



Contribution ID: 68

Type: **Invited/Keynote talk**

## Novel droplet phase of exciton-polariton mixtures in atomically thin semiconductors

*Monday 1 December 2025 12:15 (15 minutes)*

Quantum droplets are self-bound low-density configurations which may appear in ultracold gases with competing interactions. Dilute bosonic mixtures, where the attractive mean-field energy is balanced by the repulsive Lee-Huang-Yang correction stemming from quantum fluctuations, are the prototypical platform where this novel state has been first predicted [1] and shortly after experimentally observed [2,3]. Since then, quantum droplets have gained significant interest, and their study has been extended to various cold-atomic settings.

In this talk, I will show how a similar scenario can arise in a solid-state system. Specifically, we consider an atomically thin semiconductor layer embedded in an optical microcavity, where exciton-polariton quasiparticles (polaritons) result from the strong coupling between semiconductor excitons and cavity photon modes. Polaritons carry a spin degree of freedom inherited from both their matter and light components, thus resulting in the possibility of interactions between these quasiparticles [4]. We show that the competition between the attractive spin-singlet and repulsive spin-triplet channels of the interaction can lead to the formation of a novel self-bound many-body state analogous to a quantum droplet, thus demonstrating that exciton-polaritons can display both liquid- and droplet-like phenomena.

[1] D. S. Petrov, Phys. Rev. Lett. 115, 155302 (2015)

[2] C. R. Cabrera et al., Science 359, 301 (2018)

[3] G. Semeghini et al., Phys. Rev. Lett. 120, 235301 (2018)

[4] O. Bleu, G. Li, J. Levinsen and M. M. Parish, Phys. Rev. Res. 2, 043185 (2020)

**Authors:** CALDARA, Matteo (International School for Advanced Studies (SISSA)); BLEU, Olivier (Monash University); MARCHETTI, Francesca Maria (Universidad Autónoma de Madrid); LEVINSEN, Jesper (Monash University); PARISH, Meera

**Presenter:** LEVINSEN, Jesper (Monash University)

**Session Classification:** Theoretical Physics

**Track Classification:** Topical Groups: Condensed Matter & Materials