BNL-81506-2009

OFFICE OF EDUCATIONAL PROGRAMS

2009 Summer Internship

Symposium and Poster Session

August 5–6, 2009

NSF
Office of Science U.S. DEPARTMENT OF ENERGY
U.S. DEPARTMENT OF ENERGY
BROOKHAVEN NATIONAL LABORATORY

Office of Educational Programs

BROOKHAVEN NATIONAL LABORATORY

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August 6, 2009

On behalf of Department of Energy, Brookhaven National Laboratory and the Office of Educational Programs staff, I congratulate our summer participants on your research and on completing the programs in which you participated. National recognition that science and technology are essential elements of a durable economy, a safe and secure homeland, and a source of solutions to our environmental challenges makes your experience and persistence in pursuing a science and technology career more important than ever. Accordingly, the opportunities that await you are exciting and intellectually stimulating ones that will give you what we hope you experienced at BNL - "A Passion for Discovery."

The excitement of the closing events is energizing. Summer participants have acclimated to the Lab and become part of our research family, presenting their work to others. One aspect of the events that I particularly like is the fact that this is the only time of the year when such a diverse cross section of the Laboratory's research is on display. Every corner of the Lab hosts guest researchers and students who bring their work to the forefront. This makes it a great opportunity for the entire Lab community to experience the depth and breadth of the work we do as a research community.

Hosting the largest number of summer program participants ever this year required the support of multiple agencies, and the cooperation of hundreds of BNL employees. We extend our appreciation to the agencies for their support, and to the many Laboratory mentors, guest speakers, and tour guides who so graciously volunteer their time to our next generation of researchers, engineers, and technicians. It is also important to recognize the outstanding staff in the Office of Educational Programs. Their hard work, dedication to our participants, relationships with our researchers, and commitment to create a friendly, fun, and productive work environment is unparalleled. I extend my personal thanks to them for all that they do. The resources that DOE provides to BNL support a base of workforce development and educational programs that facilitate new relationships and initiatives in collaboration with universities, school districts, industry, and state and federal agencies. Programs such as these provide the necessary opportunities that motivate and stimulate our nation's youth to pursue careers in science, technology, and science education.

BNL and the Office of Educational Programs wish you all continued success in your academic endeavors and professional aspirations as we continue to build the science and technology workforce of the future.

Sincerely, and on behalf of the Office of Educational Programs staff,

Kenneth W. White

Kenneth White,
Manager, Office of Educational Programs

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General Information

Brookhaven National Laboratory offers college and pre-college faculty and students many opportunities to participate in Laboratory educational programs. The programs administered by the Office of Educational Programs are primarily funded by the U.S. Department of Energy, Brookhaven Science Associates, and other federal and non-federal agencies.

Faculty and student research participation is welcomed in physical and life sciences, computer science and engineering, as well as in a variety of applied research areas relating to alternative energy, conservation, environmental technology, and national security. Visit our website at http://www.bnl.gov/education for application deadlines and more details. Following is a description of the programs managed by the Office of Educational Programs.

U.S. Department of Energy Programs

The U.S. Department of Energy (DOE) has established many national initiatives that pair participants with members of the scientific and professional staff at the DOE national laboratories in educational programs developed to give research experience in areas of biology, chemistry, physics, engineering, environmental science, nuclear medicine, applied mathematics, high- and low-energy particle accelerators, and science writing.

Science Undergraduate Laboratory Internship (SULI)

Science Undergraduate Laboratory Internships offer undergraduate students the opportunity to conduct research at national laboratories across the country. Interns participate in a cutting-edge scientific research program, directed by a BNL staff member.

Community College Institute (CCI)

Community College Institutes are conducted at national laboratories across the country. Each offers a ten-week summer research and educational experience for highly motivated community college students.

Faculty and Student Teams (FaST)

The Faculty and Student Teams Program offers faculty and student team appointments for the summer semester. A university faculty member and up to three students work side-by-side with members of the Brookhaven scientific and professional staff for a ten-week summer research experience. These appointments can develop into greater collaboration between Brookhaven and the university.

Pre-Service Teacher Program (PST)

Teachers in training are paired with scientist mentors as well as master teachers, and are immersed in the research environment to conduct cutting-edge science. Student teachers return to the classroom well grounded not only in the skills and knowledge base required of a scientist, but also in practical experience they can apply to a classroom environment.

DOE Academies Creating Teacher Scientists (DOE-ACTS)

This program provides special training and research experiences to in-service science, mathematics, and technology teachers at the DOE national laboratories. Participating teachers spend four or more weeks in the summer at Brookhaven. Participating teachers will be eligible to receive follow-on grants for projects to be carried out in their schools,

supporting equipment, and professional development through conferences. Teachers in the program participate for a total of three years with the end goal of becoming teacher-leaders.

Additional Brookhaven National Laboratory Programs

Graduate Research Internship Program (GRIP)
The Graduate Research Internship Program (GRIP) is designed for both Masters and PhD students in the life or physical sciences, computer science, engineering and mathematics. Students work in collaboration with a scientist from BNL. Work is on a mutually agreed project that may lead to a publication or may support the student's thesis or dissertation.

College Mini-Semester
The mini-semester offers exposure to cutting-edge science through science and technology exploration to students selected from schools affiliated through Brookhaven partnerships. Students spend one week during winter break to introduce them to the Laboratory's science.

Community Summer Science Program (CSSP)
Brookhaven conducts a Community Summer Science Program for high school students who are 16 and older and have completed Grade 10. This summer commuter program consists of scientific lectures and facility tours by BNL staff scientists and hands-on workshops in biology, physics, chemistry and environmental science.

High School Research Program (HSRP)
High school students 16 years or older participate in scientific research during the summer and academic year. Students are matched with a BNL mentor and every effort is made to align the project with the student's expressed interest.

Minority High School Apprenticeship Program (MHSAP)
This program offers laboratory experience and hands-on workshops to 9th grade underrepresented minority students who have demonstrated ability and/or potential in science-oriented studies and activities. The term offers five one-week segments of instruction in physics, biology, chemistry, meteorology, and environmental science.

Informal Education Internship (IEI)
In collaboration with the Dowling Center for Minority Teacher Development and Training, recent high school graduates and college pre-service teachers work with the BNL Science Learning Center staff to learn inquiry-based teaching skills supporting science curriculum.

Open Space Stewardship Program (OSSP)
The Open Space Stewardship Program fosters partnerships between schools, land stewards, local communities, and government agencies. The program is focused on enabling teachers and students to assist in managing our open space properties on Long Island through scientific research and related activities.

Office of Educational Programs

SUMMER 2009 INTERNSHIP PROGRAMS
GRADUATE SCHOOL FAIR, POSTER SESSIONS,
SYMPOSIUM, AND CLOSING CEREMONY

WEDNESDAY AUGUST 05, 2009

8:00 am to 9:00 am	Student registration & poster set-up	Berkner Hall–Lobby
9:00 am to 11:00 am	Panel Discussion: "*Graduate School Admission"*	Berkner Hall–Auditorium
11:00 am to 11:15 am	Break	
11:15 am to 1:15 pm	Student Poster Session	Berkner Hall–Lobby
1:15 pm to 2:00 pm	Lunch	Berkner Hall–Cafeteria
2:00 pm to 4:00 pm	Graduate School Fair	Berkner Hall–Room B

BROOKHAVEN NATIONAL LABORATORY
Office of Educational Programs

SUMMER 2009 INTERNSHIP PROGRAMS
GRADUATE SCHOOL FAIR, POSTER SESSIONS,
SYMPOSIUM, AND CLOSING CEREMONY

THURSDAY AUGUST 06, 2009

8:00 am to 8:45 am	Registration and student poster set-up	Berkner Hall – Lobby
9:00 am to 11:45 am	Student Oral Presentations:	
	Environmental/Engineering/Other	Berkner Hall - Auditorium
	Chemistry	Chemistry, Bldg 555 – Auditorium
	Physics	Physics, Bldg 510 – Small Conference Room
	Medical/Biology	Medical, Bldg 490 – Large Conference Room
11:45 am to 12:30 pm	***Lunch***	***Berkner Hall***
12:30 pm to 1:45 pm	Student Poster Session	Berkner Hall - Lobby
2:00 pm to 4:00 pm	**Closing Ceremony**	**Berkner Hall - Auditorium**

Welcome and Introduction of staff by OEP Manager, Kenneth White
Video Presentation: *Summer Student's Experience*
Remarks by:
Deputy Laboratory Director, Doon Gibbs
DOE Site Office Representative, Evelyn Landini.

Keynote Speaker: Dr. James H. Wyche, Division Director –HRD, National Science Foundation

Acknowledgement of participants in the following summer programs:
FaST – Faculty and Student Teams
DOE-ACTS – DOE Academies Creating Teacher Scientists
CCI – Community College Institute
PST – Pre-Service Teacher
GRIP – Graduate Research Internship Program
SULI – Science Undergraduate Laboratory Internship
HSRP – High School Research Program
CSSP – Community Summer Science Program
IEI – Informal Education Internship, Dowling-BNL Summer Programs
MHSAP – Minority High School Apprenticeship Program

4:00 pm ***Refreshments*** ***Berkner Hall – Lobby***

Dr. James H. Wyche
Division Director, Human Resource Development

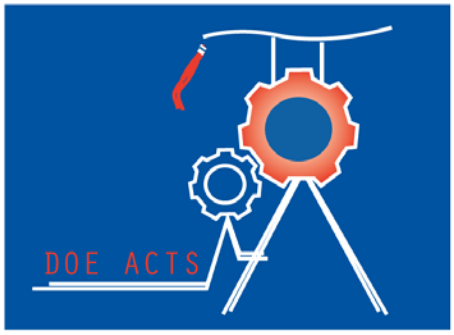
James H. Wyche holds the current position as Division Director, Human Resource Development at the National Science Foundation. He received his undergraduate degree from Cornell University in 1965 with a B.S. degree in microbiology. He received his Ph.D. at Johns Hopkins in Biology in 1972. He did postdoctoral work at the University of California at Berkeley in biochemistry and then at the University of California, San Diego working on problems related to cellular endocrinology in animal cells.

His first academic position (1974) was at the University of Missouri - Columbia with a joint appointment in the Departments of Biological Sciences (Arts & Sciences) and Biochemistry (Medical School). He moved to Hunter College, City University of New York to take a position in the Department of Biological Sciences in 1981. In 1988 he assumed the position of Associate Dean of Biology and Medicine and Associate Professor of Medical Science at Brown University. In 1991 he was appointed Associate Provost and created with President Vartan Gregorian the Leadership Alliance (www.theleadershipalliance.org) based at Brown University with 23 member institutions to advance the number of underrepresented students going into academe and private industry and to advance minority faculty development.

From 1991 to 2001 he served as Executive Director of the Alliance, developing an array of national and international student and faculty research initiatives in the US and sixteen foreign countries while conducting an active research program as Professor of Medical Science at Brown. From 2001-02 he served as interim-president at Tougaloo College, Jackson, MS and then Vice-Provost and Dean, College of Arts & Science (2002-04) and Professor of Biology and Pharmacology (2002-2005) at the University of Miami. He moved to the University of Oklahoma Health Sciences Center as Vice Provost and Professor of Biochemistry from July 2005-February 2009 and left to create and head PanCagen, Inc. with six other scientists to link their efforts for new drug development for pancreatic cancer.

His past and current research interests involve investigating basic mechanisms regulating cell death and stem cells in human cancer and animal model systems to study the effect of natural products and their analogs on killing pancreatic cancer cells.

2009 Brookhaven National Laboratory
Student Oral Presentations and Abstracts



Presentation Agenda - Environmental/Engineering/Other - Berkner Hall, Auditorium

9:05-9:18 am — **Energy Storage at IRTT Developing Ultracapacitors**
JOSEPH LOAYZA (Farmingdale State College)
HAZEM TAWFIK (Farmingdale State College)
DEVINDER MAHAJAN (Brookhaven National Laboratory)

9:19-9:32 am — **Design and Fabrication of an Improved Electromagnet for X-ray Circular Magnetic Dichroism**
THOMAS McCLINTOCK (Amherst College)
DARIO ARENA (Brookhaven National Laboratory)

9:33-9:46 am — **Advance Design of Cell & Filter for Thermophotovoltaic Combined Heat and Power Generation**
CHARLES L. RAMEY, II (Virginia State University)
FLORENCE ETOP (Virginia State University)
TOM BUTCHER (Brookhaven National Laboratory)

9:47-10:00 am — **INTERMISSION**

10:01-10:14 am — **Design, Construction, and Testing of an Improved Beam Position Monitor for National Synchrotron Light Source's Beam Line X6A**
CHRISTOPHER OWEN (University at Buffalo)
TERRELL JOHNSON (University of Maryland)
JOHN KUCZEWSKI (Shoreham-Wading River High School)
TONY KUCZEWSKI (Brookhaven National Laboratory)
VIVIAN STOJANOFF (Brookhaven National Laboratory)
PETER SIDDONS (Brookhaven National Laboratory)

10:15-10:28 am — **Chinese Cities: Recent Developments in Renewable Energy Technology**
DANIELLE BLACK (University of Illinois)
VATSAL BHATT (Brookhaven National Laboratory)

10:29-10:42 am — **The Effects of Physical and Chemical Water Quality Parameters on the Distribution of Aquatic Invertebrates within the Carmans River on Long Island, New York**
GLEN BORNHOFT (SUNY Oneonta)
VICKY LYNN GIESE (California Polytechnic University)
MELLISSA WINSLOW (Clarkson University)
TIMOTHY GREEN (Brookhaven National Laboratory)

10:43-10:56 am — **Azo Dye Degradation with the Use of Clostridium BC1 and Palladium Nanoparticles**
ASHLEY E. JOHNSON (Tallahassee Community College)
GIORVANNI MERILIS (Tallahassee Community College)
DEVICHARAN CHIDAMBARAM (Brookhaven National Laboratory)

11:57-11:10 am — **A Novel Approach to Retrieve Cloud Liquid Water Content using Two Collocated Cloud Radars**
HEFEI LI (Columbia University)
DONG HUANG (Brookhaven National Laboratory)

11:11-11:24 am — **Analysis of Quantum Dot Deposition Techniques to Fabricate Solar Cells**
CAITLIN CHAPIN (Georgia Institute of Technology)
CAROLYN SCHMIDT (Georgia Institute of Technology)
TEQULIA HARRIS (Georgia Institute of Technology)
DEVINDER MAHAJAN (Brookhaven National Laboratory)

