Cavity Jahn-Teller Polaritons in Molecules

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In this talk we will present an overview of our work on molecular Jahn-Teller polaritons and their polarization properties.

The control and exploitation of angular momentum and helicity of cavity photons constitutes one of the most active frontiers in the fields of polaritonic materials science [1] and polaritonic chemistry [2,3]. In our work [4], we have investigated the fundamental coupling mechanism of (+/−)-circular polarizations of the trapped-light modes originating from the vibronic interactions within the Jahn-Teller (JT) active molecules or material inside a Fabry-Perot (FP) cavity (cf. Fig. 1). The mechanism results in the efficient exchange of photonic and vibronic angular momenta between the light and the matter. It leads to a new type of polaritonic state with mixed polarization character, namely, the JT polariton. Due to the photonic-vibronic coupling, the magnitude and direction of the cavity polarization varies for different eigenstates of the cavity- molecule system. This type of light-matter coupling results in polarization inverted states in the polaritonic system: states that can be reached resonantly with either right or left circularly polarized light, but which are characterized by a cavity-photon polarization opposite to the external fields used to excite the system.

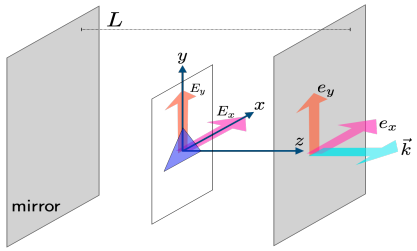

Fig. 1. Schematic of a JT active system situated inside the FP cavity. (e_x,e_y) are the (x,y)-polarized cavity modes with propagation vector k along z-axis. (E_x,E_y) are the degenerate electronic states of a JT active molecule.

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REFERENCES

[1] Z. Sun, *et al.*, "Optical control of room-temperature valley polaritons" *Nat. Photonics*, vol. 11, no. 8, pp. 491-496, 2017.

[2] J. Gautier, M. Li, T. W. Ebbesen, and C. Genet, "Planar Chirality and optical spin-orbit coupling for chiral Fabry-Perot cavities" ACS photonics vol. 9, 778-783, 2022.

[3] H. Hübener, *et al*., "Engineering quantum materials with chiral optical cavities," Nat. Mater., vol. 20, no.4, pp. 438-442, 2021.

[4] K. R.Nandipati and O. Vendrell "Cavity Jahn-Teller polaritons in molecules" (Under revision).