High-School Projects at the Laboratory for Laser Energetics (2022)

Sara Davies (Brighton) used the hydrodynamics simulation code *SAGE* to optimize the irradiation uniformity of a proposed high-gain laser system with 96 quads (1 quad = 4 beams), twice as many quads as the National Ignition Facility (NIF). She worked out how to aim the laser beams for maximum uniformity while keeping the beam aim points as close to target center as possible.

Olivia Fietkiewicz (Mercy) built and tested a knife-edge setup to measure the mode field diameter of a single-mode optical fiber. Her setup was applied to a fiber commonly used at LLE and is key to improving LLE's technical knowledge of specialty fibers.

John Giess (McQuaid) worked on the optimization of high-gain target designs for inertial fusion energy. Using the two-dimensional hydrodynamic code *DEC2D*, he calculated the target nonuniformity growth during the deceleration phase of fuel assembly to find the target-design parameter space where perturbation amplification has minimal impact on target performance.

Samuel Gray (Brighton) investigated the ability of molecular sieve 4A held at cryogenic temperatures (77 K) to pump hydrogen under vacuum conditions (less than 1 torr) using a novel prototypic cryo-sorption design. He found that the thermal conductivity of molecular sieve under these conditions is extremely poor, making it necessary to precool the medium with cryogenic helium.

Micah Kim (Home School) developed Computer-Aided Design models of optical component mounts and fabricated them using stereolithographic 3-D printing. He established design concepts that can be combined to create a monolithic structure to precisely position eight optical elements in a telecentric imaging assembly related to pulsed magnetic field experiments on OMEGA.

Jackson McCarten (Webster Schroeder) tested the viability of using a strippable polymer coating to clean particles off multilayer dielectric (MLD) coatings and diffraction gratings. He developed a procedure to apply and remove the coating, removing particles from the surface without leaving excess polymer behind, and demonstrated that the process does not damage MLD grating pillars.

Elizabeth Norris (Brighton) examined the hydrogen collection efficiency of a flow-through palladium (Pd) getter bed, using gas mixtures of 1-4% He in deuterium (D_2) flowed through the Pd bed by a turbomolecular pump. If stagnant, 1% He in D_2 would prevent gettering, but Elizabeth found that nearly all of the D_2 was collected on the Pd bed in a single pass for each gas mixture.

Arjun Patel (Brighton) studied the interaction between Terahertz radiation and soft tissue, measuring the electric field distribution in healthy pancreas and pancreatic ductal adenocarcinoma tissue. He used *COMSOL Multiphysics* to simulate the THz radiation antenna and studied the absorption coefficient and bio heating of the two types of tissues when probed with 1-3 THz radiation.

Vinay Pendri (Pittsford Mendon) utilized time-dependent density functional theory to model the electron density distribution in liquid crystals exposed to femtosecond laser pulses. He found that the temporal electron density depends on the molecules' inherent π-electron delocalization and the propagation direction and incident laser polarization angle relative to the long molecular axis.

Jayden Roberts (Brockport) investigated methods of processing CR-39 plastic track detectors for charged particle spectroscopy applications. He demonstrated that the use of a microwave-enhanced etching process is able to decrease processing time by an order of magnitude. The microwave-processed track detectors retain the same characteristics as traditionally processed detectors.

Cameron Ryan (McQuaid) researched and developed an application management system using software containers to allow scientists to access data and analysis code. His work will help provide scientists with the capability to securely develop and save new and updated analysis code, and allow them to choose how to share saved code with colleagues.

Alisha Upal (Pittsford Sutherland) used the code *SAGE* to work out a laser-beam pointing configuration for a proposed NIF experiment to evaluate a new foam-ball implosion concept. Her configuration compensates for the loss of two NIF quads used for x-ray backlighting diagnostics, produces good uniformity, and will enable backlighting experiments to use 50% more laser energy.

David Villani (Harley) developed a machine-learning model to predict the performance of the OMEGA EP laser system. The model employs a neural-network architecture to achieve excellent agreement with a physics-based model using only 0.1% of the processing time. David also suggested how the model could be incorporated into current laser operations.

Grace Wu (Pittsford Mendon) measured refractive indices of ammonium dihydrogen phosphate and potassium dihydrogen phosphate crystals at temperatures down to 200 K in a two-chamber cryostat. By fitting experimental data she corrected the classical equations for refractive index used at low temperatures. This is important for the nonlinear optical generation of UV radiation.

Jenny Zhao (Pittsford Mendon) worked on improving the laser damage resistance of liquid crystal polarizer (LCP) optics by evaluating a series of UV-transparent molecules as candidates for chiral dopants in a new LCP formulation. She identified several promising compounds that possessed high UV transparency, strong helical twisting power, and the desired LCP phase behavior.

Rick Zhou (Brighton) measured the performance of molecular sieve 5A when collecting water vapor from a flowing inert gas stream at very high flow rates. He demonstrated that the mass transfer zone within a reactor was independent of both the carrier gas species and the areal velocity (volumetric flow rate / reactor cross-section) over the range 0.1 to 25 cm/s.