Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.

Name: Aleksandr Chernatynskiy

Department: Physics

Title of Research Project: Comparison of the interatomic potentials for Gallium Nitride

Description of Research Project (maximum 200 words): Gallium Nitride is the key material for the future high-power electronics. Such devices are characterized by very large electric current which in turn generate enormous amount of heat. Removal of this heat from the device depends crucially on the thermal conductivity of GaN and thermal conductance through it’s interface with other components of the device. Elucidation of such boundary conductance requires high quality interatomic potentials that can adequately describe thermal transport properties. The goal of this project is to identify available potentials for GaN in the literature and elucidate their performance for thermal transport simulations. Result of this work might appear as a section of the paper devoted to thermal transport properties in GaN system.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words): 1. Literature search for interatomic potential that describe Gallium Nitride system. (1 month) 2. Evaluation of the potential quality through the calculation of the key materials properties: lattice constants, elastic constants, thermal conductivity. (2 month) 3. Comparison of the potentials qualities and producing recommendation for future applications (1 month).

What skills will the FYRE student acquire or enhance as a result of working on this research project?

Capability to perform scientific literature search, identify relevant publications and extract required information from them. Ability to operate in Linux operating system, parallel computing environment and basics of using widely available research community codes for performing molecular dynamics simulations, such as LAMMPS, developed by Los Alamos National Laboratory and/or GULP – general Lattice Utility Program. Student will also gain knowledge on crystal structure of materials and methods to describe and predict it.
Faculty Mentor Application for First Year Research Experience (FYRE) Program
2017-2018

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Name: Amitava Choudhury
Department: Chemistry
Title of Research Project: Developing electrode materials for Li- and Na-ion Batteries

Description of Research Project (maximum 200 words):
In this project we aim to synthesize new materials or modify a well-known electrode materials for enhanced efficiency for lithium and sodium ion batteries. Several synthesis routes including hydrothermal and high temperature ceramic methods are employed to synthesize new materials. The materials are then characterized by employing X-ray diffraction techniques. Lithium or sodium ion cells are then fabricated with the synthesized materials and then tested for their performances. The goal of this project is to understand what structural features of the materials make it a good lithium or sodium ion battery electrode and how we can improve the performance by modifying the chemistry/structure of the materials.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):
The FYRE student will be trained by a graduate student of Dr. Choudhury on how to carry out a synthesis of material. After that the student will be given a problem where he/she would try to synthesize a target compound by employing different synthesis routes. As the student makes progress in the project, the different characterization techniques will be introduced slowly as and when it is needed. The students can come at any time in the laboratory as permitted by their course work schedule. In one semester nothing much can be expected but the students can at least learn how scientific research is carried out in a laboratory and with some luck they may get some interesting results. If the students are interested in continuing the research beyond the FYRE period, they have the option to apply for OURE fellowship.

What skills will the FYRE student acquire or enhance as a result of working on this research project?

- The students learn different materials synthesis techniques
- They get training on how to handle and interpret X-ray diffraction data
- They learn how to fabricate a lithium- or sodium ion cells/batteries
- They learn electrochemistry and how lithium/sodium ion batteries work
- They learn about solid state/materials chemistry being involved in this research
- They develop skills to analyze and present scientific data
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.

Name: Jessica Cundiff

Department: Psychological Science

Title of Research Project: Does marking gender matter?

Description of Research Project (maximum 200 words):

In engineering, women are often referred to as “female engineers” whereas men are simply referred to as “engineers”. The tendency to remark upon women’s gender but not men’s in male-dominated fields such as engineering reflects assumptions about who is considered normative and who is considered deviant—we tend to remark upon features that deviate from prevailing norms. On one hand, identifying an engineer as female can be construed as potentially helpful by providing evidence that counters the normative assumption that engineers are men and suggests the possibility for female success in a traditionally male domain. On the other hand, however, highlighting women’s achievements in a way that marks women’s gender but not men’s may reinforce the notion that women are non-normative and exceptions to the rule, with unintended consequences that the proposed study is designed to examine. In particular, does highlighting women’s gender undermine their accomplishments and make those accomplishments seem less worthy? For example, is a woman evaluated less positively when she is described as a “great female engineer” rather than a “great engineer”?

