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Quantum fluid dynamics and superfluid behaviour of polaritons in microcavities

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Achievement of polariton condensation in semiconductor microcavities [1,2] has opened the way to the study of new interesting phenomena related to the behaviour of non-equilibrium Bose particles in the quantum limit. In this talk we will see the formation of a coherent quantum state of polaritons created at a given momentum and at a given time using a combination of a continuous wave pump and a pulsed probe. This state is observed to persist in the cavity for a time much longer than the cavity lifetime [3]. Using this technique we are able to investigate the behaviour of a quantum state of polaritons with an extension of ~ 20 μm moving a hundreds of microns within the cavity. One of the most striking effects of a moving polariton condensate is the observation of superfluid behaviour when crossing obstacles even at speeds only 100 times smaller than the speed of light [4]. Other interesting phenomena, which will be shown, are diffusion-less motion, due to the linearization of the polariton dispersion, and the formation of Cherenkov-like patterns for polaritons moving at supersonic velocities.

[1] J. Kasprzak et al. *Nature* **443**, 409 (2006).
[2] R. Balili et al. *Science* **316**, 1007 (2007).
[3] D. Ballarini et al. http://arxiv.org/abs/0807.3224 (arXiv:0807.3224) (2008).
[4] A. Amo et al. *Nature*, forthcoming publication (2009).