Session A – Contributed Posters

Photonics Atrium, Second Floor 5:40 – 6:40 p.m. Friday, March 1, 2006
Chair: Karl Ludwig, Boston University

A1 Undergraduate Research in Color Center Production and Photodegradation using Retroreflecting Glass Beads

EVERETT KYSOR, RUSSELL HARKAY, Keene State College

A project has been initiated at Keene State in which UV light from a Deuterium arc lamp is used to produce or bleach color centers in a wide variety of materials, including reflective glass beads used for high- way marking, alkali halides, and other transparent materials. The glass beads have a very high refractive index due to the inclusion of metallic impurities. Practical applications include varying the refractive index of a material by adding or bleaching (neutralizing) color centers, which are, in themselves, in interesting manifestation of the particle-in-a-box problem encountered in modern physics. Another practical outcome of the ongoing project is to determine the overall effect of exposure to UV light on the transmission and optical parameters of materials normally exposed to sunlight. As a sidebar experiment, work was performed in which micron-size glass beads were used to simulate two-dimensional arrays with a laser playing the role of x-rays in forming diffraction patterns.
rharkay@keene.edu

A2 The Spin on the "Source Surface" of the Solar Wind[1]

GARY PARKER, Norwich University

This observational study of coronal rotation is based on the K-coronameters aboard SOHO, the SOlar and Heliospheric Observatory. Sunspots occur within 35 degrees of the equator. Extensions of active regions into the atmosphere persist for sufficiently long that their sightings at the Sun's edge serve as timing markers to measure rotation. But magnetic structures other than those originating in active regions also reach the base of the solar wind, and the strongest rotation signal in 2002 is from latitudes higher than sunspots and is a feature of the neutral sheet of a tipped magnetic dipole. Come see the pictures.

[1]The author thanks NASA, NRL and the Eppley Foundation for support.
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A3 On Large Volume K¨ahler Inflation

PER BERGLUND, University of New Hampshire, JOAN SIMON, LICIA VERDE, RAUL JIMENEZ, VIJAY BALASUBRAMANIAN, University of Pennsylvania

We show that cosmological observables can constrain the topology of the compact additional dimensions predicted by string theory.
per.berglund@unh.edu

A4 **Potential "Circles in the Sky" matches for simple topologies of the Universe**[1]

DUSAN MALETIC, Rutgers University

If universe characteristic size is smaller than the radius of the SLS, it can intersect itself and we could observe a set of pairs of matching circles in the CMB radiation. Following the statistics proposed by Cornish, we analyze the WMAP ILC map. We apply the simplified Kp0 data mask, avoiding Galactic foregrounds. We do not consider any circles completely or partially falling within 7_ of the Galactic plane or within 20_ from the Galactic center. We do not average or smooth the data as the expected thickness of the circles can be estimated to be of the same order as the WMAP data resolution. By the nature of this phenomenon circles should be sharply defined. We examine statistics of the best matches for the CMB circles expected in the cases of Quaternionic, T3, Seifert-Weber and Poincare Dodecahedral topologies. We limit our search to the circles of the sizes between 8_ and 16_ due to the reasonable expectations related to the applied data cuts of the WMAP map and the available resolution. Due to the latter we step the matching circle coordinates during the search in the 0.5_ increments as well as the circle sizes. We consider only the circles of exactly matching sizes because for the topologies considered it would not be Physical to match differently sized circles. As a result we provide circle sets most

likely hinting the proposed set of possible topologies of the Universe.
[1]With the support of the Prof A. Kosowsky, University of Pittsburgh
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A5 Revisiting the Possibility of Resonant Decay of Axions into Photons

ANDREW PAWL, NAPS

We revisit the possibility that the coherently oscillating axion field undergoes resonant decay through its anomaly- generated coupling to the electromagnetic field. Early treatments of this process assumed a Mathieu-type resonance and suppression of decay due to the large (relative to the axion mass) electron plasma frequency at the time of onset of axion field oscillation. We explore the validity of these assumptions both analytically and numerically.
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A6 Random and Non-Random Placement of Rare Earth Ions in an Yttrium Aluminum Garnet (Y3Al2(AlO4)3) Crystal

JEREMY TUDISCO, JOHN COLLINS,
Wheaton College

When ionic insulating solids are doped with rare earth or transition metal ions, the spectroscopic properties of those ions depend on their concentration and distribution in the crystal. The efficiency of some processes, such as non-radiative energy transfer among the ions, depends on the details of their distribution, and interpreting the data requires an explicit or implicit assumption regarding that distribution. Their distribution is often assumed to be either random, or less realistically, spread evenly throughout the crystal. In this work, we construct a virtual crystal, and place dopant ions in randomly and nonrandomly, and then study the resulting distributions. We constructed a laser crystal, Yttrium Aluminum Garnet (YAG), containing up to 160,000 atoms (1000 unit cells). The doping process was simulated by selecting particular Yttrium ions, and substituting them with ions of a different type. This simulates the doping of rare earth ions, which are known to favor substituting at Yttrium sites. This doping was done at various concentrations. The random distribution was simulated with a “random” number generator. Non-random substitution of ions was also accomplished in a way that mimicked attractive and repulsive forces among dopant sites. For each ion we found the distance to its nearest neighbor and plotted the occurrence of each nearest neighbor distance. We batch-processed (1000 runs) the program in order to find an average distribution of the ions.
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A7 How to Explain the Green Flash

