Friday, Feb. 5 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Particle Swarm Optimization: application to Gravitational Wave data analysis

Presented by: Dr. Soumya Mohanty

UTB/TSC

The detection and estimation of gravitational wave (GW) signals belonging to a parameterized family of waveforms requires, in general, the numerical maximization of a data-dependent function of the signal parameters. Due to noise in the data, the function to be maximized is often highly multi-modal with numerous local maxima. Searching for the global maximum then becomes computationally expensive, which in turn can limit the scientific scope of the search. Stochastic optimization is one possible approach to reducing computational costs in such applications. We report results from a first investigation of the Particle Swarm Optimization (PSO) method in this context. The method is applied to a testbed motivated by the problem of detection and estimation of a binary inspiral signal. Our results show that PSO works well in the presence of high multimodality, making it a viable candidate method for further applications in GW data analysis.

Friday, Feb. 10 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Gravitomagnetism

Presented by: Dr. Carlos Kozameh

University of Cordoba, Argentina

In this talk we will review the Lense-Thirring effect for slowly rotating gravitational bodies. In this limit, the Einstein field equations are similar in form to the standard maxwell equations for the electric and magnetic fields. Thus, one of the striking consequences is that particles move under the action of a fictitious Lorentz force, with the electric force being the standard newtonian field and a magnetic force depending on the angular velocity of the gravitational source. This effect was predicted in 1918 but only recently has been measured. We will review these measurements and in particular, the remarkable saga of Gravity Probe B, an almost failed experiment that in the end met success.

Friday, Feb. 19 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: The New Nuclear Physics and Isoscaling

Presented by: Dr. Jorge Lopez

University of Texas at El Paso

The newest area of nuclear physics is that involving radioactive nuclei, and "isoscaling" is a new effect observed in such reactions. Preliminary studies show that isoscaling can help us understand the nuclear force in cases with excess numbers of neutrons which, in turn, can shed some light on the workings of astronomical objects such as neutron stars, supernovas, etc. This talk will introduce this new field of nuclear physics along with its newest effect, isoscaling, and will show that this effect is not limited to nuclear reactions but is rather a more general effect present in all sorts of disassembling systems.

Friday, March 12 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Cosmology Group

Presented by: Dr.Mustapha Ishak

University of Texas at Dallas

For more than a decade, a number of cosmological observations have been indicating that the expansion of the universe is

accelerating. Cosmic acceleration and the questions associated with it have become one of the most challenging and

puzzling problems in cosmology. Cosmic acceleration can be caused by i) a repulsive dark energy pervading the universe,

ii)an extension to general relativity that takes effect at cosmological scales of distance, or iii) the acceleration may be an

apparent effect due to the fact that expansion rate of space-time is uneven from one region to another in the universe. I will

review the basics of these possibilities and provide some of our recent results on these questions.

Monday, March 29 at 1:00pm

Where: Cavalry Building (CGWA conference room)

Title: Challenges in Gravitational Waves Detectors

Presented by: Dr.G.Cagnoli

INFN Perugia, Italy

The development of gravitational wave detector offers continuously technological challenges that have to be faced and won.

The presentation will focus the attention on the detectors based on laser interferometers (GEO600, LIGO, Virgo and their .

upgrades) and in particular on thermal noise related problems found on dielectric coatings, test masses and suspensions

Information on the design study for the third generation detector Einstein Telescope (ET) will be given as well. Finally, the

most recent problem related to the residual gas and discovered by the LISA scientists in Trento and relevant for LIGO will be

briefly addressed.

Friday, April 9 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Black Hole Binaries in Star Clusters

Presented by: Dr. J. Downing

University of Heidelberg

Mergers of black hole-black hole (BH-BH) binaries are some of the most promising sources for the current generation of ground-based gravitational wave detectors and, at larger separation, may be LISA sources as well. BH-BH binaries are, however, likely to merge or be disrupted due to stellar evolution before they enter the gravitational wave regime. Dynamical interactions in star clusters provide a means of producing BH-BH binaries independent of stellar evolution and thus may increase the BH-BH binary detection rate. I will review some of the methods for modelling star clusters and discuss how they can produce BH-BH binaries. I will then present some results from recent simulations that constrain the characteristics of the BH-BH binary population in globular clusters and predict LIGO and LISA event rates.