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

The student will help create stimulus materials and dependent measures, administer the experiment online, and help analyze the data:

- Week 1: Complete IRB training
- Week 2: Create stimulus materials (we will revise materials from a prior study)
- Week 3: Revise dependent measures (we will revise measures from a prior study)
- Week 4: Submit IRB application
- Week 5: Program the experiment in Qualtrics (online survey software)
- Weeks 6-9: Collect data
- Weeks 10-11: Prepare data for analysis and analyze data
- Weeks 12-13: Summarize results in either a poster or written format

A successful student can potentially continue participating in this program of research beyond the spring 2018 semester.
What skills will the FYRE student acquire or enhance as a result of working on this research project?

The FYRE student will gain experience with the entire research process, from project development to data analysis, to learn whether research with human subjects is something they are interested in pursuing. The student will learn the basics of experimental research design, including the concepts of independent and dependent variables, as well as ethical treatment of human participants. The student will also learn how to use Qualtrics, a popular online survey tool used by many researchers and businesses. The student will learn basic statistical concepts and will be introduced to SPSS, a popular software used for statistical data analysis. Finally, the student will learn how to synthesize data into a presentable format in order to communicate research results to others. Overall, the skills learned through this project will benefit the student in future coursework involving statistics, research methods, and critical thinking.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

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Name: Shannon Fogg

Department: History and Political Science

Title of Research Project: Howard E. Kershner and the American Friends Service Committee in World War II France

Description of Research Project (maximum 200 words):

The American Friends Service Committee (a Quaker organization) provided refugee relief in France during World War II. The AFSC provided material aid to Jews in internment camps in southern France, established schools inside the barbed wire, provided medical supplies, distributed clothing and food, and worked to liberate camp inmates and to facilitate their emigration. They were vital in the rescue of Jews during the Holocaust, but they also helped others by providing supplemental rations in public schools, running children’s homes, and establishing employment offices. As the director of the AFSC in France during the war, Howard E. Kershner is an important aspect of its history. The organization provided humanitarian aid in a country that actively persecuted Jews. He met regularly with French government officials, but also worked with other aid organizations such as the Red Cross and Jewish groups. As part of his job, Kershner regularly wrote articles about the wartime situation in France for an American audience. This research project will explore Kershner’s newspaper articles to see what we can learn from them. What was life like in Occupied France? How did Kershner portray the war to an American audience? What was his goal in writing the articles?

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

The student will use the semester to locate Howard Kershner’s writing related to AFSC work in France. The major primary source for the research project will be the New York Times, but the student will determine if Kershner published articles in other outlets. Kershner also produced a short documentary (available on YouTube) that may become part of the study. The student will meet with Dr. Fogg weekly to discuss the articles s/he finds. The student will be expected to analyze the information to determine themes and the purpose of Kershner’s writings. The
research work should be completed by the end of March with a completed 10-15 page paper based upon the research finished by the end of April. This information may be incorporated into a larger article related to the AFSC’s wartime work. The student will be encouraged to submit a project to the Undergraduate Research Conference in April and will participate in the FYRE showcase in May.

What skills will the FYRE student acquire or enhance as a result of working on this research project?

The student will learn how to work with online newspaper databases to search for relevant articles. Newspapers serve as an important historical source for research and the student will develop key skills in searching for materials such as identifying key words or important dates. They will also learn to analyze information about the article’s placement in the paper (is it front-page news? Buried in another section? Etc.) The student will also enhance critical thinking skills by analyzing the documents and placing them within the historical context. The student should also learn more about issues such as refugees, humanitarian aid, pacifism, antisemitism, and the context of daily life in France during World War II. The student will also work on historical writing skills such as making an argument, supporting it with evidence, and correctly citing sources.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

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Name: Garry “Smitty” Grubbs II

Department: Chemistry

Title of Research Project: Chirality Determination Using Dipole-Forbidden Transitions

Description of Research Project (maximum 200 words): Lay the ground work for actively qualifying and quantifying chirality through single dipole-forbidden rotational transition measurements. This is the very first study of its kind. This research is the beginning of a longer study of chirality using 3-wave mixing experiments and chiral tagging. Ultimately, the idea is to be quantitative AND qualitative with regards to synthetic pathways useful in the pharmaceutical and chemical analysis fields.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words): Measure the microwave spectrum of a chiral molecule with a large quadrupole nucleus. This will lay the foundation for which transitions to go after in microwave 3-wave mixing experiments using dipole-forbidden transitions.

