Friday, Jan. 27

Title:Critical Coupling Likelihood: Motivating CCL development and some early results of CCL applied to the GEO observatory data

Presented by:Dr. Cristina Torres

Research assistant professor with the CGWA

As part of LIGO's search for gravitational waves (GW) we find ourselves trying to determine if unwanted or unknown sources of noise are coupling into the output of interferometric GW detectors. There are two components to efforts trying to understand noise in a GW detector, one is understanding how noise affects the GW search algorithms, the other is understanding the physics of how the noise couples to affect the physical GW detector. I will talk about a new method being developed called the Critical Coupling Likelihood method. This method is one of many new methods being actively developed in the GW data analysis community whose aim is to quantify the operating state of a GW detector. In aLIGO, we expect regular GW detections to be common place and as such knowing how good or poor the data quality is at a given moment willbecome important. In addition to that, one needs flexible tools to help characterize the hundreds of subsystems contained in an aLIGO era detector which will be far more complex that either the iLIGO or eLIGO detector configurations. Getting ready for GW searches in aLIGO is a daunting task, and CCL is a new tool being developed for inclusion in an aLIGO detector characterization toolbox.

Friday, Feb. 3

Title:Measuring the dark matter equation of state and its cosmological consequences

Presented by:Mariano de Leon Dominguez

Observatorio Astrónomico de Córdoba

The nature of the dominant component of galaxies and clusters remains unknown. While the astrophysics comunity supports the cold dark matter (CDM) paradigm as a clue factor in the current cosmological model, no direct CDM detections have been performed. Recently, Faber and Visser (2006) have suggested a simple method for measuring the dark matter equation of state. By combining kinematical and gravitational lensing data it is possible to test the widely adopted assumption of pressureles dark matter. According to this formalism, we have measured the dark matter equation of state using improved techniques and observations and find that is not as expected.In the light of this result, we can now suggest that our understanding of the gravitational processes involved in structure formation is incomplete unless a complete general relativistic analysis is used. We have tested our techniques using simulations and we have also analyzed possible sources of errors that could invalidate or mimic our results.We explore the consequences of such measurement on the homogenous FRW universe dynamics and build an alternative cosmological scenario to the standart Lambda CDM universe. The new paradigm is based on the introduction of an effective scalar field reemplacing the undetected components of the dark sector: dark matter and dark energy in the form of acosmological constant. We compute a minimal set of cosmological parameters wich allow us to reproduce several observational

results like baryon abundance, constrains on the age of the universe, the astronomical scale of distance and the high redshift supernova data with a high degree of precision.

Friday, Feb. 17

Title: Searching for Additional Sources of Time-reversal Violation Through Polarized Particle Collisions
Presented by: Dr. Guanghua Xu

Physical Science Department of South Texas College

We first prove that the minimum standard model, with the inclusion of the CKM-matrix, requires the T-odd/P-odd total cross section of two spin-1/2 particles to vanish in all orders. Then we study the contribution to T-odd/P-odd total scattering cross sections of various channels from the Higgs sector, and optimize conditions for possible experimental measurements of these effects. These studies show that such contributions can appear at tree level, and that the spin dependent cross section asymmetry is measurable if the lightest Higgs particle is not too massive, e.g. mH â‰¼ 200GeV , and if suitable reaction channels, beam energies, and luminosities are chosen.

Thursday, Feb. 23

Title: Roles of Pel and Psl in very early biofilm development

Presented by: Dr. Benjamin Cooley

Dr. Vernita Gordon's group at UT Austin

Biofilms are dynamic, multicellular communities of unicellular organisms. Biofilms cause many chronic infections; an important case is the opportunistic human pathogen Pseudomonas aeruginosa. Bacteria in biofilms produce an extracellular matrix that binds bacteria to each other and to a surface. The two primary extracellular matrix components produced by P. aeruginosa are the polysaccharides Pel and Psl. Here we examine the roles of Pel and Psl in the very early stages of biofilm development, just after initial surface attachment. We use high-throughput automated tracking and analysis to compare wildtype bacteria with mutants incapable of producing Pel, Psl, or both. We examine motion on a surface as well as interbacterial interactions. These results quantify the unique roles played by Pel and Psl and show an unexpected relationship between Pel expression and adhesion to a surface.

