Spring 2012 Meeting of the APS Ohio-Region Section
Columbus, Ohio
http://www.aps.org/meetings/meeting.cfm?name=OSS12
Epidemic spreading on scale-free networks with dynamic centrality. DOUGLAS HOBLET, SCOTT HILL, University of Toledo — Viruses have a vanishing epidemic threshold when they spread across a static scale-free network: in the thermodynamic limit, the virus will persist indefinitely on the network no matter how low its contagion rate. In this presentation, we explore the epidemic threshold of a virus on a dynamic scale-free network under the condition of dynamic centrality, in which the virus is constrained to one of a rotating series of scale-free subnetworks with varying central “hubs.” Using simulations, we compare the epidemic threshold of the dynamic state to that of the static scale-free network as the network increases in size.
C1.00005 Monte Carlo simulations to investigate the response of RNA molecules to applied tension forces. DAN LE, University of Akron, JUTTA LUETTMER-STRAHMANN, University of Akron, Department of Physics — In many viruses, genetic information is encoded in single-stranded ribonucleic acid (RNA) molecules. These molecules are very long chains with an interesting secondary structure that is still difficult to predict from the sequence of bases along the chain. In this work, we perform Monte Carlo Simulation of a simple model for RNA molecules under an applied tension force. We determine force-extension curves under equilibrium conditions for tension forces applied to different segments of the chain and investigate the relationship between the mechanical response and the secondary structure of the chain.

C1.00006 Brewer Angle Microscopy Study of Model Stratum Corneum Lipid Monolayers at the Air-Water Interface. ELLEN ADAMS, ALEX CHAMPAGNE, JOSEPH WILLIAM, HEATHER ALLEN, The Ohio State University — As the first and last barrier in the body, the stratum corneum (SC) is essential to life. Understanding the interactions and organization of lipids within the SC provides insight into essential physiological processes, including water loss prevention and the adsorption of substances from the environment. Langmuir monolayers have long been used to study complex systems, such as biological membranes and marine aerosols, due to their ability to shed light on intermolecular interactions. In this study, lipid mixtures with varying cholesterol and cerebrosides ratios were investigated at the air/water interface. Surface tension measurements along with Brewer angle microscopy (BAM) images were used to examine the lipid phase transitions. Results indicate that cholesterol and cerebrosides form miscible monolayers, exhibiting ideal behavior. BAM images of a singular, uniform collapse phase also suggest formation of a miscible monolayer.

C1.00007 Interrogation of Co₂Zn₉Ni₂Fe₂O₄ ferrite nanoparticles for insight into specific power loss for medical hyperthermia¹. ZAFRULLAH JAGGO, GREGORY KOZLOWSKI, Wright State University, ZAFER TURGUT, Air Force Research Laboratories, EVGENY REBROV, Queen’s University — Magnetic nanoparticles (MNPs) have been shown to be viable candidates as heat sources for magnetic hyperthermia under an alternating magnetic field. The present work investigates heating characteristics of sol-gel processed ferro-magnetic Co₂Zn₉Ni₂Fe₂O₄ (ferrite) nanoparticles with different magnetic properties. The nanomaterials were prepared by precipitation of a magnetic ferrite using a 1.2 kW heating system with variable frequency in the 295-315 kHz range and a maximum current output of 100 A. Higher specific power losses were measured for nanoparticles that had lower coercivities. The advantage of having a high specific power loss for clinical applications is that a minute amount of nanoparticle has to be introduced in the body to adequately destroy malignant tumor cells.

<table>
<thead>
<tr>
<th>Name</th>
<th>GrainSize</th>
<th>M₀ (emu/g)</th>
<th>Mₛ (emu/g)</th>
<th>Hᵣ (Oe)</th>
<th>Sₚ/10₀A (W/g)²</th>
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<td>26.2</td>
<td>75.3</td>
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<tr>
<td>CoFe₂O₄</td>
<td>34.5</td>
<td>7.01</td>
<td>22.2</td>
<td>626.0</td>
<td>0.64 ± 0.05</td>
</tr>
</tbody>
</table>

¹PMI 2 Connect

C1.00008 Pulmonary surfactant and macrophages studied at the air/liquid interface revealed by Brewer angle microscopy (BAM). DANA-MARIE TELESFORD, HEATHER ALLEN, Department of Chemistry & Biochemistry, The Ohio State University, TRACY CARLSON, Department of Veterinary Biosciences, The Ohio State University, LARRY SCHLESINGER, Department of Microbial Infection & Immunity, The Ohio State University — The alveolus is lined with a complex mixture of lipids and proteins called pulmonary surfactant (PS) that lower surface tension at the alveolar air/liquid interface. The surface area of the lung for a 70 kg adult human at total lung capacity is ~70 m². The large surface area and the direct exposure to the environment with every inhalation make this organ more susceptible to invasion by viruses, bacteria, and small particles. The most abundant cell recovered in human lung lavage is the alveolar macrophage which accounts for 85% of the total. The primary function of the alveolar macrophage is to defend the lung against invasion, but also in the clearance of surfactant components in the lung. Quintero and Wright,¹ in an in vitro study observing alveolar macrophage metabolism of two lipid components dipalmitoyl phosphatidylglycerol (DPPG) and dipalmitoyl phosphatidylcholine (DPPC), noted that DPPG was removed at a faster rate. The mechanism by which this process takes place is not fully understood and our aim is to investigate the interactions of macrophages with different lipids using Brewer angle microscopy. Preliminary studies suggest that THP-1 differentiated macrophages do not significantly perturb DPPC and DPPG monolayers and research utilizing alveolar macrophages is underway. The effect of PS SP-A and SP-D is also discussed.

C1.00009 Macrophages interaction with pulmonary surfactant using coherent anti-Stokes Raman scattering (CARS) microscopy. MINETTE OCAMPO, DANA MARIE TELESFORD, HEATHER ALLEN, Ohio State University — Alveolar pulmonary surfactant, composed mostly of phospholipids, is essential for maintenance of normal lung function. However, increased production of lung surfactant can lead to many pulmonary inflammatory disorders. Alveolar macrophages are responsible for the degradation of the surfactant and exhibit increased lipid uptake in inflamed lungs. Owing to their limited clearance ability, excessive accumulation of surfactant may impair their phagocytic function. In this study, the interaction of the macrophages with different lipid components was studied using coherent anti-Stokes Raman scattering (CARS) microscopy. CARS microscopy, a nonlinear vibrational technique which combines spectroscopy and microscopy, allows noninvasive characterization and imaging of chemical species without preparation or labeling. A monolayer of THP-1 macrophages and palmitic acid-d₁₃ on phosphate buffer solution was transferred to a coverslip using the Langmuir-Blodgett method and then imaged using CARS by mapping the CH₂ stretch signal of the lipid membrane of the macrophage and C-D stretch signal from palmitic acid-d₁₃. Preliminary results showed CARS images of the macrophage on the solid substrate and thermal degradation of the sample due to long exposure to high laser power. A contrast image is expected to be observed by mapping the CH₂ and C-D signals, which can show the lipid interaction and phosphatidylcholine of the macrophage.

