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Topological Superconductivity in Ferromagnetic Metal Chains: Part II JIAN LI, Princeton University, HUA CHEN, University of Texas at Austin, ILYA DROZDOV, ALI YAZDANI, BOGDAN BERNEVIG, Princeton University, ALLAN MACDONALD, University of Texas at Austin — One most important feature of the Majorana end states observed in the STM experiments is their sharply localized spatial profile. This cannot be explained by a conventional model for 1D topological superconductors, which predicts that Majorana end states wouldn't be observable in a chain much shorter than the superconducting coherence length. In this second talk we resolve this issue by showing the fundamental difference between the naïve 1D model and a proper one, where the 1D-2D/3D hybrid nature of the real experimental structure is taken into account. The strong hybridization between the chain and the higher-dimensional host superconductor introduces long-range (power-law) coupling into the 1D system and significantly modifies the spatial profile of possible Majorana states. As a consequence the superconducting coherence length becomes irrelevant to the decay of the Majorana wavefunctions at a small length scale whereas the Fermi wavelength prevails. We will show concrete examples of eigenstates in a finite-size hybrid system where the Majorana end states are indeed localized within a length scale determined by the Fermi wavelength. This is in good agreement with experimental observations. We will also discuss the implication of this new regime, where the superconducting coherence length is irrelevant by realistic measure, in terms of the coupling energy between Majorana states and the operation time when braiding them.

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