Majorana Quasiparticles in Transport Through Hybrid Nanostructures

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The search of Majorana fermions, particles that are their own antiparticles, has triggered a considerable interest in the physics community. Although their existence is still elusive, the fate of Majoranas has stimulated extensive research in the field of condensed matter, when it turned out that zero-energy bound states of topological superconducting nanowires may behave as Majorana quasiparticles. The presence of topologically-protected Majorana bound states that form at the ends of such wire is signaled by a zero bias peak in the system's conductance. Moreover, their existence is also revealed in transport properties of attached quantum dots, where the effect of Majorana modes leaking was found to give rise to fractional values of the conductance through quantum dot. In this talk, I will present our recent results on the transport characteristics of hybrid nanostructures consisting of topological superconducting nanowires attached to quantum dots. The focus will be put on strong electron correlations and transport regimes, where the Kondo effect can coexist with topologically-protected Majorana modes leading to unique transport behavior. I will discuss the cases of both single and double hybrid quantum dot systems. In the latter case, depending on the device geometry, the Majorana mode can leak into both quantum dots, giving rise to fractional values of conductance and revealing a subtle interplay between the Kondo screening and the half-fermionic nature of Majorana quasiparticles. Finally, I will analyze the case when the leads are subject to a thermal gradient, focusing on the behavior of thermopower and discussing new sign changes in the temperature dependence of the Seebeck effect due to the presence of Majorana zero-energy modes.

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