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Influence of Exceptional Points on Nuclear Structure and Reactions

Exceptional points (EPs) are universal features of non-Hermitian systems, where at least two eigenvalues of an operator coalesce into a single eigenvalue, leading to several non-trivial effects like high sensitivity to parameter changes, unconventional behavior of resonances [1], unconventional time behavior [2], among others[3] . Though long studied in mathematical literature, EPs manifest physically in open quantum systems (OQS), they were first achieved experimentally in microwave cavities [4], but given the ubiquity of non-Hermitian systems, research on EPs spans a wide range of fields in physics such as optics [5], atomic and molecular physics [6], quantum phase transitions [7] and even nuclear physics[8].

The Gamow Shell Model (GSM) [9], as an extension of the traditional shell model into an OQS formulation, provides a natural framework to explore the effects of EPs in nuclear physics. Within this approach, we demonstrate that low-energy EPs emerge for realistic values of the single particle potentials in the 5/2- doublets present in 7Li and 7Be using the Coupled-Channels representation of GSM [10]. Given this, we studied the influence that the presence of EPs has on different reaction and structure quantities, including elastic scattering cross sections, phase shifts, quadrupole and dipole moments and electromagnetic transitions.

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