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über

Hybrid light-matter excitations in semi-conductive nanostructures: Exciton-polaritons in microcavities and photonic integrated circuits

Abstract:

Exciton-polaritons are hybrid light-matter excitations arising from the strong coupling between an excitonic state in a semiconductor and an electromagnetic mode. Mixing photonic and excitonic properties, these composite bosons can be described as interactive photons, and they are of great interest for both fundamental research and applications.

The basics of exciton-polaritons physics in semiconductor microcavities will be discussed in the first part of the talk, highlighting the role of polariton-polariton interactions in relevant physical effects such as polariton condensation and optical parametric generation [1,2]. Different examples of material platforms sustaining polariton modes both at cryogenic and room temperature will be also presented [3, 4].

In the second part of the talk, I will show how we have recently enabled new ways of controlling exciton-polaritons properties by coupling excitons to propagating modes in semiconductor waveguides. Polariton condensation in topologically protected states and electrical control of polariton properties will be discussed [5, 6].

In the final part of the talk, the emerging field of polaritons for quantum optics will also be presented, with the exciting perspective of building a new class of nonlinear quantum gates.

References

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- [2] D. Sanvitto and S. Kena-Cohen, "The road towards polaritonic devices", Nat. Mat., 15, 1061, 2016;
- [3] A. Fieramosca, V. Ardizzone et al., "Two-dimensional hybrid perovskites sustaining strong polariton interactions at room temperature", Science Advances, Science advances 5 (5), eaav9967, 2019;
- [4] V. Ardizzone et al., "Emerging 2D materials for room-temperature polaritonics", Nanophotonics 8 (9), 1547-1558, 2019;
- [5] V. Ardizzone et al., "Polariton Bose–Einstein condensate from a bound state in the continuum", Nature 605 (7910), 447-452, 2022;
- [6] D. Suarez, V. Ardizzone et al., "Electrically controlled waveguide polariton laser", Optica 7 (11), 1579-1586, 2020.