11:25-11:38 am — **Fabrication of Multilayer Thin Film Micro-Cooling Devices**
MONIQUE HARRIS (Alabama A&M University)
KIAH HEDGEMAN (Alabama A&M University)

ZHIGANG XIAO (Alabama A&M University)
ELAINE DIMASI (Brookhaven National Laboratory)

11:39-11:52 **Electron Donors Mediate the Biocatalytic Activity of *Clostridium sp. BC1* Palladium (0) Nanoparticles in the Reduction of Hexavalent Chromium**
TIMOTHY MIXSON (Oklahoma State University)
DANIEL TROBARE (Oklahoma State University)
GILBERT JOHN (Oklahoma State University)
DEVICHARAN **CHIDAMBARAM** (Brookhaven National Laboratory)

Environmental/Engineering/Other Abstracts

Energy Storage at IRTT Developing Ultracapacitors
JOSEPH LOAYZA (Farmingdale State College)
HAZEM TAWFIK (Farmingdale State College)
DEVINDER MAHAJAN (Brookhaven National Laboratory)
Due to the intermittent nature of solar and wind power as a green renewable energy, new and more efficient energy storage systems are currently under development at the Institute for Research and Technology Transfer of Farmingdale State College, State University of New York. Supercapacitor provide an excellent prospective as a high-performance electric energy storage device. In this research project, a simple supercapacitor has been developed and tested. The supercapacitor consists of two electrodes made of graphite submerged in three different concentrations of sulfuric acid solutions that acted as electrolytes. Between the two electrodes, nafion membranes of different thicknesses were used as an ionic conductor and an electrical insulating material. The effect of the nafion thickness and the concentration of the sulfuric acid solution were all tested to examine their effect on the storage power capacity, voltage, and current discharge and power output. Nafion with various thicknesses of 0.03mm and 0.15mm and sulfuric acid solution with different concentrations of 0.1mol, 0.3mol and 0.5mol were used in this work to examine their effect on the performance of the ultracapacitor. A number of experimental runs were conducted under various parameters while the supercapacitor was charged and discharged while voltage and current were monitored and recorded. The results of our research show that the .15mm nafion, the thickest separator, stored and released more energy during the charging and discharging period than the .03mm nafion, the thinnest separator. Thus, it has been concluded that the thicker separator and lower acid concentration are recommended for durability, safety, cost effectiveness, energy storage and energy output.

Design and Fabrication of an Improved Electromagnet for X-ray Circular Magneti Dichroism
THOMAS McCLINTOCK (Amherst College)
DARIO ARENA (Brookhaven National Laboratory)
An improved electromagnet was designed for use at the U4B Beamline at the National Synchrotron Light Source (NSLS) in order to overcome limitations imposed by the existing equipment. The electromagnet previously in use produced a weak magnetic field and would also overheat when generating its maximum field. This overheating causes outgassing in the vacuum chamber and disturbs experiments. The design concept for the improved electromagnet houses the magnetic poles inside of the vacuum chamber while having the core and copper coils outside, allowing for water cooling of the coils to prevent overheating. The basic design was sketched out in Maxwell 2D, which allowed for Finite Element Analysis of the design in order to optimize the magnetic field between the magnet's two poles. We then produced the mechanical design in AutoCAD, and fabrication is under way. Once built, we will install the electromagnet, increasing the magnetic field inside the vacuum chamber by a factor of five, allowing experiments at U4B involving magnetic circular dichroism and resonant magnetic scattering to probe a larger range of samples. Similar electromagnets designed in the same fashion would likely benefit most experiments dealing with magnetic fields, and this electromagnet hopefully finds some use at a beamline at NSLSII.

Advance Design of Cell & Filter for Thermophotovoltaic Combined Heat and Power Generation
CHARLES L. RAMEY, II (Virginia State University)
FLORENCE ETOP (Virginia State University)
TOM BUTCHER (Brookhaven National Laboratory)In previous experiments thermophotovoltaic (TPV) cells have been tested for heating systems but have not delivered results sufficient for reliable production of electrical energy. The efficiency of a TPV cell is dependent upon the radiation delivered to the cell and temperature at which the cells are performing. This project has led to the design of an advanced filter system to alleviate a majority of the longer, undesired infrared radiation (IR) -- radiation greater than 1.7 micron -- and excessive heat, while transmitting the optimum band-gap -- radiation less than 1.7 micron -- to allow for greater electrical output of the TPV cells. The filter system configuration "stacks" two ultraviolet (UV) quartz plates, with a cavity spacing of approximately 1 mm, adjacent to a ceramic emitter. UV quartz reflects a minor portion of the unwanted IR, while cooling water passes through the cavity as another filter to absorb the vast majority of the unwanted IR transmitted through the first UV quartz. This filter

design allows the TPV cells to remain cool and undamaged by excess heat. In order to test the viability of the filter concept for power generation a prototype oil-fired furnace, gallium antimonide (GaSb) TPV cell, and quartz-water-quartz filter system was constructed and tested. The quartz-water-quartz filter system drastically decreased the heat density and undesired IR that was causing the TPV to be inefficient at producing enough electricity for a self-reliant heating system. The results of these experiments have concluded our quartz-water-quartz filter system is capable of making heating systems more efficient by reducing heat and long IR transferred to TPV cells. Now, heating systems are no longer just capable of producing heat for space and water, but producing electricity that could someday power homes and equipment.

Design, Construction, and Testing of an Improved Beam Position Monitor for National Synchrotron Light Source's Beam Line X6A

CHRISTOPHER OWEN (University at Buffalo)
TERRELL JOHNSON (University of Maryland)
JOHN KUCZEWSKI (Shoreham-Wading River High School)
TONY KUCZEWSKI (Brookhaven National Laboratory)
VIVIAN STOJANOFF (Brookhaven National Laboratory)
PETER SIDDONS (Brookhaven National Laboratory)

Knowing the position of the X-ray beam produced at the National Synchrotron Light Source's (NSLS) beam line X6A is necessary for the alignment of micron scale protein crystals with the beam. Beam position monitors (BPM's) are capable of measuring and tracking the position of the X-ray beam to within micron distances. An improved BPM was needed to help with manual crystal alignment presently, and with automatic crystal alignment in the future, at X6A. Goals for the upgraded BPM included position resolution <50 μm, an operating area of several millimeters, and limited interaction with the beam. The previous ion chamber of the BPM interacted with the beam, causing it to burn out. Based on a split ion-chamber layout, a new ion chamber was designed to measure the 2-D position of the beam, and use the same circuitry as the original. Features of the new design included chevron-pattern collection pads and voltage gradient strips. Assembly of the chamber was done by hand at the Instrumentation building next door to the NSLS. The new ion chamber was coupled with the original circuitry and installed in a new housing to complete the improved BPM. To test, the ion chamber was passed through the X-ray beam in a raster pattern while recording the charge deposited on the four collection pads. Taking the difference divided by the sum of charge from a set of pads gave an arbitrary position of the beam. Plotted verse the distance the BPM was moved gave a linear trend, the slope of which converts from the arbitrary position to the beam position in microns. These tests showed the BPM had an operating range of 4 mm squared with a resolution of <2 μm. Though the results surpassed the goals for the improved BPM, latest tests show a measurement anomaly that needs to be explained. Should the anomaly be explained, and continued tests return similar resolution and range results, the improved BPM will soon be aiding alignment of, and eventually automatically aligning, X6A's protein crystals.

Chinese Cities: Recent Developments in Renewable Energy Technology

DANIELLE BLACK (University of Illinois)
VATSAL BHATT (Brookhaven National Laboratory)

Cities are responsible for nearly 75% of world greenhouse gas emissions, a number that will increase as urban centers develop and their populations grow, inevitably expanding the global demand for energy. City-to-city collaboration on renewable energy projects to increase energy efficiency will effectively curb the harmful effects of energy production, protecting human health and the environment. This report highlights existing actions taken by select Chinese cities to research, develop, and implement renewable energy and energy-efficient technology as a way to increase energy efficiency in urban centers. It is part of a greater study conducted by the Department of Energy, which aims to highlight potential points of collaboration on which mutually beneficial relationships between cities in the US, China, and India could develop to further achieve the goals of energy efficiency. Research through online scientific journals, Chinese and Western media sources, government websites, and reports produced by reputable international organizations investigated the recent green energy initiatives of Beijing, Guangzhou, Hefei, Kunming, Nanjing, Shanghai, and Tianjin. This report documents advances in geothermal heating techniques, biomass-fueled power stations, alternative fuel vehicles, photovoltaic technology used in building construction, and municipal government policies to assist proliferation of green technology, among others. It can be used to identify avenues for sharing lessons

learned from each city's experience on technologies and policy frameworks to augment partnering cities' capabilities to identify and respond to barriers that limit implementation and management of sustainable urban development practices, service delivery, and plans.

The Effects of Physical and Chemical Water Quality Parameters on the Distribution of Aquatic Invertebrates within the Carmans River on Long Island, New York
GLEN BORNHOFT (SUNY Oneonta)
VICKY LYNN GIESE (California Polytechnic University)
MELLISSA WINSLOW (Clarkson University)
TIMOTHY GREEN (Brookhaven National Laboratory)
While the Carmans River is one of few pristine aquatic ecosystems on Long Island, New York, roadside run-off, fertilizers, septic systems and groundwater contaminants all threaten to degrade its condition. Sensitive populations such as invertebrate species serve as indicators of biological integrity and can be useful for identifying problems in water quality. The physical and chemical variations in water quality were compared for six different locations and among three habitat types selected along the Carmans River. Water samples taken at each location were then tested in areas of varying water velocities. An electronic water quality meter was used to measure the real-time data for temperature, pH, Dissolved Oxygen (DO), conductivity, and turbidity. Using a Surber sampler, aquatic invertebrate samples were collected. Samples were then preserved, sorted, and identified using a compound light microscope and taxonomic keys. Rapid bioassessment, another technique used to assess invertebrate diversity, provided supplementary data needed to create a more accurate biodiversity index. By comparing the data collected from each site, invertebrate distributions were correlated with environmental parameters. Annual variations were determined through a comparison of results from 2009 and 2009 data sets. The results from the data collected in 2009 showed that with movement downstream, the diversity of invertebrate's increases from an average diversity index of 1.03 to 1.93 downstream as habitat complexity increases. Also, from the data it can be concluded that upstream locations are more affected by runoff and other sources of contaminants than downstream locations. Site 6, upstream had the highest values of nitrogen at 0.14 mg/l and nitrite at 0.016mg/l opposed to site 1, downstream which had values of 0.01mg/l and 0.006mg/l, respectively. Upstream locations also had lower DO levels, higher pH, and higher turbidity, which explain why the diversity of invertebrates increases downstream. Results from a t-test showed no statistical difference between diversities of invertebrates derived from the full sample and rapid bioassessment methods in this study. Policies that require assessment of biota to determine environmental quality of small streams and rivers should use the Rapid Bioassessment Protocols. Using data from this investigation, areas of concern can be targeted for future projects to improve water condition of the Carmans River.

Azo Dye Degradation with the Use of Clostridium BC1 and Palladium Nanoparticles.
ASHLEY E. JOHNSON (Tallahassee Community College)
GIORVANNI MERILIS (Tallahassee Community College)
DEVICHARAN CHIDAMBARAM (Brookhaven National Laboratory)
Studies have shown that there are more than 280,000 tons of textile dyes improperly discharged into the environment each year. The largest group of these synthetics colorants released are characterized as Diazo dyes, or sometimes termed as azo dyes. Although many industries as such as textile factories highly prefer this selected group, unfortunately, majority of these azo dyes has been tested and determined to be highly toxic, very mutagenic, carcinogenic, and could eventually lead to health hazards not only to the human race, but to animals, plants, and planet Earth as a whole. Different removal methods may be used but among the most economically friendly is toxic dye removal using bacteria. For our experiment, the bacteria Clostridium BC1 was used to break down azo dyes Methyl Orange and Evans Blue to less toxic forms. For example, Methyl Orange (MO), a toxic dye, was degraded to Sulfanilic Acid. In order to do so, 0.42ml of 20 milli-molar of MO was added to 42ml of Clostridium BC1 anaerobic solution. In order to catalyze the degradation reaction, Palladium (Pd) nanoparticles were added to the mixed solution. The degradation reactions were monitored with respect to time. The results showed that the solution containing Palladium broke down Methyl Orange and other dyes faster than the solution that did not contain Pd. Before completion of the reactions, numerous partially degraded samples were taken from each solution. Using a Ultra Violet-Visual Spectrophotometer, the absorption of each sample was measured to verify the degradation of MO, and production of Sulfanilic Acid with the

respect to time. Due to this inexpensive method, dye removal using bacteria has the potential to be one of the best ways of toxic dye removal. All in all, by detoxifying the environment from these Azo dyes using simple methods such as this, we are not just improving the quality and well being of our environment; we are also saving money in the process.

A Novel Approach to Retrieve Cloud Liquid Water Content using Two Collocated Cloud Radars

HEFEI LI (Columbia University)
DONG HUANG (Brookhaven National Laboratory)

While clouds play a major role in affecting the Earth's weather and climate, imperfect knowledge of cloud properties has long limited our ability to predict weather and climate change through computerized models. There are two methods used to obtain cloud properties: remote sensing using radars, and in situ measurements using cloud probes. However, in situ probes detect only a limited amount of information because their scope of measurement is very small. In this work, we used a remote sensing technique via two radars operated by the Department of Energy Atmospheric Radiation Measurement Program: the Millimeter Wavelength Cloud Radar (MMCR) and the W-Band ARM Cloud Radar (WACR) stationed in the Southern Great Plains region. This dual-frequency approach generates a difference in reflectivity measurements between the two radars. The differential attenuation calculated from these two radars is directly proportional to cloud liquid water content (LWC). Using this information, we can retrieve vertical profiles of cloud LWC, which are necessary to investigate other cloud properties. Unfortunately, because the LWC calculated through this approach is very sensitive to any noise present in the original radar data, this approach becomes useless. Here, we modified this approach by employing a mathematical technique, total variation regularization, to reduce the noise present in the data. We are currently downloading the radar data, but we examined several case studies which validated the mathematical approach in two ways. Generally, no significant amount of water is expected below the cloud base, and our retrieved LWC levels agreed with the heights of the cloud base, as measured independently by a laser instrument. We also calculated the liquid water path (LWP), by integrating the LWC. The LWP measures the total volume of water in an air column, and its retrieved levels also agreed with measurements taken by an independent microwave radiometer. These two factors begin to confirm the accuracy of this dual-frequency approach. By using the cloud LWC information retrieved from radar data, we can derive a suite of cloud statistics such as cloud base height, cloud top height, cloud fraction, and more important, vertical distribution of cloud LWC. These cloud statistics are essential to accurately calculate cloud representations in climate and weather forecasting models.