C1.00010 Interaction of Electric Fields with Vascular Cells. TOLOO TAGHIAN, University of Cincinnati, Physics Department, ABDUL SHEIKH, DARIA NARMONEVA, University of Cincinnati, Biomedical Engineering Department, ANDREI KOGAN, University of Cincinnati, Physics Department. Electrical stimulation has been shown to be effective in improving healing rate of the non-healing or slow-healing wounds, a significant high-cost clinical issue. In order to optimize this process, identifying the mechanisms underlying the interaction of vascular cells with electric field (EF) is of interest. We have developed a 3D model of the cultured cells to simulate EF distribution in the cell membrane. The electrical stimulation of cells has been performed using our novel device that generates EF without any contact between electrodes and cells. The results indicate that cells respond to EF by releasing a specific growth factor (PGF) which is important for blood vessel growth during wound healing.
C1.00011 Feasibility of atomic identification of adsorbates with a scanning tunneling microscope. XIAOYUE NI, CRAIG HOWARD, Marietta College — A study of the feasibility of using a scanning tunneling microscope (STM) to detect differences between individual molecules or atoms adsorbed on a metal surface is reported. For a manageable model, the current through a one-dimensional metal-vacuum-metal junction is numerically simulated. The effect of an additional molecule on the sample is modeled as a modification of the vacuum potential barrier. Because the tunnel current is used to sense the distance to the sample, the value of the tunneling current has no absolute significance. Therefore we investigate how tunneling current varies with applied bias (tip-sample voltage) and with displacement of the tip relative to the sample for a given setpoint current at the largest applied bias. With varying strengths of the molecule's perturbation to the vacuum potential, maximum differences in tunneling currents are found. These can be compared to experimental noise in scanning tunneling microscope current to determine the smallest differences in potential that a given microscope can resolve.

C1.00012 Effects of Deposition Parameters on the Properties of Single Crystal ZnO Films. ANDREW SMITH, MICHAEL McMASTERS, NAGARAJU VELPUKONDA, JOSHUA PETRUS, TOM ODER, Youngstown State University — We present the results from the investigation of the effects of deposition parameters on the properties of sputter-deposited ZnO films. The films were deposited on sapphire substrates using radio frequency magnetron sputtering from a high purity ZnO solid target. Parameters investigated were the substrate temperature during deposition, which was varied from 25 °C to 600 °C; the deposition gas pressure varied from 5 mTorr to 40 mTorr and the gas flow rate varied from 5 to 30 standard cubic centimeter per minute (sccm). After post-deposition annealing in N₂ at 900 °C for 5 min, the films were characterized using photoluminescence spectroscopy, X-ray diffraction (XRD) and Atomic force microscopy measurements. The optimum conditions consisted of heating the sapphire substrates in O₂ prior to deposition, and depositing the film at a substrate temperature of 300 °C, a gas pressure of 10 mTorr and a gas flow rate of 20 sccm. The near band edge luminescence spectra had peaks with narrow line widths as small as 8.59 meV and are attributed to radiative recombination of bound excitons. The XRD 2θ-scans had peaks at 34.4° with the best full-width-at-half-maximum value of 0.1°.

1The authors gratefully acknowledge funds from the National Science Foundation (#DMR-1006083) which supported this work.

C1.00013 Picosecond transient Rayleigh scattering spectroscopy: probing band structure and carrier dynamics of single semiconductor nanowires. HOWARD JACKSON, MOHAMMAD MONTAZERI, University of Cincinnati, AARON WADE, University of West Florida, MELODIE FICKENSHER, LEIGH SMITH, University of Cincinnati, JAN YARRISON-RILEY, Miami University, QIAN GAO, H. TAN, C. JAGADISH, Australian National University — We present picosecond pump-probe measurements of Rayleigh scattering from GaAs nanowires which show that these differential spectra are sensitive indicators of both the density and temperature of electron-hole pairs in a single nanowire. The probe pulse measures the change in the Rayleigh scattering as a function of time after excitation by the pump pulse. Because the Rayleigh scattered signal depends sensitively on both the real and imaginary parts of the dielectric response, these measurements provide direct insight into the nonlinear changes induced by both many body effects and state filling. Measurements on high quality single core-shell GaAs/AlGaAs nanowires were carried out at low temperature. Maps of the differential Rayleigh scattering spectra as a function of time are generated and interpreted using a semi-phenomenological model of these nonlinear effects. We show that both the photoexcited carrier density and the carrier temperature as a function of time can be directly obtained from the transient Rayleigh scattering data.

1 We acknowledge the support of the National Science Foundation through grants DMR-0806700, 0806572, 1105362, 1105121, and ECCS-1100489, the Australian Research Council and the Australian National Fabrication Facility.

C1.00014 Conformation of a Lennard-Jones polymer in explicit solvent. YUTING YE, MARK TAYLOR, Dept. of Physics, Hiram College — The conformation of a polymer chain is solution is coupled to the local structure of the surrounding solvent and can undergo large changes in response to variations in solvent density and temperature. The many-body effects of solvent on the structure of an n-mer chain can be formally mapped to an exact n-body solvation potential. These potentials map the chain-solvent system to a single chain, thereby dramatically reducing the computational complexity of the polymer chain-in-solvent problem. We have recently shown that a pair-decomposition of this n-body potential is valid for short Lennard-Jones (LJ) chains in explicit LJ solvent [1]. Here we use these short chains results to construct solutions potentials for long chains. We present results for the size and intramolecular structure of LJ chains up to length n=400 in LJ solvent at state points spanning the solvent phase diagram (including vapor, liquid, and super-critical regions). In comparison with simulation results for the corresponding full chain-in-solvent system, our solvation potential approach is found to be quantitatively accurate for a wide range of solvent conditions and chain lengths.


1Funding: NSF DMR-0804370

C1.00015 Electrochemical analysis of hydrogen equilibrium near the inversion temperature. DANIEL WARREN, CRAIG HOWARD, Marietta College — In this work we examine the non-ideality of the equilibrium between dissolved hydrogen ions and molecular hydrogen gas through a temperature range spanning the maximum inversion temperature of hydrogen. A pressure cell with a methanol solution, an aluminum electrode, and a platinum electrode is used to measure the approach to equilibrium. This is accomplished by simultaneously monitoring current flow between the electrodes and pressure changes for varying driving potentials as a function of temperature.

