

Polarons and quantum optics of correlated 2D materials

Ivan Amelio

Atac Imamoglu, Giacomo Mazza, Nathan Goldman

CENOLI, Université Libre de Bruxelles, CP 231, Campus Plaine, B-1050 Brussels, Belgium

ivan.amelio@ulb.be

Abstract

When a mobile impurity is immersed in a many-body background, it is dressed by the excitations of the bath, and forms «a polaron». As a result, the injection spectrum of the impurity carries the hallmarks of the correlations present in the bath. This physics is particularly relevant for excitons optically injected in few layer heterostructures and moiré materials. In this talk, we will first review the basic theoretical framework and recent experimental progress. Then, we will theoretically analyze a few cases of correlated many-body states: the impurity injection spectra are predicted to display peculiar features, that allow to distinguish whether the bath features particle-hole pairing, Mott transition, charge density waves (see Fig. 1), topological phases, a BKT transition, etc. Prospectives for quantum photonics will be discussed.

References

- [1] I Amelio, ND Drummond, E Demler, R Schmidt, A Imamoglu, *Physical Review B* **107**, 155303
- [2] I Amelio, G Mazza, N Goldman, *Physical Review B* **110**, 235302

Figures

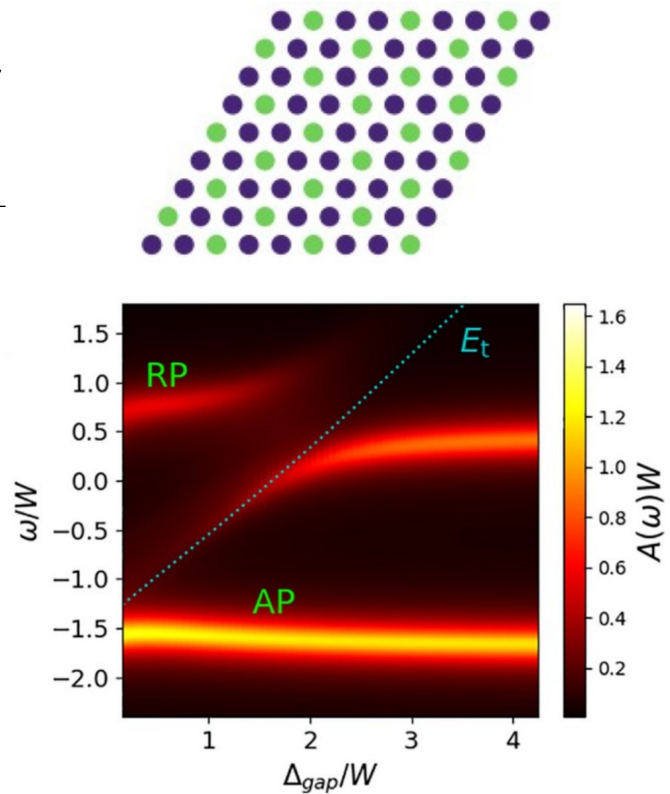


Figure 1: Optical spectrum predicted for a mobile impurity (e.g. an exciton) in a generalized Wigner crystal (see upper sketch). As the insulating gap is increased (horizontal axis), an avoided crossing occurs in the repulsive polaron line, signaling the interplay of quasi-particle excitations with the unbinding of the impurity-electron molecule.