

Session 1	What's the Matter? RFP 214-215	Let's Get Making Thistle 246	Learning About Learning Thistle 240	Ecology and Behaviour Schmon Tower 108
9:40am	Early Martian crustal formation mechanisms inferred from feldspathic units in Jezero Crater, Mars G. E. White Code: T1	Exploring Molybdenum Carbide MXene for Sustainable Hydrogen Production Kevin Stefanchuk Code: T3	Post Shrinkage Estimation for Graph Neural Networks: A Statistical Learning Framework Elfreda Narthey Code: T6	Metal Contamination Across Water, Sediment, and Benthic Organisms in Agriculturally Impacted Aquatic Ecosystems Natasha Hearn Code: T8
10am	Structural Stability and Magnetic Tuning through Sm Substitution in La₂CoMnO₆ Double Perovskites Jia Xu Code: T2	Phase-Engineered Cobalt Selenide for Stable High Current Density Alkaline Water Electrolysis Prithish Kumar Behura Code: T4	Center-based Sampling in Optimization and Machine Learning: A Theory and Review Rasa Khosrowshahli Code: T7	Evidence of olfaction and olfactory communication in Humboldt penguins Alex Wilder Code: T9
10:20am	Examining an Incautious use of Simulations for Yb₂Te₅O₁₃ - Hazel Gifford - Proposal Code: PR1	An analytical framework for humidity-dependence in polymer-polymer triboelectric nanogenerators Gurmeet Singh Code: T5	Structure-Aware Semantic Code Segmentation Across Programming Languages and Software Domains in the LLM Era - Nurbek Imangazin - Proposal Code: PR2	Being prosocial in STEM: How compassionate goals benefit graduate student wellbeing Estera Houshang Code: T10
10:40	Coffee Break			

Session 2	DNA and Physiology RFP 214-215		AI for Humanity Thistle 240	Stop Bugging Me Schmon Tower 108
11:20am	Beyond the Pellet: Rethinking What “Better” Means in DNA Recovery Giovanna Costa Code: T11		AI Drug Design to Fight The Opioid Epidemic Karl Grantham Code: T13	From contact to colonization: A model of natural locust infection by <i>Metarhizium acridum</i> Isabela Fetter Code: T16
11:40am	How do neuronal growth cones integrate opposing guidance cues? Alicia Piazza Code: T12		Scoping Review: Equitable Use of Artificial Intelligence for the Early Detection of Sepsis Hasan Rana Code: T14	Effects of hydroxyl-radical treatments on survival and reproduction of Multi-coloured Asian lady beetle (<i>Harmonia axyridis</i>), a contamination pest in Ontario’s vineyards Harmandeep Singh Code: T17
12pm	Repeated Hot Water Immersion: Effects on Females with Postural Orthostatic Tachycardia Syndrome - Lindsay Miller - Proposal Code: PR3		Common to Whom? Regional Cultural Commonsense and LLM Bias in India. Sangmitra Madhusudan Code: T15	Maternal and Developmental Influences on Thermal Tolerance in Small Carpenter Bees Joseph Armstrong Code: T18

What's the Matter

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Title: Early Martian crustal formation mechanisms inferred from feldspathic units in Jezero Crater, Mars

Keywords: Mars, Perseverance Rover, Geochemistry, Crustal Formation

Feldspathic igneous rocks provide insight to planetary crustal growth and dynamics, including lunar anorthositic crust (formed by solidification of a magma ocean) and the terrestrial Archean-age tonalite-trondhjemite-granodiorite (TTG) (formed by magmatism associated with early plate tectonics and/or stagnant lid regime). The Mars 2020 Perseverance rover has identified a series of coarsely crystalline (grains up to 2 - 3 mm), feldspar-rich rocks within the crater rim representing ancient crustal material. This is the first instance of such intrusive rocks having been examined in situ on Mars. Planetary Instrument for X-ray Lithochemistry (PIXL) observations have been conducted on both natural surfaces and 5cm abrasion patches across the Jezero crater rim region with 22 individual scans over 11 targets. Many of these targets are norites (gabbroic rocks with low-Ca pyroxene (LCP), though variable high-Ca pyroxene (HCP) is present in some scans. Some targets are anorthosites, such as Knapsack Pass and Tanda Tula with some targets containing olivine such as at Cat Arm Reservoir. Martian crustal material is distinct from both lunar and terrestrial examples, though these Martian samples are not widely distributed on Mars, which could impose a local bias. As a proxy for LREE/HREE (i.e., La/Yb, which PIXL cannot detect), K/Ti in Martian feldspathic rocks is typically low compared to terrestrial samples. Lunar anorthosite also have low K/Ti, but higher Ca# (>95). These observations are consistent with a petrogenesis involving fractional crystallization of a high-degree mantle melt with limited involvement of K-mobilization by H₂O-rich fluids for the Martian feldspar-rich lithologies.