C1.00016 Preliminary Investigations of Wind Potential at Marietta College. WILLIAM VANCE, DENNIS KUHL, Marietta College — Marietta College received a grant to build a wind turbine on campus for educational purposes, as a demonstration of alternative energy production, and to promote new energy systems minors. We report on an investigation of the potential wind energy profile on Marietta College’s campus and preliminary wind tunnel studies of variations in shroud design for a shrouded horizontal axis wind turbine. Anemometers were placed in three locations on the campus and wind velocity data was logged for several months. The data provides average wind speeds as well as prevailing wind directions. A wind tunnel was constructed to test shrouded wind turbines. A shrouded wind turbine with a diffuser and flange can maximize the wind speed through a turbine, thus maximizing its power output. This paper sets the stage for future projects to further develop the turbine models' geometry that will maximize power output.

1Funding Provided by the Rickey Endowment.
C1.00017 Partition function zeros and phase transitions of a square-well polymer. PYIE PHYO AUNG, Hiram College, TAYLOR MARK, Hiram College, Department of Physics — The zeros of the canonical partition functions for flexible square-well polymer chains have been calculated for chains up to length 256 for a range of square-well diameters. We have previously shown that such chain molecules can undergo a coil-globule and globule-crystal transition as well as a direct coil-crystal transition. Here we show that each of these transitions has a well-defined signature in the complex-plane map of the partition function zeros. The freezing transitions are characterized by nearly circular rings of uniformly spaced roots, indicative of a discontinuous transition. The collapse transition is signaled by the coalescence of roots onto an elliptical horse-shoe segment pinching down towards the positive real axis. For sufficiently small square-well diameter the elliptical collapse ring merges with the circular freezing ring yielding the direct coil-crystal transition. The root density of all rings increases with increasing chain length and the leading roots move towards the positive real axis, implying a divergence of the specific heat in the thermodynamic limit (as originally proposed by Yang and Lee).


Funded by NSF (DMR-0804370).

C1.00018 Helping teachers in middle and high school to do self-evaluations of teaching, JENNIFER ESSWEIN, Ohio State University, GORDON AUBRECHT, Ohio State University at Marion, BILL SCHMITT, Science Center of Inquiry — Formative assessments can allow teachers to immediately understand what is and is not working in their classrooms for the purpose of changing how they teach various content. We encouraged teachers who are participating in a project funded through the Ohio Department of Education to do real formative assessments as an application for the development of formative assessments in the classroom in a rural located, city high-needs district in the state of Ohio. The authors wrote formative assessments (CFAs) for the teachers in differing categories. Teachers had the opportunity to provide feedback, the CFAs were changed if necessary, and then they analyzed the CFA at the both the beginning and the end of the quarter. The emphasis in the analysis was on what student thinking as expressed in writing reveals. The pretests reveal what students think at the beginning, giving the teacher an idea of what ideas might already exist, right or wrong; the posttest should reveal to the teacher whether the instruction succeeded. The final quarter of the year, we asked the teachers themselves to draft assessments for their classes. Results indicate changes not only in the way teachers view their pedagogical approaches, but also in how teachers consider student personal epistemologies.

Work supported in part by the Ohio Department of Education under grants 60018325 (2008-2009), 60021887 (2009-2010), 60028273 (2010-2011), and 60052559 (2011-2012).

C1.00019 Local structure in hard-sphere chain-molecule fluids, SAMBID WASTI, MARK TAYLOR, Dept. of Physics, Hiram College — The conformation of a polymer chain in solvent is coupled to the local structure of the solvent environment. For hard-sphere systems, a monomeric solvent acts to compress a flexible hard-sphere-solute chain and, for a dense system, the local solvent structure is imprinted onto the chain. Here we use Monte Carlo simulation, including bond-rebridging moves, to study the size and conformation of a hard sphere chain in a hard-sphere solvent as a function of both solvent density and solvent diameter. We also study the structure of a hard-sphere-chain solute in a hard-sphere-chain solvent. In the case of a 5-mer chain in 5-mer solvent we show that the effects of solvent can be mapped to a set of two-body solvation potentials. Following our previous work on hard-sphere chains in monomeric solvent [1], we explore the application of these short chain potentials to the study of longer chain-molecule fluids.


Funding: NSF DMR-0804370.

C1.00020 Longitudinal Waves in Strongly Coupled Two-ring Dust Chains, W.L. THEISEN, T.E. SHERIDAN, Ohio Northern University — A strongly coupled two-ring dust chain of micron sized particles is created experimentally in an R-F generated plasma. The two rings with different radii are confined in a circular potential well and longitudinal dust lattice waves are transmitted along the chain. The dispersion relation is measured and compared to theory.

C1.00021 Two-dimensional diffusion in a self-heated dusty plasma, DONALD J. PLESHINGER, T.E. SHERIDAN, Ohio Northern University — We investigate self diffusion in a dusty plasma using the Dusty Ohio Northern University experimentT (DONUT). A two-dimensional liquid of about 100 dust particles is formed at the center of, and heated by, a toroidal gas of dust particles confined in the surrounding annular potential well. The motions of individual dust particles are recorded, allowing particle trajectories to be directly observed. The mean-squared displacement is found to increase linearly with time, in agreement with diffusion theory. Dependence of the diffusion coefficients and probability distribution functions on temperature will be presented.

C1.00022 Configuration phase transitions in small Debye clusters, T.E. SHERIDAN, Ohio Northern University — We consider the configuration phases of a dusty plasma consisting of \( n \leq 10 \) identical particles confined in a two-dimensional biharmonic well. The ground state configuration depends on three parameters: \( n \), the Debye screening parameter \( \kappa \) and the well anisotropy \( \alpha^2 \). Changes in any of these parameters are predicted to cause continuous or discontinuous transitions between qualitatively distinct ground state configurations. We have experimentally measured ground state configurations as the well anisotropy is varied. Both continuous and discontinuous structure transitions are observed. Experimental results show good agreement with model predictions.

C1.00023 Modeling of the photonic crystal waveguide modes with the FDTD method, BUDDHI RAI, Western Michigan University — The electromagnetic modes are investigated using a simple 1D implementation of the FDTD numerical algorithm to a model of 1D photonic crystal (layered media). The fields \( E_z \) and \( H_y \) are simulated along the \( x \)-axis, the propagation direction. Source implementation and the effects of various boundary conditions such as ABC, Mur on TF/SF fields are investigated. Of particular focus in this paper is, for example, on investigating the guided and/or radiation modes at a stop band frequency of the photonic crystal formed of linear and Kerr nonlinear media. Such structures exhibit interesting transmission and reflection properties that make them suitable for optical devices with frequency/wavelength tunable characteristics.

