Physics Oral Presentations Abstracts

P1. The Fluid Model for Return Stroke of Lightning with Current behind the Shock Front

Dacen Waters, Mostafa Hemmati
Arkansas Tech University, Russellville, AR

The electrical breakdown of a gas in a strong electric field is carried out by a wave with a strong discontinuity at the wave front, and traveling with speed comparable to speed of light. The electron gas pressure is considered to provide the driving force for propagation of the wave. For theoretical investigation of the electrical breakdown of a gas, we apply a one-dimensional, steady profile, constant velocity, three component fluid model, and consider the waves to be shock fronted. Our set of electron fluid-dynamical equations consists of the equations of conservation of mass, momentum, and energy plus the Poisson's equation. This investigation involves breakdown waves with a significant current behind the shock front propagating in the opposite direction of the electric field force on electrons. The existence of current behind the wave front alters the set of electron fluid dynamical equations and the boundary condition on electron temperature. We will present the changes due to current in the set of electron fluid dynamical equations and the boundary condition on electron temperature. Abstract ID: 48

P2. Current Range for Antiforce Breakdown Waves

Jesse Christensen, Mostafa Hemmati
Arkansas Tech University, Russellville, AR

The propagation of breakdown waves with a significant current behind the wave front moving into a non-ionized medium has been investigated. For breakdown waves propagating in the opposite direction of electric filed force on electrons (lightning return stroke), we apply a one-dimensional, steady profile, constant velocity, three component fluid model, and consider the waves to be shock fronted. Measuring channel-base currents for rocket-triggered lightning return strokes, investigators report peak current values ranging from 1 kA to 22 kA. Considering the existence of a significant current behind the shock front, we have modified the set of electron fluid dynamical equations and the boundary condition on electron temperature at the wave front. We have been able to integrate our modified set of electron fluid dynamical equations for a range of current values comparable to the experimentally observed currents. We will present the wave profile for electric field, and electron velocity, temperature and number density within the dynamical transition region of a relatively fast moving wave. Abstract ID: 49

P3. Structural and Optical Properties of Metal-Oxide Core-Shell Nanowire Arrays Fabricated by Atomic Layer Deposition

Allan Thomas, Jingbiao Cui
University of Arkansas at Little Rock

Metal oxide core-shell nanowire arrays composed of electrodeposited ZnO nanowires and atomic layer deposited (ALD) Al_2O_3, ZnO, and TiO_2 shells were fabricated at low process temperatures. The structural and optical properties of the core-shell structures were investigated and distinctive features were induced by the shell coatings. Due in part to their low temperature deposition, the effects of annealing on the core-shell nanowires were also studied in detail. In particular, the photoluminescence of the nanowire cores can be enhanced or depleted by the shell, depending on the choice of shell material. The thickness of the shell was found to be a minor factor in comparison to the shell material, indicating even very thin coatings can transform the properties of the native cores in core-shell nanostructures. Specifically, ZnO-Al_2O_3 core-shell nanowires display improved optical characteristics over their bare ZnO nanowire core equivalents. Evidence for solid state reactions between the ZnO core and metal-oxide shell at increased annealing temperatures was also observed, leading to further changes in their optical properties. These results have important implications for related optoelectronics based on ZnO nanowires or their core-shell nanostructures. A fundamental

understanding of the effects of thin shell layers on the optical properties of nanomaterials will improve their stance in advanced applications such as photovoltaic devices. Ab ID: 69

P4. Enhancing the Tunability of Material Properties in ZnO: The Use of an Oxygen Plasma in Atomic Layer Deposition

