Online Proceedings

POSTER SESSION 2

Commons East, Easel 49

1:00 PM to 2:30 PM

Stochastic Radiation in Gravitational Wave Astronomy

Holly Chang (Holly) Gummelt, Fifth Year, Physics (Bothell)
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell

The new field of gravitational wave astronomy has the potential to answer leading questions in astrophysics. With the latest technology of LIGO (Laser Interferometer Gravitational wave Observatory) and contributions from over 1000 scientists from around the world, we have made the first detection of a merger of two black holes which occurred more than one billion light years from Earth. The first few black hole mergers that have been observed by LIGO imply a merger rate in the Universe that is higher than expected. It can be estimated that there is an upper limit of three black hole mergers per hour somewhere in the Universe. If the black holes are significantly far away they will not be able to give a strong enough signal to see through the background noise. It's like trying to hear someone whisper from across the room at a busy restaurant. However, many distant mergers could produce a combined background signal like the static between radio stations. Currently, LIGO utilizes a Bayesian wavelet decomposition to match strong nearby signals to a template in the database, but a frequentist method to search for a stochastic background signal. Our research is a novel approach, using an adapted version of the Bayesian algorithm to extract the background signal emitted by these black hole mergers. The goal of this research is to find patterns in the stochastic background signal of the O1 and O2 observation runs of LIGO and from these create templates for future data analysis of gravitational waves. The more that is known about gravitational waves, the more we are able to learn about the nature of gravity and therefore the Universe itself.

POSTER SESSION 2

Commons East, Easel 50

1:00 PM to 2:30 PM

Searching for Undiscovered Pulsars with NANOGrav

Edward Curtis (Ed) Hanes, Fifth Year, Physics (Bothell)
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell

Detecting gravitational waves from the merging of supermassive black hole binaries (SMBH) in the centers of galaxies is the focus of intense interest among many in the astrophysics community. I am interested in collaborating with other scientists and students to locate and catalogue undiscovered pulsars with data collected by the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) radio telescopes (Green Bank Telescope and Arecibo) and employing data reduction techniques using the pulsar searching program PRESTO. I am also contributing to the data collection of known pulsar signals with remote observing sessions. Pulsars are neutron stars that have dense rotating magnetic fields that transmit electromagnetic radiation in the form of radio waves. The pulsars that have spin rates of once per one thousandth of a second, known as millisecond pulsars (MSP), are of particular interest as their spin periods are highly regular. The goal in finding new pulsars is to establish a Pulsar Timing Array (PTA) in which the signals have a timing precision on the scale of 200 nanoseconds for decades. The Pulsar Timing Array consists of 30 millisecond pulsars dispersed throughout the galaxy acting as a system of galactic clocks. This could allow for the monitoring of gravitational waves that exhibit frequencies in the sub nanosecond ranges, allowing these waves to be detected by analyzing the unique properties in their signals. As we add to the NANOGrav observations we become capable of studying the evolution of galaxy formation. Support from the National Science Foundation (NSF) Physics Frontier Center (PFC) makes this research possible.

POSTER SESSION 2

Commons East, Easel 51

1:00 PM to 2:30 PM

Detection and Characterization of Non-Gravitational Wave Signals in LIGO Data Using BayesWave

Katherine A. (Katie) Reyes, Fifth Year, Physics (Bothell)
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell

A breakthrough in the field of physics was made when LIGO (Laser Interferometer Gravitational Wave Observatory) de-

tected the first gravitational wave in September 2015. This discovery now proved Albert Einstein's general theory of relativity. LIGO was built to be extremely sensitive so that it can detect tiny gravitational waves originating from the far reaches of the universe. However, this also means that it can detect a multitude of other signals coming from non-astronomical sources. LIGO uses a Bayesian wavelet model algorithm called BayesWave to look for gravitational wave signals in the data gathered by LIGO. BayesWave also has the capability to search for and characterize non-gravitational wave signals called "glitches." The ability to identify glitches is important in order to rule them out as possible gravitational waves. Although very successful so far, the use of BayesWave to classify glitches is a relatively new endeavor, so it is still possible to improve its abilities to do so. The goal of this project is to develop improved input parameters for BayesWave that would allow the program to find more glitches. By using a test data set with manually injected glitches, improvements to the command line (the user inputs that tell the program how to run the data) can be easily seen and measured. Studying gravitational waves opens up a brand new gateway into better understanding the universe in which we live.

