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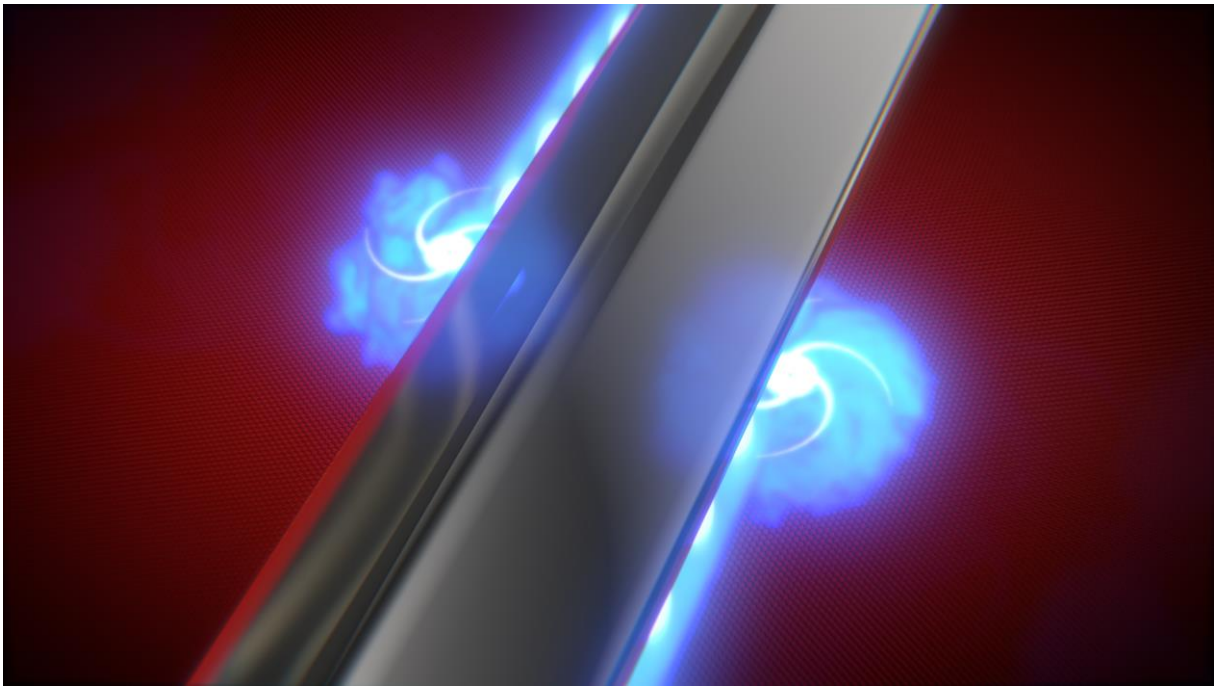
Title: **Lights topology at the nanoscale – surprises, (un)faithfulness and usefulness**



Abstract: Nanophotonics aims to control light flows and emission with nanostructures at deep-subwavelength length scales. Interestingly, light fields that we observe on a daily basis, e.g., the patterns at the bottom of a swimming pool, already contain optical entities – both phase and polarization singularities – that, in their size, put nanophotonics to shame as they are infinitesimally small. The singularities also exhibit intriguing topological features. In this lecture we explore the topology of light in nanostructures.

In a chaotic cavity the superposition of random waves leads to a spatial distribution of phase singularities in space reminiscent of ions in an ionic liquid [1]. When a parameter of the system is

changed, e.g., the optical frequency, the singularities perform a random walk. Sometimes they are created or they annihilate, always in pairs so that the total topological charge is conserved. We observe that two families exist: those that exhibit life-long fidelity and those that are “promiscuous”. The latter live “longer” [2].

Lights topology is not only a concept of foundational importance. It also offers new ways to manipulate light-matter interactions. Strong confinement of propagating light leads to a topological constellation called optical spin-momentum locking. We have used this effect to create a room temperature chiral valley-photon interface, which creates a 1-to-1 link between light emission from a specific valley in WS2 and a specific propagation direction along a nanowire [3]. This opens avenues for combining spintronics and nanophotonics in novel, energy-efficient devices.

[1] L. De Angelis, et al., Phys. Rev. Lett. 117, 093901 (2016).

[2] L. De Angelis, et al., Phys. Rev. Lett. 119, 203903 (2017).

[3] S.-H. Gong, et al., Science 359, 443-447 (2018).