Non-Hermitian topology in multi-terminal devices: from fundamental to applications

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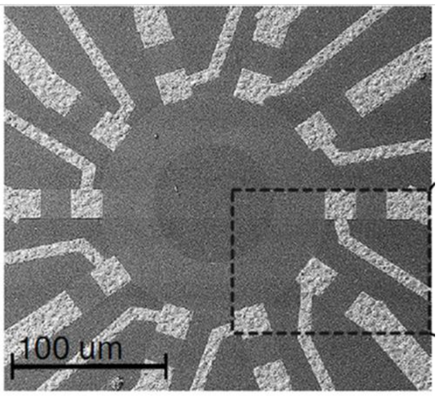
Quantum devices characterized by non-Hermitian topology are predicted to show very robust and potentially useful properties, but realizing them has remained a daunting experimental task. This is because non-Hermiticity is often associated with gain and loss, which would require precise tailoring to produce the signatures of nontrivial topology.
Instead of gain/loss, we use the nonreciprocity of quantum Hall edge states to directly observe the non-Hermitian topology of a multi-terminal ring [1]. Our transport measurements evidence a robust, non-Hermitian skin effect: currents and voltages show an exponential profile, which persists also across Hall plateau transitions away from the regime of maximum non-reciprocity. Our observation of non-Hermitian topology in a quantum device introduces a scalable experimental approach to construct and investigate generic non-Hermitian systems.
As an example, we transpose the concepts introduced for the QHE device to classical electronic systems where the non-Hermitian topology allow us to build a non-Hermitian ohmmeter [2].

References

[1] Ochkan, K. *et al.*, Nat. Phys. (2024). https://doi.org/10.1038/s41567-023-02337-4
[2] V. Könye *et al.*, arXiv:2308.11367

Figures



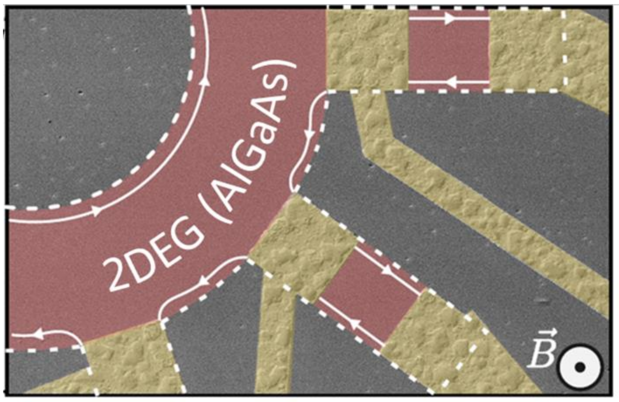


Figure 1: Scanning electron microscopy (SEM) image of the AlGaAs 2DEG device with a zoomed-in false-colour SEM image. The white lines indicate the edge quantum Hall states occurring in the presence of a perpendicular magnetic field at filling factor ν = 1, whereas the white arrows indicate the direction of propagation of electrons. The 2DEG and ohmic contacts are highlighted in red and yellow, respectively. The white dashed lines show the boundaries of the 2DEG.