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**Majorana bound states without topological superconductivity** PABLO SAN-JOSE, JORGE CAYAO, Consejo Superior de Investigaciones Científicas (CSIC) - Spain, ELSA PRADA, Universidad Autónoma de Madrid (UAM) - Spain, RAMÓN AGUADO, Consejo Superior de Investigaciones Científicas (CSIC) - Spain — Recent experimental efforts towards the detection of Majorana bound states have focused on creating the conditions for topological superconductivity. Here we demonstrate an alternative route, which achieves fully localised zero-energy Majorana bound states when a topologically trivial superconductor is opened to a normal region. The emergence of Majorana states is a consequence of non-hermitian degeneracies of the resulting open quantum system, while arbitrarily large Majorana lifetimes follow from high junction transparency and helicity of the normal side. At these degeneracies, also known as "exceptional points," both the eigenvalues and the eigenstates coalesce, and acquire Majorana properties (zero-energy, self-conjugation, $4\pi$-periodic braiding...) despite the trivial band topology. Exceptional Majoranas are thus the open-system counterparts of conventional Majorana bound states, to which they are continuously connected, and exhibit all their phenomenology while not requiring topological superconductivity.

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