Metaphotonics for optical edge detection

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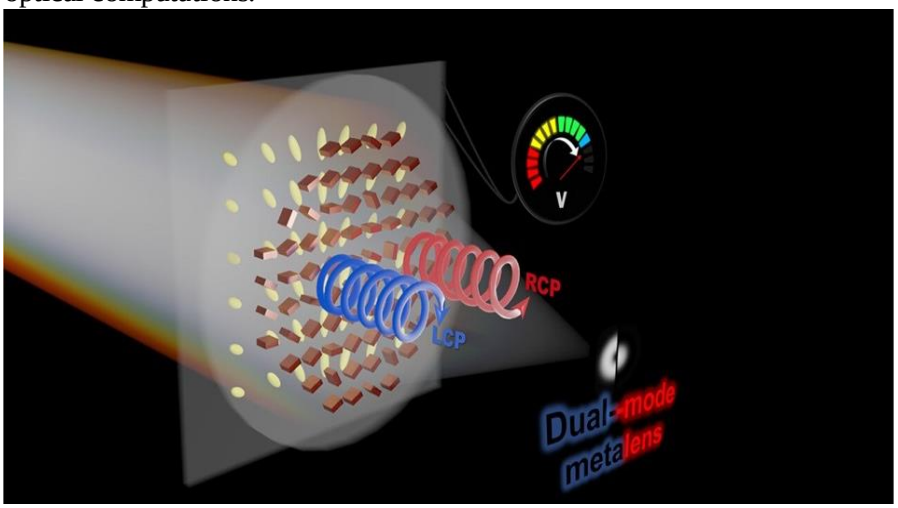
Tunable optical devices based on metasurfaces are revolutionizing functional planar optics.[1] Metalenses, flat lenses that use nanoscale phase modulation, offer compact, multifunctional solutions for imaging, displays, and augmented reality. Beyond standard imaging, metalenses enable advanced wavefront manipulation. By incorporating a spiral phase, they introduce additional topological charge modes, facilitating optical computation. This redistribution of wavevectors enhances edge detection, allowing for phase contrast imaging with a single flat device.

I will present my recent work on multifunctional metalenses integrated with liquid crystal cells for active electrical tunability at the microsecond scale. Using optimized low-loss a:Si-H, we demonstrate dual-mode metalenses capable of both diffraction-limited focusing and phase contrast imaging. Our experimental results highlight their potential for active biological imaging across the visible spectrum.[2]

Additionally, I will discuss spin-selective trichannel metalenses that combine optical computation, spatial manipulation, and diffraction-limited focusing.[3] These devices enable chiral imaging and spin-dependent operation, broadening applications in structured light and nanoscale optical computing. I hope this work paves the way for further research into multifunctional metalenses for advanced optical computations.



References

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