Joint Spring 2011 Meeting of the New England Sections of the APS and the AAPT
Lowell, Massachusetts
http://www.aps.org/meetings/meeting.cfm?name=NES11
in metatronics can also provide us with novel nonlinear lumped elements. We have investigated the concept of metatronics through extensive analysis and numerical studies, computer simulations, and recently in a set of experiments at the IR wavelengths. We have shown that nanorods made of low-stressed Si$_3$N$_4$ with properly designed cross sectional dimensions indeed function as lumped circuit elements at the IR wavelengths between 8 to 14 microns. We have been exploring how metamaterials can be exploited to control the flow of photons, analogous to what semiconductors do for electrons, providing the possibility of one-way flow of photons. We are now extending the concept of metatronics to other platforms such as graphene, which is a single atomically thin layer of carbon atoms, with unusual conductivity functions. We study the graphene as a new paradigm for metatronic circuitry and also as a “flatland” platform for IR metamaterials and transformation optics, leading to the concepts of one-atom-thick metamaterials, and one-atom-thick circuit elements and optical devices. I will give an overview of our most recent results in these fields.

2:05PM A1.00003 Terahertz Spectroscopy of Complex Materials, RICHARD D. AVERITT, Physics Department, Boston University — Terahertz time-domain spectroscopy is a powerful tool to investigate complex materials broadly defined. This includes artificial electromagnetic composites such as metamaterials, and correlated electron materials where the interplay between microscopic degrees of freedom leads to phenomena such as superconductivity or metal-insulator transitions. I will discuss our recent results in these areas. Metamaterials are a relatively new type of artificial composite with electromagnetic properties that derive from their sub-wavelength structure. The judicious combination of metamaterials with MEMS technology enables reconfigurable metamaterials where artificial “atoms” reorient within unit cells in response to an external stimulus. This is accomplished by fabricating planar arrays of split ring resonators on bimaterial cantilevers designed to bend out of plane in response to a thermal stimulus. In this way we can control the electric and magnetic response of these metamaterials. Vanadion dioxide (VO$_2$) exhibits a metal-insulator transition (MIT) at a temperature (340K) that coincides with a structural phase transition. This leads to the “chicken-and-egg” problem. Is it the structural change or electron correlations that lead to the MIT transition? Uniaxially strained VO$_2$ films have been fabricated to help solve this problem. In unstrained VO$_2$ crystals the insulator to metal transition enables the electrons move freely in three dimensions. Non-contact THz-TDS conductivity measurements of strained samples reveal that the electrons prefer to move in one direction. That is, strain induces a quasi one-dimensional metallic conductivity. These results reveal the utility of terahertz spectroscopy to investigate complex materials and point the way towards future studies of hybrid composites incorporating metamaterials with quantum-based complex matter. Such multi-scale structures may offer complementary benefits where quantum materials confer additional functionality to artificial electromagnetic composites or, conversely, metamaterials serve as a novel tool to facilitate fundamental studies of the electrodynamic response of complex quantum materials.

Friday, April 8, 2011 3:30PM - 5:20PM
Session B1 Materials II — UML ICC Ballroom - Jayant Kumar, UMass Lowell

3:30PM B1.00001 Pattern Formation in Materials, ALAIN KARMA, Department of Physics, Northeastern University — Pattern formation is ubiquitous in nature, from sand ripples formed by wind to the development of a complex biological organism with different organs and a central nervous system. In the realm of materials, patterns are formed invariably when matter is transformed between different solid, liquid or gaseous states far from thermodynamic equilibrium. Material failure is itself mediated by the propagation of cracks that form intricate patterns. Understanding how patterns form and evolve is key to design materials with desired properties and to optimize their performance and safety. This talk will discuss recent progress made to understand three distinct class of patterns including the highly branched snowflake-like dendritic patterns formed during the solidification process, polycrystalline patterns shaped by grain boundaries, and crack patterns.

4:25PM B1.00002 Nature Inspired Surface Coatings, MICHAEL RUBNER, Department of Materials Science and Engineering, Massachusetts Institute of Technology — Materials Scientists more and more are looking to nature for clues on how to create highly functional surface coatings with exceptional properties. The fog harvesting capabilities of the Namib Desert beetle, the beautiful iridescent colors of the hummingbird, and the super water repellant abilities of the Lotus leaf are but a few examples of the amazing properties developed over many years in the natural world. Nature also makes extensive use of the pH-dependent behavior of weak functional groups such as carboxylic acid and amine functional groups. This presentation will explore synthetic mimics to the nano- and microstructures responsible for these fascinating properties. For example, we have demonstrated a pH-induced porosity transition that can be used to create porous films with pore sizes that are tunable from the nanometer scale to the multiple micron scale. The pores of these films, either nano- or micropores, can be reversibly opened and closed by changes in solution pH. The ability to engineer pH-gated porosity transitions in heterostructured thin films has led to the demonstration of broadband anti-reflection coatings that mimic the anti-reflection properties of the moth eye and pH-tunable Bragg reflectors with a structure and function similar to that found in hummingbird wings and the Longhorn beetle. In addition, the highly textured honeycomb-like surfaces created by the formation of micron-scale pores are ideally suited for the creation of superhydrophobic surfaces that mimic the behavior of the self-cleaning lotus leaf. The development of synthetic “backbacks” on immune system cells that may one day ferry drugs to disease sites will also be discussed.
C1.00001 Apparatus for measuring speed through the Doppler frequency shift of sound. WALTER SCHIER, Physics Dept., UMassLowell — The Doppler frequency shift of sound apparatus is based on a one meter diameter rotary table with a "button" speaker at its outer edge. A semicircular waveguide encloses half the periphery and has a microphone pickup on its wall at the midpoint. The tangential speed of the button speaker can be determined two ways for comparison. One method calculates speed from the frequency shift of sound, the other uses the repeat sound pattern. Agreement to one percent is possible at speeds of about 25 mph. In the lab the microphone output is fed successively to pairs of students at ten computer stations. Students must also perform an exercise in their lab report that introduces them to the red shifted wavelengths of receding galaxies at determined distances from the earth thus introducing them to Hubble's law, the concept of the "Big Bang", and their estimate of the age of the universe.

C1.00002 Harvesting energy from the sun—photovoltaic panel apparatus. DAVID RICCIO, WALTER SCHIER, Department of Physics and Applied Physics, University of Massachusetts Lowell, Lowell, MA 01854 — Two 11 cm x 18 cm photovoltaic panels are mounted on a modified ballistic pendulum apparatus that was retired from service in our labs. Its heavy base with pivoted arm provides a stable mount with angle adjustment. Residential PV panel installations group the panels both in series and in parallel, extract maximum power from these groupings, and deal with varying intensity due to changing light conditions. Measurements in the undergraduate lab with a bare light bulb simultaneously provide characteristic graphs of current vs voltage, power vs voltage, load resistance vs voltage for PV panels singly, in series, or in parallel. Also intensity dependence on angle and on distance to the light source are studied in the lab. A custom junction box with a variable load resistor connects the PV panels to PASCO's interface box with voltage and current leads. PASCO's Data Studio is used to record and analyze the graphs.