Jia Xu

Title: Structural Stability and Magnetic Tuning through Sm Substitution in $\text{La}_2\text{CoMnO}_6$ Double Perovskites

Keywords: $\text{La}_2(1-x)\text{Sm}_2x\text{CoMnO}_6$, lattice distortion, magnetic properties, superexchange interaction

In $\text{La}_2(1-x)\text{Sm}_2x\text{CoMnO}_6$ double perovskites, competition between 3d transition-metal (Co/Mn) and 4f rare-earth (Sm^{3+}) sublattices—driven by antiparallel 3d-4f exchange coupling—leads to complex magnetic behaviors. In this work, bulk polycrystalline $\text{La}_2(1-x)\text{Sm}_2x\text{CoMnO}_6$ ($x=0, 0.2, 0.4, 0.6, 0.8, 1.0$) samples were synthesized via solid-state reaction. X-ray diffraction confirms the formation of single-phase double-perovskite structures across all compositions, where substituting larger La^{3+} with smaller Sm^{3+} systematically induces lattice distortion, unit cell contraction, and modifications to the Co-O-Mn bond angles. Scanning electron microscopy and energy-dispersive spectroscopy verify dense, uniform grain morphologies and target elemental stoichiometry across all compositions. DC magnetization measurements demonstrate that the Curie temperature (TC) systematically decreases with increasing Sm content, primarily driven by octahedral tilting that weakens the ferromagnetic 3d-3d ($\text{Co}^{2+}\text{-O-Mn}^{4+}$) superexchange. Zero-field-cooled curves reveal low-temperature negative magnetization and magnetic compensation, well-described by Néel's two-sublattice model through antiparallel coupling between the 3d Co/Mn network and the Sm^{3+} sublattice. Low-temperature (3K) magnetic hysteresis (M-H) loops display non-saturating behavior across the series, accompanied by remanence suppression and a marked enhancement in coercivity driven by strong single-ion anisotropy of Sm^{3+} . Furthermore, AC magnetic susceptibility measurements identify two distinct magnetic transition temperatures and probe spin-glass behavior. Together, these results demonstrate how progressive La-site substitution by Sm^{3+} drives coupled structural and magnetic evolution in $\text{La}_2(1-x)\text{Sm}_2x\text{CoMnO}_6$ double perovskites, offering insight into the design of compensated ferrimagnets with tunable transition temperatures.

Hazel Gifford
Proposal

Title: Examining an Incautious use of Simulations for Yb₂Te₅O₁₃

Keywords: condensed matter physics, neutrons, experimental physics

Yb₂Te₅O₁₃ has been proposed as a possible quantum spin liquid (QSL), as it has been shown not to magnetically order or undergo spin freezing down to 0.044 K, but its magnetic behavior remains unknown, as simulation yields a nearest-neighbor exchange two orders of magnitude above the expected value for a rare-earth oxide. The research proposed here has the goals of experimentally determining the magnetic energy scale and the nature of the quantum ground state of Yb₂Te₅O₁₃. This experiment is critical to determine whether the large exchange reflects strong frustration, an inaccurate microscopic model, or a qualitatively different ground state. The proposed measurements will resolve the magnetic energy scale of Yb₂Te₅O₁₃ by directly measuring the energy- and momentum-dependent spin correlations. This would simultaneously provide a spectrum that would reveal whether Yb₂Te₅O₁₃ exhibits excitations aligning with either a conventional singlet system, or a possible QSL. Either outcome will resolve the disputed interaction scale and establish whether Yb₂Te₅O₁₃ hosts a genuinely unconventional ground state, providing a clear basis for single-crystal spectroscopy and microscopic modelling.