Analysis of Quantum Dot Deposition Techniques to Fabricate Solar Cells

CAITLIN CHAPIN (Georgia Institute of Technology)
CAROLYN SCHMIDT (Georgia Institute of Technology)
TEQULIA HARRIS (Georgia Institute of Technology)
DEVINDER MAHAJAN (Brookhaven National Laboratory)

In order to protect the environment and human health, there is a growing need to further develop renewable energy alternatives. Of particular interest are solar cells. However, significant limitations, including efficiency and cost, must be addressed in order to make them a competitive alternative to fossil fuels. Recent studies suggest that quantum dots (QDs) offer unique energy characteristics and have the potential to drastically improve the efficiency of solar cells, because one photon can excite multiple electrons. In this study, the viability of using highly efficient QDs with wavelengths between 517 – 633 nm and low cost manufacturing techniques, i.e., extrusion and spray deposition, to fabricate QD based solar cells, patterned after dye-sensitized solar cells (DSSCs), was investigated. The QDs were deposited onto two types of substrates, glass and polyethylene terephthalate coated with titanium oxide (TiO_2) and indium tin oxide. Finite element analysis (ANSYS 12.0) was used to study the expected structural properties, e.g., load concentrations and stresses and strain distributions, of the substrates due to the impact of the QDs. Scanning electron microscopy, energy dispersive x-ray spectroscopy, and transmission electron microscopy characterization techniques were used to analyze the structural properties and chemical composition, of the various substrates before and after QD application. Open-circuit potential tests were used to analyze the electrical properties. Preliminary microscopy results reveal the complexity of attaching QDs onto the TiO_2 layer. However, once applied, it is

anticipated that the deposited thickness of the QDs will be higher relative to state-of-the-art nanofabrication techniques. It is also expected that the efficiency of the QD solar cell will be comparable to DSSCs, making these processes viable and feasible manufacturing techniques, and thus leading to more affordable alternative energy.

Fabrication of Multilayer Thin Film Micro-Cooling Devices
MONIQUE HARRIS (Alabama A&M University)
KIAH HEDGEMAN (Alabama A&M University)
ZHIGANG XIAO (Alabama A&M University)
ELAINE DIMASI (Brookhaven National Laboratory)

Integrated circuit (IC) devices can generate heat in so-called thermal hot-spots, which degrades the device performance. The rising temperature limits device minimization and decreases its lifetime. Managing high heat flux is one of the most important technical challenges facing the IC industry. Solid-state thermoelectric cooling techniques are of great interest to solve this problem because they may be integrated in the IC industry and do not involve moving mechanical parts. In this research, we fabricated solid-state thermoelectric cooling devices using multilayered Bi_2Te_3/Sb_2Te_3 and $Bi_2Te_3/Bi_2Te_{3-x}Se_x$ thin films. The Bi_2Te_3/Sb_2Te_3 and $Bi_2Te_3/Bi_2Te_{3-x}Se_x$ multilayer thin films are grown using sputtering deposition. The Bi_2Te_3/Sb_2Te_3 and $Bi_2Te_3/Bi_2Te_{3-x}Se_x$ multilayer thin films have a periodic structure consisting of alternating Bi_2Te_3 and Sb_2Te_3 layers or Bi_2Te_3 and $Bi_2Te_{3-x}Se_x$ layers, where each layer is about 10 nm thick. The performance of thermoelectric devices is measured using a figure of merit, ZT, where Z is a measure of material's thermoelectric properties and T is the absolute temperature. These thermoelectric materials demonstrate a significant enhancement in ZT at 300K. The multilayered thin films will be analyzed by X-ray diffraction and reflection using the X6B beam line at the National Synchrotron Light Source (NSLS). The devices are fabricated using the standard IC fabrication process. Through our research we hope to develop devices that could be a good candidate for the application of high-efficiency solid-state micro cooling.

Electron Donors Mediate the Biocatalytic Activity of *Clostridium sp. BC1* Palladium (0) Nanoparticles in the Reduction of Hexavalent Chromium
TIMOTHY MIXSON (Oklahoma State University)
DANIEL TROBARE (Oklahoma State University)
GILBERT JOHN (Oklahoma State University)
DEVICHARAN CHIDAMBARAM (Brookhaven National Laboratory)
Pd(0) nanoparticles readily form at the cell surface of the bacterium *Clostridium sp.* BC1 when it is treated with Pd(II) ions. These nanoparticles increase the ability of BC1 to reduce Cr(VI) (i.e., hexavalent chromium) more than two-fold. This study addresses the need to identify the metabolic products responsible for the production of BC1 Pd(0) nanoparticles and elucidate the mechanisms which underlie their catalytic activity in the reduction of Cr(VI) ions. *Clostridium perfringens* and BC1 belong to the same genus; because of this close relation, C. *perfringens* was also tested for Pd(0) nanoparticle formation and Cr(VI) reduction. The biochemical activity of *C. perfringens* parallels that of BC1, as indicated by the visible formation of Pd(0) nanoparticles and subsequent 29% reduction of Cr(VI). Electron donor activity was mediated by the experimental addition of co-enzyme NADH. When NADH is absent from the system, Pd(0) nanoparticle formation is hindered and only a 21% reduction of Cr(VI) occurs after 72 hours. Tests with a 10 – 30 kDa fraction from *C. perfringens* extracellular media extract revealed a 20% Cr(VI) reduction when NADH was present. Without NADH, only 1% of the Cr(VI) ions were reduced. These results demonstrate that Pd(0) nanoparticles catalyze the reduction of Cr(VI) only when an electron donor is present. An enzyme in the 10 – 30 kDa range may be implicated in the synthesis of Pd(0) nanoparticles and/or biocatalytic reduction of Cr(VI). Future application of this knowledge can aid in the development of an *in situ* remediation strategy for contaminant heavy metals.

Presentation Agenda - Chemistry - Building 555A, Hamilton Seminar Room

9:05-9:19 am

Pulse Radiolysis Transient Absorption Spectroscopy of Triplet Exciton States in End-Capped Polyfluorenes and Computational Modeling
ALEX ESTRADA (Queens College)
DANIEL SANGOBANWO (Queensborough Community College)
SEOGJOO JANG (Queens College)
JOHN MILLER (Brookhaven National Laboratory)

9:20-9:34 am

Synthesis of Imidazole and Pyrrolidine containing Ionic Liquids and Study of their Biodegradation Properties
SAMANTA BOURSIQUOT (Queensborough Community College)
FIRMAUSE PAYEN (Queensborough Community College)
SHARON LALL-RAMNARINE (Queensborough Community College)
MARIE THOMAS (Brookhaven National Laboratory)
JAMES WISHART (Brookhaven National Laboratory)

9:35-9:49 am

***In-Situ* Characterizations of the Inversed CeO_2/CuO Powder Catalyst for the Water-Gas Shift Reaction**
JOSÉ J. FONSECA VEGA (University of Puerto Rico)
LAURA BARRIO (Brookhaven National Laboratory)
MICHAEL ESTRELLA (Brookhaven National Laboratory)
JONATHAN HANSON (Brookhaven National Laboratory)
JOSÉ A. RODRIGUEZ (Brookhaven National Laboratory)
GONG ZHOU (Brookhaven National Laboratory)

9:50-10:04 am

Synthesis and Characterization of CdS Nanoparticles and TiO_2 Nanostructures and their Integration towards Quantum Dot Sensitized Solar Cells
SCOTT GORDON (Adelphi University)
JASON LANE (Adelphi University)
JUSTYNA WIDERA (Adelphi University)
CHARLES BLACK (Brookhaven National Laboratory)

10:05-10:14 **INTERMISSION**

10:15-10:29

Attempts to Diminish Carbon Dioxide in Earth's Atmosphere Using a Chiral Ruthenium-hydride Complex
YEWANDE JEGEDE (Kingsborough Community College)
MICKDY MILIEN (City College)
VARATTUR REDDY (Kingsborough Community College)
DAVID GRILLS (Brookhaven National Laboratory)
DMITRY POLYANSKY (Brookhaven National Laboratory)

10:30-10:44 am

Laser Absorption Spectroscopy of CH_2: the $\tilde{b}^1B_1 - \tilde{a}^1A_1$ Origin Band near 1.2 μm
TYLER LATSHA (Bloomsburg University)
ERIC OTRUBA (Bloomsburg University)
DEBRA RUST (Stony Brook University)
JU XIN (Bloomsburg University)
TREVOR SEARS (Brookhaven National Laboratory)

10:45-10:59 am

Does Spinach Contain More Iron Than Other Green Leaf Vegetables?
ARSLAN SAYED (The Medical University of Lodz)
SHREEL JOSHI (Rensselaer Polytechnic Institute)
SYED KHALID (Brookhaven National Laboratory)

11:00-11:14 am

High Pressure Synthesis of Water Splitting Oxynitrides
PARSA SHARIFI (Queensborough Community College)
WILLIAM WOERNER (Stony Brook University)
LARS EHM (Brookhaven National Laboratory)

11:15-11:29 am **Investigation of the Pharmacokinetics of Valporic Acid and Butyric Acid in Central Nervous System**
KHAING WIN (St. Joseph's College)
SUNNY KIM (Brookhaven National Laboratory)

11:30-11:44 am **Analysis of the Kinetics of a Photoinduced Conformation Shift in Nickel Nitrosyl Compounds**
MICHAEL MANAS (Georgetown University)
DAVID GRILLS (Brookhaven National Laboratory)

Chemistry Abstracts

Pulse Radiolysis Transient Absorption Spectroscopy of Triplet Exciton States in End-Capped Polyfluorenes and Computational Modeling

ALEX ESTRADA (Queens College)
DANIEL SANGOBANWO (Queensborough Community College)
SEOGJOO JANG (Queens College)
JOHN MILLER (Brookhaven National Laboratory)

Triplet exciton states generated in polyfluorene are relatively long lived ($\tau \sim 2\ \mu s$). Measuring lifetimes of such triplet excitons for polyfluorenes with different end-groups can provide unique understanding of the dynamics of excitons within conjugated polymer. The understanding of exciton dynamics is a significant field of exploration for the improved performance of plastic solar panels. Polyfluorenes with two exciton trapping end groups, anthraquinone (PF_{31}-AQ) and naphthylimide (PF_{24}-NI), were analyzed using pulse radiolysis at the Laser-Electron Accelerator Facility of Brookhaven National Laboratory. Our experiment involved varying the temperature between -60 °C and 15 °C, and measuring the transient absorbance of the polymer species. Temperature dependent changes of lifetimes and populations of triplet states were then used to deduce the magnitude of energy difference (ΔE) between the end-caps and the conjugated chain. Transient absorbance measurements provided qualitative estimates of the relative populations of excitons that remained within the polymer after irradiation with a 9.7 MeV pulse within a picosecond time scale. Full spectra of PF_{23} and PF_{24}-NI were formed, including plots of normalized peaks at 760 and 780 nm as a function of temperature. The results observed from the plots provide evidence that ΔE between the NI trap and the chain of the polymer is larger than that for the AQ trap. At lower temperatures, the peaks of PF_{31}-AQ decreased by a magnitude of 4; different from the magnitude of 2observed for both PF_{23} and PF_{24}-NI. This could signify the presence of equilibrium between the AQ trap and chain that is not present in the other two samples.

Synthesis of Imidazole and Pyrrolidine containing Ionic Liquids and Study of their Biodegradation Properties

SAMANTA BOURSIQUOT (Queensborough Community College)
FIRMAUSE PAYEN (Queensborough Community College)
SHARON LALL-RAMNARINE (Queensborough Community College)
MARIE THOMAS (Brookhaven National Laboratory)
JAMES WISHART (Brookhaven National Laboratory)

Ionic liquids are compounds with melting points below 100 °C. They are currently being used as alternatives solvents more frequently in industrial and academic laboratories. Therefore, it is important to study their polluting effects on people and the environment. The goal of this project is to synthesize ionic liquids that are commonly being used such as those containing imidazole and pyrrolidine and to study their biodegradation properties. We have successfully synthesized seven halide ionic liquids: 1-(3-hyroxypropyl)-3-methylimidazolium chloride, *N*-(3-hydroxypropyl)-*N*-methylpyrrolidinium chloride, 1-(6-hydroxyhexyl-3-methyl imidazolium chloride, *N*-(6-hydroxyhexyl)-*N*-methylpyrrolidinium chloride, *N*-ethyl-*N*-methylpyrrolidinium diethyl phosphate, *N*-ethoxymethyl-*N*-methylpyrrolidinium bromide and 1-ethoxymethyl-3-methylimidazolium bromide. These liquids were synthesized by reacting the amine (1-methylimidazole, *N*-methylpyrrolidine) with the alkyl halide 3-chloro-1-propanol, 6-chloro-1-hexanol, 2-bromo ethyl methyl ether and triethyl phosphate under reflux conditions at 60 °C in acetonitrile. *N*-ethyl-*N*-methyl pyrrolidinium diethyl phosphate was prepared under microwave conditions. The structures of these Ionic liquids have been confirmed using H-1, P-31 and C-13 NMR spectroscopy. Future work will focus on synthesizing similar ionic liquids bearing different side chains and anions. The compounds will then be tested for their biodegradation properties using soil microorganisms.

