Probing long-time dynamics in optically trapped exciton-polariton condensates

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In this talk I will present a series of studies on optically trapped exciton-polariton condensates in semiconductor microcavities which have been shown to possess coherence times exceeding the polariton lifetime by almost three orders of magnitude [1]. This has opened a pathway to drive exciton-polariton condensates into stable states under continuous-wave excitation that exhibit complex long-time dynamics such as the self-induced Larmor precession in the condensate pseudospin with almost $Q \approx 30$ periods resolvable [2], and (similarly) internal Rabi-like oscillations showing spontaneous synchronization between spatially coupled condensate traps [3].

I will discuss how by changing the geometry of the optical traps, squeezing them into anisotropic shapes, can be used to trigger polariton condensation into states of definite linear polarization with perspectives on the role of polaritons as optically tunable coherent light sources [4]. I will also show how the combination of microcavity birefringence, optical orientation of the incoherent background excitons, and the condensate's internal dynamics can dramatically affect the photon statistics of the emitted cavity light, demonstrating a smooth transition from a highly coherent to a super-thermal state of the condensate polarization components [5].

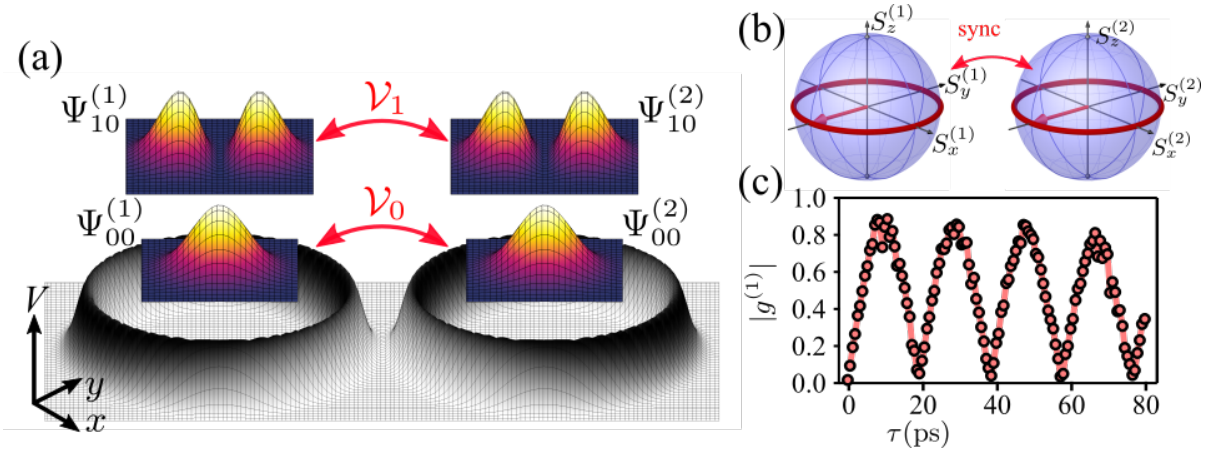

Figure 1: (a) Schematic representation of two two-level polariton condensates in optical traps coupling together. (b) Corresponding schematic Bloch sphere representation. (c) Experimentally measured oscillations of the system's first order correlation function.

[1] A. Askitopoulos et al., arXiv:1911.08981 [cond-mat] (2019).
[2] A. Askitopoulos et al., arXiv:2006.01741 [cond-mat] (2020).
[3] J. D. Töpfer et al., *Phys. Rev B* 102, 195428 (2020).
[4] I. Gnusov et al., *Phys. Rev. Appl.* **16**, 034014 (2021).
[5] S. Baryshev et al., *Phys. Rev. Lett.* **128**, 087402 (2022).