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Optical Singularities: Classical, Quantum and on the Nanoscale

The orbital angular momentum of light and the related optical singularities describe conceptual simple and beautiful approaches to understand and control light's vast number of spatial degrees of freedom. This is closely linked to the concept of optical coherence, which connects different branches in optical physics, from classical photonics to quantum optics. I will show that they give access to novel quantum entangled states also with more than two photons, and that singularities enable exploring the true nanoscale from the optical far field. This offers a new way for exploration of quantum processes in a wide range of materials from novel low dimensional solid-state systems, plasmonic nanostructures, to macromolecular systems. Eventually, I explain how this might lead to a new paradigm of quantum coherent light-matter interaction in nanoscale solid state systems.

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