C1.00003 Implementing ILDs and Assessment in Small-enrollment, Calculus-based Physics Classes — Lessons, Observations and Open Questions, DEBORAH MASON-MCCAFFREY, Salem State University — At Salem State, we offer a Physics minor, but most of our teaching load is support courses for other science majors and a lab sequence which satisfies the University's core education requirement. In three years of using assessments and ILDs in small-enrollment calculus-physics classes, there have been enough significant encouraging results, and still some open questions to report. ILDs can be highly effective teaching tools. They do require significant advance preparation as well as a safe environment for student participation. Motivating students to do their best on assessment pre- and post-tests can also be difficult. Strategies for motivating assessment performance, experiments using clickers to encourage participation in ILDs, and modifying and developing home-grown ILDs are discussed.

C1.00004 Ultrasensitive Sensing through Nanophotonics1, GARY SMITH, AAPT — In the summer of 2010, I was a participant in a summer RET experience hosted by Boston University’s Electrical and Computer Engineering department. As a part of my experience, I worked with Prof. Hatice Altug to develop classroom materials that would introduce high school students to the promise of nano-scale science, while providing them with some essential conceptual background in the subject. This summer, with NSF support, I hope to develop this background further by helping my cooperating professor refine novel techniques her group has developed in constructing nanoplasmonic antenna arrays through lithographic techniques. I currently work as a physics teacher and science department head for a Massachusetts Catholic high school.

1Boston University NSF Grant ECE-1009808 Hatice Altug Group

C1.00005 Geometric Laws in the Periodic Table of Elements, ALBERT KHAZAN, IMET — Despite many versions of the Periodic table of Elements were suggested, no one discussed the problem how the elements are connected to each other inside the Groups and Periods of the Table. As is known, the Groups are joined along the vertical (18 Groups in total), while the Periods are joined along the horizontal (7 Periods; we also suggest Period 8). Period 1 consists of 2 elements, Periods 2 and 3 : 8 elements each, Periods 4 and 5 : 18 elements each, Periods 6 and 7 : 32 elements each, and Period 8 : 37 elements. Dependency of the number of elements in each Period on its number is expressed with a broken line, described by equations of the respective linear intervals. It is shown that, according to the dependency of the common number of elements in each Period on its number, all Periods are joined into three sections, for the elements of all 18 Groups: Periods 1-3 (y=8x-6), Periods 3-5 (y=18x-36), Periods 5-7 (y=32x-106), Periods 7-8 (y=37x-141). For the elements of Group 1, we obtain a respective line. The region created by these two lines includes all elements of the Periodic Table (Khazan A. Progress in Physics, v.4, 2010, 64).

C1.00006 A new model for extracting the physical parameters from I-V curves of organic and inorganic solar cells, NADIA NEHAOUA, YAHIA CHERGUI, DJAMEL EDDINE MEKKI, Physics Department, LESIMS laboratory, Badji Mokhtar University, Annaba, Algeria — Computer simulation is an important tool for investigating the behaviour of solar cell devices and for optimising their performance. So, an accurate extraction and optimization of solar cells and solar panel parameters are very important in improving the device quality during fabrication and in device modelling and simulation. In this paper, a new method for extracting parameters (series resistance $R_s$, shunt resistance $G_s$, ideality factor $n$, saturation current $I_s$, and photocurrent $I_{ph}$) value is proposed. The proposed method deduces the characteristics curve of an ideal solar cell using the current-voltage characteristics curve measured and reported by solar cell manufacturers and calculates the difference between the deduced and actual measured curves. The method has been successfully applied to organic and inorganic solar cells under different condition of temperature and illumination. In addition, the precision of the proposed method is demonstrated by calculating the correlation between the I-V characteristics curve based on modelling parameters and the I-V curve actually measured employing a numerical method and we compare the extracted values with the experimental results and the calculated values obtained by other methods for proving its significance.

C1.00007 Correlation Functions and Glass Structure, Y. CHERGUI, N. NEHAOUA, B. TELGHEMTI, S. GUEMID, N.E. DERADDJI, H. BELKHIR, D.E. MEKKI, Physics Department, LESIMS Laboratory, Badji Mokhtar University, 23000 Annaba, Algeria — This work presents the use of molecular dynamics (MD) and the code of DI Poly, in order to study the structure of fluoride glass after melting and quenching. We are realized the processing phase liquid-phase, simulating rapid quenching at different speeds to see the effect of quenching rate on the operation of the devitrification. This technique of simulation has become a powerful tool for investigating the microscopic behaviour of matter as well as for calculating macroscopic observable quantities. As basic results, we calculated the interatomic distance, angles and statistics, which help us to know the geometric form and the structure of PbF2. These results are in experimental agreement to those reported in literature.
C.1.00008 Observation of Anomalous Potential Electric Energy in Distilled Water Under Solar Heating, FLORENTIN SMARANDACHE, University of New Mexico, Gallup Campus, V. CHRISTIANTO, Sciprint.org — In this paper, we describe a simple experiment with distilled water which could exhibit anomalous potential electrical energy with very minimum preparation energy. While this observed excess energy here is less impressive than J-P. Beberian’s and M. Porringer’s, and the material used is also far less exotic than common LENR-CANR experiments, from the viewpoint of minimum preparation requirement—and therefore less barrier for rapid implementation—, it seems that further experiments could be recommended in order to verify and also to explore various implications of this new proposition.

C.1.00009 Comparison of ultrasonic distillation to sparging of liquid mixtures, HAN JUNG PARK, HYE YUN JUNG, JOSEPH CALO, GERALD DIEBOLD, Brown University / Department of Chemistry — The application of intense ultrasound to a liquid-gas interface results in the formation of an ultrasonic fountain and generates both mist and vapor from the liquid. Here, the composition of the vapor and aerosol above an ultrasonic fountain is determined as a function of irradiation time and compared with the results of sparging for five different solutions. The experimental apparatus was designed for determining the efficiency of separation consists of a glass vessel containing a piezoelectric transducer driven at either 1.65 or 2.40 MHz. Dry nitrogen is passed over the ultrasonic fountain to remove the vapor and aerosol. The compositions of the liquid solutions are recorded as a function of irradiation time using gas chromatography, refractive index measurement, nuclear magnetic resonance, or spectrophotometry. Data are presented for ethanol-water and ethyl acetate-ethanol solutions, cobalt chloride in water, colloidal silica, and colloidal gold. The experiments show that ultrasonic distillation produces separations that are somewhat less complete than what is obtained using sparging.

C.1.00010 Neutron Scattering Cross Section Measurements for $^{160}$TM via the Time-of-Flight Technique, AFRIM ALIMETI, JAMES EGAN, GUNTER KEGEL, UMass Lowell, DEPT. OF PHYSICS AND APPLIED PHYSICS NUCLEAR PHYSICS TEAM — This research entails the first direct neutron scattering cross section measurements for $^{160}$TM via the time-of-flight technique. Neutron elastic and inelastic cross-section angular distributions were measured at 590-keV and 1000-keV incident neutron energies. Differential cross-section excitation functions were also measured in 0.1-MeV steps at 125° (scattering angle) from 495-keV to 1000-keV incident energy. The elastic measurements in the 0.5-MeV to 1.0-MeV incident neutron energy range compare favorably with the JENDL-4.0 evaluation based on nuclear reaction model calculations in the Japanese Evaluated Nuclear Data Library. The inelastic measurements are compared to JENDL-4.0 and to earlier measurements by Ko et al. (Nucl. Phys. A679, 147-162 (2000)) who used the $(n,n')\gamma$ technique for states above 100 keV in excitation. The measurements were made using the UMass Lowell 5.5-MV Van de Graaff accelerator, operated in the pulsed and bunched beam mode, producing subnanosecond proton pulses at a 5-MHz repetition rate to generate neutrons via the $^7$Li(p,n)$^8$Be reaction in a thin metallic elemental lithium target.

