



Indiana Section of the American Association of Physics Teachers

April 9, 2010

Registration: 5:00 - 6:30 pm (CP 101)

Video Analysis Workshop: 5:30 - 7:30 pm (CP 102)

Pizza: 6-6:30 pm (CP 108)

Demo Derby "Show and Tell" : 6:45 - 7:45 pm (CP 144)

Open House: 5-7 pm Lab Tours: 7-8 pm

Planetarium Show: 6-6:45 or 8-8:45 pm

(Seating is limited)

SARA Demo - Remote Observing in Chile: 8:00 PM (CP 151)

Observatory telescope viewing: 8:45 (weather permitting)

April 10, 2010

Registration: 8:00 - 10:00 am (CP 101)

Breakfast snacks (CP 108)

Opening Remarks: 8:20 am (CP 92)

Sessions: 8:30 am - 11:15 am

(CP 102, CP 92; CP 144)

Lunch: 11:30 - 12:30 pm (lobby of CP 187)

Keynote Speaker: 12:15-12:45 (CP 187)

Business Meeting/Award Presentation: 1-1:45 pm (CP 187)

Ball State University

Department of Physics and Astronomy

Muncie, Indiana

Cooper Science Building (first floor, northeast hallways)

Parking west of CS building-R11 (free after 5 pm on Friday and on Saturday)

Friday Evening Activities 4/9/10

Location: Cooper Physics

Video Analysis Workshop (5:30-7 pm in CP 102)

Based on a paper published in the January 2010 issue of *Physics Education*, Joel Bryan offers this workshop for 24 participants. Inexpensive video analysis technology now enables students to make precise measurements of an object's position at incremental times during its motion. Such capability now allows users to examine, rather than simply assume, energy conservation in a variety of situations commonly discussed in introductory physics courses. Participants in this workshop will use LoggerPro's video analysis feature to study energy conservation for (1) objects in freefall, (2) simple pendulums, (3) objects rolling down inclines, and (4) masses oscillating on springs.

Contact Information

Joel A. Bryan, Ph.D.
Department of Physics and Astronomy
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jabryan@bsu.edu

Demo Derby "Show and Tell"

(6:45-7:45 pm in CP 144)

Bring your favorite demonstration to share with the INAAPT group during this informal gathering.

Contact Information

Tim Duman
University of Indianapolis
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Friday Evening Activities 4/9/10

Location: Cooper Physics

**Ball State University Open House and Lab
Tours** (5-7 pm in CP 103, CP 90, CP 187, CP 151)

Teachers and high school students are invited to see what the Ball State University Department of Physics and Astronomy has to offer incoming freshmen.

Going Deep — Planetarium Show (6-6:45 or 8-8:45 pm)

The deeper we look into space, the farther back in time we can see. The Hubble Space Telescope has produced deep images that show the universe when it was young with galaxies in the process of birth. This program will examine how these images were obtained and what they tell us about the history of the universe.

Contact Information

Joel A. Bryan, Ph.D.
Department of Physics and Astronomy
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Session A - Talk 1

Time: 8:30 am to 8:45 am

Location: Cooper Physics 102

Title

Some ideas gleaned from HASTI

Abstract

I feel I benefited so much from HASTI this year that I thought I would share some of the neat ideas that I will try in my class. Ideas include ideas from going paperless (as much as possible) to using notebooks. I will tell what I am doing or plan to try as a result of what I learned. Some of these ideas include; using LabQuest to illustrate destructive interference, using a web cam as an "Elmo", a holistic twist, on using the science notebook, using 'Twitter', using 'Facebook' and becoming 'green'. I have not been able to implement any of the 'green' ideas like green roof, photovoltaic system, LED light bulbs, and some heat from the sun, roof but I still want to share the possibilities.

Contact Information

Bob Seal
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Indianapolis, IN
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Session B - Talk 1

Time: 8:30 am to 8:45 am

Location: Cooper Physics 144

Title

Student writing and reviewing in the laboratory

Abstract

Writing can be a synthesizing activity allowing the author to gain insight into the material with which they are engaged. As so often happens in laboratory activities, students are provided with lists of directions to follow, questions to answer, and directions on analysis. They create a laboratory report that paraphrases the directions provided the students originally. Unfortunately, this activity does not provide the opportunity for students to learn from their writing. The situation is further exacerbated by the students' writing for the entirely wrong audience: the brilliant faculty member rather than for themselves. I present our work at correcting this issue by having the students write for an on-line, peer reviewed journal. I will describe our preliminary work examining how students review papers.