Early Spring- Measure spectra

Mid-Spring- Do analysis

Late Spring- Write up results

What skills will the FYRE student acquire or enhance as a result of working on this research project?

The student will gain knowledge of how to interface and work on microwave spectroscopy techniques as well as the finer structural aspects of chirality, one of the essential building-blocks of life. They will also learn how to fit said spectra using computer tools in order to ascertain which transitions are dipole-forbidden and best suited for 3-wave testing. This will build their knowledge in the fields of organic, physical, and analytical chemistry as well as computer programming and electrical engineering.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.

Name: Amber M. Henslee, PhD
Department: Psychological Science
Title of Research Project: Data Management and Analysis of Psychology Students’ Performance across Classroom Formats

Description of Research Project (maximum 200 words):

The purpose of this study is to organize and analyze data of PSYCH 1110 (General Psychology) students’ performance on a test of their knowledge. General Psychology students were assessed at the beginning (pretest) and end (posttest) of the semester over basic psychological concepts and facts. Data exists in both hard-copy and electronic formats for pre and post assessment points, across multiple semesters, and for multiple instructors teaching in varying formats (traditional day class, evening class, and blended class). Thus, there are several variables of interest to analyze in relation to student performance. However, prior to statistical analysis, the data need to be organized and cleaned.

This project was part of a course redesign proposal funded by the Provost’s Office for the 2013 eFellow’s program. The Provost’s eFellows program was an opportunity for instructors to redesign their courses to incorporate more technology, with the overall goal of improving student performance. Such course redesigns have occurred at other institutions (see http://missourilearningcommons.org/resources.php) and data suggest that these redesigns improve student performance. Dr. Henslee consulted with one of the Missouri State instructors who presented at the symposium to construct a similar pre-post test implemented in this project.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

The FYRE student responsibilities will include:

1. Complete the online CITI training program. This is a required research ethics training program for anyone working with human subjects and human subject data. The completion certificate will be filed with the S&T Institutional Review Board.
   a. Estimated time frame: 1-2 weeks
2. Organize the hard-copy data. This task will include establishing locked, file storage space in the psychology research lab area, transferring data from Dr. Henslee’s office to the lab space, and once in the lab, sorting through the hard-copy data and organizing by instructor, semester, and assessment point.
   a. Estimated time frame: 1-2 weeks
3. Organize electronic data. This task will include searching existing electronic files, determining which variables they contain, and comparing electronic files to hard-copy data.
   a. Estimated time frame: 1-2 weeks
4. Once the FYRE student understands the status of all data, hard-copy and electronic, then he/she will begin creating an SPSS database.
   a. Estimated time frame: 2-3 weeks
5. Once the database is created, the FYRE student will clean the data and begin data analysis.
   a. Estimated time frame: remaining part of the semester

**What skills will the FYRE student acquire or enhance as a result of working on this research project?**

1. Complete CITI Training: The advantage for the FYRE student is that CITI training will be required for future psychology courses (PSYCH 2200) and/or working in other research labs, so the FYRE student will have completed this step ahead of his/her cohort.
2. Organize the hard-copy data: The FYRE student will gain hands-on experience working with data and understanding the organizational structure of variables in a research study.
3. Organize electronic data: Similar to #2, the student will acquire hands-on experience with electronic data files and understanding research variables.
4. Create SPSS database: SPSS is a common social science statistical analysis software program. The advantage for the FYRE student is that he/she will have experience working with SPSS before others in his/her cohort and before enrolling in PSYCH 2200.
5. Clean and analyze data: The student will be exposed to basic data management and data analysis. These are fundamental skills required in future psychology courses and/or other research experiences.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.