***In-Situ* Characterizations of the Inversed CeO_2/CuO Powder Catalyst for the Water-Gas Shift Reaction**

JOSÉ J. FONSECA VEGA (University of Puerto Rico)
LAURA BARRIO (Brookhaven National Laboratory)
MICHAEL ESTRELLA (Brookhaven National Laboratory)
JONATHAN HANSON (Brookhaven National Laboratory)
JOSÉ A. RODRIGUEZ (Brookhaven National Laboratory)
GONG ZHOU (Brookhaven National Laboratory

In recent years, the energy crisis has forced the scientific community to redirect its research toward new sources of clean and sustainable energy. Among the different options available, the use of hydrogen gas as fuel looks like the most promising option. The water-gas shift (WGS) reaction plays an important role in obtaining clean hydrogen from hydrocarbon reforming. Previous studies in copper-ceria catalysts had found that the active species is Cu^0; nevertheless, it also has been proven that the oxide metal support plays an important role in the reaction. In order to determine ceria's (CeO_2) role in the activity, an inverse catalyst was used where the nanoparticles of ceria were supported over a CuO matrix. The inverse catalyst was prepared by the inverse microemulsion method. Catalyst structure was analyzed in the X18A beam line at the National Synchrotron Light Source, where a recent development allowed for the simultaneous measurements of *in-situ* Time Resolved X- Ray Diffraction (TR-XRD) and X- Ray Absorption Fine Structure (XAFS). For the WGS, a 5% Carbon Monoxide in Helium, bubbled through water were used as reactants, while the temperature was stepped from room temperature to 100°C, 120°C and 140°C, analyzing reactants and products with a Residual Gas Analyzer mass spectrometer. XRD and XAFS analysis had shown that even though the Cu in the catalyst starts as CuO, it becomes reduced throughout the reaction. A Cu_2O intermediate was observed at the beginning of the reaction at 100°C, but at higher temperatures the Cu present was reduced to Cu^0, which correlates with the temperatures of higher WGS activity of the catalyst, determined by hydrogen production. In addition, the ceria lattice undergoes an expansion as the copper species are reduced, suggesting an increasing amount of Ce^{3+} species, due to partial reduction of ceria to Ce_2O_3. It was found that the active specie in the inversed CeO_2/CuO powder catalyst was the Cu^0 interacting with partially reduced CeO_X. Copper-ceria systems offer active and stable WGS catalysts, but the studies of these and other catalysts must continue. In addition, development of new instruments and techniques, as the one used in this research, are vital for the identification of active species and therefore the development of novel and enhanced catalytic systems.

Synthesis and Characterization of CdS Nanoparticles and TiO_2 Nanostructures and their Integration towards Quantum Dot Sensitized Solar Cells

SCOTT GORDON (Adelphi University)
JASON LANE (Adelphi University)
JUSTYNA WIDERA (Adelphi University)
CHARLES BLACK (Brookhaven National Laboratory

Solar devices have been developed that use a photosensitive dye to initiate a photoelectrochemical reaction to produce electricity. These Dye Sensitized Solar Cells (DSSC) rely on the absorbance of an organic dye, rather than an enhanced p-n junction (charge separation to create electrical current) between two semiconductor crystals. Organic dyes possess a limited absorption range and do not cover the broad solar spectrum, missing nearly all energy that is not at that specific wavelength range. Since the wavelength at which quantum dots absorb light can be controlled by their size and composition, a device with absorbance ranges closer to the emittance pattern of the sun can be made by using an array of different sized quantum dots. These unique nanohybrids, known as Quantum Dot Sensitized Solar Cells (QDSSC) are expected to offer high efficiencies at a low cost. Our group has developed a plan for the precise synthesis of cadmium sulfide nanoparticles, in a workable solvent, which allows for easy integration into a TiO_2 nanocrystalline lattice to create QDSSC. The particles were synthesized using a reverse micelle method with AOT as the surfactant and were characterized using Ultraviolet-Visible spectroscopy to determine the absorbance in the visible and adjacent ranges. The size, structure and thickness of the nanocrystalline films were studied using Atomic Force Microscopy, Scanning Electron Microscopy and Profilometry. Additionally, the effects of TiO_2 thickness and morphology on the overall efficiency of our QDSSC were studied, as well as the effects of different methods of film deposition i.e.: spin coating or the doctor-blade method. Schottky devices from thin films of CdS and/or TiO_2 were also made to characterize their optical and electrical properties. We concluded that spin coating of TiO_2 yields a desirable uniform,

three-dimensional nanocrystalline thin film with good electrical properties. Unfortunately due to the safety bureaucracy, not much work could be done with the CdS nanoparticles during our summer program. However, we expect to see good sensitization of TiO_2 from CdS such that efficiencies surpass that of organically sensitized TiO_2 films. This will be an integral advancement towards creating a high efficiency, low cost, non-traditional solar cell that could one day be a major source of electrical power in the world.

Attempts to Diminish Carbon Dioxide in Earth's Atmosphere Using a Chiral Ruthenium-hydride Complex

YEWANDE JEGEDE (Kingsborough Community College)
MICKDY MILIEN (City College)
VARATTUR REDDY (Kingsborough Community College)
DAVID GRILLS (Brookhaven National Laboratory)
DMITRY POLYANSKY (Brookhaven National Laboratory)

Although carbon dioxide (CO_2) is a greenhouse gas essential to maintaining the temperature of Earth, an excess of it can raise Earth's temperature to lethal levels. Attempts to develop a chemical solution in which CO_2 can be chemically reduced have been made by synthesizing Ruthenium Glucal (Ru-glu), a compound which demonstrated promising catalytic tendencies. In order to develop a better chemical solution in which CO_2 can be chemically reduced, we've synthesized Ruthenium Galactal-Diphenylphosphinomethane (Ru-gal-dppm), a similar compound to Ru-glu, differs in carbohydrate moiety, combined with a phosphine derivative. Ru-gal-dppm has the potential to act as a better catalyst because in addition to the two hydride ions (H^-) that it contains, it also has a diphosphine ligand which makes it a better electron donor. Spectroscopic and analytical techniques such as mass spectrometry and ultraviolet/visible, infrared, and nuclear magnetic resonance spectroscopy were used to determine Ru-gal-dppm's ability to donate the (H^-)'s to CO_2. We first examined how Ru-gal-dppm transfers (H^-)'s to the two known hydride acceptors, triphenylmethane (trityl) and N-benzylnicotanimide (NBN). Because it is a stronger electron acceptor, trityl has accepted the hydride readily. NBN, on the other hand, will require a little finesse. Upon successful transfer of the hydrides from Ru-gal-dppm to these compounds, Ru-gal-dppm will be tested for the chemical reduction of CO_2. The ideal results would be for the (H^-)'s to transfer faster and cleaner at room temperature due to the presence of the phosphines, allowing us to reduce CO_2 to formate, an intermediate between CO_2 and methanol. This would clearly demonstrate that Ru-gal-dppm is a solution for eliminating the excessive greenhouse gas CO_2.

Laser Absorption Spectroscopy of CH_2: the $\tilde{b}^1B_1 - \tilde{a}^1A_1$ Origin Band near 1.2 μm

TYLER LATSHA (Bloomsburg University)
ERIC OTRUBA (Bloomsburg University)
DEBRA RUST (Stony Brook University)
JU XIN (Bloomsburg University)
TREVOR SEARS (Brookhaven National Laboratory)

Methylene (CH_2), the lightest carbene, has been the subject of much study because it is a reaction intermediate radical found in many chemical processes, most importantly in the combustion of hydrocarbon fuels. Spectroscopic investigation of this radical paves the way for diagnostic measurements in combustion environments which are concerned with fuel efficiency and exhaust. Using a frequency-modulated diode laser spectrometer, we have recorded the transient absorption spectrum of the $\tilde{b}^1B_1 - \tilde{a}^1A_1$ origin band near 1.2μm for the first time. For these experiments, CH_2 radicals were created by 308nm pulse excimer laser photolysis of ketene (CH_2CO), which was formed by the dehydration of acetic anhydride over a hot filament in a slow flow system. Due to the poor Franck-Condon factor, the absorption spectrum is predicted to be very weak. In order to aid with the search of the transitions and analysis, we have created a LabVIEW program which solves the quantum mechanical eigenvalue problem incorporating the asymmetric rotor Hamiltonian, selection rules, line intensity factors and Gaussian line profile to simulate this origin band. This project is part of a continuing larger study mapping out all the energy levels of CH_2 singlet states. The results of this study give first hand information of the shape of the potential surface at its minimum, which will help to refine the singlet potential surface and also provide additional avenues for future kinetics and dynamics studies of this radical.

Does Spinach Contain More Iron Than Other Green Leaf Vegetables?

ARSLAN SAYED (The Medical University of Lodz)
SHREEL JOSHI (Rensselaer Polytechnic Institute)
SYED KHALID (Brookhaven National Laboratory)

In 1870, Dr. E. Von Wolf made a simple math error that spinach had a very high iron content. The mistake was not identified until the 1930s, but the story of Popeye and his "magical" spinach that gave him superhuman strength was already a decade old. We know today that the true amount of iron (Fe) in spinach is very small and comparable to other green leafy vegetables. In order to confirm this fact, we used the method of X-Ray Absorption Spectroscopy (XAS) to measure the amount of Fe present in spinach and other green leaf vegetables. For low concentrations of an element in the sample, XAS in fluorescence gives better signal. X-rays at 7112 eV start knocking out the "s" electrons of the first K shell of Fe, and the sample starts absorbing X-ray photons. The transmitted photons keep decreasing and the ratio of incident to transmitted photons gets a big jump (I0 / It), called the edge jump. More the amount of Fe in the sample higher will be the edge jump. Inner shell electrons are occupied by electrons from the higher orbits, giving rise to fluorescence, measured as If. The ratio (If / I0) has the similar edge information as (I0 / It) and the edge height is proportional to the amount of Fe in the sample. Using this method, data was collected and produced on graphs showing a general trend of amount of iron in spinach and other green leaf vegetables. This experiment showed that the amount of iron in spinach is very minute, and is relatively about the same as it was in other leafy vegetables. The original calculation of Dr. E Von Wolf, proved to be incorrect, even though many kids believed by listening to Popeye and eating spinach would make them really strong.

High Pressure Synthesis of Water Splitting Oxynitrides

PARSA SHARIFI (Queensborough Community College)
WILLIAM WOERNER (Stony Brook University)
LARS EHM (Brookhaven National Laboratory)

Hydrogen is a potential "green" energy source. However obtaining hydrogen through conventional processes, consumes innumerable amounts of energy. Solar water splitting on semi-conductive surfaces might be an economic way of producing hydrogen. A promising class of materials for solar water splitting are oxynitrides, $A_{1-x}B_xO_{2-y}N_y$ (A=metal, B=transition metal, $0 \le x \le 1$, $y \le 1$). The water splitting properties of oxynitrides are amplified by increasing the amounts of nitrogen. Incorporation of nitrogen can be increased in the crystal structure through the utilization of high pressure synthesis. We performed the synthesis of oxynitrides in a piston cylinder apparatus. The initial reagents were GaN and TiO2 in a stoichiometric ratio of 1:1. The runs were performed at 9.3 Kbar and at 1473 K. The synthesis products were characterized by x-ray powdered diffraction and electron microprobe analysis. Through optical microscopy, three distinct phases could be identified. Further analysis through x-ray powdered diffraction and microprobe analysis is needed to qualitatively and quantitavely identify the phases.

Investigation of the Pharmacokinetics of Valporic Acid and Butyric Acid in Central Nervous System

KHAING WIN (St. Joseph's College)
SUNNY KIM (Brookhaven National Laboratory)

Valproic acid (VPA) and butyric acid (BA) exemplify two significant therapeutic drugs in medicinal chemistry due to its notable mode of action in various afflictions of the Central Nervous System (CNS), such as seizure and neurocognitive disorders. The two acids have been known to bind histone deacetylases that suppresses gene expression. However, their pharmacokinetics and the blood brain barrier (BBB) penetration remain an enigma under physiological condition due to their negatively charged nature. Since our laboratory has a longstanding tradition in the evaluation of biological functions with the aid of non-invasive Positron Emission Tomography (PET) imaging, radiolabelling both ligands will help us solve this quandary. Hence, the aim of this research is to first develop the purification and identification of the cold synthesis (the unlabelled acids) by Grignard Reaction, and then to prepare these radiolabelled acids using a positron emitter, [^{11}C]carbon dioxide ($^{11}CO_2$) for PET studies. Starting with 4-Bromoheptane for VPA and 1-Bromopropane for BA, reaction with magnesium turnings gave the corresponding Grignard Reagent, 4-heptylmagnesium bromide for VPA and 1-propylmagnesium bromide for BA. The Grignard Reagents served as the precursors for reaction with $^{12}CO_2$ in the cold synthesis and $^{11}CO_2$ in the hot synthesis (for the radiolabelled compounds). For purification, we used a High Performance Liquid Chromatography (HPLC) system using a ^{18}C–Luna column. For identification

purposes by HPLC, a UV detector was coupled with a Refractive Index (RI) detector due to the challenges associated with the low UV absorption (set at 214-220 nm) of the acids. The optimal HPLC condition for VPA was the isocratic system of 50% acetonitrile (MeCN) and 50% 1.0mM of formic acid solution (FA), and the retention time was 7.73 minutes. Compared to VPA, BA is more polar and exhibited a shorter retention time (3.611 minutes) using the same solvent system and HPLC column. To obtain a longer retention time and thus better separation, we increased the water content and decreased MeCN. The best solvent system for BA was 85% 1.0mM of FA and 15% MeCN, and the retention time was 7.89 minutes. With purification of both acids already optimized, we are now ready to pursue radiosynthesis of the radiolabelled acids for PET studies, which would allow us to decipher if these acids cross the BBB and study their distribution in CNS, using rodents and baboons.

Analysis of the Kinetics of a Photoinduced Conformation Shift in Nickel Nitrosyl Compounds

MICHAEL MANAS (Georgetown University)
DAVID GRILLS (Brookhaven National Laboratory)

Nitric oxide (NO), while acting as a common pollutant in the air, in the body plays numerous important roles ranging from vasodilation to neurotransmission to cell adhesion. Unfortunately, it is a short-lived molecule in biological environments, quickly dimerizing and decomposing. Therefore, ways to store it in a stable state and catalyze its production are of great interest in order to gain a better understanding of reactivity NO may have in biological environments. This study aimed to gain a further understanding of the behavior of NO when bound to a late transition metal, specifically nickel (Ni). Metal-nitrosyl complexes have shown promise as a way of storing NO, as catalysts for the production of NO and have allowed us to gain an insight into the reactivity of the active sites of biological enzymes that possess nitrosyl moieties by acting as close analogues. A series of three-coordinate nickel nitrosyl complexes possessing □-diketiminate ligands with different substituents were studied to monitor the kinetics of a visible light induced conformational change in order to learn more about the reactivity of the complexes. Of specific interest was the shift from a linear Ni-NO configuration in the ground state to a side-on-bound (or 'bent') $\square^2$-NO configuration in the photoexcited state, and the measurement of the rate of recovery back to linear Ni-NO. Solutions of the complexes were studied by nanosecond time-resolved infrared (TRIR) and UV/visible transient absorption spectroscopy after laser flash photolysis, allowing the absorption spectra of the excited state species to be obtained. It was found that the excited state of the complexes exhibits an absorption band centered at 550 nm, with a lifetime of ~10 ns at room temperature. A definitive confirmation that laser excitation induces the linear-to-bent NO transformation will come from the TRIR spectroscopic investigations, in which we will monitor the □(NO) vibration. The frequency of the □(NO) band is highly sensitive to the mode of NO binding. Conclusions and results are still forthcoming.