C.1.00011 Why 400 Years to Discover Countless Planets?, PAUL H. CARR, AF Research Laboratory Emeritus — In 1584, Dominican monk Giordano Bruno envisioned the stars as “countless suns with countless earths, all rotating around their suns.” Searching for intellectual freedom, he fled his native Italy to Protestant Switzerland and Germany, but in 1600, the Roman Inquisition condemned him for heresy. He was burned at the stake. Fast-forwarding to 1995, the Swiss astronomers Michel Mayor and Didier Queloz announced the discovery of a planet orbiting a star similar to our sun (51 Pegasi). In 2010, 500 planets had been found orbiting 421 stars. On Feb 2, 2011, NASA announced 1200 planet candidates. It took 400 years for telescope technology to advance and for Copernicus, Galileo, Newton, Bradley, and Fouscail to make major contributions, culminating in today’s astrophysics with digital imaging and processing. Contrasting with Bruno, in 2010 Dominican Francisco Ayala, who had been president of the Sigma Xi and AAAS, won the $1.6M Templeton Prize for affirming life’s spiritual dimension.

C.1.00012 An alternative to Wave Particle Duality, JEFFREY BOYD, Independent — by Jeffrey H Boyd. It is incorrectly thought that there is a mountain of experimental data supporting wave particle duality, WPD. We present a theory, Theory of Elementary Waves, that equally well explains that mountain of data. TEW views waves as independent of particles. Wave interference is complete before a particle is emitted. Often the waves and particles travel in opposite directions. To support TEW we offer four experiments. One. The TEW explanation of the double slit experiment. Two. Neutron interferometer data that can be explained by TEW but not WPD. Three. A variation on the double slit experiment in which WPD and TEW predict different outcomes. Four. The TEW explanation of the Bell states above 100 keV in excitation. The measurements were made using the UMass Lowell 5.5-MV Van de Graaff accelerator, operated in the pulsed and bunched beam mode, producing subnanosecond proton pulses at a 5-MHz repetition rate to generate neutrons via the $^7$Li(p,n)$^8$Be reaction in a thin metallic elemental lithium target.

C.1.00013 Observation of Anomalous Potential Electric Energy in Distilled Water Under Solar Heating, FLORENTIN SMARANDACHE, University of New Mexico, Gallup Campus, V. CHRISTIANTO, Sciprint.org — In this paper, we describe a simple experiment with distilled water which could exhibit anomalous potential electrical energy with very minimum preparation energy. While this observed excess energy here is less impressive than J-P. Beberian’s and M. Porringer’s, and the material used is also far less exotic than common LENR-CANR experiments, from the viewpoint of minimum preparation requirement—and therefore less barrier for rapid implementation—, it seems that further experiments could be recommended in order to verify and also to explore various implications of this new proposition.

C.1.00014 Heavy Element Spectroscopy: $^{244,245,246}$Pu (Z=94) $^{1}$, SANKHA HOTA, P. Chowdhury, S. Lakhmi, S.K. Tandel, T. Harrington, E. Jackson, K. Moran, U. Shrivadkar, UMass Lowell, I. Ahmad, M.P. Carpen- ter, C.J. Chiara, J. Greene, C.R. Hoffman, R.V.F. Janssens, T.L. Khoo, F.G. Kondev, T. Lauritzen, C.J. Lister, E.A. McCutchan, D. Seweryniak, I. Stefanescu, S. Zhu, Anl, Il — We report new spectroscopic observations in the $^{115}$,151,152 nuclei. $^{244,245,246}$Pu (Z=94) in continuation of our exploration of heavy elements using deep-inelastic and transfer reactions. High-spin states in $^{244}$Pu were populated using a $^{208}$Pb beam from the ATLAS superconducting LINAC at Argonne National Laboratory, incident on a $^{244}$Pu target, with gamma rays detected by 101 high resolution high-purity Ge detectors of the Gamma sphere array. New bands are observed in $^{244}$Pu and the ground state band in $^{246}$Pu has been extended to higher spins. The new results will be discussed in the context of the physics of neighboring N=150,151 and 152 even-Z isotones, along with expected high-K configurations and their decay modes in this region. The results help constrain theoretical models that attempt to describe the stability and structure of superheavy nuclei.

1Supported by the U.S. Department of Energy.
the results of neutron-gamma detection, were used to detect neutrons and gamma-rays from a PuBe source enclosed in paraffin. Following digitization of the pulse waveforms with a 1 GHz Lecroy Digital Oscilloscope, a pulse shape discrimination algorithm was explored through custom C++ programs integrated within the ROOT analysis software developed at CERN. The selection of integration windows was optimized to provide the greatest separation between the two signals. The latest results for the CLYC and CLLB crystal will be presented and the neutron-gamma waveform discrimination ability will be compared.

1Work supported by the U.S. Department of Energy.

C1.00021 Mode Matching Analysis for Negative refraction in a two dimensional Plasmonic Metamaterial

SANDEEP INAMPUDI, IGOR I. SMOLYANINOV, VIKTOR A. PODOLSKY, MULTISCALE ELECTROMAGNETICS LABORATORY TEAM — We present a theoretical analysis of negative refraction of surface plasmons in a plasmonic metamaterial formed by the periodic PMMA array on a gold surface. We used mode matching technique to analyze the dynamics of the effective wavevector and its variation of parameters solutions for determining closed form solutions to the inhomogeneous Mathieu equation to obtain the properties of the photoacoustic waves. The periodic structure is considered to have a modulation in its density or compressibility of the form $1 - 2y \cos(2\pi a x)$, where $y$ is the modulation factor and $a$ is the periodic length of the phononic structures. The properties of the photoacoustic waves are determined by an inhomogeneous Mathieu equation. We give several different methods including Green's function solutions, series expansions, and variation of parameters solutions for determining closed from solutions to the inhomogeneous Mathieu equation to obtain the properties of the photoacoustic effect.

C1.000020 Discriminating Neutron-Gamma Waveforms from Novel Scintillation Detectors using Digital Pulse Processing

T. HARRINGTON, S. LAKSHMI, P. CHOWDHURY, University of Massachusetts, Lowell, MA, USA, J. GLODO, K. SHAH, Radiation Monitoring Devices Inc., Watertown, MA, USA — In this research, we report the results of neutron-γ pulse shape discrimination studies performed with digital signal processing techniques. Two novel scintillator crystals, Cs$_2$LiLaBr$_6$ (CLLB) and Cs$_2$LiYCl$_6$ (CLYC), (provided by Radiation Monitoring Devices Inc.) which have different pulse shapes for neutron and γ-ray detection, were used to detect neutrons and γ-rays from a PuBe source enclosed in paraffin. Following digitization of the pulse waveforms with a 1 GHz Lecroy Digital Oscilloscope, a pulse shape discrimination algorithm was explored through custom C++ programs integrated within the ROOT analysis software developed at CERN. The selection of integration windows was optimized to provide the greatest separation between the two signals. The latest results for the CLYC and CLLB crystal will be presented and the neutron-γ discrimination capabilities of the two detectors will be compared.

1Work supported by the U.S. Department of Energy.

