Two-dimensional topological superconductivity in Pb/Co/Si(111)

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Majorana fermions are very peculiar quasiparticles that are their own antiparticle. They obey non-abelian statistics: upon exchange, they behave differently from fermions (antisymmetric) and bosons (symmetric). Their unique properties could be used to develop new kind of quantum computing schemes. Majorana states are predicted to appear as edge states of topological superconductors, in a similar way as Dirac surface states appears at the edge of topological insulators. Spectroscopic signatures of Majorana bound states were claimed to be observed in one-dimensional (1D) InAs nanowires proximity-coupled to a bulk superconductor. Then Nadj-Perge et al. [1] have realized a chain of Fe adatoms on a Pb(110) crystal that is supposed to induce locally a 1D topological p-wave superconductivity. Zero-energy bound states were observed at the extremity of some the Fe chain and claimed to be interpreted as Majorana excitations [1]. Nevertheless this interpretation is challenged by close to zero-energy Shiba states [2].

We have recently decided to follow a different strategy using sizeable magnetic disks made of Cobalt buried under a superconducting monolayer of Pb grown on Si(111). We have observed that dispersive edge states appear in the superconducting gap around the magnetic domains [3]. We have interpreted these spectroscopic features as signatures of a locally induced topological superconductivity in our 2D system consisting in Pb/Co/Si(111). Indeed, we expect to get some propagative Majorana edge states around 2D topological domains since the edges have a 1D character. This is at odds with the Fe chains whose edge states are intrinsically 0D and are thus characterized by non-propagative bound states.

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