

BSRI

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A Study of Caps in $AG(8, 2)$

Francisco Andrade Mora & Yaroslav Valchyshen

Advisor: Lauren Rose

EvenQuads is a Set-like game where the players must find four cards that fit a pattern called a Quad. An EvenQuads deck with 2^n cards is a model for the Affine Geometry $AG(n, 2)$ over the field of the Integers modulo 2, where each card is represented by a binary vector.

In this project, we study caps, which are Quad free subsets of $AG(n, 2)$. We classify all caps of size 9, 10, 11, 12 and begin classifying caps of size 13 up to affine equivalence. By doing so, we aim to compute the probability that a given deck of k cards contains a quad.

Characterization of Alterations in *C. elegans* Reproductive and Feeding Behaviors in Response to *Pantoea sp*

Nazira Askari & Tree Nguyen-Ryan

Advisor: Rebecca Cox

The relationship between the microbiome and brain is a relatively new area of study that is increasingly gaining traction in biological research. Our research aims to clarify this relationship using a *C. elegans* worm model and novel bacteria species *Pantoea sp*. *C. elegans* notably has high homology with humans, making our research possibly useful to translational research with broader health applications. *Pantoea nemavictus* is a gram-negative, rod-shaped bacteria commonly found in wild *C. elegans* microbiomes (Dirksen et al). Previous research suggests a preference for *Pantoea* in chemotaxis assays, and faster development (Chai et al, Dirksen et al). We first determined that *Pantoea* gives *C. elegans* an evolutionary advantage through shorter developmental timing and earlier, larger egg lays. We then found that they preferred *Pantoea* through chemotaxis assays. To isolate neuronal pathways involved in this preference, we used exploration and pumping behavioral assays and our results indicate changes in serotonergic signaling. Knockout strains should be used to further isolate these pathways, and more steps can be made to characterize this novel *Pantoea* species.

Light Scattering Studies for Gravitational-Wave Detectors

Kincade Avery & Eric Zhao

Advisor: Antonios Kontos

LIGO uses laser interferometers with highly reflective mirrors to detect gravitational waves. Imperfection in the mirror coatings can scatter light, which may re-enter the beam and introduce noise. We study TiO_2 -doped GeO_2 coatings to understand how annealing affects their structure and light-scattering behavior.

Estimating Environmental Coupling at LIGO Livingston Using Thunderstorms During O3

Fonseca Bagchi

Advisors: Antonios Kontos & Adrian Helmling-Cornell

Before a gravitational-wave detection is believed, LIGO checks whether environmental noise could have produced it. That check relies on each environmental sensor's coupling function (CF): how much signal appears in the gravitational-wave channel (DARM) per unit of motion or sound the sensor records. CFs are measured in noise-injection campaigns, which are infrequent and compete with other commissioning work.

We explore thunderclaps as a natural noise source for measuring coupling while the detector is observing. Starting from 122 vibration-class glitches in LIGO Livingston's third observing run (O3), we keep claps during which the detector stayed locked and which coupled most strongly at the End Y station. We locate each clap at the peak of DARM's 30–100 Hz band-limited RMS and compute per-sensor CFs from foreground and background spectra. 64 claps yield CFs with at least 20 frequency points on at least one sensor.

A single clap reproduces the pre-O3 injection measurements where the injections excited both the sensor and DARM. Combining claps with sequential Bayesian inference on a B-spline model recovers coupling at 50–60 Hz without prior knowledge of it, and agrees with injection upper limits elsewhere. Thunder only excites a limited frequency band, so it supplements injection campaigns rather than replacing them. Next, we will automate event selection and write up the method.

Do Command Rejection Responses Change Assumptions about Robot Norm Understanding?

