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Experimental AMO physics in undergraduate optics and lasers courses

CHAD HOYT, Bethel University

This talk will describe experimental AMO research projects in undergraduate Lasers and Optics courses at Bethel University. The courses, which include a comprehensive lecture portion, are built on open-ended projects that have a novel aspect. Classes begin with four weeks of small student groups rotating between several standard laser and optics laboratory exercises. These may include, for example, alignment and characterization of a helium neon laser and measurements with a Michelson interferometer or a scanning Fabry-Pérot optical cavity. During the following seven weeks of the course, student groups (2-4 people) choose and pursue research questions in the lab. Their work culminates in a group manuscript and a twenty-minute presentation to the class. Projects in the spring, 2016 Optics course included experiments with ultracold lithium atoms in a magneto-optical trap, a prototype, portable, mode-locked erbium fiber laser, a home-built fiber laser frequency comb, double-slit imaging with single photons, and digital holographic tweezers (led by Nathan Lindquist). Projects in the spring, 2015 Lasers course included ultrafast optics with a mode-locked erbium fiber laser, quantum optics, surface plasmon lasers (led by Nathan Lindquist) and a low-cost, near-infrared spectrometer. Several of these projects are related to larger scale, funded research in the physics department. The format and experience in Lasers and Optics is representative of other upper-level courses at Bethel, including Fluid Mechanics and Computer Methods. A physics education research group from the University of Colorado evaluated the spring, 2015 Lasers and 2016 Optics courses. They focused on student experimental attitudes and measurements of student project ownership.