Fall 2012 Joint Meeting
of the New England Sections of
the American Physical Society and
the American Association of Physics Teachers

Abstracts and Workshop Information

Friday & Saturday, November 9 - 10, 2012
Williams College
Williamstown, Massachusetts

Friday, November 9, 2012 1:00PM - 3:00PM –

Session A1 Quantum Information Wege Auditorium - Chair: Frederick Strauch, Williams College

1:00PM A1.00001 Building blocks for a scalable quantum computer PAOLA CAPPELLARO, Massachusetts Institute of Technology — Quantum control of radiation-matter interactions at the nano-scale could yield significant improvements in fields ranging from atomic physics to magnetic resonance and chemistry. The most prominent application would be quantum computation. Although small quantum systems can be manipulated with high precision, there is still no clear path to build scalable quantum devices. We address this challenge with a bottom-up approach, where small quantum registers are assembled in a larger modular architecture. After briefly describing an implementation of quantum registers based on Nitrogen-Vacancy centers in diamond, in this talk I will focus on a key element of this proposal, quantum spin wires that connect the registers and transmit information among them. I will present recent results on quantum information transport in spin wire networks, in particular protocols that permit perfect transfer in far more relaxed conditions that previously thought, thus opening the possibility of a practical implementation. I will then show the first experimental study of these quantum information transport protocols in a unique, quasi-1D solid-state spin system. These results can be extended to other physical implementations and pave the way toward a scalable quantum computer.

2:00PM A1.00002 Quantum Optics with Superconducting Circuits: From Single Photons to Schrodinger Cats , ROBERT SCHOELKOPF, Yale University — Over the last decade and a half, superconducting circuits have advanced to the point where we can generate and detect highly-entangled states, and perform universal quantum gates. Meanwhile, the coherence properties of these systems have improved more than 10,000-fold. I will describe recent experiments, such as the latest advance in coherence using a three-dimensional implementation of qubits interacting with microwave cavities, called "3D circuit QED." The control and strong interactions possible in superconducting circuits make it possible to generate non-classical states of light, including large superpositions known as "Schrodinger cat" states. This field has many interesting prospects both for applications in quantum information processing, and fundamental investigations of the boundary between the macroscopic classical world and the microscopic world of the quantum.

Friday, November 9, 2012 3:30PM - 5:30PM –

Session B1 The High Energy Frontier and the LHC Wege Auditorium - Chair: David Tucker-Smith, Williams College

3:30PM B1.00001 Who cares about the Higgs? , MARTIN SCHMALTZ, Boston University —

4:30PM B1.00002 Discovery! How we did it and what we know so far , KYLE CRANMER, New York University — One of the great intellectual achievements of human kind is the standard model of particle physics. This theory describes how fundamental particles like electrons and quarks interact and gives us the building blocks for understanding the universe we see around us today. A key part of this theory is the Higgs field, which permeates space and time. Finding the Higgs boson - the experimental manifestation of this field - and measuring its properties has become one of the most fundamental scientific endeavors in history. After decades of searching, it was announced by CERN on July 4, 2012 that the large international collaborations ATLAS and CMS have discovered a new particle in their search for the Higgs boson using the Large Hadron Collider.

6:00PM - 6:00PM –

Session C1 APS and AAPT Poster Session Faculty House

C1.00001 Scintillator fabrication for the Antihydrogen Experiment: Gravity, Interferometry, Spectroscopy (AEGIS) , ALYSSA BARLIS, Williams College, JOSEPH SAMANIEGO-EVANS, Boston University, ANTIHYDROGEN EXPERIMENT: GRAVITY, INTERFEROMETRY, SPECTROSCOPY (AEGIS) COLLABORATION — The Antihydrogen Experiment: Gravity, Interferometry, Spectroscopy (AEgIS), an experiment at CERN's Antiproton Decelerator (AD) complex, aims to measure the effect of the earth's gravitational field on antihydrogen atoms. A key diagnostic tool for the experiment is the ability to detect antihydrogen and antiproton annihilations as they occur. The annihilations produce pions and photons, which AEgIS detects using a combination of scintillators and Photomultiplier Tubes (PMTs). We present the fabrication process of the scintillation detectors for the AEgIS experiment.

C1.00002 Increasing Hurricanes, Draughts, & Wildfires , PAUL CARR, AF Research Laboratory Emeritus — The last 12 months were the warmest on record: hurricanes, draughts, and wildfires continue to increase. HURRICANES: MIT Prof. Kerry Emanuel has correlated the rise in sea temperatures since 1995 with increasing hurricane destruction. Hurricane physics is that of a Carnot cycle. The heat source, the high- temperature sea surface, T = 300K (27C), transfers wind energy to the hurricane. The heat sink is the cooler upper atmosphere, T = 200 K (-73C). Hurricane Katrina in 2005 is an example. It caused over $100 billion dollars of damage to New Orleans. DRAUGHTS: This year's draught in our Midwest, the worst since the dustbowl, is raising corn prices to the highest level in history. WILDFIRES: The effects of global warming on temperature, precipitation levels, soil moisture, and Western Pine beetles are turning many of our forests into kindling for more wildfires. Western Pine beetles can now survive the warmer winters. The number of extreme weather events, whose average since 1980 has been 3 to 4 per year, has increased to 9 in 2008 and 13 in 2011, according to the NOAA article in the March 2012 issue of "Physics Today." Draughts, heat waves, and heavy precipitation increase from global warming according to the UN IPCC Special Report of November 2011, titled "Managing the Risks of Extreme Events and Disasters."

C1.00003 Entangled-State Synthesis and Quantum Control , ROSHAN SHARMA[1], Williams College — Controlling the quantum state of a system is a first step towards many applications in quantum information science. We come up with the fastest algorithm to synthesize entangled states for coupled resonators. We also look at the propagation of a *qudit* under a controlled Hamiltonian. We have compared several optimization techniques such as the simplex search and GRAPE algorithm to come up with the optimal set of controls to evolve an initial state approximately into the desired final state.

[1]My work was advised by Prof. Strauch of the Physics Department, Williams College.

