POSTERS ABSTRACT BOOKLET

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Poster No UCF01:

Gate-Dielectric for High Performance Organic Field-Effect Transistors

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Organic electronics is an increasingly interesting research field which promises to impact the future of semiconductors. Organic electronics offer many favorable characteristics that their traditional silicon-based counterparts do not—such as low-cost, ease of fabrication, mechanical flexibility, and potential for large-area electronics. The fundamental component of organic-based applications is the organic field-effect transistor (OFET). Interesting topics of research are dedicated to the functionality and electrical characterization of the organic semiconductor material, development of low-complexity fabrication methods, and development of dielectric materials compatible with flexible substrates. This project focuses on characterizing OFETs fabricated with the fluoropolymer gate-dielectric called Cytop. Cytop is a desirable material to use as a gate-dielectric in organic transistors for many reasons. It is an amorphous fluorpolymer and so is typically a non-destructive material and can be used along with many organic semiconductors of different forms. Its high light-transparency is idealistic for Cytop to be deposited on top of organic semiconductors, and its low moisture-absorption allows for increased device quality and environmental stability due to encapsulation. Most importantly, its low dielectric constant promises increased device performance. In order to study the effects of this dielectric on organic transistors, bottom-gate/bottom-contact devices were fabricated on Si/SiO_2 testpads with thermally evaporated gold contacts and the organic semiconductor spin-coated on top. The performance of these devices was compared with that of top-gate/bottom-contact devices obtained on the same film by spin-coating Cytop dielectric on top, followed by painting a top-gate contact. Electrical properties and device characteristics such as mobility, On/Off current ratios, and leakage currents were observed as the deposition of Cytop was optimized.

Poster No UCF02:

Mechanisms of Stability of Fibers Electrospun from Peptides with Ionized Side Chains

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Non-woven electrospun fiber mats made of polypeptides are increasingly considered attractive for basic research and technology development in the life sciences, medicine and other areas. Here, co-poly(L-glutamic acid4, L-tyrosine1) (PLEY) was adopted as a model polymer for a study of the mechanisms of fiber stability. Crosslink density has been quantified by a dye-based method. Fiber morphology, elemental composition and stability have been assessed by microscopy and energy-dispersive X-ray spectroscopy (EDX). The results have been interpreted with reference to the pH dependence of the UV absorbance and fluorescence of PLEY chains. The study has revealed that fiber stability in an aqueous medium is crucially dependent on the extent of side chain ionization, even after polymer crosslinking.

Poster No UCF03:

Inside Out: The Stellar Kinematics and HI Map of DDO 46

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This poster will present the optical and radio data for the dwarf galaxy DDO 46. From this information we can hypothesize the three dimensional structure of the galaxy. Through compiling these data, clues to the formation and evolution of dwarf galaxies can be surmised. The optical information was taken with the Mayall 4-meter + Echelle spectrograph at the National Optical Astronomy Observatory's Kitt Peak National Observatory. It was then reduced, which gave one-dimensional spectra of the stars in the disk of DDO 46. These spectra were cross-correlated with nearby radial velocity standard stars within the Milky Way. This method allowed us to derive the stellar velocities and velocity dispersions, σ_z, of DDO 46. The results of the Karl G. Jansky Very Large Array high resolution HI emission data provided integrated intensity and velocity maps that were used to find the maximum rotational velocity, V_{max}, of DDO 46. By combining the optical and radio data, we ascertained a kinematic measure, V_{max}/σ_z that quantified the three-dimensional shape of the system. The reduced HI radio data observed with the Robert C. Byrd Green Bank Telescope shows the extended, tenuous neutral hydrogen environment around DDO 46, which can potentially reveal recent interactions, mergers, or gas accretion.

Poster No UCF04:

Four-wave Mixing in Atomic Potassium

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Four-wave mixing is a non-linear optical process in which two laser beams, separated by a specific frequency, are directed into a vapor cell with a high optical depth. The frequencies of the lasers are fixed such that the frequency difference between the lasers corresponds to the energy difference between the ground energy levels of the atom. The interactions between the photons of the control and probe lasers and the atoms in the vapor cell cause a third laser beam to be formed and to exit the cell, along with the two original beams. This Stokes beam appears on the opposite side of the control beam with respect to the probe beam, and at an angle equal to the angle between the probe and control beams.