Western Michigan University.
Seminar Room - Nancy M. Santagata, Ohio State University

about getting science jobs for students, whether it's a summer research internship, an industry position, or in graduate school.

hidden physicists, using both anecdotes and statistics, and conclude with a bit about my favorite research (the physics of Spandex) and pointers

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the next cool wireless gadget, whether you want to contribute to the big-picture discussion of all things nuclear or simply save a life with positron

For example, when a horse paces it moves both left legs in unison and then both right legs and so on. The motion is described by two symmetries: Interchange front and back legs, and swap left and right legs with a half-period phase shift. Biologists postulate the existence of a central pattern generator (CPG) in the neuronal system that sends periodic signals to the legs. CPGs can be thought of as electrical circuits that produce periodic signals and can be modeled by systems with symmetry. In this lecture we discuss animal gaits; use gait symmetries to construct a simplest CPG architecture that naturally produces quadrupedal gait rhythms; and make several testable predictions about gaits.

8:30PM D1.00004 A Great Time to Do Physics. GARY WHITE, SPS Director, American Institute of Physics — Has there ever been a more exciting time to do physics? Whether you are interested in the universal questions of matter and energy or just the next cool wireless gadget, whether you want to contribute to the big-picture discussion of all things nuclear or simply save a life with positron emission tomography, you should know that physics is a great place to begin the journey. In this talk, I’ll expound a bit on career trajectories of hidden physicists, using both anecdotes and statistics, and conclude with a bit about my favorite research (the physics of Spandex) and pointers about getting science jobs for students, whether it’s a summer research internship, an industry position, or in graduate school.

Session F1 Materials Science and Condensed Matter Physics

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Friday, April 13, 2012 6:30PM - 9:00PM –

1 8:30PM D1.00003 Animal Gaits and Symmetry. MARTIN GOLUBITSKY, Mathematical Biosciences Institute, Ohio State University — Many gaits of four-legged animals are described by symmetry. For example, when a horse paces it moves both left legs in unison and then both right legs and so on. The motion is described by two symmetries: Interchange front and back legs, and swap left and right legs with a half-period phase shift. Biologists postulate the existence of a central pattern generator (CPG) in the neuronal system that sends periodic signals to the legs. CPGs can be thought of as electrical circuits that produce periodic signals and can be modeled by systems with symmetry. In this lecture we discuss animal gaits; use gait symmetries to construct a simplest CPG architecture that naturally produces quadrupedal gait rhythms; and make several testable predictions about gaits.

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6:30PM D1.00001 Banquet –

7:00PM D1.00002 OS/APS Business Meeting. JASON PINKNEY, Ohio Northern University —

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Youngstown State University — The effects of pre-deposition annealing of sapphire substrates on the properties of sputter-deposited ZnO films were investigated. The films were deposited on sapphire substrates using a ZnO solid target. Prior to the film deposition, the sapphire substrates were annealed in different gases including argon, nitrogen, oxygen and vacuum. The deposited films were annealed in N2 at 900 °C for 5 min and characterized using photoluminescence spectroscopy, X-ray diffraction (XRD), Hall effect and Atomic force microscopy measurements. The optimum conditions consisted of pre-deposition annealing in oxygen. The XRD 2θ-scans from all the samples had peaks at around 34.4 ° corresponding to the diffraction from the [0 0 0 2] plane of ZnO and indicates a strong c-axis orientation perpendicular to the surface at the sapphire substrate. The near band edge luminescence spectra had peaks with narrow line widths as small as 8.59 meV and are attributed to radiative recombination of bound excitons. The Hall effect measurements indicate n-type conductivity with high electron concentrations.

1 The authors gratefully acknowledge funds from the National Science Foundation (#DMR-1006083) which supported this work.

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Saturday, April 14, 2012 8:00AM - 9:00AM –

Session F1 Materials Science and Condensed Matter Physics

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8:00AM F1.00001 Effect of blending on nematic order in semiflexible polymers. KIRAN KHANAL, JUTTA LUETTMER-STRATHMANN, The University of Akron, Department of Physics and Chemistry — Semiflexible polymers of sufficient stiffness exhibit liquid crystalline order at sufficient polymer concentrations. In this work, we investigate blends of flexible and semiflexible polymers with the aid of Monte Carlo simulations of a bond-fluctuation model. The model is an extension of Shaffer’s bond-fluctuation model, where chain stiffness is controlled by including different forms of bending penalties, and includes attractive interactions between monomers. From simulations for a range of values of the bending energy, density, and temperature, we determine the effect of concentration of the flexible polymer on liquid crystalline order.

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8:12AM F1.00002 Effect of an external field on nematic order in semiflexible polymers. JUTTA LUETTMER-STRATHMANN, KIRAN KHANAL, University of Akron, Department of Physics and Chemistry — Semiflexible polymers of sufficient stiffness exhibit liquid crystalline order at sufficient polymer concentrations. In this work, we investigate blends of flexible and semiflexible polymers under a uniform external field with the aid of Monte Carlo simulations of a bond-fluctuation model. The model is an extension of Shaffer’s bond-fluctuation model, where chain stiffness is controlled by including different forms of bending penalties, and includes attractive interactions between monomers. From simulations for a range of values of the bending energy, density, and temperature, we determine the effect of an external field on liquid crystalline order.

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8:24AM F1.00003 Effects of Sapphire Substrate Annealing Conditions on the Quality of ZnO Films1. TOM ODER, MICHAEL MCMASTER, ANDREW SMITH, NAGARAJU VELPUKONDA, JOSHUA PETRUS, Youngstown State University — The effects of pre-deposition annealing of sapphire substrates on the properties of sputter-deposited ZnO films were investigated. The films were deposited on sapphire substrates using a ZnO solid target. Prior to the film deposition, the sapphire substrates were annealed in different gases including argon, nitrogen, oxygen and vacuum. The deposited films were annealed in N2 at 900 °C for 5 min and characterized using photoluminescence spectroscopy, X-ray diffraction (XRD), Hall effect and Atomic force microscopy measurements. The optimum conditions consisted of pre-deposition annealing in oxygen. The XRD 2θ-scans from all the samples had peaks at around 34.4 ° corresponding to the diffraction from the [0 0 0 2] plane of ZnO and indicates a strong c-axis orientation perpendicular to the surface at the sapphire substrate. The near band edge luminescence spectra had peaks with narrow line widths as small as 8.59 meV and are attributed to radiative recombination of bound excitons. The Hall effect measurements indicate n-type conductivity with high electron concentrations.

