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From single magnetic adatoms on superconductors to coupled spin chains[1]

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Magnetic adsorbates on conventional s-wave superconductors lead to exchange interactions that induce Yu-Shiba-Rusinov (YSR) states inside the superconducting energy gap. Here, we employ tunneling spectroscopy at 1.1 K to investigate magnetic atoms and chains on superconducting Pb surfaces. We show that individual Manganese (Mn) atoms give rise to a distinct number of YSR-states. The single-atom junctions are stable over several orders of magnitude in conductance. We identify single-electron tunneling as well as Andreev processes [1]. When the atoms are brought into sufficiently close distance, the Shiba states hybridize, thus giving rise to states with bonding and anti-bonding character. It has been shown that the Pb(110) surface supports the self-assembly of Fe chains, which exhibit fingerprints of Majorana bound states [2]. Using superconducting tips, we resolve a rich subgap structure including peaks at zero energy and low-energy resonances, which overlap with the putative Majorana states [3].

References:
[1] M. Ruby, et al., Phys. Rev. Lett. 115, 087001 (2015).
[2] S. Nadj-Perge, et al., Science 346, 602 (2014).
[3] M. Ruby, et al., Phys. Rev. Lett. 115, 197204 (2015).

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