Tuesday, April 13 at 9:00am

Where: Cavalry Building (CGWA conference room)

Title: Emerging Opportunities of Nanoscience for Energy, Environmental and Biomedical Applications
Presented by: Dr. K. Martirosyan

University of Houston

Recent advances in nanoscience are providing capabilities to organize materials at the molecular level into complex patterns

using various novel assembly approaches. This talk will summarize our current progress towards developing a framework of

principles for design and fabrication of nano tailored structures to use in sustainable energy, environmental protection and

biomedical applications. The fabrication methodologies and performance of various solid-state systems such as energy

harvesting devices, nano-textured magnetostrictive platforms for positioning and optical correction systems, hybrid magnetic

components for high performing power systems, superconductors, multiferroics, environmental photocatalysts,

thermosensitive MRI contrast agents for drug delivery and cancer therapy will be presented. Recent research breakthroughs

in the integration of nanoenergetic component into micro-electro-mechanical systems (MEMs) for fabrication o f

"nanoenergetics-on-a-chip" and micropropulsion devices also will be highlighted. The development of nanoenergetic

micropropulsion systems and magnetostrictive based platforms can be potentially implemented for the space gravitational-

wave detection for LISA precise correction systems. The talk will conclude with a brief discussion of emerging applications o

nanoscience to the educational program and US economy.

Friday, April 16 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Fabrication and Testing of Three Dimensionally Reinforced Laminated Multifunctional Nanocomposites Presented by: Dr. D. Askari

Dept. of Engineering, University of Texas at Brownsville

The discovery of various nano-materials with their exceptionally high and outstanding properties has opened new doors and opportunities for engineering novel nano-structured materials and nano-devices. Among the many different types of nanomaterials, carbon nanotubes (CNTs) with their unique and nearly one-dimensional tubular structures have been the most interesting nanostructures ever introduced due to their excellent mechanical, thermal, electrical, optical, and chemical properties. CNTs can be used for the reinforcement of polymers to create novel nanotube based nanocomposites with tunable properties and multifunctional behaviors. Owing to the fact that the properties of CNTs follow their quality and

characteristics, it is necessary to have substantial control over the growth of the CNTs and fundamentally understand their

growth mechanism and identify the growth parameters.

Chemical vapor deposition technique is employed to grow vertically aligned high density arrays of CNTs. To incorporate the excellent properties of CNTs into the existing traditional composite technology, the growth of CNTs perpendicular to the surface of treated 2-D woven cloths and tows of various microfibers, such as glass, Kevlar, silicon carbide, and carbon, have been successfully demonstrated in this work. These 3-D novel nanoforests-like fabrics can be used to fabricate hierarchical 3-D multifunctional nanocomposites. It is expected that the presence of vertically aligned CNTs in through-the-thickness direction and in between the adjacent fabric layers of the laminated composite can considerably enhance the inter-laminar and through-the-thickness properties of the composite laminated structures. To demonstrate the effectiveness of our approach, various composite single lap-joint specimens were fabricated for interlaminar shear strength testing. It is observed that single lap-joints with carbon cloth insertion layers having CNTs nanoforest can carry considerably higher shear stresses and strains. This concludes that the adhesion of adjacent carbon fabric layers can considerably be improved due to the growth of vertically aligned CNTs nanoforest in through-the-thickness direction.

Monday, April 19 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Polymer-Based Nanocomposites

Presented by: Dr. Mircea Chipara

UTPA

The colloquium will consist of two parts; the first one will be a brief introduction to the field of nanoscience and nanotechnology. Most important steps in the development of nanoscience and nanotechnology will be presented. The novelty and the main scientific features of the nano-revolution will be briefly discussed. The second part of the colloquium will concentrate on my recent research on nanoscience and nanotechnology at The University of Texas Pan-American (since 2006), with emphasize on polymer-based nanocomposites i.e. materials that are obtained by dispersing nanometersized fillers within polymeric matrices. The second part will include a brief discussion of the structural, mechanical, thermal, and electrical features of polymer-carbon nanocomposites (obtained by dispersing carbon nanofibers, single walled carbon nanotubes, or multiwalled carbon nanotubes within various polymeric matrices), a short presentation of magnetic nanocomposites, and a concise analysis of electrorheological materials. Exotic applications of nanocomposite materials in extreme environments such as nuclear plants and space will be briefly presented. The second part will conclude with a succinct presentation of present work and future research. The colloquium will provide a basis for technical and scientific discussions regarding the field of nanoscience and nanotechnology will present the experimental capabilities available at UTPA as well as future research directions aiming to ignite collaboration(s) and joint projects in this emerging field of science.

