



Seminar

Dynamical Shiba states and bands in s-wave superconductors

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Time: 2:00pm, March. 9, 2017 (Thursday)

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2:00

Venue: Room w563, Physics building, Peking University

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Magnetic impurities inserted in an s-wave superconductor give rise to spin-polarized in-gap states called Yu-Shiba-Rusinov (YSR) states. When a set of such impurities are put in proximity with one another, forming for example a chain, they hybridize and they rise to a Shiba band that is described by a p-wave, or topological superconductor [1]. Such a system can host at its edges zero energy Majorana fermions, which are the basic units for topological quantum computing, an extremely promising avenue for building up a quantum computer. While all previous studies dealt with static magnetic impurities, in this talk, I will address the physical manifestations associated with the dynamics of such impurities. For the single Shiba state, I will show that the impurity spin precession pertains to dc charge and spin currents flowing through a normal STM tip tunnel coupled to the superconductor in the vicinity of the impurity. The resulting charge current is found to be proportional to the difference between the electron and hole wave-functions of the Shiba state, being a direct measure for such an asymmetry [2]. In the case of a Shiba band, I will show that such a dynamical setup gives rise to a Hamiltonian that shows non-trivial topological properties, and present the corresponding topological phase diagram. I will show that changing precession frequency potentiates control over topological phase transitions and the emergence of Majorana bound states. Finally, I will show that our proposal could be implemented in an on-chip setup, by driving the magnetic impurities or texture by means of the spin-transfer torque [3].

[1] Gerbold C. Ménard, Sébastien Guissart, Christophe Brun, Mircea Trif, et al, arXiv:1607.06353

[2] V. Kaladzhyan, S. Hoffman, M.Trif, arXiv:1611.09722

[3] V. Kaladzhyan, P. Simon, M.Trif, (to appear this week)

Prof. Mircea Trif is a theory faculty in Institute for Interdisciplinary Information Sciences (IIIS) at Tsinghua University. He obtained PhD from University of Basel in Switzerland in 2010 under supervise of Daniel Loss, where he worked on spin-electric coupling in quantum dots and molecular magnets. After one year postdoc in Basel, he worked with Yaroslav Tserkovnyak at UCLA (2011-2013) and with Pascal Simon and Cristina Bena at University of Paris-Saclay (2014-2016). Since last winter, he became an assistant professor in IIIS at Tsinghua University. He has published around 30 papers in a field of spintronics, topological matter, graphene, cavity quantum electrodynamics, molecular magnet and spin qubits, which includes 4 PRL and one PRX and 10 PRB. His total citation is above 700 with hindex 13.