Emily Campos & Juan Diego Mora Rubio

Advisor: Theresa Law

Robots may sometimes be given a command that they both cannot and should not accept. How do the different ways of a robot rejecting these commands affect the assumptions people make about a robot's level of norm understanding? In our previous work, we ran two online studies in which a robot rejected a norm violating command that was given by the participant. Within this study the robot was incapable of carrying out the command, and gave one of four possible explanations as to why it rejected the command (non-verbally, minimal verbal explanation, capability only explanation and both moral and capability explanations). We found that participants that were given the capability only explanation believed the robot would otherwise follow a non-normative command if it were not for the capability limitation. In this work, we were interested to see if those findings would hold up when people interacted with a robot in person rather than online. In this in-person experiment, therefore, participants were asked to collaborate with a robot by controlling it and placing it within multiple norm-breaking scenarios. When placed in one of the norm-breaking scenarios, the robot would respond to the participant with one of the four command rejection explanations. Participants would then be allowed to bypass the capability or moral limitations and issue the norm-breaking command again, to which the robot would comply. Contrasting our online studies, we did not find any significant differences between the conditions with regards to people's perceptions of the robot's understanding of norms.

Multiple-emitting Cyclometalated Platinum(IV) Compounds

Ricardo Cortines Rama

Advisor: Craig Anderson

Although Pt(II) and Pt(IV) have similar photophysical properties such as long excited states lifetimes, and high quantum yields, it has been recently discovered that Pt(IV) compounds exhibit further photocyclical tuning that its more reduced counter part. During my time at this year's Bard Summer Research Internship, I worked with both iminic and isocyanide/phosphine ligands to make six-coordinated Pt(IV) compounds. We synthesized a range of Pt(IV) compounds differing ligand structures, and bonded them to different isocyanide compounds. To synthesize the Pt(IV) ligands we used Tetramethyl platinum dimer $[\text{Pt}_2\text{Me}_4(\mu\text{-SMe}_2)_2]$. The octahedral Pt(IV) compounds were characterized with 1-D and 2-D NMR spectroscopy, IR spectroscopy, LC-MS, elemental analysis and single crystal X-ray diffraction. Their photophysical characterization was performed by analyzing the excited-state lifetimes, UV-VIS spectroscopy, and quantum yield measurements. We compared the photophysical data of the compounds in solution, solid state, and as dopants in PPMA films. Quantum yield values increased significantly for compounds when doped in PPMA.

Using Photogrammetry to Measure the Fidelity and Roughness of 3D Microstructures Made by Two-Photon Polymerization

Avery Crafton, Jaiden Johnson, Zihan Chen, & Lyric Mateo
Advisor: Christopher LaFratta

Assessing the accuracy of a microscopic 3-D printed object's shape compared to its intended design is challenging because of its small size. Scanning electron microscopy (SEM) is often used for imaging samples made by two-photon polymerization (TPP); however, these images are inherently 2-D, making 3-D comparison difficult. We used photogrammetry on a series of electron micrographs to reconstruct a 3-D point cloud of the printed object. Next we virtually overlaid the measured point cloud with the original stereolithography design file used to print the object to see how the features lined up with one another. Discrepancies, potentially stemming from shrinkage or optical aberrations, were measured and could be corrected in future prints. Using this methodology we can measure the accuracy of microstructures made by TPP.

A Laboratory Model for Iron Snow In Planetary Cores

Pape Davidson, Shichen Shen, & Jirui Liu

Advisor: Michael Bergman

Iron snow consists of solid iron crystals that form and move through a liquid planetary core, redistributing heat and chemical elements as they grow, settle, or melt. This process may contribute to Earth's proposed F-layer immediately above the inner-core boundary and influence the fluid motions associated with planetary magnetic fields. Although theoretical models describe iron-snow formation and transport, experimental tests are needed to assess whether their predicted behavior is physically realizable.

This project develops a new laboratory model of iron-snow dynamics in a reactive, thermally stratified fluid. Here, "reactive" means that crystals can grow or melt while exchanging heat and material with the surrounding liquid. Our objective is to test the physical feasibility of the coupled crystallization and transport processes underlying iron-snow theory and evaluate the assumptions used to describe them.

