Generation of a Bottle Beam

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A bottle beam is a laser beam that has zero intensity at its focus surrounded in all directions by regions of relatively high intensity [1]. Bottle beams define an “optically dark potential” and can be used to measure the dynamics of a nanoparticle in the dark focal region.

In this project a bottle beam will be generated by sending a Gaussian laser beam through a stressed glass window with a nonuniform birefringence distribution [2]. The generated bottle beam will be characterized as a function of stress, laser polarization, and beam diameter. Once completed, the bottle beam will be integrated into a vacuum-based nanoparticle trapping and cooling experiment.

Top: Intensity distribution near the focus of a bottle beam. Bottom: Photograph of a stressed window and its nonuniform birefringence.


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Prerequisites: Basic knowledge of electrodynamics, electronics, and measurement techniques.