In my project, I attempted to observe four-wave mixing in atomic potassium and rubidium. I increased the optical depth of the atoms by heating the cell; I examined the lasers exiting the cell with a CCD camera. In atomic potassium, the maximum optical depth achieved in the cell was 5.9; this attenuation factor was not large enough and I did not observe four-wave mixing in the potassium vapor cell. In atomic rubidium, the optical depth reached was 6.5, but did not increase with increasing temperature due to a conflicting process that produced purple light and a co-propagating laser beam. I was unable to find the source of the light causing the interfering process and did not observe four-wave mixing in the rubidium vapor cell.

Poster no UCF05:

Femto-Second Laser Pump and Probe Technique and the Two-Temperature Model: Developing a Simulation of Electron-Phonon Heat Exchange

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The purpose of this project was to develop a computer program to simulate electron-phonon heat exchange in a thin lattice based on predictions made by the two-temperature model (TTM). The first task of the project was to acquire an understanding of multi-photon photo-emission (MPE) and thermionic emission (TE) in a thin gold foil. This was done with reference to the laser-pump and probe technique used in the lab to acquire electron shadow images of the lattice during stimulated emission. A simplified version of the mathematical model was first adapted to create a C++ routine and then this routine was revised several times in order to produce and accurate approximation of TTM. The program was used in conjunction with Gnuplot to visualize the rapid heat exchange process. The final model indicates when the creation of warm dense matter (WDM) occurs in the lattice, and can be compared with the electron shadow images created in the lab. In the future, the model may be applied to different laser pump-line frequencies and lattices of various substances.

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Poster no UCF06:

Tunable Band structures of Fluorinated Graphene

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Ultraviolet photoemission spectroscopy measurements reveal that there is notable variation of the electron density of states in valence bands near the Fermi level. Evolution of the electronic structure of graphite and rotation-stacked multilayer epitaxial fluorinated graphene as a function of the applied electric bias is investigated using first-principles density-functional theory included interlayer van der Waals interactions. The experimental and theoretical results demonstrate that the tailoring of electronic band structure correlates with the interlayer coupling tuned by the applied bias. Additionally, the increase in the work function of fluorinated graphene demonstrates the ability of fluorination to modify electron emissions characteristics of graphene.

Poster no UCF07:

W Boson Production Charge Asymmetry in the Electron Channel

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We present a measurement of W boson production charge asymmetry in p-pbar collisions through $W \rightarrow e\nu_e$ decays. The collision of an up quark with an anti-down quark can produce a W^+ boson while the collision of an anti-up quark with a down quark can produce a W^- boson. The W bosons decay rapidly but we are able to measure they asymmetry by studying the resulting final state electrons and neutrinos. These results will be used to further constrain fits to parton distribution functions (PDFs) and improve the accuracy of future predictions for new physics.

Poster no UCF08:

BLACK HOLE COLLISIONS

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One of the more interesting and exotic systems in the universe is a system of two black holes. When black holes orbit each other, they will eventually collide, forming a single black hole that is almost as big as the two original black holes put together. The missing "mass" or energy is converted into gravitational radiation. This project focuses on the timescales at merger and how the total energy is radiated. In this poster, I plot the change in energy for the physical parameters of the black holes, namely mass and spin. To acquire these graphs, I do computational work using Matlab. The graphs are then analyzed for patterns and any information it depicts. For example, as the difference in the mass of the two black holes increases, the change in energy radiated decreases; it also takes longer for merger to occur. However, for increasing spin and constant mass ratio, the energy radiated increases along with the peak amplitude.