C1.00004 Rethinking Alain Aspect's Bell test experiment with delayed choice , JEFFREY BOYD, Retired — John Bell proposed that Einstein's idea of local realism violates the predictions of quantum mechanics for two correlated particles traveling in opposite directions. A long history of experiments have confirmed Bell's ideas and refuted Einstein's. The watershed experiment by Alain Aspect's team published the first such experiment with delayed choice in 1982. This poster explores Aspect's research with a different assumption: that waves are not the same as particles, indeed waves often travel in the opposite direction as particles. This Theory of Elementary Waves TEW is an alternative to QM, keeping quantum mathematics but providing a different picture of what the quantum world looks like. TEW has some features of a local and some features of a nonlocal theory. We claim that TEW (1) can explain the result of that 1982 delayed choice experiment; (2) TEW does not involve any concept of entangled photons; (3) the predictions of TEW differ from the predictions of Einstein, Podolsky, Rosen and Bohm by five standard deviations; and (4) TEW lies outside the jurisdiction of Bell's Theorem.

C1.00005 When Can Two Fermions Be Characterized as a Boson? , CHRISTINA KNAPP, Williams College Student — I am investigating when a pair of distinct fermions can be characterized as a boson. In particular I am exploring whether there exists a relationship between the level of bosonic character of the pair and the entanglement. My system is N pairs of fermions, each pair consisting of one A particle and one B particle. My measure of bosonic character is a comparison of the fermion pair creation operator with an ideal bosonic creation operator. My measure of entanglement is based on the purity. Preliminary results suggest there is a strong connection between bosonic character and entanglement.

C1.00006 PhysTEC at Boston Univeristy: Enhancing Physics Teaching in Area High Schools AND at the University[1] , MARK GREENMAN[2], ANDREW DUFFY[3], Boston University — The PhysTEC grant awarded to Boston University is helping to encode in the DNA of the physics department a culture that sees basic physics research and excellence in teaching as dual missions of a strong physics department. Boston University, a large research university located in an urban center, is working with area school districts to increase the number of highly qualified high school physics teachers. The experience of working with pre- and in-service physics teachers has had the added benefit of encouraging reflection within the physics department on strategies for effective teaching and learning. Physics majors are being encouraged to become undergraduate Learning Assistants, so physics majors graduating from Boston University will provide more effective instruction in physics, whether in the role of high school teacher, teaching assistant in graduate school, or research physicist mentoring and educating another generation of physicists.

[1]The PhysTEC grant is funded jointly by APS and AAPT through support provided by the NSF

[2]Mark Greenman, Teacher in Residence in the Boston University Department of Physics, is a recipient of the Presidential Award for Excellence in Mathematics and Science Teaching and served as an Einstein Fellow at the NSF Division of Undergraduate Education

[3]Andrew Duffy, Master Lecturer in the Boston University Department of Physics, is the 2012 recipient of the BU Metcalf Cup and Prize, the University's top teaching award, and serves as principal investigator for the BU PhysTEC grant.

C1.00007 Constraints on a b-philic Quark and Z' from LHC Results , DYLAN GILBERT, DAVID TUCKER-SMITH, Williams College — Final states rich in bottom jets are predicted by a variety of extensions to the Standard Model. A model introducing a new heavy quark Q, charged under a Z' boson and mixing with down-type Standard Model quarks, can lead to an excess of high b-jet multiplicity final states at the LHC, with both Q and the Z' decaying preferentially to bottoms. We estimate the constraints placed on this model's parameter space by LHC results.

C1.00008 Raising Standards and Expectations in a College Physics Classroom: An Invitational Approach , VANDANA SINGH, Framingham State University — This poster describes the results of an alternative pedagogical approach in a calculus-based college physics classroom at Framingham State University in Spring 2012, where the majority of students were pre-medical or pre-engineering students, or chemistry majors. The approach incorporated elements of the invitational or promising syllabus as described by educator Ken Bain, as well as an interdisciplinary approach to understanding physics concepts, and was informed by the work of educational psychologist Carol Dweck. The "promise" or invitation that began the course was that students would understand how uncertainties, errors and mistakes occur in the real world, with particular emphasis on engineering and medicine, and what methods, skills, and habits of mind can minimize error. Results are discussed. The small sample size makes statistics-based conclusions impossible to generalize, but the study is suggestive of the potential benefits of a rigorously high-standard, process-oriented, interdisciplinary and real-world-connected approach to teaching physics to future engineers and doctors.

C1.00010 Incorporating Nanotechnology into High School Curricula , GARY SMITH, AAPT — In the summers of 2010 and 2011, 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, gaining insight into novel techniques her group has developed in constructing nanoplasmonic antenna arrays through lithographic techniques. In addition Prof. Altug and I worked 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. I have now implemented these techniques into a second year (non-AP) course in high school physics. This course emphasizes themes of sustainability, fundamental physical principles, and ways in which new developments in materials are leading to the next generation of engineering developments. I currently work as a physics teacher and science department head for a Massachusetts Catholic high school.

C1.00011 A Molecular Predictor of Enthalpies of Vaporization , JONATHAN MITSCHELE, Retired — There is a proportional relationship between a molecule's polarizability and its enthalpy of vaporization, with offsets reflecting contributions from permanent dipoles, hydrogen bonding, and the effect of molecular shape. We present the results of a survey of nearly 400 molecular substances and discuss the conclusions one can draw from these results.

C1.00012 A Precise Measurement of the Stark Shift in the $5P_{1/2} \rightarrow 6S_{1/2}$ 410nm Transition in Indium[1]

NATHAN SCHINE, GAMBHIR RANJIT, ANDERS SCHNEIDER[2], ANTONIO LORENZO[3], PROTIK MAJUMDER, Williams College — We are nearing completion of a new precise experimental measurement of the Stark shift (scalar polarizability) for the 410nm, $5P_{1/2} \rightarrow 6S_{1/2}$ E1 transition in atomic indium. We use an atomic beam, which greatly reduces Doppler broadening of the atomic absorption signal, in conjunction with frequency modulation spectroscopy to measure atomic absorption at low atomic densities. We also use both a Fabry-Perot interferometer and a vapor cell saturated absorption spectroscopy to linearize and calibrate the frequency scale for the absorption signal and observed shift. Our preliminary measurement has a statistical uncertainly of less than 1%. A final precision at this level would represent an order of magnitude improvement in precision over the previous measurement. This measurement will test state-of-the-art *ab initio* atomic theory which seeks to improve calculated wave function accuracy in multi-valence-electron Group IIIA atoms such as indium and thallium. Such theoretical accuracy is crucial to help interpret results from symmetry violation experiments in these high-Z atomic systems.

