BMIT eNews | Spring 2026

Current circulation: 400

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Canadian Light Source | Centre canadien de rayonnement synchrotron

Dear BMIT User,

Start of a New Cycle!

Welcome to cycle 41, a new year of beamtime, and, according to the groundhogs, spring! It has already been about a month since we have returned to normal operations, and it has been a wonder to see users old and new returning to the beamlines. We are excited for the year ahead and look forward to working with our users to support their projects. In this edition of the eNews we will cover some important updates to work that has been going on at the beamlines, provide some information on the results of the cycle 41 call for proposals and the upcoming cycle 42 call for proposals, look back at the BMIT user publications from 2025, and finally, highlight some amazing works that have come out since our last communication.

Updates to the Beamlines

Since beam returned in early October, we have been busy with both the BM and ID beamlines to perform regular maintenance and ensure that everything is operating as expected and to make sure everything runs smoothly for our users. We would like to thank any early users that were available on such short notice to come in during the past few months to perform some preliminary experiments and provide us with an opportunity to check the quality of the beam and test out equipment, such as the PCO Edge 10 bi, for all kinds of different samples and setups. The results of our regular beamline maintenance have shown that most things at the beamlines are working as expected, with a few small issues appearing here and there that are usually resolved as soon as they are identified. The CLS facility as a whole has been recovering from an unexpected power outage that occurred in late January, and the beamlines have mostly recovered as we receive further updates regarding beam and getting back into top-up mode. However, a couple of larger repairs at the ID beamline are still ongoing.

The repair that has impacted the ID beamline the most is a water leak that occurred over the holiday period. A section of vacuum before the beam enters the experiment hutch had developed a leak, and the vacuum conditions were observed to be poor. Since then, the identified leak has been undergoing repairs, and the vacuum conditions are slowly recovering as the system pumps down. Unfortunately, the vacuum repair has affected some of our users, and we have had to cancel beamtime. We apologize for any inconvenience this has caused. We always look forward to working with our users, and it is unfortunate that technical issues such as this can occur unexpectedly. If your beamtime is expected to be impacted by any technical issues, your BMIT *Primary Point of Contact* for your experiment will contact you. We do look forward to seeing you here in the future and would encourage everyone to make beamtime requests for the next cycle in the Call for Proposals.

Cycle 41 Call for Proposals Results

We received 9 new proposals and 46 beamtime requests against active proposals for a total of 55 proposals. The peer-review process has been completed, and allocation of the proposals has gone out in multiple phases as many projects scheduled for this cycle have been dedicated to our commitment to supporting users who have been affected by the new LINAC project and lost beamtime. We have already begun supporting projects as early as last October for early user testing while we monitored the beam quality, and have been reaching out to principal investigators, spokespersons, and delegates for the current cycle to schedule beamtime and introduce the scientists that will be supporting your projects. Your BMIT *Primary Point of Contact* for your experiment will contact you several weeks before the scheduled beamtime to confirm the details regarding samples, detectors, and training.

Cycle 42 Call for Proposals is Now Open

The cycle 42 call for proposals is now open! For full information on the upcoming cycle and how to apply for beamtime, please visit:

https://www.lightsource.ca/users/getting-started/applying-for-beamtime.php

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Activities at the Beamlines – 2025 Review

With the end of a year and the start of a new cycle, we would like to look back on 2025 and the work that has come from you, our users. While the CLS has been down for the replacement of the LINAC, with normal operations and cycle 41 starting up as of January 2026, that hasn't stopped our users from contributing to the greater scientific community. In fact, 2025 saw the highest total number of annual publications at BMIT compared to all previous years! We are proud of our users' research, and we hope to keep this momentum going in the years to come!