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In teaching about the green flash which is occasionally seen as the sun sets below the horizon, there are five points to consider. 1) With the sun just below the true geometrical horizon, refraction caused by the atmosphere bends the red and orange colorsless than the blue and violet end of the spectrum. Thus light from the top of that low sun will have more shorter-wavelength colors. 2) However, scattering by the air decreases the proportion of shorter wavelength light, leaving more of the green than the blue or the violet. 3) Most often the intensity of the thin greenish portion at the top of the sun would be too low to see visually. But given a mirage produced by thermal stratification, that last green view is appreciably brighter. 4) When watching a sunset, one's retinal cones are affected resulting in compromised color judgment because of a complementary-colored afterimage. Nonetheless I can report having once observed an emerald green flash just prior to sunrise. 5) Depending on various atmospheric conditions a range of green flash phenomena are possible, including green dots, green segments, and even green rays.

A8 Student understanding of differentials and the Maxwell relations in thermodynamics

John R. Thompson, Brandon R. Bucy, and Donald B. Mountcastle
Department of Physics and Astronomy
University of Maine, Orono, ME

We are engaged in a research project to study teaching and learning in upper-level thermal physics courses. These courses are taken by third- and fourth-year undergraduate physics majors, and may include first-year graduate students. As part of this project, we are

exploring student understanding of the mathematical concepts required for productive reasoning in various thermal physics contexts. We report here on findings associated with total differentials and the Maxwell relations, which equate mixed second partial derivatives of various state functions. Our preliminary results suggest that students are often unable to apply the appropriate mathematical concepts and operations to the physical situations encountered in the course, despite having taken the appropriate prerequisite mathematics courses. Furthermore, many students have difficulties understanding either the mathematical or physical significance of the Maxwell relations, even after instruction.

Supported in part by NSF Grant #PHY-0406764.

A9 PHOTON2 Program Overview

Fenna Hanes, New England Board of Higher Education

Photonics technology – the practical application of light – is one of the most pervasive, important new technologies of the twenty-first century. Lasers, optics, fiber optics, CD players, holograms, bar-code scanners, LCDs, and satellite imagery are just a few examples of the practical applications of photonics. In the same way that electronics changed our lives in the twentieth century, optics will play a critical role in enabling manufacturing, medical, sensing, telecommunications, homeland security, and defense technologies in this century.

Funded through a three-year grant from the Advanced Technological Education (ATE) program of the National Science Foundation (NSF), Project PHOTON2 builds on the highly successful previous Project PHOTON. High school and college educators from several geographic locations (seven regions nationally) have been brought together to facilitate photonics technology education at their institutions.

PHOTON 2 has developed a one semester professional development course, "Introduction to Photonics," that has been offered via distance learning by Three Rivers Community College in Norwich, Conn. The course is based on a 15-chapter set of notes, more than 20 laboratory exercises, a dozen explorations and an industry quality laboratory kit. PHOTON2 hosts and active listserv with teachers and industry mentors. A final Showcase workshop is scheduled to be co-located with the SPIE annual meeting in San Diego in August 2006. For further information contact PI Fenna Hanes at the New England Board of Higher Education at 617-357-9620 x129 or by email at fhanes@nebhe.org.

A10 Optical Characteristics of Nd-doped PLZT Ceramic Laser Materials at Different Temperatures and Nd Concentrations

Pi Ling Huang, Andrew Durocher'09*, Xuesheng Chen
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The neodymium ion (Nd^{3+}) doped PLZT, is a newly developed transparent ceramic laser material that possesses great potentials for making high-power and high-efficient lasers. A major focus in this research is to investigate temperature and Nd^{3+} concentration dependence of absorption of this material in the wavelength range from 600 to 900 nm. The samples investigated are 0.5% and 1% Nd doped PLZT's, each being 1 mm thick; temperature of the sample is being controlled at several chosen temperatures from 30 to 300K. The absorption peaks are found to be narrow, thus distinguishable at low temperature, but the lines are broadened as temperature increases. The absorption intensity and peaks can also change with temperature. The absorption peaks reveals what wavelengths the materials absorb well, which is critical in determing what kinds of pump light sources to use. This research provide critical information on choosing appropriate critical parameters such as temperature and concentration for the development of high-efficiency lasers with this new kind of the transparent ceramic laser materials, Nd^{3+}:PLZT. Results and conclusions will be presented in details at the meeting.
We would like to acknowledge the support from NSF grant DMI-0450547 and the Wheaton Research Participation Program and collaboration with BATI and Boston College.

* Andrew Durocher is an undergraduate student at Wheaton College, Norton, MA.