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Friday, April 13, 2012 6:30PM - 9:00PM –

6:30PM D1.00000 Opening —

Session D1 Banquet and After-dinner Talk. Physics Research Building Smith Seminar Room - Gordon Aubrecht, Ohio University

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6:30PM D1.00001 Banquet —

7:00PM D1.00002 OS/APS Business Meeting. JASON PINKNEY, Ohio Northern University —
8:36AM F1.00004 Characterization of metallic adatoms on GaAs, DAVID GOHLKE, JAY GUPTA, Ohio State University, Department of Physics — As semiconductor nanostructures become smaller, defects play an ever-increasing role in systems of interest. Scanning tunneling microscopy (STM) can be used to probe and manipulate systems on the atomic scale. For exceptionally clean systems, we study our samples at low-temperature (5K) and ultra-high vacuum (UHV). Here we examine the properties of charged atoms on the surface of the semiconductor gallium arsenide (GaAs). We determine the binding site and charge of these adatoms, and use this information to tune the energy levels of electron acceptors in the surface. Funding for this research was provided by the Center for Emergent Materials at the Ohio State University, an NSF MRSEC (Award Number DMR-0820414). http://www.physics.ohio-state.edu/~jgupta/

8:48AM F1.00005 Nanoscale Assessment of Water Incursion to the Metal/Coating Interface1, HYUNGJIN LEE, Dept. of Polymer Science, The University of Akron, JIM BROWNING, Spallation Neutron Source, ORNL Neutron Science, MARK FOSTER, Dept. of Polymer Science, The University of Akron — While a great deal of research on macroscopic corrosion phenomena has been done and an empirical knowledge of effective corrosion mitigation strategies is available, a fundamental understanding of many nanoscale aspects of corrosion or precorrosion processes at metal interface is lacking. Neutron reflectometry (NR) can be used to nondestructively determine depth profile of a substance near an interface with a resolution of 1-2 nm. Key precorrosion phenomena that we have focused on are ingress of small molecules such as water and salt into coating or coating/metal interface. To simulate a practical precorrosion process, an in situ experiment in which the sample is in the presence of water vapor can be performed. Samples of a thin epoxy coating containing siloxane on an aluminum substrate having a native oxide have been studied by NR. Composition depth profile of water at coating/oxide interface can be inferred using a comparison of the data from samples under dry and humid conditions. We have shown that water incursion along coating/metal interface is fast compared to incursion through face of coating. Also, our work has provided evidence that, with a more highly crosslinked coating, after a small amount of water has entered along the interface water incursion slows dramatically.

1We acknowledge the research support of Department of Defense and support of the Oak Ridge National Laboratory, U.S. Department of Energy, in providing the neutron research facilities used in this work.

Saturday, April 14, 2012 8:00AM - 9:00AM — Session F2: Gravitation and Fields  Physics Research Building 1009 - Christopher Orban, Ohio State University

8:00AM F2.00001 Cosmic Microwave Background Radiation (CMB) explained using Modern Einstein (Gedanken) Laboratory Experiments, CHARLES SVEN1, Independent Researcher — Three explanations presented: two old school, unsupported by physics, and a brand new one that best explains all the NASA CMB observations, further incorporates many current experiments conducted by Stanford - SLAC National Accelerator Laboratory among other equivalent organizations, including a very simple setup that may be reproduced in any laboratory designed by the author.

1This is a continuation of my presentations at 7 previous APS meetings starting with the 2009 APS April Meeting May 2-5, 2009; Denver, Colorado.

8:12AM F2.00002 The Arithmetic of events and a new theory of Gravitation, MALEK ABBASI, None — Of fundamental importance in physics is the concept of event. This study tries; first, to provide a mathematical background showing how must deal with these events and based on what laws the watches, another important concept used frequently in this research, record them. Armed, then, with this mathematical background, the Gravitational Clouds Theory, a novel theory of gravitation concerning the role of the matter and energy in the universe, is proposed. This completely new theory leads to miscellaneous results some of which are: the second Einstein’s postulate; the well known identity E = mc2; the time-dilation phenomenon and Fitzgerald-Lorentz contraction. This theory will also explain why indeed we never feel the speed of the Earth, what is the origin of Dark matter-energy and many other extraordinary results associated with cosmology.

8:24AM F2.00003 Coherent Perfect Rotation, MICHAEL CRESCIMANNO, NATHAN DAWSON, JAMES ANDREWS, Dept. of Physics, Youngstown State U. — Two classes of conservative, linear, optical rotary effects (optical activity and Faraday rotation) are distinguished by their behavior under time reversal. In analogy with coherent perfect absorption, where counterpropagating light fields are controllably converted into other degrees of freedom, we show that in a linear-conservative medium only time-odd (Faraday) rotation is capable of coherent perfect rotation, by which we mean the complete transfer of counterpropagating coherent light fields into their orthogonal polarization. This highlights the necessity of time reversal odd processes (not just absorption) and coherence in perfect mode conversion and may inform device design.

8:36AM F2.00004 Convergence of a Quantum Particle Swarm Optimizer, TYLER STAY, CAVERNISH MCKAY, Marietta College — We examine the convergence of a quantum mechanical particle swarm optimizer (QPSO). A number of possible convergence criteria are examined, including a number of measures of swarm width. In contrast with classical particle swarm optimization algorithms, where measures must be taken to prevent swarm explosion, QPSO can suffer from swarm collapse, reducing the effective population size. We present a method for avoiding swarm collapse which is inspired by both the statistics of interacting fermions as well as the global optimization method simulated annealing.
8:48AM F2.00005 Ab-initio Modeling of Ultra-Intense Laser-Matter Interactions with Cone-coupled Wire Targets¹. CHRIS ORBAN, VLADIMIR OVCHINNIKOV, KRAMER AKLI, DOUGLASS SCHUMACHER, The Ohio State University, MILAD FATENEJAD, DONALD LAMB, Flash Center for Computational Science at the University of Chicago — Current experiments with ultra-intense lasers can potentially yield valuable information on the fast-ignition (FI) approach to achieving high-yield fusion in the laboratory. Using the Particle-In-Cell code LSP and the radiation-hydrodynamics code FLASH, we present simulations that self-consistently model the irradiation of Al cone targets coupled to Cu wires at the Titan laser based at Lawrence Livermore National Laboratory. Our novel approach ensures that the nanosecond time-scale pre-irradiation of the target by leakage light ahead of the main laser pulse is modeled in its full complexity by the FLASH code. By using these results as initial conditions for LSP simulations, the picosecond time-scale interaction of the main pulse with the target can be self-consistently modeled as well. This coupling of the codes has revealed valuable insights into the experimental results, and yield interesting ramifications for the Fast-Ignition route to fusion energy.

