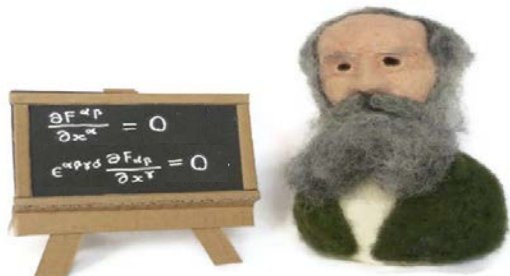


Quantum Condensed Matter Research Group **found several extraordinary features in electromagnetism, optics, and classical interpretations of quantum phenomena.**



Maxwell's free-space electromagnetism

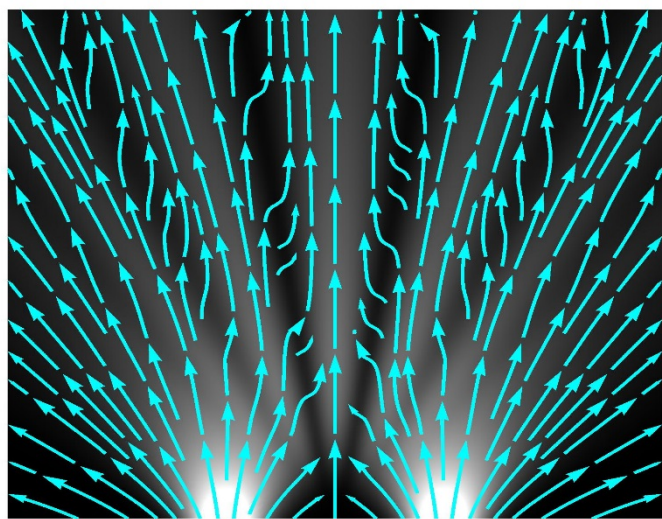
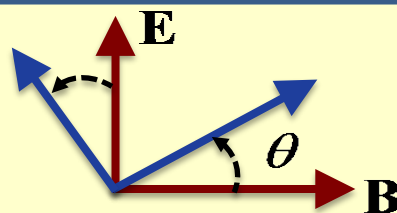


Fig. 2. **Photon trajectories in complex wave interference**

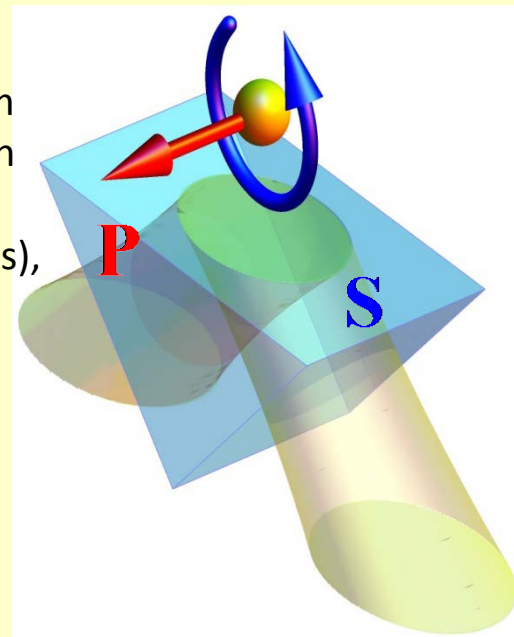


$$\mathbf{E} \rightarrow \mathbf{E} \cos \theta + \mathbf{B} \sin \theta$$

$$\mathbf{B} \rightarrow \mathbf{B} \cos \theta - \mathbf{E} \sin \theta$$

Fig. 1. **Dual symmetry** of free-space Maxwell's equations

Fig. 3. Extraordinary momentum and spin in *evanescent* waves. In sharp contrast to the usual electromagnetic waves (photons), such evanescent waves possess **transverse helicity-dependent momentum P** and **transverse helicity-independent spin S**.



- (1) K.Y. Bliokh, A.Y. Bekshaev, F. Nori, "Dual electromagnetism: helicity, spin, momentum, and angular momentum", New J. Phys. 15, 033026 (2013) [ISI highly cited during 2013].
- (2) K.Y. Bliokh, A.Y. Bekshaev, A.G. Kofman, F. Nori, "Photon trajectories, anomalous velocities, and weak measurements: a classical interpretation", New J. Phys. 15, 073022 (2013).
- (3) K.Y. Bliokh, A.Y. Bekshaev, F. Nori, "Extraordinary momentum and spin in evanescent waves", Nature Communications 5, 3300 (2014). [ISI highly cited].