Spin and charge dynamics of polaritons in semiconductor microcavities

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Since they were described 15 years ago, semiconductor microcavities continue to provide surprises and new insights into the way that light and matter interactions can be modified. The success of planar semiconductor cavities is the ability to explore quasi-particle scattering cleanly across a window of quasi-particle velocities, and hence allow us to gain insights into the scattering processes in general in semiconductors. In this talk, I will discuss experiments and theory that show how the spin of polaritons and the electronic charges that they interact with can produce unusual behaviour in their dynamics.[1] This has strong implications for the way that we can make efficient light emitters out of these structures, as well as exploring the nature of the coherent polariton states that emit.

I will also discuss a variety of new microcavity structures in which both photonic and electronic wavefunctions are now confined in all three dimensions,[2] which provides the opportunity for extremely low power optical nonlinearities as well a host of new polariton phenomena.

[1] PRL 84 1547 (2000); PRL 85 3680 (2000); PRL 90 206401 (2003); APL 81 412 (2002); 83 (2003); PRB 65, R161310 (2002); Semicond. Sci. & Tech., 18, S279-S434 (2003); PRB 66 85304 (2002)
[2] Adv. Mat. 13, 1368 (2001); PRL 87, 176801 (2001); Chem.Mater. 14 2199 (2002); APL 83, 767 (2003); Faraday Discussions 215, (2003); Adv. Mat (2003)