Fate of exceptional points in the presence of nonlinearities

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The non-Hermitian dynamics of open systems deal with how intricate coherent effects of a closed system intertwine with the impact of coupling to an environment. The system-environment dynamics can then lead to so- called exceptional points, which are the open-system marker of phase transitions, i.e., the closing of spectral gaps in the complex spectrum. Even in the ubiquitous example of the damped harmonic oscillator, the dissipative environment can lead to an exceptional point, separating between under-damped and over-damped dynamics at a point of critical damping. We examine the fate of this exceptional point in the presence of strong correlations, i.e., for a nonlinear oscillator [1]. By employing a functional renormalization group approach, we identify non- perturbative regimes of this model where the nonlinearity makes the system more robust against the influence of dissipation and can remove the exceptional point altogether. The melting of the exceptional point occurs above a critical nonlinearity threshold. Interestingly, the exceptional point melts faster with increasing temperatures, showing a surprising manifestation of coherent dynamics when coupled to a warm environment.

References:

[1] A. Khedri, D. Horn, and O. Zilberberg, *arXiv*, arXiv:2208.11205 (2022)