Non-reciprocal Wave Phenomena and Spatial-temporal Symmetries

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We discuss the roles of spatial-temporal symmetries in phenomena associated with non-reciprocal dispersion in photonic systems. We first illustrate that a magnetized chain of plasmonic nanoparticles can support a non-reciprocal dispersion only when a kind of spatial-temporal symmetry is broken. Through coupling between the plasmon modes with free photon modes, we see that the “diatomic” plasmonic chain can serve as an optical isolator for nanophotonics. In the second part of the talk, we present a one-way surface mode in a parity-time (PT) symmetric magnetized photonic system at “effective” magnetic permeability close to zero. The new mode is non-propagating and purely magnetic when the system is infinite while it becomes propagating in the finite case. One-way optical tunneling is supported in oblique-incidence configuration. In the finite-slab case, the radiative mode supports non-reciprocal unidirectional beam shift at normal incidence. The PT symmetry provides exceptional point and high transmission.