C1.00022 Nanocoulomb Proton Burst

NICHOLAS BORGES, KIMYLI RECCA, GREGG PARKER — At the UMASS Lowell Van-de-Graph accelerator, we are required to provide proton irradiation doses which corresponds to proton charges much less than 1 μC. We found that machine regulation requires a proton beam of about 1 μA. We designed a shutter provided with a slit which allows us to irradiate a sample for a fraction of 1 second with a 1 μA beam. To determine the time, $\Delta t$, during which the shutter is open, we use a light beam. Our equipment consists of the following: a photomultiplier tube (BURLE S83010E) set up as a photodiode, an electrometer (KEITHLEY 6514), a HeNe laser and a shutter that interrupts the laser beam. We measure the photodiode current, $i_0$, with the shutter open and we measure the charge with the electrometer, $Q = i_0\Delta t$, delivered to the target which the shutter is operated. From this data we obtain $\Delta t$, the time during which the shutter permits the light beam to pass, and during which we would pass the proton beam.
C1.00023 Application of CeBr₃ Scintillator Crystals for Sub-Nanosecond Lifetime Measurements¹, N. D’OLYMPIA, S. LAKSHMI, P. CHOWDHURY, E. JACKSON, UMass Lowell, Lowell MA, J. GLODO, K. SHAH, RMD Inc., Watertown MA — Ongoing efforts in the development of next generation radiation detectors has yielded several new scintillation crystals with gamma ray detection properties superior to more traditional materials. Amongst these so-called “super” scintillators is CeBr₃, which exhibits fast timing properties similar to that of LaBr₃ and BaF₂, as well as excellent energy resolution. The time resolution of CeBr₃ detectors has been found to be as low as 120 ps in coincidence measurements. We are currently investigating the use of CeBr₃ detectors for research in basic and applied nuclear physics involving fast timing measurements. In the work presented here, a pair of CeBr₃ detectors have been used to directly measure the half-life of a 1.48 ns isomer in 1⁰⁵Sm using the delayed coincidence technique and a multi-parameter data acquisition system. Further work is underway to apply this method for measuring sub-nanosecond lifetimes in isotopes created through thermal neutron capture at the UMass Lowell research reactor.

¹This work was supported by the U.S. Department of Energy

C1.00024 Bending Loss Optimization in Hollow Flexible Terahertz Waveguides, PALLAVI DORADLA, C.S. JOSEPH, JAYANT KUMAR, ROBERT H. GILES, University of Massachusetts Lowell, STL, UNIVERSITY OF MASSACHUSETTS LOWELL TEAM — Hollow, flexible, metal (Ag/Au) coated polycarbonate waveguides have been designed and fabricated for the transmission of Terahertz radiation. Attenuation characteristics of waveguides with bore diameters 4.1mm, 3.2mm, 2 mm were studied at two different wavelengths 215µm and 513µm. Minimal propagation loss of 2dB/m was achieved by coupling the lowest loss TE11 mode into the waveguide from an optically pumped terahertz laser. Maximal bending loss of 0.8dB was achieved for waveguides of bending radii 8, 13, 18cm and bending angles of 30 to 150 degrees. The investigation shows that a mode can be preserved in metal coated waveguide by launching the lowest order TE11 mode into a small bore hollow guide. Results will be presented during APS meeting.

C1.00025 Pion Identification Methods in Pion Photoproduction Measurements at MAX-lab¹, DANIEL KELLEHER, University of Massachusetts Dartmouth, FOR THE MAX-TAGG COLLABORATION — One of the unsolved problems in nuclear physics is describing the properties of nucleons in terms of the framework provided by Quantum Chromodynamics (QCD). To do this, the comparison of experimental measurements with theoretical predictions can be made for those reactions where both theory and experiment can be performed accurately. One reaction where this is possible is pion photoproduction near threshold, which is a fundamental reaction in which a photon interacts with a proton or neutron to produce a pion. Theoretical approaches such as Chiral Perturbation Theory and model-independent partial-wave analysis can provide accurate predictions for this reaction. A program to measure the γp → π⁺p reaction is underway using the MAX-lab photon tagging facility in Lund, Sweden. One difficulty with these measurements is isolating the pion events from the large proton and electron background present in the counters. By searching for the extra energy deposited from the π⁺ → μ⁻ decay, it is possible to reliably identify the pion events. This event identification technique will be discussed and additional tests used to confirm the reliability of this method will be shown.

¹Sponsored by NSF OISE/IRES award 0553467.

C1.00026 Gain Calibrations for Scintillation Counters in Pion Photoproduction Measurements at MAX-lab¹, KHAYLA ENGLAND, University of Massachusetts Dartmouth, FOR THE MAX-TAGG COLLABORATION — In nuclear science, researchers strive to describe the properties of nucleons in terms of the underlying quark structure. In order to do this, comparison of experimental measurements with theoretical calculations are made for those reactions where both theory and experiment can provide accurate answers. One such reaction is pion photoproduction near the threshold energy. This is a fundamental nuclear reaction in which a photon interacts with a proton or neutron to produce a pion. Measurements of the γp → π⁺n reaction are being performed using the photon tagging facility located at MAX-lab in Lund, Sweden. The outgoing pions were detected in scintillation counters. To ensure the accuracy of the pion energy measurements, gain calibrations of the scintillation counters were made during the data acquisition period. The energy spectrum produced by γ-rays emitted from a Th-C source was recorded. These data were analyzed to determine the position of the Compton edge, which has a known energy. Daily calibrations enabled changes in the scintillation counter gains to be monitored and corrected for in the data analysis. Additionally, these data also provided an estimate of uncertainties in the pion energy determination.

¹Sponsored by NSF OISE/IRES award 0553467.

C1.00027 Studying the Charge Transport Property through Fitting the Current of Carrier Extraction by Linearly Increasing Voltage (CELIV), KE YANG, JAYANT KUMAR, Center for Advanced Materials and Department of Physics and Applied Physics University of Massachusetts Lowell, AKSHAY KOKIL, RAMASWAMY NAGARAJAN, Center for Advanced Materials and Department of Plastics Engineering University of Massachusetts Lowell, NAGARJUNA GAVVALAPALLI, DHANDAPANI VENKATARAMAN, Department of Chemistry University of Massachusetts Amherst — A new method of measuring the charge extraction property through fitting the CELIV measurements is to be developed. Measurements based on CELIV experiments is developed to determine the semiconductors' mobility and conductivity. This method is to solve the differential equation governing the carrier extraction process, and use the numerical solution to predict the carrier extraction current and compare the prediction with the experimentally extracted current. The best fit is obtained by adjusting the mobility, conductivity and the dielectric constant automatically in computer program loops until the minimum current difference is reached. The condition for the conventional CELIV method that the dielectric relaxation time should be much longer or shorter than the transit time is not required for this fitting method. The mobility and conductivity of the p-n junction film and the semiconductor film are consistent with the results from Space Charge Limited Current (SCLC) measurements and the LCR meter measurements on the same film.

