Controlled directional scattering in nano-optics

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Optical nanoantennas attract tremendous attention in modern classical and quantum optics [1]. A widely prevalent class of nanoantennas is isotropic high-refractive index dielectric nanoparticles that support strong electric and magnetic resonances. Simultaneous in-phase excitation and interference of these resonances result in unidirectional scattering of visible and near-infrared light [2, 3]. Controlling the coupling of light to these sub-wavelength nanoantennas allows for tunable directional scattering, paving the way for a variety of far-field and near-field optical functionalities.

Tightly focused polarization-tailored beams feature highly complex spatially-variant three-dimensional (3D) electromagnetic field landscapes, enabling the selective excitation of sub-wavelengths nanoantennas [4, 5]. The capabilities to manipulate the 3D phase and amplitude distributions of the incident electric and magnetic fields at the nanoscale provide the basis for applications of tunable polarization-controlled directional scattering in nano-optics such as nanoscopic position sensing [6], sub-Ångström localization [7] and nanoscale light routing [8].

In summary, future efforts in nanoscale engineering of electromagnetic fields and intelligent design of resonant low-loss high-refractive index dielectric nanoantennas may yield superior functionality for applications of directional scattering in nano-optics. These abilities may have far-reaching implications in modern nanometrology, super-resolution microscopy, nanoscale light routing and beyond.

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