Contact Information

Mark F. Masters

Department of Physics

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Session C - Talk 1

Time: 8:30 am to 8:45 am

Location: Cooper Physics 92

Title

Spintronics applications of nanoscale ring structures with embedded quantum dots

Abstract

Spintronics is an emerging field of nanotechnology in which the spin of the electron is used to communicate information and to accomplish switching functions. We analyze a model of a nano-electronics device composed of an Aharonov-Bohm ring with a quantum dot (QD) embedded in each arm. Quantum dots are nano-structures which behave as artificial atoms. Using desktop computing, we calculate the electron transmission through these devices and show how an external magnetic field can effectively provide spin-polarized electron current in the output. The current is modulated by the Aharonov-Bohm (AB) effect for perpendicular field orientation. The AB-effect shifts the phase of the electron wave-function, even in regions where the field itself is zero. The electron spins interact with the magnetic field via the Zeeman effect to produce spin-split energy levels in the QD's, allowing the device to function as a spin filter or a spin polarizer.

Contact Information

Eric R. Hedin, Ph.D.

Ball State University

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Session A - Talk 2

Time: 8:50 am to 9:05 am

Location: Cooper Physics 102

Title

Hitting collisions hard with Google Maps

Abstract

Presenting a new twist on momentum studies... Google maps gives great satellite / aerial imaging of your local intersections. Print screen allows cut and paste of individual cars. Add a few skid marks, and a collision is born. Can your students work backwards from a crash scene that you have created to find the initial velocity of cars involved in collisions (assuming perfect inelastic or elastic)? Google even includes a scale! For 1-D inelastic, and 2-D inelastic it as easy as (1) find your intersection, (2) cut out car images, and (3) add cars to intersections—adding skid marks, as desired. Assuming initial E-W and N-S motion simplifies work. *For 1-D and 2-D elastic, realize that kinetic energy conservation will make a “true” set up more challenging.* An exercise that can be applied to a very wide level of skills.

Contact Information

John Taylor
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Session B - Talk 2

Time: 8:50 am to 9:05 am

Location: Cooper Physics 144

Title

Making physics general education courses more exciting through interactive learning

Abstract

Physics is an intimidating subject for many, so those brave students that register for that physics general education course should be rewarded to find that physics is also a fascinating subject. Typically when topics are introduced students are asked to imagine frictionless surfaces and magic air that offers no resistance to motion, all of which deviate from a student's every day perception of the world. While many students do not have a solid understanding of how the physical world around them works, they do have a considerable amount of perceived knowledge acquired from day to day observations. I found that guiding students to work in small groups discussing various topics in physics pools their knowledge and improves their ability to articulate their ideas. These ideas can then be tested with a variety of simple experiments that confirm or challenge their understanding of these physical situations. As a result, students begin to alter their perceptions of the physical world, develop problem solving skills that may be applied to all facets of their lives, learn how to make perform simple yet informative experiments and gain an understanding of the nature of science. I will present some of the materials used in my course to get students to discuss and understand physics through interest and involvement in physics.

Contact Information

Dr. Jacob Millspaw

Indiana University-Purdue University Fort Wayne

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Session C - Talk 2

Time: 8:50 am to 9:05 am

Location: Cooper Physics 92

Title

DNA computing review and DNA electron transport

Abstract

Computers are continuing to improve with smaller and faster microprocessors as described by Moore's law, but due to the limitation in size, eventually Moore's law will fail to uphold and new computing methods will need to be developed. One such idea is replacing silicon, the transistor material in current computers that demonstrates semi-conducting behavior, with DNA. By studying the electrical properties of DNA and the transport of electrons through DNA, we can recognize the effects of the different parameters that affect the transmission of the electrons. Through my research of relatively simple models of electron transport, using both one and two DNA base pairs, I was able to observe semi-conducting behavior in DNA. In addition, transmission results demonstrating the dependence on inter-base coupling, base-pair sequencing, and DNA-to-lead electrical coupling are shown.