C1.00028 The Rare Isotope Breeder Upgrade to ATLAS at Argonne National Laboratory, P.F. BERTONE, F. BUCHINGER, S. CALDWELL, A. CHAUDHURI, P. CHOWDHURY, J.A. CLARK, J.E. CRAWFORD, A.Y. DEO, J.P. GREENE, S. GULICK, F.G. KONIDY, S. LAKSHMI, D. LASCAR, A.F. LEVAND, G. LI, C.J. LISTER, C. NAIR, R.C. PARDO, G. SAWARD, K.S. SHARMA, M. STERNBERG, T. SUN, J. VAN SCHELT, R. VONDRASEK, B.J. ZABRANSKY — The CAlifornium Rare Isotope Breeder Upgrade (CARIBU) to the Argonne Tandem-Linac Accelerator System (ATLAS) represents a highly novel approach to producing radioactive ion beams (RIBs) for nuclear physics studies. There are currently only two RIB facilities in the US. When commissioned, CARIBU will provide many exciting new opportunities to extend basic science knowledge as well as yielding valuable data for applications. The presentation will provide a brief overview of the physics goals for the facility, the suite of experimental apparatus, and current status.
GHz count rate near-IR single-photon detection, FAUSTIN CARTER, DANIEL SANTAVICCA, DANIEL PROBER, Yale University — The single-walled carbon nanotube is a truly one-dimensional conductor. The currently accepted theory describing propagation of electrons in the nanotube is Luttinger liquid theory, which predicts collective charge modes moving at a velocity greater than the Fermi velocity. By modeling the carbon nanotube as a transmission line, this propagation velocity can be determined from the standing wave resonances in the system. Due to the high resistance of carbon nanotubes, a length on the order of one micron must be used, resulting in resonances which occur at terahertz (THz) frequencies. These resonances can be measured using the heating of the nanotube electron system [1]. To avoid the use of a conducting substrate that absorbs THz, we use a side gate. We describe the development of nanotube samples with side gates for the proposed THz experiment.


Supported by NSF-DMR

C1.00030 Optical coupling to nanoscale superconducting transition edge sensors for GHz count rate near-IR single-photon detection, FAUSTIN CARTER, DANIEL SANTAVICCA, DANIEL PROBER, Yale University — Detection of individual near-IR photons with GHz count rates, good timing resolution, and high quantum efficiency is important in a number of applications. These include quantum key distribution, single-photon classical communication, and CMOS imaging for defect analysis. We propose a nano-scale superconducting niobium transition edge sensor (TES). The extremely small detector volume allows for single-photon sensitivity at 4 K, with a much faster response time (nsec) than conventional TES detectors operating below 0.4 K. The proposed device is intrinsically photon number resolving, unlike a superconducting nanowire single-photon detector or an avalanche photodiode. Efficient photon coupling is achieved with a resonant near-IR planar antenna. This is non-trivial in the near-IR regime. We present numerical simulations of the optical coupling for such a device.

C1.00031 Spintronics and Transportation, RICHARD KRISKE, University of Minnesota — The author has previously suggested that Fermi Energy Levels on the interior of nanotubes may be result in a novel transport mechanism that may on the one hand act as a QED mechanism and on the other as the normal Fermi Energy theory of Solid States. At this boundary between Classical and Quantum Physics many unexpected properties of Spintronics may be seen that could be useful for Computational and Electronic Devices.
8:48AM F1.00005 Estimation of annual occupational effective doses from external ionizing radiation at medical institutions in Kenya. GEOFFREY KORIR, Department of Physics and Applied Physics, University of Massachusetts Lowell, JESKA WAMBANI, Radiology Department, Kenyatta National Hospital Kenya, IAN KORIR, National Nuclear Regulator, South Africa — This study details the distribution and trends of doses due to occupational radiation exposure among radiation workers from participating medical institutions in Kenya, where monthly dose measurements were collected for a period of one year ranging from January to December in 2007. A total of 367 medical radiation workers were monitored using thermoluminescent dosemeters. They included radiologists (27%), oncologists (2%), dentists (4%), Physicists (5%), technologists (45%), nurses (4%), film processor technicians (3%), auxiliary staff (4%), and radiology office staff (5%). The average annual effective dose of all categories of staff was found to range from 1.19 to 2.52 mSv. This study formed the initiation stage of wider, comprehensive and more frequent monitoring of occupational radiation exposures and long-term investigations into its accumulation patterns in our country.

9:00AM F1.00006 A Laser Testing Facility for the Characterization of Silicon Strip Detectors. SARAH PHILLIPS, University of New Hampshire, UNH NUCLEAR PHYSICS GROUP TEAM. CLAS12 COLLABORATION — Silicon strip detectors are used for high-precision tracking systems in particle physics experiments. During the 12 GeV upgrade to the accelerator at Jefferson Lab, a new spectrometer, CLAS12, will be built in Hall B. The University of New Hampshire is part of the collaboration designing and building CLAS12. Among the detector systems being developed for CLAS12 is a silicon vertex tracker that will be placed close to the target, providing excellent position resolution for vertex determination. It is vital to have the ability to perform quality assurance tests and to evaluate the performance of the individual silicon strip detectors before installation in CLAS12. UNH is designing and building a laser testing facility to perform this task. The design consists of an infrared laser system and a precision computer-controlled positioning system that scans the laser light on the detector. The detector signals are read out by a data acquisition system for analysis. The facility includes a cleanroom area and a dry storage containment system. The facility allows the characterization of the large number of detectors before the final assembly of the silicon vertex tracker.

1IAEA support under RAF/9/033-Strengthening Radiological Protection of Patient and Medical Exposure Control.

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8:36AM F1.00004 Dual x-ray absorptiometry. ALBERT ALTMAN, University of Massachusetts Lowell, Dept of Physics and Applied Physics, RONALD AARON, Northeastern University — Dual x-ray absorptiometry is widely used in analyzing body composition and imaging. We discuss the physics of the method and exhibit its limitations and show it is related to the Compton and photoelectric contributions to the x-ray absorption coefficients of materials.

8:48AM F1.00002 Activated kinetics of the Crystalline to Nematic (K-N) and Nematic to Isotropic (N-I) phase transitions of Pentylcyano-biphenyl (5CB) liquid crystal. DIPTI SHARMA, WIT/MCPS — Activated kinetics of the crystalline to Nematic (K-N) and the Nematic to Isotropic (N-I) phase transitions of the Pentylcyanobiphenyl (5CB) liquid crystal are discussed here. A kinetic comparison of the same types of transitions of other family member with higher number of carbon atoms i.e. Octylcyanobiphenyl (8CB) are also made to see the difference between the kinetic behavior of the above two transitions of the liquid crystals. Experiments were performed using high resolution calorimetric technique for heating and cooling runs. Two different scans i.e. Temperature scans and Rate scans were performed for 5CB and 8CB from 280 to 333 K at various rates to get the detailed behavior of the transitions. As a result, Double activation was observed for 5CB for two heating rate regimes whereas 8CB indicated single activation only. The 5CB has smaller enthalpy and entropy of the transitions and needs larger activation than 8CB. This kinetic change can be explained in terms of the length scale and mobility of the liquid crystal molecules.

