BRIDGE TO THE PH.D. PROGRAM IN STEM

12TH YEAR-END RESEARCH SYMPOSIUM

THURSDAY, JUNE 16, 2022

COLUMBIA UNIVERSITY
SCHAPIRO CEPSR, DAVIS AUDITORIUM

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RESEARCH ABSTRACTS

The El Niño Southern Oscillation-Tropical Cyclone Relationship in a Statistical-Dynamical Downscaling Model

Christina K. Francis[1], Suzana J. Camargo[1,2], and Chia-Ying Lee[1]
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[2]*Dept. of Earth and Environmental Sciences, Columbia University, New York, NY*

The El Niño Southern Oscillation (ENSO) is a coupled atmospheric-oceanic climate variability that describes regional observed correlations between atmospheric circulation over equatorial Pacific Ocean and sea surface temperature. Additionally, it is well-known in modulating tropical cyclone (TC) activity at interannual timescales, which has been named the ENSO-TC relationship. During El Niño events, the warm phase of the ENSO, easterly trade winds weaken and reduce equatorial cold-water upwelling thus increasing tropical central Pacific Ocean temperatures. In contrast, during La Niña events, the cold phase of the ENSO, trade winds intensify and cold-water upwelling in the tropical Pacific Ocean strengthens. Since warm tropical water serves as fuel for the development of TCs and ENSO periodicity causes changes in global atmospheric circulation, these dynamic cycles influence TC formation and their subsequent evolution. Ultimately, this study aims to investigate changes in the ENSO-TC relationship due to anthropogenic-induced global warming by using global climate models (GCM) in conjunction with the Columbia HAZard (CHAZ) model. CHAZ is a statistical-dynamical model that “downscales” large-scale atmospheric and oceanic conditions from GCMs to generate synthetic tropical cyclones. We will observe annual frequency, genesis and patterns, and the ENSO-TC relationship demonstrated through CHAZ. These will be observed using ECMWF v.5 (ERA5) data from 1981 to 2019 and HadGEM3-GC31-LL and GFDL-ESM4 GCMs from 1951 to 2014. Results from CHAZ’s downscaled model outputs will be compared to those of TC historical observations sourced from the International Best Track Archive for Climate Stewardship (IBTrACS) v.4 dataset. Evaluating the accuracy of synthetic TC modeling in historical simulations is an imperative step to ensure that CHAZ is an adequate tool for projecting TC activity in a future warming climate.

Spectral Properties of Graphene Trilayers with Asymmetric Twists

Jireh S. García[1], Ana Asenjo-Garcia[1], and Héctor Ochoa[1]
[1]*Department of Physics, Columbia University, New York, NY*

Graphene, a two-dimensional (2D) crystal of carbon atoms arranged in a honeycomb lattice, has been of great interest due to its promising electronic and optical properties such as high thermal and electrical conductivity, flexibility, and mechanical strength. Recently, the multiple layering of graphene and other van der Waals materials has introduced an entirely new field of research, moiré materials. When stacking two or more 2D layers on top of each other with a relative twist, an interference pattern emerges known as a moiré superlattice. These highly-tunable stacking arrangements exhibit unconventional properties that differ from their single-layer counterparts. Here, we present a theoretical description of the electronic properties of twisted

bilayer graphene (TBG), the structure consisting of two individual layers of graphene rotated relative to each other by a twist angle. We treat the incommensurate TBG as quasi-periodic, limiting our twist angle to less than 10 degrees. Using a low-energy continuum model, we describe the energetic coupling between the two graphene layers and obtain the electronic band structure and density of states of the system. At certain "magic angles", the electronic bands near zero energy are remarkably flat. Band flattening at magic angles has been associated with the emergence of strongly correlated electronic behavior such as superconducting and insulating states, once interactions are included into the framework. Motivated by recent observations of electronic correlated states in twisted trilayer graphene, we consider the case of two different twist angles in the trilayer. Specifically, we focus on twist angles ranging from 0-5 degrees, near (but not exactly at) a mirror-symmetric configuration. Our goal is to compute the electronic spectrum and local density of states within an extension of the continuum model. For that purpose, we have identified pairs of twist angles satisfying a commensuration relation between the two individual moiré patterns. In future work, we hope that the study of asymmetric twists in twisted trilayer graphene can provide insight on the robust unconventional superconductivity exhibited in the system.