POSTER SESSION 2

MGH 206, Easel 173

1:00 PM to 2:30 PM

What Is the Source of Microbial Contamination in the North Creek Wetlands of the Bothell Campus?

Vaughn Shepherd, Senior, Biology (Bothell Campus)
Mentor: Keya Sen, School of STEM, UW Bothell

The North Creek watershed in Bothell contains elevated levels of fecal coliforms, including *Escherichia coli*. This research is primarily concerned with the characterization of the *E. coli* present in the North Creek watershed and the determination of the sources of contamination. Contamination in these waters may increase the risk of infection due to contact. The North Creek Wetlands is a roosting destination for nearly 10,000 crows so, they may be major contributors to the contamination. *E. coli* isolates from water and feces have been obtained from the North Creek Wetlands where genotyping methods are employed to screen for extraintestinal pathogenic strains and intestinal pathogenic strains. The extraintestinal pathogenic strains are determined through the presence or absence of certain virulence genes. Some of these virulence genes include genes that encode for invasins, adhesins, toxins, and siderophores. The intestinal pathogenic strains are determined by the presence of Shiga toxin genes and the intimin adherence gene, *eae*. *E. coli* isolates obtained during June and July of 2016 tested positive for multiple extraintestinal pathogenic genes with 33% for *TraT*, 22.2% for *PAI*, 11.1% for *iutA*, 22.2% *fyuA*, 25.0% for *KpsmtII*, 2.8% for *sfa/foc*, and 13.9% for *papEF*. Further virulence testing with more recent isolates are currently in process. None have tested positive as intestinal pathogenic strains. Additionally, amplified *iutA* PCR products from a few isolates have been sequenced and used in a BLAST search through NCBI to determine their source. The ones which had successful sequencing primarily point towards an avian origin but more source tracking methods will be utilized to make the source determination more precise and reliable. In future studies the complexities of the North Creek ecosystem should be explored as well as the interconnectedness of environemental, microbiological, and human factors that affect the risk of infection.

POSTER SESSION 2

MGH 206, Easel 172

1:00 PM to 2:30 PM

Pathogenticy and Virulence of *Campylobacter jejuni* from the American Crow *Corvus brachyrhynchos* in the Seattle Metro Area

Tanner Berglund, Senior, Biology (Bothell Campus), Environmental Science - Bothell Campus
Mentor: Keya Sen, School of STEM, UW Bothell

Campylobacter jejuni infection is the most frequent diarrhea causing bacterial infection in the United States (CDC, 2014). *C. jejuni* can be present in many different warm blooded species without causing diarrhea (*Griffiths and Park, 1990*). The ability to infect a host and severity of infection are a direct result of the presence of virulence genes in the bacteria. In previous studies virulence genes from *C. jejuni* were identified and were tested using PCR and gel electrophoreses (*Laprade et al., 2016)*. In this study *C. jejuni* was isolated from crows in the Seattle metro area. As crows move to and from a roost during the day it is important to know what possible risk to human health they can pose through their fecal droppings. The isolates obtained from the fecal droppings were tested for the motility gene *flaA*; the colonization genes *dnaJ*, *racR*, *ciaB*, and *pldA*; and the antibiotic resistance gene *tetO* using the method created by Laprade et al. Twenty-three fecal isolates were tested; 100% tested positive for *flaA*; 100% tested positive for *dnaJ*; 60.87% tested positive for *racR*; 43.48% tested positive for *tetO*; 91.30% tested positive for *ciaB*, and 13.04% tested positive for *pldA*. Presence of other virulence genes such as toxin genes from the *cdtABC* gene cluster need to be determined. My preliminary results indicate that crows in the Seattle metro area that carry *C. jejuni* may carry a virulent or pathogenic form of the bacteria.