Session B Photonics 203 8:00 – 10:00 a.m. Saturday, April 1, 2006
Chair: Laurence Gould, University of Hartford

B1 8:00 a.m. Dark Matter Scattering of Type Ia Supernovae Radiation

DAVID W. KRAFT, University of Bridgeport

Although more than 75 years have passed since the existence of dark matter was inferred to account for observed motions of stars and galaxies, there is still no firm understanding of its composition or structure. It is proposed here that, in a critical density Universe, a portion of the dark matter consists of baryonic matter in the form of an ionized intergalactic hydrogen plasma. An estimate of the density of this baryonic dark matter is obtained from the atomic abundance of hydrogen and from the observed matter density as inferred from its gravitational effect on visible matter. We apply our hypothesis to study the effect of Thomson scattering by the free electrons in the plasma on the dimming reported for Type Ia supernovae and find that these observations can be accounted for without recourse to cosmic acceleration or jerk.
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B2 8:15 a.m.
Conversion of Energy into Mass

KURT LEHOVEC, Professor EMERITUS
University of Southern California, Los Angeles (USC)

The work done by a constant force accelerating a mass is the Einstein energy of its velocity-induced mass increment. $E=[m(v)\ m(o)]\ c^2$.
kurtlehovec@yahoo.com

B3 8:30 a.m.
Dark Matter and Dark Energy Explained

SOL AISENBERG, International Technology Group

The standard model of the universe has many mysteries and defects requiring the use of large fudge factors such as Dark Matter and Dark Energy. We will show that Dark Matter is needed when we try to extend Newton's law of gravity (based upon observations in our solar system) to galactic distances. Dark Matter was introduced to explain the observed flat velocity rotation curves of the outer parts of spiral galaxies, as observed by Vera. Rubin. Much earlier, the (under appreciated) Fritz Zwicky introduced the need for large amounts of missing invisible matter to explain the surprising observed motion of groups of remote galaxies. In our hypothesis, the modification of Newton's laws by the addition of a linear term to the gravitational constant that increases with distance will eliminate the need for dark matter. Our hypothesis is different from the MOND theory of Milgrom, which depends upon acceleration. The Red shift observations by Hubble as a function of distance, and interpreted as "apparent Doppler effect" led to the unproven belief that the universe is expanding, and thus to the Big Bang. In turn the apparent acceleration of the expansion required the introduction of Dark Energy. Actually there are three additional components of the red shift that are solely due to gravity and distance and can be larger than the Doppler contribution.
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B4 8:45 a.m. Spacetime as Canvas in Soho: Physicists' Interpretation of Art Work by Tehching Hsieh

ANDREW CHEN, EduTron Corp.

In this somewhat unconventional presentation, the provocative works of artist Tehching Hsieh, "performed" more than 20 years ago in New York City, are analyzed in the language of physics by an MIT physicist. Physical presence took on the role of paintbrushes; 4-dimensional spacetime served as the canvas. Work samples for the following pieces will be demonstrated: "Cage", "Time", "Outdoor" , "Art/Life", and "Life." The audience will participate in reconstructing these paintings (READ: world lines) and appreciate the tremendous effort, and if appropriate – significance, of this unfunded and underappreciated experiment in physics and in art.
schen@EduTron.com

B5 9:00 a.m. The Stand-Up Physicist: A New Way to Teach Physics

DOUGLAS SWEETSER

To communicate a physics theory requires teaching: small doses of storytelling that are technically and emotionally compelling. Starting from a Lagrange density, there are hours of partial differential equations to get to experimental tests of my unification of gravity and light proposal. 26 half hour shows are planned for community access TV and web downloads. One third of the shows will be non-technical. All shows will contain a comedy sketch. 13 shows were broadcast on Boston Neighborhood Network last Fall. One show, Why Quantum Mechanics is Weird, won a Best of Festival award in education category of the 2005 Berkeley Video and Film Festival.
Sweetser@alum.mit.edu

B6 9:15 a.m.
Harmonizing Physics & Cosmology With Everything Else in the Universe(s)

PAL ASIJA, OUR PAL LLC

This paper postulates a theory of everything including our known finite physical universe within and as sub-set of an infinite virtual invisible universe occupying some of the same space and time. It attempts to harmonize astrophysics with everything else including life. It compares and contrasts properties, similarities, differences and relationships between the two universe(s). A particular attention is paid to the interface between the two and the challenges of building and/or traversing bridges between them. A number of inflection points between the two are identified. The paper also delineates their relationship to big bang, theory of evolution, gravity, dark matter, black holes, time travel, speed of light, theory of relativity and string theory just to name a few. Several new terms are introduced and defined to discuss proper relationship, transition and interface between the body, soul and spirit as well as their relationship to brain and mind. Physical bodies & beings are compared with virtual, meta and ultra bodies and beings and how the "Virtual Inside" relates to people, pets, plants and particles and their micro constituents as well as macro sets. The past, present, and potential of the concurrent universe(s) is compared and contrasted along with many myths and misconceptions of the meta physics as well as modern physics.
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B7 9:30 a.m.
Noumen Mechanics: a Program

EDOUARD ROCHER

Noumen Mechanics (NM): geometric synthesis between Relativistic Mechanics (RM) and Quantum Mechanics (QM) based on a more fundamental approach to RM. Events (1905) are geometric points in Minkowski space-time M4, noumens (1972) in C4, M4 complex extension. A noumen is a chiral entity containing more information than an event, thus suggesting doing physics in C4 instead of M4. Three main principles: Representation duality: M4= C4_xC4 since Sl(2;C) acts on C4 and is the fundamental representation of the Lorentz group. Homogeneous hypercomplex space: C4 and M4 are quotient spaces of homogeneous spaces CC4 and MM4. A geometric point is represented by a homogeneous class; the coefficients of homogeneity _ is its electroweak charge in CC4, and $\mu = |\_|2$ its mass in MM4. Analytic function of physical points: Physical points are bounded sets of geometric points, noumens in C4, events in M4, with the resulting electroweak charge and mass. Phase 1: gain a deeper understanding of the mathematical sources of QM and RM. Two main NM results: bound electrons do not radiate; C4/M4 is the solution to physics hierarchy problem. Phase 2: apply new concepts to nuclear physics, following Pauli's interpretation (1936) of Fermi's weak-interaction constant (1934).
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B8 9:45 a.m. Surface Brightness Test and Plasma Redshift

ARI BRYNJOLFSSON, Appl. Rad. Ind.