Name: Yew San Hor

Department: Physics

Title of Research Project: Electric Field Exfoliation of Nanolayered Crystalline Materials

Description of Research Project (maximum 200 words):
Layered materials such as graphite, transition metal dichalcogenides and layered metal dichalcogenides exhibit many intriguing physical properties for examples topological insulators and topological superconductors. By reducing their thickness down to nanometer scale, they can be fabricated into miniature electronic devices for future technology and scientific exploration. However, it has been difficult to obtain nanostructure layered crystalline materials. The existing method in obtaining the nanolayered materials is mechanical exfoliation or “Scotch tape method”. This method is a long and tedious process. Recently, we have developed a new method in exfoliating layered crystalline materials by utilizing electric field. The process is capable in peeling off ultrathin flakes from bulk crystals. This method is elegant, clean and effective in obtaining nanolayered materials. The nanolayered materials that are extracted using this method are demonstrated to be flat, freestanding, and relatively large compared with those obtained by the Scotch tape method. High quality nanolayered materials will be used in future electronic device fabrications and applied for fundamental studies of novel physics phenomena such as Majorana physics and axion electrodynamics.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):
Student who is interested in the project will use the electric field exfoliation method to exfoliate 2D metal chalcogenides such as NbSe2, TaSe2 and Bi2Se3 on silicone substrates. The student will then characterize the exfoliated flakes by using atomic force microscope (AFM) which is available in Hor’s laboratory. The AFM has high resolution and it is capable in observing one-nanometer thick samples. It has been used to observe graphene (graphite with one atom thickness) successfully. The student will spend the first month in Spring 2018 to learn how to use the electric field exfoliation set up and the AFM in the laboratory. In the following months, the student will perform the exfoliation and characterization of the 2D metal chalcogenides. He/she will learn how to write a report and present his/her findings to other lab members in April 2018. The student will work closely together with lab members. The thin flakes of the 2D materials with thickness ranging from 1 to 20 nm will be expected. The flakes will then be used for physics device fabrications. Device fabrications will be performed by other lab members and the obtained results will be discussed among lab members in lab meetings.

What skills will the FYRE student acquire or enhance as a result of working on this research project?
The student will have experience in condensed matter physics research. He/she will be an expert in using AFM and producing nanostructured materials which are important for future technology and fundamental physics exploration.
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Name: Yinfa Ma
Department: Chemistry
Title of Research Project: Early Cancer Screening Using Urinary biomarkers

Description of Research Project (maximum 200 words):
Early cancer detection is the only way for cancer prevention and no physician can cure advanced cancers! To detect cancer early, the best way is to use non-invasive technique to quantify the biomarkers in a person’s biological fluid, such urine, to assess the corrections between cancer development and the level of cancer biomarkers. In this project, the undergraduate student will do literature search and identify the possible urinary biomarkers for a specific type of cancer, such as, lung cancer, liver cancer, breast cancer, etc. Then the student will design the experimental procedures and will use modern technology in my laboratory to conduct research to determine whether those markers indeed correlate with development of the cancer, by using the urinary samples that have already collected clinically.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):
In this project, the undergraduate student will start with literature search and understand how biomarkers correlate with cancer development. Then, the student will work with the advisor to develop a plan for determining those biomarkers in the urine samples that have been collected. Then the student will design the experimental procedures under the guidance of the advisor and analyze the marker level in the urine samples of the normal subjects and the cancer patients to determine whether those markers indeed correlate with development of the cancer. The results will be presented at professional conferences and published as the project is completed.
What skills will the FYRE student acquire or enhance as a result of working on this research project?

The following skills will be gained through the research:

1. The student will gain experience on how to conduct literature search before conducting research
2. How to design a real scientific research experiment
3. Problem-solving and critical thinking
4. How to write scientific papers
5. How to present research data at a professional conference
6. How to use modern technology to conduct research
7. Scientific communication skill
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Name: Vadym Mochalin

Department: Chemistry and Materials Science & Engineering

Title of Research Project: New Synthetic Routes to 2D Transition Metal Carbides and Nitrides (MXenes)

Description of Research Project (maximum 200 words):

