Topological control of light with graphene devices

Coskun Kocabas
The University of Manchester, Department of Materials, National Graphene Institute, Manchester, UK
Coskun.Kocabas@manchester.ac.uk

The topological structure associated with the branchpoint singularity around an exceptional point (EP) can provide tools for controlling the propagation of light. Using graphene-based devices, we demonstrate the emergence of EPs in the electrically controlled interaction of light with a collection of organic molecules in the terahertz regime at room temperature. We show that the intensity and phase of terahertz pulses can be controlled by a gate voltage which drives the device across the EP. Our electrically tuneable system allows reconstructing the Riemann surface associated with the complex energy landscape and provides a topological control of light by tuning the loss-imbalance and frequency detuning of interacting modes. Our approach provides a platform for developing topological optoelectronics and studying the manifestations of EP physics in light-matter interactions.

References

[1] Ergoktas, M. Said, et al. "Topological engineering of terahertz light using electrically tunable exceptional point singularities." Science 376.6589 (2022): 184-188.

Figures

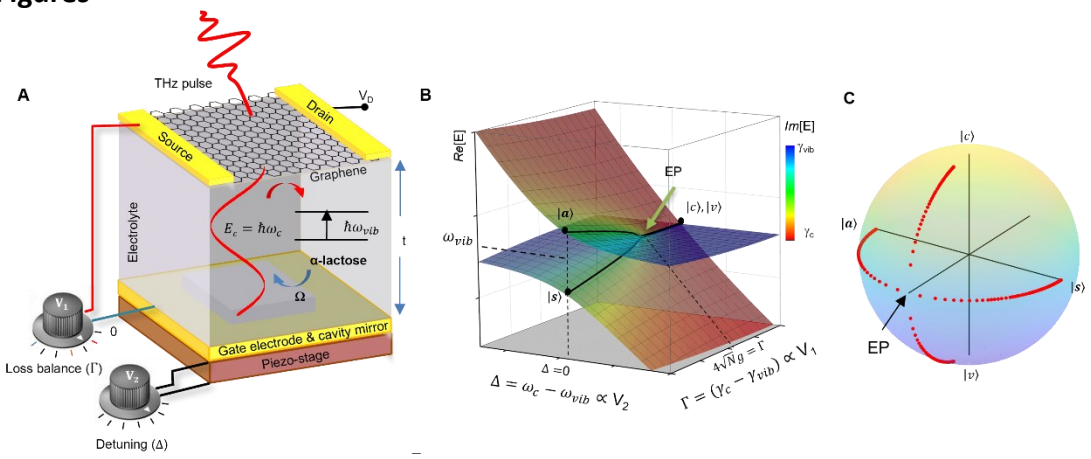

Figure 1: Electrically tuneable EP device. A, Schematic of the electrolyte-gated graphene transistor embedded with lactose microcrystals. B, Riemann surface obtained using numerical simulations shows the complex energy eigenvalues of the device plotted on the two-parameter voltage space defined by V_1 and V_2. C, Visualization of the evolution of the supermodes of the coupled system on a Bloch sphere as the gate voltage V_1 is varied (loss imbalance Γ is tuned).