Current-driven non-reciprocal plasmons in graphene

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Realizing surface plasmon polariton modes with long lifetimes is the biggest challenge of contemporary plasmonics. Graphene sheets encapsulated between boron nitride crystals, which currently have the highest *room-temperature* dc mobility in the realm of two-dimensional materials [1], display amazingly long plasmon lifetimes in the mid-infrared spectral range, approaching 1 ps [2]. Unfortunately, this is not yet enough for applications where vectoring confined optical signals over long distances is required (i.e. optical interconnects). In this talk, I will discuss a recent theoretical proposal [3] where a fundamental materials science aspect of graphene, i.e. its capability to withstand large dc currents without burning [4], is utilized for achieving plasmon non-reciprocity and collimation. I will present extensive calculations of the plasmonic properties of a graphene sheet carrying a dc current. By employing a suitable random phase approximation, which is *non-perturbative* in the ratio between the drift velocity and the graphene Fermi velocity, I will demonstrate that graphene plasmons in the presence of a dc current display non-reciprocity and collimation.

[1] See, for example, D.A. Bandurin, I. Torre, *et al*., Science (February 11, 2016; DOI: 10.1126/science.aad0201) and arXiv:1509.04165.
[2] A. Woessner, M.B. Lundeberg, *et al*., Nature Mater. **14**, 421 (2015).
[3] B. Van Duppen, A. Tomadin, *et al*., 2D Mater. **3**, 015011 (2016).
[4] J. Moser, A. Barreiro, and A. Bachtold, Appl. Phys. Lett. **91**, 163513 (2007).