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Hyperbolic polaritons in nanoparticles ZHIYUAN SUN, Department of Physics, University of California San Diego, 9500 Gilman Drive, La Jolla, California 92093, USA, ANGEL RUBIO, FRANCISCO GUINEA, Instituto de Ciencia de Materiales de Madrid, CSIC, Cantoblanco, E-28049 Madrid, Spain, DIMITRI BASOV, MICHAEL FOGLER, Department of Physics, University of California San Diego, 9500 Gilman Drive, La Jolla, California 92093, USA — Hyperbolic optical materials (HM) are characterized by permittivity tensor that has both positive and negative principal values. Collective electromagnetic modes (polaritons) of HM have novel properties promising for various applications including subdiffractional imaging and on-chip optical communication. Hyperbolic response is actively investigated in the context of metamaterials, anisotropic polar insulators, and layered superconductors. We study polaritons in spheroidal HM nanoparticles using Hamiltonian optics. The field equations are mapped to classical dynamics of fictitious particles (wave packets) of an indefinite Hamiltonian. This dynamics is quantized using the Einstein-Brillouin-Keller quantization rule. The eigenmodes are classified as either bulk or surface according to whether their transverse momenta are real or imaginary. To model how such hyperbolic polaritons can be probed by near-field experiments, we compute the field distribution induced inside and outside the spheroid by an external point dipole. At certain magic frequencies the field shows striking geometric patterns whose origin is traced to the classical periodic orbits. The theory is applied to natural hyperbolic materials hexagonal boron nitride and superconducting LaSrCuO.

Zhiyuan Sun
Univ of California - San Diego

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