Contact Information

Andrew Joe, E.R. Hedin and Y.S. Joe
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Center for Computational Nanoscience
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Session A - Talk 3

Time: 9:10 am to 9:25 am

Location: Cooper Physics 102

Title

Electronic field mapping

Abstract

This is a different way to collect data points for the standard electric field mapping experiment with conductive paper, power source, and a probe. When one tries to record every point on the conductive paper, a total of 546 points or more, it takes a lot of time to record all those points onto an Excel spreadsheet, but the effects are so powerful. There is a way to speed up the process using Vernier's Logger Pro Software and the LabPro interface with a Differential Voltage probe. This session will show how to record all this data and create a three-dimension graph in one 45 minute lab session. The conductive paper and special conductive ink pen may be purchased through Pasco.

Contact Information

Bob Seal
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Indianapolis, IN
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Session B - Talk 3

Time: 9:10 am to 9:25 am

Location: Cooper Physics 144

Title

New Tech IDEAS

Abstract

At New Tech IDEAS of Decatur Central High School, introductory physics is taught in a Project Based Learning environment with two technology classes. The mechanics portion of physics is teamed with Transportation Systems. Energy topics (electricity, light, etc.) are combined with Communication Systems. We teach this double class to all our students once they have completed the first semester of Algebra 1. Our class incorporates modeling concepts with Physics First in a PBL classroom.

Contact Information

Peter Berg & Rob Weisbach
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Session C - Talk 3

Time: 9:10 am to 9:25 am

Location: Cooper Physics 92

Title

Temperature dependent electron transport through a four-channel DNA molecule

Abstract

The temperature dependence of the conductivity of lambda phage DNA has been experimentally measured by Tran *et al* [PRL **85**, 1564 (2000)]. Since the variation of temperature induces twist angle fluctuations between neighboring base pairs, electron wave functions are more localized so that electron transport through DNA molecules is strongly affected. In order to understand the temperature effects of electron transport theoretically, we study a two-dimensional, four-channel DNA model using a tight-binding (TB) Hamiltonian. In this system, we present a temperature-dependent localization length and a temperature-driven transmission by modulating temperature-dependent hopping integrals between molecular sites of the DNA. Finally, we incorporate magnetic field effects into the analysis of the transmission through the DNA in order to modulate the quantum interference between the electron paths that comprise the 4-channel structure.

Contact Information

Sunhee Lee, E.R. Hedin, Y.S. Joe

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Session A - Talk 4

Time: 9:30 am to 9:45 am

Location: Cooper Physics 102

Title

Physics for Future Presidents *Project*

Abstract

In the fall of 2008, a colleague brought the book Physics for Future Presidents by Richard Muller to my attention, and with the historic election taking place I decided to create a project that incorporated both physics and politics. The book is written as if you are about to be elected President of the United States, and it covers the physics you need to know to make decisions. What I created is a project that involves scientific literacy, requires knowledge of traditional and alternative energy sources, and asks students to synthesize opinions into an evaluative letter to their congressman. The project won a \$1000 grant from the Penn-Harris-Madison Educational Foundation and purchased a class set of books for physics students at Penn High School. I will share with you all of my background papers that organize the project, and share student letters that have been written to their congressman.

Contact Information

Stacy McCormack

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Session B - Talk 4

Time: 9:30 am to 9:45 am

Location: Cooper Physics 144

Title

Teaching the International Baccalaureate Science Standard and upper-level curriculum

Abstract

North Central High School has been teaching the international baccalaureate science syllabus for 21 years. In this time we have enjoyed great success and are considered by the international baccalaureate to be one of the better schools in the country and certainly in the state. The purpose of my paper is to discuss what it is we do here at North Central in getting students ready for their standard level and higher-level exams in physics. I will speak to what the curriculum is and how it compares either favorably or unfavorably to the AP-B curriculum which we also teach as a blended class with IB. Teachers leaving this session will have the syllabi for the higher and standard level program. I will also bring examples of the exams and notebooks that students will have turned into me this year. Included will be a grading rubric that the IB program requires that I follow.