¹This work was supported by the US Department of Energy under contract DE-FG02-05ER54834 (ACE) and allocations of computing time from the Ohio Supercomputer Center.

Saturday, April 14, 2012 8:00AM - 9:48AM –
Session F3 Nuclear Physics Physics Research Building 4138 - Richard Furnstahl, Ohio State University

8:00AM F3.00001 Proton Halos in Effective Field Theory¹. BIJAYA ACHARYA, DANIEL PHILLIPS, Ohio University — Single proton halo systems are studied using an effective field theory (EFT) that exploits the separation of scales between the size of the system and the size of the core. The strength of Coulomb interaction between the proton and the core is calculated at leading order (LO) and next-to-leading order (NLO) in the EFT by using the effective range parameters derived from a square well model. The LO and the NLO results are compared to the full result obtained by solving the Schrödinger equation for the square well model. This is done both at first order and to all orders in the electromagnetic coupling constant. Calculations of proton halo electromagnetic observables of will be presented.

¹Work supported by the US DOE (Office of Nuclear Physics) under Contract No. DE-FG02-93ER40756 with Ohio University.

8:12AM F3.00002 Polarization Phenomena in the Reaction $^6\text{He}(p,p)^6\text{He}$¹. AZAMAT ORAZBAYEV, Ohio University, STEPHEN WEPPNER, Eckerd College, CHARLOTTE ELSTER, Ohio University — Recently, the polarization in elastic scattering of $^6\text{He}$ off a polarized proton target was measured at the RIKEN facility. It turns out that calculations of this observable using conventional microscopic optical potentials fail to describe the data. The goal of this work is to improve the microscopic folding optical potential by explicitly taking into account the shell structure of $^6\text{He}$. This leads to additional terms containing the full spin-momentum structure of the nucleon-nucleon (NN) t-matrix as well as the shell structure of the valence neutrons. The density matrix of the $^6\text{He}$ nucleus is obtained by using harmonic oscillator wave functions. Parameters of the wave functions are chosen to fit the experimental value for the charge radius and theoretical estimations for the matter radius of $^6\text{He}$. The NN t-matrix is calculated from the CD-Bonn potential. Preliminary results indicate that the polarization is sensitive to the additional terms. The calculations are performed in a recoil free approximation.

¹Work supported by the US DOE (Office of Nuclear Physics, under contract No. DE-FG02-93ER40756 with Ohio University)

8:24AM F3.00003 The Supernova Equation of State: Potential vs. Field-Theoretical Approaches. CONSTANTINOS CONSTANTINOU, SUNY Stony Brook & Ohio University — An important ingredient in simulations of core collapse supernova explosions is the equation of state of nucleonic matter for densities extending from $10^{-7}$ to $10^{-3}$ fm$^{-3}$, and temperatures up to 50 MeV, and proton-to-baryon fraction in the range 0 to 1/2. In this work we study supernova matter using a non-relativistic potential model as well as a relativistic mean-field theoretical one. In the former approach, we employ the Skyrme-like Hamiltonian density of Akmal, Pandharipande, and Ravenhall which takes into account the long scattering lengths of nucleons that determine the low density characteristics. In the latter, we use a Walecka-like Lagrangian density supplemented by non-linear interactions involving $\sigma$, $\omega$, $\rho$ meson exchanges, calibrated so that known properties of nuclear matter are reproduced. We focus, initially, on the bulk homogeneous phase and calculate its thermodynamic properties as functions of baryon density, temperature, and proton-to-baryon ratio. The exact results are then compared to approximate ones in the degenerate and non-degenerate limits for which analytical formulae have been derived. Our next step would be to extend our calculations of the state variables to the subnuclear region in which nuclei are present.

8:36AM F3.00004 Nuclear Scaling with Low Momentum Interactions¹. E.R. ANDERSON, The Ohio State University — Nuclear scaling is observed in the ratios of inclusive electron scattering on different nuclei for $1.5 \leq x_B \leq 2.0$ at large momentum transfer $Q^2$. The ratios depend on the nucleus but are independent of $Q^2$, and have been understood to be a result of strong short-range correlations induced by the nucleon-nucleon interaction. Recent calculations of nuclear structure make use of the similarity renormalization group to soften the nuclear potential through a series of unitary transformations, which suppress these short range correlations. However, we can now understand and calculate this scaling ratio as an effect of low momentum nuclear structure via factorization of operator expectation values. Recent calculations in nuclear matter, and in a Hartree-Fock basis for finite nuclei will be presented. We also apply this framework to an observed correlation with the EMC effect.¹

¹Supported in part by the NSF under Grants No. PHY-1002478 and the UNEDF Scidac Collaboration under DOE Grant DE-FC02-09ER41586.

8:48AM F3.00005 Universalities in SRG Evolved Potentials and the Choice of an Efficient Potential¹. BRIAN DAINTON, The Ohio State University — Two-body nuclear observables can be accurately described using a variety of potentials. Using the similarity renormalization group (SRG), evolved interactions exhibit universality in the low energy regime. One can exploit this universality by choosing a computationally efficient potential. A separable potential from inverse scattering is one such analytically simple potential. With a simple solution to the two-body interaction, one can more efficiently solve few- and many-body problems.

¹Supported in part by the NSF under Grant No. PHY-1002478.
9:00AM F3.00006 Making sense of scale- and scheme-dependent observables in low-energy nuclear physics1, R.J. FURNSTAHL, Ohio State University — Nuclear observables such as binding energies and cross sections can be directly measured. Other physically useful quantities, such as spectroscopic factors, are related to measured quantities by convolutions whose decompositions are not unique. I’ll discuss some of the implications of such scale- and scheme-dependent observables in the context of renormalization group methods for low-energy nuclear physics.

1Supported in part by the NSF.

9:12AM F3.00007 Momentum space evolution of chiral three-nucleon forces1, KAI HEBELELER, The Ohio State University — A framework to evolve three-nucleon (3N) forces in a plane-wave basis with the Similarity Renormalization Group (SRG) is presented and applied to consistent interactions derived from chiral effective field theory at next-to-next-to-leading order (N2LO). We demonstrate the unitarity of the SRG transformation, show the decoupling of low and high momenta, and present the first investigation of universality in chiral 3N forces at low resolution scales. The momentum-space-evolved 3N forces are consistent and can be directly combined with the standard SRG-evolved two-nucleon interactions for ab-initio calculations of nuclear structure and reactions.

1Supported in part by the NSF.