[1]Research supported by NSF grant # 0969781.

[2]Class of 2012.

[3]Class of 2011.

C1.00013 Misconception in Physical Science at the Middle School Grades

ZENOBIA LOJEWSKA, Springfield College, Springfield, MA 01109, ROBERT BARKMAN, Retired, PETER POLITO, JULIANNE SMIST, Springfield College, Springfield, MA 01109, RICHARD KONICEK- MORAN, Retired — 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. The follow up activities took place during the academic year 2010/2011. 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.

C1.00015 Exploring a Theory of Dark Matter

ALICE SADY, DAVID TUCKER-SMITH, Williams College — We examine an extension to the Standard Model that accounts for the existence of dark matter. In addition to the Standard Model sector, we include a Dirac fermion serving as our dark matter candidate, a Z' boson that mediates interactions between the Standard Model particles and dark matter sector, and a Higgs-like scalar whose vacuum expectation value gives mass to the Z'. We take the Z' couplings to Standard Model fermions to be proportional to a linear combination of hypercharge Y and B-L number. We allow for kinetic mixing between the Z and Z' boson, as well as a quartic coupling between the Standard Model Higgs field and the dark matter sector Higgs field. We use the measurement of the dark matter relic abundance, results from dark matter direct detection experiments, and results from colliders to constrain the parameter space of this model.

C1.00016 A Mathematica Quantum simulator for hybrid qubit -qutrit systems

FRANK TABAKIN[1], University of Pittsburgh — QDENSITY[2] is a Mathematica quantum computation simulator. QCWAVE[3] not only updated QDENSITY's treatment of states and operators and included amplitude displays, circuit diagram drawing and Dirac notation features, but also invoked the parallel processing capabilities of Mathematica 8.0 to simulate errors and error correction. Parallel versions of QCWAVE run simultaneously with random errors introduced on some of the processors, with an ensemble average used to represent the real world situation. Within this approach, error correction steps can be simulated and their efficacy tested. This capability allows one to examine the detrimental effects of errors and the benefits of error correction on particular quantum algorithms. Now there is an addition to the codes "QDENSITY" and "QCWAVE," called BTSystem[4], which includes hybrids of binary (B) qubit and triplet(T)qutrit systems. Formation of BT states, density matrices, gates and partial traces are among the many features of BTSystem.

[1]resides in Lenox, MA

[2]Bruno Julia-Diaz, Joseph M. Burdis and Frank Tabakin, Computer Physics Communications 174 (2006) 914

[3]Frank Tabakin, Bruno Julia-Diaz, Computer Physics Communications 182 (2011) 1603

[4]BTSystem is available at http://www.pitt.edu/∼tabakin/QDENSITY/

C1.00017 "Global Warming, Climate Change" (AGW) — A Critical Look

LAURENCE I. GOULD, University of Hartford — There continues to be an increasing number of scientists from around the world who are challenging the dominant claim that has been bolstered by so-called "consensus" scientific views — that dangerous "global warming/climate change" is caused primarily by human-produced carbon dioxide. This poster will show that scientific evidence contradicts that claim. It will also explain some of the errors that have been introduced from a corruption of the scientific method.

[1] Major Reference: *Climate Change Reconsidered* — http://www.nipccreport.org/index.html
[2] Nobel Laureate in Physics, Ivar Giaever, public presentation, *The Strange Case of Global Warming* critiquing AGW (Lindau 2012 conference of Nobel Laureates) http://www.mediatheque.lindau-nobel.org/#/Video?id=1410
[3] Articles illustrating issues (pro and con) about AGW can be found in the *NES APS Newsletters* beginning with the Fall 2007 issue — http://www.aps.org/units/nes/newsletters

C1.00018 Measurement of the Total Cross Section for $\gamma n \rightarrow \pi^- p$ Near Threshold at MAX-lab[1]

, KHAYLA ENGLAND, University of Massachusetts Dartmouth, MAX-TAGG COLLABORATION — In nuclear science, researchers strive to describe the properties of the nucleons using the framework provided by QCD. A number of theoretical approaches, such as Chiral Perturbation Theory, can be used to solve the QCD equations for nuclear processes. The predictions of these theories can be compared with the results from experimental measurements for those nuclear reactions where both theory and experiment can provide accurate answers. One such reaction where this comparison is possible is pion photoproduction close to threshold. A measurement of the total cross-section very close to threshold for the $\gamma n \rightarrow \pi^- p$ reaction is currently being performed using the Tagged Photon Facility at MAX-lab in Lund, Sweden. A LD_2 target was used to provide the neutron target. Due to the target thickness, the π^- were not detected directly but instead were captured on another nucleus in the target. This capture resulted in a nominal 128 MeV γ-ray approximately 25% of the time. This gamma-ray easily exited the target and was detected using three large NaI(Tl) detectors: CATS, BUNI, and DIANA. The π^- capture γ-ray is clearly seen in the data. An overview of the measurement and preliminary results will be presented.

[1]Sponsored by NSF OISE/IRES award 0553467

C1.00019 Gain Calibrations for the BUNI Large-Volume NaI(Tl) Detector at MAX-lab[1]

, OLIVIA CAMPBELL, University of Massachusetts Dartmouth, MAX-TAGG COLLABORATION — Quantum Chromodynamics (QCD) provides a framework for understanding the properties of the nucleon. Predictions from QCD-based theories combined with experimental results can provide important tests of these theories. A measurement of $\gamma n \rightarrow \pi^- p$ close to threshold was performed in 2011 using the tagged photon facility at MAX-lab in Lund, Sweden. Using a LD_2 target, the π^- had insufficient energy to escape the target to be detected directly but were captured in the target producing a nominal 128-MeV gamma-ray through the $\pi^- d \rightarrow nn\gamma$ channel. These high-energy gamma-rays were detected in three large-volume NaI(Tl) detectors located around the target. The NaI(Tl) detectors consist of a core surrounded by a segmented annulus. The core energy calibration was performed by placing each detector directly in the tagged photon beam which has a known energy and was monitored using cosmic-ray measurements throughout the experiment. During the data acquisition period, the gain of the annulus segments were measured daily using a Th-C gamma-ray source. These calibrations ensured that changes in the detector gains were accurately monitored and corrected for during the analysis of the data. Results from the gain calibrations will be presented.