We use ice platelets in a vertical saltwater tank with temperature-controlled upper and lower boundaries. Because ice rises while iron crystals sink, the experiment reverses particle motion and the corresponding temperature gradient. A double-bucket filling technique establishes thermal layering. Seeds of prescribed size and controlled release orientation allow comparisons of crystal motion and drag with theoretical predictions.

Initial work has focused on preparing the thermal gradient and developing seed-preparation and release procedures. Preliminary trials identified coiled tubing and an internal rod as promising components for controlling filling disturbances. Planned camera measurements will quantify crystal trajectories and

orientation, followed by observations of growth and melting. These experiments will provide laboratory constraints on the fluid dynamics of iron snow and help assess the applicability of theoretical models to planetary cores.

Microbial Life in the Saw Kill Watershed

Ray Greenberg, Kelly Lee, Lincoln Grisso, Royal Hooper, Riley Mabry, Nyla Lawrence, Hameed Azad

Advisors: M. Elias Dueker & Gabriel Perron

The Sawkill Creek is used for both drinking water and wastewater disposal, as well as recreation. It is home to a variety of animal and plant life, but also microbial life that is not visible to the naked eye. Our lab worked on several projects related to microbial life in the river this summer. We used the Sawkill Watershed Community's over 10 years of sampling data to test concentrations of microbial DNA across place and time, including antibiotic resistance genes that can be harmful to human health. We performed qPCR on extracted DNA from the samples for *16S* (general bacterial abundance) and *Int1* (antibiotic resistance and general marker for human impact/pollution). We also surveyed diatoms and other algae in the Sawkill to get an idea of their diversity and the health of the microbial ecosystem. Our group also reorganized the Sawkill Watershed Community Database to be more readable and user-friendly, so this public health and environmentally relevant data can be more easily accessed by members of our community.

Efficient and Green Synthesis of Halobenzo[b]thiophenes Using Mild Reagents

Saaraf Ibnat Hasan & Fuhua Feng Wu

Advisor: Tanay Kesharwani

The synthesis of functionalized heterocyclic compounds is a key area of research in organic chemistry, particularly in the pursuit of greener and more sustainable practices. In this study, we introduce a practical method for preparing 3-halobenzo[b]thiophenes through the use of mild reaction conditions and less hazardous reagents. By utilizing accessible starting materials and simplifying the synthetic process, this approach offers an alternative to conventional halogenation methods that rely on hazardous chemicals or harsh conditions. The reaction also accommodates a broad range of functional groups, enabling the synthesis of diverse products in good to high yields.

Thienyl and Phenyl-derived Cyclometalated Platinum Compounds from Competing C-H/C-X Bond Activation Pathways

Benett Hathaway, Jaiden Johnson, & Everest Oppenheimer
Advisor: Craig Anderson

X-C[^]N[^]N (X = Br, Cl) ligands were reacted with [Pt₂Me₄(μ-SMe₂)₂], 1, resulting in a six-coordinate cyclometalated platinum(IV) compound containing an anionic C[^]N[^]N ligand when X = Br, and both a platinum(IV) and a platinum(II) product when X = Cl. The X-C[^]N[^]N (X = Br, Cl) ligands included both phenyl and thienyl derivatives. Both varieties gave similar product distributions. A platinum(II)/C-H activation product was obtained for the thienyl derivative when X = H, but could not be isolated for the phenyl derivative. The platinum compounds were characterized by multinuclear NMR spectroscopy and single crystal X-ray diffraction (SCXRD). Photophysical properties were explored using UV/vis, emission, and transient absorption (TA) spectroscopies. Kinetics of the reactions were monitored by NMR spectroscopy. DFT and TDDFT calculations were performed to examine the competition between C-H activation and C-X oxidative addition, and compared to experimental results.