The plasma redshift of photons in a hot sparse plasma follows from basic axioms of physics. It has no adjustable parameters (arXiv:astro-ph/0406437). Both the distance- redshift relation and the magnitude-redshift relation for supernovae and galaxies are well-defined functions of the average electron densities in intergalactic space. We have previously shown that the predictions of the magnitude-redshift relation in plasma- redshift cosmology match well the observed relations for the type Ia

supernovae (SNe). No adjustable parameters such as the time variable "dark energy" and "dark matter" are needed. We have also shown that plasma redshift cosmology predicts well the intensity and black body spectrum of the cosmic microwave background (CMB). Plasma redshift explains also the spectrum below and above the 2.73 K black body CMB, and the X-ray background. In the following, we will show that the good observations and analyses of the relation between surface brightness and redshift for galaxies, as determined by Allan Sandage and Lori M. Lubin in 2001, are well predicted by the plasma redshift. All these relations are inconsistent with cosmic time dilation and the contemporary big-bang cosmology.
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Session C Photonics 205 8:00 – 10:15 a.m. Saturday, April 1, 2006
Chair: Karl Ludwig, Boston University

C1 8:00 a.m. Can McLeod's Naturoptic Vision Improvement Patent Innovations Be Transferred, with Franchise Safeguards, to Specialists in the Arts and Sciences, Education, Engineering, Law, Medicine and Research, to Other Countries, by Teachers he has Trained?

ITALANI ATAIDE, JADE ATAIDE, Camaragibe, PE, Brazil, ROGER MCLEOD, University of Massachusetts, Lowell

We hope that we can soon demonstrate that an important part of a nation's scientific, technologic, health and other educational or economic indicators, such as productivity and agrarian progress, are linked to the visual capabilities of its population. We propose to engage Brazilians specifically, and other South or Central Americans generally, in deciding whether Naturoptic Vision Improvement patent innovations or services, can be nurtured by the countries involved, for a franchisor who will be granting time-limited but protected and profit-free use permission, for the purposes referred to above. Cost-benefit analyses are readily accomplished. Insurers can easily improve their profitability by establishing that their clients, whose vision has been Naturoptically improved, are safer drivers than individuals with static vision states, caused or abetted by glasses, contacts or surgically altered corneas.
RogerMcLeod@uml.edu

C2 8:15 a.m. Can Naturoptics fund Naturopathic Universities to Develop Interlocked Mentoring Relationships with Proposed Universities to Check Sensitivities of Individuals with Spina Bifida, to Environmentally Generated EMF Information about 'Quakes, Hurricanes, etc.?

DAVID M. MCLEOD, Bastyr University, ITALANI ATAIDE, Camaragibe, PE, Brazil, ROGER D. MCLEOD[1], University of Massachusetts, Lowell

Individuals harboring the herpes zoster virus following chicken pox, are susceptible to attacks of shingles. They may indicate peculiar awareness of pricking 'pin and needle' sensations and co-symptoms of tinnitus and/or Meuniere's syndrome. RDM used similar symptoms in FL to predict the earthquake ninety miles north of Guantanamo bay in 1998. An astounding burial site in Florida from over six thousand years ago had a teenaged boy with severe spina bifida, with non-Asian genes, who

could not have survived without very capable health support. Two youthful individuals likewise afflicted with spina bifida were unearthed from one site at Pompeii, entombed by the eruption of Vesuvius, August 24 and 25, CE 79. We know how to locate sites, active with EMF, which have tornado, hurricane and earthquake associations, and would like to foster joint research also involving Hawaiian and other volcanoes.

[1] author #3 presenter
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C3 8:30 a.m. Are Naturopathic Universities "The Natural Places" to investigate Attention-Deficit Type Disorders, with Possible Linkages to Cultural Patterns and the EMF?

BEATRIZ DE SOUZA, Camaragibe, PE, Brazil, CHAN BALAM MATAGAMON, SAGAMO PAWA MATAGAMON[1], Pawtucket Lodge, Merrimack Watershed Indian Council, MA, NH

We desire serious investigations of behavioral impacts of certain localized or larger-scale environmental elements, such as the electromagnetic spectrum as detected by us at some sites. One author was impacted by the earth's EMF to such an extent in FL that it falsely convinced him that he was having a heart attack more severe than his nearly fatal one. Instead, it preceded an earthquake he then predicted six hours in advance. Chitto Tustenugee's 'everglades' site, in Miramar FL, evokes tinnitus. Elsewhere, unease, terror, inappropriate behavior or sporadic loss of attention occurs where it can impact runway or roadway safety. Physics and Naturopathic Universities could be appropriate partners for understanding, preventing or curing these.
[1] McLeod, will present
RogerMcLeod@uml.edu

C4 8:45 a.m. Has Vision been Universally Modeled in a Way that Predicts Damage from Improper Use, or Rapid and Safe Repair to a Normal, Dynamic, Feedback Protected State, by Patented and Trademarked Naturoptic Vision Improvement Methods?