Presentation Agenda – Physics – Building 510, Small Conference Room

9:05-9:19 am

Detecting Heavy Metals in Rat Kidneys Using X-Ray Absorption Spectroscopy
ASHLEY JONES (Jackson State University)
BARBARA WILSON (Jackson State University
LISA MILLER (Brookhaven National Laboratory)

9:20-9:34 am

Apparatus Development for the Calibration of Charge-Coupled Device Arrays for the Large Synoptic Survey Telescope
JUSTINE HAUPT (State University of New York at Stony Brook)
PAUL O'CONNOR (Brookhaven National Laboratory)

9:35-9:49 am

The Effects of Copper in Temperature Treated Zeolite
SHREEL JOSHI (Rensselaer Polytechnic Institute)
SYED KHALID (Brookhaven National Laboratory)

9:50-10:04 am

Investigating the Influence of Micro-structure on the Thermoelectric Efficiency of Bismuth Telluride Doped with Antimony
EDWIN MARSHALL MAK (The City College of New York)
RON SCHNEIDER (The City College of New York)
JIUFENG J. TU (The City College of New York)
QING JIE (Brookhaven National Laboratory)
QIANG LI (Brookhaven National Laboratory)

10:05-10:14 am **INTERMISSION**

10:15-10:29 am

The Design of a Detector for the Electron Relativistic Heavy Ion Collider using an Object-Oriented Data Analysis Framework
WILLIAM FOREMAN (Stony Brook University)
MATTHEW LAMONT (Brookhaven National Laboratory)
ELKE-CAROLINE ASCHENAUER (Brookhaven National Laboratory)

10:30-10:44 am

Heating and Cooling Temperature Regimes in Gallium Arsenide and Bialkali Photocathodes
ELIZABETH GANGONE (Stony Brook University)
TRIVENI RAO (Brookhaven National Laboratory)

10:45-10:59 am

Beam Transport analysis for Relativistic Heavy Ion Collider (RHIC) Elastic Polarized Proton Scattering (pp2pp) Experiment
GABE HERCZEG (Brooklyn College)
TODD SATOGATA (Brookhaven National Laboratory)

11:00-11:14 am

Relativistic Heavy Ion Collider and High-Energy Beam Transfer Soil Activation
JENNIFER CHU (Carnegie Mellon University)
KIN YIP (Brookhaven National Laboratory)

11:15-11:29 am

Studies of Contributing Factors to the Response of Cadmium Zinc Telluride Detectors
KYLE POLACK (University of Michigan)
MICHAEL HIRT (University of Michigan)
ALEKSEY BOLONIKOV (Brookhaven National Laboratory)

11:30-11:44 am

Using Magneto-Optic Kerr Effect to Characterize Iron on Magnesium Oxide Substrate, a Ferromagnetic Material
DENNIS THOMPSON (Morgan State University)
ARON HADGU (Morgan State University)
DEREJE SEIFU (Morgan State University)
STERLING PRINCE (New Jersey Institute of Technology)
DARIO ARENA (Brookhaven National Laboratory)
ELIO VESCOVO (Brookhaven National Laboratory)

Physics Abstracts

Detecting Heavy Metals in Rat Kidneys Using X-Ray Absorption Spectroscopy
ASHLEY JONES (Jackson State University)
BARBARA WILSON (Jackson State University
LISA MILLER (Brookhaven National Laboratory)
Drinking water contains heavy metals that can be harmful at chronic low level exposure. In a previous study Sprague Dawley rats received chronic exposure to arsenic, As2O3 in 3% nitric acid. The rats were sacrificed and the organs were preserved to determine the effects of the exposure to heavy metals. Using the X-ray Absorption Spectroscopy (XAS) instrument arsenic forms were detected in the rat kidneys. Preparing standard and running them on the XAS enabled the specification of each arsenic form detected in the kidneys, yielding the toxicity of that organ based on the arsenic remaining in the kidneys. As3 and small amount of the As5, which is very harmful, were detected in the kidney. As2O3 reacted with the biological functions of the rat kidney and formed traces of harmful arsenic. The chronic low level exposure to the heavy metal, arsenic, which can be found in drinking water, did not leave the body through biological functions. The arsenic remained in the kidney, and it could possibly cause disease.

Apparatus Development for the Calibration of Charge-Coupled Device Arrays for the Large Synoptic Survey Telescope
JUSTINE HAUPT (State University of New York at Stony Brook)
PAUL O'CONNOR (Brookhaven National Laboratory)
The Large Synoptic Survey Telescope (LSST) is an extremely wide field, ground based observatory that will be built in Chile. This telescope is of special interest to the cosmological community, who hope the instrument's data will reveal information about the curvature of the universe and dark energy. It is the task of the Brookhaven National Laboratory LSST group to design and fabricate the telescope's image sensor, which will be an array of Charge-Coupled Devices (CCDs) – the largest ever created. While several telescopes exist which are larger than the LSST, none have an imaging plane (and CCD array) quite as big. Current telescopes are generally designed so that the image produced is small relative to the telescope aperture; there isn't an optical advantage to scaling image size in proportion to aperture, so image sensors are able to be kept at a scale which is lent to economy and precision. The LSST, however, will image such an unusually wide field of view that a physically large image sensor is required to capture deep sky objects with sufficient resolution for the instrument's research intent. For this reason, the tolerance requirements for the CCD array are very strict, and an assortment of specialty metrology equipment was needed to test and calibrate the CCDs and the CCD array support mechanisms. This equipment was designed in 3D CAD software (Autodesk Inventor) and prototyped on a 3D printer. Parts were fabricated at various on-site machine shops, as well as on a CNC water-jet cutter at the machine shop at Harvard University. Of all the equipment and parts that were designed and built, perhaps the most notable was a compact version of the CCD array's mounting system, which was small enough to fit inside a single testing dewar for sensor calibration and characterization in a cryogenic environment. This system, besides being compact, had to have the additional virtue of replicating exactly the high mounting forces that will be on the telescope's actual sensor assemblies once installed. Other designs included sensor mock-ups for calibration testing, a vibration-resistant mount for a testing sensor, and numerous adapters and mounting plates of various function. This equipment allowed for the accurate calibration of the LSST's CCDs and CCD assemblies, and a very unique sensor array is thus able to be built which meets the stringent technical requirements that this telescope demands.

The Effects of Copper in Temperature Treated Zeolite
SHREEL JOSHI (Rensselaer Polytechnic Institute)
SYED KHALID (Brookhaven National Laboratory)
Zeolites are aluminosilicates used in detergents and in oil cracking and refining industries. The catalytic properties of zeolites depend upon the type of cations exchanged in it and their location upon heat treatment. The goal of this experiment was to successfully refine a technique for mapping and analyzing copper interactions in zeolites and to examine if temperature had an effect on the interactions. Copper exchanged zeolite X was treated at 195, 130 and 70 degrees Fahrenheit and the remaining copper cation was eluted from the open site using ammonium chloride. Extended X-ray Absorption Fine Structure Spectroscopy (EXAFS) data was taken in fluorescence and transmission and analyzed using the data analysis programs Athena and

Artmis. The fully exchanged zeolite was structurally stable as measured by X-ray diffraction. It was found that the copper in the fully exchanged and heat treated zeolite was different from the copper metal sample, its preferred site as found from other studies was site I in hexagonal prism and I' in sodalite cages. Data fitting with copper oxide indicates that the copper exchanged in zeolites is more of a copper oxide form as expected from it being locked in hexagonal prism and in sodalite cages. It was also found that zeolite treatment at different temperatures did not affect the results. The results of this experiment match previously known data about copper exchanged zeolites, proving EXAFS as a valid technique for ion tracking in zeolites and can be utilized by industries to further enhance zeolite catalysts and make them more efficient.

Investigating the Influence of Micro-structure on the Thermoelectric Efficiency of Bismuth Telluride Doped with Antimony

EDWIN MARSHALL MAK (The City College of New York)
RON SCHNEIDER (The City College of New York)
JIUFENG J. TU (The City College of New York)
QING JIE (Brookhaven National Laboratory)
QIANG LI (Brookhaven National Laboratory)

Thermoelectric (TE) materials are a class of materials that, when in thermal contact with a heat gradient, generate electricity. Despite the potential for incorporating TE materials in systems that will utilize renewable energy, the current effectiveness of these materials is relatively low. In an attempt to understand and maximize the efficiency of TE materials (ZT), the research explored the correlation between the micro-structure within a material and the TE properties it displayed. Samples of bismuth telluride doped with antimony were prepared by two different methods (melt spinning (MS) and ball mill (BM) grinding) that generated micro-structure variations, and then underwent hot-press sintering. At the end of the sintering process, the sample's electrical and thermal properties were recorded using a Physical Property Measurement System. The micro-structure of both kinds of samples was analyzed by Transmission Electron Microscopy (TEM). Experimental results indicated that samples prepared by MS had maximum ZT values that were roughly twenty percent higher than those of samples prepared by BM. Electrical conductivity (at the peak of ZT was also about twenty percent higher for the MS samples. Preliminary TEM results showed that BM samples contained more impurities and disorders at the grain boundaries compared to the MS samples. The higher ZT values associated with MS can be attributed mostly to higher , which is consistent with the TEM observations. Further research is needed in order to determine all contributing factors quantitatively. Ultimately, this research will provide a better understanding of TE materials. Such knowledge could help increase the efficiency of nearly all combustion-based technology by improving our ability to convert waste heat into electricity.

The Design of a Detector for the Electron Relativistic Heavy Ion Collider using an Object-Oriented Data Analysis Framework

WILLIAM FOREMAN (Stony Brook University)
MATTHEW LAMONT (Brookhaven National Laboratory)
ELKE-CAROLINE ASCHENAUER (Brookhaven National Laboratory)

Deep inelastic scattering (DIS) and diffractive scattering, processes by which a high energy lepton interacts with a hadron through the exchange of a virtual boson, are used to probe the internal structure of hadrons and have produced clear evidence for extremely large gluon densities in the proton. During the design of experiments, such high-energy processes are simulated using Monte-Carlo (MC) event generators such as RAPGAP which use random numbers to rapidly replicate the complex interactions in such collisions. New information from these simulations is needed to design a detector for the proposed Electron Relativistic Heavy Ion Collider (eRHIC) at Brookhaven National Laboratory (BNL), set to be completed by 2020. Millions of electron-proton (e+p) collision events were produced by RAPGAP, simulating both DIS and diffractive physics at energies of 4 on 100, 4 on 250, 10 on 100, 10 on 200, 10 on 250, and 20 on 250 GeV, after which C++ code using intrinsic ROOT functions was edited and run to read the data, calculate kinematic variables, and organize the results into a data tree. Additional C++ and ROOT codes were modified and run to produce customized plots to visually represent the massive amounts of data and to help understand the realistic quality of the simulator. Over time these codes can be easily modified to plot information as needed, and can be applied to newly produced MC generator data simulating collisions between electrons and heavy ions. By comparing e+p data plots, significant differences were found between DIS and diffractive scattering in the distribution of momentum and scattering angle for electrons, pions, and kaons.

From these results comes a better understanding of these intricate processes, and by knowing where particles go after a collision and how much energy they carry, estimates of positions and spatial dimensions of various particle-sensitive materials around the collision point can be better determined. Such information is vital in designing an eRHIC detector at BNL that will most effectively collect useful and groundbreaking data in future experiments.

Heating and Cooling Temperature Regimes in Gallium Arsenide and Bialkali Photocathodes

ELIZABETH GANGONE (Stony Brook University)
TRIVENI RAO (Brookhaven National Laboratory)

The testing and improvement of photocathodes is vital for a number of Brookhaven National Laboratory (BNL) projects. Through these studies, further changes to the system are made to improve its overall functionality and efficiency during deposition. The two photocathodes of interest are a bialkali system, which consists of potassium, cesium and antimony (K_2CsSb), and a gallium arsenide (GaAs) system. Understanding the heating and cooling cycles of these systems are imperative when attempting to produce electrons from the sources. The fabrication process for the bialkali cathode requires accurate control of the substrate temperature while the constituents are being evaporated on to it. The GaAs surface must be atomically clean and is obtained by heating a carefully prepared GaAs sample to approximately 540 °C using a stalk heater in ultra high vacuum. In both of these photocathodes, heating is accomplished by passing current through a resistor; in turn, this raises the temperature of the substrate or GaAs by radiative and conductive heating. Thermocouples, which are attached to the source and stalk, are used to record temperature every three minutes throughout the entire process. Testing of the heating and cooling cycles is essential to determine both the time it takes for these processes, as well as the corresponding voltage or current values required to reach the desired temperature. Through this testing and analysis of the results, it is possible to establish the conduction and radiation dominated regimes during the heating and cooling cycles, especially when considering plots of the stalk or source temperature as a function of time. The differential equation for heat loss through radiation and the exponential equation for heat loss through conduction are both plotted on each of the cooling curves. Results show that stalk temperature above approximately 150 °C is radiation dominated, while below that region is mainly conduction dominated. This will establish the operating parameters for the bialkali system during its heating and cooling phases. This will also impact the future design of the sample holder in the GaAs system, due to the maximum temperature reached at the source and melting points of certain metals used.

Beam Transport Analysis for Relativistic Heavy Ion Collider (RHIC) Elastic Polarized Proton Scattering (pp2pp) Experiment

GABE HERCZEG (Brooklyn College)
TODD SATOGATA (Brookhaven National Laboratory)

The RHIC pp2pp experiment measures small-angle Coulomb scattering of 100 GeV polarized protons. This experiment acquired data in June 2009. Data analysis requires precision measurements of beam transport from the scattering site to their detectors (Roman pots) located near the Solenoidal Tracker “STAR” at RHIC. One way to measure this transport is to excite a standing wave in the beam orbit with an alternating current dipole magnet, and to measure the oscillatory response at locations around the experiment with beam position monitors. We developed C++ code to analyze this oscillatory response using SVD methods, and used this code to calculate the beam transport. We analyzed ten data sets from the Blue RHIC ring and seven sets from the Yellow RHIC ring and calculated the beam transport in each longitudinal plane as a 2x2 real unimodular matrix. The results of this analysis will be compared to optics measurements and used by the pp2pp collaboration for their experimental data analysis.