Year #2: Burpee Trial Garden

Marcos Hernandez , Lucia Lennox , Anders Osler , Nico Van Lenten

Advisor: Amy Parrella '99

The Burpee Trial Garden is a new initiative at Bard designed to test and grow experimental flowers, vegetables and herb seeds. It provides educational opportunities for hands-on gardening and scientific evaluation for field-proven top performers to home gardeners and the horticultural industry. The trial garden was grown, maintained and evaluated by students during June to October 2026. Students made daily observations and evaluated each plant for a variety of characteristics. Two "New Product Candidates" were evaluated for this project. Also, American heritage varieties and indigenous crops were also grown in celebration of America's 250th semi-quincentennial anniversary. Preliminary conclusions and a suggestion for additional research were concluded. All data will be shared with the Burpee Foundation.

Exploring the Effects of Ruthenium Compound Ru79 on DNA–RNA Hybrid Stability and CRISPR-Cas9 Activity

Sahil Husaini

Advisor: Swapan Jain

DNA–RNA hybrid structures play important roles in biological processes such as transcription, genome stability, and gene regulation, and have recently gained attention as potential targets for small molecule drugs. Ruthenium-based compounds have emerged as promising alternatives to platinum-containing compounds due to their lower toxicity and flexible modes of interaction with biomolecules. In this study, we investigate the effect of the ruthenium compound Ru79 on DNA–RNA hybrid stability and CRISPR-Cas9 activity. UV-Vis melting studies show that the addition of Ru79 significantly decreases the melting temperature of a 20-basepair DNA:RNA hybrid, indicating reduced hybrid stability. In CRISPR cleavage assays using linearized pUC19 DNA, Ru79 leads to the disruption of normal DNA cleavage in a concentration-dependent manner compared to controls. These results suggest that Ru79 interacts with DNA–RNA hybrids and can influence their stability and function, highlighting its potential as a small molecule for targeting hybrid structures.

Visible Light Photocatalysis of N-aminopyridinium Reagents: Scope and Mechanism of the Direct Aziridination of Alkenes

Gwendolyn E. Jamison & Elliana K. Welby

Advisor: Emily McLaughlin

This summer during BSRI, we explored the utility of visible-light photocatalyzed carbon-nitrogen (C-N) bond formation, to prepare aziridine ring systems. Our methods focus on the development of protocols sensitized by iridium polypyridyl complexes, activating electrophilic, bench-stable N-amino pyridinium reagents in their reaction with alkenes, and alkynes. The feasibility, scope, and evidence of this photocatalytic mechanism is reported. To better understand the nature of the reactive intermediate, effects of substitution and stereochemistry of the alkene reaction partner and resulting aziridine products are observed. Additionally, we evaluate the scalability of this methodology, including its application under flow conditions.

The Appropriateness of AI in Virtual Graveyards

Shiraz Kirmani, Meredith Gardner, & Chelsea Lynch

Advisor: Annabel Rothschild

FindaGrave is an online platform used publicly by users to document gravestones across the world, with extra information about the deceased such as obituaries and family trees. As a community data project, FindaGrave is run by volunteers to host and maintain the digital cemetery. Part of our study was to investigate how/if users were being affected by artificial intelligence (specifically generative AI) on the platform and their attitude towards such technology being used in the virtual graveyard space. Preliminary findings suggest that FindaGrave users worry that using generative AI could threaten the sites' reputation as a historical archive and unfavorably reconceptualize the deceased posthumously. We also found that attitudes varied based on the user's understanding of the purpose of the site. For example, some see it as a historical archive and, thus, believe generative AI is not accurate or verifiable enough to be used as a tool, whereas others see it as a memorial space and are unbothered by those who express their grieving using generative AI.