Let's get Making

Kevin Stefanchuk

Title: Exploring Molybdenum Carbide MXene for Sustainable Hydrogen Production

Keywords: Molybdenum carbide, MXene, Hydrogen evolution reaction, Electrocatalysis

The growing global demand for renewable energy, coupled with rising emissions, has intensified the search for carbon-neutral fuels. Hydrogen is a promising clean energy carrier; however, its carbon-neutral production remains a significant challenge. This research investigates molybdenum carbide (Mo₂CTx) MXene as a lower-cost electrocatalyst for the hydrogen evolution reaction (HER), with the broader aim of reducing reliance on precious-metal-based catalysts for alkaline water electrolysis. Mo₂CTx MXene is synthesized from a molybdenum gallium carbide (MoGa₂C) MAX-phase precursor using a fluoride-free hydrothermal etching approach. The MAX phase is treated hydrothermally to selectively remove gallium and produce the layered MXene structure. Structural and compositional changes associated with the MAX-to-MXene transformation are investigated using X-ray diffraction (XRD) and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM/EDS). The resulting unexfoliated MoCT is deposited onto conductive nickel foam and evaluated as an electrocatalyst for HER in alkaline media. Preliminary electrochemical testing demonstrates promising activity, achieving an overpotential of approximately 343 mV at a current density of 100 mA cm⁻². Further exfoliation and optimization of the material are expected to increase accessible active sites and improve electrocatalytic performance. This work demonstrates the potential of fluoride-free synthesized Mo₂CTx MXenes as tunable electrocatalytic materials for lower-cost and more sustainable hydrogen production.

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Title: Phase-Engineered Cobalt Selenide for Stable High Current Density Alkaline Water Electrolysis

Keywords: Transition metal chalcogenides, HER, OER, Water Electrolysis, Phase Engineering

The development of active and stable electrocatalysts for overall water splitting is essential for advancing efficient alkaline electrolysis and sustainable hydrogen production. Transition metal selenides have attracted considerable interest owing to their favorable electrical conductivity and tunable catalytic properties. However, their activity and operational stability at practically relevant current densities remain challenging. In this work, we report a facile electrochemical deposition strategy for constructing binder-free ruthenium-engineered cobalt selenide (Ru-CoSe) nanostructures directly on nickel foam, producing a self-supported bifunctional electrode for alkaline water splitting. Incorporation of Ru induces structural and electronic modulation of the cobalt selenide phase while generating a porous morphology that facilitates electrolyte access, charge transport, and exposure of active sites. The optimized Ru-CoSe electrode exhibits enhanced HER and OER performance, requiring overpotentials of 148 and 340 mV to deliver 100 mA cm^{-2} , respectively. When employed as both electrodes in a two-electrode alkaline electrolyzer, the Ru-CoSe electrode achieves cell potentials of 1.75, 2.02, and 2.23 V at 100, 500, and 1000 mA cm^{-2} , respectively. The cell also demonstrates sustained electrochemical stability during prolonged operation for 350 hours at high current density (1 A cm^{-2}). While maintaining the pristine structure and elemental composition. These findings demonstrate the potential of Ru-engineered cobalt selenide as a robust bifunctional electrode for high-current-density alkaline water electrolysis.

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Title: An analytical framework for humidity-dependence in polymer-polymer triboelectric nanogenerators

Keywords: triboelectric nanogenerators, humidity-dependence, relative permittivity, surface charge density

Triboelectric nanogenerators (TENGs) convert mechanical motion into electricity, but their output collapses in humid air. The loss ranges from tens of percent to more than two orders of magnitude, and no single material property explains that spread. We present an analytical framework in which humidity reaches the device output through two measurable descriptors. The effective permittivity follows from a three-phase Bruggeman relation separating bound water from free water, so that high water uptake does not imply high permittivity. The surface charge density follows from treating moisture as removing charge already separated rather than preventing separation, placing that removal at contact, where a mobile water film short-circuits the two charged faces. How much is lost depends on whether the wetted regions connect across the interface, making the threshold a property of the pair, not of either film. Applied to sixteen polymer pairs, the framework predicts retention of open-circuit voltage between 10 and 90 percent RH spanning 0.7 to 65 percent, with the ranking of pairs inverting between dry and humid operation. Measurements on five pairs place the half-points at 56 to 75 percent RH, against 57 to 77 percent predicted. Temperature acts on the device through the same two descriptors, and deployed harvesters and sensors rarely hold either variable fixed. Our earlier temperature-dependent model for this device family (Nano Energy 153, 111942, 2026) routes thermal effects the same way, so the two frameworks can be combined into a single environment-aware description. That coupling is the next step.