Relativistic Heavy Ion Collider and High-Energy Beam Transfer Soil Activation

JENNIFER CHU (Carnegie Mellon University)
KIN YIP (Brookhaven National Laboratory)

The beam dump of the Relativistic Heavy Ion Collider and the ‘Y’ chamber at the High-Energy Beam Transfer line are two of the radiation hot spots at Brookhaven National Laboratory. When proton beams hit the beam dump intentionally or the ‘Y’ chamber accidentally, the high-energy protons can scatter and collide into nuclei to knock off neutrons. Neutrons, from this spallation process, because of their neutrality, have high penetrating power and can interact with atoms in the soil, making them radioactive. This process is called soil activation. The purpose of this

investigation is to determine the amount of soil activation underneath these areas. A simulation software called Monte Carlo Neutral Particle X-tended will be used with a realistic three-dimensional geometry of the surrounding areas. The results are plots of the contours of neutron flux in these two radiation hot spots. The results of the project will help document the amount of soil activation in the accelerator facilities.

Studies of Contributing Factors to the Response of Cadmium Zinc Telluride Detectors

KYLE POLACK (University of Michigan)
MICHAEL HIRT (University of Michigan)
ALEKSEY BOLONIKOV (Brookhaven National Laboratory)

Large volume cadmium zinc telluride (CZT) radiation detectors are a promising technology being investigated by the Department of Energy and other agencies for use in high-resolution detection of gamma rays emitted by radionuclides. Unfortunately, shortcomings in crystal manufacturing techniques prevent CZT crystals from being produced on a cost effective, commercial scale without performance inhibiting defects, such as twins, grain boundaries, dislocations and tellurium inclusions. This work, performed at Brookhaven National Laboratory (BNL), investigated correlations between tellurium (Te) inclusions and Te decorated dislocations and their impact on the performance of bar geometry, virtual Frisch-grid CZT detectors. Performance of these detectors is gauged by their spectral energy resolution of the full energy photopeak; generally a resolution of less than 1.5% is considered good performance. The spectral responses were acquired by irradiating CZT detectors with gamma rays from sealed sources, including ^{137}Cs and ^{68}Ge. An infrared (IR) transmission microscope was used to image the Te inclusions allowing us to calculate the concentration and sizes of these inclusions in each crystal. Additionally, the X-19C beamline at the National Synchrotron Light Source was used to perform white X-ray diffraction topography on a number of the crystals, allowing us to identify defects invisible in the IR images. We measured resolutions between 0.75% and 12% and concentrations of inclusions between 5e5 to 1.2e6 inclusions per cm^3, which were generally below 10 μm in diameter. We found no correlation between these two sets of data. The detectors exhibiting poor performance showed dislocation, twin and subgrain boundary defects in the X-ray topography images, while the detectors exhibiting good performance showed none of these defects. These results support previous studies suggesting that Te inclusions less than 20 μm in diameter in concentrations below a threshold level have no effect on detector performance. The poor performance observed is therefore caused by the extended defects identified in the X-ray images. These results provide a greater understanding of CZT material, which is important due to the great demand for these detectors in many areas, including medical and industrial imaging, astrophysics, and national security.

Using Magneto-Optic Kerr Effect to Characterize Iron on Magnesium Oxide Substrate, a Ferromagnetic Material

DENNIS THOMPSON (Morgan State University)
ARON HADGU (Morgan State University)
DEREJE SEIFU (Morgan State University)
STERLING PRINCE (New Jersey Institute of Technology)
DARIO ARENA (Brookhaven National Laboratory)
ELIO VESCOVO (Brookhaven National Laboratory)

The Magneto-Optic Kerr Effect (MOKE) studies the properties of ferromagnetic materials by describing the changes of light being reflected from magnetized samples. Ferromagnetic materials are materials such as iron in which the magnetic moments of the atoms spontaneously line up with each other. When they are aligned we can use a laser to alter the magnetic moment of that material to determine its strength. Our objective is to obtain a hysteresis loop by observing a variety of samples using a MOKE setup. We constructed a MOKE setup to obtain an analysis from samples by using a laser, polarizer, analyzer, electro-magnet, photo diode, sample of iron on magnesium oxide substrate, and a multi-layer sample consisting of aluminum, zinc, copper, and silicon to generate a hysteresis loop. The light that is reflected from a magnetized surface can change in polarization to indicate the presence and strength of a hysteresis loop. The goal is to measure the magnetic properties of samples by observing rotation of polarization of the reflected light. Throughout this experiment we tested iron on magnesium oxide substrate and a multi-layer. We took MOKE a step further by including a Photo Elastic Modulator to increase the sensitivity of the light. We used LabVIEW 8.0 to control most of our devices by using a General Purpose Interface Bus connection. Magneto-optical effects can be studied in non-magnetic

samples such as glass when a Magnetic field is present. This is due to the fact that a glass with a magnetic field present will alter the direction of the light from up and down or left and right to a circular motion. After setting the voltage on the picoammeter from 4.900V-5.400V for the multi-layer sample results showed that it is a weaker ferromagnetic material compared to the Fe on MgO substrate. The strength of the multi-layer sample ranged from 5.165V-5.200V therefore its strength is 0.035 volts. After setting the voltage from 4.980V-5.020V for the iron on magnesium oxide sample, results showed that it is a stranger material than the multi-layer sample. The Fe on MgO ranged from 4.980V-5.020V therefore its strength is 0.040 volts. This project can lead to a more inexpensive way to operate twenty first century electronics powerful, compact computational devices, and wireless devices. This will be accomplished by categorizing the strength of each ferromagnetic materials and deciding which would be the best. After carefully experimenting with both iron on magnesium oxide substrate and a multi-layer sample we found it best to use the multi-layer sample for switching applications. We also discovered that iron on magnesium oxide substrate would be best when designing applications that require a permanent magnet.

Presentation Agenda – Biology/Medical – Building 490, Large Conference Room

9:05-9:19 am

Oxidation of 2-[^{18}F]Fluoro-2-Deoxyglucose to 2-[^{18}F]Fluoro-1,3-Propanedial—A Novel F-18 Precursor for Positron Emission Tomography (PET) Radiotracers
SIDNEY HILL (North Carolina State University)
JACOB HOOKER (Brookhaven National Laboratory)

9:20-9:34 am

The Effects of Chronic Methamphetamine and the Co-Administration with Nicotine on Rodent Behavior
RONALD KIM (Stony Brook University)
PANAYOTIS (PETER) K. THANOS (Brookhaven National Laboratory)

9:35-9:49 am

The Effect of Transcriptional Regulation Dependent on P53 on Cell Cycle Regulated Genes
DMITRI KOTOV (Ohio State University)
KRASSIMIRA ALEXIEVA-BOTCHEVA (Brookhaven National Laboratory)

9:50-10:04 am

Study on Cocaine-Induced Changes in the Rat Brain Using Laser Doppler Spectrometry
RUBING PAN (University of Urbana-Champaign)
DAVID SMITH (Brookhaven National Laboratory)
ZHONGCHI LUO (Brookhaven National Laboratory)

10:05-10:14 am

Developing New Methods for Rapid Serial Crystallography
RUCHI PAREKH (Suffolk County Community college)
ALEXEI SOARES (Brookhaven National Laboratory)

10:15-10:29 am **INTERMISSION**

10:30-10:44 am

Induction of Triacylglycerol Biosynthesis by Exogenous Fatty Acids in Chlamydomonas reinhardtii
THOMAS RUSSO (Binghamton University)
JILLIAN FAN (Brookhaven National Laboratory)
CHANGCHEN XU (Brookhaven National Laboratory)

10:45-10:59 am

Histone Acetyl Transferase 1 in the Response to DNA Damage
MATTHEW STEVENS (Binghamton University)
STEFAN TAFROV (Brookhaven National Laboratory)

11:00-11:14 am

Expression, Purification and Crystallization of ArsR Protein from C. Metallidurans CH34
LISA WANG (Stony Brook University)
YIAN-BIAO ZHANG (Brookhaven National Laboratory)

11:15-11:29 am

Small Molecule Inhibitor, Lucanthone Inhibits Apurinic Endonuclease-1 by Direct Protein Binding
ELIZABETH LIPMAN (Queens College)
MAMTA NAIDU (Brookhaven National Laboratory)

11:30-11:44 am

Research Methods of Endophyte Inoculation: Root Versus Spray Inoculation
WHITNEY RANDOLPH (Alcorn State University)
LEE NEWMAN (Brookhaven National Laboratory)

Medical/Biology Abstracts

Oxidation of 2-[^{18}F]Fluoro-2-Deoxyglucose to 2-[^{18}F]Fluoro-1,3-Propanedial—A Novel F-18 Precursor for Positron Emission Tomography (PET) Radiotracers

SIDNEY HILL (North Carolina State University)
JACOB HOOKER (Brookhaven National Laboratory)

Positron emission tomography (PET) is a noninvasive imaging technique that utilizes beta-emitting radionuclides to quantitatively assess biological processes and diseases in vivo. Due to the short half lives of the nuclides commonly used in PET (carbon-11, 20.4 min; fluorine-18, 109.8 min), there is a need for more versatile labeled precursors and rapid methods to incorporate them into pharmaceuticals used for PET studies. To address this need, we have investigated the feasibility of using sodium periodate ($NaIO_4$) for the rapid conversion of 2-[^{18}F]fluoro-2-deoxyglucose ([^{18}F]FDG) to 2-[^{18}F]fluoro-1,3-propanedial ([^{18}F]FPD), a new precursor with potential to label proteins. Studies were carried out by modeling radioactive (hot) reactions using nonradioactive (cold) reactions. Preliminary cold investigations involved oxidizing D-glucose, 2-deoxy-D-glucose (2DG), and [^{19}F]FDG in the presence of excess $NaIO_4$ and monitoring product formation over time by ^{1}H, and ^{19}F NMR in D_2O. Subsequent studies involved the investigation of temperature effects on these reactions and performing these reactions in H_2O to observe ^{19}F-^{1}H *J* coupling. Results from the ^{1}H-NMR studies suggest the formation of formic acid (δ = 8.25 ppm) in each case as predicted; however in the case of 2DG, the presence of a doublet at δ = 8.45 ppm suggests the presence of 1,3-propanedial. The ^{1}H spectrum of the oxidation of [^{19}F]FDG lacks a clear di-aldehyde resonance, however a doublet of triplets (δ = -215.1 ppm) on the ^{19}F spectrum may suggest formation of the desired product. Further analysis by ^{19}F-NMR suggests over-oxidation of the FDG intermediates occurs with time and elevated temperatures resulting in the formation of NaF. This observation was supported by analyzing a hot [^{18}F]FDG oxidation by radio-thin layer chromatography. Consequently, we have shown that it is feasible to oxidize [^{19}F]FDG using $NaIO_4$ to form [^{19}F]FPD; however further studies are needed to assess optimal reaction conditions.

The Effects of Chronic Methamphetamine and the Co-Administration with Nicotine on Rodent Behavior

RONALD KIM (Stony Brook University)
PANAYOTIS (PETER) K. THANOS (Brookhaven National Laboratory)

Methamphetamine (MA) is a psychostimulant which has been used to treat attention-deficit hyperactivity disorder, sleeping disorders and in extreme cases, even obesity. However, MA is more commonly known for its recreational abuse. Chronic use of MA has been shown to cause neurodegeneration in the brain. However, in clinical trials involving patients who abuse MA, it has been shown that nicotine (NIC) may possibly prevent neurodegneration caused by MA abuse. It is thought that NIC can prevent neurodegeneration by inhibiting the expression of monoamine oxidase (MAO), a enzyme that breaks down many important pathways in the brain. The inhibition of MAO expression by NIC may prevent neurotoxicity caused by chronic MA abuse as well as other neurodegenerative disorders such as Parkinson's disease. To assess the validity of clinical trials, a preclinical experiment was conducted using rodents. The experiment consisted of groups of rats that were chronically treated with intraparitoneal injection for 5 months with vehicle (saline), low dose MA (LD) (4mg/kg) or high dose MA (HD) (8mg/kg). Other groups of rats received a shorter duration of treatment for 1 month of MA (vehicle, LD, HD) and a combination of NIC (vehicle, LD (1mg/kg) or HD (4mg/kg)) via osmotic pump. Rats were examined for locomotor activity, novel object recognition (NOR) and circadian rhythm. Rats treated with only chronic MA showed a significant dose dependent increase in circadian rhythm activity. Weekly measurements of locomotor activity showed that LD MA treated rats showed a 92% increase in locomotor activity whereas HD MA treated rats did not differ from vehicle treated rats. Chronic MA treatment also resulted in a 16% decrease in LD MA treated rats and 17% decrease in HD MA treated rats in ability to recognize novel objects. Thus, chronic MA treatment increased locomotor activity and decreased the ability to recognize novel objects. The co-administration of MA and NIC yielded similar results. Rats who only received LD MA plus vehicle NIC showed a similar significant increase in locomotor activity post treatment whereas those correlated with LD MA and NIC did not show a significant change in locomotor activity. HD MA rats co-treated with vehicle or NIC also did not show significant changes in locomotor activity. In addition, rats treated with MA regardless of dose and NIC did not show a decreased ability to recognize novel objects. These results all show that NIC may prevent the neurotoxic effects of MA. Future studies include brain

imaging studies to specifically examine which parts of the brain are being affected by MA and NIC.