Poster No UCF09:

Variable ASAS Counterparts to Galactic Bulge Survey X-ray Sources

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The Galactic Bulge Survey (GBS) is a shallow Chandra X-ray survey of two 6x1 degree strips located 1 degree above and below the Galactic Plane. After removing duplicates, the final GBS catalogue has 1640 unique X-ray sources. The goal of the survey is to test binary evolution models and increase the number of known Low Mass X-ray Binaries, in order to investigate questions such as the distribution of black hole mass and constrain the equation of state of neutron stars. We aim to identify all variable optical counterparts to the X-ray sources and analyze their periods. This lightcurve information, along with other multi-wavelength observations, enables the classifications of these GBS sources. Many of the GBS X-ray sources coincide with stars in the All Sky Automated Survey (ASAS). We report here on variable counterparts to GBS sources identified within the ASAS dataset, examine their characteristics, and discuss their likely classification. This work is supported by the National Science Foundation under Grant No. AST-0908789. Monique Gabb also acknowledges support from the REU Site in Physics and Astronomy (NSF Grant No. 1004822) at Louisiana State University.

Poster no UCF10:

Gravitational Radiation resulting from Binary Black Hole Collisions

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The merger of a binary black hole collision is composed of three stages: inspiral, merger (non-linearities), and ringdown. The main objective is that by focusing on the mode spectrum of the ringdown, the late stages of the merger at which point the black holes have already merged and are settling to a steady state, we can find that the masses and spins of the final black hole are embedded in the signal in the form of a decaying sinusoid with a unique decay time and angular frequency. The latter can be extracted through fitting algorithms of the ringdown signal such as those proposed by E. Berti and F. Echevarria. We concluded that the ringdown emerges from the nonlinear phase at a specific time post-black hole merger, and it ends about 4-5 full-width-half-max after peak. This timescale gave the best agreement for predicted final masses and spins of the final black hole. These features can then be used to fine-tune the search algorithms hunting for these collisions with the Laser Interferometer Gravitational Wave Observatory (LIGO). The early and late stages of the binary-black-hole collision can be approximated by perturbations to a background, solutions to linearization of the Einstein's equations. However, once the two black holes are within several radii of each other, and ultimately collide, the solution is intrinsically non-linear. The main objective is to intuitively understand the non-linear portion of the solution to the Einstein equation by performing simulations of such mergers. I will identify the non-linear regime through a process of elimination. The early stages of the coalescence are well known by post-Newtonian theory. The end state is approximated very well by perturbation theory, the waveforms decay as a damped sinusoidal with a frequency and decay time uniquely determined by the mass and spin of the final black hole in theory. I will isolate the non-linear portion of the waveform by fitting the early stages to the post-Newtonian solution and the late stages to the perturbative solution. What remains is the non-linear region. Once isolated, we will search through the physics parameter space of the binary black holes for bulk features. These features can then be used to fine-tune the search algorithms hunting for these collisions with LIGO.

Poster no UCF11:

Optimizing the Decay Pipe Length in the Long Baseline Neutrino Experiment Beam line

Catherine Ayuso

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Neutrinos are massless neutral particles in the Standard Model of particle physics. There are three types, or flavors, of neutrinos, and they have been observed to change from one flavor to another upon traveling a distance. This quantum mechanical phenomenon is known as neutrino oscillation, and requires that neutrinos have mass. This observation of characteristics beyond the Standard Model has made neutrinos a key area of study for particle physics, and for new physics explorations. Following these observations, physicists have measured most oscillation parameters with increasing precision, while some remain unknown. Neutrino oscillation can be parameterized by three mixing angles (θ_{12}, θ_{23} and θ_{13}), the difference in the squares of the neutrino masses (Δm^2_{21}, Δm^2_{32}) and the CP-violating phase (δ_{CP}). The Long Baseline Neutrino Experiment (LBNE), a project proposed and founded by several laboratories and research groups nationwide, including Brookhaven National Laboratory (BNL), seeks to measure both the phase δ_{CP}, and to resolve the order of the masses, known as the mass-hierarchy problem. Plans of developing a beam line to accurately measure these parameters have initiated at BNL. This is being done by running exploratory simulations seeking to determine the most optimal and technically attainable beam design. The neutrino beam is generated by bombarding a target with protons from the Main Injector at Fermilab. The resulting mesons are focused by a pair of magnetic horns, and are allowed to decay along a decay pipe. The current configuration consists of a target 35cm before the horn, a horn current of 200kA in both horns and a horn spacing of 6m, as well as an air-filled decay pipe of 200 meters. The horn design is that of the existing NuMI (Neutrinos at the Main Injector) horns located in Fermilab. Although, this is the most feasible design proposed and studied thus far, this study seeks to increase the neutrino flux by varying the decay pipe length between 200 and 300 meters and alternating between vacuum and air-filled pipes. The integrated number of neutrino events is evaluated in the 0-15 GeV range and the more interesting 0-2 GeV range; a range known for its sensitivity to neutrino oscillations. Sensitivity to δ_{CP} and mass hierarchy is investigated by a chi-squared analysis. These studies will determine the optimal length for the air-filled and evacuated decay pipes to measure δ_{CP} and mass hierarchy with highest precision, and aid in the final design decision.

