Questionable stability of dissipative topological models for classical and quantum systems

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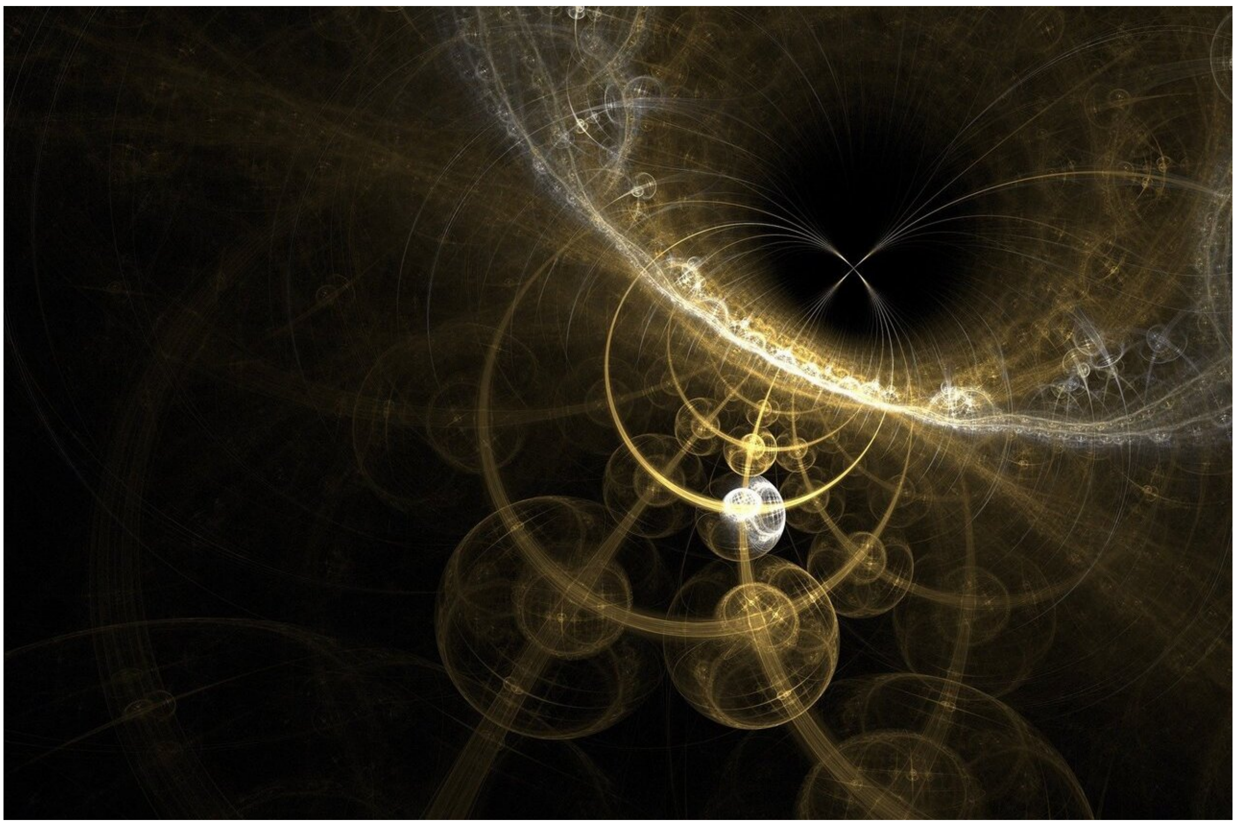

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Energy conservation lies at the core of every physical theory. Effective mathematical models however can feature energy gain and/or loss and thus break the energy conservation law by only capturing the physics of a subsystem. As a result, the Hamiltonian, the function that describes the system's energy, loses an important mathematical property: it is no longer Hermitian. Such non-Hermitian Hamiltonians have successfully described experimental setups for both classical problems—in e.g. some optical systems and electrical circuits—and quantum ones, in modelling the motion of electrons in crystalline solids. In a new paper in *EPJ D*, physicists Rebekka Koch from the University of Amsterdam in the Netherlands and Jan Carl Budich from Technische Universität Dresden, in Germany, describe how these functions provide new insights into behaviour at the edges of topological materials.

However, non-Hermitian Hamiltonians break with concepts that are known from energy-conserving systems such as the bulk-boundary correspondence (BBC) in these materials. This correspondence relates the topological properties of the bulk of the material to the physics of the edges. In the Hermitian case, the bulk of such a material can be described by neglecting the edges and just assuming the material to be infinite or periodic, since boundary effects do not affect the physics of the inside.

Surprisingly, this holds no longer true if the energy is not conserved: the properties of the boundary suddenly have a huge influence on the bulk system and subsequently have to be taken into account. It leads to a drastically altered BBC (bulk-boundary correspondence) for non-Hermitian systems. In particular, Koch and Budich studied different strengths of the coupling between boundaries and their effect on the bulk system. Knowing that in realistic quantum mechanical systems there is always an interaction between the edges—admittedly an extremely small one—they explored the extent to which decoupled edges are generally observable. Koch and Budich found that the spectrum of the topological material is stable under physically motivated perturbations such as the suppressed interactions between the boundaries.

More information: Rebekka Koch et al, Bulk-boundary correspondence in non-Hermitian systems: stability analysis for generalized boundary conditions, *The European Physical Journal D* (2020). [DOI: 10.1140/epjd/e2020-100641-y](https://dx.doi.org/10.1140/epjd/e2020-100641-y)

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