SYMPOSIUM ON UNDERGRADUATE RESEARCH

Session ThEE

1:30 PM – 4:30 PM Room: 103C John Noé, SUNY Stony Brook, USA, Presider
Division of Laser Science of A.P.S – ILS XVII – 18 October 2001 – Long Beach, CA

LISTED CONTRIBUTIONS

ThEE1 1:30 PM: **Feedback control of a laser pointing device.**
K.A. Jensen, R.J. Larson, S.D. Bergeson, Brigham Young Univ., USA. We have built a stabilized laser pointing device as a demonstration of closed loop feedback control. This experiment is designed to teach students the rudiments of feedback control in an electronics laboratory setting.

ThEE2 1:45 PM: **Beam alignment guide for laser experiments.**
Catherine R. DeMarco, Matthew E. Anderson, San Diego State Univ., USA. The Beam Alignment Guide for Laser Experiments (BAGLE) is an automated system that aligns visible and near-infrared optical beams. The responses of two quadrature detectors, located directly behind semi-transmissive mirrors, are analyzed electronically. A feedback loop controls motorized mirror positioners to adjust the beam accordingly.

ThEE3 2:00 PM: **Measuring the fine structure constant using laser and electro-optic techniques.**
Marc Smiciklas, Marty Fix, Ryan Cottier, David Shiner, Univ. of North Texas, USA. We discuss an experiment using laser spectroscopy to measure the 32 GHz 2P fine structure interval in atomic helium. An integrated electro-optic modulator is used to provide precise laser frequency control. The transition frequency may be determined with a ~1 kHz uncertainty, yielding a new value for the fine structure constant.
Supported in part by NSF and an NIST Precision Measurement Grant.

ThEE4 2:15 PM: **Macroscopic observation of quantum effects: A study on the formation of interference fringes with polarized light.**
Jose Mawyin, Mirna Lerotic, John Noé, Harold Metcalf, Laser Teaching Center at SUNY–Stony Brook, USA. Our project studied the effects of 'tagging' photons with linear polarizers as they travel through a Mach-Zehnder interferometer. With orthogonal polarizers the fringes disappear, but they reappear when a third polarizer is added after the interferometer. Visibility of the fringes was deduced by analyzing intensity plots taken from photographs.

ThEE5 2:30 PM: **Rotational and translational manipulation of micro-sized particles using optical tweezers**
Henry I. Sztul, Enrique J. Galvez, Colgate Univ., USA. We present the results of experiments that aim at having full motional control of trapped particles in an optical tweezer. Higher-order Gaussian beams are used to exert torques on particles in addition to trapping forces. The optical beams are prepared using computer-generated holograms or an open-frame laser.

2:45 PM – 3:15 PM - Coffee break

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ADDITIONAL CONTRIBUTIONS

ThEE6 3:15 PM: **Three-dimensional optical coherence microscope for imaging the early development of plants and animals.**
James W. Perry, Thomas A. Driscoll, Richard C. Haskell, Daniel C. Petersen, Harvey Mudd College, USA. The implementation of a 3-D optical coherence microscope (OCM) is described. This OCM has a lateral resolution of 5 microns and a depth resolution of 10 microns, appropriate for non-invasive imaging of highly scattering biological tissue. A rotating image is presented to demonstrate the 3-D perspective that can be achieved.

ThEE7 3:30 PM: **Imaging early development in the frog with optical coherence microscopy.**
J. Daniel Pennington, Andrew J. Schile, Richard C. Haskell, Mary E. Williams, Daniel C. Petersen, Harvey Mudd College, USA; Scott E. Fraser, Cyrus Papan, California Institute of Technology, USA; Zhongping Chen, Hongwu Ren, Beckman Laser Institute, USA. Optical Coherence Microscopy (OCM) is capable of imaging non-invasively the early development of individual organisms. We have followed the dynamic process of gastrulation in the frog (Xenopus laevis). We will present time-lapse movies taken at both 850 and 1300 nm and discuss their implications for current models of gastrulation.

ThEE8 3:45 PM: **Self-directed experimentation in holography.**
Doug Broege, John Noé, and Harold Metcalf, Laser Teaching Center, SUNY at Stony Brook, USA. Holography, a fascinating and versatile tool in both science and art, is an ideal subject for self-directed hands-on optics learning. In this project materials from an inexpensive diode laser kit were used to make reflection and transmission holograms with a variety of interesting properties and potential applications.

ThEE9 4:00 PM: **Femtosecond studies of nonequilibrium electron distributions in metals.**
N. Breznay, P. sanGiorgio, T.D. Donnelly, Harvey Mudd College, USA. Electron dynamics in metals are not well characterized in the femtosecond time regime. We investigate the relaxation of electrons in a laser-heated metal on such a timescale. In addition, we discuss current techniques for modeling these interactions.

ThEE10 4:15 PM: **Generation of micron-scale fluids using ultrasonic atomization techniques.**
M. Scubmehl, B. Forrest, A. Bernoff, T.D. Donnelly, Harvey Mudd College, USA. Generating sub-micron water droplets with a controlled size distribution is important for laser fusion and fluid dynamics research. Ultrasonic atomization is an attractive approach to nebulization, but additional theoretical and experimental work is required to explore this alternative. We summarize our recent research and outline future goals.