

# Tunable polarisation degeneracy points in a perovskite-filled open cavity

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The strong coupling between light and matter, achieved through manipulations of both the active material and the sample structure, enables the observation of a variety of nonlinear, topological, and non-Hermitian effects. A particularly intriguing system involves microcavities filled with quasi-2-dimensional perovskites, where stable excitons enable the manifestation of polariton effects at room temperature. The perovskite birefringence facilitates the generation of diabolical points as a degeneracy for two linearly polarized polariton modes [1].

We expanded this framework by incorporating a birefringent  $[(4F-C_6H_4(CH_2)_2NH_3)_2PbI_4]$ , PEPI-F, in an open double cavity, which allowed us for the observation of non-Hermitian coupling between a polariton and an additional photon confined in air gap between the perovskite crystal and DBR [2]. This strongly modified polariton dispersion reveals multiple inflection points. We observed subsequent regions of steep and flat dispersion, leading to a highly non-quadratic dispersion shape. When this complex behaviour is further juxtaposed with the birefringence of PEPI-F perovskite, it leads to unconventional diabolical points that appear along the dispersion. These diabolical points are repeated within a single mode pair and demonstrate a significant contribution to the circular polarization. Remarkably, these findings are accurately reproduced by the Berreman method, which relies on the anisotropic transfer matrix method, as well as by an analytical model employing synthetic Hamiltonians.

Furthermore, manipulation of the thicknesses of perovskite and microcavities enables precise control over the locations of such degeneracy points. This provides a pathway to further explore the effects of non-Hermitian physics in polariton systems.

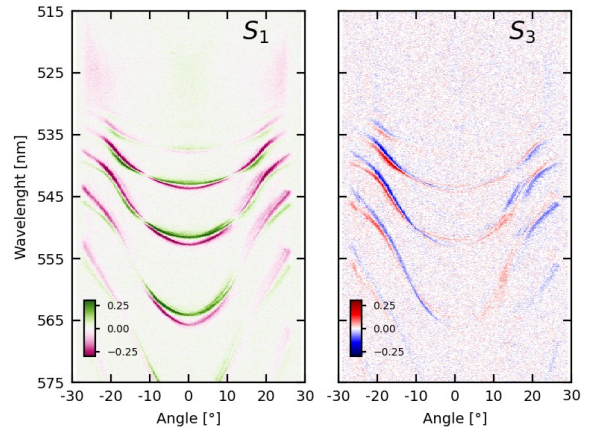


Figure 1: Measured degree of linear (left) and circular (right) polarization of a PEPI-F filled open microcavity.

[1] L. Polimeno et al. *Nature Nanotechnology* **16**, 1349 (2021).

[2] M. Kedziora et al. *Non-Hermitian polariton-photon coupling in a perovskite open microcavity*, **2023**, under review.