Learning about Learning

Elfreda Nartey

Title: Post Shrinkage Estimation for Graph Neural Networks: A Statistical Learning Framework

Keywords: Graph Neural Networks, Post-Shrinkage Estimation, High-Dimensional Statistical Inference and Regularization and Variable Selection

Graph neural networks learn from node features, connectivity and, depending on architecture, edge features. However, regularization creates a statistical dilemma: inclusive models may retain unnecessary variability, whereas parsimonious models may discard weak but informative components. This research develops a post-shrinkage estimation framework that adaptively reconciles these competing estimators. The framework operates at three complementary levels. Structural post-shrinkage combines row-centred logits, avoiding ambiguities associated with comparing raw neural-network parameters. A layer-wise surrogate formulation distinguishes strong, weak, and null contributions within graph-propagated representations. An end-to-end formulation treats the trained network locally as a graph-dependent penalized M-estimator, with parameter comparisons restricted to a common identifiable representation. Across these levels, a positive-part shrinkage rule restores a data-dependent proportion of the discrepancy between inclusive and parsimonious estimators. Calibration accounts for graph dependence and the cross-covariance induced by fitting both estimators to the same data. Evaluation examines estimation error, weak-signal retention, and shrinkage behaviour. In an illustrative Erdős–Rényi scenario with 500 nodes and 500 Monte Carlo replications, structural post-shrinkage reduced mean squared logit error by approximately 7.2% relative to the inclusive estimator. With oracle support and covariance, post-shrinkage retained weak contributions while reducing parameter estimation error relative to the inclusive fit. The parsimonious estimator nevertheless achieved lower error in this scenario, underscoring that improvement depends on the signal regime and estimation target. These findings support post-shrinkage as an adaptive approach to weak-signal uncertainty, providing a statistical framework for investigating when partial restoration of excluded information offers a useful compromise between estimation variability and omitted-signal bias.

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Title: Center-based Sampling in Optimization and Machine Learning: A Theory and Review

Keywords: High-dimensional search space, center-based sampling, optimization, machine learning

High-dimensional optimization and machine learning (ML) pipelines frequently rely on randomized proposals inside box-constrained domains, yet it is often unclear when concentrating proposals near the box center improves the chance of generating useful candidates. We study center-based sampling (CBS) in the D -dimensional unit hypercube, where candidates are drawn from a central subcube rather than uniformly from the full box. Under a simple single-draw model, we prove that CBS reduces expected squared distance to an independent target by a fixed per coordinate amount, so the total reduction grows linearly with the dimension. When the target is uniform on the hypercube, this means advantage upgrades to a high probability regime in which the probability that a center draw is closer than a uniform draw converges to one exponentially fast in D , with explicit Hoeffding and Bernstein guarantees and an accurate central limit theorem (CLT) approximation. The expectation comparison also extends beyond the uniform target model to any independent target with finite second moment, for which the mean advantage is unchanged because the uniform and CBS samplers share the same center while CBS has smaller variance. We complement the theory with same budget random search experiments on shifted Sphere, Rastrigin, and Ackley functions over box-constrained domains where CBS consistently improves the best objective under a fixed sample budget, with the strongest gains when the optimum is centrally located. These results position CBS as a useful geometric baseline for box-constrained randomized search while clarifying that the concentration theorem is specific to the uniform target cube model.

Nurbek Imangazin

Proposal

Title: Structure-Aware Semantic Code Segmentation Across Programming Languages and Software Domains in the LLM Era

Keywords: Semantic code segmentation, Structure-aware code analysis

This research investigates structure-aware semantic code segmentation across programming languages and software domains in the LLM era. Its goal is to divide source code into meaningful semantic blocks that reflect functional changes in the code, rather than treating code as a flat sequence of lines, tokens, syntactic nodes, or fixed-size chunks. Recent work shows that code chunking and semantic segmentation remain important because LLM-based tools depend on the quality of the code context they receive. This research combines manually audited benchmarks, weakly labeled training data, structural/code-aware features, and machine-learning models to study segmentation across Python, JavaScript, Java, and planned domain-specific datasets in security, AI/ML, and networking. The expected contribution is a reusable dataset, improved segmentation methods, and evidence of whether semantic code blocks can support downstream code-intelligence tasks such as summarization, search, vulnerability analysis, retrieval-augmented generation, and LLM-based software engineering.