Contact Information

Carl Gibson
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Indianapolis, IN
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Session C - Talk 4

Time: 9:30 am to 9:45 am

Location: Cooper Physics 92

Title

Buildup factors of MCP-96 alloy for radiation protection and cancer treatment

Abstract

Various materials are used in cancer treatment to protect normal cells while providing maximum possible damage to tumors, and to protect the entire body when working in a radiation area. However, these materials must be investigated for properties that affect dose delivery and exposure to radiation. Build-up factor is one of these important properties that need to be determined before a material can be used clinically. We determined the buildup factors of MCP-96 alloy. A broad beam of gamma radiation with varying energy was allowed to fall on a NaI detector. Some of the radiation was absorbed by the MCP-96 attenuator. Additional radiation, obtained by the detector due to scattering of radiation, developed the build-up factor. Buildup factors for the MCP-96 alloy were calculated by plotting the varying thickness of the attenuator against the radiation detected in narrow and broad beam geometry.

Contact Information

Deidre Hopkins, Muhammad Maqbool, Mohammad Islam

Ball State University

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Session A - Talk 5

Time: 10:00 am to 10:15 am

Location: Cooper Physics 102

Title

Hands-on with wind energy

Abstract

The presenter will share his use of the Exploring Wind Energy unit from the NEED (National Energy Education Development Project) curriculum. Last fall, students enrolled in ICP at Northwestern High School constructed their own model wind turbines. The students picked the materials and designed their own blades. Through a process of guided and non-guided inquiry they determined how to produce optimal voltage and current. This unit is adaptable to many levels: high school, middle school, or elementary school. A high school physics teacher could use it to illustrate energy and power or to introduce topics such as fluid dynamics and electromagnetism.

Contact Information

Craig Williams
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Session B - Talk 5

Time: 10:00 am to 10:15 am

Location: Cooper Physics 144

Title

What does “Teach Problem Solving” mean?

Abstract

One of the frequently stated goals of introductory physics instruction is to teach problem solving, but what does this mean? Does this mean we are helping the students learn problem solving skills? If so, what are the specific skills we are targeting and how are we promoting the learning of these skills? I believe most physics instructors implicitly understand this goal to mean that students will develop the ability to handle the type of tasks presented at the ends of the chapters in general physics books. But we know from physics education research that most students develop what facility they have on such tasks in a rote manner, so what long term benefit does this give the students? In this presentation I will explore other interpretations of this goal and the implications of those interpretations for the types of tasks we have students work.

Contact Information

David P. Maloney
Indiana University-Purdue University Fort Wayne
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Session C - Talk 5

Time: 10:00 am to 10:15 am

Location: Cooper Physics 92

Title

Energy transfer in Erbium and Ytterbium ions doped in AlN deposited by RF sputtering and luminescence enhancement in Yb⁺³

Abstract

Sputter deposited thin film amorphous AlN:Er (1 at. %) emits in the green (554 – 561 nm) under 50 mW 532nm Nd:YAG laser excitation. The emission at 554 nm and 561 nm occurs as a result of $^2H_{1/2} \rightarrow ^4I_{15/2}$ and $^4S_{3/2} \rightarrow ^4I_{15/2}$ transitions. AlN:Yb (1 at. %) gives a weak emission peak at 966 nm as a result from $^2F_{5/2} \rightarrow ^2F_{7/2}$. The codoping of Er and Yb in AlN results in the energy transfer from Er⁺³ to Yb⁺³ and enhances the Yb⁺³ emissions by an order of magnitude. Transfer of electrons occurs from $^4S_{3/2}$ state of Er⁺³ to the $^2F_{5/2}$ state of Yb⁺³. The weak emission from Yb⁺³, when excited by 532 nm laser in the absence of Er⁺³, confirms that the luminescence enhancement in ytterbium is due to energy transfer and not due to direct green light excitation by the erbium emission. The intense green emission from Er⁺³ is useful for applications in optical and photonic devices in visible region. The infrared luminescence enhancement in Yb⁺³ as a result from the energy transfer is useful for biomedical applications due to the high penetration ability of infrared waves in human body.

Contact Information

Tyler Corn and Muhammad Maqbool

Ball State University

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Session A - Talk 6

Time: 10:20 am to 10:35 am

Location: Cooper Physics 102

Title

High altitude ballooning for research and outreach

Abstract

The University of Indianapolis has started an undergraduate research and outreach program using High Altitude Ballooning as a central focus. High altitude ballooning is a relatively inexpensive way for undergraduate non-majors (and majors!) to experience a full cycle of the scientific process: experimental design, data collection and analysis within the period of a few weeks. Students create their own experiments that satisfy fairly strict design criteria giving the feel of a real space project". Video, photographs and data from three launches during the 2009-2010 school year will be reviewed.