Allan Thomas, Jingbiao Cui
University of Arkansas at Little Rock

Atomic layer deposition (ALD) is quickly becoming the method of choice for the growth of high quality, uniform, and conformal layers of many metal oxides. Among various metal oxides, ZnO is of particular interest due to its rich optical and electrical properties. The use of a plasma in ALD has recently shown that material properties can be further improved in comparison to conventional thermal ALD techniques. In this work, three separate growth methods for ZnO films using ALD were investigated: 1) classic thermal-ALD using diethylzinc (DEZ) and H_2O vapor; 2) plasma enhanced-ALD (PE-ALD) using DEZ and a remote O_2 plasma; 3) plasma enhanced thermal-ALD (PET-ALD) in which a remote O_2 plasma step is added after each cycle of the classic thermal ALD process. In an effort to understand the effects each type of growth process has on the ZnO materials, their structural, optical, and electrical properties were studied in detail. We have found that the reaction dynamics and physical properties of ZnO are highly sensitive to the plasma conditions. Specifically, the conductivity of the ZnO films can be controlled within seven orders of magnitude and the carrier concentration adjusted by five orders of magnitude for films all deposited at the same process temperature. Such a wide range of material properties is rarely achievable in other ALD techniques. Ab ID: 70

P5. DNA Aberrations Induced by Gamma Radiation on the Drosophila melanogaster

Paul M Morgan, Salomon F Itza, William J Doria
University of the Ozarks

DNA aberrations resulting from exposure to controlled amounts of gamma radiation were investigated in the common fruit fly, Drosophila melanogaster. Five successive generations of the D. melanogaster were subjected to a daily dose of 244 Î¼Gy of gamma radiation from a Cobalt-60 source. DNA electrophoresis will be performed to compare the DNA from exposed and non exposed larva, pupa, and adult tissues to investigate changes in the DNA. A comparison of the absorption of ultraviolet radiation at 260nm for DNA in larva, pupa, and adult tissues using UV-Vis Spectroscopy will also be performed to correlate the quantity of DNA to the absorption of electromagnetic radiation. Ab ID: 78

P6. Properties of Interacting Dark Energy Models

Chad Smith, Hamed Shojaei
Arkansas Tech University, Russellville, AR

Interacting dark energy models were introduced to replace the regular cosmological models. The main purpose is to explain the cosmic coincidence problem. We would like to know why at the present time dark energy and matter have the same order of magnitude, unlike what regular cosmological models predict. Interaction can convert dark energy to matter to make them in equilibrium. In this presentation we study the behavior of interacting models in general. Then we use these models in some special cases to explain the present abundance in matter and dark energy. Ab ID: 85

P7. Particle size dependence of superparamagnetic blocking in magnetite (Fe_3O_4) nanoparticles

Joy D. Counts, Cristian E. Botez, Ronald J. Tackett
Arkansas Tech University, Russellville, AR

In recent years, driven by many factors including the push for consumer technologies that are lighter, stronger, and most importantly, smaller, the field of nanotechnology has been one of extreme activity. With this said, the need for a basic understanding of the underlying physics behind materials on the microscopic scale has never

been more evident. This presentation will outline experimentation on nanoscale magnetite (Fe_3O_4), a common magnetic material which exhibits the interesting property of superparamagnetism when dimensionally constrained. Focus will be put on the synthesis of these particles as well as the characterization of their interesting magnetic properties. Ab ID: 98

P8. Charge azimuthal correlation and charge separation in relativistic heavy ion collisions

Bin Zhang, Guo-Liang Ma
Arkansas State University, Shanghai Institute of Applied Physics

Charge separation is an important consequence of the Chiral Magnetic Effect. Within the framework of a Multi-Phase Transport model, the effects of final state interactions on initial charge separation are studied. We demonstrate that charge separation can be significantly reduced by the evolution of the Quark-Gluon Plasma produced in relativistic heavy ion collisions. Hadronization and resonance decay can also affect charge separation. Moreover, our results show that the Chiral Magnetic Effect leads to the modification of the relation between the charge azimuthal correlation and the elliptic flow that is expected from transverse momentum conservation only. The transverse momentum and pseudorapidity dependences and the effects of background on the charge azimuthal correlation are also discussed. Ab ID: 115

P9. Comparing Methods for Interpolation of Raster DEMs

Jay C Guarneri, Robert C Weih, Jr.
University of Arkansas at Monticello

Digital elevation data are available as raster files at 100, 30, and 10m resolutions for the contiguous United States and are used in geographic analyses. Some projects may require a finer resolution. GIS software offers many options for interpolating data to higher resolutions. We compared ten interpolation methods using 10m sample data from the Ouachita Mountains in central Arkansas. We interpolated the 10m DEM to 5m, 2.5m, and 1m resolutions and compared the RMSE for each using surveyed control points. Ab ID: 118

P10. The Link Between Central Black Holes, Bar Dynamics, and Dark Matter Halos in Spiral Galaxies

Marc S Seigar[1], Patrick Treuthardt[1], Amber D Sierra[1], Ismaeel Al-Baidhany[1], Heikki Salo[2]
[1]University of Arkansas at Little Rock, [2]The University of Oulu, Finland.