Ecology and Behaviour

Natasha Hearn

Title: Metal Contamination Across Water, Sediment, and Benthic Organisms in Agriculturally Impacted Aquatic Ecosystems

Keywords: Contamination, Agriculture, Aquatic Ecosystem

Metal contamination in agricultural watersheds varies across water, sediments, and aquatic organisms, yet water patterns do not necessarily reflect contaminant concentrations retained in sediments or found in benthic organisms. Whether these differences reflect location, environmental medium, or biological group remains unclear, especially in agriculturally impacted ecosystems. In this study, we examined ten metals across water, sediment, and benthic macroinvertebrates across six sites in an agricultural watershed from April-November 2025. Metal concentrations in water, sediments, and benthic macroinvertebrates were measured by ICP-MS. Kruskal-Wallis tests with Bonferroni-adjusted comparisons assessed site and functional feeding group (FFG) patterns, while principal component analysis compared profiles across sample types. Water concentrations varied significantly among sites for eight of ten metals. Copper and nickel ($p < 0.001$) showed strong spatial patterns, with a municipal drain (WD), distinct from the other sites for both metals. Sediment concentrations showed an even stronger spatial pattern, with all ten metals varying significantly among sites; lead and nickel ($p < 0.001$) differed significantly across nearly all site comparisons. In contrast, none of the ten metals differed significantly among FFGs. A PCA showed clearer separation between water and sediment profiles than among sites. Sediment provided the clearest picture of spatial metal enrichment, while water and benthic metal patterns did not show the same consistent site or FFG patterns. This suggests that identifying where metals are concentrated is only part of understanding ecological exposure, as environmental hotspots do not necessarily predict metal accumulation in the organisms living there.

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Title: Evidence of olfaction and olfactory communication in Humboldt penguins

Keywords: Animal Communication, Ecology, Chemical communication, Conservation

Animals use a variety of signals to communicate, including visual, auditory, and chemical signals. However, many penguin species have reduced olfactory bulbs and fewer olfactory receptors, suggesting limited use of olfactory signalling, and the importance of olfaction is highly debated in penguins. Humboldt penguins (*Spheniscus humboldti*), colonial seabirds of conservation concern, are commonly kept under human care in breeding programs. Interestingly, Humboldt penguins can use preen oil—a waxy secretion primarily used for feather maintenance and waterproofing—as a scent signal to discriminate between kin and non-kin. We hypothesized that Humboldt penguins rely more on olfactory cues than previously thought and use preen oil as a scent signal to identify mates. Penguins at the Calgary Zoo were exposed to scent cues from their mates versus non-kin, non-mate colony members, and their behaviors were observed. Initial results indicate that penguins identify non-mate scents and show adverse responses to non-kin, non-mate stimuli. Penguin preen oil samples have also undergone GC-MS analysis to determine individual scent profiles as well as search for sex, age, and temporal variation. These findings enhance our understanding of scent signalling in penguins and offer conservation managers novel strategies for penguin management and remediation.

Estera Houshang

Title: Being prosocial in STEM: How compassionate goals benefit graduate student wellbeing

Keywords: Prosociality, STEM education, graduate student wellbeing

Graduate students in STEM face many pressures that can leave them feeling overwhelmed and isolated, impacting both their mental health and their academic experience. Although scientific research culture sometimes prioritizes individual achievement and independence over helping others, previous research suggests that STEM students can reap a variety of benefits from acting prosocially (e.g., mentoring undergraduates, supporting labmates). We hypothesized that STEM graduate students who are prosocially motivated by compassionate goals (caring intentions to be helpful to others in their academic environment) will experience enhanced academic wellbeing, through support-giving actions and a sense that their work is meaningful to self and valuable to others. In two cross-sectional studies with graduate students in Engineering, Physics, and Computer Science ($N = 517$) and Biology and Earth & Environmental Sciences ($N = 288$), and an experience sampling study surveying STEM graduate students for 10 consecutive weekdays in winter term ($N = 194$), participants reported their prosocial motives (compassionate goals) and actions (support-giving) towards people in their graduate program. Two forms of support-giving were measured: socio-emotional and practical support. Participants then completed measures of academic wellbeing (e.g., research engagement and burnout). Multiple regression and mediation analyses revealed significant relationships between compassionate goals and academic wellbeing outcomes, through practical support-giving (Study 1 & 2) and perceived personal meaning and social value of work (Study 2 & 3). Multilevel modeling analyses revealed same-day effects of compassionate goals on academic wellbeing, through perceived meaning and value of work (Study 3). Implications of these findings are discussed.