Contact Information

Steve Spicklemire
University of Indianapolis
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Session B - Talk 6

Time: 10:20 am to 10:35 am

Location: Cooper Physics 144

Title

Building confidence for teaching AP Physics courses

Abstract

A summer workshop uniquely designed to help high school teachers master the content and problem-solving techniques necessary to successfully teach an AP Physics course is described. For many years, the Department of Physics & Astronomy at Ball State University has offered a Masters-level, 3-credit, 1-week workshop designed to accommodate both novice and experienced teachers in preparation for teaching AP physics classes. The 1-week format minimizes the expense and time away from home. Typical workshop attendance is 8-10 teachers from a variety of backgrounds. Separate workshops focus on either Mechanics or Electricity & Magnetism, with some emphasis on special topics from modern physics, optics, and thermodynamics. One afternoon session is devoted to exploring laboratory ideas and equipment. Teachers attending the workshop participate in “mini-presentations” of physics topics, AP-Physics problem-solving, and presentations of solutions. The workshops are facilitated by an experienced faculty member in the Dept. of Physics & Astronomy.

Contact Information

Eric R. Hedin
Ball State University
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Session C - Talk 6

Time: 10:20 am to 10:35 am

Location: Cooper Physics 92

Title

Fuel Requirements for Earth-moon racetrack orbit

Abstract

We examined “racetrack” orbits for a space shuttle type vehicle between the Earth and the Moon. It is known, and well documented that three body interactions are chaotic in nature. The feasibility and fuel costs associated with using a rocket powered system to keep the vehicle in a stable orbit are examined numerically. Solutions were modeled in the Visual Python programming language, and included the proper motion of the Earth-Moon system as it orbits about the Sun. The restricted, circular, planar, three-body problem has a long history of interest and has been well studied. However, to the best of our knowledge, the problem has not been studied with a powered object in orbit.

Contact Information

Brayton Thompson and J. West
Indiana State University
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Session A - Talk 7

Time: 10:40 am to 10:55 am

Location: Cooper Physics 102

Title

Polarized light classroom demonstrations

Abstract

A series of demonstrations suitable for use in the high school physics classroom will be presented.

Contact Information

Charles Emmert
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Session B - Talk 7

Time: 10:40 am to 10:55 am

Location: Cooper Physics 144

Title

The “Game” of formulating and testing hypotheses

Abstract

This session will introduce participants to an activity—reverse game play—that can be used to help students explore a critical facet of scientific reasoning: formulating and testing hypotheses. Participants will be given some data about an abstract strategy game and their task, working in small groups, will be to determine the rules of the game. The presentation will culminate in a discussion how the activity can be used in a variety of classes to help students develop a better understanding of this important aspect of doing science.

Contact Information

David P. and Mark F. Masters
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Session C - Talk 7

Time: 10:40 am to 10:55 am

Location: Cooper Physics 92

Title

Accelerated frames of reference: a relativistic polygon traveler watches fast aging

Abstract

The time dilation of non-inertial travelers in circular and polygonal closed paths is well known. Observers completing a round trip will age less than an observer at rest with respect to the circle / polygon. This rapid aging is contrary to the slow aging that would be documented by “temporarily comoving” inertial observers. A detailed description of what the traveling non-inertial observer might actually see that would explain the “quick aging” of “stationary” observers is presented. The topic of whether an “accelerated frame of reference” is a valid concept is discussed

Contact Information

Joseph West
Indiana State University
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Session A - Talk 8

Time: 11:00 am to 11:15 am

Location: Cooper Physics 102

Title

Transition from mechanics to waves

Abstract

I will briefly discuss the activities in the unit on the oscillatory particle model and show how students can use their understanding of motion, forces, and energy to build a deeper understanding of mechanical waves.

