Spin-resolved scanning tunnel spectroscopy of artificial spin-lattices: emulation of complex electron phases

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Using a scanning tunnel microscope tip, arrays of hundreds of atomic spins can be assembled at various geometries on solid body surfaces containing itinerant conduction electrons [1]. The hybrid system formed by the spin-lattice coupled to the itinerant electrons can realize complex zero- (0D), one- (1D) and two-dimensional (2D) electron phases at will enabling an extensive control over the system‘s parameters [2 – 8]. Application of low-temperature spin-resolved scanning tunnel spectroscopy then permits us to measure the local electron density of states of such electron phases, as well as their excitations, with atomic spatial and high spin- and energy-resolution [9]. In this talk, I will introduce the methodology we use, and focus on two example systems we studied: (i) a small-gap 1D topological superconductor hosting precursors of Majorana edge modes [5] and (ii) a (0D) quantum dot with proximity-superconducting modes [8] coupled to the Yu-Shiba-Rusinov states induced by a single spin. I will finally discuss prospects of future projects and collaborations.

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