Injectable Vascularized Therapeutic Organoids Using Sacrificial Hydrogels for Peripheral Artery Disease

Autumn Greco[1] and Samuel Sia[1]
[1]*Department of Biomedical Engineering, Columbia Engineering, New York, NY*

Organoid platforms are touted for their impact in high-throughput drug screening and disease modeling but have witnessed less development as vehicles for cell therapy. Since current approaches for organoid production lack scalability and reproducibility in size and architecture, an innovative method is needed to achieve controlled culture and release of such structures for therapeutic use. We have previously presented a method of using hydrogels as sacrificial scaffolds, which enable cells to self-organize into spheroids and be harvested for injection. This system was then successful in generating blood-vessel units composed of endothelial cells (ECs) and mesenchymal stem cells (MSCs) to treat peripheral artery disease (PAD). In a murine model, intramuscular injections of these units in surgically-induced ischemic limbs resulted in restoration of vascular perfusion within seven days. This cell therapy can serve as an alternative to existing treatment options (e.g., endovascular and surgical intervention) and re-establish functional vasculature. We seek to further evaluate the angiogenic potential of this system in a more severe model of PAD by inducing an ischemic injury more consistent with critical limb threatening ischemia (CLTI), and further elucidate the value presented by spheroids as opposed to cell suspensions containing equal number of cells at equivalent ratios. We intend to interrogate the role of induced pluripotent stem cells (iPSCs) for their therapeutic potential in this system and explore additional clinical uses. As organoid cell therapy transforms into a new therapeutic class, this hydrogel-based method could offer high yields of self-organized, multicellular spheroids for restoring loss function in multiple disease models.

Using Machine Learning Techniques to Understand Opioid Usage

Diahmin Hawkins[1] and Tian Zheng[1]
[1]*Department of Statistics, Columbia University, New York, NY*

Currently, the U.S. is experiencing a high volume of overdoses and bloodborne-infection deaths due to the opioid epidemic. In 2017 alone, there were 32,337 and 15,263 opioid deaths in males and females, respectively. Opioids, compound substances derived from the opium poppy, are medically used for pain relief. Because of their euphoric effects, there have been increases in recreational use and overuse of opioids and their derivatives. Large networks of people who share non-sterile instruments for opioid delivery are at higher risk of overdosing and contracting infectious diseases like Hepatitis C and HIV. Organizations like HEALING (Helping to End Addiction Long Term), ORCCA (Opioid-overdose Reduction Continuum of Care Approach), and CTH (Communities That Heal) target disproportionately impacted minority populations to implement evidence-based practices to provide citizens with resources to fight opioid addiction. Data from the Erie County Task Force found that fentanyl (a synthetic opioid) contributes to 78% of opioid-induced overdose deaths due to its illicit availability. Using survey data from this organization, we have identified users that survived at least one overdose through Naloxone Rescue and discuss their experiences. Using machine learning techniques, such as Respondent Driven Sampling (RDS), we plan to identify neighborhoods in the US that are vulnerable to increased use of these substances. Findings from this study will contribute to understanding the causes and the impact of opioid usage and help lower the risk factors of opioid outbreaks.

High-throughput Screening of Multi-compositional Electrocatalysts for the Oxidation of Propionic Acid to Ethylene

Nicole Llewellyn[1], William Stinson[1], Marissa Beatty[1], and Daniel Esposito[1]
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Ethylene is one of the most highly produced chemicals in the world, surpassing 150 million metric tons per year. It is a versatile chemical that is used to manufacture polymers such as polyethylene and polyvinyl chloride, which are raw materials for plastics. A major environmental concern regarding the production of ethylene is the emissions of more than 126 million metric tons per year. Presently, ethylene is only produced via steam cracking of ethane which burns large amounts of fossil fuels. Oxidation of propionic acid, an abundant by-product of biodiesel production and carbon-negative feedstock, is a more promising approach to produce ethylene without emitting greenhouse gasses. To enable the oxidation of propionic acid, the activity, stability, and selectivity of electrocatalysts must first be optimized. However, electrocatalyst development is a prolonged process that prevents the timely integration of more sustainable alternatives to produce chemicals. Through the establishment of the Center for Decarbonizing Chemical Manufacturing Using Sustainable Electrification (DC-MUSE), a collaborative entity comprised of approximately ten research groups in the United States, our aim is to electrify ethylene production and thereby work towards the decarbonization of the

chemical industry. Specifically, our research group is interested in developing a high-throughput screening method using scanning electrochemical microscopy (SECM) to image electrocatalysts with varying composition gradients. Promising electrocatalysts will exhibit high current densities, indicating a high conversion efficiency and selectivity. Findings from this work will assist in testing and enhancing the activity of electrocatalysts that will facilitate the decarbonized production of ethylene.

Emotion and Memory in Daily Life: The Effects of Positive Reminiscence on Mood and Wellbeing

Anisha Marion[1], Megan Speer[1], and Kevin Ochsner[1]
[1]*Department of Psychology, Columbia University, New York, NY*

Reminiscing about positive memories has been shown to improve mood and dampen stress in clinical settings. Although we assume that studies in the laboratory setting are analogous to everyday life, to our knowledge, no study has explicitly tested whether such findings translate to daily experience in the real world. Beyond the emotion memories evoke, a key aspect of positive reminiscence is the social context in which these memories occur. For instance, some of our most treasured memories are likely experiences shared with others (e.g., celebrating a birthday), rather than something we did alone (e.g., receiving a good grade). Given that social connection is an important element for maintaining our physical and mental well-being, an intriguing question is whether thinking about positive memories that are rich in social contexts will inspire us to connect (e.g., talk more frequently and spend more time with friends and family)? By using Ecological Momentary Assessment (EMA), we aim to assess the effects of positive reminiscence in real-time across different measures of mood, well-being, and social behavior. Thus, a primary goal of this research is to explore the effects of positive reminiscence on mood, overall well-being, and social behavior.