[1]Sponsored by NSF OISE/IRES award 0553467

C1.00020 Sympathetic Cooling of Na+ Ions by Ultracold Na Atoms in a Hybrid Trap[1]

, WINTHROP SMITH, ILAMARAN SIVARAJAH, DOUGLAS GOODMAN, JAMES WELLS, Physics Dept., University of Connecticut, Storrs, CT 06269-3046, FRANK NARDUCCI, Naval Air Systems Command, EO Sensors Division, Bldg 2187, Suits 3190, Patuxent River, Maryland — Laser cooling atoms to ultracold temperatures has opened a fruitful new regime for atomic physics. Closed-shell atomic ions, such as Na+, and nearly all molecular ions lack the optical transitions from the ground state that are required for laser cooling, restricting their use in a variety of experiments: near zero-K reaction studies, cold ion spectroscopy and quantum gates. We have created a hybrid atom-ion trap system to study cooling and reactions of atomic and molecular ions which cannot be laser cooled. It consists of a magneto-optical trap (MOT) for Na, concentric with a linear Paul r.f. ion trap. Recent simulations we have carried out using SIMION 7 [PRA 86, 033408 (2012)] show that cold MOT atoms may be used to sympathetically cool hot atomic or molecular ions to sub-Kelvin temperatures. We found experimental evidence of this: trapped Na+ ions exposed to equal mass Na MOT atoms have extended lifetimes when MOT-refrigerated in the Paul trap. Unwanted ions (e.g. Na_2^+ from the MOT) may be quenched with minimal disturbance of the trapped Na^+ ions.

[1]Supported by NSF under grant PHY-0855570.

C1.00021 Quantum Fourier Transform with Qudits

, QIAO ZHANG, Williams College — We study the implementation of the quantum Fourier transform (QFT) over d-dimensional quantum systems (qudits). Specifically, we generalize the qubit algorithm to qudits and characterize its complexity with respect to gate sets appropriate for qudit-oscillator implementations (based on the Jaynes-Cummings Hamiltonians). We find that, for experimentally realizable interactions, highly efficient implementations of the qudit QFT are possible.

C1.00022 An XRF Study of Meteorites

, KIERSTIN DAVIAU, Bard College, R.G. MAYNE, A. EHLMANN, None — Meteorites from the Oscar E. Monnig collection at TCU were scanned with a Bruker Tracer-III SD XRF machine in order to create a library of XRF spectra for different groups of meteorites. Over a ten week period this study examined 122 chondritic and achondritic samples, a total of eight groups. The XRF machine was run at a voltage of 40.00 and a current of 3.00 amps without vacuum. Selected meteorites had at least one smooth, flat surface. Each meteorite was scanned a minimum of five times at differing positions for a surface analysis. Average values for each element found was calculated in ARTAX 7. The elements identified by the XRF as useful in distinguishing meteorite groups are Mn, Si, and Mg. Within the chondritic meteorites Fe also differed. For achondrites, Ti, Ca and Al varied. The XRF also recognized two non obvious a-typical meteorites. The XRF has already proven useful to the field of meteoritics and has the potential to continue doing so. It has been used frequently at TCU to identify meteorites from "meteorwrongs." An XRF library of meteorites could take this tentative identification process a step further. Depending on the spectra of the rock it may be possible to not only determine whether it is a meteorite but to also give some idea of what group it may belong to.

[1] Bunch, T.E, et. al. (2009) *Northwest Africa 2824: Another Eucrite-like Sample from the Ibitira Parent Body?*
[2] Meteoritical Bulletin Database. http://www.lpi.usra.edu/meteor/metbull.php

C1.00023 Optical Laser Pulse Scattering in the Atmosphere

, NIMMI SHARMA, Central Connecticut State University — At Central Connecticut State University optical atmospheric remote sensing is conducted by studying the scattering of laser light pulses by atmospheric constituents. Using a technique known as laser radar (also called lidar), laser light is transmitted vertically into the atmosphere and the fraction of the resultant light scattered back towards a detector by components in the atmosphere (e.g. air molecules, aerosols such as soot, etc.) is collected and analyzed. Atmospheric parameters which influence the detected signal include aerosol altitudes, types, sizes, shapes, and phase functions. Through combining multiple instruments and/or appropriate assumptions, the portion of the detected signal that is caused by air molecules can be separated from that caused by aerosols, small particulates suspended in the atmosphere. The derived information on aerosols may then be useful for a wide variety of studies including air pollution monitoring and compliance, weather, and atmospheric dynamics.

C1.00024 Ultracold atoms in novel optical lattices , NATHAN LUNDBLAD, Bates College — We report progress towards optical lattice experiments using a planned Bose-Einstein condensate of ^{87}Rb. We describe vacuum chamber construction, design and construction of a spin-flip Zeeman slower, characterization of laser cooling tools, the results of magnetic trapping and evaporative cooling, and plans for a hybrid dipole trap approach for reaching BEC, as well as optical lattice design and construction.

C1.00025 Dispersion in an all-optical fiber modelocked laser , JOSEPH IAFRATE, JEFFERSON STRAIT, Williams College — We have built an all-optical fiber laser modelocked with a nonlinear optical loop mirror (NOLM) designed to produce pulses on the order of one picosecond duration. The performance of this laser crucially depends on the net dispersion of the cavity, so we have investigated combining positive dispersion and negative dispersion optical fibers to optimize stability with short duration pulses.

C1.00026 Thermodynamic of cellulose solvation in novel solvent mixtures , RITANKAR DAS, University of California, Berkeley — Biomass contains abundant amounts of cellulose as crystalline microfibrils. A limiting step to using cellulose as an alternative energy source, however, is the hydrolysis of the biomass and subsequent transformation into fuels. Cellulose is insoluble in most solvents including organic solvents and water, but it is soluble in some ionic liquids like BMIM-Cl. This project aims to find alternative solvents that are less expensive and are more environmentally benign than the ionic liquids. All-atom molecular dynamics simulations were performed on dissociated glucan chains separated by multiple (4-5) solvation shells, in the presence of several novel solvents and solvent mixtures. The solubility of the chains in each solvent was indicated by contacts calculations after the equilibration of the molecular dynamics. It was discovered that pyridine and imidazole acted as the best solvents because their aromatic electronic structure was able to effectively disrupt the inter-sheet interactions among the glucan chains in the axial direction, and because perturbation of the solvent interactions in the presence of glucan chains was minimal.