DNA and Physiology

Giovanna Costa

Title: Beyond the Pellet: Rethinking What “Better” Means in DNA Recovery

Keywords: DNA - Precipitation - Co-precipitants – Recovery

DNA precipitation is a routine technique in molecular biology, yet DNA loss during the process is often overlooked. These losses become particularly important at low DNA concentrations, where reduced recovery can compromise subsequent analyses. Established co-precipitants can minimize DNA loss, but materials not traditionally used for this purpose may offer alternative strategies for improving recovery. Five materials with distinct physicochemical properties – polyethylene glycol (PEG), linear polyacrylamide (LPA), glycogen, dextran, and bovine serum albumin (BSA) – were compared during ethanol precipitation of short DNA. Recovery was evaluated across different initial DNA concentrations and two co-precipitant concentrations, allowing established and alternative co-precipitation strategies to be assessed under the same conditions. Co-precipitant selection significantly influenced DNA recovery, whereas increasing co-precipitant concentration did not produce an overall improvement. Recovery was also strongly dependent on the initial amount of DNA, and the relative performance of the tested materials changed across DNA concentrations. At lower DNA inputs, several materials substantially improved recovery compared with precipitation alone, while these advantages became less pronounced as DNA input increased. PEG achieved near-complete recovery under the most favorable conditions, while the other materials displayed distinct DNA-dependent recovery profiles. Overall, these findings demonstrate that effective DNA precipitation depends not simply on adding more co-precipitant, but on selecting the appropriate material for the amount of DNA being recovered. By looking beyond conventional co-precipitants, this study expands the strategies available for improving DNA recovery when every molecule counts.

Alicia Piazza, Gaynor E. Spencer

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Title: How do neuronal growth cones integrate opposing guidance cues?

Keywords: Guidance cues, Growth cone, microRNAs, Regeneration

Growth cones, located at the tip of growing axons, can sense and interpret cues (repulsive or attractive), which facilitate their guidance during axonal pathfinding, a process important in both brain development and regeneration. Growth cones must travel long distances to contact their appropriate target cells and form functional connections. During this trip, they often encounter opposing cues (repulsive and attractive), which they must integrate into a proper response. Retinoic acid, the metabolite of Vitamin A, is an important guidance cue required for brain development and regeneration in many species. Utilizing regenerating molluscan neurons (brain cells), we have shown that retinoids induce attractive growth cone turning and that this response requires new protein synthesis and microRNA, miR-124. We show that exposure to multiple guidance cues affects growth cone behaviour and examined the underlying molecular pathways. Growth cones show diminished responses to retinoic acid immediately following their exposure to a repulsive cue. We have determined the role of a Rho-associated protein kinase ROCK (a downstream effector of RhoA-GTPases and target of miR-124) in both attractive and repulsive growth cone behaviors and examined how the integration of signaling to the different guidance cues affects the spatial and temporal expression of miR-124. These experiments provide insights into the signaling pathways involved in cue integration during axon pathfinding.

Lindsay Miller

Proposal

Title: Repeated Hot Water Immersion: Effects on Females with Postural Orthostatic Tachycardia Syndrome

Keywords: Postural Orthostatic Tachycardia Syndrome (POTS), Thermoregulation, Heat Acclimation, Hot Water Immersion