Tracing Efference Copying in the Brain for Evidence and Exploration of Subcortical Projections to the Cortex

Amara Nakamura[1], Kristen Lawlor[1], and Qi Wang[1]
[1]*Department of Biomedical Engineering, Columbia Engineering, New York, NY*

Efferent copies are internal duplicates of outwardly flowing, movement-producing signals deriving from the motor system.They can be collected with reafferent sensory inputs that result from an organism’s movement to compare actual movement with desired movements. Also, they manipulate perception from specific self-induced effects on the sensory input to accomplish perceptual stability. In this way, they enable the brain to predict the effects of an action and improve motor adaptation. Efferent copies also allow suppression of sensory consequences of willed movements. For example, the neurological divergence responsible for Parkinson’s Disease causes unintended and uncontrollable movement, resulting in tremors, stiffness, and balance/coordination impairments. Understanding the subcortical projections to the motor cortex during overt movement has implications for improving the treatment of such neurological disorders. The purpose of this research is to trace neural circuitry through immunohistochemistry methods and collate resultant images with paired neural-behavior data to investigate the

efference copying phenomenon in mouse brain models. This methodology explores the optimal technologies capable for visualizing activity in the subcortical and primary somatosensory cortex regions. Future work involve the use of various surgical techniques and analysis within target subcortical and cortical regions in mice. Findings from this and future studies can provide novel insight into the nuances of subcortical function in relation to motor behavior.

Validating Specific Kinases as Mediators of the MycN Ablating Activity of Pomiferin and Isopomiferin

Nailah Smith[1] and Brent Stockwell[1]
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MycN is an oncogene that codes for a driver protein often found in the cells of tumors with poor prognoses. One such tumor driven by MycN is neuroblastoma (NBL), a common brain tumor affecting children under the age of five years. This oncogene has been previously characterized as being undruggable due to the absence of adequate binding pockets for potential drug compounds. Previous work has shown that intervening in MycN-protein interactions can stop or reduce MycN activity in these tumors. As a result, indirect approaches to ablating MycN activity currently are under investigation. From a screen of ~5,000 compounds, isopomiferin (a naturally occurring isoflavone found in Osage oranges) was found to be extremely effective at reversing MycN activity in cell-based models of tumorigenesis. From this screen, pomiferin (a commercially available derivate of isopomiferin) also was observed to be an effective MycN suppressor. Previous studies have demonstrated confirmed that pomiferin directly inhibits caesin kinase 1 (CK1) and phosphatidylinositol 3-kinase (PI3K). By inhibiting these kinases, isopomiferin and pomiferin induce the destabilization of MycN in cell-based models. The primary aim of this study is to determine which kinase, or combination of kinases, has a role in MycN ablation. Findings from this work will provide more information regarding the mechanism(s) by which these compounds suppress MycN. Once this mechanism is understood, future studies can result in the development of novel targeted therapies for MycN-driven cancers.

Mapping the Eccentricity of Pale Red Dots

Diana Solano-Oropeza[1] and David Kipping[2]
[1]*Columbia Astrophysics Lab, Columbia University, New York, NY*
[2]*Department of Astronomy, Columbia University, New York, NY*

Eccentricity, the elliptical nature of a planet's orbit, is vital to understanding the dynamics, history, and potential habitability of planets found outside our solar system. Despite the thousands of confirmed planets observed, it has proven extremely difficult to obtain the radial velocity (RV) measurements necessary for calculating their eccentricities, as their host stars are too faint or our view of their orbits is skewed. This is a problem for Earth-like discovery efforts in general, as those planets are more likely to orbit fainter stars. An alternative to RV measurements lies in the photoeccentric effect or asterodensity profiling. After acquiring two distinct measurements of a star's density, the ratio of the two measurements is used to calculate a minimum eccentricity bound.

The first measurement is derived from a transiting planet's light curve under the assumption that the planetary orbit is circular, and the second is derived independently of this assumption. We can then estimate the true eccentricity by applying Markov Chain Monte Carlo analysis. The primary methodology for this study will apply this analysis on a large scale, which has not been performed due to the difficulty in calculating independent stellar densities. However, it is possible to do this for M-dwarfs stars by using an empirical relation between mass and magnitude published in *Mann, et al (2019)*. Using Mann's relation to satisfy the photoeccentric effect, this study aims to produce a catalog of eccentricity data for over 800 planetary candidates detected by the Transiting Exoplanet Survey Satellite (TESS). This catalog will provide much-needed insight into the exoplanetary science community. Additionally, this work will explore the potential relationship between host stars' densities and their planets' eccentricities by producing a map of their distributions. Findings from this study will contribute to the efforts to confirm the existence of Earth-like planets.