The Effect of Transcriptional Regulation Dependent on P53 on Cell Cycle Regulated Genes

DMITRI KOTOV (Ohio State University)
KRASSIMIRA ALEXIEVA-BOTCHEVA (Brookhaven National Laboratory)

P53 is a tumor suppressor, which binds to gene promoter regions causing transcriptional repression within the genes survivin, Cdc2, Cdc25c and others. This process is one of the causes for apoptosis, which is a programmed cell death. Transcriptional repression can be caused by epigenetics, specifically DNA methylation. To better understand the epigenetics regulation of the genes through p53, focusing on whether survivin, bax, and Cdc2 are repressed by demethylation and whether p53 contributes to this repression, it was necessary to study DNA methylation and protein levels in wild type p53 and p53 null cells. The human colon cancer cell line HCT-116 and the human diploid fibroblast IMR90 were used. The treatments for both cell lines consisted of the drugs Adriamycin and Decitabine. Adriamycin is a drug used in chemotherapy because it is a p53 inducer, therefore after treatment with Adriamycin cells should display an increased p53 response, while Decitabine is used for the treatment of myelodysplastic syndromes and hypomethylates DNA by inhibiting DNA methyltransferase. To study the interactions of the genes, CpG methylation, and p53, methylation sensitive quantitative polymerase chain reaction (qPCR) was utilized to measure the DNA methylation of the untreated and treated HCT-116 cell lines. The methyl sensitive restricting enzymes MspI and HpaII were used for the methyl sensitive qPCR, with MspI being used to digestion the entire DNA thereby providing a baseline, while HpaII is blocked by CpG methylation. Western blots were used to examine the expression of p53 and DNA (cytosine-5) Methyltransferase 1 (DNMT1) in the IMR90 and HCT-116 cell lines. Chromatin Immunoprecipitation (ChIP) was used to isolate the protein-DNA interactions of p53 and Mdm2, bax, survivin, and Cdc2, which were then used with qPCR to determine the levels of the protein-DNA interaction. Preliminary results gathered from ChIPs show that bax and Cdc2 both show increased levels of enrichment after treatment with a combination of Adriamycin and Decitabine. However, further experiments are needed to accurately examine the effect of the treatments on survivin and to confirm the results of the current data. Further research could lead to a better understanding of the effect of DNA methylation and p53 on bax, survivin, and Cdc2, which could further research into cancer treatment and medication.

Study on Cocaine-Induced Changes in the Rat Brain Using Laser Doppler Spectrometry

RUBING PAN (University of Urbana-Champaign)
DAVID SMITH (Brookhaven National Laboratory)
ZHONGCHI LUO (Brookhaven National Laboratory)

Cocaine, a crystalline tropane alkaloid that suppresses the central nervous system, and one of the most abused illegal drugs in the world, can induce many serious health risks, including neurological complications such as strokes, insomnia, hypersomnia, ischemia, and lethargy. Even though we know the life-threatening complications caused by cocaine abuse, the pathophysiological effects of cocaine on the brain are not completely understood. In this study we measured the effect of cocaine on the Local Cerebral Blood Flow (LCBF) before and after an induced ischemic event on the motor cortex of the rat brain. Five female Taconic rats were intubated, anesthetized with isoflurane, and then mechanically ventilated. The rats were then catheterized (vain, and artery), while their physical parameter such as heart rate, mean blood pressure and respiration rates were continuously monitored. A craniotomy was performed above the motor cortex area of the brain. Then, the Laser-Doppler probe was placed over the cerebral cortex to measure cerebral blood flow and hemoglobin concentration. After 10-20 minutes of baseline recording, acute cocaine was injected through the femoral vein (1mg/kg, i.v.) then followed by 40 minutes of recovery, and afterward a transient ischemia was induced for five minutes followed by a twenty-five minute reperfusion. Our data showed that cocaine decreased the local cerebral blood flow from 100.0%±3.2% to 76.2±1.5% within the time period of 3 to 4 minutes, and took about 25 minutes to recover back to the baseline (100.0%±3.2%). The transient ischemia also produced a decrease in mean CBF. However, both the ischemia and cocaine did not induce any changes in hemoglobin concentration within the cortical brain of the rat. According to the data we have so far, it can be ascertained that acute cocaine challenge has short-term effects on the brain that is similar to a transient ischemic occurrence in the brain. In the

future, we plan to compare our results with data with studies that involve long term cocaine abuse so we can hopefully understand more about the neurological effects of cocaine.

Developing New Methods for Rapid Serial Crystallography

RUCHI PAREKH (Suffolk County Community college)
ALEXEI SOARES (Brookhaven National Laboratory)

The availability of very high intensity synchrotron sources is increasingly motivating a change of the traditional single-specimen paradigm for macromolecular crystallography. At existing third generation synchrotron, data collection speed is limited by mechanical constraints and not by photon flux because single crystal specimens must be precisely rotated. Brilliant X-ray sources such as the Advanced Photon Source attenuate their beams by 99% or more so that mechanical and electronic components can keep up. Insulin micro crystals (the dimension of 25μm, space group **R3**) were grown overnight from a published crystallization mother liquor (200ml of 0.02M HCL, 100ml of 0.02M sodium citrate, 60ml acetone, 20ml H2O, 2.5ml of 0.12M ZnSO4, and 0.025gm of Zn powder). The crystals were mounted using MiTeGen micro meshes and there were about 50 crystals on each mesh. Anomalous data at the Zinc edge (1.28 Å wavelength) were obtained from beamlines X12B and X12C at the National Synchrotron Light Source (NSLS). Data were collected using the CBASS program and processed with HKL2000. Custom software was developed to rapidly scan the mesh though the X-ray beam, and to help examine the resulting data. The 400 micron square area of the MiteGen mesh was divided into equal fields with dimensions similar to the majority of the crystals (20 microns), and each field was over-exposed for 3 rotations of 1 degree, for 90 seconds each. Useful data were partitioned from poor or empty fields by inspection, aided by custom software. A single working set was generated by combining data from 169 different micro crystals on three 400 micron meshes (1.7Å resolution, Rsymm 15%, completeness 85.8%, mean redundancy 9.7). Overall completeness was limited because the crystals have a flat rhomboid habit that readily orients with the 3-fold axis normal to the mesh, and the majority of crystals were randomly oriented in only two of the three dimensions. Various attempts to remedy this problem failed, and we eventually introduced an additional 42 individually oriented large (100 micron) crystals for an expanded data set (large crystal data came from three rotations of one degree, but with an exposure time of only 5 seconds). The micro crystal data readily yielded a highly interpretable map when phased by molecular replacement, but the anomalous data from two zinc atoms located on the three fold axis proved too weak to obtain a SAD structure. A SAD structure was obtained from the expanded data set. We aim to demonstrated that crystal structures can be readily solved from many randomly oriented micro crystals that are too small to be rotated or visualized. This technology will employ the full intensity of NSLS-II to discover novel structures using slurries of micro crystals that are currently not suitable for conventional single-crystal experiments.

Induction of Triacylglycerol Biosynthesis by Exogenous Fatty Acids in Chlamydomonas reinhardtii

THOMAS RUSSO (Binghamton University)
JILLIAN FAN (Brookhaven National Laboratory)
CHANGCHEN XU (Brookhaven National Laboratory)

Fatty acids are predominant structural components of membrane lipids and storage triacylglycerols (oils). In the unicellular microalga Chlamydomonas, just like in higher plants, fatty acids are almost exclusively produced in the plastids. Although incorporation of exogenous lipids in the form of liposome into membrane lipids has been reported in Chlamydomonas, it is not known whether this algal species can take up and utilize fatty acids from their growth medium. In an attempt to develop a system for manipulating oil production and storage and for isolating mutants affected lipid metabolism, we tested the effects of exogenous fatty acids supplied in various forms on cell growth, oil biosynthesis and oil droplet formation in Chlamydomonas, a model organism with rich genetic and genomic resources. We monitored the cell growth by counting Chlamydomonas cells using a microscope counting chamber (hemocytometer), the oil production by thin layer chromatography (TLC) and the oil droplet formation by Nile Red staining followed by observation under fluorescence microscope. Our results showed that Chlamydomonas cells can readily make use of exogenous free fatty acids such as oleic acid, but not the fatty acid ester in the form of Tween-80, to produce oils. Various concentrations of oleic acid were tested. The growth of algal cells was inhibited to a small extent by 1 mM of oleic acid and ceased to grow at 2 mM. Lipid analysis by TLC revealed an optimum concentration of oleic acid for induction of oil production at 0.5 mM, at which the growth of algal cells was not affected in

comparison with cells grown in the absence of oleic acid. The number and the size of lipid droplets were substantially increased after feeding of oleic acid for 2 days. In contrast to its free form, oleic acid complexed to BSA did not inhibited the growth of algal cells at a concentration of as high as 10 mM and this BSA complex only slightly increased the oil production possibly due to the presence of amino nitrogen in BSA, which is known to inhibit the oil production in Chlamydomonas. We are currently testing the effects of a mixture of Tween-80 and oleic acid on growth and oil production and also trying to determine the fatty acid composition of oils in Chlamydomonas by GC-MS. The use of the oil produced has applications in bioenergy as biodiesel, which would reduce the strain on conventional crops that are also used as feed stocks

Histone Acetyl Transferase 1 in the Response to DNA Damage

MATTHEW STEVENS (Binghamton University)
STEFAN TAFROV (Brookhaven National Laboratory)

The nuclear Ki-67 protein is known for its ability to indicate the cellular proliferative potential and is specifically used to determine the aggressiveness of different cancers, such as breast cancer. Histone Acetyl Transferase 1 (HAT1) is a protein known for its ability to participate in assembling newly synthesized chromatin by providing acetylated histone H4 molecules. When Deoxyribonucleic Acid (DNA), which stores our genetic information, is damaged, several different protein systems are activated to allow the damaged DNA strand to be marked for repair and then to be replaced by the correct one. It is hypothesized that the level of HAT1 in the nucleus will increase during DNA repair because it provides acetylated H4 molecules to be assembled on the repaired DNA. It is also hypothesized that Ki-67 will decrease during DNA repair because cell signals will trigger cell cycle arrest and block of its proliferating ability. The goal of this study is to establish a relationship between the levels of Ki-67 and HAT-1. This goal was achieved by comparing the distribution of both proteins in untreated cells and in cells exposed to increased amounts of radiation. Two sets of experiments were performed: One set of cells was exposed to gamma rays, while another set was subjected to high energy and mass (HZE) particles. After the treatments the two sets of cells were allowed to recover for 20 minutes or 24 hours in growth media, which provide nutrients for the cells to live. The groups were then analyzed based on the amount of radiation to which they were exposed. At the desired time point the cells were fixed with 4% Paraformaldehyde, which cross links the proteins to “freeze” the cells in their exact state. Then the cells were immunostained with anti HAT-1 and Ki-67 antibodies and mounted on slides with the 4', 6-diamidino-2-phenylindole (DAPI) to stain the nuclear DNA. Senescent cell that ceased to divide are not expressing Ki-67. Also in senescent cells HAT-1 could be localized predominantly to the nucleus, to both – the nucleus and the cytoplasm or mainly to the cytoplasm of the cells. Damage of the DNA after exposure to HZE radiation triggers bright nuclear staining for HAT-1. Our results show that in 90 percent of the cases cells that do not express Ki-67, have HAT-1 localized to the nucleus. Since X- and gamma rays radiation and more recently HZE particles treatment are commonly used for radiation therapy of cancer patients, the results obtained in our study will help to better predict the outcome of the therapy.

Expression, Purification and Crystallization of ArsR Protein from C. Metallidurans CH34

LISA WANG (Stony Brook University)
YIAN-BIAO ZHANG (Brookhaven National Laboratory)

Arsenic is extremely toxic metalloid that adversely affects human health. However, low doses of arsenic trioxide have been shown to induce remission in certain blood and bone marrow cancers by inducing cell-death in leukemic cells. In order to understand how cell reacts to toxic arsenic salt, using genomic bioinformatic and biochemical characterization, *arsR,* a gene encoding a putative transcription factor, was identified from *Cupriavidus metallidurans* CH34*.* ArsR proteins are a family of metalloregulatory proteins which regulate arsenical resistance (*ars*) operons. The *arsR* gene was cloned into pET28a and pTYB3 vectors separately and the metalloregulatory ArsR protein was overexpressed in *Escherichia coli* BL21 (DE3) as both his-tagged and untagged proteins. ArsR protein was purified to greater than 95% in a single step by using both Ni-NTA affinity chromatography or chitin-bead affinity chromatograph. ArsR protein was further purified by size chromatography. The result of gel filtration column indicates ArsR protein eluted in the right range of molecular size with 99% purity. The crystallographic conditions of ArsR protein are screened by using crystallization test kits. Those conditions will be further tested and refined to get a better crystal for X-ray diffraction.

Small Molecule Inhibitor, Lucanthone Inhibits Apurinic Endonuclease-1 by Direct Protein Binding

ELIZABETH LIPMAN (Queens College)
MAMTA NAIDU (Brookhaven National Laboratory)

Certain cancers that have elevated Apurinic Endonuclease-1 (Ape1), a base excision repair (BER) enzyme, are radio resistant, making them extremely difficult to treat. In addition to its' DNA repair function, the Ape1 protein is a redox activator of transcription factors such as p53, NF-κB, and AP-1. Lucanthone, a small molecule inhibitor of Ape1, makes cells radio sensitive by inhibiting the DNA repair function of Ape1 (found in the C-terminus) without altering its redox activity (found in the N-terminus). Since lucanthone is non-toxic and easily crosses the blood brain barrier, it is in Phase II clinical trials as an adjuvant in brain tumor radiotherapy. The aim of this study is to determine the mechanism of Ape1 endo activity inhibition by lucanthone. Our previous Ape1 structure (PDB 2ISI) shows the presence of a hydrophobic site overlapping the active site, which is lined by amino acids Phe266, Trp280, and Leu 282, where we hypothesize that lucanthone can dock. A logical approach for determining the effect of lucanthone is the measurement of the Ape1 protein (wild type and mutated) and its' endonuclease activity in presence of lucanthone using procedures to study Ape1 protein like SDS-PAGE Western blot and Ape1 its endonuclease assay using depurinated DNA substrate. For any enzyme inhibition, there are two ways an inhibitor can act; by direct or indirect inhibition. As lucanthone was shown to inhibit the Ape1 endo activity of recombinant Ape1, it is clear that lucanthone inhibition involves interaction between Ape1, its' substrate, the depurinated DNA and lucanthone. Thus, in order to understand which interaction can explain the mechanism of inhibition of Ape1's endo activity by lucanthone, Circular Dichroism (CD) and direct binding studies (BIACORE) were used to determine the conformational changes in the Ape1 protein in presence of lucanthone. Our present data show that lucanthone inhibits wild type Ape1 protein / endonuclease activity, due to changes in its protein conformation; however, there were no conformational changes in either the non-related bovine serum albumin (BSA) protein (negative control) or the hydrophobic site mutant (F266A) Ape1. Lucanthone inhibits the endonuclease activity of Ape1 by direct binding to one of the hydrophobic site residues (F266A), causing changes in its conformation, resulting in the inhibition of endo activity of Ape1. Studies with other hydrophobic and active site mutants are underway. Thus, the present data, which explains the mechanisms by which lucanthone inhibits Ape1, emphasizes the vital role of small molecule inhibitor in conjunction with radiation therapy, as a more effective treatment of certain cancers.