C1.00027 Novel Magnetic Measurement Apparatus , JAN MAKKINJE, GEORGE ZIMMERMAN, Boston University — We have developed a version of a Guoy Balance for the measurement of magnetization and magnetic susceptibility by the use of commercial neodymium magnets and a scale capable of milligram accuracy. The scale, modified for digital data acquisition is capable of measuring the magnetic properties of both diamagnetic and paramagnetic substances. Examples of the materials we have measured are the magnetic properties of liquid nitrogen, liquid oxygen, various magnetic chemical compounds and high transition temperature superconductors. The construction and use of the device as well as sample measurements will be presented.

Friday, November 9, 2012 8:00PM - 9:00PM –
Session D1 Banquet Talk Faculty House

8:00PM D1.00001 Quantize This! , SETH LLOYD, Massachusetts Institute of Technology — This talk explores some of the quirkier aspects of quantum mechanics, including the quantum speed limit, the use of quantum entanglement and quantum codes by living systems, and the quantum mechanics of time travel.

Saturday, November 10, 2012 8:00AM - 9:00AM –
Session E1 Teaching Physics TPL 203 - Chair: Kannan Jagannathan, Amherst College

8:00AM E1.00001 InterLACE: Interactive Learning and Collaboration Environment[1] , GARY GARBER, Boston University Academy — A growing body of research has shown two things: (1) collaborative design-based inquiry activities show remarkable gains in students' understanding of science and (2) such activities are largely absent in the classroom because they can be challenging to implement. In order to rectify the current situation, the Interactive Learning and Collaboration Environment, or InterLACE, project seeks to design a suite of technological tools that facilitates class-wide collaborative sense-making. To that end, we have created an idea aggregation tool that enables students to upload their verbal and pictorial representations of science concepts to a Web-based platform that can then display these artifacts on a centrally located screen, thus encouraging discussion and debate among the students in an iterative process, which will not only help refine their thinking but also grant them ownership of the learning process. InterLACE is part of a multi-year program in which a dozen high school physics teachers are collaborating with researchers at Tufts University to develop these classroom educational technology tools for promoting inquiry-based education. By participating in the technology-design project, teachers are experiencing the inquiry process as well as developing tools that will facilitate using inquiry-based methods in their classrooms.

[1]Work sponsored by the Center for Engineering and Education Outreach at Tufts University

8:12AM E1.00002 Explorers in the Classroom, Space and History , ELIZABETH CAVICCHI, Edgerton Center, MIT — Across historical time, people have wonder, observed and explored what is up, out, above, and beyond us. As these explorers go deeper in observing, always they come upon further unknowns and curiosities. Students in my classroom find themselves becoming colleagues with explorers in the past. Students delves into stories of their predecessors, evolve their own observations and experiments in the space around us, and imagine possibilities for future projects. The underlying support for the students' explorations, discussions and wonderment is the research pedagogy of critical exploration in the classroom, developed by Elanor Duckworth from the work of Jean Piaget, Bärbel Inhelder and the Elementary Science Study. Curriculum emerges through students' involvement and curiosity with materials of science and history, each other, and the teacher. The explorers are here; I invite you into their stories!

8:24AM E1.00003 Fascinations with Flight , DANIELLE GOLDIE, MICHAELA DANEK, JOSHUA MISHRIKEY, Harvard University — Reading the words of Galileo, Kepler, the Wright brothers, and Armstrong (among others), in addition to doing critical explorations of phenomena related to motion, air, mass, space, and flight, has piqued our interest in building model rockets and gliders. We continue to explore scientific phenomena as we follow our curiosities and the questions that arise. What we build, how we build it, and which phenomena challenge our thinking and further pique our curiosities are all yet to be determined! We will discuss the evolution of our thinking and how we might apply discoveries regarding our own learning to our teaching practice.

8:36AM E1.00004 Exploring Scientific Phenomena , DANIELLE GOLDIE, MICHAELA DANEK, JOSHUA MISHRIKEY, Harvard University — It is a rare opportunity to be able to follow one's curiosities in the science classroom, moving beyond lab protocols and textbooks to come to one's own understanding of basic scientific phenomena. In this talk, we will discuss our experiences with "critical exploration" - the joys of playing with (and reading about) science, the discomforts of not-knowing, and the satisfactions of trusting our observations and questions above all else.

8:48AM E1.00005 Man-Made "Global Warming" (AGW): A Critical-Thinking Approach to Exposing Some of Its Scientific and Methodological Flaws , LAURENCE I. GOULD, University of Hartford — "The temperature of the Earth is increasing dangerously! Rising sea levels could flood cities! Polar bears are threatened! Glaciers are melting! And human beings are responsible, mainly, because of their activities which emit greenhouse gases." Such alarming scenarios are similar to the ones being propagated by various scientists, politicians, and educators as well as through the major news media and in the movies. But are those scenarios true? That is the question addressed by this talk.

[1] Major Reference: *Climate Change Reconsidered* — http://www.nipccreport.org/index.html
[2] Nobel Laureate in Physics, Ivar Giaever, public presentation, *The Strange Case of Global Warming* critiquing AGW (Lindau 2012 conference of Nobel Laureates) — http://www.mediatheque.lindau-nobel.org/#/Video?id=1410
[3] Articles illustrating issues (pro and con) about AGW can be found in the *NES APS Newsletters* beginning with the Fall 2007 issue — http://www.aps.org/units/nes/newsletters

Saturday, November 10, 2012 8:00AM - 9:00AM –

Session E2 Gravity, Cosmology, and Related Topics Wege Auditorium - Chair: William Wootters, Williams College

8:00AM E2.00001 Topological Lorentz Defects , MICHAEL SEIFERT, Williams College — Models in which a vector or tensor field takes on a non-zero vacuum expectation value have been a subject of great interest in recent years, particularly in the framework of the Standard Model Extension. Such models spontaneously break Lorentz symmetry, raising the possibility of topological defects arising via the Kibble mechanism. I present the results of recent work into the existence and properties of these solutions, particularly the monopole solutions that can arise when an antisymmetric two-tensor takes on a vacuum expectation value. These relic monopoles would in principle be observable either via their gravitational effects or via direct coupling to the Maxwell field.

