

WISE National Conference 2026



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Abstract

The 2026 Women in Science and Engineering National Conference took place at the Westin Harbour Castle in downtown Toronto on January 17-18. It welcomed several hundred student, research, and industry participants across all STEM disciplines. Student delegates were invited to submit abstracts describing their research for publication in collaboration with URNCST. The resulting collection spanning life science, physical science, and engineering work is featured here.

Keywords: WISENC; conference; student

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Conference Abstracts

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Improving Tools for Sensing and Calibration in Optically Detected Magnetic Resonance

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Optically detected magnetic resonance (ODMR) is a technique for measuring magnetic fields by tracking fluorescence intensity of lattice defects as a function of applied microwave frequency. This non-invasive, highly sensitive technique enables nanoscale magnetic sensing, and thus is valuable for laboratories studying molecular structures. Laboratories lack tools to conduct ODMR efficiently. This research seeks to improve the ODMR process by developing a microstrip patch antenna tailored to the resonant frequency of the recently discovered defect in diamond: TR12. The microstrip patch antenna is designed for TR12's resonant frequency and minimal radiation loss. The optimized design, determined through Computer-Aided Design and simulations in Ansys HFSS, achieves the exact resonant frequency of TR12, 2533.3MHz, and has minimal scattering characterized by a low S11 parameter value, -12.7504dB, lower than the threshold of -10dB as required. As the antenna was tested in simulation, future work includes fabrication and experimental validation.

Echoes of Adversity: The Prevalence and Associations of Invisible Symptoms with Adverse Childhood Experiences, Attachment Style, Self-Compassion, and Care Preferences in People with Multiple Sclerosis

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Multiple sclerosis (MS) is a chronic inflammatory neurodegenerative disorder characterised by the destruction of the sheath that insulates neurons in the central nervous system. Over 90,000 Canadians live with MS, one of the highest prevalences worldwide. People with MS (PwMS) tend to suffer from scarcely researched 'invisible symptoms' including vision problems, muscle weakness, tingling, numbness, bladder control problems, dizziness, and trouble with cognition. Many environmental and demographic factors are linked with disease onset, progression, and symptom severity, but recent studies suggest that there is an association between adverse childhood experiences (ACEs) and MS. Further research is urgently needed to explore this relationship in more detail, because if there is a high prevalence of ACEs in people with MS, this has important implications for health service design and delivery, meaning providers should be trained to deliver trauma-informed treatments that are effective in this population. What is the prevalence of invisible symptoms in Canadians with MS, and how do these symptoms relate to ACEs, attachment style, compassion, and care preferences? Quantitative surveys will be employed to measure invisible symptoms and ACE burden in up to 90,000 Canadians with MS, along with clinical and sociodemographic factors, stress, attachment style, patient satisfaction, and quality of life. Furthermore, qualitative interviews will be conducted with survey respondents reporting ACEs to explore their perspectives on how these experiences impact their MS symptoms, coping, and care needs. MS healthcare providers will also be interviewed to understand how they approach treating patients with invisible symptoms and ACEs, as well as how their education affects this. Findings will help shape policy and optimize the care of MS patients with invisible symptoms and ACEs. Given the highly diverse MS population in Canada, this study will be important locally, nationally and internationally.

Base Editing-Mediated Correction of a Nonsense Variant in Congenital Muscular Dystrophy

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Merosin-deficient congenital muscular dystrophy type 1A (MDC1A) is a neuromuscular disease caused by autosomal recessive loss-of-function LAMA2 variants, which encode the $\alpha 2$ chain of laminin-211. Deficiencies in this structural protein compromise interactions between skeletal myofibers and the extracellular matrix, leading to myofiber instability and fatal muscle wasting. Adenine base editors (ABE) are CRISPR-derived genome editing tools that convert A-to-G by deaminating deoxyadenosine, however, their clinical translation has been limited by unintended RNA off-target effects and bystander editing. Here, we optimize components of ABE to treat patient-derived MDC1A fibroblasts with a LAMA2 nonsense variant. Primary fibroblasts were Sanger sequenced to confirm compound heterozygous LAMA2 p.R1029X/L1984Ffs*4 genotype. Various Cas9 orthologues, guide RNA (gRNA) spacer lengths, and TadA8e deaminases were screened to identify the most efficient components of ABE. This workflow involved gRNA cloning, lentiviral production and titration, and lentiviral transduction to patient derived fibroblasts. LAMA2 editing efficiency of the nonsense allele was evaluated by Sanger sequencing. Functional rescue of laminin- $\alpha 2$ was assessed by Western blot analysis. Among the Cas9 orthologues, Staphylococcus aureus Cas9 (SaCas9) achieved the highest editing efficiency at 30%. TadA8e deaminase variant V106W demonstrated reduced RNA off-target effects and bystander activity while maintaining editing efficiency. Western blot analysis confirmed laminin- $\alpha 2$ rescue. These findings demonstrate that ABE are an efficient and clinically translatable strategy for treating LAMA2 nonsense variants, highlighting its potential as a gene editing therapeutic for up to 50% of pathogenic single nucleotide variants.

