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Design and Implementation of High Powered Laser Systems and Fast Imaging Systems for Creation and Detection of Optical Lattices MATTHEW GILLETTE, A.J. HACHTEL, ETHAN CLEMENTS, SAMIR BALI, Miami — Many exciting fledgling technologies such as Nanolithography and Quantum Computing rely upon the use of ultracold atoms arranged in a periodic nanoscale spatial structure created by interfering laser beams called an "optical lattice." By altering the polarizations and intensities of the interfering laser beams one can vary important properties of the optical lattice such as the spatial period and the binding strength at each site. The creation of the optical lattice requires extremely narrowband continuous laser powers of several hundred mW. Standard diode laser systems can be made to achieve the narrow linewidth but in doing so, are capable of eking out just a few mW of power. We present detailed plans for the construction and operation of a laser amplifier system capable of amplifying the diode laser output by two orders of magnitude, yet retaining the requisite narrow linewidth. Measurements of the tapered amplifier light output through a single-mode optical fiber are presented as a function of seed intensity and driving current. Detection of the optical lattice is not straightforward as the separation between adjacent lattice sites is a small fraction of the laser wavelength. The state-of-the-art imaging system commercially available for this purpose costs $40-50,000. We have designed an imaging system that can be implemented for less than $4000.

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