Optical Momentum, Spin, and Angular Momentum in Dispersive Media

Objective

To study the optical momentum, spin, and angular momentum in dispersive media

Summary of Research Activities

We examine the momentum, spin, and orbital angular momentum of structured monochromatic optical fields in dispersive inhomogeneous isotropic media. There are two bifurcations in this general problem: the Abraham-Minkowski dilemma and the kinetic (Poynting-like) versus canonical (spin-orbital) pictures.

We show that the kinetic Abraham momentum describes the energy flux and group velocity of the wave in the medium. At the same time, we introduce novel canonical Minkowski-type momentum, spin, and orbital angular momentum densities of the field. These quantities exhibit fairly natural forms, analogous to the Brillouin energy density, as well as multiple advantages as compared with previously considered formalisms.

As an example, we apply this general theory to inhomogeneous surface plasmon-polariton (SPP) waves at a metal-vacuum interface and show that SPPs carry a "supermomentum," proportional to the wave vector $k_p > \omega/c$, and a transverse spin, which can change its sign depending on the frequency ω.

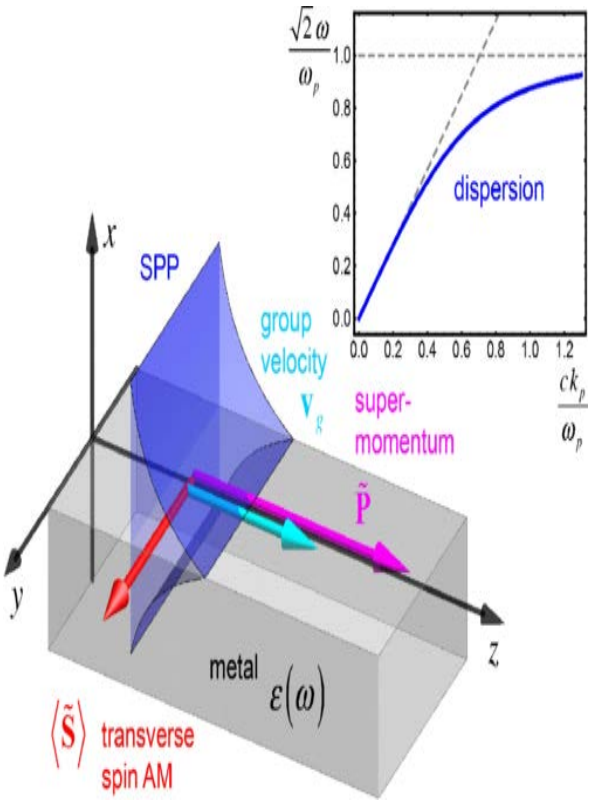

Fig. 1. Geometry and main properties of a SPP at a metal-vacuum interface.

Publications

K.Y. Bliokh, A.Y. Bekshaev, F. Nori, *Optical Momentum, Spin, and Angular Momentum in Dispersive Media,* Phys. Rev. Lett. **119**, 073901 (2017). [PDF][Link][arXiv]

K.Y. Bliokh, A.Y. Bekshaev, F. Nori, *Optical momentum and angular momentum in complex media: from the Abraham–Minkowski debate to unusual properties of surface plasmon-polaritons,* New Journal of Physics **19**, 123014 (2017). [PDF][Link][arXiv]