VECTORIAL LIGHT SHAPING FOR THE CREATION OF UNIFORM BOTTLE

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Optical bottle beams have garnered significant scientific interest because of their ability to trap absorbing and negative polarizability particles. Just made them ideal for various scientific applications including atom trapping, imaging, and biophotinacs applications.
However, the generation of bottle beams, utilizing higher order bessel and optical vortex beams, often exhibit three-dimensional lobed structures that can lead to instabilities in the optical trap and allow trapped particles paths for escape. In this study, we investigate the requirements for achieving a perfect optical bottle beam with a uniform and completely enclosed dark region.

We utilize a novel light shaping approach based on a convex algorithm that enables control over its polarization properties, phase, and amplitude of the beam. Leveraging these advanced light manipulation methods, we delve into the creation of optical bottle beams, which were previously unattainable through conventional means.

Our investigations are driven by the need to address the limitations imposed by the presence of nodal surfaces in modern optical bottle beams, resulting in the undesirable lobed structure of the beam. We seek to determine if these lobed structures can be eliminated to create a perfectly enclosed dark region, thereby providing a stable and secure optical trap for particles.

Our research outcomes hold significant potential for advancing the field of beam shaping particular the beams with topological properties. It may also allow for the creation of new types of atom traps and precise control of micro particles.

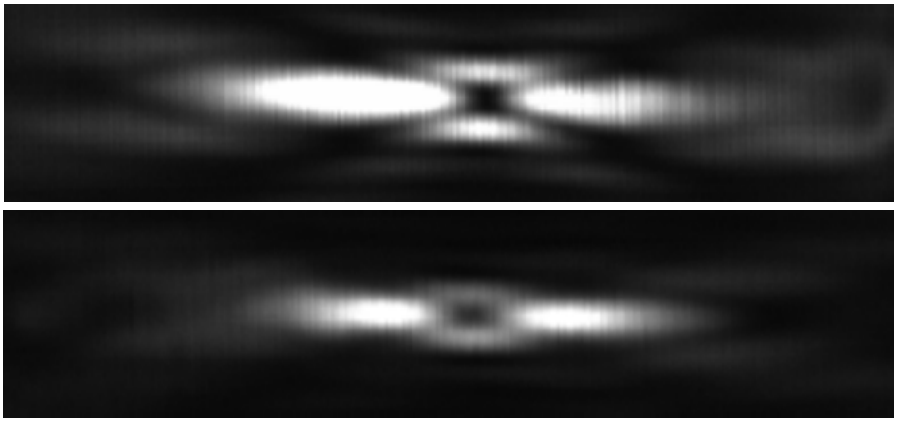

Fig. 1: Experimental crossections of two bottle beams. With (top) and without (bottom) nodal planes

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