Majorana bound states in encapsulated bilayer graphene

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The search for robust topological superconductivity and Majorana bound states continues, exploring both one-dimensional (1D) systems such as semiconducting nanowires and two-dimensional (2D) platforms. In this work we study a 2D approach based on graphene bilayers encapsulated in transition metal dichalcogenides that, unlike previous proposals involving the Quantum Hall regime in graphene[2,3], requires weaker magnetic fields and does not rely on interactions.

The encapsulation induces strong spin-orbit coupling on the graphene bilayer, which in turn has been shown to open a sizeable gap and stabilize fragile pairs of helical edge states[4]. We show that, when subject to an in-plane Zeeman field, armchair edge states can be transformed into a p-wave one-dimensional topological superconductor by laterally contacting them with a conventional superconductor. We demonstrate the emergence of Majorana bound states (MBSs) at the sample corners of crystallographically perfect flakes, belonging either to the D or the BDI symmetry classes depending on parameters.

We compute the phase diagram, the resilience of MBSs against imperfections, and their manifestation as a 4π-periodic effect in Josephson junction geometries, all suggesting the existence of a topological phase within experimental reach.

References

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Figures

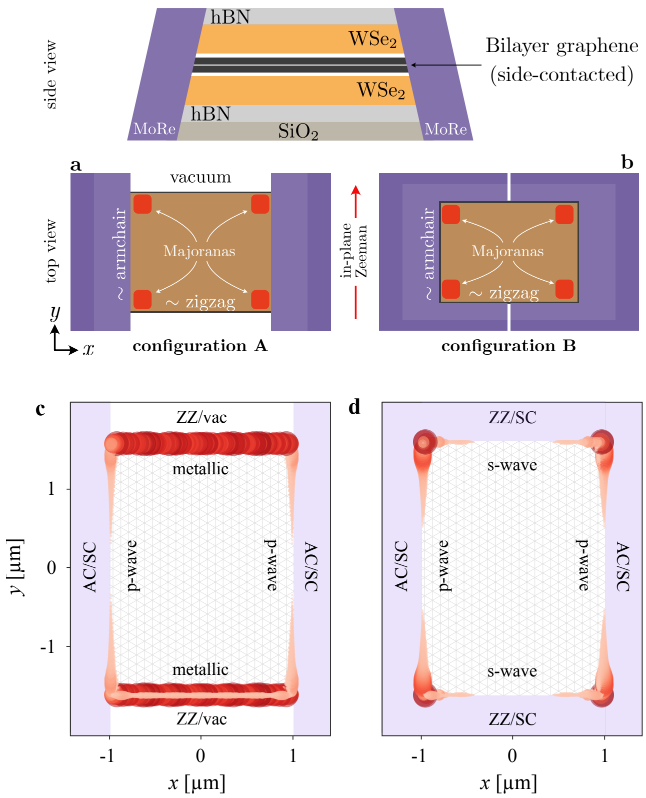

Figure 1: Top and lateral views of the proposed device configurations A and B (a-b). Spatial density of Majorana delocalised zero modes (c) and Majorana bound states (d) on top of the lattice.