

Friday, Mar. 4 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Mechanisms and Materials Challenges for Its Application

Presented by: Dr. Alex Ignatiev

University of Houston

The recently identified electric-pulse-induced resistance change effect in transition metal oxide thin films has opened the exciting new technology area of non-volatile resistive memory. Resistive switching has been identified in thin film transition metal oxides ranging from simple binary oxides to complex perovskite oxides. The resistance change device is a simple two-terminal electrode-oxide-electrode (M-I-M) device, in which electrical pulses of either opposite polarity or of increased duration can switch device resistance reversibly between high and low resistance states. Resistance switching under pulses as short as 10 nsec duration and 2-5 V amplitude has shown reversible resistance change of several orders of magnitude. However, suggestions on the mechanisms active in resistance switching in RRAM devices have been surprisingly diverse. Two general categories of mechanisms have emerged as models for the resistance change effect: oxygen vacancy motion and pile-up in complex oxides; and filament formation and 'breaking' in binary oxides. Both of these mechanisms will be discussed as will the optimization of performance of RRAM devices by modification of material properties that could reduce the fluctuations currently seen in switching parameters, and thus move the current devices to a level acceptable for technology application.

Monday, Mar. 7 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: The search for compact binary coalescence in association with short GRBs with the first-generation LIGO and Virgo detectors

Presented by: Dr. Nick Fotopoulos

California Institute of Technology

Gamma-ray bursts (GRBs) are fantastically powerful, faraway explosions. Every day, we detect light from these explosions with the several spacecraft that form the interplanetary network, but their mysteries endure. For a subset of bursts, the short-duration GRBs, the prevailing progenitor theory is that the explosions occur in the final stages of the inspiral of a neutron star with either another neutron star or a black hole. Such cosmic violence would make itself known also through an outpouring of gravitational waves. Detection of these gravitational waves would not only solve the astronomical puzzle of the origin of short GRBs, but also provide measurements of the equation of state for matter at super-nuclear densities, measure the dark matter and dark energy content in the Universe, and allow tests of Einstein's general relativity in the strong-field regime. I will describe a search for these gravitational waves using detectors from the Laser Interferometer Gravitational-wave Observatory (LIGO) and Virgo in their first-generation configurations.

Friday, Mar. 11 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Space Radiation Research at Prairie View A&M University

Presented by: Dr. Richard Wilkins

Prairie View A&M

Risks associated with particulate radiation pose critical challenges for the human and robotic exploration of space. In earth orbit, these risks are primarily associated with effects from proton and electron radiation from the sun, including trapped particles in the radiation belts. In interplanetary space, galactic cosmic rays (GCR) are also a substantial component of the radiation field. Earth-bound experimental and modeling studies examine ways to measure and mitigate the risks from space radiation for humans and instrumentation. Investigators at Prairie View A&M University have been studying space radiation effects and dosimetry for over fifteen years, using ground based radiation sources to simulate components of the expected space radiation environment. This talk will briefly review space radiation risks and associated studies performed at PVAMU. Also described are current research efforts focused on developing planetary surface testbeds for studies on radiation shielding, radiation interaction modeling, dosimetry, materials degradation, the space radiation environment, and radiation effects on electronics.

Friday, Apr. 8 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Normal Mode Analysis and Entropy Estimates for Multiscale Models of DNA

Presented by: Dr. Andreas Hanke

University of Texas at Brownsville

Multiscale modeling has become a major focus in computational biophysics in order to simulate systems of ever-increasing complexity. We use principles of polymer physics to model DNA on two different length scales. Atomistic length scales are studied in full atomic resolution by molecular dynamics simulation. Normal mode analysis is used to study the major modes of flexibility of short DNA molecules. On larger length scales, DNA is modeled as a discretized wormlike chain and studied by Monte Carlo simulations. Biological interactions seek to minimize the free energy $F = U - TS$. Thus the free energy of a biomolecule is a key quantity to understand biological recognition, protein folding, and DNA topology. While the computation of the internal energy U of biomolecules from simulation data is straightforward, the entropy S is notoriously difficult to determine. We show how quasi-harmonic analysis can be used to obtain entropy estimates for DNA plasmids of a few 1000s of base pairs.

Friday, Apr. 22 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Comparison of Signals from Gravitational Wave Detectors with Instantaneous Time-Frequency Maps Presented by: Dr. Alexander Stroeer

University of Texas at Brownsville

Gravitational wave astronomy relies on the use of multiple detectors, so that coincident detections may distinguish real signals from instrumental artifacts, and also so that relative timing of signals can provide the sky position of sources. I show that the comparison of instantaneous time-frequency and time-amplitude maps provided by the Hilbert-Huang Transform (HHT) can be used effectively for relative signal timing of common signals, to discriminate between the case of identical coincident signals and random noise coincidences, and to provide a classification of signals based on their time-frequency trajectories. The comparison is done with a χ^2 goodness-of-fit method which includes contributions from both the instantaneous amplitude and frequency components of the HHT to match two signals in the time domain. This approach naturally allows the analysis of waveforms with strong frequency modulation.