Aperiodic Monotile Lattices for Enhancing the Crash Resistance of EV Battery Packs

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Architected cellular materials are widely used in energy-absorbing structures, yet their mechanical response is strongly determined by topology. Periodic lattices such as hexagonal honeycombs exhibit efficient load transfer but fail through directional buckling, leading to stress drops and localized collapse. In this work, we experimentally investigate an aperiodic “hat monotile” lattice as a topology-engineered alternative designed to disrupt continuous failure paths. Monotile and hexagonal specimens were fabricated by stereolithography and density matched to $\bar{\rho} \approx 15\%$ through analytical calibration of wall thickness and characteristic length. Quasi-static compression tests ($\dot{\epsilon} = 10^{-3} \text{ s}^{-1}$) provided force-displacement and laser-based deformation data. Monotile lattices exhibited smoother stress-strain evolution and spatially distributed collapse, with deformation spread across many struts rather than concentrated in discrete crush band formation characteristic of the hexagonal topology. Normalized stress-strain curves ($\sigma/\sigma_f(\epsilon)$ and $\sigma/E(\epsilon)$) revealed consistent peak and elastic behavior across repeats, while monotile response lacked catastrophic drops and absorbed deformation through gradual, multiorientation strut bending. Deformation images confirmed isotropic compaction in the monotiles versus crush bands in hexagons. Despite slightly lower peak stress, the monotile geometry provided more stable load transfer and reduced collapse localization. These findings offer the first experimental evidence that aperiodic monotile lattices achieve comparable strength to-weight performance while enhancing deformation uniformity, highlighting their potential for crash-tolerant battery

Informing Resource Allocation Policies Through Equity-Aware Epidemic Modeling

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Equitable allocation of resources like vaccines are a central challenge in epidemic response, particularly when disease burden is unequally distributed across population subgroups. Most existing research prioritizes efficiency, by minimizing infections or deaths, while giving less attention to the equity implications of these strategies. Real-world populations exhibit disparities in transmission risk and disease vulnerability, raising questions about how to allocate limited resources fairly. To address this gap, we aim to systematically characterize the equity-efficiency tradeoff and identify disparity contexts where equity goals become more or less costly. We developed a deterministic compartmental epidemic model based on an extended Susceptible-Infected-Recovered framework, with two subgroups having heterogeneous transmission and mortality rates. We evaluated four equity-aware optimization strategies from the literature. For each disparity metric, we fixed one group’s parameter, varying the other’s across four values. We simulated these scenarios, recording the optimal allocation under each strategy and the resulting deaths and infections. Preliminary simulations show that the “cost of fairness”—the efficiency loss when shifting from an efficiency-optimal to a fairness-constrained solution—varies with the type of disparity and optimization strategy, with some approaches consistently yielding fairer but more costly allocations. Our findings contribute to growing research intersecting epidemiology and social equity. This work offers public health policymakers a clearer understanding of when equity goals can be pursued with minimal loss in overall health outcomes. Future work will extend this to stochastic models and real-world data, bridging the gap between theoretical insights and actionable epidemic response strategies.

A Dynamic Crop Selection Tool for Space-Based Food Production

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As human missions extend beyond Earth, reliable fresh food production methods are essential. Limited resupply opportunities and harsh environmental conditions place significant demands on closed-loop plant growth systems. To date, comprehensive model-based tools for crop selection that balance mission objectives and system capabilities remain limited. This research presents the development of a dynamic crop selection tool to support mission planning and increase the success of space-based plant production. The tool is built upon a database of candidate crops, incorporating key parameters such as nutritional composition and growth requirements (e.g., temperature, humidity, water, nutrients, light, and crop cycle length). User-defined inputs such as mission timeline, dietary needs, and environmental control capabilities are considered alongside the evaluation of mission priorities using multi-criteria decision analysis methods. This tool enables interactive comparison of crop options while estimating yield and resource consumption rates (e.g., oxygen production, carbon dioxide uptake, and water flows) to optimize plant production and ensure crew health. By supporting rapid assessment of biomass and nutritional trade-offs, this tool enhances the efficiency, adaptability, and success of space food production strategies. This tool can

equally support food security initiatives in Northern Canada, where remote communities face resource limitations and environmental challenges analogous to those in lunar and Martian systems.

