

Making Majoranas step by step

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In most theoretical proposals, creation of Majorana bound states appears to be deceptively easy: one only needs to combine superconductivity, spin-orbit coupling, control over electron density, and Zeeman effect of magnetic field. However while control over every single one of these five parameters is a relatively standard task, combining all of them at once in a controllable fashion is an enormous experimental challenge. I will introduce some possible ways of solving this problem. Specifically, I will show how Majoranas can be created in a bottom-up approach, by tuning a single parameter at a time in a position-dependent fashion similar to spin qubits. I will further introduce a way to remove the need for an external magnetic field by substituting it with superconducting phase differences. I will prove that this becomes possible in a quantum dot with more than two superconducting terminals, when the phase differences satisfy a 'vortex condition'.