The discovery of a relationship between supermassive black hole (SMBH) mass and spiral arm pitch angle (P) is evidence that SMBHs are tied to the overall secular evolution of a galaxy. The discovery of SMBHs in late-type galaxies with little or no bulge suggests that an underlying correlation between the dark matter halo concentration and SMBH mass exists, rather than between the bulge mass and SMBH mass. In this paper we measure P using a two-dimensional fast Fourier transform and estimate the bar pattern speeds of 40 barred spiral galaxies from the Carnegie-Irvine Galaxy Survey. The pattern speeds were derived by estimating the gravitational potentials of our galaxies from near-infrared images and using them to produce dynamical simulation models. The pattern speeds allow us to identify those galaxies with low central dark halo densities, or fast rotating bars, while P provides an estimate of SMBH mass. We find that a wide range of SMBH masses exist in galaxies with low central dark matter halo densities, which appears to support other theoretical results. If an upper mass limit exists for galaxies with fast bars, based on our sample it is a relatively large mass of 1.7×10^7 Solar masses. We also find that galaxies with low central dark halo densities appear to follow more predictable trends in P versus de Vaucouleurs morphological type (T) and bar strength versus T than barred galaxies in general. The empirical relationship between SMBH mass and total gravitational mass of a galaxy (Mtot) allows us to predict the minimum Mtot that will be observationally measured of our fast bar galaxies. Ab ID: 119

P11. Compton Scattering and Topological Reconstruction of Gamma Rays in a Xenon Time Projection Chamber

Jeremy Dunklin[1], Abdel Bachri[1], and Azriel Goldschmidt[2]
[1]Southern Arkansas University, [2]Lawrence Berkeley National Laboratory

The role of the research group at the Lawrence Berkeley National Laboratory (LBNL) is to develop a prototype Xenon gas time projection chamber (TPC) as part of the Neutrino Experiment with a Xenon TPC (NEXT) collaboration. The primary advantage of the xenon gas TPC is that it gives both excellent energy resolution and the ability to map events within the chamber. Compton scattering is well understood, making it ideal for testing the TPC's ability to properly map event topology. Compton scattering occurs when an incoming gamma ray ejects an electron from an atom and scatters at an angle. The scattered gamma ray, having given some of its energy to the electron, then interacts with another atom, usually via the photoelectric effect. The Compton event can be reconstructed using the energies and positions of the two resulting electrons. After reconstructing the event, the scattered gamma energy can be calculated using the position of the electrons and then compared to the actual value measured in the TPC. After comparing these measurements, there has shown to be significant error in the scattering angle measurement. This discrepancy is due to the fact that the two electron tracks are actually quite long, meaning there is a substantial amount error regarding their actual original positions. Ab ID: 159

P12. Energy Resolution Deterioration due to Recombination in High Pressure Xenon Detectors along Delta Electron Tracks

Kahli Remy[1], Abdel Bachri[1], and Azriel Goldschmidt[2]
[1]Southern Arkansas University, [2]Lawrence Berkeley National Laboratory