Where Does Wealth Come from? A Norwegian Study to be Applied to the United States

Cora Touchstone[1], Sandra Black[1], Paul J. Devereux[1], Fanny Landuad[1], and Kjell G. Salvanes[1]
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[3]*University College Dublin, Dublin, Ireland*
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Wealth inequality has garnered much attention in recent decades. The study, *Where Does Wealth Come From,* used administrative data from Norway to create a measure of lifetime resources and examined how this measure relates to the observed net wealth of individuals at any given point in time. Findings from this study demonstrated that individuals from different segments of wealth distribution accumulate wealth from different resources. In particular, labor earnings play an important role for persons outside of the top 1% of the wealth distribution. For those within the top 1%, capital income and capital gains on financial assets become significantly important. Here, we aim to identify how the results from this study can be applied to wealth distribution in the United States. Using survey data from the Panel Study of Income Dynamics, we will recreate the measure of lifetime resources and compare our results to the previous study.

The Influence of Attentional Fluctuations on Memory

Aria Tsegai-Moore[1] and Mariam Aly[1]
[1]*Department of Psychology, Columbia University, New York, NY*

Imagine going through a long day of classes and later being asked to recall this day to a friend. There may be times when you were paying attention during class; this would be characterized as being "in the zone." On the other hand, there may be times throughout the day when you were day-dreaming and focused on other thoughts; this would be characterized as being "out of the zone." Prior research has shown that one's attentional state during an experience can influence their later memory, but less is known about how this state can influence the order in which one remembers events during an experience (Zacks et al., 2007; DuBrow & Davachi, 2016). Previous studies have been conducted to help answer this question using only behavioral methods, however, attentional

fluctuations indexed by response time do not seem to predict memory organization (Jayakumar et al., 2022). This led to the question of if changes in pupil size (pupillometry) could be a better index of attentional states and fluctuations. To help better answer this question, subjects will participate in a modified sustained attention task (Jayakumar et al., 2022), in which they will study a number of objects and be asked to recall them at a later time. Changes in pupil size will be observed to characterize "in the zone" and "out of the zone" attentional states.

PRESENTER BIOGRAPHIES

Zohal Barsi (Cohort 13) was born in Al Ain, the United Arab Emirates to Sudanese parents and immigrated to San Antonio, Texas at the age of four. She graduated from Wellesley College in May of 2019 with a Bachelor of Arts in economics and English. As a component of her undergraduate program, she completed a year of study at the London School of Economics and Political Science. Following graduation, she participated in the American Economic Association Summer Training and Scholarship Program at Michigan State. In addition to taking courses in microeconomics, mathematics and econometrics, Zohal researched the impacts that leisure-enhancing technologies, such as cellphone applications, have on time allocation by country. From September 2019 to June 2020, Zohal served as a Mariam K. Chamberlain Fellow at the Institute for Women's Policy Research in Washington D.C. There, she worked on employment and earnings projects and researched the rise of entrepreneurship among women of color. As a Bridge Scholar, she is researching topics in urban economics with Donald Davis in the Department of Economics. After completing the Bridge to the Ph.D. Program, Zohal plans to pursue a Ph.D. in economics at the University of Wisconsin.

Christina Francis (Cohort 14), a born and raised New Yorker, graduated with honors from Johns Hopkins University in Spring 2021 with a B.S. in Environmental Science. Throughout her undergraduate career, she spent every semester and summer gaining research experience in various fields of study that fall under the umbrella of environmental science to expose herself to an array of subdisciplines. Some of those research experiences include a hydrology project estimating volume changes of a storm water retention basin at Unity College in Maine; an ecology project determining the non-consumptive effects of predator presence on the eastern oyster in New York City waters; a microbiology project examining correlations between soil nematode reproductive organ structure and population dynamics; and another ecology project improving long term ecological forecasts. While participating in Stanford's Summer Undergraduate Research in Geoscience and Engineering (SURGE) Program, she conducted a study that analyzed the effects of oil and gas well site activity on air pollutant concentrations in California. She adapted this project into a senior thesis, which investigated the contribution of a local incinerator to downwind concentrations of nitrogen oxides and particulate matter in Baltimore City, Maryland. Through these latter research experiences, she began to develop an affinity for atmospheric sciences and is excited to continue exploring this subject further via the modeling of tropical cyclones. As a Bridge Scholar, Christina is working under the guidance of Prof. Suzana J. De Camargo in the Division of Ocean and Climate Physics (Lamont-Doherty Earth Observatory). After completing the Bridge Program, Christina intends to pursue her graduate studies in the environmental sciences with a focus on atmospheric sciences.

