Nonlinear Chiral Plasmonics in Graphene

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The realm of plasmonic devices based on graphene and akin materials promises us a way to bridge electronics and photonics, closing the THz gap [1]. Here we study the occurrence and behaviour of nonlinear plasma waves [2] – viz. Solitary (Fig. 1) and localized chiral waves – in two-dimensional materials and discuss the foreseeable applications. In particular, we consider a graphene structure as a unidirectional waveguide; where solitary waves arise from the interplay of Coulomb long-range interaction and quantum Bohm potential [3] in the bulk. Secondly, we study localized plasmonic modes propagating along a magnetic domain wall (Fig. 2), showing that such modes are topologically protected chiral waves [4].

References

[1] P. Cosme and H. Terças, Applied Physics Letters, 118 (2021), 131109
[2] P. Cosme and H. Terças, Phys. Rev. B, 107 (2023) 195432
[3] J. L. Figueiredo, J. P. S. Bizarro, and H. Terças, New Journal of Physics, 24 (2022) 023026
[4] C. Tauber, P. Delplace, and A. Venaille, Physical Review Research, 2 (2020) 013147

Figures

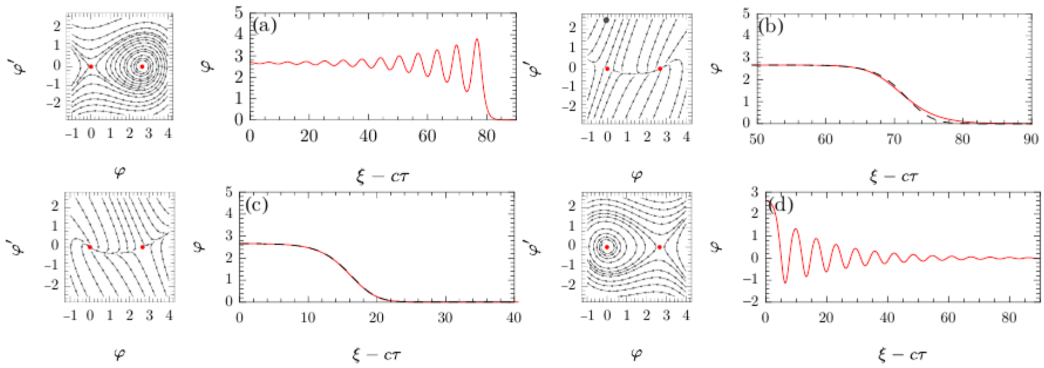

Figure 1: Phase space and solutions of the non-linear plasmon waves in graphene. From [2]

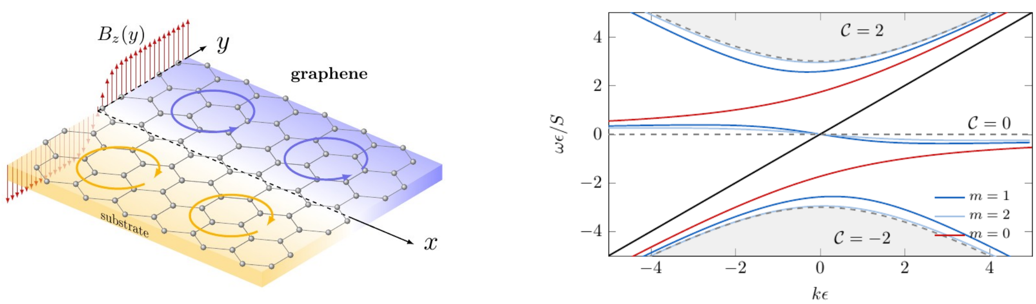

Figure 2: (Left) Proposed graphene topological wave guide device (Right) Dispersion relations for the chiral modes with Chern number ±2. The bulk continuum bands are represented as the gray shaded area.