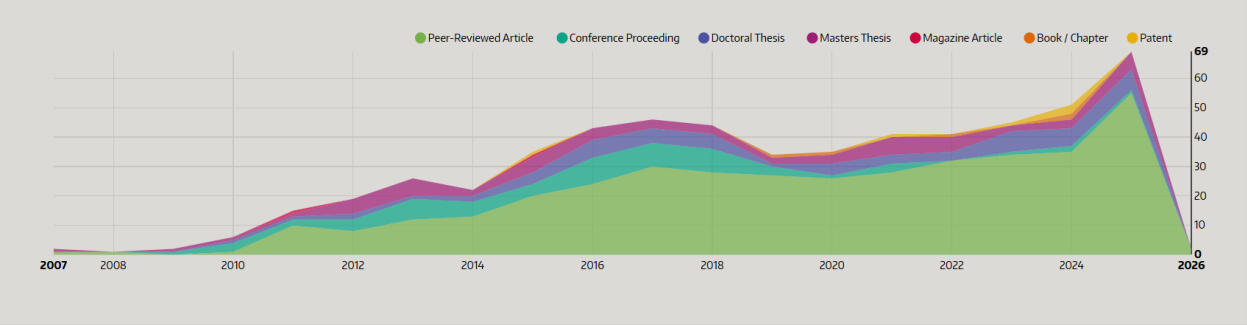
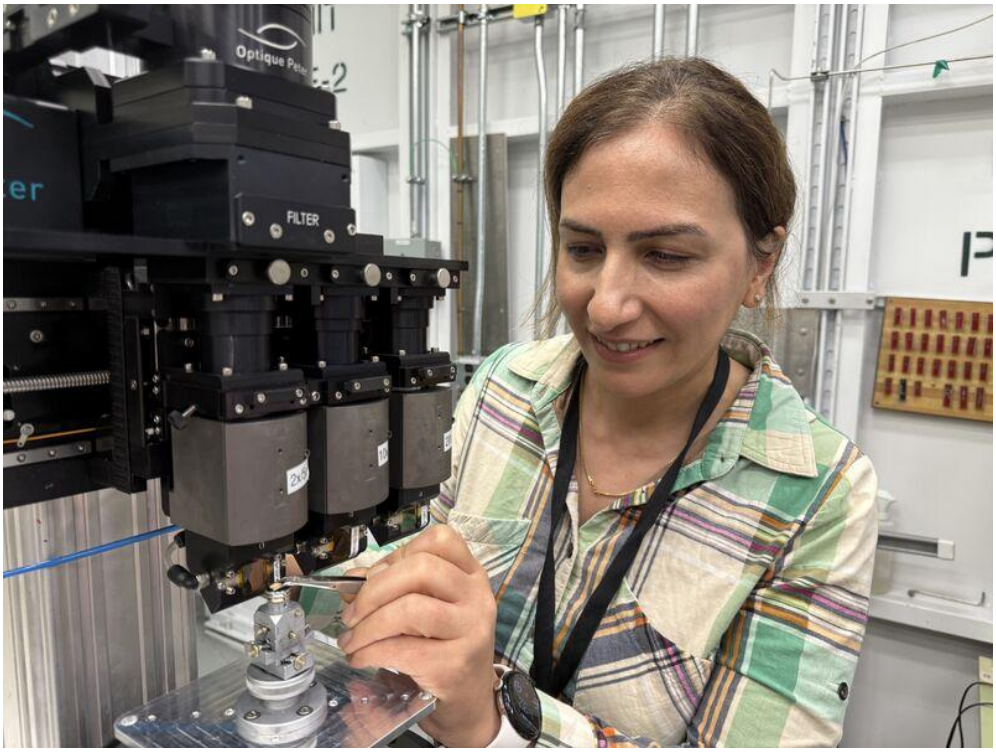


Figure. Comparison of Annual Publication Quality Metrics at BMIT

In 2025, we saw a total of 69 publications based on the data collected at the BMIT beamlines. 80% are journal articles, 19% are Doctoral and Masters' theses, and 1% are peer-reviewed conference proceedings. This brings our total number of publications to 578 at the BMIT beamlines at the end of 2025. 67% are journal articles, 20% are Doctoral and Masters' theses, 11% are peer-reviewed conference proceedings, with the remainder being books, chapters, magazine articles, and patents.

