What is a Laser Amplifier?
More broadly, optical amplifiers are devices that amplify an optical signal directly. There is no need to convert the signal to an electrical signal.

System Overview

Goal
The project goal is to build a high power, ultrafast laser amplifier. This is achieved by focusing a 940 nm wavelength laser emitted from four 7.2 kW laser diode stack assemblies onto a crystal surface with a spot size of 15-25 mm.

Background
Previous research done at the Advanced Beam Laboratory has been conducted using stacked laser diode bars outputting 8kW each at a wavelength of 940 nm. The light emitted from the laser diodes was then focused on a Yb:YAG crystal with a spot size of 15 mm.

Design Team

Dr. Jorge J Rocca – Selecting us for this project. The amount of experience to be gained and skills learned will undoubtedly be a benefit to our future careers.
Dr. Mario Marconi – Advising us over the summer and defining the design requirements of components, milestones and scheduling expectations.
Dr. Yong Wang – Teaching ZEMAX Software and spending many hours advising us during the optical system design.
Sergio Oloriz Master’s Student – For verifying Mastercam CNC programming and taking on a considerable workload fabricating several of the optical mounts.
Kristian Dehne Master’s Student – For help with controller and power supply integration and Cryogenic system familiarization.
Peter Rhodes BSEE – For providing us with initial training in SolidWorks and COMSOL
Sean Jones BSME – For Teaching us machining procedures, Mastercam programming and CNC operations.
Aaron Davenport PhD Student – For application of anti-reflective coating no lenses.

Our Contributions

Solid Body Design/Fabrication
- Lens mounts
- Breadboard
- Diode mount
- Dummy load

Controller redesign, retrofit, and repair
- Cryogenic controller
- Laser diode driver controller

Optical system design
- Power optimization
- Scattering optimization
- Collimation and homogenization of beam pattern

Results
We achieved our output power goal of 2J at 200Hz. This is not the end of our project however, lots of time is spent optimizing and packing this high average power ultrafast laser amplifier.

Future Consideration/Plans
- Attempt to increase output to 2J at 400Hz.
- Add a 3rd optical path to increase power output.
- Create breadboard and enclosure.