Bright VS Dark: Conditioned Pupillary Light Response

Nini Kontselidze & Aizhamal Aitmamat kyzy

Advisor: Sean O'Bryan

The human pupil is known to constrict once it attends bright stimuli and dilate when attending a dark stimuli. The Pupillary Light Response (PLR) is an autonomic nervous system function which regulates visual acuity, but more precisely it refers to rapid and reflexive constriction of the pupil in response to the stimuli with intense bright luminance. Despite previous failures to classically condition the PLR – hence allowing the brain to learn associative and adaptive features of this physiological response – all the previous studies have had one common denominator our study decided to address. In our experiment, we devised a visual search task which accompanied stimulus-onset in order to add on the functional significance element to PLR conditioning: will the pupil better learn an adaptive response if the task performance required it to? We devised the task with two separate but standardized bright and dark conditions and found that across participants, we saw more evidence for conditioning of PLR in bright conditions. The relationship between two sessions is integral for understanding the magnitude of the conditioning effect. This is especially important for our study since we showed that the size of the conditioning effect in bright predicts performance in dark. Furthermore, our study is one of the first in the field that showed that pupils exhibit certain discriminating features of PLR that correlate across bright and dark conditions, thus it contributes to the field of associative learning and visual attention.

Extensive Karyotypic Diversity in Closely Related Isolates of the Generalist, Multibudding Yeast *Aureobasidium pullulans*

Finch Kortus & Durga Norris

Advisor: Robert Todd

The black yeast *Aureobasidium pullulans* has been identified around the globe inhabiting a variety of natural environments and it is widely considered to be polyextremotolerant. In addition to its ability to grow in a wide variety of extreme environments (ice, water, soil, plant matter), *A. pullulans* has recently been used in both the biotechnology and agricultural industry due to its ability to produce a wide variety of secondary metabolites that can be used in both industrial processes and as biological control agents. However, very little is known about the genome of this polyextremotolerant yeast and how it is able to adapt to such diverse environments. Here, we report the identification of ten environmental isolates obtained from the Bard College campus. Using whole genome sequencing technologies paired with chromosome karyotyping, we identified an incredible amount of genomic diversity which might play a role in the ability of this organism to inhabit a wide variety of environments.

Metal- and Acid-Free Synthesis of 9-Nitrophenanthrenes via Radical-mediated Nitration

Jay Lee & Kaylie Pak

Advisor: Tanay Kesharwani

9-Nitrophenanthrenes are important polycyclic aromatic intermediates that serve as key building blocks in the bottom-up construction of nanographenes, including pyrene, perylene, and coronene. Herein, we describe an efficient, metal- and acid- free approach to the synthesis of 9-nitrophenanthrene derivatives via radical-mediated nitration, using tert-butyl nitrite as the nitrating agent. Using the metal- and acid- free approach described above, we achieved 70% yield under the optimization condition using DMF as the solvent at 100°C, which closely approaches the maximum yield reported by previous studies. Our next objective is to optimize the reaction under other solvent conditions, expand the substrate scope, and explore their utility as precursors for the stepwise synthesis of larger polycyclic aromatic hydrocarbons (PAHs).

Quads as Dimension Grows

Yiyang Min & Chenlu Yu

Advisor: Lauren Rose

In the card game Quads, players look for collections of four cards satisfying a particular pattern, called quads. The cards correspond to points in the vector space F_2^6 , and quads correspond to planes in this vector space. We explore how many quads there can be in a fixed number of cards, as well as methods for expanding particular quad-free sets to larger quad-free sets. We examine possible quad counts in different dimensions and study how they change as the number of cards increases. We conjecture that possible quad counts are nested as the number of cards increases, up to the maximum cap size. We also conjecture that as dimension increases, the probability of finding no quads approaches one, while the probabilities of other quad counts decrease. Further research could test these conjectures in higher dimensions.

Synthesis and Characterization of Organometallic Complexes and Biologically-Relevant Ligands

Meghan Murphy & Charlie Grenadier

Advisor: Craig Anderson

This study focuses on the synthesis of organometallic compounds, primarily ruthenium(II)-arene complexes that contain anionic chlorido ligands which can be substituted for other, more complex structures. This afforded our team the opportunity to explore an array of different ligands and their reactivity to metallic centers. With the coordination of these ruthenium complexes to biologically-relevant ligands, there is the potential to create novel therapeutic agents. This report proposes various approaches to synthesizing ligands that are capable of coordinating to a metallic center; but, also ruthenium(II)-arene complexes that utilize these ligands to form a unique organometallic compound. Through our pursuit to synthesize and begin preliminary characterization of these molecules, this creates an opportunity to find new structures that hold anti-metastatic properties, as well as other therapeutic abilities.