This project will systematically address the following questions: i) Can other, less hazardous and more convenient etchants than hydrofluoric acid (HF) be used to synthesize MXenes from MAX phases? ii) How do MXenes react with common acids, bases, and water? iii) Can new MXenes be synthesized using synthetic routes that do not involve HF? It is commonly accepted that Al layer in MAX phases is bonded to the MX blocks by weak metallic bonds, thus Al should be able to react as a metal with the inorganic acids such as HF, HCl, HNO₃, etc. These reactions should result in dissolution of Al with formation of the corresponding MXene, Al salt, and H₂ evolution. However, only the reaction with HF (ex situ or in situ) was explored for synthesis of MXene thus far. We propose to study reactions of Ti₃AlC₂ with concentrated bases first. We will vary concentration of the base, time of treatment, temperature, and particle size of the initial MAX phases, many of which are available commercially. Those MAX phases which are not commercially available will be synthesized form their corresponding elements using well established techniques. We then will explore the potential of these reactions to synthesize new MXenes.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

The student will be responsible for systematic studies of reactions of MAX phases with different bases. We will start with the most common MAX phase Ti₃AlC₂. It will be first grinded and sieved to produce Ti₃AlC₂ fractions of different size (2 weeks). Each fraction will then be involved in reactions with different bases including NaOH (2 weeks), KOH (2 weeks), NH₄OH (2 weeks), LiOH (2 weeks) etc. In these experiments we will vary the base concentrations, temperature, and time of treatment to find the conditions in which the corresponding MXene (Ti₃C₂) is formed. All solid products of these reactions will be characterized using X-Ray diffraction (1 month in total). The student will present her current progress at our weekly group meetings where the results will be discussed and next experiments planned based on
the outcomes. In the end, based on the material from her weekly group presentations the student will write a final report, which then will be used to prepare a publication and a conference presentation (e.g. for MRS meeting). The student is expected to significantly contribute to the publication and presentation.

**What skills will the FYRE student acquire or enhance as a result of working on this research project?**

Work with one of the leading groups in the world on novel 2D transition metal carbides will provide an invaluable experience for the FYRE student. The student will be exposed to first class research project at the very frontiers of 2D materials research. The student will be working directly with one of my post-doctoral researchers involved with MXene research. While working on the experimental program of the project, the FYRE student will learn techniques to produce novel 2D materials – MXenes. The student will also learn how to synthesize MAX phases, disperse MXenes in colloidal solutions and analyze their structure by X-Ray diffraction. Besides these specific skills, the FYRE student will get firsthand experience working in wet chemistry lab that will significantly improve her general experimental skills regardless of her future career path. Active participation in discussions, presenting at our weekly group meetings, writing reports and parts of publications, as well as conference presentations will significantly improve writing and presentation skills of the FYRE student.
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Name: Dr. Susan Murray

Department: Psychological Science

Title of Research Project: Increasing Grit and achieving long-term goals

Description of Research Project (maximum 200 words): Grit is defined as perseverance and passion for long-term goals. Dr. Duckworth has developed a scale that measures grit (Grit-S) which will be used in this study. Higher levels of grit are related to improved GPA, student retention, and other positive outcomes. A question that has yet to be answered is “How can we increase a student’s level of grit?” This project will be a pilot study to identify and explore some potential interventions that might increase grit among college students.

The project will include
- Becoming familiar with the Grit-S scale and literature in the area
- Identifying/creating potential interventions to increase grit
- Obtaining IRB approval to conduct research with 1st year students
- Gathering exploratory data

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

1) Literature review of grit (January – February)
2) Develop potential intervention (March)
3) Develop survey and submit IRB paperwork (April)

What skills will the FYRE student acquire or enhance as a result of working on this research project?