It has been shown that the energy resolution of Xenon degrades rapidly when the density of the Xenon becomes higher than $0.5 g/cm^3$, reaching a plateau in the liquid phase. The goal is to determine what the specific reasons for this are. The accepted explanation involves the creation of high energy (delta) electrons. The problem with delta electrons is that there are few made if any, and are unpredictable. Following a primary ionizing collision between an electron and a Xenon atom, one or more energetic electrons are ejected. Delta electrons are the small fraction of the ejected electrons possessing energies that maybe larger compared to the ionization potential of Xenon. Also because of the small number of delta electrons the statistical fluctuations can be very large. With delta electrons, energy loss per unit length goes up which leads to a higher chance that the Xenon atoms that lost electrons will grab free electrons in a process known as recombination. This is problematic for two reasons. First, the rate of recombination at high density is hard to predict. Even worse, it is difficult to determine how many delta electrons were made to begin with. The testing of this explanation and possibly developing a different explanation by running computer simulations in Garfield++ and Root is the focus of this paper. We will develop the Onsager Radius within the simulation. The Onsager Radius can be used to evaluate the rate of recombination at high pressures for xenon. We have only looked so far at up to 10.5 atmospheres xenon. The rate of recombination for that pressure is low, if any. In conclusion, the simulation needs to be analyzed further for high pressure xenon. But it does effectively output the Onsager radius value, and can run at higher pressures. We will be continuing work on this simulation. Ab ID: 161

Physics Poster Presentations Abstracts

P-1. Electrochemical polymerization of nanocomposite polypyrrole (PPy)/ Multi Wall carbon nanotubes functionalized by Cooh as a counter electrode dye -sensitized solar cell

Samir AbdulAlmohsin, Muatez Mohammed, Jingbiao Cui
University of Arkansas at Little Rock

Poly pyrrole/MWCNTS nano composite films coated on conductive glass by electrochemical deposition using Multi -Wall carbon nano tube functionalized with the carboxylic acid groups (-Cooh) can contribute to synthesize polymer-MWCNTS nonocomposite .The PPy were electrochemically polymerized using FTO glass as working electrode ,and pltinum wire as a counter electrode by using F-MWCNTS as adopant in electrolyte .The amount of MWCNTS with ppy increased with the increase percentage of FMWCNTS and the performance of polypyrrole/MWCNTS nano composite then used as a catalyst materials for counter electrode based dye -sensitive solar cells ,The performance od solar cells dependent upon different percentage weight of MWCNTS .Electrochemical impedance spectroscopy suggests that the superior performance of alternative current for poly Pyrrole / Mwcnts nano composite solar cells is due to their lower charge-transfer resistance with increase percentage weight of MWCNTS between counter electrode and electrolyte. Ab ID: 44

P-2. Spin coater deposited P3HT pristin and nanocomposite G-P3HT for dye-sensitized solar cell counter electrodes comparable Tio2 and ZnO nanorode as working Electrode

Samir AbdulAlmohsin, Muatez Mohammed, Jingbiao Cui
University of Arkansas at Little Rock

P3HT films with and without mixing 5 wt % graphene were coated on conductive glass by spin coater deposition. They were then used as the dye-sensitized solar cell counter electrodes. Use Tio2 and Znonanorode to study four situations and comparable between each others. Scanning electron microscopy revealed that P3HT forms a nano plate -like structure on the conductive glass. Using P3HT pristine and with 5 wt % graphene acts different performance of tio2 and ZnO nanorode based desensitized solar cells is dependent upon polymer mixing with graphene and pristine . The highest efficiency of alternative current and direct currentP3HT mix graphene based dye-sensitized solar cells (DSSCs) increase from 0.16 to 0.31 for tio2 as working electrode, for ZnO nrode increase from 0.087 to 0.172, the resistivity digressed from 12000 Ω.cm for pristine P3HT to 72 Ω.cm for nanocomposite GP3HT respectively. Electrochemical impedance spectroscopy suggests that the superior performance of alternative current P3HT-graphene solar cells is due to their lower charge-transfer resistance between counter electrode and electrolyte. The large charge-transfer resistance of direct current solar cells is attributed to the existing of graphene nano plate. Ab ID: 45

P-3. A Measuring and Comparison Supermassive Black Hole Mass using Two Independent Techniques

Ismaeel Al-Baidhany, Marc Seigar, Patrick Treuthardt, Daniel Kennefick, Julia Kennefick, Ben Davis
University of Arkansas at Little Rock