PAUL NIEMI, O.D., Franklin Pierce College, ROGER MCLEOD, University of Massachusetts, Lowell

Mc Leod predicts that in visual tasks with pupil diameter changes, a longer, quasimonochromatic wavelength interval is coincident with foveal cones, and rods. A shorter, partially overlapped interval separately aligns with extrafoveal cones. Wavelengths follow the Airy disk radius formula. Extended visual tasks of a type requiring shorter wavelengths, pair extrinsic eye muscles in inappropriate states, one in extension, the other in contraction, exceeding "Hooke's law" settings. Hysterisis prevents feedback-driven, self repair. The universal model for vision predicts myopia, hyperopia and presbyopia. Niemi can test and evaluate that model: repair needs triggering and facilitating demands of the possibly overridden feedback signals.
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C5 9:00 a.m. Can Youthful Students be Encouraged to Self-repair Damaged Vision Using Elementary Mathematics and Physics Principles?

NADJA FERREIRA, Camaragibe, PE, Brazil, ROGER MCLEOD[1], University of Massachusetts, Lowell

Safe and easy self-repair of damaged vision in youth, detected from squinted eyes, motivated by simple applied math and physics, and over-stretched elastics. Parental permission and participation, with math skills of numerical cancellation, bring physics understanding to students. They recognize pupil diameter changes with light intensity. Ideas of focal surfaces and wavelength dependence can be achieved by burning paper with a magnifying glass, and dispersing light with a prism. Safeness of eye and head movements required are like those of the mother in applying makeup, or of a father in shaving. Easily defined, performed and monitored visual tasks can complete the repair(s).
[1]Submitter will present
RogerMcLeod@uml.edu

C6 9:15 a.m. Can Naturoptics Vision Improvement Methods Help Clear Cataracts, as Claimed by the Member of the Naturopathic Physicians Association of Massachusetts who Stabilized and/ or Improved Vision in all the Retinitis Pigmentosa, RP, Patients Treated by him?

JEAN MACDOUGALL, Pembroke Pines, FL, ROGER MCLEOD, University of Massachusetts, Lowell

MacDougall was advised against having a single crystalline lens with a slight cataract surgically removed; it would impact her ability to reengage vision's self-correcting feedback mechanisms. Her Florida ophthalmologist removed both lenses. A Massachusetts ophthalmologist was recently delicensed for improperly performing just those services. An optometrist says reputed vision repair can easily be tracked and evaluated; we posit that Naturoptics effects on cataracts can be similarly assessed. "Cures" are detectable. Naturoptics users may show glaucoma reversal. EDWARD R. ELLIS, Jr., N.D. (The Chelmsford Clinic, Massachusetts), stabilizes RP, preventing blindness.
RogerMcLeod@uml.edu

C7 9:30 a.m. Can Portable Technology Capture Subtle Phenomena, Related to Quakes, Hurricanes, Tornados, and Volcanoes, Culturally Reported in the Americas by an Equivalent of "Kokopelli" or ˜N ari Huallac, i.e., the EMF?

JADE ATAIDE, ROGER MCLEOD, University of Massachusetts, Lowell

Peruvians who produced the CD ˜NARI HUALAC say this name of their home village represents two of their few original words, meaning "serpent God." Arizona, hurricane, mullah, Molocket, Millinocket and Allagash of Maine, Allahpata, and Apalachicola of FL, and Allegheny of PA are some partial cognates for these ancient words. They are culturally detected aspects of the EMF, like Kokopelli, the "hunchbacked, flute-playing, dancing around" icon of our southwest. That aspect of 'flutes' indicated by tinnitus, and its co-associated symptoms of Meuniere's syndrome, along with the sensation of 'pins and needles', signify the rotation of secondary magnetic poles, stimulating nerve endings with their EMF that technology can detect, here and in Brazil. Can they fool us about some religious concepts?
RogerMcLeod@uml.edu

C8 9:45 a.m. Is a 'Brane' Electron Modeled by a Closed-loop String of Neutrinos, is time formally a periodic function, and can tornadoes be "turned off"?

ROGER MCLEOD, University of Massachusetts, Lowel, DAVID MCLEOD, Bastyr University

Model a 'planar' electron by a closed string of vibrating neutrinos; displacement values are proportional to the speed of light times the square root of the mass. 'Spin' supplies required inward spherical fields in three spatial dimensions. Interlocked quark loops model protons or neutrons; ideas like strong and weak forces, or an uncertainty principle, arise. Subtle, longer string-like 'vibrating,' quasi-periodic, lighted phenomena we detect are at locations used by some of our Native American forebears, or by the Hopi or Maya -locations indicated by problematic constructions, by 'sacred' place-names, or by individuals with 'titles' identified as names. Lighted 'tubes,' associated with EMF, required by our model for tornado generation, imply breaking the EMF lines will 'kill' any tornado. 'Kokopelli's hair,' is the place to construct a designated current loop.
RogerMcLeod@uml.edu

C9 10:00 a.m. Were Viking Dry-dock methods in the Americas used earlier to Build Pyramids, with Outflow Eroding the Sphinx, and were Stonehenge, the Obelisks, and Moas Similarly Erected?

