

Friday, Jan. 17, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Working at the Arecibo Observatory

Presented by: Anthony Ford, Arecibo Observatory

As a graduate of the ARCC program, I would like to share my experience of my first 3 months working at the Arecibo Observatory, and the new developments going on there. I would also like to share information on the REU opportunities available at AO this summer as well as possible opportunities for collaborative work.

Friday, Jan. 24, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: The Advanced LIGO Gravitational Wave Detector

Presented by: Volker Quetschke, University of Texas at Brownsville

The Laser Interferometer Gravitational-Wave Observatory (LIGO), consisting of three interferometers at two observatory sites, is currently being upgraded to become Advanced LIGO. The talk will give a brief overview about gravitational waves, how advanced interferometric technologies are used to measure them and how they are integrated in the Advanced LIGO detector.

Friday, Jan 31, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: LIGO lasers

Presented by: Oliver Puncken, Department of Physics and Astronomy, UTB

A high-power continuous-wave laser with good beam quality, narrow linewidth and low power- and frequency-noise is required for the interferometric gravitational wave detector LIGO (LIGO=Laser Interferometer Gravitational-wave Observatory). For the current version of the detector, "Advanced LIGO", the light source is a Nd:YAG high-power ring oscillator, being injection locked to the 35 W MOPA system, which had already been used in a previous stage of the project. To achieve the required stability levels, adequate control actuators, feedback control loops, and passive filtering are part of the laser design. This talk intends to give an overview on the the laser concept for Advanced LIGO and the associated stabilization scheme.

Friday, February 21, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: X-ray measurements of the structure of tantala coatings

Presented by: Matt Abernathy, LIGO Caltech Lab, LIGO Scientific Collaboration

A primary goal of the LSC coatings working group has always been the reduction of the mechanical loss of the mirror coating materials in order to reduce thermal noise in the detectors. Recent work has focused on correlating structural changes in the coating materials to changes in mechanical loss. This approach may lead to new insights into the causes of mechanical loss in amorphous materials. This talk reports on recent X-ray absorption spectroscopy (XAS) measurements of tantala coatings taken at the Stanford Synchrotron Radiation Lightsource. Preliminary XAS results highlight the observed changes in the local short-range atomic structure of the tantala coatings that occurs when titania doping and postdeposition heat-treatment are systematically varied.

Friday, March 21, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: A New Search for Radio Pulsars in M33, the Triangulum Galaxy

Presented by: Fronefield Crawford, Franklin and Marshall College

Radio pulsars are excellent laboratories for the study of fundamental physics owing to their extreme physical properties and the high-precision measurements that are possible. To date, 99% of all radio pulsars that have been discovered are located in our own Galaxy. The remaining 1% are in two nearby dwarf galaxies, the Large and Small Magellanic Clouds. No pulsars have yet been detected beyond the Clouds. New observing technology at the 305-m Arecibo radio telescope has recently made the detection and study of such distant pulsars a promising possibility. One excellent search target is the spiral galaxy M33 (the Triangulum Galaxy) in the Local Group. M33 is located 15-20 times farther from us than the Magellanic Clouds but is still very close by extragalactic standards. The discovery of pulsars in another spiral galaxy would constrain the neutron star formation process, probe the poorly understood ionized intergalactic medium, and help us understand pulsar evolution during early stages. Pulsar detections from M33 are most likely to come in the form of large-amplitude, single "giant pulses" that some pulsars (including the well-studied young Crab pulsar) have been observed to emit. Other manifestations of neutron stars that might emit giant pulses may also be detectable. We estimate that our search should be sensitive to every single "Crab-like" pulsar residing in M33 that is beaming in our direction. I will describe the new search of M33 for pulsars, discuss the motivating features and technical challenges of the search, and outline the current status of the search.

Thursday, March 27, 2014 at 3:00pm Where: Cavalry Building (CGWA conference room)

Title: Testing General Relativity with Gravitational Waves Presented by: Laura Sampson, Montana State University

In the next few years, physicists will begin to make direct observations of the gravitational waves that are currently being produced in numerous astrophysical systems. These waves, which are propagating perturbations in the metric that describes the geometry of space-time, are Einstein's last prediction. Among the most interesting science we will be able to accomplish with these observations is in the area of testing General Relativity. In this talk, I give a brief overview of tests of GR that have been performed to date, and then spend the bulk of the talk discussing the tests we will be able to perform using gravitational waves. In particular, I focus on template-based searches for deviations from GR.

Friday, March 28, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Data Analysts Without Borders: A Case Study

Presented by: Warren Anderson, University of Wisconsin-Milwaukee

Gravitational wave data analysis for ground-based interferometers has traditionally divided signals and search algorithms into four categories - compact binary inspirals, unmodeled bursts, continuous waves and stochastic backgrounds. While this has been a convenient paradigm, we are finding that the boundaries between these four categories are blurry and artificial. More and more data analysts are ending up in multiple camps. I will present the particular example of the STAMP group who are drawing from multiple camps to get results, and why it will be important for future generations of gravitational wave data analysts to do likewise.