In this study we measure and compare the masses of supermassive black holes (SMBHs) for a sample of ~40 spiral galaxies estimated by applying the correlations between SMBH mass and both hostgalaxy bulge luminosity, and pitch angle. We selected a sample of nearly face-on spiral galaxies and used IRAF to determine the ellipticity and major-axis position angle in order to deproject the images to face-on. We used two methods provide a determination of SMBH masses. We first method, we determine the spiral arm pitch angles using a 2D Fast Fourier Transform decomposition technique, and second we determined the bulge luminosity using a 2-D surface brightness profile modeling routine. We determine and compare SMBH masses for each of these galaxies using each method. Ab ID: 59

P-4. Characterization of Aluminum doped ZnO/PANI Hybrid Solar Cells Using Electro-polymerization Technique

Samir AbdulAlmohsin, Muatez Mohammed, Jingbiao Cui
University of Arkansas at Little Rock

The photovoltaic properties of AZO/PANI hetero-structure sandwiched between two ITO-coated glasses were studied. AZO films were deposited using sputtering technique while PANI films were deposited using electro-polymerization technique. Ab ID: 73

P-5. Schottky Diode Solar Cells by Using Electrochemical Polymerization of Polyaniline on the Au/Plastic

Samir AbdulAlmohsin, Muatez Mohammed, Jingbiao Cui
University of Arkansas at Little Rock

Schottky diode solar cells were fabricated by electrochemical polymerization technique to make polyaniline films on the top of gold nanoparticles film. The aluminum contact was deposited by thermal evaporation. The electro-optical characteristics of these devices were compared with different
polymerization time. Here we achieved the highest ever reported open-circuit voltage of 0.8 V with the electrochemical polymerization technique the films produced at the different polymerization time. The polymerization of poly aniline films was thought to be a major factor in enhanced performance. Effects of varying the polyaniline thickness the device performance were investigated. Ab ID: 74

P-6. Synthesis Study of the Optical properties of Sprayed ZnO and ZnO:Ga Thin Films

Nadir F Habubi, Sami S Chiad, Shaymaa A Jabbar, Wasmaa A Jabbar
Al Mustasiriyah University, Baghdad, Iraq

Characteristics and optical constant of pure and Ga-doped ZnO thin films have been studied. Pure and Ga doped zinc oxide thin films are deposited onto glass substrates using the spray pyrolysis technique. Optical absorption studies in the wavelength range (300-900) nm showed peak in the wavelength region 450 nm for different doped films, in addition to the peak for un-doped ZnO. Increasing the doping concentration of Ga up to 7% induces a severe increase in the optical constants of films. This increase is attributed to the formation of charge transfer complexes. ZnO thin films doped with Ga has been improved optical transmittance in the visible region. The addition of gallium also induces an obvious increase in the optical band gap of films; the optical band gap of Ga-doped films was slightly higher than that of undoped samples (3.1 eV). This study also found that the highest Eg =3.4 eV being observed for the film deposited with doping concentration of 5% gallium. Ab ID 84

P-7. Fabrication and Studies on CdS to be a N-P-N Solar Cell Junction

Muatez Z. Mohammed, Samir AbdulAlmohsin, Alaa A. AL-Hilo, Tar-pin Chen, Jingbiao Cui
University of Arkansas at Little Rock

We have fabricated CdS/MWCNT bi-layers. In this process CdS has been prepared by a simple and efficient chemical depositing method (CBD). The bi-layers were fabricated on (FTO) substrate and sandwich with MWCNTs thin film on n-Si to be fabricated as a transistor solar cell. The thickness of the CdS films is different for difference bi-layer. The materials which made the transistor solar cell (N-P-N) were characterized by XRD, SEM, EDX, Raman, UV and IV- characteristic. Experimental results show that CdS thin film with different thickness will act as a good n-type material for solar cell. The IV-characteristic shows the efficiency increase with increase the thickness of CdS thin film which resulting from increase chemical depositing time. Ab ID: 96

P-8. Double Shottcky of NiO/Graphene/Si for Enhance Efficiency Solar Cell

Muatez Z. Mohammed, Samir AbdulAlmohsin, Alaa A. AL-Hilo, Tar-pin Chen, Jingbiao Cui
University of Arkansas at Little Rock

