Intrinsic Josephson coupling and non-resonant spin switching in an optically trapped polariton condensate

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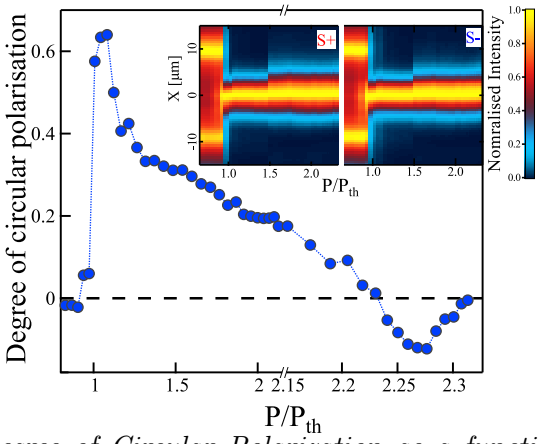
We investigate the spin dynamics of polariton condensates spatially separated from and effectively confined by the pumping exciton reservoir [1, 2]. With increasing excitation density we observe a reversal of the Degree of Circular polarization of the system. The spin dynamics of the trapped condensate are described within the framework of the spinor complex Ginzburg-Landau equations in the Josephson regime, where the dynamics of the system are reduced to a current-driven Josephson junction.



Degree of Circular Polarization as a function of excitation power vs threshold power. The inset shows the 2 normalised spin components of the 1D real space profile of the condensate with respect to power above threshold.

The density dependent non-linear spin reversal is observed at moderate optical excitation densities (see figure) and well below the quenching of the strong coupling. The non-linearity of polariton spin dynamics is described and theoretically reproduced by introducing an internal Josephson coupling term in the spinor GLE, which arises due to asymmetry at the quantum-well interfaces, mechanical stresses, or due to the anisotropy-induced splitting of linear polarisations in the microcavity. We show that the observed spin reversal is due to the interplay between an internal Josephson coupling effect and the detuning of the two projections of the spinor condensate via transition from a synchronised to a desynchronised regime. These results facilitate the design and implementation of polariton based non-linear spinoptronic devices such as electrically pumped polariton spin switches.

[1] Askitopoulos, A., Ohadi, H., Kavokin, A. V., Hatzopoulos, Z., Savvidis, P. G., and Lagoudakis, P. G. *Physical Review B* **88**(4), 041308 July (2013).
[2] Askitopoulos, A., Liew, T. C. H., Ohadi, H., Hatzopoulos, Z., Savvidis, P. G., and Lagoudakis, P. G. *Physical Review B* **92**(3), 035305 July (2015).