Friday, April 18, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Measuring Student Understanding of Gravity

Presented by: Kathryn Williamson, National Radio Astronomy Observatory

The topic of Newtonian gravity offers a unique vantage point from which to investigate and encourage conceptual change because it is something with which everyone has daily experience, and because it is taught in two courses that reach a wide variety of students introductory-level college astronomy (Astro 101) and physics (Phys 101). This talk will characterize Astro 101 and Phys 101 students understanding of Newtonian gravity within four conceptual domains Directionality, Force Law, Independence of Other Forces, and Threshold. I will discuss how the most common student difficulties informed the development of a 26-item multiple-choice survey called the Newtonian Gravity Concept Inventory (NGCI). The NGCI is shown to be reliable, valid, and robust in quantitatively measuring students Newtonian gravity abilities, and changes in these abilities, i.e. learning, due to instruction. The talk will conclude with a discussion of the significance of other factors influencing student learning of Newtonian gravity, with insights into possible uses of the NGCI for future curriculum reform.

Friday, April 25, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Observing G2 As It Plummets Toward the Milky Way's Central Black Hole Presented by: Daryl Haggard, Northwestern University/CIERA

A dense, dusty object (G2) is on a collision course with Sgr A\*, the radio source at our Galactic Center. G2 is on an eccentric orbit and already shows signs of tidal disruption by the black hole. High-energy emission from the Sgr A\*/G2 encounter will likely rise toward pericenter (Spring 2014) and continue over the next several years as the material circularizes. This encounter may also enhance Sgr A\*'s flare activity across the electromagnetic spectrum. I will present intensive multiwavelength campaigns (X-ray through radio) aimed at studying the radiation properties of Sgr A\* as G2 breaks up and feeds the accretion flow, to constrain the rates and emission mechanisms of faint X-ray flares, and to detect G2 itself as it is shocked and heated.

Friday, May 2, 2014 at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: The Cosmic Microwave Background and Fundamental Properties of the Universe Presented by: Philip Mauskopf, Arizona State University

Measurements of the Cosmic Microwave Background have provided evidence for a number of new fundamental phenomena including: the homogeneous and isotropic expansion of the universe and the finite age of the universe from the existence of the CMB at all, an absolute reference frame for the universe and our motion with respect to it from the CMB dipole, the existence of dark matter and dark energy, and the existence of coherent oscillations in the early universe on superhorizon scales from CMB temperature anisotropies and temperature-polarization cross-correlations. In addition, recently the BICEP2 collaboration announced a detection of B-mode CMB anisotropy which is a type of polarization anisotropy that could be generated by primordial gravitational waves. I will describe how these measurements have been made and how they have led to the current concordance model of cosmology. I will describe the BICEP2 results and the implications for studying inflation and probing physics at the grand unification energy scale. Finally, I will describe current and future CMB experiments which have the potential to confirm and refine B-mode measurements and probe other fundamental phenomena such as the properties of neutrinos and primordial magnetic fields and non-gaussianity.

Thursday, July 3, 2014 at 12:00 pm Where: Cavalry Building (CGWA conference room)

Title: Star-songs in spacetime: Launching into gravitational wave astrophysics

Presented by: Grant Meadors, University of Michigan

This talk will discuss squeezing, feedforward filtering and the gritty business of cancelling noise, and pulsar searches, the fun of finding [simulated] signals.

Friday, Sept 12, 2014, at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Tidal perturbations to the gravitational inspiral of J0651+2844

Presented by: Matthew Benacquista, University of Texas at Brownsville

The recently discovered J0651+2844 is a detached, eclipsing white dwarf binary with an orbital period of 765 s. We investigate the prospects for the detection of gravitational radiation from this system and estimate the effect of the tidal deformation of the low-mass component on the period evolution of the system. Because of the high inclination of the system, the amplitude of the gravitational waves at Earth will be as much as a factor of two lower than that from an optimally oriented system. The dominant contribution of tidal corrections to the period evolution comes from the increase in rotational energy of the components as they spin up to remain tied to the orbital period. This contribution results in an advance of the timing of the eclipses by an additional 0.3 s after one year.

Monday, Sept 22, 2014, at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Probing Core Collapse Supernova Physics with Laser Interferometers

Presented by: Michele Zanolin, Embry Riddle Aeronautical University

Core Collapse Supernovas are routinely observed with today's telescopes, but many aspects of their inner physics (like the driving force behind the shock wave) are still not understood. The photons detected at Earth do not carry information about the initial explosion since they are originated hours after the initial collapse and the currently considered models display highly chaotic behavior, with strong dependence on the symmetries of the process. Gravitational waves carry information directly from the explosion since they are not scattered from outer layers. In this talk I will review the status of the current search of Gravitational Waves from Core Collapse Supernovae in initial LIGO-Virgo data and discuss some of the prospects for advanced LIGO and Beyond.

