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Quantum and nonlocal phenomena in plasmonic nanoparticles

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The field of plasmonics is widely explored with a classical mindset, while recent experimental efforts now reveal plasmon phenomena beyond expectations rooted in classical electrodynamics [1]. In particular, intrinsic length scales of the electron gas are anticipated to manifest in a nonlocal plasmonic response [2] and other quantum corrections to the light-matter interactions [3]. I will discuss theory and experimental efforts to understand nonlocal dynamics (size-dependent frequency shifts and damping) in metallic nanoparticles with true nanoscale dimensions [4], providing also a link between the observed spectral shifts and the fraction of electromagnetic energy attributed to quantum degrees of freedom [5].

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[3] T. Christensen, W. Yan, A.-P. Jauho, M. Soljačić & N.A. Mortensen, "Quantum corrections in nanoplasmonics: shape, scale, and material", arXiv:1608.05421

[4] S. Raza *et al.*, "Multipole plasmons and their disappearance in few-nanometer silver nanoparticles", Nature Communications **6**, 8788 (2015)

[5] W. Yan & N.A. Mortensen, "Nonclassical effects in plasmonics: An energy perspective to quantify nonclassical effects", Phys. Rev. B **93**, 115439 (2016)