High-School Projects at the Laboratory for Laser Energetics (2024)

Isaac Allen (Brockport) used the artificial intelligence "ChemCrow" software to model the refractive indices of a series of liquid crystal (LC) molecules based on structural variations of two widely known LC materials. He found that ChemCrow was able to select the variation that produced the highest refractive index and identify a method for chemical synthesis of the compound.

Alexis Anauo (Eastridge) first characterized the reflectivity of targets using an optical ratiometer setup and then analyzed data from laser-heated targets to determine the reflectivity of Al and Ti up to 200 GPa. She found the Ti reflectivity to continuously increase by ~5% to a peak pressure greater than 200 GPa, while the Al reflectivity decreased continuously by over 24% to the same pressure.

Ty Badre (Pittsford Sutherland) performed experiments and simulations to understand the effect of rotating the OMEGA EP injection throttle wave plate away from normal incidence. She also simulated how Laser Bay temperature fluctuations affect the wave-plate retardance. Ty's results will help Laser System Science better understand future injection throttle calibrations.

Aria Banks (Pittsford Mendon) explored improvements to the statistical model used for predicting the results of OMEGA cryogenic implosions. She used a database covering hundreds of cryogenic implosions to look for dependencies between terms in the model and found a correlation between target fill age and hydrodynamic stability.

Justin Chan (Webster Schroeder) built a double-plate lateral shearing interferometer for short-coherence-length optical sources. The double-plate scheme ensures equal-path-length interference between the sheared replicas. He demonstrated that the measured phase obtained by this method agrees with the known phase on a setup using a picosecond laser source and a spatial light modulator.

Chloe Chen (Penfield) used the two-dimensional hydrodynamics code *SAGE* to optimize laser-beam pointings for an experiment for the National Ignition Facility to study x-ray physics using gold-coated plastic spheres. She was able to improve the uniformity compared with a previous design by defocusing the laser beams and changing their aimpoints.

Sam Cohen (Brighton) measured the equilibrium pressures of hydrogen and deuterium gas over palladium at fixed temperatures as a function of the H:Pd ratio, extending the dataset of these measurements to very low temperatures below 180 K. His work has applications to hydrogen isotope separation techniques and novel means of pressurizing fusion targets.

Malachi Falco (Churchville-Chili) evaluated new solvent blends for cleaning sensitive optics that are safer, more sustainable and better cleaning agents than what is currently used by LLE. His modeling work predicted several promising candidates that will be tested in future studies.

Sophia Fietkiewicz (Mercy) compared different scanning techniques to digitize film data produced during OMEGA experiments. She developed MATLAB routines to compare the quality of these techniques by looking at spatial resolution, dynamic range, and distortion. She developed one of these techniques from scratch and wrote an algorithm for high-dynamic-range imaging.

Evan Hoefen (Brighton) developed a large database of one-dimensional simulations using the code *LILAC* to optimize the target and laser pulse shape designs for cryogenic implosions on OMEGA. He applied an evolutionary optimization algorithm to enhance a critical measure of performance and demonstrated the capability of machine learning to generate an optimal design.

Forrest Li (Webster Thomas) developed an algorithm for the automated analysis of data acquired with x-ray framing cameras in OMEGA cryogenic implosions. His script uses image-recognition algorithms to track the trajectories of the laser-deposition region in these experiments, giving a measurement of energy coupling. It is being adapted for automatic analysis of future implosions.

Prathiksha Mangalasubaskaran (Pittsford Mendon) investigated the ability of polymer waterproof coatings to protect phosphate laser glass from flowing aqueous coolants in disk amplifiers for NSF-OPAL, a proposed new laser. She developed and implemented a coating process that produces a highly uniform, defect-free coated surface that resists etching by water for over three months.

Chelsie Odenbach (Honeoye Central School) used atomic force microscopy and optical profilometry to characterize the nano-scale roughness of optical coatings, coated at LLE, intended for use on high power laser systems. Her efforts demonstrated that the nano-scale roughness is based on coating material and film thickness.

Colton Perry (Bloomfield) developed an experimental setup and software for controlling a "Z-scan" measurement system in which a laser beam is focused onto a sample material at various locations. This system will be used to measure the nonlinear refractive index of a number of optical materials in order to assess their suitability for use in next-generation high power lasers.

Johnny Piermarini (Red Jacket) participated in a facility sustainment project to select an x-ray sensor suitable for replacing those in use on the Omega Laser Facility pinhole-camera imaging systems. He used CAD software to design and 3D print an enclosure for one sensor. He also developed Python code to analyze data from two sensors to compare and contrast their signal quality.

Noah Rose (Geneseo) used the hydrodynamics code *SAGE* to investigate the possible use of defocused laser beams on cryogenic target experiments on OMEGA for two sets of phase plates, optics that determine the beam spot size at best focus. He found that using a defocused small-spot phase plate improved both uniformity and absorption fraction compared with the standard design.

Timothy Seo (Pittsford Mendon) used computer simulations of the electron distribution function (the probability of electrons having different velocities) to study how intense laser fields affect heat conduction in plasmas. He developed a model for an unusual effect that drives backwards heat flow (from cold to hot), which could improve predictions of laser-heated plasma conditions.