Friday, Mar. 2

Title: Searching for gravitational waves from compact binary coalescence

Presented by: Dr. Ruslan Vaulin

LIGO Scientific Collaboration

General theory of relativity predicts that binary systems consisting of massive, compact objects (e.g. neutron stars and/or black holes) radiate their energy in the form of gravitational waves. In the last

stage of this process, when the compact objects inspiral in close orbits and eventually coalesce, the gravitational-wave signal is the strongest and is detectable by the ground based detectors such as LIGO and Virgo. If detected, it will not only serve as a direct confirmation of the general theory of relativity, but also provide invaluable information on the gravity in the strong field regime and the physics of neutron stars and black holes. In anticipation of the start of the advanced LIGO and Virgo detectors at around 2015, I will review the methods and strategies that are used to search for gravitation waves from coalescing binaries illustrating them with some of the results from the recent scientific runs of the initial LIGO and Virgo detectors. When discussing prospects of observing coalescing binaries with advanced detector network I will focus primarily on new and rapidly developing multi-messenger program in which central role is given to the low-latency searches with followup observations of interesting candidates by optical, X-ray and radio telescopes. While presenting with new challenges in implementation and data analysis, this approach offers exciting possibility of observing binary coalescence in multi-wavelengths thus providing a complete picture of the process.

Friday, Mar. 9

Title: The search for indicators of prostatic cancer during the early stage biotecnology

Presented by: Dr. Juan Guevara

UTB Physics Department

The etiology of prostatic carcinomas remains unknown. In January 1980, the Urology Research Laboratory at M.D. Anderson Hospital and Tumor Institute at the Texas Medical Center was established to explore new methods for detecting early stage urogenital malignancies. Two-dimensional polyacrylamide gel electrophoresis (2D-PAGE), which can resolve proteins according to their native/intrinsic properties including surface charge and molecular mass, was used to analyze human body fluids and tissues. Samples, obtained from individuals who were asymptomatic and with no clinical evidence of disease and from individual with confirmed urogenital cancer, were analyzed by 2D electrophoresis. A new, highly sensitive silver staining technique was used to visualize proteins resolved in 2D gels. The result was a 2D protein map that was then archived using a computer-assisted progressive line laser scanning methods. Anomalies indicated by a shift, appearance or disappearance of a spot(s) in the maps were evaluated for relationship to the disease. A method for eluting proteins from 2D gels was developed in order to characterize further any proteins of interest. Three decades ago, our laboratory and othersâ€™ throughout the scientific community conducted experiments that spawned proteomics, genomics and supporting industries.

Friday, Mar. 30

Title: Searching for periodic gravitational wave signals

Presented by: Andrzej Krolak

Institute of Mathematics, Polish Academy of Sciences, Warsaw

Rotating neutron stars and white dwarf binaries are important sources of periodic gravitational wave signals to be detected by ground based and space borne detectors. A number of data analysis tools required in order to search the data from gravitatational wave detectors for the periodic signals are presented. These are the optimal statistic, threshold for significant signals, placement of templates in the parameter space, efficient numerical algorithms to calculate the optimal statistic, candidate verfication and the upper limits.

Friday, Apr. 13

Title: Radio pulsar populations in the Galaxy and beyond

Presented by: Duncan Lorimer

Department of Physics at West Virginia University

Radio pulsars provide a powerful way to study the demographics of neutron stars in a wide variety of environments. The greatest challenge in this work is to unravel the many selection effects that bias the observationally selected sample. In this talk, following some historical perspective and a general introduction to the techniques used to infer the properties of the underlying population, I will highlight some recent findings from population studies in the Galaxy, Globular Clusters and the Magellanic Clouds. Time permitting, I will also look ahead to the next decade of pulsar searching with current and upcoming facilities.

