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TOPICAL REVIEW

Dressing light to illuminate axion-symmetry matter

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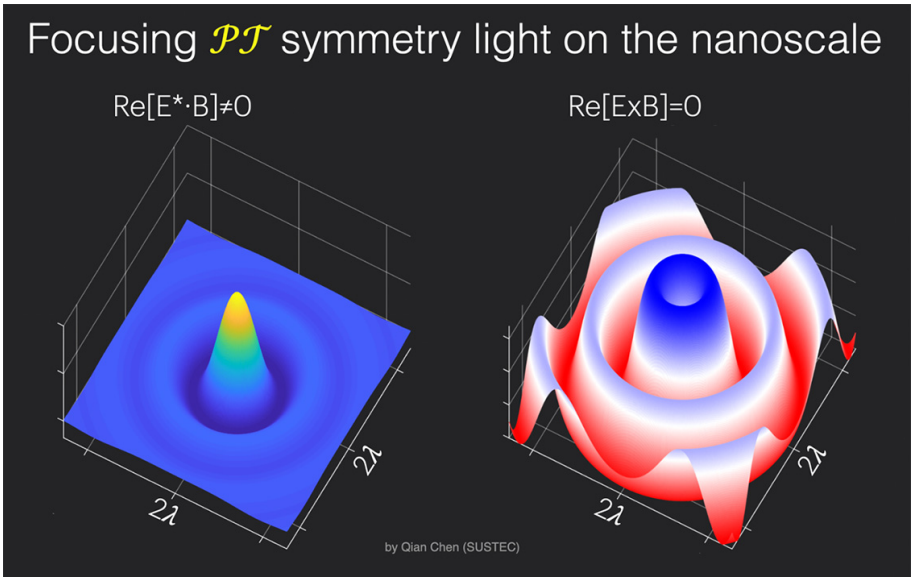
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Author introduction

Hrvoje Petek, a Jugoslavian scientist, obtained his Ph.D. in Chemistry at the University of California at Berkeley. He spent his formative 15 years at the Institute for Molecular Science, where he learned methods of ultrafast spectroscopy, and Hitachi, Advanced Research Laboratory in Japan, where he developed ultrafast coherent photoelectron spectroscopy. In 2000 he returned to the USA to the University of Pittsburgh, where he is the R.K. Mallon Chair of Physics and Astronomy. There he developed the methods of ultrafast coherent photoelectron microscopy, which he applies to topological plasmonic fields that are featured in this video article. He has received the 2019 Ahmed Zewail Award for Ultrafast Science and Technology.

Highlights

- Vectorial surface plasmon polariton fields are imaged by nonlinear photoemission microscopy.
- The E·B ≠0 term is imaged in plasmonic vortices as the fields gyrate at 0.5 PHz frequency.
- Structured surface plasmon polariton fields of defined geometry focus E·B ≠0 to 190 nm.
- The parity-time symmetry of E·B ≠0 enables coupling to axion quasiparticles and spin-charge entanglement.
- The E·B ≠0 fields are of interest as a portal to detect axion dark matter.



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Dressing light to illuminate axion-symmetry matter

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Abstract The putative axion particles with parity-time symmetry do not interact with transverse electromagnetic fields; hence, they are thought to constitute at least a part of the cosmological dark matter. Structured optical fields with E·B≠0 have the right symmetry to interact with axion dark matter. With the goal of generating fields with E·B≠0 that can interact with axion quasiparticles in condensed phase, as a portal for detecting dark matter, we image the vectorial surface plasmon polariton fields with 15 nm spatial resolution and 50 attosecond precision (at the speed of light) to reveal E·B≠0 term within the plasmonic vortex cores.

Keywords E·B≠0, parity-time symmetry, axion quasiparticles, spin-charge entanglement, ultrafast photoemission electron microscopy

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