Friday, April 23 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Optics, Interferometry, and Differential Geometry of LIGO

Presented by: Dr.M. Rakhmanov

UTB/TSC

The Center for Gravitational Wave Astronomy at UTB is heavily involved in searches for gravitational waves with LIGO -- the

Laser Interferometer Gravitational-wave Observatory. With the recent upgrade last year, the LIGO detectors have becom e

more sensitive than ever, reaching far into the Universe, and analyzing the data for potential gravitational-wave emission.

The science of the detectors and the physical principles on which they are built are as fascinating as the search itself. In this

talk, I will describe some of the most interesting properties of the detectors basic elements -- the 4-km long Fabry-Perot

cavities, their interferometric and dynamic responses, and will analyze how these classical devices operate in the realm o f

general relativity ruled by the rigorous laws of differential geometry.

Friday, April 30 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Double-Negative Behavior of Two-Dimensional Periodic Passive Arrays

Presented by: Dr. F. Urbani

UTB/TSC Department of Engineering

Since 1967 when Victor Veselago theoretically predicted that special materials could exhibit a negative refractive index, engineers and researchers around the world have set out to study the advantages that could originate from such an unusual property. Recent years have seen an unprecedented growth in the research directed at the use of novel engineered materials containing characteristics not found in nature. This research includes the design of microwave antennas and devices. The studies in this area have shown increased directivity and bandwidth, reduced observability, and frequency shift. Out of the numerous classifications and characterizations that have been proposed in literature, this presentation will focus on left-handed metamaterials. The concept of left-handed or double-negative (DNG) materials plays an important role in science and technology for its broad range of applications including artificial dielectrics; lens; absorbers; antenna structures; optical and microwave components; frequency selective surfaces; and composite materials. DNG materials are artificial structures with electromagnetic properties different from conventional materials. Both their permittivity and permeability can be

negative over a certain frequency range. A DNG material consists of a periodic assembly of identical conductive elements arranged in a two-dimensional array. In this talk the numerical and experimental analysis of a periodic planar structure designed and manufactured in the Applied Microwave & Electromagnetic Laboratory at UTB are presented. Several simulations and measurements comparisons will be shown along with possible applications of such new artificial material.

Friday, June 4 at 11:00am

Where: Cavalry Building (CGWA conference room)

Title: Artificial Neural Networks: A Robust Classification Tool for Astronomy

Presented by: Dr. Ranjan Gupta

IUCAA

Artificial Neural Networks (ANN) have been known as a powerful tool for pattern recognition in various applications over past several years since the multi-layer-back-propagation algorithm (MBPN) was developed. In the recent years, ANN have been successfully used in classification type applications in Astronomy.

The talk would highlight ANN as a tool for pattern recognition in general and Astronomical applications in particular. It would also review the stellar spectral classification trends and new applications carried out by our group recently viz. extracting stellar atmospheric parameters from observed stellar spectra, determination of color excess from IUE-UV spectra and use of PCA as a pre-processor for ANN applications. Its application to a fairly large sample of 2000 spectra of IRAS and subsequent classification results will be shown. Recent applications of ANNs by our group are on the large 1273 spectra of CFLIB INDO-US spectral library and estimation of interstellar extinction from UV simulated satellite data etc. and star-galaxy classification for upcoming satellite missions TAUVEX/ASTROSAT/GAIA etc.

Monday, July 12 at 10:00am

Where: Cavalry Building (CGWA conference room)

Title: Standard Cosmology & beyond with CMB

Presented by: Tarun Souradeep

IUCAA

Recent years have seen the emergence of a "standard" model of cosmology -- a geometrically flat, Lambda-Cold Dark Matter FRW model. I will review the underlying evidence in the Cosmic Microwave Background (CMB) measurements. Further, the exquisite quality of CMB data allows for meaningful searches for subtle deviations from (and/or the validation of) certain basic assumptions that may prove key to identifying the physics of the early universe. I will touch up on some aspects of these efforts.

Wednesday, August 11 at 1:00 pm

Where: Cavalry Building (CGWA conference room)

Title: Bayesian Nested Sampling and Gravitational Wave Dat Analysis

Presented by: Philip Graff

University of Cambridge Queens' College

Current gravitational wave detection pipelines used in LIGO implement a templatebank search. As we use higher-

dimensional templates and require a more thorough analysis, this will no longer be a good way of analysing data. Bayesian

inference provides a solution by giving a full probabilistic result. Nested sampling offers a way to perform this analysis more

efficiently and its implementation i the MultiNest algorithm is also very robust in handling all types of degeneracies. I will

describe Bayesian inference and nested sampling with its use in MultiNest. I will then show how this has been used for the

detection of burst signals in mock LISA data andcan also be used for burst model selection.

