High-School Projects at the Laboratory for Laser Energetics (2019)

Henry Berger (Brighton) used a particle transport code to model a nuclear diagnostic for the real-time detection of fast neutrons over a full energy spectrum (1 MeV to 20 MeV), up to very high flux without saturation. By changing key characteristics of a converter foil, he achieved optimal energy resolution. A spectrometer based on his design will be built and tested at LLE.

Adelyn Carney (Webster Schroeder) wrote and used numerical tools to optimize the placement and orientation of laser-driven foils to uniformly irradiate a spherical capsule on the OMEGA Laser System with x rays. Her work enables experiments testing x-ray pre-illumination of capsules to suppress laser imprint and improve the performance of laser-driven implosions.

Ji-Mi Jang (Pittsford Mendon) used Raman spectroscopy to investigate how laser-induced damage modifies materials. She acquired and analyzed the Raman scattering spectra of damaged silica and hafnia thin films, which are used in the production of multilayer dielectric coatings for optics on the OMEGA and OMEGA EP lasers.

Christopher Kukla (Pittsford Mendon) first used Matlab programs to produce and Fourier analyze synthetic backlit images of grids including small-scale structures. He then applied this Fourier analysis to x-ray images taken with Fresnel zone plates in the LLE X-Ray Laboratory and on the OMEGA EP Laser System. He demonstrated high spatial resolution at scales approaching 1 micron.

Michele Lin (Attica) compared the bulk etching properties of methanol/NaOH and ethanol/NaOH solutions on CR-39 polymer, used to detect charged nuclear particles from OMEGA implosions. She determined optimal etching conditions for future procedures by etching CR-39 using different molarities and temperatures, measuring material removal rates while preserving data quality.

Anthony Mazzacane (Pittsford Mendon) optimized the grid used to simulate neutron and charged-particle diagnostics for the Monte Carlo particle tracking code IRIS3D, which is used as a postprocessor to hydrodynamic simulations. His work resulted in faster calculations that now allow for a greater throughput of postprocessed simulations of experiments.

George Morcos (Rush Henrietta) investigated the feasibility of using new glassy liquid crystal materials, based on cholesterol and displaying high UV transparency and laser damage resistance, to fabricate high-optical-quality polarization control devices for high-peak-power lasers. Using hot-stage polarizing microscopy, he showed that a device he fabricated had desirable properties.

Adam Mroueh (Pittsford Sutherland) built a Schlieren imaging device designed to visualize and measure the effects of turbulence and heat sources on the environment in which laser beams propagate. He developed data acquisition methods and data analysis software that enable one to determine the effect these factors have on the propagation of a laser beam.

Ka-Hyun Nam (Brighton) used nickel deposited on alumina granules to measure the efficiency of extracting oxygen from an inert gas stream for a range of concentration, flow, and temperature conditions. This data will guide the design of full-scale flow-through reactors. These reactors provide the tritium community with a simplified method of reducing emissions to the environment.

Simon Narang (Pittsford Sutherland) developed a computer program that uses x-ray images of the liquid DT contained in a fusion fuel capsule to predict the final thickness of the uniform solid DT layer after cooling. His work supports the new OMEGA cryogenic system under development. Simon was selected as a Scholar in the Regeneron Science Talent Search for this work.

Max Neiderbach (Geneseo) developed a Raspberry Pi based data acquisition unit to retrieve calorimeter data on the OMEGA Laser System. This was used to provide better resolution, greater reliability, and lower noise for calorimetric measurements. Max’s work involved testing different analogue-to-digital converter systems and calorimeter insulations.

Stephen Rosa (Eastridge) measured the equilibrium pressure of hydrogen over palladium at temperatures between 144 and 237 K. Palladium absorbs and reacts with hydrogen to form palladium hydride above 237 K. Stephen observed that hydrogen adsorbs onto palladium below 237 K.

William Wang (Pittsford Sutherland) wrote a new “view-factor” code and used an existing hydrodynamic simulation code to show that a proposed modification of the Chinese SG4 laser beam arrangement will enable it to implode fusion fuel capsules using direct drive as well as indirect drive, with good uniformity in both cases.

Hanna Wiandt (Pittsford Mendon) carried out hydrodynamic simulations of proposed experiments on the National Ignition Facility in which multiple targets would be irradiated simultaneously. She showed that fusion capsules can be imploded with reasonable uniformity using just 25% of the laser beams and developed designs for different beam selections, target materials, and target sizes.