Postural Orthostatic Tachycardia Syndrome (POTS) is an autonomic disorder characterized by excessive increases in heart rate during upright posture, often accompanied by presyncope, fatigue, and thermoregulatory disturbances. Heat exposure can exacerbate symptoms and limit quality of life. Although POTS pathophysiology is not fully understood, hypovolemia, impaired vascular regulation, and altered autonomic control are implicated. Heat acclimation (HA) induces plasma volume expansion, improves thermoregulatory function, and reduces cardiovascular strain in healthy individuals, but its effects on individuals with POTS remain unexplored. This study examines whether repeated hot water immersion (HWI) improves cardiovascular, orthostatic, and thermoregulatory responses in females with POTS. Females (20–35 years) diagnosed with POTS will complete six laboratory visits: screening, four consecutive HA sessions, and a 72-hour recovery assessment. Testing will occur during the early follicular phase when possible, with menstrual cycle phase otherwise standardized within participants. Each HA session will involve 40 minutes of HWI at 40°C. Participants will initially be immersed to neck depth until core temperature reaches approximately 38.6°C, after which immersion depth will be adjusted to maintain core temperature. Outcomes include heart rate, blood pressure, core and mean skin temperature, plasma volume, and subjective measures. HWI is expected to induce HA adaptations, including plasma volume expansion, improved thermoregulatory function, reduced cardiovascular strain, and improved orthostatic and heat tolerance. This study will provide preliminary evidence for repeated HWI as a non-pharmacological intervention for POTS and may inform future therapeutic strategies.

AI for Humanity

Karl Grantham

Title: AI Drug Design to Fight The Opioid Epidemic

Keywords: Machine Learning, AI for public health, Drug Design, Computer Science

Drug design is a complex, expensive, and time consuming task. It can take up to 15 years and \$2 billion USD to develop a single drug. At the same time, new public health concerns are increasing in their severity, thus further increasing the need to speed up drug development. One such concern is the worsening opioid epidemic. Here, newer, more powerful opioid antagonists are needed to combat ever-increasingly potent narcotics. AI-powered drug design is a promising new technique to assist in designing promising new compounds. Before this design can take place, such algorithms need to learn the chemical syntax and the interaction between chemical structure and predicted properties. These AI models have the ability to inform manual drug design, by leading researchers to areas of high interest, but can also integrate into larger AI systems to inform de-novo drug design. This work seeks to develop an AI molecular property predictor for designing opioid antagonists which utilizes transfer learning to improve the learning efficiency of a multi-task transformer model. Various approaches to find synergies between the conflicting objectives are explored to find the optimal approach.

Hasan Rana

Title: Scoping Review: Equitable Use of Artificial Intelligence for the Early Detection of Sepsis

Keywords: Sepsis, Equity, AI

Artificial intelligence (AI) is increasingly being used to support early sepsis recognition in hospital settings, with evidence suggesting improved predictive performance compared to traditional approaches. However, concerns remain regarding the equitable development, evaluation, implementation, and governance of AI-enabled approaches, particularly for populations historically underserved by health systems. Although previous reviews have synthesized evidence on the effectiveness of AI for sepsis recognition, the extent to which equity considerations have been incorporated into this rapidly growing field remains unclear. This scoping review aims to map the peer-reviewed literature on AI-enabled approaches to sepsis recognition in hospital settings and examine how equity has been conceptualized, operationalized, and addressed within the field. This protocol follows the Joanna Briggs Institute (JBI) methodology for scoping reviews, and findings will be reported in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR). Electronic searches will be conducted in MEDLINE (Ovid), Embase (Ovid), Scopus, and CINAHL, supplemented by hand searching the reference lists of included review articles and seed papers. Four reviewers will independently screen studies according to predefined eligibility criteria. Data will be extracted using a standardized form and synthesized using complementary quantitative and qualitative approaches. This review is designed to provide a comprehensive overview of how equity has been considered within the literature on AI-enabled sepsis recognition. The findings will identify knowledge gaps and priorities for future research and may help inform the equitable development, implementation, and governance of AI-enabled approaches to sepsis recognition.

Sangmitra Madhusudan

Title: Common to Whom? Regional Cultural Commonsense and LLM Bias in India.

Keywords: NLP, cultural commonsense, benchmark dataset

Existing cultural commonsense benchmarks treat nations as monolithic, assuming uniform practices within national boundaries. But does cultural commonsense hold uniformly within a nation, or does it vary at the sub-national level? We introduce INDICA, the first benchmark designed to test LLMs’ ability to address this question, focusing on India—a nation of 28 states, 8 union territories, and 22 official languages. We collect human-annotated answers from five Indian regions (North, South, East, West, and Central) across 515 questions spanning 8 domains of everyday life, yielding 1,630 region-specific question-answer pairs. Strikingly, only 39.4% of questions elicit agreement across all five regions, demonstrating that cultural commonsense in India is predominantly regional, not national. We evaluate eight state of-the-art LLMs and find two critical gaps: models achieve only 13.4%–20.9% accuracy on region-specific questions, and they exhibit geographic bias, over-selecting Central and North India as the “default” (selected 30-40% more often than expected) while under-representing East and West. Beyond India, our methodology provides a generalizable framework for evaluating cultural commonsense in any culturally heterogeneous nation, from question design grounded in anthropological taxonomy, to regional data collection, to bias measurement.