8:24AM F2.00003 The Role of Localized and Propagating Surface Plasmons in Periodically-Arrayed NAnopillars. FRANCISCO BEZARES, JOSHUA CALDWELL, OREST GLEMOCKI, RONALD RENDELL, MARIYA FEYGELOSON, Naval Research Lab, MARAIZU UKAEBGU, Howard University, RICHARD KASICA, NIST, LORETTA SHIREY, NAIDIL BASSIM, Naval Research Lab, CHARLES HOSTEN, Howard University — Periodically-arrayed nanopillars have been shown to exhibit evenly distributed electromagnetic (EM) fields and some of the largest average surface-enhanced Raman Scattering (SERS) enhancements reported for large-area nanostructures, making them ideal for optical sensors. Although these characteristics are thought to be the result of the combined contributions from localized (LSP) and propagating (PSP) surface plasmons, the degree to which each of these modes impacts the SERS enhancement efficiency of such nanostructures is unclear. To better understand the roles that LSPs and PSPs play in the SERS process, we have measured the SERS enhancement from periodic arrays of aminated Si nanopillar arrays that either feature both types of modes and those with only isolated LSP modes. These results illustrate that although the optimal nanopillar diameter (e.g. SPR condition) is determined primarily by the LSP modes, cooperative interactions between LSP and PSP modes result in at least an order of magnitude increase in the average enhancement factor and a broadening in the diameter response (e.g. increased SPR linewidth).
8:36AM F2.00004 Development of a Fabrication Path for Au-Organothiol-Carbon Nanotube Molecular Junctions. JASON MOSCATELLO, Michigan Tech, YOKE KHIN YAP RESEARCH LABORATORY TEAM. — Silicon electronics is at the scaling limit and new approaches are necessary. Nanomaterials have significant promise in addressing this problem and each has its own potentially useful properties, yet making the material is only the first step in harnessing those properties. Transitioning from developing materials to integrating them into devices is no small endeavor - placement, wiring, etc. are nontrivial on the nanoscale. This talk details work done at Michigan Tech developing a fabrication process for Molecular Electronic Junctions (MEJs). The goal is to study the lifetime of MEJs containing strong bonds because short lifetime is the largest limiting factor in many MEJs. It is important that the physics studied remains accurate even if the size is scaled down and the MEJs are arranged into arrays - two things that are necessary for MEJs to be used commercially. In addition the process is widely usable, since it only utilizes inexpensive and/or common processes (e.g. dielectrophoresis and photolithography). An overview of the fabrication process will be detailed, along with carbon nanotube (top electrode) placement by dielectrophoresis, and initial results.

1at Michigan Tech

8:48AM F2.00005 Enhanced efficiency in dye sensitized solar cells using reduced graphene oxide-TiO$_2$ nanocomposites. SOUMITRA SATAPATHI, Center for Advanced Materials and Department of Physics, University of Massachusetts Lowell, LIAN LI, RAVI MOSURKAL, LYNN SAMUELSON, US Army Natick Soldier Research, Development & Engineering Center, Natick, Massachusetts, JAYANT KUMAR. — Center for Advanced Materials and Department of Physics, University of Massachusetts Lowell. — Graphene, in the last few years, has elicited considerable interest for its remarkable electronic and optical properties. It has possible applications in the fabrication of organic solar cells, single molecule sensing and field effect transistors. Here, we, report the synthesis of graphene oxide starting from graphite nanoplatelets using Hammer's method. Subsequently, graphene oxide was reduced by hydrazine to obtain chemically reduced graphene oxide. The reduced graphene oxide-TiO$_2$ nanocomposites were prepared by physically mixing Triton-X stabilized reduced graphene aqueous dispersion and TiO$_2$ (P25) nanoparticles. Dye-sensitized solar cells (DSSC) were fabricated. It was observed that incorporation of 1wt% graphene into TiO$_2$ leads to 16% enhancement of overall power conversion efficiency.

1Corresponding author: Jayant_Kumar@uml.edu
9:00AM F3.00006 Sensitive detection of explosives via fluorescence quenching and pattern recognition technique

ABHISHEK KUMAR, ROBINSON ANANDAKATHIR, Center for Advanced Materials, University of Massachusetts Lowell, JUNG HWAN CHO, PRADEEP KURUP, Department of Civil and Environmental Engineering, University of Massachusetts Lowell, JAYANT KUMAR, Center for Advanced Materials, University of Massachusetts Lowell — There is significant interest in developing chemical sensors for detection of trace explosives. Optical sensors are inherently very sensitive and have potential to detect explosive vapors at room temperature and ambient conditions. There is a need to develop materials for optical sensors to fabricate a sensor array which can provide required sensitivity and selectivity. Here, we report an optical sensor array combined with pattern recognition technique for sensitive and selective detection of explosives. The optical sensor array consists of four conjugated polymers. These polymers have good quantum yield of fluorescence and large Stoke’s shift. We have shown that by employing pattern recognition technique, the presence of nitro containing explosive TNT (2,4,6-trinitro toluene) can be discriminated with other common chemical interferants in 60 seconds.

1National Science Foundation

Saturday, April 9, 2011 8:00AM - 9:48AM –
Session F4 Environment, Astronomy, Theory
Olney Science Center 0-115 - Aram Karakashian, UMass Lowell

8:00AM F4.00001 Possible impact of global warming and ocean acidification on underwater sound in northern oceans: another perfect storm

DAVID BROWNING, University of Rhode Island — The greatest ocean pH change, which will result in lower low frequency sound attenuation, is predicted for higher latitudes. Here shallow sound channel axes exist, allowing the impact on sound to be seen sooner and also more extensively since the principal propagation paths will be near the surface. However, at the same time, higher wind speeds and greater ice breakup, as well as increased ship traffic, could result in higher noise levels. Marine mammals in this environment may have, on one hand, improving communication conditions but also the possibility of increased background noise.

8:12AM F4.00002 The impact of tropical ocean on Arctic climate

CONSTANTIN ANDRONACHE, Boston College — Climate variations at high latitudes are dependent on the perturbations of sea - ice extent, snow cover over continents, sea surface temperature (SST) anomalies, and predominant atmospheric circulation patterns. In this study we report on possible links between sea surface temperature anomalies (SSTA) in the tropical global ocean and various oceanic regions in the Arctic. We use the National Oceanic and Atmospheric Administration (NOAA) observed SST, the data from NCEP/NCAR Reanalysis project and statistical techniques to detect possible connections between various parts of the global ocean. We show that SSTA have notable correlations between:
1) Tropical Atlantic and North East Atlantic, impacting climate in Scandinavia; 2) East equatorial Pacific (NINO 3.4 area) and North West Pacific, impacting climate in Alaska; and 3) Tropical Indian Ocean and northern latitudes (with impact on Scandinavian and Canadian climate). Our analysis confirms earlier reports based on statistical analysis and model simulations showing a connection between the tropical ocean and the climate at higher latitudes.

8:24AM F4.00003 CO2 - The Canary in the Energy Efficiency Coal Mine

PETER SOMMSICH, Portsmouth, NH — While much of the discussion surrounding CO2 is focused on its role as a GHG (green house gas) and its affect on Climate Change, CO2 can also be viewed as an indicator for reductions in fossil fuel use and increased energy efficiency. Much as the canary in a mine was used to warn miners of unsafe health conditions in a mine, CO2 can be seen as allowing us to effectively track progress towards energy efficiency and sustainability. Such an effort can best be achieved by either a Carbon Tax or a Cap and Trade system which was highly effective as part of the 1992 Clean Air Act, contributing to a significant reduction of SO2 and acid rain. A similar attempt has been made using the 1997 Kyoto Protocol to reduce carbon emissions. The mechanisms of how this treaty was intended to work will be explained, and examples will be given, both in the USA and Europe, of how the protocol was used to reduce energy consumption and energy dependence, while also reducing CO2 emissions. Regardless of how strong an impact CO2 reduction may have for Climate Change issues, a reduction of CO2 is guaranteed to produce energy benefits, monetary benefits and can even enhance national security. For all of these reasons, we need the CO2 canary.

