

Spontaneous build-up and control of spin polarisation of semimagnetic exciton-polariton condensates

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Exciton-polaritons are eigenmodes of a system consisting of excitons created in quantum well and photons confined in a microcavity. These quasiparticles have been widely studied, but their spin properties are still not fully understood. In most cases condensation is associated with spontaneously chosen linear polarisation of emission. Exciton-polaritons can also condense into circularly polarised quantum state [1], but still this effect is stochastic and difficult to tune. Here we report on a spontaneous circular polarisation of the exciton-polariton condensate and its control with magnetic field or laser excitation. For this purpose we use semimagnetic quantum well strongly coupled to the mode of the optical microcavity. Such structures enabled observation of many interesting phenomena not observed in nonmagnetic samples [2-5].

We find that intrinsic anisotropy of the cavity lifts spin degeneracy of exciton-polaritons. It is manifested by non-zero circular polarisation of condensate emission even while exciting the system with linearly polarised laser at the absence of magnetic field. Depending on the position on the sample we find localised condensates with different degree and sign of circular polarisation. Independently of the initial polarisation, we are able to smoothly tune the degree of circular polarisation of condensate or even reverse its sign by using external magnetic field (Figure 1.). Control of the spin polarisation can be reached in reasonably wide range also by changing polarisation of the laser and excitation power. Our results pave the way to use spin interactions in realisation of quantum simulators and neural networks in polaritonic system.

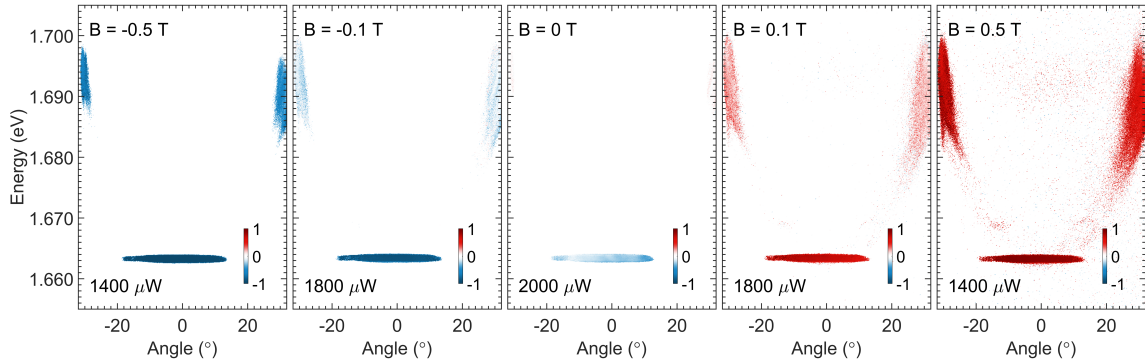


Figure 1. Degree of circular polarisation of exciton-polariton condensate in photon in-plane momentum space at threshold power at different external magnetic fields. Excitation is nonresonant with linearly polarised laser beam.

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