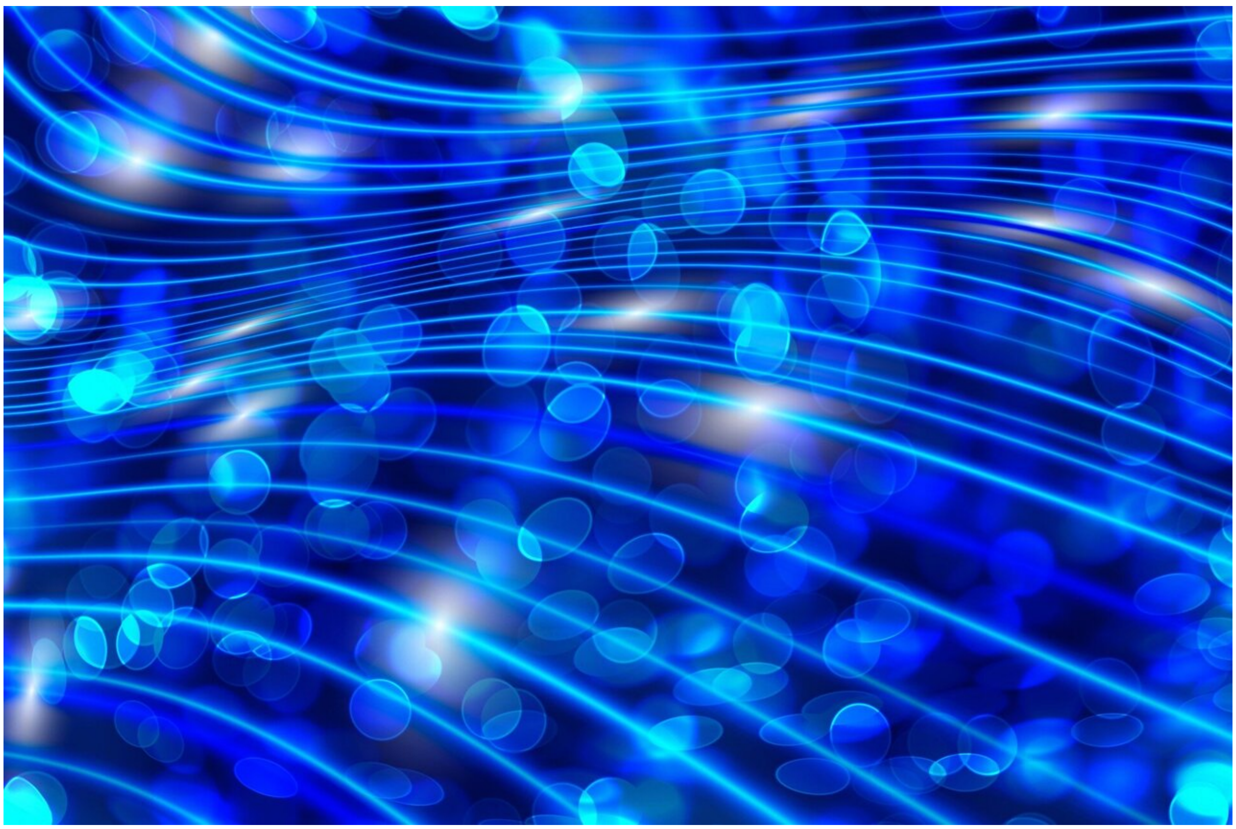
Researchers realize an anomalous Floquet topological system

July 6 2020



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An international team led by physicists from the Ludwig-Maximilians Universitaet (LMU) in Munich realized a novel genuine time-dependent topological system with ultracold atoms in periodically-driven optical honeycomb lattices.

Topological phases of matter have attracted a lot of interest due to their unique electronic properties that often result in exotic surface or boundary modes, whose existence is rooted in the non-trivial topological properties of the underlying system. In particular, the robustness of these properties makes them interesting for applications.

Periodic driving has emerged as an important technique to emulate the physics of undriven topological solid-state systems. The properties of driven topological systems, however, transcend those of their static counterparts. Using a BEC of 39K loaded into a periodically-modulated optical honeycomb lattice, we could generate such a time-dependent topological system.

For certain modulation parameters the system is in a so-called anomalous Floquet regime, where the Chern numbers of all bulk bands are equal to zero, while at the same time chiral edge modes exist in all quasienergy gaps. These non-trivial topological properties stem from the non-trivial winding of the quasienergy spectrum and cannot occur in undriven systems.

By combining energy gap and local Hall deflection measurements, the full set of topological invariants describing the time-dependent system was determined experimentally for the first time and the existence of chiral edge modes could be revealed even in a geometry with smooth boundaries. Due to its remarkable properties, especially in the presence of disorder, the anomalous Floquet phase promises the realization of interacting, periodically-driven systems, that may support a many-body-localized bulk, but thermalizing edge modes—an intriguing non-equilibrium many-body phase that may prove resilient to conventional Floquet heating.

More information: Karen Wintersperger et al, Realization of an anomalous Floquet topological system with ultracold atoms, *Nature Physics* (2020). DOI: 10.1038/s41567-020-0949-y

Provided by Ludwig Maximilian University of Munich