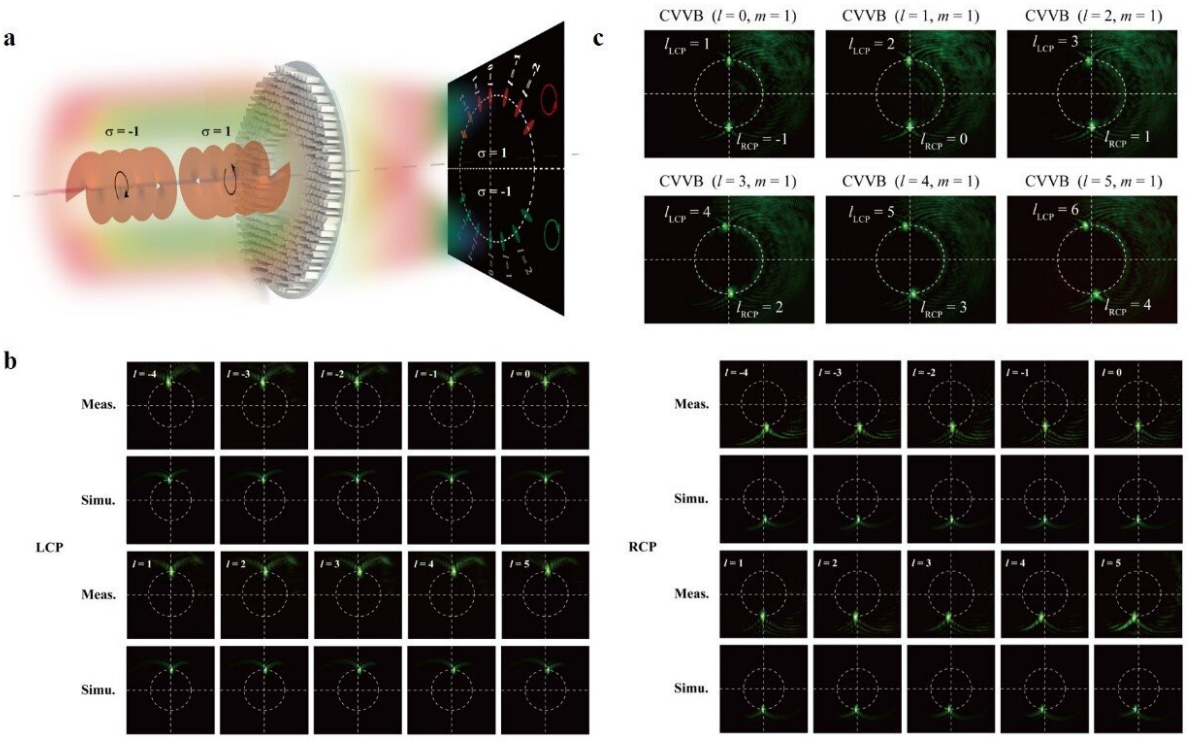
Single metasurface for simultaneous detection of SAM and OAM

April 20 2021



a, Schematic of a spin-decoupled metasurface that merges the geometric phase and dynamic phase for simultaneous SAM and OAM sorting via PMTs. Vortex beams with different spins are transformed into focusing patterns on two separated halves of the screen on a transverse focal plane with topological charge-dependent azimuthal rotations. b, SAM and OAM sorting at a wavelength of 532 nm. Measured and simulated focusing patterns for different SAMs and OAMs with the topological charge changing from -4 to 5. c, Cylindrical vortex vector beam sorting at a wavelength of 532 nm. Measured focusing patterns for different phase singularities changing from 0 to 5 and polarization singularity m = 1. Credit: Yinghui Guo, Shicong Zhang, Mingbo Pu, Qiong He, Jinjin Jin,

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Simultaneous SAM and OAM identification is a significant but challenging topic. Chinese scientists have demonstrated that a single spin-decoupled azimuth-quadratic phase metasurface could perform photonic momentum transformation, where different spin vortices are converted into focusing patterns with a distinct azimuth on a transverse plane, so that simultaneous identification of both SAM and OAM can be done via a single-shot measurement. This approach may underpin the development of integrated optical systems.

With inherent orthogonality, both SAMs and OAMs of light have been utilized to expand the dimensions of optical communications and signal processing, wherein unambiguous SAM and OAM identification is one of the significant topics. Conventional sorting approaches suffer from complicated optical setups, multiple bulky devices, repeated projection measurements, and cannot simultaneously distinguish SAM and OAM.

In a new paper published in *Light Science & Applications*, a team of scientists, led by Professor Xiangang Luo from State Key Laboratory of Optical Technologies on Nano-Fabrication and Micro-Engineering, Institute of Optics and Electronics Chinese Academy of Sciences, and co-workers have showed that a single spin-decoupled metasurface that merges the geometric phase and dynamic phase could perform simultaneous SAM and OAM mode discrimination via momentum transformation, where vortex beams of different spins were transformed into focusing patterns on two separated halves of the screen on a transverse focal plane with topological charge-dependent azimuthal rotations.

Further experimental investigations have proven that the single spin-

decoupled metasurface possesses the ability to detect cylindrical vortex vector beams with simultaneous phase and polarization singularities. Spin-decoupled PMTs were experimentally demonstrated at several different wavelengths in the visible band. Finally, they showed that the proposed approach could be extended to sorting of superimposed OAMs with a proper mode interval. These results reported here may have many important applications in momentum measurement of both the spin and angular momentum and singularity detection of both phase and polarization singularities.

More information: Yinghui Guo et al, Spin-decoupled metasurface for simultaneous detection of spin and orbital angular momenta via momentum transformation, *Light: Science & Applications* (2021). DOI: 10.1038/s41377-021-00497-7

Provided by Chinese Academy of Sciences