Localized defects turn graphene to topological: dislocations & fractional charge

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The iconic integer quantum Hall effect initiated an unabated interest in topological materials and their measurable quantities. However, there is no systematic way to design on-demand topological materials. Furthermore, given a topological material, it is usually unknown which quantity gives access to Chern or winding numbers. I will show how to design defects and/or textures using properly tailored potentials that provide topological invariants, protected zero modes, and fractional charges and how to compute these topological properties for the specific example of graphene. We propose a novel method to access topological numbers from a new interference effect observable in STM wavefront dislocations. I shall also discuss how topology modifies fundamental physical phenomena e.g., Friedel oscillations, magnetic impurities (Anderson model) and relate those to the anticipated accumulated fractional charge.

References

[1] Y. Abulafia, A. Goft, N. Orion, and E. Akkermans, arXiv:2307.05185 (2023)
[2] A. Goft, Y. Abulafia, N. Orion, C. L. Schochet, and E. Akkermans, Phys. Rev. B 108, 054101 (2023).

Figures

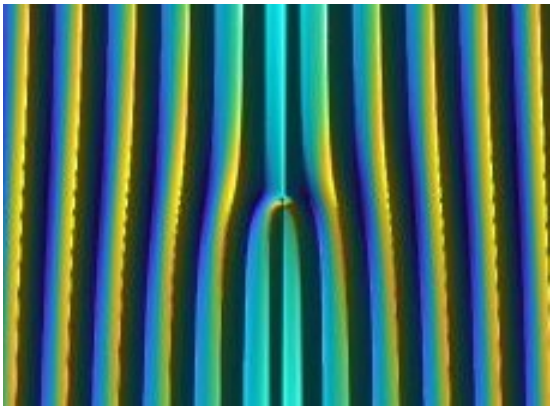

Figure 1: Graphene with a vacancy – a topological defect- induce a single STM wavefront dislocation.

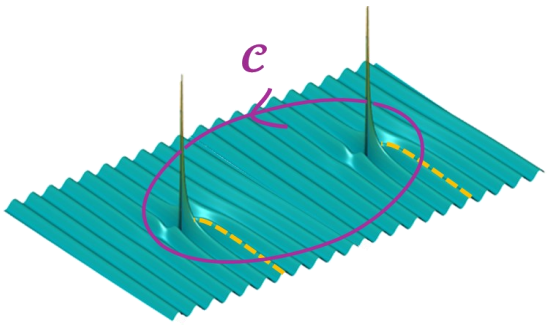

Figure 2: A contour around two topological defects of the same type in graphene accumulates the number of dislocations