Around the Beamlines

Researchers with the University of Guelph, Ontario Agricultural College and colleagues used the BMIT-BM and Mid-IR beamlines to analyze different sprouted wheat varieties. Using X-ray imaging, they mapped the structural breakdown of wheat endosperm and detailed structural changes in the starch, proteins, and cell wall polymers during sprouting. The team aims to use these insights to improve the consistency of commercial sprouting processes and improve the quality and nutritional benefits of sprouted wheat products. Read more here.



Pictured. Reihaneh Abdi

BMIT User Data Back-up Policy

BMIT's data retention policy at present is - a period of 2 cycles or 1 year plus the current cycle for any "raw" data, and 90 days for any files created by users in their "rec" folders. The CLS has setup a new server using Globus to better link users to projects that they are affiliated with and can now access their data directly, eliminating the need to perform mass copying of projects when users need to retrieve their data. Users can find a personal download for Globus at https://www.globus.org/globus-connect-personal, and once setup, will receive an email from the Globus server to access their data.

Please note that at no point will we back-up reconstructed and processed data - this is the sole responsibility of the research groups. At the end of this retention period, data will be evaluated for its ongoing value and relevance. If data is deemed no longer necessary, it will be securely disposed of following data sanitization procedures. If you require a copy of your data, please contact the BMIT scientist that helped you with your experiment.

Remote Access for microCT Data Reconstruction and Visualization Server

Now that we are back into normal operations, it is expected that many of our users will require access to the BMIT server for data reconstruction and analysis following their beamtime. A comprehensive guide for what to do after your beamtime can be found at:

https://bmit.lightsource.ca/user-guide/after-beamtime/

Please contact Xiao Fan Ding (XiaoFan.Ding@lightsource.ca) for details and scheduling. Depending on the number of requests, the duration of access may be limited to 2-3 days.

Pictures of the Season – Gone Fishing

Oxidative Stress-Induced Intervertebral Disc Remodelling and Elevated Stiffness Drive Idiopathic Scoliosis in Preclinical Models

Contact Information: Brian Ciruna, University of Toronto
Reference: Pumputis, P. G., Xu, R., Gopaul, J., Panahifar, A., Erfani, V., Van Gennip, J. L. M., Eames, B. F., Fakhari, N., Baranger, J., Lebel, D. E., Villemain, O., & Ciruna, B. (2025). Oxidative stress-induced intervertebral disc remodelling and elevated stiffness drive idiopathic scoliosis in preclinical models. *Nature Communications*, *16*(1), Article 8719. https://doi.org/10.1038/s41467-025-63742-2

Adolescent idiopathic scoliosis (AIS) is the most prevalent pediatric spine disorder, developing in the absence of obvious physiological defects. Genome sequencing and functional studies have demonstrated association of musculoskeletal collagen variants and cartilaginous extracellular matrix (ECM) defects in a subset of patients. However, the underlying biological causes of AIS remain poorly understood, limiting treatment options. Using multiple zebrafish AIS models, we demonstrate that reduction-oxidation (redox) imbalances induce cell stress and collagen remodelling within intervertebral segments of the developing spine. Mutant spines are consequently stiffer, as measured by shear wave elastography, and exhibit deformations of intervertebral structures.

Remarkably, elevated stiffness and intervertebral ECM phenotypes are detectable prior to scoliosis onset, suggesting a causal relationship, and can be suppressed by antioxidant treatment. Together, our preclinical studies implicate oxidative stress-induced intervertebral deformations in the pathogenesis of AIS and identify elevated spine stiffness and redox imbalance as plausible first-in-kind prognostic biomarkers and therapeutic targets.