8:36AM F4.00004 Shaping the Brown Dwarf Desert: Constraints from Turbulent

PETER JUMPER, ROBERT FISHER, University of Massachusetts Dartmouth — The brown dwarf desert is the term used to describe the notable absence of brown dwarfs within about 5 AU from the central main- sequence star in binary brown dwarf-stellar systems. Previous work by other researchers has focused on a dynamical mechanism as the origin of the desert; namely, that brown dwarfs formed within the desert will migrate into their central stars on a relatively short timescale of approximately 10 Myr. We will develop models of turbulent giant molecular cloud cores, which subsequently form a binary system containing a brown dwarf. We will assume that the brown dwarfs form via gravitational fragmentation from the parent core, as supported by recent observations. A key goal of this current research is to understand the role of the brown dwarf formation process in shaping the brown dwarf desert.
my classmates’) curiosity and fascination with his ingenious use of mathematics. I discovered to understand the magnitude of Galileo’s telescope. Galileo’s study of motion, like pendulum and inclined plane, deepened my (and paper cards along the desk helped me to discover the geometry; reading Galileo’s Sidereal Messenger allowed me to apply the geometry that I found the ordinary world no less intriguing and unsettling to explore, as the historical world of protagonists in Galileo’s Dialogue their observations, notice things they had never noticed before, and extend their understanding in the midst of pervasive confusion. Personal experiences while interactively following students’ emergent understandings. In the context of Galileo, students learned to observe carefully, trust their role by means of their own explorations. These classroom journeys include: sighting through picture frames to understand perspective, watching the night sky, experimenting with lenses and motion, and responding to Galileo’s story. In teaching, I use critical exploration, the research pedagogy developed by Eleanor Duckworth that arose historically from both the clinical interviewing of Jean Piaget and B¨ arbel Inhelder and the night sky, experimenting with lenses and motion, and responding to Galileo’s story. In teaching, I use critical exploration, the research pedagogy developed by Eleanor Duckworth that arose historically from both the clinical interviewing of Jean Piaget and B¨ arbel Inhelder and the Elementary Science Study of the 1960s. During critical explorations, the teacher supports students’ investigations by posing provocative experiences while interactively following students’ emergent understandings. In the context of Galileo, students learned to observe carefully, trust their observations, notice things they had never noticed before, and extend their understanding in the midst of pervasive confusion. Personal investment moved students to question assumptions that they had never critically evaluated. By becoming Galileo in today’s classroom, we found the ordinary world no less intriguing and unsettling to explore, as the historical world of protagonists in Galileo’s Dialogue.

8:12AM F5.00002 Discover Mathematics in the Physical World , YAN YANG, Harvard Graduate School of Education — Playing with perspective windows generated an initial idea related to mathematics; an extended experiment with paper cards along the desk helped me to discover the geometry; reading Galileo’s Sidereal Messenger allowed me to apply the geometry that I discovered to understand the magnitude of Galileo’s telescope. Galileo’s study of motion, like pendulum and inclined plane, deepened my (and my classmates’) curiosity and fascination with his ingenious use of mathematics.
8:24AM F5.00003 ITOP: graduate courses for physics teachers1, ANDREW DUFFY, MANHER JARIWALA, Boston University, Physics Department, PETER GARIK, Boston University, School of Education — In this talk, we will describe Project ITOP, a set of 10 two-credit graduate courses for in-service physics teachers, offered through the College of Arts and Sciences at Boston University (BU). ITOP (Improving the Teaching of Physics) is based at BU, but we also teach the courses in Chicopee, MA, for teachers in western and central Massachusetts. The physics content in the courses ranges from Newton’s laws of motion through to quantum mechanics, special relativity, and computer modeling. In addition, we discuss both the conceptual history of physics, as well as readings from the Physics Education Research literature. Our primary goal is to develop the pedagogical content knowledge of participating teachers, enabling teachers to be more effective in their own classrooms. ITOP web site: http://physics.bu.edu/teachers/

1ITOP was funded from 2005 - 2010 by the Massachusetts Department of Higher Education.

8:36AM F5.00004 Particle Physics Masterclass as a Context for Learning about NOS, MICHAEL WADNESS — This research addresses the question: Do secondary school science students attending the U.S. Particle Physics Masterclass change their view of the nature of science (NOS)? The U.S. Particle Physics Masterclass is a national physics outreach program run by QuarkNet, in which high school physics students gather at a local research institution for one day to learn about particle physics and the scientific enterprise. Student activities include introductory lectures in particle physics, laboratory tours, analysis of actual data from CERN, and the discussion of their findings in a conference-like atmosphere. Although there are a number of outreach programs involving scientists in K-12 education, very few of them have been formally evaluated to determine if they provide adequate learning of NOS. Therefore, the significance of this study is that it investigates the claim that science outreach programs may be designed to address science literacy, specifically as a context for explicit NOS instruction.

8:48AM F5.00005 Gay-Lussac Did Better Than He Knew, CHARLES H. HOLBROW, JOSEPH C. AMATO, Department of Physics & Astronomy, Colgate University — In his 1802 paper Joseph Louis Gay-Lussac reported the first definitive experimental evidence that many different gases exhibit the same fractional expansion of volume when heated. This property is known as Charles Law, Amontons Law, Dalton’s Law, or the law of volumes. Gay-Lussac concluded from his experiments that many gases expand by 37.5% when heated from 0°C to 100°C. Although his result is within 2.5% of the modern value of 36.6% = 100/273.15, the discrepancy is surprising because his direct and simple experimental method allowed him to measure changes in volume with a precision of a few tenths of a percent. An examination of his original paper suggests, however, that he did not take into account that his measurements of the initial and final volumes of gas were made at slightly different pressures. With reasonable assumptions about the diagrams in his paper, one can use Pascal’s law and the ideal gas law to correct the measured volumes so that they correspond to the same initial and final pressure. With this correction the results imply ∆V/V = .366. Gay-Lussac did better than he knew.

9:00AM F5.00006 Misconception in Physical Science at the Middle School Grades, ZENOBIA LOJEWSKA, ROBERT BARKMAN, PETER POLITO, JULIANNE SMIST, Springfield College, RICHARD KONICEK- MORAN, UMass Lowell — The presentation will focus on the physical science content and pedagogy workshops addressing student’s misconceptions at the middle school level. These workshops were conducted at Springfield College during summer 2010 for in-service teachers from Springfield MA Public Schools. A partnership among Springfield MA Public Schools, Springfield College, and the City of Springfield Science Museum was developed to implement an innovative program to prepare highly-qualified educators. Concepts of force, motion, energy, and energy transformation were explored in a physics laboratory setting and student’s misconceptions were addressed.

