Seminarankündigung

Dienstag, 30. Januar 2018
13:00 Uhr

WSI, Seminarraum S 101

“Lights topology at the nanoscale -faithfulness, tragedy and usefulness-”

We use a near-field microscope to visualize light fields in and around nanophotonic structures. The microscope gives us access to the amplitude and phase of not only the electric but also the magnetic in-plane field components [1,2]. Thus, we gain access to the full in-plane electric and magnetic “Poincaré sphere”. We have used the microscope to visualize optical entities -both phase and polarization singularities- that, in their size, put nanophotonics to shame as they are infinitesimally small.

In a chaotic cavity the superposition of random waves leads to a distribution of phase singularities in space reminiscent of the arrangement of particles in an ionic liquid, but not quite due to lights vectorial nature [3]. As a parameter of the system is changed, e.g., the optical frequency, the singularities perform a Brownian motion. Sometimes they are created in pairs. And sometimes a pair of singularities annihilates. We observe that the “life and death” of pairs that annihilate with their creation partner and therefore exhibit life-long fidelity, seems to take place predominantly in the parameter range where the random light field patterns exhibit coherence. Promiscuity occurs all the “time” [4].

Lights topology is however not only a concept of foundational importance. It also forms the basis of finding new ways to manipulate light-matter interactions. Strong confinement of light propagating along a nanowire leads to a topological constellation in which light on either side of the wire has a so-called transverse optical spin. On either side of the nanowire the spin has an opposite sign. Symmetry considerations immediately show that if the direction of propagation is reversed, the signs of the optical spin will be flipped everywhere. We have used this effect to create a room temperature chiral valley-photon interface. We were able to effectuate a direct coupling with 90% efficiency between emission from a specific valley in WS2 to a specific propagation direction along a nanowire [5]. This 1-to-1 coupling opens avenues for ways to combine spintronics and nanophotonics in novel, energy efficient devices.

[1] B. le Feber, et al., Nature Photonics Vol. 8, 43-46, (2014).
[2] N. Rotenberg and L. Kuipers, Nature Photonics Vol. 8, 919-926, (2014).
[3] L. De Angelis, et al., Phys. Rev. Lett. 117, 093901 (2016).
[4] L. De Angelis, et al., Phys. Rev. Lett. 119, 203903 (2017).
[5] S.-H. Gong, et al., Science (accepted, expected publication date 26 January 2018).

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