Plenary Talk PV XII Fri 8:30 Audimax

Photonic graphene and beyond - topological features of optically created artificial matter — •Cornelia Denz and Haissam Hanafi — Institute of Applied Physics, University of Muenster

Graphene with its hexagonal band structure of the energy spectrum has been celebrated in the past years as a wonder material due to its intriguing features. Among them, its topological phases are attributed to singular points in the band structure, the so-called Dirac points, and flat bands. Varying the lattice structure beyond graphene extends these topological phases of matter, leading for example to topological insulation. While condensed matter systems are difficult to adapt, optically created artificial dielectric photonic lattices represent an ideal testbed for these 2d materials. This has led to the area of topological photonics, an emerging field in which geometrical and topological concepts are implemented to design and control the behavior of complex light. In our contribution, we summarize fabrication techniques of photonic lattices with structured light based on additive femtosecond laser machining in fused silica or on optical induction in nonlinear photonic crystals. We demonstrate topological features of artificially created 2d graphene and twisted bilayer materials and showcase first realizations of photonic borophene, the optical equivalent of the new rising star of solid-state physics, and fractal lattices. Further, we demonstrate numerous fascinating topological effects ranging from light localization in flat bands to robust edge-mode transport and nonlinear light localization in higher-order topologies.