Melatonin Reveals Anticancer Potential via Systems Biology Analysis on Cancer Cell

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Melatonin, a neural hormone secreted by the pineal gland that regulates circadian rhythms, has emerged as a potential anticancer agent. This study investigated melatonin's effects on cancer cell viability and its cellular mechanism of action via transcriptomic changes across multiple cancer types. In experimental studies, melatonin has been shown to play a key role in limiting cell proliferation by inducing apoptosis, generating free radical oxygen species to combat oxidative stress, and upregulating suppressor genes and survival pathways. Using the NCI60 dataset, 60 different human cancer cell lines were treated with melatonin at various concentrations; cell survival was measured using an SRB assay to determine half-maximal inhibitory concentration (IC₅₀) values. Results revealed significant variations in cell line sensitivity to melatonin—renal cancer cell line 786-O demonstrated high sensitivity, while K562 myeloid leukaemia and SW620 colorectal cancer lines showed relative resistance. Melatonin also exhibited greatest potency against renal and CNS cancer cell lines, with 19 of 63 cell lines showing significant sensitivity. Transcriptomic analysis using the L1000 assay revealed that melatonin treatment produced gene expression changes like knockdowns of genes involved in cell cycle regulation and upregulation of apoptotic pathways. These genetic similarities extended to compounds with antioxidant properties, suggesting melatonin's anticancer effects operate through multiple molecular mechanisms including modulation of oxidative stress response. This study highlights melatonin's varied anticancer effects across different cancer types. Future research should focus on optimizing melatonin's therapeutic potential in animal models of sensitive cancers and exploring chronobiological intervention strategies for cancer prevention and treatment.

Experimental Demonstration of a Confined Two-Locus CRISPR Toxin-Antidote Gene Drive

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Gene drive systems enable rapid spread of desired transgenes throughout populations. Advances in CRISPR-Cas9 technology have facilitated the construction of toxin-antidote gene drives, which utilize a CRISPR nuclease as the toxin to disrupt an essential wild-type gene, alongside a recoded version of the same gene as the antidote. Because these systems propagate by eliminating wild-type alleles rather than directly copying themselves like homing drives, they typically exhibit introduction thresholds. Here, we constructed a drive system targeting two essential but haplosufficient genes, *sim* and *hairy*, using two different drives located at different genomic locations. Each drive targets the gene that the other rescues. The system showed high cleavage in individual crosses. When released into a multigenerational cage population above the introduction threshold, the drive successfully and rapidly modified the entire population; below this threshold, it was eliminated. However, due to inherent fitness costs in the drive construct, our experimentally determined introduction threshold (34%) exceeded the threshold predicted by idealized computational models assuming zero fitness cost (18%). Our findings indicate that two-locus CRISPR toxin-antidote drives represent promising tools for effective and regionally confinable population modification gene drive.

From Rivers to Dinners: Tracing Microplastics Through Clams

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Microplastics are a global research priority due to their toxicity, their ability to act as vectors for environmental pollutants, and their potential for bioavailability and bioaccumulation across food webs. As a result, microplastics released into aquatic environments can enter human systems through dietary exposure. This study focuses on bivalves, among the most heavily consumed seafood worldwide, as a critical link between environmental contamination and human exposure. Microplastics

were extracted, characterized, identified, and quantified from the soft tissue of 36 soft-shell clams (*Mya arenaria*) collected across 11 sampling sites in the Saguenay and St. Lawrence rivers. Both physical characteristics (particle size, morphology, color) and chemical composition were analyzed to trace potential sources and assess environmental fate. Among the detected and confirmed microplastic particles, 40% were smaller than 1 mm. In terms of morphology, ~80% were fibers, and 30% were composed of synthetic polymers, compared with natural and non-synthetic materials. Among synthetic polymers, particular attention is drawn to polyvinyl fluoride (PVF), which was dominant. PVF is a high-risk fluoropolymer that is widely used in water-repellent clothing, yet it is rarely monitored in environmental studies. Finally, these findings are placed within the broader context of human health by summarizing current understanding of microplastic exposure and its potential biological impacts. Together, these results highlight the need for improved monitoring of overlooked polymer types in aquatic food systems.

Conflicts of Interest

While the WISENC affiliate authors are not explicitly aware of any conflicts of interest, they acknowledge the wide variety of universities and institutions, including their various sponsors and affiliates, associated with the production of research included in this abstract book.

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