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Spatially resolved spin angular momentum mediated by spin-orbit interaction in tightly focused spinless vector beams in optical tweezers

We present an efficient method to generate spatially resolved longitudinal spin angular momentum (LSAM) in optical tweezers using tightly focused first-order spirally polarized vector (SPV) beams with zero intrinsic angular momentum. When focused into a refractive index (RI) stratified medium, the beam forms spherically aberrated intensity patterns with off-axis lobes carrying LSAM of opposite helicity to the beam center. We trap birefringent particles both at the center and off-axis lobes, observing them spin in opposite directions depending on their location and size. Large particles rotate clockwise or anticlockwise based on the beam's polarization spirality, while smaller particles spin according to spatial positioning. Numerical simulations agree with experiments, revealing a simple yet powerful route to spatial spin control in optical tweezers, opening new directions in spin-orbit optomechanics.

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None

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