Influence of Ruthenium Metal Complexes on DHFR and PKM2 Activity, DNA Structure, and CRISPR Cas9 Function

May Moe Naing & Madeleine Clark-Wade

Advisor: Swapan Jain

Ruthenium metal complexes are known to bind to DNA and proteins, which makes them useful tools for studying how small molecules affect biological processes. In this study, the effects of two ruthenium complexes Ru79 and Ru80, on CRISPR-Cas9 function, DNA structure and the activity of pyruvate kinase M2 (PKM2) and dihydrofolate reductase (DHFR) were examined. Gel electrophoresis showed that Cas9 cleavage of pUC19 DNA was inhibited by Ru79, with stronger inhibition observed at higher concentrations. When Ru79 was added after the CRISPR complex had formed, cleavage was largely unaffected, suggesting that Ru79 acts before or during complex formation. In gel mobility shift assays, DNA migration was altered by Ru79 in a concentration-dependent manner, consistent with DNA binding. In a luminescence-based assay, PKM2 activity was reduced by both Ru79 and Ru80, with greater inhibition observed for Ru79 at higher concentrations. Strong binding between DHFR and DHF in the presence of NADP⁺ was demonstrated by isothermal titration calorimetry, establishing a baseline for future testing with Ru80. These results suggest that both DNA-dependent processes and enzyme activity can be disrupted by ruthenium complexes. Future work will further investigate the mechanisms underlying these effects.

Housing on Paper: How Towns Comply Without Building

Natalie Novoseltseva

Advisor: F. Daniel Hidalgo, Massachusetts Institute of Technology

In 2021, Massachusetts ordered 177 municipalities to zone for more housing near transit. Nearly all of them complied, but adoption alone does not guarantee construction. The state's MBTA Communities Act sets municipality-specific housing capacity targets but leaves local officials discretion over which parcels to include in new zoning districts. This discretion creates room for "paper compliance": zoning that satisfies the state's numeric housing targets while steering development toward sites unlikely to ever be built on. Existing compliance checks can confirm whether a town meets its target, but cannot tell whether that target was met in good faith or through strategic parcel selection: a gap in current housing policy research. This project builds an empirical method for detecting paper compliance. Based on a review of planning board minutes across several municipalities, we identified site-level conditions associated with paper compliance and the main strategies municipalities use to satisfy the law without enabling development. These indicators will inform a parcel-level feasibility model estimating realistic development potential. These findings will provide a framework for evaluating whether zoning reform produces genuine housing, with direct relevance for researchers and policymakers overseeing state housing mandates.

Recurrent Aneuploidy of Chromosome R in the Human Fungal Pathogen *Candida albicans* Identified During Early Stages of Adaptation to Antifungal Drug

Jordan Pollard & Sivaan Barak Saacks

Advisor: Robert Todd

Multiple lines of evidence emphasize the importance of genome instability in the acquisition of drug resistance and tolerance in the human fungal pathogen *Candida albicans*. In particular, the acquisition of aneuploid chromosomes and structural variants, ploidy shifts, loss-of-heterozygosity, and point mutations have all been implicated in the rapid acquisition of drug resistance to the most widely used class of antifungal drugs, the azoles. Yet the mechanisms underlying these changes, the order in which they arise, and the diversity of evolutionary trajectories that unfold during adaptation remain poorly understood. Here, we employ a solid agar based time-lapse imaging scheme without subculturing to directly observe and dissect the steps and evolutionary trajectories that single colony-forming units take as they adapt to the antifungal drug fluconazole. Amplification or structural variations on chromosome R were identified in all (3/3) lineages after only a single passage on drug and maintained throughout the experiment. Uncovering the evolutionary trajectories that occur during drug exposure and connecting specific genomic alteration to the phenotypic outcomes provides a framework for understanding how, and in what order, resistance and tolerance arise. Defining these early and recurrent routes of adaptation may reveal conserved trajectories that could be targeted and exploited to limit the emergence of antifungal drug resistance.