Jireh Garcia (Cohort 13) was born and raised in Tegucigalpa, Honduras. After high school, she moved to New York City to pursue her undergraduate studies and enrolled at LaGuardia Community College as a mechanical engineering student. There, Jireh developed a passion for physics after taking an introductory course in the subject. In May 2020, Jireh graduated *magna cum laude* from the City College of New York with a B.S. in physics. At City College, Jireh conducted research in atmospheric physics as an NOAA-CESSRST scholar, under the mentorship of James Booth. More specifically, she worked on relating the occurrences of Rossby wave breaking, atmospheric blocking, and weather anomalies. Through her coursework, Jireh enjoyed studying topics relating to electrodynamics and quantum mechanics, which prompted her to conduct research in these subdisciplines of physics. During the summer of 2019, she was chosen to be an REU scholar at Columbia University where she investigated topics in condensed matter physics. Under Cory Dean's mentorship, Jireh studied twisted 2D heterostructures and their applications in electronically correlated phenomena. In addition to her interests in physics, Jireh is passionate about community outreach catered towards underrepresented students in STEM fields and plans to engage in this work as a Bridge Scholar. In the Bridge Program, she is working with Ana Asenjo-Garcia to answer interdisciplinary questions in quantum optics and condensed matter physics. After completing the Bridge Program, Jireh plans to obtain a Ph.D. in molecular engineering at the University of Chicago.

Autumn Greco (Cohort 13) was born and raised in New York, NY. In June 2020, she graduated from Stanford University with a B.S. in bioengineering. During her time at Stanford, Autumn worked in Geoffrey Gurtner's laboratory where she studied applied regenerative medicine in wound healing. Specifically, Autumn investigated the regenerative properties of cryopreserved human skin allografts as a possible treatment for chronic wounds and burns. Autumn also has research experience in liquid biopsy diagnostics and acute myeloid leukemia therapeutics at Stanford University and Roswell Park Cancer Institute, respectively. Through these research experiences, Autumn has developed an interest in immunology and device prototyping. Autumn is passionate about translational medicine and seeks to design biomedical systems for clinical use. In addition to conducting research, Autumn enjoys mentoring and encouraging younger students to pursue STEM careers. As a Bridge Scholar, Autumn is working in Samuel Sia's laboratory in the Department of Biomedical Engineering at Columbia Engineering where she is investigating cell and tissue-engineered therapies. After completing the Bridge to the Ph.D. Program, Autumn plans to pursue a Ph.D. in biomedical engineering at Johns Hopkins University.

Diahmin Hawkins (Cohort 14) was born in Birmingham, Alabama and graduated *magna cum laude* from Tennessee State University with a B.S. in mathematical sciences. She developed a strong passion for mathematics while participating in math competitions and derbies where she was often ranked first in the region and district. Diahmin began her STEM research journey as a Student Opportunity for Advancement in Research Skills participant at Tennessee State University, which funds undergraduate research for underrepresented populations in STEM. She is looking to pursue a career in mathematics in order to produce research and new developments on robotic systems that will transition technology to a higher and efficient distinction. Under the guidance of Prof. Tamara Rodgers at Tennessee State University, Diahmin conducted research in robotic navigation and mapping to detect climate change. Additionally, she was a Leadership Scholar for the Department of Homeland of Security where she conducted research on the topic of graph theory in relation to domestic and foreign affairs. Through her research with the Department of Homeland Security, she used graph theory to construct the connectedness between subjects, draw conclusions, demonstrate the relationship, and communicate the ideology through a graph or image to explain the relationship. In addition to these two research experiences, she interned for Congressman Jim Cooper, Representative Pat Marsh, and Representative John Ray Clemmons at the Tennessee State Capitol,

Air Force Research Laboratory, and Brookhaven National Laboratory, respectively. As a Bridge Scholar, Diahmin is working under the mentorship of Prof. Tian Zheng in the Department of Statistics. After completing the Bridge to Ph.D. Program in STEM, Diahmin plans to further her education career path by studying statistics. She plans to give back to her community and create opportunities for low-income, minority students pursuing undergraduate or graduate studies in mathematics.

