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Photonic topological insulators MIKAEL RECHTSMAN, Technion - Israel Institute of Technology, JULIA ZEUNER, Friedrich-Schiller-Universität, Jena, YONATAN PLOTNIK, YAAKOV LUMER, Technion - Israel Institute of Technology, STEFAN NOLTE, Friedrich-Schiller-Universität, Jena, MORDECHAI SEGEV, Technion - Israel Institute of Technology, ALEXANDER SZAMEIT, Friedrich-Schiller-Universität, Jena — We present the first experimental observation of Photonic Topological Insulators (Photonic TIs). TIs are a new state of matter, which are bulk insulators, but conduct electrons on the surface. In photonic TIs, the propagating waves are electromagnetic, rather than electronic (in our case, visible light). Beyond their fundamental signifiucance, photonic TIs have also been suggested for a number of applications, including highly robust optical delay lines, on-chip optical diodes, and spin-cloaked photon sources. In solid-state TIs, topological protection is achieved by virtue of the Kramers degeneracy, which does not apply to photons. Therefore, for a non-fermionic TI, another mechanism is required. Our system is composed of an array of helical waveguides arranged in a honeycomb lattice. The helicity induces a fictitious, time-varying electric field, and the structure becomes equivalent to a Floquet TI (proposed by Lindner et. al.). By probing the diffraction of light through the lattice, we demonstrate topologically-protected edge states, scatter-free propagation around corners and upon encountering defects. Our setting will allow for the probing of mean-field interactions in TIs through optical nonlinearities, as well as the effects of controllable disorder.

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