Stop Bugging Me

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Title: From contact to colonization: A model of natural locust infection by *Metarhizium acridum*

Metarhizium is a genus of entomopathogenic fungi comprising species that range from broad host generalists to highly specialized pathogens. *Metarhizium acridum* infects insects exclusively within the family Acrididae (locusts and grasshoppers), yet the ecological methods of locust encounter remain poorly resolved. We investigated infection pathways of *M. acridum* across the lifecycle of *Locusta migratoria*. Laboratory experiments were conducted using sterile soil–vermiculite (50%), inoculated with conidial suspensions (1×10^7 conidia mL⁻¹) of labeled *M. acridum* (GFP) and the generalist *Metarhizium robertsii* (mCherry). Locust pairs were allowed to oviposit in treated substrates over a 10-day period. Mortality of adults and nymphs was recorded, and fungal infection was confirmed using fluorescence microscopy and sporulation assays. Adult mortality did not differ among treatments, however, *M. acridum* exhibited higher sporulation in females ($\chi^2 = 10.438$, $p = 0.005$) and was the only observed to sporulate on males. Nymph mortality was higher in *M. acridum*-treated soil, reaching 69.5% ($\chi^2 = 66.914$, $p < 0.001$) and sporulation of 40% ($\chi^2 = 22.565$, $p < 0.001$). These findings demonstrate that *M. acridum* can infect locusts via soil-mediated transmission during oviposition, mating, and nymph emergence, highlighting an ecological pathway for host encounter and infection in entomopathogenic fungi.

Harmandeep Singh

Title: Effects of hydroxyl-radical treatments on survival and reproduction of Multi-coloured Asian lady beetle (*Harmonia axyridis*), a contamination pest in Ontario's vineyards

Keywords: Lady beetle, Clean works, wine taint, pest management

Multi-coloured Asian lady beetle (*Harmonia axyridis*), is a contamination pest in Ontario's vineyards. When grapes are harvested for wine processing, beetles are crushed, releasing isopropyl methoxypyrazine. This alters wine taste and quality, leading to "ladybug taint". Insecticides are used to manage this pest in vineyards, however a sustainable alternative is needed. Clean Works Inc. (CW) developed a technology that generates hydroxyl-radicals, using UV-C light, hydrogen peroxide and ozone. Four different hydroxyl-radical treatments were applied to adult beetles in laboratory conditions to determine which of the treatments lowered the survivorship of the beetles compared to the untreated beetles. We observed that none of the treatments made any significant difference in lowering the survivorship. Fecundity, fertility and development time of the progeny of the treated beetles was also observed post CW treatments. No significant differences were observed in any of the measured parameters between the treated and untreated beetles.

Joseph Armstrong

Title: Maternal and Developmental Influences on Thermal Tolerance in Small Carpenter Bees

Keywords: Bees Thermal Tolerance

Thermal tolerance is an important determinant of bee fitness in increasingly variable climates, yet the relative contributions of maternal inheritance and developmental temperature to thermal tolerance in small carpenter bees (*Ceratina* spp.) remain poorly understood. During the spring and summer of 2026, local *Ceratina* were provided with nesting substrates of raspberry (*Rubus* spp.), teasel (*Dipsacus* spp.), and rose (*Rosa* spp.), resulting in the establishment of 242 nests. Nest development was monitored in the field until harvest, and 64 nests were selected for study. *Ceratina* foundresses were assessed for critical thermal maximum (CTmax) as a measure of adult thermal tolerance. Offspring from each nest were reared under standardized laboratory conditions until pupation, after which they were randomly assigned to one of two developmental thermal regimes: a constant-temperature treatment or a daily fluctuating-temperature treatment. Following adult emergence, offspring CTmax was measured to evaluate the effects of pupal thermal environment on thermal tolerance. By comparing CTmax between foundresses and their offspring, we examined the relative contributions of maternal phenotype and developmental thermal environment to thermal tolerance in *Ceratina*. These findings provide insight into the capacity of solitary bees to respond to changing climatic conditions.