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Implementing Majorana fermions in quantum wires with periodic Zeeman fields XIAOYU ZHU, WEI CHEN, RUI SHEN, DINGYU XING, National Laboratory of Solid State Microstructures and Department of Physics, Nanjing University, Nanjing 210093, China — We introduce a category of periodic Zeeman field and apply it to 1-D quantum wire placed on an s-wave superconductor substrate. By decomposing the field into two counter-propagating spiral fields, we argue that each spiral component corresponds to a separate topological non-trivial region where Majorana fermions emerge. As a result, Majoranas exhibit reentrance behavior with the increase of chemical potential. The position of non-trivial regions in phase diagram can be adjusted through modulating Rashba amplitude and periods of Zeeman fields. Furthermore, we find that different non-trivial regions determined by the two spiral components begin to overlap when Zeeman fields increase to a certain point, with the overlapping area supporting fractional fermions instead of Majoranas. In the end, we study the spin texture of Majorana zero mode bound states and demonstrate that local spin polarization depends strongly on phases of Zeeman fields as well as on chemical potential, suggesting a feasible way to modulate Majorana spin.

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