Contact Information

Rob Spencer

West Lafayette Jr/Sr High School

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Session B - Talk 8

Time: 11:00 am to 11:15 am

Location: Cooper Physics 144

Title Continuation of Session B - Talk 7

The “Game” of formulating and testing hypotheses

Abstract

This session will introduce participants to an activity—reverse game play—that can be used to help students explore a critical facet of scientific reasoning: formulating and testing hypotheses. Participants will be given some data about an abstract strategy game and their task, working in small groups, will be to determine the rules of the game. The presentation will culminate in a discussion how the activity can be used in a variety of classes to help students develop a better understanding of this important aspect of doing science.

Contact Information

David P. and Mark F. Masters

Indiana University-Purdue University Fort Wayne

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Session C - Talk 8

Time: 11:00 am to 11:15 am

Location: Cooper Physics 92

Title

Dark matter

Abstract

There are possibilities for the d'Broglie hypothesis in both atomic and cosmological situations. One of the outstanding problems in physics is the topic of quantum gravity which should entail d'Broglie's relation. A photon traveling through the increasing gravitational field should also be traversing a 'Broglie-like quantum gravitational medium. The connection of such a quantum gravity to the dark matter will be examined. It goes against common sense to think of matter without protons and electrons; so, if one of two identical metallic spheres in close proximity is given a negative charge there will be attraction greater than gravity until they should touch and equalize the charge.

Contact Information

Jonathan O. Brooks
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Keynote Speaker

4/10/2010

Time: 11:30 am-12:30 pm

Location: CP 187

The Future of Nanotechnology

The fundamental reasons for the development of nanotechnology are briefly described. The current applications and commercial availability of nanotechnology are reviewed. Research directions and recent advances are highlighted and “crystal-ball” projections are given on the future of nanotechnology. Comments will be made concerning the integration of nanotechnology topics into the science curricula at the secondary and undergraduate levels.

Dr. Ron Cosby

BSU Center for Computational Nanoscience

George and Frances Ball Distinguished Professor of Physics.

Ron Cosby joined the faculty of the Department of Physics and Astronomy at Ball State University in August of 1970 and has spent his entire career there. He received his PhD (1971) and MS (1968) in solid state physics from the University of Kentucky and an MA (1987) in computer science from Ball State University. For the last nineteen years, his research and educational interests have been focused on computational nanoscience and nanotechnology. He was one of three faculty members in his department who led the development of the Center for Computational Nanoscience at Ball State University in 2003, funded by the State of Indiana. Earlier in his career Ron conducted research in alternative energy science, developed an educational program in solar energy, and led the establishment and construction of the Energy Center at Ball State University. In addition, he developed and for many years taught Advanced Placement and other topical summer workshops for teachers at Ball State University.

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Time	Session A - CP 102	Session B - CP 144	Session C - CP 92
Talk 1 - 8:30 to 8:45 am	Some ideas gleaned from HASTI— pg 4	Student writing and reviewing in the laboratory— pg 5	Spintronics applications of nanoscale ring structures with embedded quantum dots— pg 6
Talk 2 - 8:50 to 9:05 am	Hitting collisions hard with Google Maps— pg 7	Making physics general education courses more exciting through interactive learning— pg 8	DNA computing review and DNA electron transport— pg 9
Talk 3 - 9:10 to 9:25 am	Electronic field mapping— pg 10	New Tech IDEAS— pg 11	Temperature dependent electron transport through a four-channel DNA molecule— pg 12
Talk 4 - 9:30 to 9:45 am	<i>Physics for Future Presidents</i> Project— pg 13	Teaching the International Baccalaureate Science Standard and upper-level curriculum— pg 14	Buildup factors of MCP-96 alloy for radiation protection and cancer treatment— pg 15
Break - 9:45 to 9:55 am	Break	Break	Break
Talk 5 - 10:00 to 10:15 am	Hands on with wind energy— pg 16	What does “Teach Problem Solving” mean— pg 17	Energy transfer in Erbium and Ytterbium ions— pg 18
Talk 6 - 10:20 to 10:35 am	High altitude ballooning for research and outreach— pg 19	Building confidence for teaching AP Physics courses— p 20	Fuel requirements for Earth-moon race-track orbit— pg 21
Talk 7 - 10:40 to 10:55 am	Polarized light classroom demonstrations— pg 22	The “Game” of formulating and testing hypotheses— pg 23	Accelerated frames of reference: a relativistic polygon traveler watches fast aging— pg 24
Talk 8 - 11:00 to 11:15 am	Transition from mechanics to waves— pg 25		Dark matter— pg 27