Dipolar exciton-polariton interactions

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Microcavity exciton-polaritons are neutral quasiparticles, hybrid between matter and light, that arise from the strong coupling between semiconductor excitons (bound electron-hole pairs) and cavity photons. The investigation of these systems has become a vast research field [1, 2, 3] which continues to grow nowadays with the appearance of novel two-dimensional semiconductor materials [4, 5]. A crucial property of exciton-polaritons is their ability to interact with each others. Using low-energy scattering theory going beyond the Born approximation, some of us previously derived analytical formula for the estimation of polariton-polariton interaction strengths [6]. In doing so, we unveiled that the coupling to light can enhance the polariton-polariton interactions compared to the exciton-exciton ones.

These previous results were obtained for conventional polaritons composed of monolayer excitons that interact via short range interactions. In this talk, I shall present recent calculations for the interactions of dipolaritons which are made of spatially indirect excitons. Such indirect excitons can exist in multilayer structures of two-dimensional semiconductors [7, 8, 9], and exhibit a permanent electric dipole due to the separation between their electrons and holes. As a consequence, they interact via a dipole-dipole potential rather than a short range potential. Our results show that the enhancement of interactions due to the coupling to light is also present for dipolar exciton polaritons. Moreover, we find that our full numerical results can be accurately described by analytical low energy expressions when the energy scale of the exciton-photon coupling is small compared to the dipole energy scale. Our work is relevant for the pursuit of the regime of strongly interacting polaritons using dipolaritons.

References

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