Saturday, April 9, 2011 9:15AM - 10:00AM —
Session G1 Undergraduate Education
Olney Science Center 0-150 - Partha Chowdhury, UMass Lowell

9:15AM G1.00001 The Student-Centered Active Learning Environment for Undergraduate Programs (SCALE-UP) Project, ROBERT J. BEICHNER, North Carolina State University — How do you keep a classroom of 100 undergraduates actively learning? Can students practice communication and teamwork skills in a large class? How do you boost the performance of underrepresented groups? The Student-Centered Active Learning Environment for Undergraduate Programs (SCALE-UP) Project has addressed these concerns. Because of their inclusion in a leading introductory physics textbook, project materials are used by more than 1/3 of all science, math, and engineering majors nationwide. The room design and pedagogy have been adopted at more than 100 leading institutions across the country. Physics, chemistry, math, astronomy, biology, engineering, earth sciences, and even literature classes are currently being taught this way. Educational research indicates that students should collaborate on interesting tasks and be deeply involved with the material they are studying. We promote active learning in a redesigned classroom for 100 students or more. (Of course, smaller classes can also benefit.) Class time is spent primarily on “tangibles” and “ponderables”—hands-on activities, simulations, and interesting questions. Nine students sit in three teams at round tables. Instructors circulate and engage in Socratic dialogues. The setting looks like a banquet hall, with lively interactions nearly all the time. Hundreds of hours of classroom video and audio recordings, transcripts of numerous interviews and focus groups, data from conceptual learning assessments (using widely-recognized instruments in a pretest/posttest protocol), and collected portfolios of student work are part of our rigorous assessment effort. Our findings (based on data from over 16,000 students collected over five years as well as replications at adopting sites) can be summarized as the following: 1) Female failure rate is 1/5 of previous levels, even though more is demanded of students. 2) Minority failure rate is 1/4 that seen in traditionally taught courses. 3) At-risk students are more successful in later engineering courses. 4) Top students gain the most, although students at all levels benefit. 5) Conceptual learning and problem solving are significantly improved, with same content coverage. In this talk I will discuss the need for reform, the SCALE-UP classroom environment, and examine the findings of studies of learning.

Saturday, April 9, 2011 10:00AM - 11:40AM —
Session H1 Materials III
Olney Science Center 0-150 - William Goodhue, UMass Lowell
achieving those goals will be described. Finally, policies and practices that promote (or stifle) exceptional science teaching will be discussed.

University of Massachusetts Lowell — What kind of teaching is indicative of an exceptional practice? In this secondary science teacher talk we will discuss theoretical foundations of optics of hyperbolic metamaterials and will also present the results of recent experimental studies of these unique systems.

10:00AM H1.00001 Bending the laws of diffraction with hyperbolic metamaterials, Photovoltaics, and Biosensing, Z.F. REN, Department of Physics, Boston College — Nanomaterials have many potential applications in energy conversion systems due to their special structural and physical properties. Such applications often require materials manufacturing at large scale and low cost. In the first part of this talk, I will discuss the manufacturing of nanostructured bulk thermoelectric materials at large scale with improved thermoelectric properties. The materials were produced by a low cost ball milling and hot pressing process. The ball milling makes nanopowders in the quantities of up to multiple tons. Such nanopowders were then hot pressed by a direct current induced hot pressing into dense bulk materials. In the second part of this talk, I will demonstrate the concept and realization of nano coax cables that can be used for sub-wavelength light transmission and efficient solar conversion into electricity. In the last part of this talk, I will show a highly sensitive biosensor using aligned carbon nanotubes and gas sensors using nano coaxial cables.

Saturday, April 9, 2011 10:00AM - 11:30AM –
Session H2 Physics Teaching
Olney Science Center 0-218 - Zenobia Lojewska, Springfield College

10:00AM H2.00001 Physics With Robotics: A decade with our little electromechanical friends, WILLIAM CHURCH, Littleton High School — Robotics tools for secondary classrooms have developed greatly in the past ten years. Currently available robotics resources offer a physics student many opportunities to explore the concepts and skills of physics. Opportunities range from 15-minute prediction testing exercises to multi-week engineering projects and multi-grade outreach projects. Physics skills developed through robotics exercises range from graph interpretation to experimental design. Topics to explore with robotics include kinematics, dynamics, thermodynamics, electricity and magnetism, vibrations, and wave phenomena. This session will provide many specific examples from the authors past decade's work with robotics as a highly engaging student centered physics learning tool.

10:30AM H2.00002 Exceptional Science Teaching, DAVID LUSTICK, Graduate School of Education, University of Massachusetts Lowell — What kind of teaching is indicative of an exceptional practice? In this secondary science teacher workshop, participants will explore and consider an array of standards based instructional strategies designed to foster specific types of student learning outcomes. Using a backward design approach, first the goals of science learning will be identified and then the best strategies for achieving those goals will be described. Finally, policies and practices that promote (or stifle) exceptional science teaching will be discussed. Specific examples of classroom teaching will be shared throughout to illustrate the concepts addressed.

11:00AM H2.00003 Effective instructional strategies in physics classrooms, SACHIKO TOSA, Department of Physics, Joint appointment in Teacher Education, Wright State University — Instructional strategies such as Think-Pair-Share and Socratic questioning are powerful ways to get students engaged in thinking processes. In this talk, tips and techniques that help students make sense of physics concepts in lecture-based classes are presented with specific examples. The participants will see the effectiveness of the instructional strategies by actually experiencing the process as learners with the use of clickers.

Saturday, April 9, 2011 11:40AM - 12:30PM –
Session J1 Concluding Plenary Session: Remarkable Materials
Olney Science Center 0-150 - Albert Altman, UMass Lowell

11:40AM J1.00001 A Series of Fortunate Events: Serendipitous Encounters with Remarkable Materials, MARK SILVERMAN, Trinity College — Chance involvement in bizarrely controversial issues relating to the unexpected behaviour of more or less ordinary materials led to many of the projects I have undertaken as a physicist. Some of these unusual undertakings included (a) organic dyes and the amplification of light that does not pass through them, (b) left-right asymmetric materials and the resolution of conflicting claims over the validity of Maxwell’s equations, (c) opaque turbid media and the surprising capacity to see through them with polarised light, (d) radioactive materials and the radical proposition that nuclear decays are correlated by an unknown universal force, (e) hot metal and the non-Newtonian behaviour of their cooling curves, (f) exploding glass and the thorny question of how solids fragment, and (g) quantum condensates and the unresolved fundamental problem of matter distribution in the universe. To the extent that time permits, I will discuss salient features of these diverse physical systems and the materials that contributed to, or helped resolve, the associated controversies.
Saturday, April 9, 2011 1:00PM - 3:00PM –
Session L1 Workshop I: Phenomenal Physics–A Guided Inquiry Curricula for Pre-College Education and Conceptual Physics Instruction at the College Level
Olney Science Center 0-104 - Russ Hankay

1:00PM L1.00001 Phenomenal Physics–A Guided Inquiry Curriculum for Pre-College Education and Conceptual Physics Instruction at the College Level, J. RUSSELL HARKAY, Keene State University —

Saturday, April 9, 2011 1:00PM - 3:00PM –
Session L2 Tutorial: Anthropogenic “Global Warming”–Illuminating Some of its Scientific and Methodological Flows
Olney Science Center 0-115 - Laurence Gould, University of Hartford

1:00PM L2.00001 Anthropogenic “Global Warming”–Illuminating Some of its Scientific and Methodological Flaws, LAURENCE GOULD, Universit of Hartford —

Saturday, April 9, 2011 3:00PM - 5:00PM –
Session M1 Workshop II: Interactive Lecture Demonstration–A Research-based Active and Minds-on-Learning Pedagogy
Olney Science Center 0-106 - Mark Greenman, Marblehead High School (retired)

3:00PM M1.00001 Interactive Lecture Demonstration–A Research-Based Active and Minds-On Learning Pedagogy, MARK GREENMAN, Marblehead High School (retired) —