Friday, August 27 at 10:00 am

Where: Cavalry Building (CGWA conference room)

Title: Molecular Master Key for Cell Entry

Presented by: Dr. Juan Guevara

University of Texas at Brownsville

Several human pathogenic viruses have been shown to gain cell entry via the low-density lipoprotein receptor (LDLr) and/or related receptors. LDL, the "Bad Cholesterol", includes a large heterogeneous population of lipid and protein particles which are produced by the liver and are secreted into the plasma compartment. The two important proteins in these lipid transporting particles are apo B100 and apo E. Apo B100 is a large, partly hydrophobic molecule comprised of 4,536 amino acids. Apo E is a smaller protein of 299 amino acids. For the last 4 decades, the only function ascribed to these proteins is that of transport and delivery of lipids, which may be a minor role. The true function(s) of these proteins is still a mystery. We have shown using electrophoretic mobility shift assays that LDL, particles in which apo B100 represents a major fraction of the its protein constituents, and VLDL, particles with apo E as it dominant protein, both bind to nucleic acids, DNA and RNA. Proteolytic digestion of the particle destroys its nucleic acid binding capacity. Our thorough study of the primary structures of both apo

B100 and apo E revealed similarities to known DNA and RNA binding domains in cytoplasmic signaling proteins of the Interferon Regulatory Factors which are key elements in the immune response to viral infections and malignant transformation. Sequence comparison analysis also showed that these apolipoproteins contain Lysine/Arginine clusters and motifs present in the polyproteins of flaviviruses including dengue,hepatitis c virus, west nile virus, yellow fever virus, rocio virus, and Japanese encephalitis virus. The polyprotein undergoes proteolytic cleavage at specific sites to yield 3 structural proteins (including the capsid and the envelop proteins) and 7 non-structural proteins.Interestingly, the N-terminal region of apo B100 and the receptor ligand region of apo E shar the K/R-X-X-K/R sequence motifs present in the viral capsid and envelope proteins. We have shown that K/R-X-X-K/R-containing synthetic peptides representing of N-terminus of apo B100 have the capacity to bind DNA, deliver to the cell perhaps via the LDLr or related receptors, and translocate the nucleic acid to the cell's nucleus. We explore the significance of several sequence motifs for cell entry and nuclear translocation of human apolipoproteins and viral proteins.

Friday, October 1 at 10:00 am

Where: Cavalry Building (CGWA conference room)

Title: Elastic deformation of initial LIGO test masses induced by actuation and calibration forces
Presented by: Pablo Daveloza

University of Texas at Brownsville

Large-scale interferometric gravitational-wave projects, for example LIGO, VIRGO, GEO600, are based on Michelson interferometer composed of optics, also called “test masses”, suspended as pendula. It was shown that, the local deformation of the test masses affect the response of the interferometer at high frequencies (above 1kHz). In this study, Finite Element Analysis is used to model how actuation or calibration forces could produce elastic deformation in the initial

LIGO End Test Masses which will affect the calibration of the interferometer. The simulations show that above 1kHz, the Optical Shadow sensor and Magnetic actuator produce elastic deformation of the mirror, changing the shape of the sensed surface producing perturbation in the response of the interferometer.

Friday, October 8 at 10:00 am

Where: Cavalry Building (CGWA conference room)

Title: Stellar Black Holes Across the Universe

Presented by: Dr. Krzysztof Belczynski

University of Texas at Brownsville

I will refresh data, both observational and theoretical, on known stellar mass black holes (the black holes that form out of ordinary stars). Then I will show that these black holes are much different than previously believed in the context of gravitational radiation observations. Time permitting, I will also

comment on the nature of the most distant known objects in Universe: ultra-high redshift Gamma-ray bursts and their connection with stellar mass black holes.

Friday, November 5 at 10:00 am

Where: Cavalry Building (CGWA conference room)

Title: Towards the Next Generation Magnetic Technologies

Presented by: Dr. Dmitri Litvinov

University of Houston

This presentation will outline the state-of-the-art in magnetic data storage, signi?cance of the superparamagnetic limit with respect to extending magnetic recording beyond the one Terabit/in2 mark, possible routes for future technology development, and the need for advanced nanomanufacturing tools.The advantages of bit-patterning for next generation magnetic recording systems will be discussed. Bit-patterned medium recording, where the data are stored in arrays of discrete elements, nanomagnets, is projected to enable recording densities in excess of 40 Terabit/in2.

