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Engineering Majorana fermions in atomic chains with collinear magnetic order. PANAGIOTIS KOTETES, ANDREAS HEIMES, DANIEL MENDLER, GERD SCHÖN, Karlsruhe Institute of Technology — We propose new mechanisms for engineering Majorana fermions (MFs) based on atomic chains with collinear magnetic order, on top of a conventional superconductor. For antiferromagnetic ordering, we show [1] that a weak Zeeman field and a supercurrent convert the preexisting topologically-unprotected Shiba states into MFs, without the requirement of Rashba spin-orbit coupling (SOC). Remarkably, the electronic spin-polarization of the arising edge MF wavefunctions depends solely on the parity of the number of magnetic moments, which can serve as a unique signature of the MFs. Instead, if Rashba SOC is present, both ferro- and anti-ferromagnetic orders can lead to topological phases which can harbor one or even two MFs per edge [2]. We demonstrate how to experimentally access the diverse MF phases by varying the adatom spacing, the SOC strength, or the magnetic moment of the adatoms in consideration.The two magnetic orderings lead to qualitatively and quantitatively distinct topological features that are reflected in the spatial profile of the MF wavefunctions. Our findings connect to the recent observations of MFs in atomic chains [3] and can open alternative routes for confirming the emergence of MFs. [1] A. Heimes, P. Kotetes, and G. Schön,PRB 90, 060507(R) (2014). [2] A. Heimes, D. Mendler, and P. Kotetes, arXiv:1410.6367. [3] S. Nadj-Perge et al., Science 346, 602 (2014).

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