Tuning quantum non-local effects in graphene plasmonics

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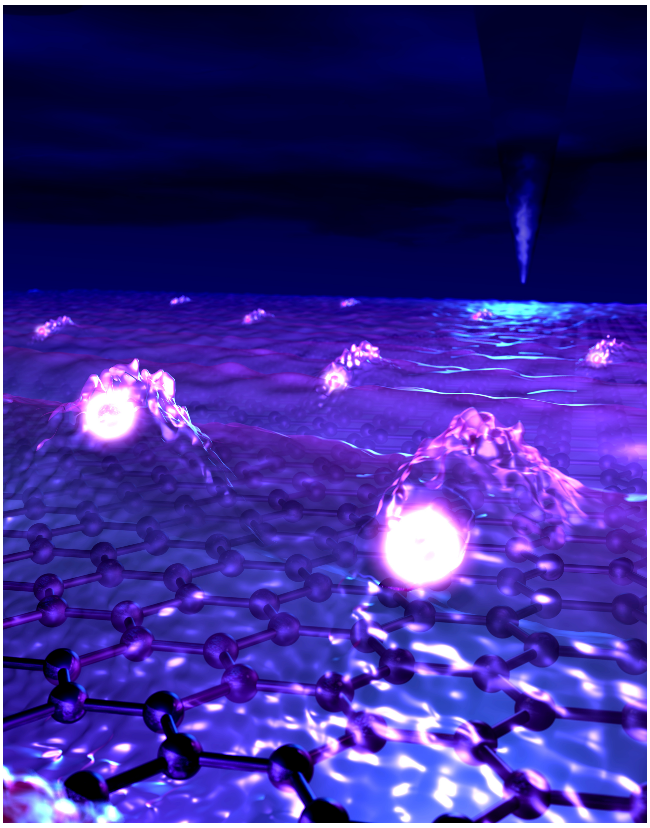
The control of polaritons are at the heart of nano-photonics and opto-electronics. Two-dimensional materials have emerged as a toolbox for in-situ control of a wide range of polaritons: plasmons, excitons and phonons. By stacking these materials, heterostructures can be designed with control at the atomic scale, while maintaining extremely high quality and clean interfaces.

In this talk, we will show several examples of 2d material heterostructure devices with novel ways of exciting, controlling and detecting polaritons [1,2,3]. We challenge the limits of quantum light-matter interactions [5,6] as well as extremes in propagating plasmon confinement, down to the scale of a few nanometers.



More recently, we used propagating graphene plasmons, together with an engineered dielectric–metallic environment, to probe the graphene electron liquid and unveil its detailed electronic response at short wavelengths. The near-field imaging experiments reveal a parameter-free match with the full theoretical quantum description of the massless Dirac electron gas, in which we identify three types of quantum effects as keys to understanding the experimental response of graphene to short-ranged terahertz electric fields. We demonstrate how, in principle, our experimental approach can determine the full spatiotemporal response of an electron system.

References

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