Online Proceedings

Poster Session 1

MGH 258, Easel 179

11:00 AM to 1:00 PM

Novel Red Fluorescent Protein (RFP) Reporter for Quantifying Intracellular Invasion of *Shigellia flexneri*

Shareef Shaheen, Junior, Extended Pre-Engineering
Mentor: Samuel Arnold, Medicine
Mentor: Molly McCloskey

Utilizing the Type III Secretion System (T3SS), *Shigella spp.* uses a cascade of proteins to manipulate, penetrate, and colonize host eukaryotic cells. Inducing epithelial necrosis, *Shigella spp.* infection is responsible for moderate to severe diarrhea in millions of children and immunocompromised individuals — the majority from under-developed communities. Previous translational research on *Shigella spp.* has been limited due to the lack of proper in vitro and in vivo models. Understanding infectivity of *Shigella spp.* heavily relies on imprecise estimations of intracellular *Shigella spp.*, which ultimately impacts vaccine and antibiotic efforts. This project aims to address this problem by developing a novel red intracellular reporter to quantify successful invasion of *Shigella flexneri*. By using a series of polymerase chain reaction (PCR) assemblies, we aim to construct a plasmid with a RFP reporter to be expressed during successful invasion of *Shigella spp*. The IpaH9.8 MxiE promoter, which has been shown to be expressed upon cell entry, has been integrated within the pUltra RFP plasmid through a Gibson-Reaction assembly and cloned using PCR. The new DNA replicate was electroporated into a streptomycin-resistant *S. flexneri* strain. We initially tested each strain in vitro by inoculating HCT-8 cells with the newly engineered *S. flexneri* and monitored for selective RFP expression by intracellular *S. flexneri*. The outcomes of this project will provide an accurate and efficient method of quantifying invasive *S. flexneri.* in vitro and in vivo, as well as quantifying efficacy of new antibiotic treatments. The implications of this project are crucial to the advancement of shigellosis research and in furthering the efforts of the international community to abate the rates of disease mortality and burden.

Poster Session 3

Commons East, Easel 48

2:30 PM to 4:00 PM

Graviational Wave Data Sorting Enhanced with BayesWave Algorithm

Guohao (GoGo) Huang, Senior, Physics (Bothell)
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell

For centuries, human beings have been using optics, which belongs to the electromagnetic family, to look at the universe. Now, an alternative way has developed, and that is LIGO. Different from the traditional electromagnetic observatory, LIGO (Laser Interferometer Gravitational Wave Observatory) uses gravitational waves to observe the universe. It is measures extremely tiny ripples in the space, which caused by very massive accelerating objects, such as binary black holes. In order to measure such tiny distortion in spacetime approximately 1/1000 of the width of a proton, LIGO has to be very sensitive even to the quantum scale. Therefore, the signal noise would be one of the major issues in the data collected from LIGO. BayesWave is a statistical algorithm which we use to help to analyze the data into different dimensions. Through this algorithm, one of the applications is characterizes the data to find out the non-astronomical-noise source, called “glitches”. For this project, my goal to is to help improve the success rate of finding glitches with this algorithm model. To achieve the goal, I downloaded data from LIGO and utilized it to BayesWave-model computer program. By changing the parameters comparing to the test data set, the success rate of sorting the glitches would be improved. With this algorithm, we are able to optimize the efficiency of sorting the data in a way that we could understand.

Poster Session 3

Commons East, Easel 50

2:30 PM to 4:00 PM

LIGO Remote Control Room

Brandon Masao Iritani, Senior, Physics: Biophysics
NASA Space Grant Scholar
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell

LIGO (Laser Interferometer Gravitational-wave Observatory) is an international collaboration whose purpose is to detect Gravitational waves, and explore their implications on the fundamental physics of gravity and the behavior of our universe. Gravitational waves are a prediction of Einstein’s 1916 theory of Relativity. They are everywhere around us, but only detectable at large magnitudes such as from the collisions of black holes. The Gravitational Wave Astronomy research group at University of Washington contributes to LIGO data analysis and detector characterization. There are two LIGO detector facilities, one in Hanford, Washington, and one in Livingston, Louisiana. The data from the detectors contain gravitational wave signals as well as transient noise, known as glitches. Scientists use the two facilities, and Virgo, a partner observatory in Italy, to pinpoint the direction to the gravitational wave source and to ensure that readings are not just noise glitches at one site. Each facility has its own control room, including computer consoles displaying and processing data. At the University of Washington Bothell, my project was to design and implement a remote control room, modeled after those at the LIGO Hanford and LIGO Livingston sites. My goal was to set up a remote control room that can aid LIGO research by being able to characterize glitches and identify gravitational wave signals. My main role was determining the hardware and software necessary to implement a remote control room, such as Matlab and some LIGO specific programs. The capabilities of our remote control room include access to environmental monitoring channels and the ability to do our own simulated signal injections. We receive a live data feed directly from the facilities, which is exciting because we are able to see the current status of the detectors, including whether or not they are online.