Alex Johnson (Cohort 13) is from the greater Washington D.C. Metropolitan Area of Maryland. From a young age, Alex has had a deep passion for mathematics, physics and space, which set him on an early path to science and engineering. Alex obtained his B.S. from the University of Maryland (UMD) where he majored in aerospace engineering with a focus on dynamics, controls, and space robotics. As an undergraduate, Alex worked on a number of projects related to modeling dynamic systems and developing algorithms for autonomous vehicles. A particularly significant research experience at UMD's Institute for Systems Research involved developing path planning algorithms for unmanned aerial vehicles. After completing his undergraduate studies, Alex worked at NASA Goddard Spaceflight Center as an attitude control system engineer for the Tracking and Data Relay Satellite (TDRS) fleet. There, Alex performed analyses to explain failures of the TDRS satellites' attitude control systems and respond to these failures in real-time. Alex also developed a number of analysis tools that were used to predict the momentum state of these satellites and make modifications to operations. After a year at NASA, Alex pursued his graduate studies at Carnegie Mellon University and received a master's degree in electrical and computer engineering. While at Carnegie Mellon Alex learned a great deal about pattern recognition, artificial intelligence, and computational analysis. Alex's studies at Carnegie Mellon was a pivotal moment in the determination of his academic trajectory because he realized that he wanted to use these computational methods to a career in physics. After graduating from Carnegie Mellon, Alex set out to switch fields to physics, leading him to the Bridge Program. As a Bridge Scholar, Alex will develop computational tools to analyze structures in the Milky Way Galaxy under the guidance of Kathryn V. Johnston. In particular, he will use Single Spectrum Analysis and other techniques to automate the analysis process in hopes that these automated approaches will reveal new Milky Way structures beyond traditional techniques. After completing the Bridge Program, Alex hopes to obtain a Ph.D. in physics at Harvard University.

Alexis Kim (Cohort 13) was born to two Cambodian refugees and raised in Lowell, Massachusetts. After taking an introductory biology course in high school, she became fascinated with the biological sciences and medicine. This fascination led her to pursue a Bachelor of Science at the University of Massachusetts (UMass), Amherst, where she majored in biochemistry and molecular biology. After taking a neurobiology course at UMass, her curiosity about neuroscience led her to join Karine Fenelon's laboratory in the summer of 2019 under the William Lee Science Impact Program (Lee SIP). As a Lee SIP scholar, Alexis tested the efficacy of optogenetics using electrophysiological field recordings. From there, Alexis continued to work with Dr. Fenelon in the fall to conduct a year-long research project that investigated the significance of the hippocampus in sensorimotor gating using prepulse inhibition (PPI) in a murine model system. Abnormal or impaired PPI has been linked to patients with schizophrenia, obsessive-compulsive disorder, and Huntington's disease. In conjunction with this project, Alexis also joined the laboratory of Dong Wang, after completing his biochemistry course. In this group, she investigated the mechanism of nitrogen-fixing symbiosis

amongst legumes and bacteria, using CRISPR Cas-9 genome engineering systems. Alexis worked in these two laboratories until May of 2020 when she became the first in her family to graduate from university. Currently, Alexis is working under the mentorship of Bianca Jones Marlin at the Mortimer B. Zuckerman Mind Brain Behavior Institute. Her research focuses on understanding the transgenerational epigenetic inheritance of trauma and neuromodulation. After completing the Bridge to the Ph.D. Program in STEM, Alexis plans to work in management consulting prior to studying medicine.

Nicole Llewellyn (Cohort 14) was born in China but raised in Rochester, New York. At an early age, Nicole always had an interest in math and chemistry, which was influenced by several inspirational teachers in high school. Combining these passions, Nicole completed her undergraduate studies in chemical engineering and neuroscience at Syracuse University. During Nicole's undergraduate years, she worked on several research projects. Nicole's background in neuroscience led her to gain research experience in Prof. Zhen Ma's research group at Syracuse University, where she modeled cardiac cells to better predict cardiac defects during pregnancy. However, her work in Prof. Jesse Bond's research group at Syracuse University shaped her desire to pursue clean energy research. There, she investigated carbon monoxide (CO) methanation reaction rates by synthesizing and characterizing various bimetallic catalysts to provide evidence of methane as a greener fuel alternative. Ultimately, Nicole seeks to conduct research in the field of sustainable energy and catalysis. Outside of research, she enjoys teaching and promoting engineering interests in younger students through STEM outreach. As a Bridge Scholar, she will investigate different electrocatalysts for the electroorganic synthesis of ethylene under the guidance of Prof. Daniel Esposito in the Department of Chemical Engineering. Following the completion of the Bridge to the Ph.D. Program in STEM, Nicole will pursue a doctorate in chemical engineering.

Anisha Marion (Cohort 13) is a proud member of the Ojibway and Abenaki Nations, whose land includes present-day Ontario and Quebec provinces. She received her Bachelor of Arts in psychology from the State University of New York at Plattsburgh. Through several undergraduate research experiences, she developed a passion for understanding how historical trauma impacts minority communities, specifically focusing on American Indian communities, both at the individual and community level. By integrating research and clinical practice, she hopes to apply more culturally sensitive therapies to minority communities. Anisha has worked in a residential facility where she taught self-regulation and emotional regulation skills to teenage girls with mental health disorders. The primary focus of her work focused on helping them understand their emotions and how to implement healthy coping strategies. As a Bridge Scholar, Anisha is working with Kevin Ochsner in the Social Cognitive and Affective Neuroscience Laboratory in the Department of Psychology. Her research focuses on understanding the psychological and neural bases of emotional experiences in regards to perception and emotional regulation. After completing the Bridge to the Ph.D. Program, Anisha plans to pursue a Ph.D. in clinical psychology at the University of Utah.