EDWARD MCLEOD, Rumford, ME, ROGER MCLEOD, University of Massachusetts, Lowell

Chisel-quarried recycled granite in MA is datable by runes to 1069 CE; it could corroborate dating by a LIDAR. Associated sites, possibly used by Vikings to dry-dock their ships, could have exploited lock-like controls, possibly a continued technology. Site-leveling at the Giza Pyramids proves water was used. 'Locks' and body-immersion worked for building, moving, erecting, or watering, at sites like Stonehenge, The Hanging Gardens at Babylon, the Moas of Easter Island, or The Pyramids, where the eroding water discharge was deliberately flushed over the Sphinx complex. It enhance the electromagnetically excited blue light signals we can detect, especially at sites frequented by Molocket of ME. Information, as at America's Stonehenge, in NH, and constructions at Acton MA, at Giza or at Rumford ME proves that the Pyramids and Sphinx were engineered and built about 4500 BP.
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Session D Photonics 210 8:00 – 9:45 a.m. Saturday, April 1, 2006
Chair: Andrew Duffy, Boston University

D1 8:00 a.m.
Teaching Science in a Faith Community

Henderson Cole, APS Fellow, Retired
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Despite Judge Jones' ruling that the teaching of intelligent design as science is unconstitutional there still seems to be an emotionally driven conflict between some students and their science teachers. Although perhaps not satisfying to some there is a way of containing this conflict and that is to clearly define what the subject matter of the field of science is at the beginning of the term. I know we talk about the scientific method, but I propose it is better to talk about discoveries (facts) which are never in dispute, and the explanations, called theories, which can be. The important point is that, by definition, the theory which is finally accepted as scientific must predict correctly new discoveries not yet made. This automatically puts explanations with no predictive powers, such as miracles, or done by super intelligent beings whose existence and powers are defined only by belief outside the field of science. One may object to this definition, but all human activities are bounded by rules and regulations which define them. This understanding of what is and is not science sets aside the question of whether there are truths outside of science. But it does say that if there are they belong in some other field. Further details will be presented.

D2 8:15 a.m. Easy Java Simulations

Andrew Duffy, Department of Physics, Boston University
aduffy@bu.edu

Want to create Java simulations while knowing little or no Java? This talk will demonstrate how to do it using the Easy Java Simulation program created by Francisco Esquembre of Spain, and available at: http://fem.um.es/Ejs/

D3 8:30 a.m.
Open Source Interactive Media

Bob Tinker
Concord Consortium

You should think about using open source software in education. For starters, the price is right - it's free. And some of it is quite good. Examples will give a taste of what is possible. For more information, see http://www.concord.org/publications/newsletter/2005-spring/opensource.html

D4 8:45 a.m. A New Look at Electromagnetic Radiation

Lou Turner, retired physics teacher, Western Reserve Academy
lturns67@adelphia.net

Dick Feren, retired physics teacher, Milford High School
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Physics textbooks usually contain statements like "When the magnetic flux through a wire loop is changing, an emf is induced in the loop." This statement is valid if understood to mean emf occurs together with changing magnetic flux. However, Faraday's Law and Lenz's Law are always stated in a way that suggests that the changing magnetic field causes the emf to be created. This method of analysis gives correct answers, but it gives students a false impression of what is actually happening. CASTLE electricity has devised a series of simple experiments which demonstrate in convincing fashion that it is the acceleration of charge that creates an electric field that is radiated and drives charge flow in external circuits. This approach is more consistent with the fact that only electric fields are capable of causing charge that is initially at rest to begin moving. The presentation will include the experiments which support the claim that accelerating charge is the cause of the created emf.

D5 9:00 a.m. Faraday vs. the Spiritualists: How England's Great Scientist Fought the Supernatural - and Lost

Alan Hirshfeld, Physics Dept.
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In the 1850s, renowned physicist Michael Faraday launched a public campaign against pseudoscience and spiritualism, which were rampant in England at the time. Faraday objected especially to claims that electrical or magnetic forces were responsible for paranormal phenomena, such as table-spinning and communication with the dead. Using scientific methods, Faraday unmasked the deceptions of spiritualists, clairvoyants and mediums and also laid bare the credulity of a public ill-educated in science. Despite his efforts, Victorian society's fascination with the paranormal swelled. Faraday's debacle anticipates current controversies about public science education and the interface between science and religion. This episode is one of many described in the new biography, The Electric Life of Michael Faraday (Walker & Co.), which chronicles Faraday's discoveries and his unlikely rise from poverty to the pinnacle of the English science establishment.

