**SESSION 1C**

**PUBLIC HEALTH**

Session Moderator: Clarence Spigner, Health Services

MGH 231

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

A Survey of Prevalence of *Helicobacter pylori* within Vietnamese Community through the Vietnam Health Clinic (VHC)

Ky Ngo, Senior, Biology (Physiology), Biochemistry

UW Honors Program

Lisa Chang (Lisa) Ngo, Recent Graduate,

UW Honors Program

Yogavedya (Yoga) Mukkamala, Non-Matriculated,

Jacky Vinh Tran, Recent Graduate,

Mentor: Scott Fung, Office of Minority Affairs & Diversity, Instructional Center

*Helicobacter pylori* (*H. pylori*) are gastric bacteria known to cause chronic gastritis, peptic ulcers, and can eventually lead to gastric adenocarcinoma in the long term. Prevalence of *H. pylori* among Caucasian, Hispanic and African-American populations has been previously surveyed in past studies. However, prevalence and distribution of *H. pylori* among Asian communities has yet to be exhaustively profiled. While *H. pylori* exhibits worldwide circulation, studies have shown that infection is more prevalent in developing third world countries. The Vietnam Health Clinic (VHC) is a mobile clinic that provides free healthcare to underserved populations in Vietnam every year. The data collected from the roughly 3000 patients served from VHC trips between 2012 and 2014 presents an invaluable opportunity to learn more about *H. pylori* prevalence and distribution within the native Vietnamese community. By delving into the patient’s background, medical history and previous treatment history of *H. pylori*, we give the dataset more meaningful resolution that can facilitate novel prevention and treatment processes in future VHC trips. Data and statistical analysis with Tableau and Excel is currently in progress and the consequent results will prospectively be available in May for the Symposium presentation. As this is a retrospective and exploratory study, a causation link cannot be drawn. However, by providing insight into a patient’s demographic and connection with *

**POSTER SESSION 3**

MGH 241, Easel 137

2:30 PM to 4:00 PM

Measuring NV Center Lifetimes with a Pulsed Laser

Seth Hyra, Senior, Physics: Comprehensive Physics

Mentor: Kai-Mei Fu, Physics/EE

Mentor: Michael Gould, Physics

This project aims to build a pulsed laser for lifetime measurements of nitrogen-vacancy (NV) centers in diamond. Such measurements are an important tool for characterizing the quantum information processing potential of NV-center-based photonic devices. Specifically, the radiative lifetime of an NV center is indicative of the proportion of photons being emitted at the useful zero phonon line (ZPL) wavelength. Optical emission at other wavelengths cannot be used for quantum information processing. As NV centers naturally emit only ~3% of photons at the ZPL wavelength, a major objective of our lab is to increase this quantity through photonic integration. Although lifetime measurements have been performed previously in our lab, the excitation source used had a pulse width of 4 ps, much shorter than needed and thus requiring a high optical intensity. This tended to damage the photonic devices under investigation. Therefore, a pulsed laser with a pulse width on the order of 10 ns is being constructed for future lifetime measurements. An important feature of this laser will be a pulse fall time significantly shorter than the NV center’s radiative lifetime. After the laser becomes operational, we will utilize it to implement lifetime measurements of NV centers coupled to photonic devices. This will lead to a better characterization of device performance, and ultimately to large scale NV-center-based quantum information processing.

Undergraduate Research Program

May 20, 2016 Mary Gates Hall

Mary Gates Hall
Design of a Microwave Resonator for Use with Diamond Magnetometry
Kelsey Michelle (Kelsey) Bates, Senior, Physics: Comprehensive Physics, Mathematics (Comprehensive)
Mentor: Kai-Mei Fu, Physics/EE
Mentor: Edward Kleinsasser

Our lab is using the nitrogen-vacancy (NV) center, which is a specific impurity in diamond, to measure magnetic fields on a microscopic scale. The ability to measure these fields unobtrusively and in real time will be a valuable tool for studying biological systems tagged with magnetic nanoparticles. The NV centers fluoresce when exposed to green light, but in the presence of a microwave field of a specific frequency this fluorescence decreases. The precise frequency at which this occurs is dependent on the local magnetic field strength and direction. Thus, by sweeping this microwave field over a range of frequencies, we can measure the magnetic field at the NV centers. Here we use computer software, HFSS, to design a resonator to produce the necessary microwave field. Critically, the resonator needs to produce a uniform microwave field over the imaging area on a diamond chip for a wide frequency bandwidth. It also needs to integrate with other aspects of the overall design; in particular it should be transparent at the center to allow us to image through it. Designs are fabricated at the University of Washington MakerSpace, and a comparison between the simulations and these fabricated devices will be presented.

POSTER SESSION 3
MGH 241, Easel 138
2:30 PM to 4:00 PM

Measuring T1 of Electrons Bound to Donor Impurities in ZnO Nanowires
Cameron Johnson, Senior, Physics: Comprehensive Physics
UW Honors Program
Mentor: Kai-Mei Fu, Physics/EE

An electron bound to a donor impurity in a semiconductor exhibits properties of a quantum system that could be used as a spin quantum bit (qubit) for quantum computing. For such a quantum system to be considered a candidate for a spin qubit there must be minimal interaction with its surrounding environment, maximizing the time the system can store quantum information. Longitudinal electron spin relaxation time (T1), the characteristic time for perturbed electron spins to return to thermal equilibrium, serves as a fundamental upper limit for quantum information storage time an electron spin qubit. Theoretical calculations and previous electron spin resonance measurements of donor bound electrons in bulk ZnO provide promising predictions for long storage times of ZnO donor electrons. To date there has been no direct optical measurements of T1 for donor bound electrons in ZnO. Here I present the experimental method and results of measuring T1 for electrons bound to gallium and indium donor impurities in ZnO nanowires. A measurement of T1 on the order of milliseconds for donor bound electrons in ZnO would merit further research to determine if these donor electrons can be realized as qubits with good properties. The nanowire structure of our ZnO samples also has the potential to meet another requirement for the donor bound electrons to be considered candidates for spin qubits; they must have qubit-specific measurement capabilities. By isolating a single nanowire, with the right sample dopant concentrations, we would be able to spatially resolve a single qubit.