Sustainable Acid-Free Synthesis of 3-Nitrobenzo[b]thiophenes

Delilah Rodrigo, Mia Asquini, & Eli Hnatokova

Advisor: Tanay Kesharwani

Benzo[b]thiophenes are important molecules involved in a wide range of pharmaceuticals, functional materials, and heterocyclic chemistry. Benzo[b]thiophene is used as a critical structural component of pharmaceuticals relating to cancer, osteoporosis, major depressive disorder, schizophrenia, and asthma treatments. We have achieved a yield-efficient, inexpensive, and environmentally friendly synthesis of benzo[b]thiophene using tert-butyl nitrite as the nitrating agent. The synthesis occurs without the traditional use of transition metals or corrosive acids, using minimal reagents. Once optimized, we will further study the scope of this reaction by adding different substituents to benzo[b]thiophene.

Synthesis, Structure, and Photoluminescence of Mn^{2+} Halide Materials

Alys Semenov & Artem Protsenko

Advisor: Matthew Greenberg

The synthesis of lead-free metal halide nanomaterials with tunable photophysical properties comparable to lead halide perovskite nanomaterials is an important goal for applications of these materials due to the environmental toxicity of Pb^{2+} . In this work, we investigated red- and green-light-emitting metal halide nanocrystals that use Mn^{2+} as an alternative to Pb^{2+} . Red light emitting CsMnCl_3 and CsMnBr_3 nanomaterials were synthesized and structurally characterized with X-ray scattering. Green-emitting Mn^{2+} phases could be obtained from an isopropanol-induced nanocrystal phase transformation.

One Step, Metal-Free, High Yield Synthesis of 4-Methylthio Isocoumarins via DMTSF-Mediated Electrophilic Substitution

Min Kyaw Swar Khant

Advisor: Tanay Kesharwani

Isocoumarins and their dihydro derivatives are important scaffolds in medicinal chemistry because of their diverse biological activities, including antibacterial, antifungal, antimalarial, anti-inflammatory, antiallergic, and antiproliferative effects. Naturally occurring compounds such as amicoumacin A, oosponol, cladosporin, hydrangenol, thunberginol A, and 5-hydroxymellein illustrate the biological relevance of this compound family. In this study, we developed an efficient synthesis of 4-(methylthio)isocoumarins through the cyclization of 2-alkynylbenzoates using dimethyl(methylthio)sulfonium tetrafluoroborate (DMTSF). The reaction proceeds in acetonitrile at room temperature without an added metal catalyst or a separate activating reagent. A range of substrates furnished the desired products in high isolated yields, demonstrating the utility of this approach for preparing substituted isocoumarins under mild conditions. This method provides access to sulfur-functionalized isocoumarin derivatives that may support further synthetic and medicinal chemistry research.

Learned Functional Modulation of the Pupillary Light Reflex Supports Performance on Visual Task

Kaeyla Taavialma

Advisor: Sean O'Bryan

The Pupillary Light Reflex (PLR) is a reflexive response our pupils elicit to optimize visual acuity for different light intensities. Despite decades of research theorizing that the PLR could be consistently evoked through learning about neutral cues that are associated with bright or dark stimuli; the definitive ability to classically condition this response remains unknown. In our experiment, we devised a procedure that required learned implicit preparatory constriction and dilation responses to aid task performance. This meant that the brain's ability to properly prepare for the task (i.e., become classically conditioned) was functionally significant for increasing performance on the task itself. We found that across participants, performing the correct conditioned pupillary response was positively correlated with a correct response for that trial. We also found a number of participants who showed a consistent conditioned response over the course of the task, revealing novel insights into the sensitivity of classically conditioning the PLR. This is one of the first studies to show relative success of classically conditioning the Pupillary Light Reflex, as well highlighting new insights into the brain's adaptive pupillary modulation over time.

