A Mode Cleaner Cavity for Improved Stability of an Optical Dipole Trap

PATRICK BAGGE, DE LUO, JASON H. V. NGUYEN, RANDALL G. HULET, Department of Physics and Astronomy and Rice Center for Quantum Materials, Rice University, Houston, TX 77005 — The use of optical dipole traps has become a standard technique to trap ultracold atoms. Generated by a focused, far-detuned laser beam, our single-beam optical dipole trap is intended to be a strictly TEM$_{00}$ mode, as the presence of higher order modes can introduce instabilities in the trap. In particular, the location of the laser beam focus can vary over time when higher-order modes are present. We implement a monolithic mode cleaner cavity designed to pass the TEM$_{00}$ mode and suppress higher-order transverse modes. The cavity consists of four mirrors in a bow-tie configuration and is locked on resonance by using the tilt locking method\textsuperscript{2}. We characterize the performance of the cavity and its effect in improving the stability of an optical dipole trap used in experiments with bright matter-wave solitons.

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