9:24AM F3.00008 In-Medium Similarity Renormalization Group for Finite Nuclei, HEIKO HERGERT, Ohio State University — The Similarity Renormalization Group (SRG) has emerged as a powerful and versatile tool for many-body physics. So far, its primary application in the framework of the nuclear many-body problem is the derivation of effective interactions from underlying realistic NN (and recently 3N) interactions. A recent development is the In-Medium SRG, where the Hamiltonian is evolved directly in the A-body system (i.e., at finite density). By a suitable choice of generator the ground state is decoupled from particle-hole excitations, and the IMSRG can be considered an Ab Initio technique for solving the many-body problem. The computational effort is comparable to Coupled Cluster approaches, which makes calculations for medium-mass and heavy nuclei feasible. I will give a brief overview of the method, present results for closed-shell nuclei with NN and 3N interactions, and discuss an effort to generalize the IM-SRG formalism for arbitrary reference states, with the aim of extending our calculations to open-shell nuclei. References: K. Tsukiyama, S. Bogner, and A. Schwenk, Phys. Rev. Lett. 106, 222502 (2011) S. Bogner, R. Furnstahl, and A. Schwenk, Prog. Part. Nucl. Phys. 65, 94 (2010)

9:36AM F3.00009 Local Projections of Low-Momentum Potentials1, KYLE WENDT, The Ohio State University — Nuclear interactions evolved via renormalization group methods to lower resolution become increasingly non-local (off-diagonal in coordinate space) as they are softened. This inhibits both the development of intuition about the interactions and their use with some methods for solving the quantum many-body problem. By applying local projections, a softened interaction can be reduced to a local effective interaction plus a non-local residual interaction. At the two-body level, a local projection after similarity renormalization group (SRG) evolution manifests the elimination of short-range repulsive cores and the flow toward universal low-momentum interactions. The SRG residual interaction is found to be relatively weak at low energy, which motivates a perturbative treatment.

1This work was supported in part by the National Science Foundation, the UNEDF SciDAC Collaboration under DOE, and by the DOE Office of Science Graduate Fellowship (SCGF) program.

Saturday, April 14, 2012 8:00AM - 9:24AM – Session F4 Physics Education Alpheus Smith Laboratory 1005 - James Sullivan, University of Cincinnati

8:00AM F4.00001 Teaching Electronics with an Arduino Microcontroller, HERBERT JAEGGER, Miami University — We have been teaching an electronics instrumentation laboratory course for well over 20 years. From the very beginning the central theme was interfacing physics apparatus to microcomputers, beginning with Apple and Intel-based PCs using some form of BASIC language and later moving to LabVIEW software and National Instruments data acquisition hardware. More recently we have begun to incorporate microcontrollers into our curriculum. We are using the Arduino platform, because it is open source, very affordable, and there exists a large community to turn to for help with problems of all sorts. Programming the Arduino is quickly learned, in particular by students who are familiar with introductory-level C or Java programming. We report on the capabilities of the Arduino and how we use it in our electronic instrumentation laboratory.

8:12AM F4.00002 Teaching Instrumentation Concepts by the Examination of Thermal Properties of Elastomers, TIMOTHY VIERHELLER, The University of Akron - Wayne College — Fundamental instrumentation concepts were taught using two important thermal techniques in characterizing elastomeric materials: Differential Scanning Calorimetry (DSC) and Thermal Gravimetric Analysis (TGA). Instrumentation concepts included the following: calibration, resolution, accuracy, and precision. Basic thermal properties (such as specific heat capacity, glass transition temperature, melting temperature, melting enthalpy, and decomposition temperature) of elastomeric materials were reviewed, as was how DSC and TGA measure these properties. Using this background, instrumentation concepts were taught using examined using collected data and related statistical information. Materials examined included polyethylene, nitrile rubber, and a natural rubber-butadiene blend.

8:24AM F4.00003 Feynman’s angular momentum paradox revisited, BEN YU-KUANG HU, BRIAN LOEBER, The University of Akron — We reexamine Feynman’s angular momentum paradox, in which a cylinder of charge around a current carrying solenoid is set in rotational motion when the current is turned off (due to the induced electric field caused by the change in magnetic flux). It apparently violates conservation of angular momentum. The standard explanation of the resolution of this paradox is that, when the electric current in the solenoid is on, the combination of the magnetic field from the current and the electric field from the charges results in non-zero angular momentum which is stored in the electromagnetic fields in the vicinity of the solenoid. This angular momentum is transferred to the charged cylinder when the current is turned off. However, we show that for certain geometries of the solenoid and position of the charges, the angular momentum in the vicinity of the solenoid is in fact zero even when the solenoid carries electric current and hence magnetic field is present in the vicinity of the solenoid. We show that angular momentum is in fact still conserved, because the electromagnetic fields which radiate outwards from the solenoid after the current is turned off carry angular momentum which is opposite to the direction of the angular momentum imparted to the charge on the cylinder.
8:36 AM F4.00004 What College Students Don’t Know about Density , D.J. WAGNER, Grove City College, SAM COHEN, Grove City College and Dallastown High School, ADAM MOYER, ELIZABETH CARBONE, KATHRYN MERRYMON, Grove City College — As part of the development of a fluid statics assessment, our research group conducted clinical interviews with students in both conceptual physics and calculus-based introductory physics courses. What were intended as “basic” questions about density quickly became a significant focus of those interviews, as only one of the eight students interviewed demonstrated a confident understanding of mass density. Questions have since been added to the fluid assessment to probe the prevalence of these difficulties. In this talk, I will summarize our preliminary data and discuss future plans for the assessment and our instruction.

8:48 AM F4.00005 The “new” International System of Units , GORDON AUBRECHT, Ohio State University at Marion — The CGPM has decided that, eventually, the “explicit unit” basis of the International System of Units (SI) will be replaced by the “explicit-constant formulation,” in which fixing certain physical constants will fix the base units exactly. How this is contemplated will be discussed in this talk.

9:00 AM F4.00006 POOLkits: Applying Object Oriented Principles from Software Engineering to Physics Object Oriented Learning – Preliminary Concepts , THOMAS KASSEBAUM, Byrd Polar Research Center, GORDON AUBRECHT, Ohio State University — Object-oriented development depends upon the creation of generic pieces that can be built into more complex parts. In physics, we begin teaching basic principles and then develop more complex systems, a fertile environment to develop learning objects. Each learning object consists of observable quantities, such as the physical properties of a block of wood, and operators that act on the object, such as force. Additionally, each object can also include an assessment operator that evaluates the impact of the learning object on student comprehension. The physics object-oriented learning kits (POOLkits) will be developed to enhance student understanding of physics concepts, as well as, build a framework for developing a software object based on the physics concept. A POOLkit can be extended, similar to the concept of extending classes in object-oriented programming, as physics knowledge expands. The expectation for these POOLkits would be to provide physics students with a solid foundation in the first principles to be able to derive more complex formulae and have the understanding of the process with a secondary benefit of enhancing the object-oriented programming capabilities of physics students.

