonov-Bohm interferometers Phys. Rev. B 84, 035323 (2011);(arXiv: 1103.2232)

[2] S. Matityahu, A. Aharony, O. Entin-Wohlman and S. Katsumoto, Robustness of spin filtering against current leakage in a Rashba-Dresselhaus-Aharonov-Bohm interferometer Phys. Rev. B 87, 205438 (2013); (arXiv: 1302.6772)

[3] R. I. Shekhter, O. Entin-Wohlman, and A. Aharony Mechanically-controlled Rashba spin-splitters Phys. Rev. Lett. 111, 176602 (2013); (arXiv:1306.5125)

[4] M. Wei-Yuan Tu, A. Aharony, W-M Zhang and O. Entin-Wohlman Real-time dynamics of spin-dependent transport through a double-quantum-dot Aharonov-Bohm interferometer with spin-orbit interaction. Phys. Rev. B 90, 165422 (2014); (arXiv:1406.6258)