Friday, Sept. 2 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Stellar mass compact Object Binaries and the New LISA

Presented by: Dr. Matthew Benacquista

University of Texas at Brownsville

Dr. Matthew Benacquista will review the current status of the Laser Interferometer Space Antenna and potential modifications to the mission design. All Potential mission designs are still sensitive to gravitational radiation from the Galactic population of close white dwarf binaries, and some designs may be more sensitive to extragalactic black hole binaries. I will conclude with a discussion of the prospects for detection of these systems and the science that can be done with a detection.

Friday, Sept. 23 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Two Stories on Galactic Black Holes

Presented by: Krzysztof Belczynski

University of Texas at Brownsville and University of Warsaw

The Fate of Cygnus X-1:

Models of the binary system indicate that it will evolve to become a neutron star/black hole system.

Missing Black Holes Unveil The Supernova Explosion Mechanism:

In the rapidly growing population of remnants with observationally determined masses, a striking mass gap has emerged at the boundary between neutron stars and black holes. The heaviest neutron stars (such as the one in the binary system Vela X-1) reach a maximum of two solar masses, while the lightest black holes are at least five solar masses. Few, if any, remnants have been observed in between. At first this gap was attributed to a paucity of observations, and then as statistics improved, it was assigned to observational bias, as researchers preferentially sought heavier candidates to ensure the presence of a black hole. However, with recent determinations of the masses for more than 20 black holes, the gap has remained intact and become a significant challenge to our understanding of compact object formation. Over a decade after

this gap was initially noted, we offer the first insights into the physical processes that bifurcate the formation of remnants into

lower mass neutron stars and heavier black holes. Combining the results of full stellar modeling (including detailed treatment

of nuclear burning inside progenitor stars) with multidimensional hydrodynamic simulations of supernova explosions in which

remnants are formed, we both explain the existence of the gap, and also put stringent constraints on the inner workings of

the supernova explosion mechanism. In particular, we show that the explosion is driven by Rayleigh-Taylor instability and

launched within first 200 milliseconds after a star collapse.

Friday, Oct. 7 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Mapping the Galaxy with LISA

Presented by: Jose McKinnon

University of Texas at Brownsville

Binary stars are a source of gravitational wave and the Laser Interferometer Space Antenna (LISA) will be used to detect and obtain valuable information describing the gravitational wave like amplitude, frequency, phase, and angle locations for example. The parameters obtained will uniquely describe each binary and knowing how effective LISA will be to detect these binary stars will help to construct the shape of the galaxy with little or no errors. Selecting binaries that stand out the initial LISA signal to noise ratio threshold have a better chance to be detected with less noise on the gravitational wave signal. The parameters of these resolved binaries are then fed into the Fisher code we have implemented to obtain the expected errors in the parameter estimation if a true data analysis were performed. These signals are then regressed from the initial LISA signal and the process is repeated until no binaries meet the detection threshold. A Matlab Fisher Matrix code was implemented in order to study how LISA observations of Galactic compact object binaries can be used to better understand

Galactic structure. The code simulates the results of data analysis and estimates the variance and covariance of recovered parameters. We will use the recovered parameters to estimate Galactic structure. Here we present first results applied to a standard Galaxy model. These data indicates that the errors found are well defined and can precisely relocate each resolved binary star.

Friday, Oct. 14 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Understanding black hole plunges

Presented by: Dr. Richard Price

University of Texas at Brownsville

Black hole binary mergers consists of three epochs. The first (gradual quasi-Newtonian, quasicircular lazy inspiral), and the last (black hole ringing) are well understood. What is not understood is the "plunge," the transition from the first to the last epoch. A study of the gravitational wave patterns of this transition has so far provided remarkably common-sense explanations of some features, in particular the mysterious "antikick," and suggests the direction for a more general understanding of the dynamics of this epoch.

Friday, Oct. 21 at 10:00am

Where: Cavalry Building (CGWA conference room)

Summer Physics Internships (Part 1: UTB Students at MIT)

Title: Characterization of nano-scaled strained Si/Ge heterostructures

Presented by: Liliana Ruiz-Diaz

In the Microsystem Technology Lab nanoscale strained Si/Ge heterostructures are being developed and investigated. The interest in these materials stems from their extremely high carrier mobility which has applications in low power and high performance electronics, particularly in MOS transistors. The project objective of the summer internship was to analyze the electrical and material characteristics of MOS Capacitors, key component of MOS transistors, composed of strained silicon / strained germanium hetero-junctions. This analysis included capacitance-voltage (CV) measurements, from which information about the line-up of the energy bands can be extracted. Furthermore, the task was to obtain the layer thicknesses with a scanning electron microscope (SEM), and the examination of the surface morphology of the structure by using an Atomic Force Microscope (AFM).