A simple and effective method, the electrodepositing method, was used to fabricate a NiOx/graphene (PMS) bi layer Shottcky junction. An n-Si/graphene (NMS) Shottcky junction is then fabricated on top of the NiOx/graphene bi layer Shottky junction to form a double Shottcky solar cell. Thus this Double Shottcky combination contains an n-type nSi/grphene (NMS) Shottcky junction and a p-type NiOgraphene (PMS) Shottcky junction – an over all n-p junction. The thicknesses of the NiO film are different for different junctions and will perform as an excellent p-type substance for solar cell. To study the physical properties, SEM, EDX, UV, XRD, Raman, along with IV and spectroscopy experiment were carried out on the samples. The IV characteristic curves shown that the power conversion efficiency improved when electrodepositing time increases, i.e. the thickness of NiO thin film increases. Ab ID: 97

P-9. Particle size dependence of superparamagnetic blocking in magnetite (Fe_3O_4) nanoparticles

Joy D. Counts, Cristian E. Botez, Ronald J. Tackett
Arkansas Tech University, Russellville, AR

In recent years, driven by many factors including the push for consumer technologies that are lighter, stronger, and most importantly, smaller, the field of nanotechnology has been one of extreme activity. With this said, the need for a basic understanding of the underlying physics behind materials on the microscopic scale has never been more evident. This presentation will outline experimentation on nanoscale magnetite (Fe_3O_4), a common magnetic material which exhibits the interesting property of superparamagnetism when dimensionally constrained. Focus will be put on the synthesis of these particles as well as the characterization of their interesting magnetic properties. Ab ID: 98

P-10. Impervious Surface Area Change By County In Arkansas

Long E Daniel, Robert C Weih Jr
University of Arkansas at Monticello

Impervious Surface Area (ISA) is a measurement used to determine stream quality as well as urban sprawl. ISA was calculated as part of the National Land Cover Dataset (NLCD) using Landsat imagery by the Multi-Resolution Land Characteristics Consortium (MRLC) in both 2001 and 2006. ISA for each of the 75 counties in Arkansas was taken from the NLCD for both 2001 and 2006. Using the ISA data, percent imperviousness was determined for each county in each time period as well as the difference between the 2 periods. These data were also compared to census projections for the 2 time periods as well as the difference between them. The differences between percent ISA and census changes will be compared to determine overall trends on a county level. Ab ID: 123

P-11. Modeling Patient Flow in an Outpatient Clinic

Aaron L McMoran, R B Lenin, Hari Easwaran
University of Central Arkansas, University of Arkansas for Medical Sciences

University of Arkansas for Medical Sciences (UAMS) opened a new facility on west side of the town to cater to a rising demand for appointments from obstetrics /gynecology (OB/GYN) patients. One of the goals of the clinic was to provide an efficient service while minimizing the waiting times for the patients. In order to decrease the waiting time, it is essential that the clinic optimizes patient flow and resource utilization. One approach to this problem involves creating a computer simulated model of the clinic. This approach would

allow for certain changes to be made in the computer model to see if the changes would produce a more efficient system. The initial goal for this project was to successfully model the clinic, using a discrete-event simulation software called Medmodel, before the clinic was in full operation. This process involves a series of steps (problem definition, data collection, model building, verification, validation, experimentation, results, and analysis) that would allow us to successfully model the clinic.(Montgomery) The next goal was to accurately estimate nurse (RN) and patient representative (PR) hiring requirements while optimizing physician utilization and resource availability. After validating the model with data from a similar OB/GYN clinic, we were able to produce an optimal system that contained the appropriate amount of PR's and RN's for the new clinic. Ab ID: 135

P-12. Electrical and Physical Properties of Micropipettes Pulled from Borosilicate Glass

