Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Ge hut wires: a material platform good for hosting spin and topological qubits?"

Georgios Katsaros, Institute of Science and Technology Austria

Abstract: The interest in holes as potential spin qubits has strongly increased in the past few years. Due to the intrinsically large spin orbit coupling, hole spin qubits are electrically tunable and show high Rabi frequencies. Indeed in 2016, the first hole spin qubit with Rabi frequencies as high as 70MHz was demonstrated [1]. In my talk I will present the first Ge heavy hole spin qubit. The qubit is formed in a Ge hut-wire [2] double quantum dot. G-factor measurements underline the heavy-hole character of the confined states [3]. Presumably due to the even stronger spin orbit coupling in Ge, Rabi-frequencies of 140 MHz were reached [4]. Ramsey experiments revealed dephasing times of 130 ns. Finally, by measuring the spin relaxation time of holes in Ge hut wires an upper bound for the coherence time could be extracted [4].

While the reported results are a first step towards the realization of viable hole spin qubits the measured dephasing times are clearly rather short. Alternatively one might consider to use Ge nanowires as a host for the realization of Majorana fermions [6]. I will discuss challenges and possible strategies towards the use of Ge for the realization of topological superconductivity.

[1] R. Maurand et al., Nature Communications **7**, 13575 (2016)
[2] J. J. Zhang et al., Phys. Rev. Lett. **109**, 085502 (2012)
[3] H. Watzinger et al., Nano Lett. **16**, 6879 (2016).
[4] H. Watzinger, J. Kukucka et al., Nature Comm. **9,** 3902 (2018)
[5] L. Vukušić et al., *Nano Lett.*, **18**, 7141 (2018)
[6] F. Maier et al., Phys. Rev. B **90**, 195421 (2014)

2:00pm
Tuesday, March 12, 2019
Duboc Room (4-331)

Host: Constantin Schrade