Friday, Apr. 27

Title: Nano- and Micro-Scale Labels for Medical Diagnostics: Retroreflectors, Nanoparticles, and Engineered Viruses Presented by: Richard Willson

University of Houston, The Methodist Hospital Research Institute

This talk will discuss our work in developing two types of diagnostics: point-of-care detectors of pathogen infection, and ultrasensitive assays for cancer biomarker proteins. Each of these takes advantage of the specific recognition of a target by antibodies, and centers on the development of novel labels for transducing target binding into a human-interpretable signal. Our work in pathogen detection is aimed at early recognition of biodefense or emerging disease events, and relies upon direct detection of the pathogen itself to accelerate identification of an unexpected event. We have demonstrated the inexpensive fabrication and very high detectability of micron-scale retroreflectors, and brightness modulation by immunomagnetic particles (for integration with sample preparation) in an analyte-responsive manner. A single 2.8 Î¼m magnetic bead, can be reliably detected on each element of a large retroreflector array, with simple optics potentially costing less than $1000. Planarization of the retroreflector array improves mass transfer and flow-force enhancement of specificity.Survival rates for various forms of cancer vary greatly, and a major source of this variability is the stage at which the presence of cancer is detected. For some cancers, there exist candidate protein biomarkers whose presence in clinical samples can serve as a warning of the possible presence of cancer, if they can be detected at sufficiently low levels. The gold standard for DNA detection is polymerase chain reaction,

PCR. PCR can amplify a preselected DNA target to detectable levels starting with only a few molecules, but no similar amplification technique is available for proteins. We are coupling antibodies for specific protein detection with DNA as a PCR-detectable label to achieve very sensitive detection of proteins.

Suppression of non-specific adsorptive background is vitally important in the development of suchultrasensitive assays. In contrast to previous efforts, we use nanoparticles and engineered virus particles as carriers for both antibodies and DNA, to increase sensitivity and specificity of detection.

Thursday, May 10

Title:The formation and evolution of double compact objects

Presented by: Michal Dominik

University of Warsaw

In the last decade we have witnessed milestone developments in single and binary star evolution. I'm going to discuss the physics behind the model and show these advances influence massive binary stars forming double compact objects - potentially the primary sources of gravitational waves.

Friday, May 11

Title: Pump head design for the Advanced LIGO 200-W laser

Presented by: Dr. Oliver Puncken

High power levels of continuous wave lasers with good beam quality, narrow linewidths and low power and frequency noise are the requirements for laser systems to be used in interferometric gravitational wave detectors. For Advanced LIGO, the light source will be a Nd:YAG high-power ring oscillator, which is injection locked to the 35 W MOPA system, which had already been used in the previous stage of the detector. The complexity of this oscillator limits a closer examination of its scalibility with respect to the power and beam quality characteristics. Therefore, the system has been simplified for the experiments presented in this talk to an asymmetric standing-wave resonator, which still allows to conclude on the properties of the more complex ring oscillator. In the first part of the talk the concept of the pump heads and the performance

of the standing wave laser will be presented. The second part deals with investigations on how the performance of the laser

might be improved by a smart choice of the laser crystal design.

Friday, Oct. 12

Title: Transient narrowband gravitational wave signals: detection and estimation using Particle Swarm Optimization Presented by: Dr. Soumya Mohanty

UTB Physics Department

Transient gravitational wave (GW) signals with a narrow frequency bandwidth could arise in several astrophysical scenarios, such as the accoustic supernova model of Burrows et al. Such signals generically consist of a carrier that is modulated in phase and amplitude, where the frequency of the carrier as well as the modulation functions are not known a priori. The detection and estimation of these signals is a challenge in GW data analysis that is still lacking adequate solutions. A new method is presented in this context that is based on a combination of Particle Swarm Optimization (PSO) with regression spline estimation. First results suggest that it works significantly better than time-frequency methods for the accoustic supernova signal.

Friday, Nov. 16

Title: The Dark Ages Radio Explorer

Presented by: Joe Lazio

JPL

Shortly after the Big Bang, the Universe transitioned to a largely neutral, largely uniform state known as the Dark Ages. Today, the Universe is largely ionized and highly structured. How did the Universe become reionized? Resolving this question is one of the last frontiers in cosmology. I will review the extremely limited evidence to indicate that the formation of the first stars and compact objects was the driving aspect behind this transition. I will then summarize the Dark Ages Radio Explorer (DARE) mission concept. DARE is a lunar orbiter carrying a single science instrument, a radiometer operating in the 40--120 MHz band. With this frequency range, DARE can observe the (highly) redshifted 21 cm hyperfine transition from neutral hydrogen at redshifts of 11--35. By forming an all-sky averaged spectrum, observations with DARE will be used to track the evolution of the neutral intergalactic medium during the formation of the first stars and allow us to address such questions as when did the first stars form? and when did the first accreting black holes form?

