# Spontaneous spin polarisation of localised semimagnetic exciton-polariton condensates.

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Despite the fact, that the physics of cavity exciton–polaritons is relatively new field of science, a huge interest in this light-matter quasiparticles resulted in observation of many interesting effects. Their unique properties have allowed to observe phenomena such as Bose–Einstein condensation [1] and polariton lasing [2]. Due to the low effective mass it is possible to localise polaritons in micrometer traps. This effect is used to create bosonic Josephson junctions [3] or lattices of interacting condensates in order to build a platform for quantum simulations [4]. Our approach is to focus on spin properties of localised semimagnetic exciton-polariton condensates in order to extend the platform towards the spin-based operations [5]. We study microcavity with quantum wells containing 4% of manganese. The incorporation of magnetic ions results in *s,p–d* exchange interaction between localised electrons of the $d^5$ shell of $Mn^{2+}$ and delocalised band electrons in the system [6].

In our work we present formation of the localised condensates with different spin polarisations depending on the magnetic field, power, energy and polarisation of the excitation laser and photonic inhomogeneity on the sample. Thanks to the polarisation-retaining confocal microscopy setup with superconducting magnet delivering a magnetic field up to 9 T we are able to observe formation of condensates with different polarisation in low-dimensional traps. In contrast to nonmagnetic systems where the emission from the condensate is linearly polarised, in semimagnetic samples condensate favours circular polarisation. For particular position on the sample it is possible to reverse the sign of circular polarisation of condensate by applying magnetic field (Figure), increasing the excitation power or changing polarisation of laser excitation. Our results demonstrate the importance of spin interactions in localised condensates for quantum manipulations.

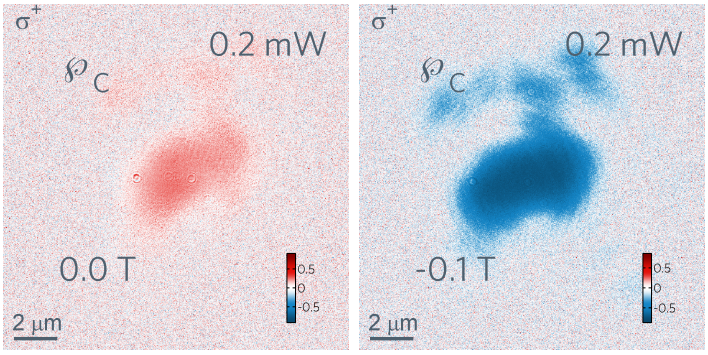


Figure: Degree of circular polarisation of exciton–polariton condensate in real space at zero (left) and nonzero (right) magnetic field. Excitation power (0.2 mW) and polarization ($\sigma^+$) of the laser are kept constant.

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