Our team has prototyped patterned medium prototypes using ion-beam proximity lithography (IBPL). We have applied this prototyping capability to develop exchange-coupled high anisotropy magnetic multilayers designed for bit-patterned medium, to understand the origins of switching ?eld distribution in high anisotropy nanostructured arrays, to study the recording physics of bit-patterned arrays. The research has resulted in the signi?cant expansion of the knowledge-base on bitpatterned medium recording needed for read/write systems design.

Beyond magnetic recording, scaling into the nanoscale has led to nanomagnetic phenomena taking over the conventional device physics with all its challenges and opportunities. Nanomagnetic systems have their functional magnetic building blocks smaller than the characteristic length, the domain wall thickness, of the constituent magnetic materials. Such single magnetic domain building blocks promise to enable unprecedented functionalities far beyond what is achievable in conventional macroscopic systems. The applications of nanomagnetic concepts to systems of technological interest such as magnetic random access memories, magnetic biosensors, and magnetic logic will be outlined.

Friday, November 12 at 10:00 am

Where: Cavalry Building (CGWA conference room)

Title: Discrete analog of Maxwell-Morse theory and its applications to Image Processing

Presented by: Dr. Oleg R. Musin

University of Texas at Brownsville

In differential topology, the techniques of Morse Theory give a very direct way of analyzing the topology of a surface (manifold) by studying functions on that manifold. There are many applications of

this technique in mathematical physics, dynamical systems, mechanics etc. In fact, it was first considered by J. C. Maxwell in 1870. Maxwell suggested to analyze a landscape based on critical points (maximums, minimums, and saddle points) and structural lines (or watersheds and channels), (or seperatricces). During the 1990s I participated in several projects where we investigated possible applications of Morse Theory to image analysis to compression, pattern recognition, medical images, and so on. In this talk I am going to discuss a discrete analog of the theory and results of its applications to Image Processing.

This talk does not assume any special knowledge of topology and relies only on basic Cal 3. I am considering this talk as an invitation for a discussion about further collaboration between departments in our college.

Friday, November 19 at 10:00 am

Where: Cavalry Building (CGWA conference room)

Title: Restrictions of Standard Approximation Techniques and "New" Approach for Signal Processing
Presented by: Dr. Vesselin Vatchev

University of Texas at Brownsville

In Signal Processing the task is to extract features of a particular signal or function. The signal could be an observation or a model function. In Approximation Theory one aims to develop easy to implement methods that provide good approximation for classes of functions. Usually the classes depend on the smoothness of the functions measured in different norms. The two main tools for establishing the "goodness" of an approximation method are Jackson (Direct) and Bernstein (Inverse) type results. The Bernstein type results restrict the growth of the approximant (locally and globally) and consequently the variety of features that the approximant could inherit from the function. In the talk a new method for localizing "significant" changes in 1-D signals will be presented. The Bernstein restriction is replaced by an adaptive local "growth" estimate that preserves the growth of the function and in turn provides better approximation using less information. The essence of the method is to consider a partition by the inflections of the functions and to determine a second-order differential operator on each subinterval with minimal energy.

For images or terrains the analogue uses the partition that Dr. Musin presented on November 12 but there is an extra step to determine the optimal operator on each of the cells. Relation to statistical methods that lack Bernstein type results will be considered.

Friday, December 3 at 10:00 am

Where: Cavalry Building (CGWA conference room)

Title: Exploratory data analysis strategies for gravitational wave detectors

Presented by: Dr. Alexander Stroeer

University of Texas at Brownsville

Exploratory data analysis (EDA) strategies pro-actively analyze data for unknown features and suggest a hypothesis to explain them. Gravitational wave (GW) astronomy is a research field primed for the use of EDA due to the unknown nature of real detected signals and their properties, with adaptive Bayesian inference found to be one particular useful realization. EDA is a relatively novel concept and thus in flux and development, e.g. with current adaptive Bayesian inference GW algorithms still having difficulties to cope with the likelihood surfaces of known complex waveforms (LIGO) or the sheer mass of simulated overlapping systems (LISA. I will present the state-of-the-art in the field, and offer thoughts and concepts for its future.