Thursday, Nov. 29

Title: Space Weather Events Global 3D MHD Simulations in the Interplanetary Medium

Presented by: Cristiane Loesch de Souza Costa

Instituto Nacional de Pesquisas Espaciais (INPE)

The development of new tools to improve our knowledge of the Sun â€“ Earth interaction and the magnetosphere's response to that interaction is one of Space weather's main goal. Lately, global MHD models are one of the most powerful tools in the efforts to understand our geospace. These models have been used in the hopes of filling the gaps left by observations and to improve our understanding of the ambient around us. In this work we discuss their importance and some of the difficulties involved on performing space weather events simulations. We present the results of two simulations performed with the Space Weather Modeling Framework (SWMF), a global 3D MHD code developed at the

Michigan University. The first simulation, using ideal MHD, studies the propagation of two different coronal mass ejections (CMEs) in the lower corona. We show that although the two CMEs possess different initial energies and magnetic configuration, the main observables such as acceleration, shock speed, Mach number, etc, present very similar behavior between 2 e 6 RÊ˜. The analysis of other quantities such as sheath width and postshock compression shows the effect of different magnetic configurations and initializations can be distinguished. The second simulation, using resistive and Hall MHD, investigates the solar wind effects on Earth's magnetosphere. We present our preliminary results on the magnetopause response simulation during the magnetic storm of April 5th, 2010.

Friday, Nov. 30

Title: Transient Gravitational-Wave Astronomy: Electromagnetic Follow-Up of Gravitational Wave Candidates Presented by: Marica Branchesi

University of Urbino

In the last years multi-wavelength electromagnetic (EM) observations have provided a detailed picture of the Universe. Now, the most exciting frontier in astronomy is the detection of gravitational waves (GWs), which will open an entirely new window into the Cosmos. Promising sources of GWs are the most violent astrophysical events such as the merger of neutron stars and/or black holes and the core collapse of massive stars. These events are believed to produce the most electromagnetically luminous objects in the Universe, the gamma-ray bursts and the supernovae. The first electromagnetic follow-up program of candidate GW events has been performed during the last GW detectors LIGO/Virgo run (Dec 17 2009 to Jan 8 2010 and Sep 4 to Oct 20 2010). It involved ground-based and space EM facilities observing the sky at optical, Xray and radio wavelengths. An overview of the follow-up program will be presented, focusing on the optical transient followup and image analysis procedures. The current procedures represent a milestone towards the upcoming advanced LIGO/Virgo detector era and point out the challenges and opportunities for the future GW/EM joint observations. The simultaneous availability of more sensitive GW detectors observing together with space and ground-based EM telescopes will offer the great opportunity to explore the Universe in a new multi-messenger perspective.

Friday, Dec. 7

Title: Scanning/Transmission Electron Microscopy as a Tool for Nanotechnology

Presented by: Dr. Gilberto Casillas

UT-San Antonio

The advancement of nanotechnology in building devices and nanostructures has rendered conventional characterization techniques impractical, if not useless, to pinpoint the properties of new materials. From nanoparticles to transistors in semiconductors, the features that we are dealing in characterizing these objects fall down to single atom manipulation. In this talk, I will discuss different applications of Scanning/Transmission Electron Microscopy (S/TEM) for materials science. I will further describe the

application of aberration-corrected high angle annular dark field (HAADF) imaging to characterize core-shell bimetallic nanoparticles down to atomic columns, along with elemental composition, among other structures. Moreover, in recent years, specialized in-situ holders have been developed to take the TEM one step further, and perform experiments at the same time we we observe the experiment (sample) down to the atomic level. In particular, I will discuss in-situ mechanical properties of individual nanoparticles below the 100 nm range. Particles with special twin boundaries and single cristal were analyzed with remarkable differences. Finally, a new detwinning mechanism in nanoparticles below 20 nm will be discussed, as observed by in-situ high resolution TEM experiments.