8:12AM E2.00002 The quantum geometric limit , SETH LLOYD, MIT — This talk presents fundamental quantum limits to measuring space-time geometry. By applying the fundamental physical bounds to measurement accuracy to ensembles of clocks and signals moving in curved spacetime – e.g., the global positioning system – I derive the quantum geometric limit: the total number of ticks of clocks and clicks of detectors that can be contained in a four volume of spacetime of radius r and temporal extent t is less than or equal to $rt/\pi\ell_P t_P$, where ℓ_P, t_P are the Planck length and time.

8:24AM E2.00003 FLRW Cosmology from Yang-Mills Gravity with Translational Symmetry , DANIEL KATZ, University of Massachusetts Lowell — We extend to basic cosmology the subject of Yang-Mills gravity - a theory of gravity based on local translational gauge invariance in flat spacetime. It has been shown that this particular gauge invariance leads to tensor factors in the macroscopic limit of the equations of motion of particles which plays the same role as the metric tensor of General Relativity. The assumption that this "effective metric" tensor takes on the standard FLRW form is our starting point. Equations analogous to the Friedman equations are derived and then solved in closed form for the three special cases of a universe dominated by 1) matter, 2) radiation, and 3) dark energy. We find that the solutions for the scale factor are similar to, but distinct from, those found in the corresponding GR based treatment.

8:36AM E2.00004 Type Ia supernova radiation examined in the framework of Thomson scattering , DAVID W. KRAFT, University of Bridgeport — The apparent dimming of radiation emitted in Type Ia supernovae explosions has been interpreted as evidence for an accelerated expansion of the Universe and the 2011 Nobel Prize in Physics was awarded for this work. However, alternative explanations have also been proposed so it is possible that action by the Nobel Committee may have been premature. We discuss here one such alternative, namely the effects of Thomson scattering of the supernova radiation. Specifically the observed distances to supernova objects are corrected for the Thomson scattering of their radiation photons by free electrons in their path. Previous work has shown that an independent estimate of the free-electron density in a dark intergalactic plasma provides close agreement of the corrected distances with predictions of the luminosity-distance relation. Hence the apparent dimming of Type Ia supernova objects can be understood without recourse to cosmic acceleration and cosmic jerk. The present work includes additional data for the high-z regime.

8:48AM E2.00005 Plasma Redshift Cosmology , ARI BRYNJOLFSSON, Retired — Plasma redshift theory is derived from more accurate physics than that used by big-bang cosmologists. Plasma redshift explains the intrinsic redshifts of the Sun, the stars and the quasars, the cosmological redshift, the magnitude redshift relation for SNe Ia, the surface brightness redshift relation for galaxies, cosmic microwave background and X-ray background. There is no need for big-bang, cosmic expansion, or cosmic time dilation. There is no need for artificial parameters, such as: dark energy, dark matter, accelerated expansion, and black holes. In addition, plasma redshift explains many peculiar observations that have been difficult to explain, such as the steep temperature increase in the transition zone to the solar corona, the heating of the solar corona, the increase of the solar redshift with frequency, the eruptions in the Sun, the variations in the center to limb effect from line to line, the K effect and Trumpler effect in O and B stars, the absence of 21 cm wavelengths in high redshift objects, and absence of redshifts in high density low temperature plasma. In addition the plasma redshift experiments show that the photons are gravitationally repelled. This obviates the need for Einstein's Lamda and Black Holes. It makes the Universe stable and ever lasting.

Saturday, November 10, 2012 8:00AM - 9:24AM –

Session E3 Quantum Physics and Plasma Physics TPL 205 - Chair: Jefferson Strait, Williams College

8:00AM E3.00001 Minimal Proofs of the Kochen-Specker theorem within the N-qubit Pauli group , MORDECAI WAEGELL, P.K. ARAVIND, Worcester Polytechnic Institute — A complete class of minimal KS proofs is given for a system of N qubits. There exists a class of KS proofs using the observables of the N-qubit Pauli group, which make no direct use of rays. One particular family of these proofs, which we call "Kites," is given for all N, with the N=2 case being the familiar Peres-Mermin Square. Each Kite generates a set of rays and bases which also prove the KS theorem. By discarding some of these rays and bases we obtain minimal KS proofs in Hilbert Spaces of all dimensions 2^N. These proofs involve different numbers of projectors, but always contain just 9 measurement bases (or contexts), with Cabello's 18-9 proof for N=2.

8:12AM E3.00002 Semiclassical Dynamics of Charges in a Magnetic Field , CHRISTIAN BRACHER, Bard College, ALEXANDROS FRAGKOPOULOS, Georgia Institute of Technology — Using the semiclassical method, we study the propagation of charged, monochromatic particle-waves emitted by an isotropic point source into a two-dimensional layer in the presence of crossed, homogeneous electric and magnetic fields, akin to the Hall configuration. While individual charges follow simple trochoid paths that combine cyclotron and drift motion, in combination they form intersecting trajectory fields that are characterized by intricate caustic structures and foci. Interference among these paths gives rise to strong modulations in the current emitted by the source: Depending on the energy of the charges and the electric and magnetic field strengths, the semiclassical electric flux can be strongly enhanced or completely suppressed, in accordance with quantum calculations. The associated current profile bears little resemblance to the classical trajectory pattern. Instead, we observe three distinct limiting behaviors—global suppression of particle emission, emission into discrete parallel current "stripes," and closed current fields looping around the source.

8:24AM E3.00003 Nanoscale placement of germanium quantum dots on silicon surface by low dose focused ion beam templating of the substrate , MARIA GHERASIMOVA, Unvieristy of Bridgeport, ROBERT HULL, Rensselaer Polytechnic Institute, FRANCES ROSS, IBM T. J. Watson Research Center — Germanium nucleation on silicon surface typically proceeds via spontaneous formation of nanoscale islands at random locations due to the strain caused by the lattice mismatch. Due to the narrower band gap width of germanium relative to silicon, quantum confinement of charge carriers in the islands causes them to exhibit the properties of zero-dimensional quantum dots (QDs). For a variety of potential applications, such as the construction of quantum cellular automata (QCA), it is desirable to control the placement of the nucleating islands on the surface. In this work, controlled placement of Ge islands on Si substrate is achieved by templating the Si surface with focused ion beam (FIB) pulses prior to Ge growth by chemical vapor deposition in an ultra-high vacuum (UHV) environment. Ge islands are synthesized inside a transmission electron microscope equipped with a video-rate data capture capability for in situ observation, immediately after the FIB implantation in an adjacent UHV chamber. QD assembly reliability on the patterned sites is studied as the separation between the target QD locations is decreased below 100 nm, and the role of surface diffusion during growth is identified as one of the mechanisms influencing the fidelity of pattern registration. The formation of square clusters of four closely spaced islands (the arrangement of interest for the QCA) is discussed in detail as the four-fold symmetry of the (100) Si surface may provide means for obtaining the desired configuration via self-assembly.

