Abstract

Diode pumped alkali lasers (DPALs) are high power lasers that are of interest to the military and can be modeled using a supercomputer. For this project, the capabilities of modeling with the supercomputer were tested first, finding that only a few nodes were needed to run calculations efficiently. Following that, a few of the laser parameters were varied to see their effects on output power. First, the input and output power were compared for different concentrations of Rb. Second, out-coupling and output mirror reflectivity were varied. The final experiment involved altering the radius of curvature of the mirrors to escape the confocal condition. Though output power remained fairly constant, there were significant changes in the laser mode.

Background

The laser modeling toolkit (LMTK) was developed as an extension to a computational fluid dynamics program, Fluent. Fluent preforms the calculations on the gases inside the laser cavity and LMTK uses this information when it does the optical calculations. The calculations for LMTK and Fluent are intensive and necessitate high performance computing resources.

Methods

This project was conducted on the Air Force Research Laboratory supercomputer, Thunder. Using an established baseline case, identical jobs were run using one to eight nodes (36 cores per node) to find what an efficient number of nodes to use would be. This established, LMTK was used to calculate the output power as a function of pump power. This was done for three different concentrations of Rb. Again using LMTK, the reflectivity and out-coupling of an unstable resonator were tested. A typical unstable resonator has a purely reflective (ideally) mirror so that all power escapes around the small, output mirror. The size and reflectivity of this mirror was varied to see if the sum of the power through and power past the mirror might be greater than just the power past a purely reflective mirror. The final experiment involved changing the LMTK code so that the radius of curvature could be changed in a way so as to go off the confocal curve. This required altering the source code of LMTK.

Results

HPC Optimization for Next Generation Diode Pumped Alkali Laser Concept Development

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Pump Power and Rb Density Results

Figure 2. Output power increases with the pump power as well as with the Rb density, though not linearly

Looking Ahead

There is still more work that can be done. Studying the partially reflective output mirror yielded some interesting results that should be studied in more detail to ascertain whether or not a partially reflective mirror could be a reasonable design. This could also be combined with a study of changing the radius of curvature so that the beam converges toward the center of a partially reflective mirror. These things have never been tested before using LMTK and might yield promising results.

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