Research Methods of Endophyte Inoculation: Root Versus Spray Inoculation

WHITNEY RANDOLPH (Alcorn State University)
LEE NEWMAN (Brookhaven National Laboratory)

While the most common definition of an endophyte is a plant, growing within another plant, this is not the best definition. It in fact is an organism, usually a bacteria or fungus, that can live within the body or cell of a plant, and in most cases does not cause any harm or damage to its host. Studies have shown that endophytes can be beneficial to some plants. As part of my research I along with a group of scientists at Brookhaven National Laboratory have been studying such plant/endophyte relationships. My individual project, however; has been to research which method of inoculating the endophytic bacteria is best: root or spray inoculation. While root inoculation is traditionally used, spray inoculation may be a more time saving, economical way to introduce the endophytes. After planting poplar plants to experiment with, the bacteria Enterobacter 638 (Ent 638) was grown. The cells from the Ent 638 solution were spun down using a centrifuge, then utilizing a spectrophotometer the concentration of the cells needed for inoculation was measured. Some plants were strictly root inoculated, some spray inoculated, and others both spray and root inoculated. Two weeks after the initial planting, growth measurements of each plant was taken. This data was then entered into an excel spreadsheet, where all the results were analyzed to determine which method yielded the best results. At the moment the results of the experiment are not clear, but look promising. All the plants seem to be growing well, and we hope the trend continues. If the overall project goes well, we will be able to tell which method worked the best and will contribute optimum growth of the poplar plants which scientists hope will soon replace corn, which is a major food source, as the main biomass for biofuel production.

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2009 Science Undergraduate Laboratory Internship Program (SULI)

2009 Science Undergraduate Laboratory Internship (SULI) Program

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Laura Luvera	Dorene Price	Suffolk County Community College	
Xiao Xu	Ann Emrick	Michigan State University	

2009 Policy Students

Jennifer Elsmore St. Joseph's College

Eric Jones Stony Brook University

2009 Faculty and Student Teams (FaST) Program

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Eric Otruba	Trevor Sears	Laser Absorption Spectroscopy of CH_2: the $\tilde{b}^1B_1$ – $\tilde{a}^1A_1$ Origin Band near 1.2 μm	Bloomsburg University of PA	126
Langston Parks	Mickey Chiu	Muon Trigger Upgrade for a Relativistic Heavy Ion Collider	Morgan State University	121
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Daniel Sangobanwo	John Miller	Pulse Radiolysis Transient Absorption Spectroscopy of Triplet Exciton States in End-Capped Polyfluorenes and Computational Modeling	Queens College	122
Daniel Santiago	Devinder Mahajan	The Development of a Direct Methanol Fuel Cell	Farmingdale State U.	107
Carolyn Schmidt	Devinder Mahajan	Analysis and Characterization of Quantum Dots to Fabricate Efficient Solar Cells	Georgia Institute of Technology	110
Ron Schneider	Qiang Li	Investigating the Influence of Micro-structure on the Thermoelectric Efficiency of Bismuth Telluride Doped with Antimony	City College of New York	105
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Daniel Trobare	Dev Chidambaram	Electron Donors Mediate the Biocatalytic Activity of Clostridium sp. BC1 Palladium (0) Nanoparticles in the Reduction of Hexavalent Chromium	Oklahoma State University	124
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Participating Professors

Dr. Ju Xin	Bloomsburg University	Dr. George Armstrong	Tougaloo College
Dr. Hazem Tawfik	Farmingdale State University	Dr. Ann Brown	Medger Evers College
Dr. Widera Justyna	Adelphi University	Dr. Elhag Shaban	Southern University Baton Rouge
Dr. Varattur Reddy	Kingsborough Community College	Dr. Jiufeng Tu	City College of New York
Dr. Zhigang Xiao	Alabama A&M Univ	Dr. Ray O'Neal	Florida A & M University
Dr. Murty Kambhampati	Southern University New Orleans	Dr. Gabriel Gwanmesia	Delaware State University
Dr. Carol Scarlett	Florida A & M University	Dr. Onarae Rice	Furman University
Dr. Tequila Harris	Georgia Institute of Technology	Dr. Barbara Wilson	Jackson State University
Dr. Peter Spellane	NYC College of Technology	Dr. Abebe Kebede	NC A&T State University
Dr. Florence Etop	Virginia State University	Dr. Mangala Tawde	Queensborough Community College
Dr. William Powell	Morgan State University	Dr. Seogjoo Jang	Queens College
Dr. Gilbert John	Oklahoma State University	Dr. Dereje Seifu	Morgan State University
Dr. Hakeem Olusseyi	Florida Institute of Technology		

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2009 Community College Institute (CCI) Program

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2009 Pre-Service Teacher (PST) Program

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Elizabeth Leupp – Master Teacher

2009 DOE Academies Creating Teacher Scientists (DOE-ACTS)

2009 DOE Academies Creating Teacher Scientists (DOE-ACTS)

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Master Teacher: Michael Drozd

2009 High School Research Program (HSRP)

2009 High School Research Program (HSRP)

Student	Advisor	School
Evan Baden	Jim Wishart	Half Hollow Hills HS East
Catherine Bautista	Craig Thorn	St. Anthony's
Daniel Bornstein	Alistair Rogers	John F. Kennedy HS
Deep Vansh Chopra	Daniel Van der Lelie	Syosset HS
Andrew Cohen	Tom Butcher	Columbia Grammar & Prep School
Scott Dunaisky	Sachin Junnarkar	Half Hollow Hills HS East
Emil Fine	Ivan Kotov	Ward Melville HS
Pelle Hall	Sean McCorkle	Shoreham Wading River HS
Alvin Jeon	Fritz Henn	Jericho HS
Garrett Kingman	Yannis Semertzidis	Riverdale Country School
David Lawrence	Peter Takacs	Comsewogue HS
Bernard Liu	Tim Hallman	Manhasset HS
Kyle Messina	Jennifer Higbie	Wm. Floyd HS
Maha Mian	Rakhi Agarwal	Longwood HS
Eric Mintzer	Gary Halada	Kings Park HS
Angelo Piazza	Ramesh Gupta	Kings Park HS
Amanda Rizzo	Elana Shumay	Sayville HS
Devin Schaefer	John Miller	Ward Melville HS
Nicholas Sferrazza	Alexy Bolotnikov	Half Hollow Hills HS West
Sachin Sharma	Ivan Kotov	Half Hollow Hills HS East
Krzysztof Sitko	Jerome Lauret	Ross School
Marie Sweet	Paul Freimuth	Shoreham Wading River HS
Luke Stephen	Keith Jones	Kings Park HS
Beverly Agtuca	Lee Newman	Sachem HS East
Alice Shanklin	Elana Shumay	Shoreham-Wading River HS

2009 Community Summer Science Program (CSSP)

2009 Community Summer Science Program (CSSP)

Addison, Brianna	North Babylon High School
Ardashev, Ruslan	Rocky Point High School
Budd, Elise	Bellport High School
Chan, Clifton	Western High School
Corbin, Kaitlyn	Convent of the Sacred Heart
Ford, Kristen	North Babylon High School
Goodman, Theodore	Walt Whitman High School
Heilbrun, David	Shoreham Wading River HS
Kim, Rebecca	Connetquot High School
Patel, Priyanka	Ward Melville High School
Rosen, Andrew	Half Hollow Hills HS West
Wong, Ryan	Centereach High School
Agtuca, Lorabelle	Sachem East High School
Botlo, Alexandra	Ward Melville High School
Campbell, Morgan	Rocky Point High School
Cincotta, Steven	Miller Place High School
D'Auria, Thomas	West Islip High School
Gallagher, Rigina	Sacred Heart Academy
Harrison, Victoria	Sachem East High School
Jones, Darrell	Longwood High School
Ma, Max	Comsewogue High School
Romanelli, Mark	St. Anthony's High School
Wexler, Alyse	Babylon High School

2009 Minority High School Apprenticeship Program(MHSAP)

Coleman, Bria	Longwood HS	Colombo, Christina	N. Babylon HS	Dominguez, Bryan	Francis Lewis HS
Farese, John	Sayville HS	Hazel, Devin	Kellenberg Memorial HS	Lopez, Alexander	N. Babylon HS
Lopez, Dakota	E. Islip HS	Magel, Christina	Half Hollow Hills West	Miller, Tiffany	N. Babylon HS
Millings, Joshua	Immanuel Christian Academy	Robinson-Smikle, Brittney	Huntington HS	Rudowsky, Sean	Locust Valley HS
Smalls, James	N. Babylon HS	Saldamando, Jonathan	Brentwood Freshman Ctr.	Veneable, Djane	Longwood HS
Whitehorn, Kaitlin	Elwood-John Glenn HS				

2009 Open Space Stewardship Program (OSSP)

Names and School Districts of people in the 2009 OSSP Summer Workshop

Kevin Willi – Shoreham/Wading River
Jeanine Dunphy- Patchogue/Medford
William Franek – South Country
Ivan Suarez – Longwood
Dorothy Arnold – Hauppauge

Richard Muller - Shoreham/Wading River
Anthony Grausso – Longwood
Marie Aiello – Elwood/John Glenn
Victoria Bruno – Lindenhurst
Francis Amendola – Deer Park

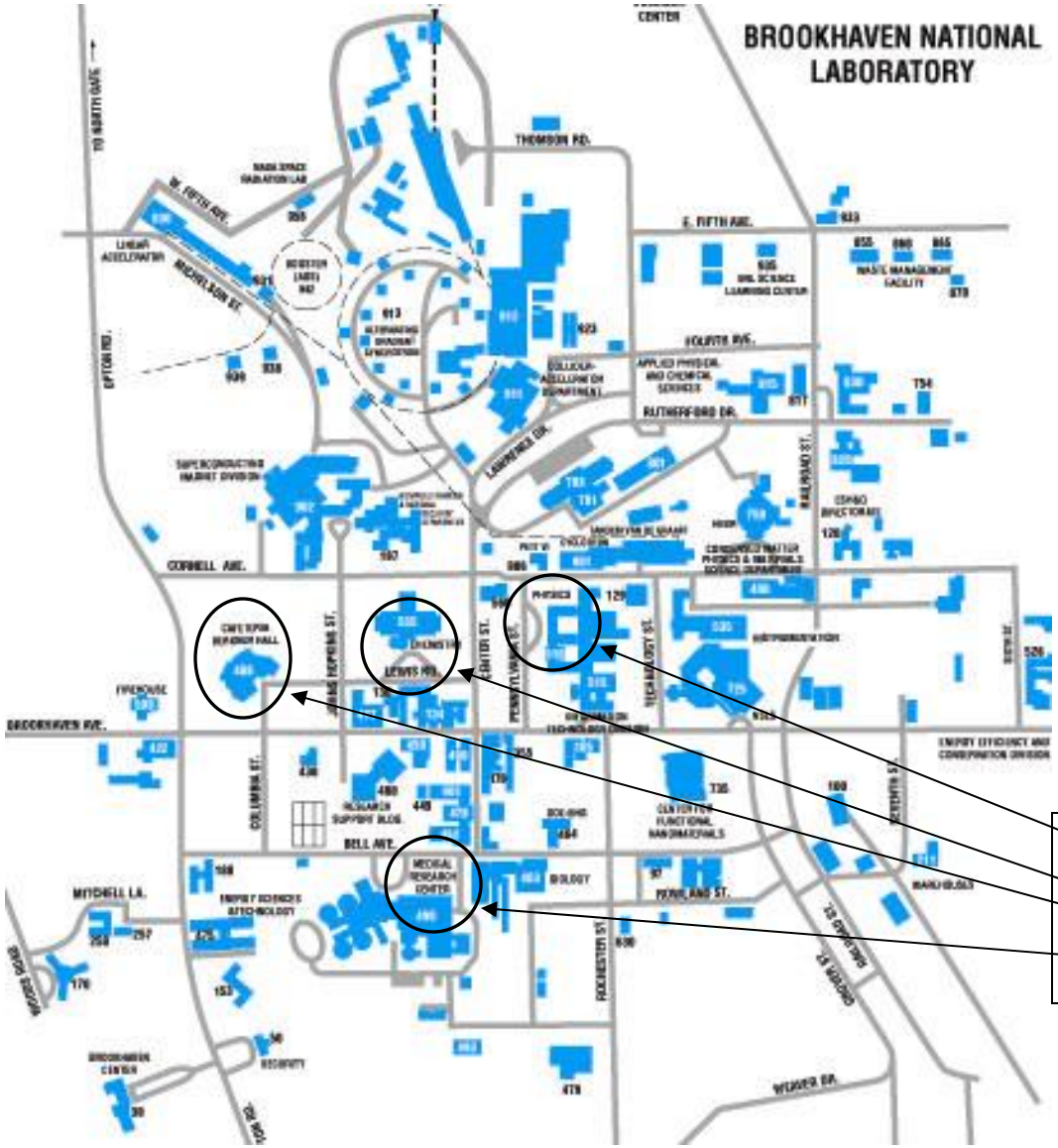
Kahille Dorsinvil – BNL
Beth Fazio – Islip
Amy Meter – Wm. Floyd
Richard Velazquez – Islip
Mel Morris – Brookhaven Lab

Ashley Bloch – Islip
Mike Digidio – Middle Country
Rosemarie Espinal – Central Islip
Christine Sanfratello – Lindenhurst

2009 Informal Education Internship

Back row: Jorge Maldonado, Naderge Romain, Donille Murray, Sabrina Rivera, Tamara Fields,
Front row: Matania Augustin, BNL Mentor Kahille Dorsinvil, Adriana Gomez, Devin Wentt, Erica Choissone

Pre Service Teachers from Dowling College's Summer Science Institute participate for six weeks in BNL's Science Learning Center's summer programs learning inquiry teaching methods, science content knowledge, and BNL research-related program development skills.


BROOKHAVEN NATIONAL LABORATORY
Physics, Building 510
Chemistry, Building 555
Berkner Hall
Medical, Building 490

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- Centers of Research Excellence in Science and Technology (**CREST**)
- Brooklyn Opportunities in Science and Careers Program ***(*BOSC*)***
- Queens Community College BRIDGE program (**QCC Bridge**)
- Large Synoptic Space Telescope Corporation (**LSST**)
- Computer and Mathematics Scholar Support Alliance (**CAMSSA**)

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National Nuclear Security Administration (**NNSA-DOE**)

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