Poster no UCF12:

Using the Cooling of Rubidium-85 Atoms to Ultra Low Temperatures with Lasers Atomic Molecular Optical Undergraduate Research

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An Atomic and Molecular Optical (AMO) Physics research lab is an excellent tool to train undergraduate students in advanced laboratory techniques. Students gain valuable basic experience in experimental designs, data acquisition techniques, working with high precision optical equipment, and working in the machine shop. Current projects involve machining mounts to hold the vacuum chamber that will contain Rb-85 atomic vapor and be used to trap the atoms in a Magneto Optical Trap (MOT). This project includes designing, building and baking out the vacuum chamber and building the lasers for a saturation-absorption system that is used to probe the 52S1/2→ 52P3/2 hyperfine energy transitions of the Rb-85 atom. These energy transitions will be used to frequency-lock a diode laser to trap rubidium-85 atoms and then cool them to ultra low temperatures once the vacuum chamber is mounted and baked out. This cooling will permit observation and measurement of the fundamental properties of atoms. This research benefits not only physics majors but also optometry students who seek to gain experience in optics.

Poster no UCF13:

The Sensing and Inhibition of Mold Fungi Growth Using Biosynthesized Nanoparticles

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The detection and treatment of bio-hazardous species, particularly in the areas of high humidity and temperature are important. Mold particles, complex mixtures of biological chemicals can have allergenic or toxigenic properties. This research investigation focuses on health safety and bio-defense:

1. The feasibility of mold detection using extracellular biosynthesis process
2. Inhibition of mold growth by biosynthesized silver nanoparticles treatment

Our approach hypothesizes the ability of fungi to reduce noble nanoparticles from silver, gold salt, like $AgNO_3$, $HAuClO_4$, creating a reaction process known as extracellular/intracellular biosynthesis. Analysis of mold specimens, using Optical Microscopy, UV-Visible Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR) and comparison with literature data, showed presence of *Altenaria, sp., Aspergillus, sp.p, and Rhizophus, sp.* This combination fungi successfully reduced silver nanoparticles. The reaction process was monitored using UV-Visible spectroscopy. The absorption peak of 420nm corresponds to appearance of silver nanoparticles. After injection of 20 µL with 10 ppm concentration of silver in Petri dishes filled with 100mL Sabouraud Dextrose Agar (SDA), no mold growth was observed. Future research will pursue investigation of minimum inhibitory concentration, preventing mold growth and measurement conductivity during the extracellular biosynthesis reaction for mold sensor application.

Poster no UCF14:

Quartz Detector for the Trigger System of the Super-HMS Spectrometer

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The quartz detector is to be used for the trigger system of the Super HMS spectrometer, Jefferson Lab Hall C, needed for the 12-GeV energy upgrade. The task of the quartz detector is to provide a clean detection of charged particle, provide a high level of background rejection, and provide an accurate tracking efficiency determination. There are a total of twenty-one quartz bars (Corning 7980 grade 0-F) which will be attached to photomultipliers (PMTs). The PMTs are UV sensitive Photonis XP2020Q and 9814 from Electronic Tubes (ET). Therefore, in order to maximize the light output of the bars, a couple of prototype quartz detectors were constructed to test: choice of wrapping material, choice of glue and optical grease for the bar, time and position resolution measurement, and determination of photoelectron yield. Some results of the testing will be presented.