POSTER SESSION 4
MGH 241, Easel 131
4:00 PM to 6:00 PM

Mitigating Spectral Instability in Solid-State Defects for Quantum Information Processing
Ian Robert (Ian) Christen, Senior, Mathematics (Comprehensive), Physics: Comprehensive Physics
Mary Gates Scholar, NASA Space Grant Scholar
Washington Research Foundation Fellow
Mentor: Kai-Mei Fu, Physics/EE

The nitrogen-vacancy (NV) center is a defect in diamond which shows promise as a solid-state qubit for scalable quantum computation. However, inhomogeneity and instability in the frequency of NV optical emission inhibits efficient quantum entanglement generation between NV centers, thus preventing the realization of quantum algorithms. This work implements two methods—one passive, one active—to mitigate these effects. First, high-temperature annealing improves the uniformity of the carbon lattice, which stabilizes the electro-magnetic environment of NV centers. Specifically, detrimental defects occupying nearby lattice-points diffuse out of the crystal. We build and test a system capable of non-destructively annealing diamond to 1200°C. Second, the application of strong local electric fields across NV centers enables active frequency control via the Stark Effect. To apply these fields, we fabricate gold electrodes directly on the surface of diamond containing near-surface NV centers. To determine the effectiveness of this method, we monitor the frequency of NV emission with photoluminescence excitation spectroscopy while fluctuating the applied electric field. Future work will involve the integration of these two systems with previously-demonstrated photonic circuits to realize efficient multi-qubit entanglement generation.
The Influence of Conserved Elements Responses during the Acute Infection of HIV on the Response to ART and DNA Therapeutic Vaccination

Nika Hajari, Senior, Microbiology
Mary Gates Scholar, UW Honors Program
Mentor: Deborah Fuller, Microbiology
Mentor: Paul Munson, Microbiology

While HIV treatment is improving, there are still problems associated with it. Antiretroviral therapy (ART) has unfavorable side effects, is expensive, and requires a lifelong daily pill intake. However, it has been proposed that a therapeutic vaccine could provide durable control of viremia in the absence of ART. This is a difficult approach due to the high mutation rate of the virus. Research has shown that there are conserved elements (CE) within the virus that do not change because they are important for the viral fitness. Accordingly a therapeutic DNA vaccine is being investigated that targets the CE epitopes. To address this, rhesus macaques were infected with SIV (Simian Immunodeficiency Virus), put on ART, vaccinated with four doses of DNA vaccine expressing CE, removed from ART, and their viral loads monitored. A successful vaccine is expected to reduce the viral loads to negligible amounts post ART cessation. My research project investigates the role of CE responses developed during acute infection. I hypothesize that macaques that naturally develop higher CD4+ and CD8+ T cells (types of white blood cells) with CE specificity in response to the acute SIV infection will respond better to ART and CE vaccinations. To investigate this I collected plasma and lymphocytes from the blood during acute infection and analyzed the CD4+ and CD8+ T cells using enzyme linked immunospot (ELISpot) and intracellular cytokine stain (ICS) assays. The viral loads were monitored by measuring the concentration of viral RNA in the plasma. T cell responses measured at each time point was then correlated to viral loads post ART-pre vaccinations or to CE responses measured after the final DNA vaccination by Spearman Rank correlative test. My findings will help us better understand the significance of conserved elements in controlling the HIV and thus design better human therapeutic vaccines.

POSTER SESSION 4
Balcony, Easel 102
4:00 PM to 6:00 PM

Designing Protein Oligomers and Fibers Using Parametrically Generated Helical Bundles
Sereno Luis Roberto (Sereno) Lopez Darwin, Sophomore, Pre-Sciences
Mentor: Chunfu Xu

De novo protein design can be used to create many types of biomaterials. In this project we explored if helical bundles (structural motifs consisting of several alpha helices arranged with rotational symmetry) could be used to create two different nanomaterials: fibers and oligomers. Both structures have broad industrial and experimental applications including small-molecule transport, structural support, and catalysis, so developing a strategy for specific and stable design is an important task. The oligomers (structures made from a small number of repeating units) consisted of two cylindrical layers of helices connected by short loops. The fibers were made with tapered helical bundles which docked into one another and bound strongly to form a string. Both the fibers and the oligomers were designed parametrically; we set intervals for several geometric variables and used the macromolecular modeling program Rosetta to determine which combinations of variables created the most energetically favorable shape for protein folding, as well as which amino acid sequences were most likely to fit these shapes. We then used the HB-net protocol to insert hydrogen bond networks (polar amino acid groups which form hydrogen bonds with one another to increase binding specificity). For each round of design, we chose four designs to express in E. coli based on amino acid ratios, solubility, and hydrogen bond network quality. For the fiber expression, no 6-helix bundles formed correctly, but several 5-helix bundles were successful. We have selected and expressed the oligomers and have used mass spectrometry and SAXS (small angle x-ray scattering) data to confirm structure. In the future, we will use this design strategy to make stable oligomers and fibers with larger internal radii that can accommodate large molecules such as DNA.