Polariton and Photon Condensates in Organic Materials

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By confining light into a microcavity, it is possible to engineer combined light-matter systems which can undergo Bose-Einstein condensation at relatively high temperature. Polaritons (superpositions of microcavity photons and semiconductor excitons) have clearly demonstrated a well thermalised BEC [1] at 20K. More recently, photons in organic dye filled microcavities, or polaritons made with Frenkel excitons in organic molecules (anthracene) have shown similar behaviour at room temperature [2]. Such experiments pose several questions; among these, how does such coherent light emitting systems differ from a laser, and, particular to the organic systems, what effect does the strong electron-phonon coupling intrinsic in organic molecules have on light-matter coupling. I will discuss our recent work on both these questions [3], showing how strong coupling to phonons can lead to a thermalised condensate via a mechanism that is closely related to traditional lasing, but which avoids the need for inversion.

[1] Kasprzack et al, Nature 443 409 (2006)

[2] Klaers et al, Nature 468 545 (2010); Kena-Cohen and Forrest, Nature Photonics 4 371 (2010)

[3] Kirton and Keeling, arXiv:1303.3459; Cwik, Reja, Littlewood and Keeling, arXiv:1303.3720