The student will learn how to conduct a literature review and how a research proposal is prepared. This is a good introduction to psychological research. He or she will also gain insight that may increase his or her own success in college.
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Name: Manashi Nath

Department: Chemistry

Title of Research Project: Designing Efficient Electrocatalyst for Solar to Fuel Energy Conversion

Description of Research Project (maximum 200 words): In recent times electrocatalytic and photoelectrocatalytic water splitting has emerged as one of the most potent form of clean energy generation. This project is focused on designing efficient catalysts from earth-abundant resources for electrocatalytic water splitting and integrating these new catalysts with solar photoabsorber nanostructure arrays. Catalyst design follows a simple hypothesis which optimizes catalytic performance based on the material’s properties, specifically anion electronegativity and degree of covalency in the structure. Rational design of the electrocatalyst will be achieved through combinatorial electrodeposition whereby, a phase diagram will be explored in a systematic way by varying relative amounts of respective precursor in the electrolyte. Photoabsorber nanostructure arrays will be fabricated through patterned electrodeposition on lithographically defined nanoelectrodes. Specifically, nanoelectrodes created through E-beam lithography will be subjected to electrodeposition of the photoabsorber layer. Changing shape of the nanoelectrode will lead to different types of nanostructure arrays such as solid nanopillar and hollow nanotubes. Electrocatalyst will be then decorated on the photoabsorber nanostructure arrays. Electron microscopy (SEM and TEM) will be performed to elucidate structural and morphological information, while electrocatalytic and photoelectrocatalytic activities of these devices will be studied through detailed electrochemical studies involving linear sweep and cyclic voltammetry, chronoamperometry and impedance measurements.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

This project is part of a bigger NSF-funded research venture, and the undergraduate researcher will be involved in executing the catalyst design through combinatorial electrodeposition part, as well as designing patterns for E-beam lithography. The combinatorial electrodeposition has been designed specifically with undergraduate
researchers in mind, and involves preparation of the electrolytic bath by systematic variation of the relative precursor concentration followed by electrodeposition. Electrodeposition is a simple synthesis method to grow films and the student will be required to follow a general protocol for electrodeposition. This method produces a library of product composition and the FYRE student will be expected to build this library by choosing different transition elements from the periodic table. The student is also expected to study the catalytic activity of these electrodeposited films through detailed electrochemical measurements, and confirm their composition and morphology through bulk characterization techniques such as SEM, TEM, and powder X-ray diffraction. Other job responsibilities include designing pattern files for E-beam lithography using a lithography-based software installed in MRC.

It takes about 3-4 weeks to complete a library of 50 compositions in a trigonal phase diagram through combinatorial electrodeposition, and the student can ideally build two such libraries within the semester.

What skills will the FYRE student acquire or enhance as a result of working on this research project?

- Proficiency in nanostructure synthesis.
- Learn about E-beam lithography and how to design diverse patterns. Missouri S&T has recently acquired a state-of-the-art E-beam lithography system (through NSF-MRI), Raith E-line, which will be used extensively for this project. Since this is a high-end instrument, the undergraduate researcher will work closely with a trained graduate student, and will gain first-hand experience in creating the design file for the pattern.
- Learn about the basics of electrochemistry including electrodeposition, electrochemical measurement and experiments, and how to interpret electrochemical data, starting from basic such as current-voltage profile, to advanced concepts like capacitance, Faradaic efficiency, and electrochemically active surface area.
- Learn about material characterization through electron microscopy including SEM and TEM, as well as compositional analysis from other techniques such as powder X-ray diffraction, EDS, and X-ray photoelectron spectroscopy. The student will learn the basics of data interpretation for each of these techniques.
- Since, this project is part of a bigger NSF-funded project, the student will also acquire skills related to collaborative teamwork.
- Acquire skills related to oral scientific presentation of the research work.
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Name: Professor Justin Pope

Department: History and Political Science

Title of Research Project: Mapping Slave Uprisings Across the Atlantic World

Description of Research Project (maximum 200 words): In one of the first projects of its kind, this study traces stories of slave rebellion across the Atlantic Ocean in the eighteenth century. Using colonial American and English newspapers, we will follow reports of slave unrest from port to port. The goal of the project is to see how early Americans reported news of early slave rebellion, the speed of shipping, and how the arrival of reports of rebellion influenced colonial governments.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words): The student researcher will assist in transcribing newspaper accounts of slave unrest and recording them in an excel sheet (I have already transcribed the majority of these accounts). The first two months will be spent compiling these reports. In the second half of the semester, the student will assist in digitally mapping rumors of rebellion in the Atlantic Ocean.

The project will expose the student to historical research of documents from the eighteenth-century. Examining accounts of slave unrest will provide unique insights into the history of slavery in colonial America.