Friday, Nov 7, 2014, at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Characterizing the Atmospheres of Hot Jupiters with Large Ground-Based Telescopes Presented by: Knicole Colon, Lehigh University

It has recently been possible to characterize the atmospheres of some extrasolar planets via transit spectroscopy or spectrophotometry, which is a crucial stepping stone towards future studies of Earthlike planets. For typical hot Jupiters, potassium has been predicted to be one of the strongest sources of opacity at optical wavelengths and has been previously detected in the atmospheres of one of my planets of interest (XO-2b). I will present narrow-band spectrophotometric observations of XO-2b as well as TrES-2b made with the 10.4-meter Gran Telescopio Canarias. Specifically, I observed three transits of XO-2b and two transits of another planet, TrES-2b, in multiple narrow bandpasses around the potassium absorption feature at 770 nm. I will discuss the results from my search for potassium absorption in these planetary atmospheres as well as differences between my technique and those used in other atmospheric studies. I will also discuss recent progress made in characterizing the atmospheres of hot Jupiters with other large ground-based telescopes.

Friday, Nov 14, 2014, at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: The NASA Cyclone Global Navigation Satellite System

Presented by: Chris Ruf, Director of the Space Physics Research Laboratory at the University of Michigan

The Cyclone Global Navigation Satellite System (CYGNSS) is a spaceborne mission focused on tropical cyclone (TC) inner core process studies. CYGNSS attempts to resolve the principle deficiencies with current TC intensity forecasts, which lie in inadequate observations and modeling of the inner core. The inadequacy in observations results from two causes: 1) Much of the inner core ocean surface is obscured from conventional remote sensing instruments by intense precipitation in the eye wall and inner rain bands. 2) The rapidly evolving (genesis and intensification) stages of the TC life cycle are poorly sampled in time by conventional polar-orbiting, wide-swath surface wind imagers. CYGNSS combines the all-weather performance of GNSS bistatic ocean surface scatterometry with the sampling properties of a constellation of eight satellites to mitigate these deficiencies. An introduction to satellite remote sensing methods will be presented, followed by a summary of the CYGNSS mission.

Friday, Nov 21, 2014, at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Multiscale Modeling of Macromolecular Systems in Biology

Presented by: Andreas Hanke, UTB Physics Department

Computer modeling of complex macromolecular systems have transformed the fields of Biochemistry, Material Science, and Physics. Multiscale approaches are useful to obtain a comprehensive understanding of complex interactions within biological systems, which in turn facilitates the manipulation of atoms and molecules to create new nano-devices, materials, and drugs. In this talk, multiscale approaches based on Molecular Dynamics Simulations, Monte Carlo Simulations, and Statistical Mechanics will be used to model single-molecule force spectroscopy of DNA in the presence of DNA-binding ligands, and to obtain accurate predictions for the free energy of semiflexible macromolecules. Applications to nonequilibrium steady states obtained in systems of supercoiled and knotted DNA acted on type II topoisomerases will be discussed.

Monday, Nov 24, 2014, at 10:00am Where: Cavalry Building (CGWA conference room)

Title: Detecting very low frequency gravitational waves with pulsar timing arrays Presented by: Yan Wang, UTB Physics Department

Several worldwide projects are in progress to open the gravitational wave window for observational astronomy. Taken together, these projects will span a wide range of astrophysically promising source frequencies, providing complementary views of the GW Universe. In this talk, I will give an overview of current global efforts of detecting GWs in very low frequencies ( $10^{-9}$ - $10^{-6}$  Hz) with pulsar timing arrays. The focus of my talk is on the detection and characterization of the individual continuous gravitational waves from supermassive black hole binaries residing in the cores of galaxies. We have devised a coherent network analysis based on the generalized likelihood ratio test (GLRT). This method maximizes the likelihood ratio over the extrinsic parameters semi-analytically and searches for global optimum in the high dimensional intrinsic parameter space by the Particle Swarm Optimization (PSO). The performance and extension of this method will be reported in the talk.

Friday, Dec 5, 2014, at 1:45pm Where: Cavalry Building (CGWA conference room)

Title: Habitability in the Environments of Main-Sequence Stars

Presented by: Manfred Cuntz, University of Texas at Arlington

In this presentation, I will explore the general possibility of exobiology for different types of stars, especially main-sequence stars. I will take into account aspects of stellar evolution, including nuclear evolution (which often entails considerable changes in the stellar luminosity) and magnetic evolution. The latter is relevant in regard to the circumstellar UV environment, which may have both supportive and destructive significances for the existence and sustainability of life. Moreover, I will consider the astrobiological significance of F-type main-sequence stars, which usually receive little attention by the scientific community. For those stars, it is found that the estimated biological damage for planets at Earth-equivalent positions is noticeably higher than for planets around solar-like stars (but the results are not hopeless), and that there are intricate relationships for the time-dependence of damage during the stellar main-sequence evolution. Intriguing aspects pertaining to habitable environments are also identified for stellar binary systems (which are dominant compared to single stars), where the existence of habitable regions requires additional consideration owing to stellar radiative and gravitational constraints.