Visible-light Catalyzed [2 + 2] Photocycloadditions of Vinylogous Esters and α,β -unsaturated Carbonyls

Alexandria Thomas & Brady D'Agostino

Advisor: Emily McLaughlin

We report an intermolecular visible-light mediated [2+2] coupling of vinylogous esters with α,β -unsaturated carbonyl compounds, mediated by iridium polypyridyl photocatalyst. These reactions demonstrate regio- and diastereoselectivity across representative substrates. We further explore the influence of structural variations on reactivity, specifically comparing the five-versus six-membered ring vinylogous esters. Through this work, an energy transfer (EnT) mechanism is proposed, supported by photophysical properties, including absorbance and phosphorescence profiles, and complemented by triplet energy calculations.

An Assessment of Recreational Water Quality at Kingston Point Beach

Kerri Tran

Advisor: Emily White

Routine monitoring of recreational beach water quality is vital to protect public health. Fecal Indicator Bacteria (FIB) are indicators that water quality is impacted by sewage and serve as a proxy for the *possible* presence of pathogenic microorganisms. We monitored *E. coli* at Kingston Point Beach, one of only four public Hudson River swimming areas, during the 2026 June to September swimming season. Out of the 83 days we tested, 11 (13%) were found to exceed the 235 MPN/100 mL regulatory limit. In contrast, no exceedances were reported by the Ulster County Department of Health during our study period. Initial, qualitative analysis indicates a relationship between elevated *E. coli* levels and rainfall, Rondout Creek discharge, and reported Combined Sewer Overflow (CSO) events. Our work shows that more frequent sampling and better communication is needed to help beachgoers appropriately judge the risk. More data (i.e., multiple monitoring seasons) are needed to better understand and predict the timing and causes of rainfall-triggered water quality impairment at Kingston Point Beach.

Heavy Metal Analysis of Regenerative Agriculture via ICP-OES

Kasiem Washington

Advisor: Swapan Jain

Climate change remains one of the world's ever growing problems, as most systems employed today affect changes of the global climate. Sky High farms, a 500 acre farm in Pine Plains, NY has changed its practice of industrial farming into regenerative agriculture in an attempt to lower emissions and revitalize the health of soil. My project measures the health of the soil using metrics such as metals and phosphorus to determine whether a change in practice of agriculture actually increases the health of the soil. Following my submission of Sproj and graduation, I plan to apply to Environmental Engineering School with aims of becoming an political advocate for the environment and environmental scientist.

Pt(IV) and Cu(I)/Ag(I) Compounds with N^S Thioureate Ligands

Abraham Yu, Asa Platt, & Camila Sandaal
Advisor: Matthew Greenberg

In this work, we synthesized Pt(IV) and Cu(I)/Ag(I) complexes bearing N^S chelating ligands. These compounds are potential single-source precursor materials for metal sulfide materials. Additionally, Cu(I) and Ag(I) complexes, clusters, and polymeric materials with sulfide and neutral sulfur donor ligands are an emerging class of materials with interesting optoelectronic properties often arising from close Cu...Cu and Ag...Ag interactions. Platinum(IV) compounds with bis-chelate N^S thioureate ligands were prepared by the reaction of N,N,N'-trisubstituted thioureas (N,N=methyl, N'=aryl) and [Pt2Me4(μ-SMe2)2]. In-situ NMR studies were performed to understand the mechanism of the oxidation of the square-planar Pt2Me4(μ-SMe2)2 reactants to give octahedral Pt(IV) dimethyl bis(thioureate) products. Cu(I) and Ag(I) starting materials were reacted with N,N,N'-trisubstituted thioureas to afford crystalline polymeric materials that could be solubilized by adding triphenylphosphine as a neutral donor ligand. Solid-state photoluminescence was observed for the Cu(I) complexes with thiourea and triphenylphosphine ligands.