# Magneto-Optics of Anisotropic Exciton Polaritons in Two-Dimensional Perovskites

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Two-dimensional metal-halide perovskites exhibit remarkable excitonic properties, including large binding energies and high oscillator strengths, making them exceptional candidates for room-temperature exciton polaritonics [1]. The application of a magnetic field has proven invaluable for probing their rich exciton fine structure. Emission studies have revealed deviations from Boltzmann statistics, with unexpectedly intense emission from higher-energy bright states even at cryogenic temperatures. This effect arises from an exciton relaxation bottleneck caused by a mismatch between dark-bright exciton splitting and the energy of the involved optical phonons [2]. However, the combination of an in-plane magnetic field and the strong coupling regime remains largely unexplored in these 2D perovskite systems.

In this work [3], we combine microscopic many-particle theory [4] with a rigorous solution of Maxwell's equations to model the magneto-optics of exciton polaritons in layered 2D perovskites (Fig. 1a). We predict that the brightened low-energy dark exciton state $X_D$ can enter the strong coupling regime, resulting in a Rabi splitting of 10 meV depending on the azimuth angle $\varphi$ (Fig. 1b, c). Furthermore, we show that the magnetic field-induced mixing of polarization selection rules and the breaking of in-plane symmetry lead to highly anisotropic polariton branches, which are optically accessible via a simple in-plane rotation. Specifically, the absorption of polariton branches can be tuned by adjusting the azimuth angle of the light beam with respect to the magnetic field. This study provides a deeper microscopic understanding of the exciton fine structure in 2D perovskites and demonstrates the cavity control of highly anisotropic and polarization-sensitive exciton polariton branches.

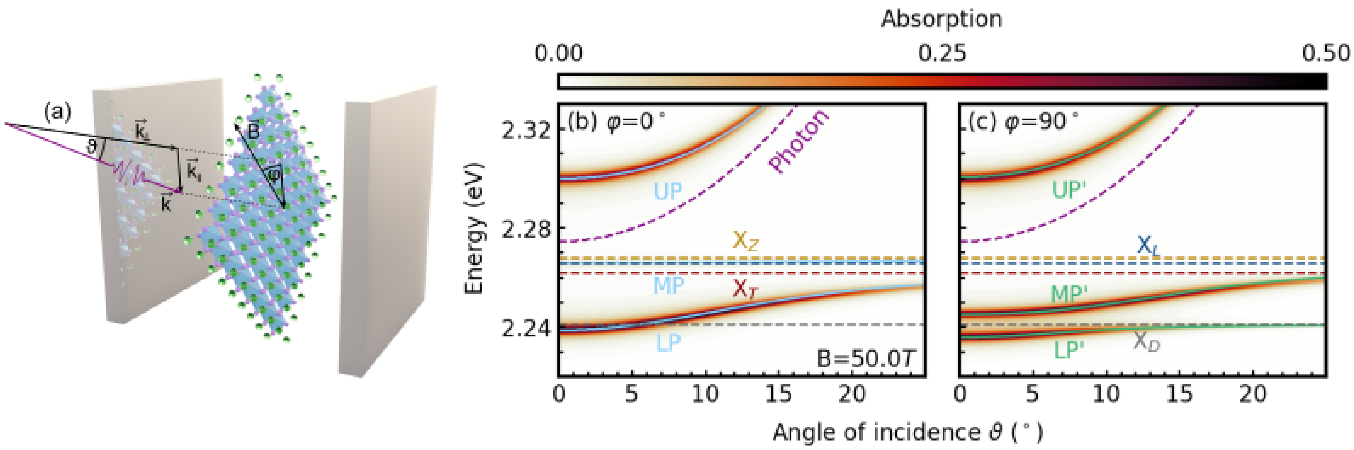


Figure 1: (a) Schematic figure of a 2D perovskite slab integrated within a Fabry-Pérot cavity. The photon (purple arrow) is incident at an angle $\vartheta$ and momentum $\mathbf{k}$. There is an in-plane magnetic field $\mathbf{B}$ with an azimuth angle $\varphi$ relative to the parallel component of the wave vector. (b) and (c) Absorption of the perovskite integrated in the cavity as a function of the photon energy and angle of incidence for $B = 50\,\mathrm{T}$ and different azimuth angles $\varphi$. The horizontal dashed lines indicate the exciton energies. Depending on $\varphi$, different polariton branches appear as a result of the selection rules of the respective excitonic states.

## References

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