High-School Projects at the Laboratory for Laser Energetics (2011)

Brandon Avila (Allendale Columbia) researched Natural Language Processing (NLP) for extracting information from LLE documentation libraries. He developed an NLP application using Python, XML, and Natural Language Toolkit modules.

Andrew Boyce (McQuaid) carried out experiments to measure the rate at which tritium is removed from metal surfaces when exposed to flowing helium gas containing water vapor. He used a liquid scintillation cocktail to measure the activity of the tritium and measured the dependence of the rate of tritium removal on temperature and humidity.

Matthew DeCross (Pittsford Sutherland) used data from high-speed video cameras on the OMEGA target chamber to study the motion of cryogenic fusion targets. This motion fit a 3-D ellipse and in some cases could be used to predict the position of the target at the time of the laser shot. An estimate of the damping of cryogenic targets was obtained for the first time using these data.

Avery Gnolek (Webster Thomas) worked on a non-contacting photoalignment technology as a replacement for buffed alignment layer technology used in liquid crystal wave plates in OMEGA. He fabricated and demonstrated prototype small-aperture photoaligned liquid crystal wave plates that met all optical specifications at 1054 nm for current OMEGA liquid crystal wave plates.

Dana Gretton (Honeoye Falls) designed a prototype master timing generator (MTG) for the OMEGA Laser System on a state-of-the-art programmable logic device as a replacement for the previous MTG that uses 20-year-old discrete-circuit technology. The MTG synchronizes all the triggers to diagnostic hardware such as computers, cameras, and sensors to the laser pulse.

Sean Hamlin (Fairport) investigated the K-alpha x-ray fluorescence from shell additives as a diagnostic of shell compression in implosion experiments. He compared spectra from a simple analytic model with spectra from a detailed atomic-physics, radiation-transport model to show how measured spectra can be interpreted in a simple way to infer the shell areal density.

Felix Jin (Brighton) worked on the design, fabrication, and calibration of magnetic coils to be used in magnetized plasma experiments on the OMEGA laser system. He created a Matlab program to calculate the magnetic field profile and to analyze the resistive heating of the coil. He also measured the magnetic field and compared the results with calculations.

Jefferson Lee (Canandaigua Academy) wrote a computer program to model the diffusion of tritium through metal, a process that is important both for tritium decontamination and for moisture removal in the semiconductor industry. He looked at how the change of diffusion coefficient between the metal bulk and the surface metal-oxide layer affects the diffusion of particles.

Kevin Mizes (Pittsford Sutherland) worked with Andrew Zhao on a technique known as grid image refractometry. This will be used together with an optical probe beam being installed on the OMEGA EP laser to characterize plasma density profiles. Kevin assembled and aligned two optical systems that generated 2-D grid arrays of optical probe beams to test the technique.

Patricia Olson (Brighton) performed hydrodynamic simulations to develop optimized designs for two shock-ignition experiments, one proposed for the OMEGA laser and the other for the U.S. National Ignition Facility. Her designs improved the predicted implosion uniformity in both cases. She was named a semifinalist in the 2012 Intel Science Talent Search based on this project.

Sean Reid (Fairport) developed a method to grind and polish CR-39, a plastic used to analyze ions produced during fusion implosions, to eliminate etch-induced noise pitting. He found that the grinding and polishing process eliminated shallow data pits as well as noise pits. He developed a strategy to increase the depth of the data pits by exposing the CR-39 to UV light.

Madeline Rutan (Penfield) worked on improving the abrasion resistance of sol-gel antireflective coatings. She found that organosilane-modified sol-gel coatings crosslinked with dithiols had abrasion resistance 36 times greater than the coatings used currently in OMEGA.

Michael Statt (School of the Arts) fabricated a liquid crystal radial polarization converter device by irradiating a substrate coated with a photoalignment layer on a rotating stage coupled with a slit, after building and optimizing the fabrication setup. Such devices have applications in microscopy, machining, and laser electron acceleration.

Troy Thomas (Webster Thomas) worked with an optical time-domain reflectometer for measuring retroreflected light from targets in OMEGA EP. He developed Matlab-based software to analyze oscilloscope data acquired on shots, and planned and conducted a shot campaign to calibrate the instrument.

Harrison Xiao (Pittsford Sutherland) modeled the time-dependent, electron-optic distortions of the deflection systems in picosecond-time-resolution streak cameras. He showed that a common-mode voltage applied to the deflection plates can be used to correct the defocusing.

Andrew Zhao (Webster Thomas) worked with Kevin Mizes to develop and program Matlab mathematical models that analyze grid image refractometery. He used Kevin's optical grid array generators to probe optically refractive glass samples that approximated the refractive gradients expected in plasmas generated on OMEGA EP.