Probing Atomic Structure and Majorana Wavefunctions in Mono-Atomic Fe-chains on Superconducting Pb-Surface

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Motivated by the striking promise of quantum computation, Majorana bound states (MBSs) [1] in solid-state systems [2-3] have attracted wide attention in recent years [4-6]. In particular, the wave-function localization of MBSs is a key feature and crucial for their future implementation as topological qubits [2-3]. Here, we investigate the spatial and electronic characteristics of topological superconducting chains of iron atoms on the surface of Pb(110) by combining scanning tunneling microscopy (STM) and atomic force microscopy (AFM) at low temperature. We demonstrate that the Fe chains are mono-atomic, structured in a linear fashion, and exhibit zero-bias conductance peaks at their ends which we interpret as signature for a Majorana bound state. Spatially resolved conductance maps of the atomic chains reveal that the MBSs are well localized at the chain ends (< 25 nm), with two localization lengths as predicted by theory [7-8]. Our observation lends strong support to use MBSs in Fe chains as qubits for quantum computing devices.

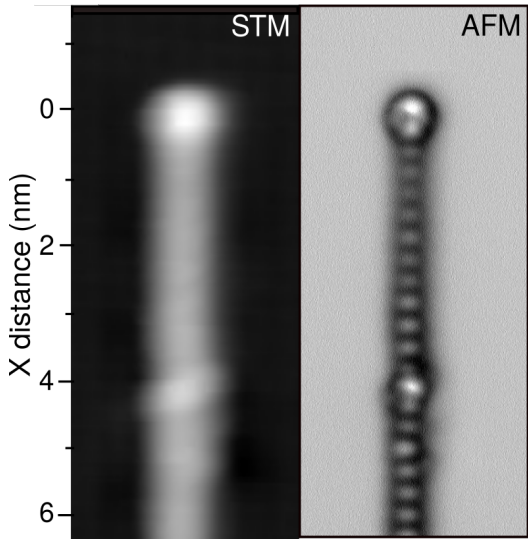

Figure 1: a, STM topographic image of the Fe chain end on Pb(110). **b,** Corresponding AFM image revealing the atomic structure of the chain.

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