Title: Development of an Ionic Liquid Ion Source for Space Propulsion Applications

Presented by: Sergio H. Cantu

Ionic Liquid Ion Sources (ILIS) are being investigated for potential use in a wide range of applications, such as space propulsion. Despite advances in this field, there is still much to learn about ILIS and electro spray propulsion.

One of the biggest issues is the role of electrochemistry in the performance of electro spray propulsion devices. The project goal is to develop a device that completely removes the electrochemical effects in the electro spraying process. Our approach is to introduce novel materials into the device that will aid in the transport of ions throughout the ionic liquid. If successful, this experiment will settle whether or not electrochemistry is essential in ILIS devices.

Friday, Oct. 28 at 10:00am

Where: Cavalry Building (CGWA conference room)

Summer Physics Internship (Part 2: UTB Students at Caltech)

Title: Development of electronics platforms for in situ thermal infrared imaging

Presented by: Steven Shoen

Portable imaging often requires a robust control platform, capable of resolving a wide range tasks over various clocking domains. Like many portable systems, remote imagers have come to rely heavily on microprocessors for nearly all processes. Yet, problems like crosstalk, skew and jitter have limited the functionality of microprocessors when dealing with a wide range of timing domains. Another family of logic devices, Field Programmable Gate Arrays (FPGAs), has been shown to be capable of driving many such systems without many of the timing related errors experienced by microprocessors. An introduction to the FPGA based design process will be given, and the functionality of the two platforms will be discussed. The architecture of both logic devices will be discussed in the context of remote imaging systems, and some exciting applications being developed by the Infrared Photonics Group at JPL will be presented.

Title: Long-Term Stability Tests of First-Article Advanced LIGO Optical Levers

Presented by: Gregorio Tellez

In Advanced LIGO, the Optical Levers subsystem will serve to monitor the alignment of all the large suspended optics and most of the HAM tables. Each lever consists of various mechanical, electrical and optical components which must be characterized to assure that they meet standards of stability over long periods of time. During the summer of 2011, we performed long-term stability tests of the first-article Test Mass Optical Lever at the Hanford Observatory (LHO). These tests were performed in the Mid-Y VEA, from which the BSC chamber was recently extracted. Results and development on this summer's task will be discussed along with work in progress for further improvement.

Friday, Nov. 4 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: UTB at the top of the world or are gravitational waves visible?

Presented by: Dr. Mario Diaz

University of Texas at Brownsville

Over the past few years the astronomical community have promoted a method called Multi-messenger astronomy. This is the combined effort of different kinds of instruments and scientists to understand and study together a given astrophysical phenomenon or event. With the advent of Advanced LIGO and the new generation of gravitational wave detectors Multimessenger Astronomy will become a very rich reality. In this seminar I will explain how optical astronomy can complement gravitational wave detection through modern interferometers. I will also discuss efforts already started during the last scientific run with several telescopes around the world. I will then describe a pilot project at UTB to install an optical observatory in the high Andes mountains of the Argentine Puna, and the prospective of it joining a multi-messenger astronomy effort before and during advanced LIGO.

Friday, Nov. 11 at 10:00am

Where: SETB, 3rd floor, Conference Room

Title: Some random remarks about fractals and chaos

Presented by: Joe Romano

University of Texas at Brownsville

The study of chaotic systems is a relatively new area of research (roughly 50 years old), spurred on in part by easy access to computers. The ability to quickly iterate a calculation hundreds or thousands of times, and then to display the results in interesting ways, has led to many discoveries that were hidden from earlier generations of scientists and mathematicians who lacked such tools. The Mandelbrot set, Lorenz attractor, logistic equation, and Feigenbaum number are iconic symbols of this field. Yet they are very seldom--if ever--taught as part of the standard curriculum, even though much of the requisite mathematics is at the highschool level---e.g., calculus is generally NOT required. In this presentation, I will try to explain a few of the basic ideas underlying fractal structures and chaotic systems, and show some surprising (at least to me) connections between the above-mentioned icons. This is a pedagogical talk, not a research seminar, and is geared more for students.

Friday, Dec. 2 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Pulsar Search Results from the Arecibo Remote Command Center

Presented by: Kevin Stovall

Ph.D. Student at UTB/UTSA

In recent years, there has been a large effort to find many new pulsars, particularly millisecond pulsars, which can be used

in pulsar timing arrays with the goal of detecting gravitational wave signatures. There are four large scale recent or ongoing

pulsar surveys using one of either the Arecibo Observatory in Puerto Rico or the Green Bank Telescope in West Virginia. I

will describe these four surveys and present recent discoveries.

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