What skills will the FYRE student acquire or enhance as a result of working on this research project?

Students will gain skills in historical research. While reading eighteenth-century English newspapers can be challenging, the student will quickly become skilled at transcription. He or she will also improve skills in Excel.

Some experience with digital mapping would be preferred, but is not required.

The student will be credited for his or her assistance in any publications that result from the research.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.

Name: Dr. Terry Robertson

Department: ALP

Title of Research Project: Environmental Communication and the Media

Description of Research Project (maximum 200 words):

This study will first review environmental communication research of the past four decades and delineate some of the key trends and approaches in research which has sought to address the role played by media and communication processes in the public and political theatres. Second, the elaboration and contestation of environmental issues and problems within the media will be explored by utilizing content analysis of media news toward environmental issues. Specifically it will investigate the need to reconnect the traditional three major foci of communication research on media and environmental issues, i.e., the production/construction of media messages and public communications; the content/messages of media communication; and the impact of media and public communication on public/political understanding and action with regard to the environment.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words): The student will be responsible for helping with the initial survey of literature, development of research questions, and then assist with the content analysis portion of the media analysis. The student may be asked, if comfortable, to aid in the writing of the literature review.

I expect to obtain a conference paper and perhaps a publication of this study. The timeline for this study will include

Oct/Nov: Survey of literature

Dec/Jan: Writing the literature review

Feb/Mar: Conducting the content analysis

Mar-June: Writing the final draft
What skills will the FYRE student acquire or enhance as a result of working on this research project?

The student’s library skills, social science research ability, and writing skills will be enhanced with this research. If the research is published and the student participates in helping to write the literature review, they will receive credit on the final publication.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.

Name: Dr. Daniel B. Shank

Department: Psychological Science

Title of Research Project: Surprising Decisions of Artificial Intelligence in Real Life Interactions

Description of Research Project (maximum 200 words): As people interact with artificial intelligences (AIs) such as self-driving cars, recommender systems, smart home hubs, or game bots the AIs are likely to make decisions that provide important real life outcomes. However, it is often not the difficulty or value of the outcome that makes people further consider the AIs as a social entity, but the novelty of the decision. Most people today are not surprised that AIs can play excellent chess, can give us ordered-by-importance search results, or provide informative answers to straightforward queries. It is those decisions where the AI forges new connections, provides insight, or is simply less-predictable where people reevaluate its status as a tool to a social entity. Because little is known about if, when, how often, and to what ends this occurs in real life, this project seeks to first answer those queries. Additionally, this research project will also explore the important outcomes AIs provide because of their surprising decisions. One type of outcome is the direct result of the surprising interaction (e.g., information, advice, an emotional reaction) whereas another type is psychological: how these interactions change one’s perception of the AI’s intelligence, mind, and moral status.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

This project has three phases – literature review, study and analysis – which are ordered but may overlap. For the literature review the FYRE student will focus on searching for relevant research that has measured similar types of situations. The student will also summarize some literature that Dr. Shank will provide directly, for example, studies that have measured perceived mind of AIs. The FYRE student will write a literature outline which documents some of the most important findings and measures from 10-15 related studies. From the measures
in this outline, the FYRE student will adapt and write measures and questions to ask people about their experiences with AIs making surprising decisions. This will result in a short Qualtrics survey which will ask people an open-ended question about their experience and then more specific quantitative measures such as perceived mind and intelligence of the AI. Once ready and approved by IRB, the data can be collected less than a day from the general population using Amazon Mechanical Turk. The final phase would be analysis of the results, which would include the FYRE student classifying of the types of AIs, situations, and outcomes and producing descriptive statistics (means, range, correlations) for the measures.

What skills will the FYRE student acquire or enhance as a result of working on this research project?