D6 9:15 a.m.
Looking inside Telephones from the Past

Elizabeth Cavicchi
Dibner Institute for the History of Science and Technology, MIT

The circuitry of today's phones is miniaturized, compact, and inscrutable to a novice. By contrast, on nineteenth century telephones, wiring can be traced visually and the functions of different components are suggested by their lay-out and construction. This paper describes the explorations, discoveries and inferences made by two university students as they took apart historical telephones in the MIT museum collection with curator Debbie Douglas. This activity suggests how historical artifacts engage science students' inquiry and interest

D7 9:30 a.m. Beady Eyes, Efficiency, and When Does One Plus One Not Equal Two?

J. Russell Harkay, Keene State College
Keene, NH 03435-2001

Some ideas for guided inquiry exercises are presented and some freebies will be handed out. These include a few selections from my recent text relating to force vectors, efficiency of machines, and fun with glass retroreflective beads.

Session E Photonics 206 8:15 – 9:45 a.m. Saturday, April 1, 2006
Chair: Nick Nicastro, Wachusett Regional High School

E1 8:15 a.m. Boston University Academy Science and Engineering Research Program

Gary Garber, Instructor of Physics
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High School students in 11th grade at Boston University Academy spend a year in a science seminar to prepare themselves to spend 8 weeks working in a science or engineering research laboratory at Boston University. They develop their work into a 30 page senior thesis.

E2 8:30 a.m. Boston Regional FIRST Robotics Competition

Gary Garber and Steve Cremer

High School students from over ten schools in the Boston area all participated in the FIRST Robotics competition. Students spent six weeks designing and building their robots which competed at Boston University in late March. This presentation will show highlights from the competition and detail the building process of several teams. There will also be information on how to form a team.

E3 8:45 a.m.
Physics Theorynet Outreach Program*

Tomasz Taylor, Northeastern University
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Physics Theorynet is a spinoff of Quarknet initiated in 2004 by the NSF Theoretical Physics Program for developing interactions between Boston area particle theorists and cosmologists with high school students and teachers. Its main component is the direct interaction between physicists, students and teachers through presentations, demonstrations and question and answer sessions during regular class hour visits and after class. At the present time, the program involves 7 teachers and 7 physicists, but it is expected to grow due to its initial success. I will describe the goals of Theorynet, its achievements and challenges.

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*Supported in part by the National Science Foundation under grant PHY-0242834

E4 9:00 a.m. An Investigation into the Effectiveness of Physics First in Maine

Michael O'Brien* and John R. Thompson*+
*Center for Science and Mathematics Education Research
+Department of Physics and Astronomy
University of Maine, Orono, ME

Data from three high schools that teach physics in ninth grade and three that teach physics in twelfth grade were used to make comparisons between these classes. Research tools include written pre- and post-tests of kinematics and mechanics concepts, a written physics attitudes and expectations survey, and individual student interviews. Portions of these tools were excerpted from well-known and thoroughly tested instruments. We compare the normalized gains on the conceptual survey, and discuss which kinematics and mechanics concepts ninth- and twelfth-graders appear to learn differently. We also compare students' perceptions of physics from the ninth- and twelfth-grade viewpoints. Preliminary results suggest that while the populations are similar affectively, they have significant differences in conceptual understanding, and this difference is amplified by different instructional approaches.

E5 9:15 a.m. Turning Physics Around

Aaron Osowiecki and Jesse Southwick
Boston Latin School

Traditionally, most students begin their investigation the physics of motion in great detail – graphically and algebraically. While trying to make sense of different types of graphs and applying what seem like "magic" equations, students often fail to realize how physics connects to their own lives, right from the beginning of the course. Consequently, the physics community loses many students describing *how* things move before they even get to *why* things move.

The physics teachers at Boston Latin School have turned physics around. Unlike traditional courses, we introduce energy and its conservation right at the beginning (after defining speed); the students gain an

appreciation for why objects move and affect their environment. Energy remains the focus and central theme as students investigate more concepts such as work, friction, and Newton's Laws of Motion. Instead of learning physics as a series of disjointed units our students use energy as a unifying concept. They come to learn accelerating, lifting, heating, or lighting as all requiring energy. We have had initial successes with our revised order of topics, and have found that the mathematical sophistication builds nicely, since we no longer have the often challenging and abstract study of motion in the first weeks of the year.

Chances are that after studying physics people rarely have the opportunity (or need) to develop a motion graph for an object or calculate the distance it will travel if one knows the acceleration. However, everyone can use energy as a unifying principle by which to understand the world, especially as energy becomes a more and more important world and society concern.

E6 9:30 a.m. Introductory Physics with LEGO and ROBOLAB

Robert M. Hart, Nataliia Perova, Chris Rogers
CEEO, Tufts University, Somerville, MA.

The Center for Engineering Education and Outreach at Tufts University (CEEO) and collaborators are developing activities using LEGO bricks and robotics for use in teaching introductory physics. Massachusetts Science and Technology/Engineering Curriculum Framework states that inquiry and experimentation should be part of the science curriculum, and that high school students should learn to design and conduct experiments. LEGO and the ROBOLAB software system are an effective set of tools for learning physics with this hands-on approach. LEGO parts allow students to make their own experimental apparatus and the LEGO robotics microprocessor (RCX) with its associated sensors and software create an environment for data collection, calculation, and for the documentation of experimental work. We will present sample experimental activities in 1-D motion, projectile motion, and quantifying the effect of electro-magnetic forces on an object's terminal velocity. We will also show how to use LEGO parts to teach optics by constructing an optics bench and a telescope. Finally, we will use the LEGO motors to explore the conversion of energy from one form to another. In each of these activities, students design and build apparatus, collect data, make quantitative predictions, and analyze results. We have found that the LEGO workbench provides enough flexibility that the students can be creative in their engineering solutions, yet it is advanced enough that they can get quantitative data from their experiments.

