Artificial spin chains on superconductor surfaces

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A magnetic chain on an s-wave superconductor hosting a spin spiral or strong spin-orbit coupling can potentially realize a one-dimensional topological superconductor with Majorana bound states on its edges [1-5]. Here, we investigate artificial spin chains, which have been built atom-by-atom, with respect to the emergence of such topologically nontrivial electron phases. By this approach we not only vary the substrate and adatom species [6,7,8], but also tailor the interactions between the Yu-Shiba-Rusinov states induced by the adatoms [8] which eventually results in the formation of multi-orbital in-gap bands for the chain. We correlate the electronic properties of these bands with the spin structures of the chains as revealed by spin-resolved scanning tunneling spectroscopy [9].

In particular, we analyze the interference of Bogoliubov quasiparticles in short chains and, thereby, reveal the formation of multiple in-gap bands. This enables us to access momentum information about their band dispersions. Using this information, we find evidence that one of the bands is topologically non-trivial and gapped by effective p-wave correlations. This work features an important step towards the distinct experimental determination of topological phases from bulk properties only.

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