The FYRE student will gain a number of basic skills including (1) searching for and summarizing the most pertinent aspects of research articles, (2) how to reword existing measures in the literature so that they work in a slightly different context, (3) what real self-report data from humans looks like, (4) how to conduct descriptive analyses and classifications, and (5) how to make sense and interpret data. Additionally, the student will get an on-the-ground perspective of a cutting edge research area of applying psychology to people’s interactions with advanced technology.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: *This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.*

Name: Matthew Thimgan

Department: Biological Sciences

Title of Research Project: Objective Detection of Sleepiness Using Physiologic Measures

Description of Research Project *(maximum 200 words):*

Inadequate sleep is a threat to the health of an individual and all of our public safety. Sleepiness can be as cognitively impairing as alcohol. Sleep-deprived decision making has led to such disasters such as the Exxon Valdez, the near meltdown at Three Mile Island, and the refinery explosion in Texas City. On a smaller scale, sleep deprivation also accounts for errors in truck drivers, pilots, and doctors. Unlike a breathalyzer for detecting alcohol, there is currently no method to assess how sleepy an individual is which is key to know if they are fit to drive or do other tasks. This project aims to develop a simple, objective, and inexpensive and 30 sec to 1 min metric to assess human sleepiness in real-world situations, such as factories, military environments, or other workplace settings. We have “Big Data” from 20 participants from last year in which we have collected cognitive, subjective sleepiness, and physiologic data. In addition, we continue to collect data throughout this year to further understand the relationship between sleep patterns and cognitive function. We will use these results to develop a physiologic test for sleepiness.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline *(maximum 200 words):*

Initially, participating students will help recruit subjects and administer tests to subjects participating in the study. Students will learn the background and rationale for these particular experiments. The student will be responsible for ushering students through the protocol at the testing sites. In addition, we are looking for students that are interested in analyzing data to that relates cognitive metrics to sleepiness. The student will also participate in data handling as well as analyzing data to correlate sleepiness with physiologic measures.

What skills will the FYRE student acquire or enhance as a result of working on this research project?

The student will learn several aspects to conducting a human study and understanding how sleepiness affects human performance. These skills can directly translate to jobs that want experience in how to conduct one’s self with patient contact, design and execution of human experimentation, and analysis and variability of human data. Skills that will be developed include:
1) Coordinating and administering tasks in human studies.
2) Principles that underlie statistical analysis as well as procedures to analyze the data.
3) Students will have the opportunity to work with either mathematics or computer science to begin to develop methods to find connections between cognitive data to start.
4) Understanding the role that each test plays in understanding the role that sleepiness plays in human performance.
5) Participate in analyzing data and correlating objective and subjective tests with evidence of sleepiness.
Faculty Mentor Application for First Year Research Experience (FYRE) Program 2017-2018

Faculty: This document will be reviewed by potential FYRE students as they try to identify research projects that interest them, so please keep that audience in mind as you answer the following questions.

Name: Alexey Yamilov

Department: Physics

Title of Research Project: Time-dependent propagation of waves in multiple scattering medium: development of computer simulation code in Python programming language

Description of Research Project (maximum 200 words):

Light propagation in translucent media such as clouds, fog, paint, and biological tissue is not a simple line-of-sight as e.g. in a regular glass. Instead, the light propagates via a random walk before emerging on the other side. This mixes input and makes it impossible to see through. However, the information is not lost, it is merely scrambled. The goal of this project is to develop a part of a code to help unscramble the light propagation to enable detection of objects inside scattering medium.

Brief description of FYRE student’s responsibilities during Spring 2018, including expected outcomes and rough timeline (maximum 200 words):

The specific task of the student will be to develop a post-processing code to convert frequency transmission to time transmission. This will be accomplished with the help of Fourier transform. Student responsibilities will include:

1. Weekly meetings with the project mentor.
2. Learning the basic mathematical formalism related to Fourier transforms.
3. Learning to code in Python programming language, specifically input/output of data and performing Fourier transform using the existing library subroutines.
4. Creating the sequential images of light propagation and merging them to create videos.
5. The student is expected to prepare the final report and participate in the end-of-the-project presentations.

What skills will the FYRE student acquire or enhance as a result of working on this research project?

The student participating in this project will:
(i) learn what it takes to participate in the day-to-day cutting edge research project;

(ii) familiarize him/herself with the general problem of wave propagation in turbid media with applications to imaging;

(iii) learn about Fourier transforms and their applications to signal processing;

(iv) learn to code in Python, with the emphasis on numerical analysis of big data sets;

(v) learn to visualize the result of numerical simulation in Matlab.