Poster UCF015:

The Beryllium Bottleneck and its Effect on Nuclear Synthesis

Mia Ferris

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Beryllium-8's extreme nuclear instability brings to light many interesting questions for investigation. Be-8 most commonly fissions immediately into two heliem-4 nuclei, or alpha particles. This almost instantaneous fission makes creation of heavier nuclei extremely difficult. Yet, within celestial bodies, when temperatures reach levels of 100 million K, helium may be converted into carbon, with the formation of Be-8 being a necessary step in this process. This formation of carbon is the beginning of the formation of stable, heavier elements and is known as the Triple-Alpha Process.

In this poster, this nucleus is addressed using the no-core symplectic model (NCSpM) based on the symplectic symmetry, which has been found important in projections of the *ab initio* no-core shell model (NCSM) wavefunctions onto symplectic, Sp(3,R), symmetric basis states (T. Dytrych). We use a schematic, but fully microscopic, interaction, which has previously yielded good results for carbon-12 (A. Dreyfuss). With no fitted parameters, we apply this interaction to beryllium-8. This has allowed us to obtain a comparatively accurate energy spectrum when using the symplectic slices up through 22 harmonic oscillator (HO) shells that build upon states that span the entire $0\hbar\omega$ space as well as states from both the $2\hbar\omega$ and $4\hbar\omega$ excitations. Within these spaces we have calculated good values for the second 0^+ state, a state that no other *ab initio* model has been able to describe thus far. We have also been able to estimate the rms radius of beryllium 8 not available from experiment. Our calculated radius falls within range of experimental rms radii of neighboring beryllium isotopes. This model also produces good energy spectra for beryllium isotopes A=10, 12, and 14, showing that without adjusting any parameters from previously obtained, accurate finding on C-12, new and accurate results are calculated by our Sp(3, R) based model.

Poster UCF016:

CALET: Monte Carlo simulations for the CALET electron telescope on the Space Station

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The CALorimetric Electron Telescope (CALET) mission is an international collaboration between Japan, Italy, and the United States designed to explore the High Energy Universe. The instrument is a large, deep calorimeter designed primarily to measure the spectrum of cosmic ray electrons up to 20 TeV. Additional goals of CALET are to address outstanding questions such as (1) the nature of the sources of high energy particles and photons, (2) the details of particle transport in the Galaxy, and (3) signatures of dark matter, in either the high energy electron or gamma ray spectrum.

The US collaboration is participating in the development of the CALET instrument, as well as its testing, pre-launch calibrations, flight operations, flight data processing, and science analysis along with the international CALET team. One of the main goals of the LSU collaboration is to develop analysis software using IDL that will process CALET flight data for the entire CALET collaboration. This analysis will then be compared to the ROOT analysis for secondary validation. An initial simulation has been run for 10,000 events, including energy deposit and timing. Results will be shown demonstrating the energy deposited in individual channels and demonstrating the trigger efficiency and particle identification capabilities.

Poster UCF017:

The Search for Large Extra Dimensions via Single Photon plus Missing Energy Final States

Alicia Gomez, Todd Adams

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Large extra spatial dimensions (LED) provide a possible solution to the hierarchy problem in the standard model of particle physics. The hierarchy problem asks why the force of gravity is many orders of magnitude weaker than the other fundamental forces. We are looking for signs of LED through the analysis of quark-antiquark collisions which produce one photon and have missing transverse energy. It is hypothesized that the missing energy is attributed to the production of a Graviton which carries the missing energy into another dimension. The data we are using is from the D0 experiment at Fermilab National Accelerator Laboratory. In our analysis we are determining the limits on the effective Planck scale in accordance with the ADD (Arkani-Hamad, Dimopoulos, Dvali) model.