9:12 AM F4.00007 Teaching Physics at a University in Finland , JAMES SULLIVAN, University of Cincinnati — From January through May, 2011 the author was able to teach physics courses in an engineering curriculum at a university in Helsinki, Finland. Many differences, both in the curriculum and the culture, were experienced during this period and these will be discussed in this paper.

Saturday, April 14, 2012 9:00 AM - 9:48 AM
Session G1 Biophysics Physics Research Building Smith Seminar Room - R. Sooryakumar, Ohio State University

9:00 AM G1.00001 The neurophysical basis of mind and consciousness , JAMES BEICHLER, Retired — A living body is just a complex pattern of energetic particle exchanges to physicists when compared to the biochemical processes studied by chemists and biologists. New research has centered more upon the electric, magnetic and electromagnetic characteristics of life. It is easy to model and consciousness as the electric and magnetic counterparts of living organisms. Mind is an extremely complex electric scalar field pattern and consciousness is the corresponding magnetic vector potential field pattern. As humans, we may have the most complex and advanced mind and consciousness known, but all living organisms display mind and consciousness at various lower levels than our human mind and consciousness. Mind and consciousness have mistakenly become associated with the brain and no other part of the body because of the dense concentration of neurons in the brain. A strict study of the magnetic vector potential field patterns associated with neural microtubules, neurons and neural nets demonstrates how thoughts and streams of thought originate in the brain and are stored magnetically. Microtubules, which act as magnetic induction coils, are the primary structural bio-unit used for building, storing and retrieving memories in the mind.

9:12 AM G1.00002 Energy landscapes for a homopolymer protein-like folding transition1 , MARK TAYLOR, Dept. of Physics, Hiram College, WOLFGANG PAUL, Martin-Luther-Universität, Halle, Germany, KURT BINDER, Johannes-Gutenberg-Universität, Mainz, Germany — Many small proteins fold via a first-order “all-or-none” transition directly from an expanded coil to a compact native state. We recently reported an analogous direct freezing transition from an expanded coil to a compact crystalsite for a simple flexible homopolymer [1]. Wang-Landau sampling was used to construct the 1D density of states for square-well chains up to length 256. Analysis within both the micro-canonical and canonical ensembles shows that, for a chain with sufficiently short-range interactions, the usual polymer collapse transition is preempted by a direct freezing transition. A 2D configurational probability landscape, built via subsequent multi-canonical sampling, reveals both a dominating folding pathway and an inherent configurational barrier to folding. Despite the non-unique homopolymer ground state, the thermodynamics of this direct freezing transition are identical to the thermodynamics of two-state protein folding. A free energy barrier separates a high entropy ensemble of unfolded states from a low entropy set of crystallite states and the transition proceeds via a formation of a transition-state folding nucleus.


1 Funding: NSF DMR-0804370 and DFG SFB-625/A3.

9:24 AM G1.00003 What do numerical sleep models say about “nontraditional” sleep schedules? , CAVENDISH MCKAY, Marietta College — The human sleep system can be modeled by the interaction of an oscillating process and a saturating process. Although these two process model was developed to explain natural (unforced) sleep regulation, it can also be used to examine the feasibility of an externally imposed sleep schedule. Results will be shown for a variety of potential schedules, ranging from the typical (a single 8 hour block of sleep at night) to the radical (sleep taken in small chunks throughout the day).
Effects of Passivation on Charge Transport in DNA-CTMA and P3HT Thin Films Using the Time of Flight (TOF) Technique, TIMOTHY GORMAN, PERRY YANEY, University of Dayton, FAHIMA OUCHEN, University of Dayton Research Institute — TOF measurements were carried out on a variety of thin films of deoxyribonucleic acid (DNA) of MW ∼ 200 kDa with and without hexacetyltrimethylammonium chloride (CTMA) along with thin films of regioregular poly(3-hexylthiophene (P3HT) with and without passivation in room air. A 20 ns, pulsed Nd:YAG laser with doubled output at 532 nm was used for P3HT and quadrupled output at 266 nm was used for DNA to inject charge carriers to produce a photoconduction transient with an applied electric field. Charge mobilities are derived from these transients. Without any passivation, photoconductive response signals were seen to change shape and decay in amplitude by factors of more than three with exposure to room air for both P3HT and DNA-CTMA. It was found that thin layers of polyurethane gave some degree of passivation to the DNA devices to preserve the photoconductive signals. A glass cover sealed over devices using Norland Products UVS 91 solvent-free epoxy was found to successfully passivate P3HT devices on a glass slide, which produced consistent signals in room air over the span of days.

Single-stranded DNA scanning and deamination with Single molecule resolution, DAVID RUEDA, Wayne State University — Over the past decade, single-molecule fluorescence resonance energy transfer spectroscopy (smFRET) has become an increasingly popular tool to study the structural dynamics of biopolymers, such as DNA, RNA and proteins. The most attractive aspect of single-molecule experiments is that, unlike ensemble-averaged techniques, they directly reveal the structural dynamics of individual molecules, which would otherwise be hidden in ensemble-averaged experiments. Here, we will present a novel single molecule assay to study, for the first time, scanning of an enzyme (APOBEC3G, involved in the defense against HIV) on single stranded DNA (ssDNA). We have investigated the ssDNA scanning and activity of Apo3G with smFRET. Our data show that Apo3G scans ssDNA randomly and bidirectionally with average excursion lengths of ∼ 10 Å and ∼1 s-1 scanning rates. Apo3G quasi-localization is observed on highly reactive motifs located near the one end of the ssDNA. Motif-dependent ssDNA bending is also observed, where the bending is maximal for highly reactive targets located near the DNA end. Interestingly, both the Apo3G scanning and Apo3G-induced ssDNA bending is reduced with lowered ionic strength, indicating that Apo3G motion on ssDNA is facilitated by salt by reducing ‘electrostatic friction’. Although scanning is random, asymmetric catalytic orientation may be the reason for Apo3G directional activity.

The Mechanics of the Human Genome, MICHAEL POIRIER, Ohio State University — Each of our cells contains 1 meter of DNA that is tightly wrapped to fit inside the ∼5 μ wide nucleus of the cell. This highly condensed state of our DNA plays a central role in how the information in our genes is replicated, read and repaired. Yet, the mechanics by which the genome organization regulates the processing of DNA remains a mystery. I will discuss what is currently understood about the first level of genomic organization, the nucleosome - a 50 nm stretch of DNA tightly wrapped ∼2 times around a protein core. Recent measurements from our group suggest how mechanical properties of our genome could regulate gene expression and DNA repair.