Session F Photonics 211 8:00 – 9:45 a.m. Saturday, April 1, 2006
Chair: Jeff Williams, Bridgewater State College

F1 8:00 a.m. Getting the Picture: Improving Student Understanding with Imagery And Animations

Jerold Touger, Curry College, Milton MA 02186
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Students in our introductory physics courses have approaches to learning and expectations about the process of learning that differ substantially from those of physicists. In particular, whereas physicists' understanding is dense and richly interconnected, beginning students tend to see physics as discrete elements with few interconnections. For many students, visualization within a coherent story line can be critical to understanding – the mortar that holds the conceptual edifice together. I will draw on electronic media examples available on the web site for my textbook (www.wiley.com/college/touger) to illustrate how imagery and animations can promote "getting the picture".

F2 8:15 a.m. Student (mis)application of partial differentiation to material properties

Brandon R. Bucy, John R. Thompson, and Donald B. Mountcastle
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Students in upper-level undergraduate thermodynamics courses were asked about the relationship between the complementary partial derivatives of the isothermal compressibility (κ) and the thermal expansion coefficient (β) of a substance. Both these material properties can be expressed with first partial derivatives of the system volume. Several of the responses implied difficulty with the notion of variables held fixed in a partial derivative. Specifically, when asked to find the partial derivative of one of these quantities with respect to a variable that was initially held fixed (e.g., $\left(\partial\kappa/\partial T\right)_P$), a common response was that this (mixed second) partial derivative must be zero. We have previously reported similar difficulties in the context of the Maxwell relations, indicating persistent confusion applying partial differentiation to state functions. We present results from before and after instruction and discuss the design of curricular materials to address these issues.

Supported in part by NSF Grant #PHY-0406764.

F3 8:30 a.m. Analysis of student understanding of symmetry in Gauss' law

Adrienne L. Traxler*, Katrina E. Black+, John R. Thompson*+

* Center for Science and Mathematics Education Research
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University of Maine
Orono, ME

To study introductory physics student difficulties with electrostatics, we compared student use of Gauss' law when finding the electric field for a spherically symmetric and a non-spherically symmetric situation. We used short interviews to design a free-response and multiple-choice-multiple-response survey that was administered to students in introductory calculus-based courses. We describe the development of the survey based on interview data. We also present the survey results and discuss them in light of Singh's results for Gauss' law, Collins and Ferguson's epistemic forms and games, and Tuminaro's extension of games and frames.

F4 8:45 a.m. A limited toolbox when using integrals and boundary conditions

Katrina E. Black, Eleanor C. Sayre, Michael C. Wittmann
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We use short small-group interviews to probe student learning in a sophomore-level mechanics course. We analyze four such interviews for student use of boundary conditions when solving first-order differential equations in both mathematical and physical contexts. In a purely mathematical context, groups rely on a memorized solution or on indefinite integration to find the general result. In both situations, they

then use the boundary condition to find the value of the integration limits, groups choose inappropriate limits of integration based on what "seems right" or use indefinite integration before arriving at physically reasonable limits.

F5 9:00 a.m. Femtosecond Laser Pulses and the Uncertainty Principle

Elisha Huggins
Department of Physics, Dartmouth College

The MacScope II software oscilloscope program was designed to make it easy to use Fourier Analysis in an introductory physics course. As an example, we will use MacScope's ability to demonstrate that the time-energy form of the uncertainty principle is a direct consequence of the particle-wave nature of matter, and Max Born's probability of the particle's wave. That takes less than 5 minutes. For the rest of the talk we will briefly introduce Fourier Optics and show how to teach the mathematics of Fourier Analysis in a non calculus course.

F6 9:15 a.m. Misrepresentations of Einstein's Second Postulate in Special Relativity

Patrick J. Carey, East Longmeadow High School, East Longmeadow, MA
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Many explanations of special relativity make reference to the two postulates that Einstein proposed near the beginning of his 1905 paper. These explanations invariably quote his first postulate correctly. This is the principle of relativity extended to electromagnetic phenomena. They also usually mis-quote his second postulate.

Einstein called his second postulate the law of the constancy of the velocity of light. Many authors make the mistake of claiming that Einstein initially postulated that the velocity of light would appear constant independent of the motion of both the light source and all inertial frame observers. In reality, Einstein included only the motion of the source in his initial postulate. The strong version of the law of the constancy of the velocity of light, which includes the observers, is a corollary of his theory, not a postulate.

Not recognizing this difference demonstrates a lack of appreciation for the eloquent style of Euclidean deduction used by Einstein as he logically proved his Theory of Special Relativity.

F7 9:30 a.m. Teaching Physics and Astronomy to College Art Students

Ben Blum
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In order to give art college students a meaningful experience of physics and astronomy, I have made two innovations: (1) teaching a small number of fundamental concepts and (2) having students make, along with written work, art which demonstrates what they have learned. In this presentation, my methods, successes, and challenges will be described.