

Abstract Submitted  
for the MAR05 Meeting of  
The American Physical Society

**Microscopic near-field optics of metallic nanoparticles** YONGQIANG XUE, University at Albany - SUNY — Microscopic near-field optics of metallic nanoparticles: The further miniaturization of integrated optical devices requires investigating optical elements with dimensions on the nanoscale. Methods are therefore needed for detecting and guiding light on a scale much smaller than the wavelength of the light. Near-field optics, which exploits evanescent rather than propagating light fields, attracts a lot of attention as a promising way of circumventing the diffraction limit. Since the evanescent fields bound to the nanostructures decay in intensity within a fraction of the light wavelength, they carry information about sample features on a sub-wavelength. It is clear that to investigate light-matter interaction in a spatial extension much less than the optical wavelength, one can not in general have confidence in the macroscopic electrodynamics so far popular in near-field optics and photonic band-structures. Instead a microscopic approach treating rigorously the local-field effect is highly desirable. In this work we present a microscopic theory of near-field optical effect in single and coupled metallic nanoparticles. Our theory is based on the Lagrangian formulation of semiclassical electrodynamics, where we treat the nanoparticle optical response quantum-mechanically within the jellium model. We discuss the insights obtained from such microscopic analysis for understanding light confinement in subwavelength structures and near-field mediated electromagnetic energy transport through resonant excitation of surface plasmon polariton modes. We also discuss light scattering by charged metal nanoparticles.

Yongqiang Xue  
University at Albany - SUNY

Date submitted: 03 Dec 2004

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