8:36AM E3.00004 Dynamics of Dust Aggregates in a Complex Plasma[1] , ALLEN DAVIS, Williams College, JORGE CARMONA-REYES, LORIN MATTHEWS, TRUELL HYDE, Baylor University — Charged dust aggregates play an important role in many astrophysical phenomena, such as early stages of protostellar and protoplanetary growth, the dynamics of planetary rings and cometary tails, and the formation of noctilucent clouds in earth's upper atmosphere. Dust is also expected to be an unwanted byproduct in the operation of plasma fusion devices, such as ITER. In all of these environments, direct study of the dust aggregates in their *in situ* environment is extremely difficult, if not impossible. As a model for these complex plasma environments, dust aggregates are formed in a laboratory plasma as monodisperse spheres are accelerated in a self-excited dust density wave. Individual dust aggregates are perturbed using a diode pumped solid state laser (Coherent VERDI) with their motions recorded by a high-speed camera at 1000 fps. Analysis of the particle motion allows determination of the aggregate characteristics which determine the grain dynamics, such as charge, mass, and gas drag.

[1]This work was supported in part by the National Science Foundation under Grant No. 0847127 through the Research Experience of Undergraduates program, and by the Baylor Department of Physics.

8:48AM E3.00005 Mie Resonant Absorption in Periodic Si Nanopillar Arrays[1] , FRANCISCO BEZARES, OREST GLEMBOCKI, JAMES LONG, RONALD RENDELL, Naval Research Laboratory, RICHARD KASICA, National Institute of Standards and Technology, LORETTA SHIREY, Naval Research Laboratory, JUNPENG GUO, University of Alabama at Huntsville, JOSHUA CALDWELL, Naval Research Laboratory — Although Mie resonators possess characteristics that offer many advantages in the development of novel photonic devices and have been widely studied, the extent to which they interact collectively as well as the relationship between their near- and far-field properties is relatively unexplored. In this talk, we report on the results of experiments in which bright field reflectance was carried out on periodically-arrayed Si nanopillars, fabricated via electron-beam lithography, to study their collective and far-field optical properties. In addition, μ-Raman scattering measurements demonstrated a clear enhancement in both the incident laser absorption and the Raman scattering from the silicon nanopillars when the incident laser line and the Mie resonance of a nanopillar were coincident. This is directly correlated to electromagnetic near-field enhancement, as a function of nanopillar diameter and array pitch. Finite Element and Finite-Difference Time Domain simulations were carried out and provide valuable insight into the nature of these dielectric resonances, the mechanism by which the Raman signal is enhanced and are in good agreement with experimental results.

[1]FB is an ASEE Postdoctoral Fellow with residence at the Naval Research Laboratory

9:12AM E3.00007 Operational Dynamic Modeling Transcending Quantum and Classical Mechanics[1] , DMITRY ZHDANOV, Department of Chemistry, Northwestern University, DENYS BONDAR, RENAN CABRERA, HERSCHEL RABITZ, Department of Chemistry, Princeton University — We introduce a general and systematic theoretical framework for Operational Dynamic Modeling (ODM) by combining a kinematic description of a model with the evolution of the dynamical average values. The kinematics includes the algebra of the observables and their defined averages. The evolution of the average values is drawn in the form of Ehrenfest-like theorems. We show that ODM is capable of encompassing wide ranging dynamics from classical non-relativistic mechanics to quantum field theory. The generality of ODM should provide a basis for formulating novel theories.

[1]We acknowledge support from NSF and ARO.

Saturday, November 10, 2012 8:00AM - 8:48AM – Session E4 Theory TPL 114 - Chair: David Tucker-Smith, Williams College

8:00AM E4.00001 GEM Unification Rescinded Officially , DOUGLAS SWEETSER, none — I have claimed to find a testable candidate to unify gravity and the three other fundamental forces of Nature. Thanks to sometimes trying efforts on a Science20 blog, I now have reasons why the claim is in error. Gravity conserves angular momentum. The hypercomplex numbers used in the field strength tensor would require breaking angular momentum conservation. Mass is conserved. Without a gauge transformation, mass is not a conserved quantity like electric charge is with U(1) gauge symmetry. It is difficult to quantize any field theory. The use of hypercomplex numbers may make such an effort futile. One prediction of the work, that there was no Higgs boson, has be shown to be inaccurate due to the the discovery at the LHC. The proposal was in field theory form and never worked out as a force, a unacceptable omission. Any future work on unification of gravity with the other forces of Nature will need to directly resolve these issues.

8:12AM E4.00002 Gravity and the Conservation Laws , RAYMOND DAVIES[1], Retired — Gravity is arguably the Physical Phenomenon with which we are most familiar and yet it is one of the least understood. Gravitons or Gravity waves have not been detected and identified. Add the fact that gravity affects bodies according to their mass, regardless of their size or shape, raising doubts about the applicability of the Inverse Square Law, then there is good reason to look for some quite different explanation for that which holds the whole Universe in place while allowing considerable freedom of movement. The presentation will suggest that separated bodies can not apply a force on one another, but that, on the contrary, all bodies in a system move independently of one another maintaining their momentum, while adhering to a constant total separation between each pair of bodies that represents the total energy between them. An additional dimension (X) is needed for this to happen. With this dimension, all free-fall trajectories are circles that, in space, appear as circles, ellipses or even vertical lines. The hypothesis concludes that Newton's equation for acceleration does not apply to all Gravitational effects, such as the trajectory of a body dropped vertically from several thousand miles above the earth. Its acceleration, in contrast to that calculated using the Inverse Square Law, decreases as the body falls.

[1]In 1954 aa an Experimental Officer with the UKAEA I was apppointed as the Senior Demonstrator at the Harwell Reactor School. From 1961 to 1964 I was Physicist-in-Charge of the reactor GLEEP. In 1968 I emmigated to the USA and worked in NY and MA.

