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Extraordinary spin and momentum in evanescent waves

Momentum and spin represent fundamental dynamical properties of quantum particles. For photons, momentum is associated with the wave vector and is independent of polarization. In turn, spin is associated with a circular polarization and is also collinear with the wave vector. We show that situation becomes strikingly different for evanescent optical waves. First,evanescent waves possess momentum component, which depends on circular polarization and is orthogonal to the wave vector. Second, there is a spin angular momentum, which is largely independent of the polarization, and is also orthogonal to the wave vector. Although these extraordinary proper ties seem to be in contradiction with what we know about photons, we show that they reveal a fundamental quantum spin current hidden in propagating fields. Numerical calculations of the Mie scattering demonstrate that the transverse momentum and spin push and twist an absorbing probe particle in an evanescent field, so that they can be detected straightforwardly.