Amara Nakamura (Cohort 14) was born and raised in Orange County, CA. She paves her way in STEM as a Chinese-Japanese American woman, empowered by the resilience and hard work of her immigrant family and so many like hers who continue to give back to this world with an underlying belief that we are all one. In May 2021, she graduated from

California State University of Long Beach (CSULB) with a B.S. in biomedical engineering and a minor in computer science. As an undergraduate at CSULB, Amara pursued research spaces across biomedical engineering and kinesiology because of her desire to optimize health and medical capabilities. Amara dedicated most of her formative years in research working in Prof. Ga-Young Suh's laboratory where she focused on cerebral perfusion analysis using computational fluid dynamics and modeling of the brain and its arteries. Amara worked alongside her team to create a 3D-based methodology that used eight open-sourced patient cases to create extensive cerebral artery models co-registered to their respective brain tissue models for blood flow simulation quantification. This research's aim was to discover cerebral blood flow correlations to brain perfusion and to understand causes for complex cerebral diseases better for clinical treatment. Through these research experiences, Amara developed an affinity for neurovascular relationships and brain biomechanics. As a Bridge Scholar, Amara is working in Prof. Qi Wang's research group in the Department of Biomedical Engineering where she is studying neural coding of perception and cognition. After completing the Bridge to Ph.D. Program in STEM, Amara will pursue her Ph.D. in biomedical engineering and explore her passion for teaching and working with students, as she strives towards her overarching goal to help better all lives within our global community.

Jhevon Smith (Cohort 13), born and raised in St. Andrew, Jamaica, came to the U.S. in search of opportunity and to attend university. He obtained his bachelor's and master's degrees in mathematics from the City College of New York (CCNY), and he has over a decade of experience teaching at the collegiate level. During his undergraduate studies, he worked as a tutor in the largest STEM tutoring center at CCNY and eventually became the director of that center. After receiving his bachelor's, he began teaching in the Mathematics Department at CCNY. Also, he has taught at several institutions in the City University of New York system, including John Jay College of Criminal Justice, Baruch College, and LaGuardia Community College. In 2018, he also became a lecturer at the Bronx campus of Fordham University. Through completing moderate research projects, meeting exceptional people in his field, consulting with other education professionals, and motivating his students, Jhevon became inspired himself about the academic and professional possibilities in applied mathematics and engineering. He recently became enamored with the field of operations research and is currently working under Van-Anh Truong of Columbia Engineering's Department of Industrial Engineering and Operations Research. Truong's work deals with applied optimization in information-rich, dynamic environments. Upon completing the Bridge Program, Jhevon plans on pursuing a Ph.D. in operations research at Princeton University.

Nailah Smith (Cohort 14), the daughter of Jamaican immigrants, was born and raised in Brooklyn, NY. From an early age, she realized that she had a knack for math and sciences and was lucky enough to have teachers and mentors who supported her scientific endeavors. As a high school student, she interned at what is now the New York University (NYU) Tandon School of Engineering under the supervision of Prof. Jin Montclare. At NYU, she discovered her love of biochemical research. After a nearly 10-year break in her education, she enrolled at Columbia University where she earned a BA in chemistry. As an undergraduate at Columbia University, Nailah worked in Prof. Brent Stockwell's research group in the Department of Biological Sciences and will continue to as a Bridge Scholar. In the Stockwell group, Nailah will continue to research the use of small molecules to probe cell death and disease. After completing the Bridge to Ph.D. Program in STEM, Nailah plans to pursue a Ph.D. in biochemistry with a focus on researching potential drug therapies for diseases.

Diana Solano-Oropeza (Cohort 14) grew up along the 7 Train Line in Queens, New York. They discovered their passion for astrophysics during high school while participating in a research internship program at the American Museum of Natural History. They went on to pursue a bachelor's degree in physics with a concentration in astrophysics at Drexel University. While there, they worked with Profs. Stephen McMillan and Joshua Wall on producing simulations of stellar formation that intended to resemble real-life observational images of stars. Diana also minored in sociology and frequently advocated for social justice during their time at Drexel University. For their senior thesis, they took a brief stint away from astrophysics to work on an interesting statistical physics project that intersected with linguistics and data science. Working with Prof. Jake Ryland Williams at Drexel's College of Computing and Informatics, Diana investigated the reasons behind why Zipf's law (which provides a mathematical relationship between words and how many times they appear in a document) failed to explain certain aspects of written-language data. Now, as a Bridge Scholar, they work with Prof. David Kipping in the Cool Worlds Lab to improve how Earth-like planets outside our solar system are detected through transits. Diana plans to pursue a Ph.D. in astronomy after completion of the Bridge to the Ph.D. Program in STEM.