POSTER SESSION 3

Commons East, Easel 52

2:30 PM to 4:00 PM

Pulsar Signal Simulator

Jacob Chad Hesse, Senior, Earth & Space Sciences (Physics)
Undergraduate Research Conference Travel Awardee
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell
Mentor: Jeffrey Hazboun, Physical Sciences Division

Recent observations of gravitational waves have opened up a new field of gravitational astronomy. Through this new field, many questions, thought difficult to address with electromagnetic astronomy, have become tractable. Gravitational waves allow us to look further back in time than conventional telescopes, and allow us to directly observe the gravitational interaction of compact objects. The North American Nanohertz Observatory for Gravitational waves (NANOGrav) collaboration aims to detect and study gravitational waves using a Pulsar Timing Array (PTA) made of millisecond pulsars. Pulsars are a special type of neutron star that emits radio waves at extremely consistent time intervals. The pulsars are monitored using the Green Bank Telescope in West Virginia and the Arecibo Observatory in Puerto Rico. To help study the signal from these stars, a project called the Pulsar Signal Simulator (PSS) is being built by NANOGrav and is the focus of my research. The simulator is able to calculate a pulsar signal from source to detection. It starts with the initial signal of a pulsar and adds the different effects that alter the signal, before it reaches Earth, such as dispersion, scintillation, and scattering. My project is to work on a portion of the simulator that takes, as input, the name of a known pulsar and automatically simulates a signal with user-defined changes. I aim to increase efficiency as well as validate simulation output. This project is beneficial to the NANOGrav collaboration by characterizing the noise in our galactic scale gravitational wave detector. Progress in gravitational wave astronomy will allow for deeper insight into galaxy evolution, black holes, and the early history of the universe.

POSTER SESSION 3

Commons East, Easel 51

2:30 PM to 4:00 PM

Characterizing Transient Noise in LIGO Data

Jojo Perkins, Senior, Physics (Bothell)
NASA Space Grant Scholar
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell

The Laser Interferometer Gravitational-Wave Observatory (LIGO) is one of the most sensitive experiments ever developed, it can detect distance changes to about a width of a proton. The first detection of a gravitational wave signal was from a binary black hole merger on September 14, 2015. First predicted by Albert Einstein's Theory of General Relativity in 1916, gravitational waves carry energy through space due to collisions of compact objects, usually black holes or neutron stars. However, noise transients, also known as glitches, mimic astronomical gravitational wave signals decreasing the sensitivity of the detectors. Glitches occur due to a variety of reasons, including environmental noises or instrumental malfunctions. In this research, I work to improve the quality of the collected data and eliminate as much noise as possible in the interferometers. I participate in detector characterization that uses tools and methods to identify, characterize, and remove noisy data in the analysis time. Performing data quality shifts enhances the ability of the instruments to probe some of the most exotic objects in the universe, including black holes and neutron star mergers. The search for gravitational waves opens a new era in astrophysics enabling us to observe events that an ordinary telescope can't. In addition to seeing how our universe is altering, we now can also hear these changes, like sound waves, caused by vibrations that are audible to the human ear.

Poster Session 3

Commons East, Easel 62

2:30 PM to 4:00 PM

Assigning *E. coli* Isolates from Wetlands to respective Phylo-groups

Lara (Laura) Khalil, Senior, Biology (Bothell Campus)
Mentor: Keya Sen, School of STEM, Biological Sciences, UW Bothell

Although commensal *E. coli* is an inhabitant of the normal flora of humans and most animals, including crows, several variants have been found to be the cause of gastrointestinal as well as extra-intestinal diseases, such as in urinary tract infections. Based on previous phylogenetic studies, infection causing strains were more likely to be members of either B2 or D phylo-groups rather than A or B1. This study investigates the most common phylo-groups among crow fecal samples and water samples influenced by crows at the wetlands within the University of Washington, Bothell campus. It is expected that B1 and/or A groups to be more dominant than other phylo-groups because the commensal *E. coli* is likely to be abundant in these samples. Fecal samples were collected from the UW Bothell wetlands on four different dates. Water samples were also collected on the same dates from four sites within the wetlands; two sites within the crow roosting area and two outside of it. A quadruplex PCR assay was used to detect the genes *chuA*, *yjaA*, *arpA* and a DNA fragment TspE4.C2. Gel electrophoresis was used to determine the presence/absence of these four fragments from which an *E. coli* strain could be assigned to one of the 8 main phylo-groups. Results of fecal samples showed Group B1 to be most predominant in 37.93% of samples, as expected, followed by B2 with 22.41%. For water samples, phylo-group B1 was also predominant with 26.67% frequency followed by phylo-group B2 with 17.78%. Since the North Creek flows past the roost area, it may bring in strains of the B2 or D phylo group, especially due to storm water runoff following a rainfall. Those *E. coli* strains that are found to be under the B2 or D phylo groups will be used to look for virulence-associated factors.