8:24AM E4.00003 Colliding with the Speed of Light, Using Low-Energy Photon-Photon Collision Study the Nature of Matter and the Universe , MEGGIE ZHANG, AISRO — Our research discovered logical inconsistence in physics and mathematics. Through reviewing the entire history of physics and mathematics we gained new understanding about our earlier assumptions, which led to a new interpretation of the wave function and quantum physics. We found the existing experimental data supported a 4-dimensional fractal structure of matter and the universe, we found the formation of wave, matter and the universe through the same process started from a single particle, and the process itself is a fractal that contributed to the diversity of matter. We also found physical evidence supporting a not-continuous fractal space structure. The new understanding also led to a reinterpretation of nuclear collision theories, based on this we succeeded a room-temperature low-energy photon-photon collision (RT-LE-PPC), this method allowed us to observe a topological disconnected fractal structure and succeeded a simulation of the formation of matter and the universe which provided evidences for the nature of light and matter and led to a quantum structure interpretation, and we found the formation of the universe started from two particles. However this work cannot be understood with current physics theories due to the logical problems in the current physics theories.

8:36AM E4.00004 The Red Shift in Electrons and Excess Mass , RICHARD KRISKE, University of Minnesota — If one where to imagine standing on a nucleus of an Atom, and looking at the orbital of an electron. Imagine the Electron as a standing wave as in the DeBroglie Atom. If you look to either Horizon, the wavelength lengthens as if it where Redshifted, due to the fact that it is normal to a curved surface (in the simple case it is normal to a circle). The surface has to be a space time surface with time normal to every point of space, so the Redshift is not just imagined, but has to be there. The time normal to the observer on the nucleus is not the time normal at the Horizon. Every now and then an Electron tunnels directly through the nucleus. The observer on the nucleus would see an electron with the opposite time normal appear. What is the meaning of this? Using the Schroedinger equation, this electron would have the wrong mass, when it appears. This orbital would cause the Nucleus to vibrate slightly and the atom would be radioactive. This author believes he has found a new explaination for "Excess Mass" that may be tied to the Red-Shift, or the lack of Red-Shift in the radioactive nucleus.

Saturday, November 10, 2012 9:30AM - 11:30AM – Session F1 Science at the Nanoscale Wege Auditorium - Chair: Daniel Aalberts, Williams College

9:30AM F1.00001 Virus assembly and DNA translocation , MURUGAPPAN MUTHUKUMAR, University of Massachusetts —

10:30AM F1.00002 Subwavelength manipulation of light , MICHAEL NAUGHTON, Boston College —

Saturday, November 10, 2012 11:30AM - 12:30PM – Session G1 Physics Education Wege Auditorium - Chair: Michael Seifert, Williams College

11:30AM G1.00001 What do the students need? , DAVID HAMMER, Tufts University — The instruction we offer students, at any level, presumably reflects what we believe will help them understand physics. But we don't often subject our beliefs to scrutiny. Most physics instructors work from common sense assumptions about what students needclear explanations, demonstrations, motivation and practice. As in physics, however, common sense ideas (e.g. "objects move because they are pushed") aren't always correct. I will present evidence that these usual assumptions are insufficient and offer an expanded set of possibilities, focusing in particular on how students understand knowledge and learning. In some cases what students most need is help taking a different approach to learning, a "refinement of everyday thinking" (Einstein, 1936) rather than a reception of information.

Saturday, November 10, 2012 2:00PM - 5:00PM –
Session H1 AAPT Workshop I TPL 215 - Chair: Morton Sternheim, University of Massachusetts-Amherst

2:00PM H1.00001 Nanoscale Science and Engineering in High School Physics , ROB SNYDER, MORT STERNHEIM, MARK TUOMINEN, University of Massachusetts-Amherst — Integrating Nanoscale Science and Engineering into high school physics is often perceived as a daunting addition to the curriculum rather than as an opportunity for students to apply their understanding of fundamental physical principles and to further develop inquiry skills. Interestingly, there are numerous examples of classroom activities that can build an understanding of this rapidly expanding field while seamlessly being integrated into the STEM curriculum. One example appropriate for both introductory and advanced high school physics is the assembly and manipulation of a simple lever mechanism that requires the management of torques and the reflection of a laser beam by a series of mirrors. This mechanism simulates measurements made by an atomic force microscope (AFM), an instrument that maps materials at the nanoscale. An animation provides an opportunity for students to compare and contrast their simulation of an AFM that involves a rigid lever arm with an actual AFM that utilizes a flexing cantilever. The simulation can also serve as a springboard to an introduction to properties and applications that are unique to matter at the nanoscale.

Saturday, November 10, 2012 2:00PM - 5:00PM –
Session H2 AAPT Workshop II TPL 106 - Chair: Andrew Duffy, Boston University

2:00PM H2.00001 iPhone and ipad App Development , ANDREW DUFFY, Boston University — This workshop is a basic introduction to creating apps for the iPhone, the iPod Touch, and the iPad. No prior knowledge is assumed. We will cover the basics of drawing and animating; learn a little Objective-C; become familiar with the XCode environment in which apps are created on the Mac; and get an introduction to Interface Builder, where we lay out various buttons and sliders, etc. Workshop attendees must bring their own Mac computers, with Apple's latest version of XCode already downloaded and installed.

Saturday, November 10, 2012 2:00PM - 5:00PM –
Session H3 AAPT Workshop III TPL 312 - Chair: Mark D. Greenman, Boston University

2:00PM H3.00001 Digital Media Supporting Physics Teaching and Learning , MARK D. GREENMAN, Marblehead Science Matters — Leave with a suite of free high quality, content rich and high interest digital media resources to engage and prepare physics students. Bring your laptop. Participants in this hands-on workshop will learn to utilize digital media from NSF 360, NOVA Spark, WGBH Teacher Domain and PhET to help facilitate science teaching and learning. Participants will explore short focused videos, student interactive activities, archival scientific documents,full-length videos, lesson plans, simulations and more provided by these resources. The presenter has vetted videos, activities, documents simulations and lesson plans that will provide participants with illustrative examples of how to use these engaging and content rich resources for students in pre-college and freshman college courses. Participants will go through all aspects of using these resources including the use of filters to develop narrow search criterion to support specific topics and levels. Participants will leave having the competency and confidence to implement these resources into their own classroom immediately upon returning home from the conference.