Nick S Martinez, Dr. Azida Walker
University of Central Arkansas, Conway, AR

The plasma membrane is one of the most important structures of the cell. Not only is the membrane the boundary between the inside and outside of the cell, it also acts as a gatekeeper regulating ion flow. Ion transport occurs at specific proteins that are embedded in the plasma membrane called ion channels. Understanding the structure and function of these channels have many applications in cellular physiology along with pharmaceutical research. The most popular method for studying ion channels is the patch clamping method. The principle of this method is to isolate a patch of membrane electrically from the external solution and to record ionic current. This is done by pressing a glass micro pipette that is filled with an electrolyte solution against a cell and applying suction. These pipettes are usually created on site by using a micropipette puller. The geometry of the pipette along with the type of glass being used are the determining factors for what type of resistance is produced. For this study a vertical micropipette puller was used to produce borosilicate glass micropipettes by using two methods; the one-step pull (commonly used for micro-injections) and the two-step pull (commonly used for patch clamping). The scanning electron microscopy technique (SEM) was used to show how the resistance varies with the tip dimensions. The data presented will compare the resistances of pipettes drawn from each method and confirm experimentally that the resistance is inversely proportional to the tip radius of the micropipette. Ab ID: 142

P-13. Compton Scattering and Topological Reconstruction of Gamma Rays in a Xenon Time Projection Chamber

Jeremy Dunklin[1], Abdel Bachri[1], and Azriel Goldschmidt[2]
[1]Southern Arkansas University, [2]Lawrence Berkeley National Laboratory

The role of the research group at the Lawrence Berkeley National Laboratory (LBNL) is to develop a prototype Xenon gas time projection chamber (TPC) as part of the Neutrino Experiment with a Xenon TPC (NEXT) collaboration. The primary advantage of the xenon gas TPC is that it gives both excellent energy resolution and the ability to map events within the chamber. Compton scattering is well understood, making it ideal for testing the TPC's ability to properly map event topology. Compton scattering occurs when an incoming gamma ray ejects an electron from an atom and scatters at an angle. The scattered gamma ray, having given some of its energy to the electron, then interacts with another atom, usually via the photoelectric effect. The Compton event can be reconstructed using the energies and positions of the two resulting electrons. After reconstructing the event, the scattered gamma energy can be calculated using the position of the electrons and then compared to the actual value measured in the TPC. After comparing these measurements, there has shown to be significant error in the scattering angle measurement. This discrepancy is due to the fact that the two electron tracks are actually quite long, meaning there is a substantial amount error regarding their actual original positions. Ab ID: 159

P-14. Energy Resolution Deterioration due to Recombination in High Pressure Xenon Detectors along Delta Electron Tracks

Kahli Remy[1], Abdel Bachri[1], and Azriel Goldschmidt[2]
[1]Southern Arkansas University, [2]Lawrence Berkeley National Laboratory

It has been shown that the energy resolution of Xenon degrades rapidly when the density of the Xenon becomes higher than 0.5g/cm^3, reaching a plateau in the liquid phase. The goal is to determine what the specific reasons for this are. The accepted explanation involves the creation of high energy (delta) electrons. The problem with delta electrons is that there are few made if any, and are unpredictable. Following a primary ionizing collision between an electron and a Xenon atom, one or more energetic electrons are ejected. Delta electrons are the small fraction of the ejected electrons possessing energies that maybe larger compared to the ionization potential of Xenon. Also because of the small number of delta electrons the statistical fluctuations can be very large. With delta electrons, energy loss per unit length goes up which leads to a higher chance that the Xenon atoms that lost electrons will grab free electrons in a process known as recombination. This is problematic for two reasons. First, the rate of recombination at high density is hard to predict. Even worse, it is difficult to determine how many delta electrons were made to begin with. The testing of this explanation and possibly developing a different explanation by running computer simulations in Garfield++ and Root is the focus of this paper. We will develop the Onsager Radius within the simulation. The Onsager Radius can be used to evaluate the rate of recombination at high pressures for xenon. We have only looked so far at up to 10.5 atmospheres xenon. The rate of recombination for that pressure is low, if any. In conclusion, the simulation needs to be analyzed further for high pressure xenon. But it does effectively output the Onsager radius value, and can run at higher pressures. We will be continuing work on this simulation. Ab ID: 161