Aria Tsegai-Moore (Cohort 14) was born and raised in Buffalo, NY. From an early age, she always held an interest in the mind and why people behaved and acted in specific ways. Years later, with the help and guidance of her professor from an introductory psychology course, she realized that she wanted to pursue a career in the field of psychology. From that point, she followed her passion for psychology and graduated from Stony Brook University in 2021, where she double majored in psychology and sociology. As an undergraduate at Stony Brook, she worked as a research assistant in Prof. Hoi-Chung Leung's Cognitive Neuroscience Lab. There, she worked on projects that focused on visuo-spatial working memory using eye-tracking techniques. She expanded this research for her honors thesis by investigating the effects of Parkinson's Disease and dopaminergic medication on pupillometry during working memory tasks. In addition to this research experience, Aria also participated in summer research programs at Carnegie Mellon University and the University of Delaware. All of the knowledge and skills that she gained from her academic and professional pursuits inspired her interest in working with aging populations. Specifically, she is interested in studying cognitive decline in these populations by using various approaches and techniques such as functional magnetic resonance imaging (fMRI) and eye-tracking. Currently, Aria is working in Prof. Mariam Aly's research group in the Department of Psychology to strengthen her knowledge on areas impacted by cognitive decline such as memory and attention. Upon her successful completion of the Bridge to the Ph.D. Program in STEM, she will pursue a Ph.D. in psychology with a focus on cognitive decline in the aging population.

Cora Touchstone (Cohort 14) was born and raised in Marietta, Georgia. She completed her undergraduate education at Grinnell College in 2019, majoring in mathematics and economics. As part of her undergraduate research, she participated in MIT's Summer Research Program assisting

Prof. Jonathan Gruber in collecting data on grant funding and tax credits given to Canadian corporations for R&D expenditures and identified when tax credits lose their ability to provide an incentive for R&D expenditure. There, she also developed code in Stata to estimate overall and marginal Scientific Research and Experimental Development (SR&ED) tax credits for Canadian corporations. In addition to this research experience, she worked as a research assistant, tutor, and student organization president for Black Students in STEM at Grinnell College. After graduation, she began working as a research associate for the National Economic Research Associates in its securities and finance practice. Currently, her research interests rest at the intersection of applied microeconomics, political economics, and network theory. As a Bridge Scholar, she is researching topics on wealth with Sandra Black in the Department of Economics. After completing the Bridge to Ph.D. Program in STEM, Cora intends to pursue a Ph.D. in economics.

BRIGDGE PROGRAM'S ALUMNI/AE

While the scholars from Cohort 12 (2019-2021) have completed the Bridge Program, we are proud of their accomplishments and would light to highlight what they have been up to over the past year.

Cohort 12				
Scholar	**Advisor(s)**	**Discipline**	**Current Graduate Program**	
Olalekan Bello	Douglas Almond Reka Juhasz	Economics	Currently working in management consulting with plans to apply to graduate programs in Fall 2022	
Jashvina Devados	Pierre Gentine	Earth & Environmental Engineering	University of California, Berkeley	Environmental, Science, Policy & Management (Ph.D.)
Syntia Hadis	Nim Tottenham	Psychology	Columbia University	Psychology (Ph.D.)
Dafne Murillo López	Eric Verhoogen Michael Best	Economics	Columbia University	Economics (Ph.D.)
Chinwendu Nwokeabia	Elizabeth Hillman	Biomedical Engineering	University of Michigan	Biomedical Engineering (Ph.D.)
Maggie Reed	Charles Hailey	Physics	University of California, Berkeley	Physics (Ph.D.)
Talha Rehman	Laura Kaufman	Chemistry	Harvard University School of Engineering & Applied Sciences	Applied Physics (Ph.D.)

ACKNOWLEDGMENTS

As a program that promotes diversity in higher education, the Bridge to the Ph.D. Program in STEM is grateful to have countless supporters and collaborators that ensure the success of this program. We would like to express our sincere gratitude to the Office the Vice Provost for Faculty Advancement and the Office of Graduate Student Affairs at Columbia Engineering; in particular, Dennis Mitchel, Soulaymane Kachani, Leora Brovman, Jenny Mak, Shih-Fu Chang, Adina Berrios Brooks, Shana Lassiter, Helen Lu, and Garud Iyengar. The Bridge Program would like to thank Marcel Agüeros and Geraldine Downey for understanding the need of and promise for this program. In addition, we would like to recognize Chole Bulinski, Jeremy Dodd, and our advisory board for providing advice and suggestions for ensuring the success of the Bridge Program. Also, we are indebted to the numerous principal investigators (PIs) that have served as mentors, advisors, and advocates for our scholars. The Bridge Program would like to recognize Elliot Gewirtz for his generous gifts in support of our annual symposium. Finally, it has been an immense honor to work and interact with the gifted and talented scholars.