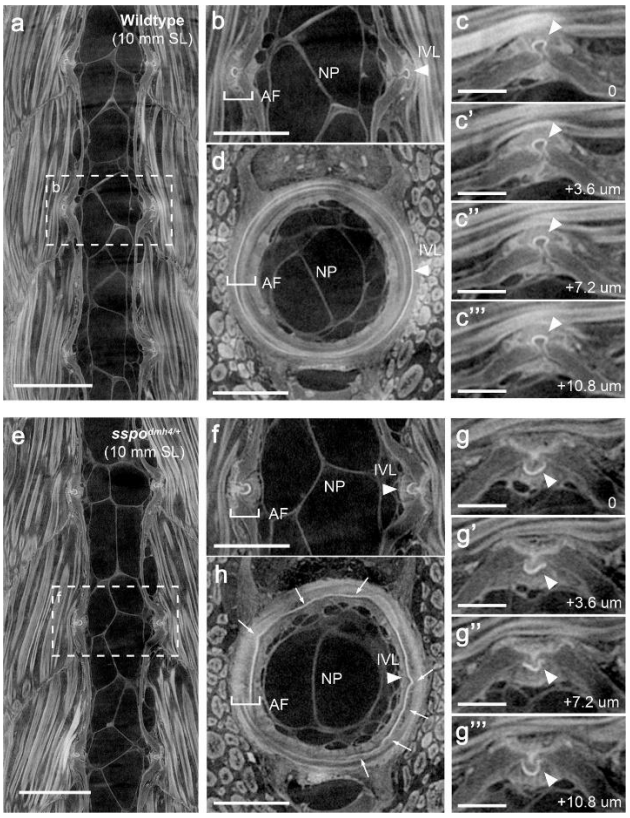


Figure. a–**g** High-resolution synchrotron-based X-ray micro-computed tomography (μCT) imaging of iodine contrast-stained wildtype (**a**–**d**) and *sspo*$^{dmh4/+}$ mutant (**e**–**h**) juvenile fish at 21 dpf (10 mm SL). Representative sections from coronal (**a**–**c**, **e**–**g**) and transverse (**d**, **h**) planes are shown. Dashed boxes (**a, e**) indicate featured intervertebral segments. Arrowheads (**b**–**d**, **f**–**h**) indicate the intervertebral ligament, which loops outward toward neighboring musculature in wildtype animals ($N = 3$ fish, $n = 13$ IVDs analyzed), but often exhibited structural deformations and even inverted orientations in *sspo*$^{dmh4/+}$ mutants ($N = 8$ fish; $n = 22/29$ IVDs appeared abnormal). Arrows (**h**) highlight sites of *sspo*$^{dmh4/+}$ IVL deformation in the transverse plane. Sequential images (3.6 μm step) through the coronal plane of wildtype (**c-c'''**) and *sspo*$^{dmh4/+}$ (**g-g'''**) zebrafish highlight the highly deformable structure of *sspo*$^{dmh4/+}$ mutant IVLs. Scale bars = 20 μm (**c**, **g**); 50 μm (**b**, **d**, **f**, **h**); 100 μm (a, **e**). IVL intervertebral ligament, AF annulus fibrosus equivalent, NP nucleus pulposus equivalent.

Marine Origins and Freshwater Radiations of the Otophysan Fishes

Contact Information: Juan Liu, University of California, Berkeley
Reference: Liu, J., Brinkman, D. B., Murray, A. M., Newbrey, M. G., Zhou, Z., Van Loon, L. L., & Banerjee, N. R. (2025). Marine origins and freshwater radiations of the otophysan fishes. Science (American Association for the Advancement of Science), 390(6768), 65–69. https://doi.org/10.1126/science.adr4494

Otophysans, known for their enhanced hearing enabled by the complex Weberian apparatus, comprise two-thirds of extant freshwater fish species. Previously, they were thought to have originated in fresh water before the breakup of Pangea, implying a nearly 80-million-year gap between the origin and oldest known fossil. However, the discovery of a Late Cretaceous freshwater otophysan challenges this view. Integrating fossil, morphological, and genomic data, we estimate a younger crown group origin of ~154 million years ago. Notably, ancestral range and habitat reconstructions indicate marine origins for the otophysan crown groups, with at least two transitions to fresh water. Functional simulations of the Weberian ossicles of this fossil suggest that the distinctive hearing capabilities of otophysans evolved in conjunction with fusion of hearing ossicle parts and freshwater adaptations.

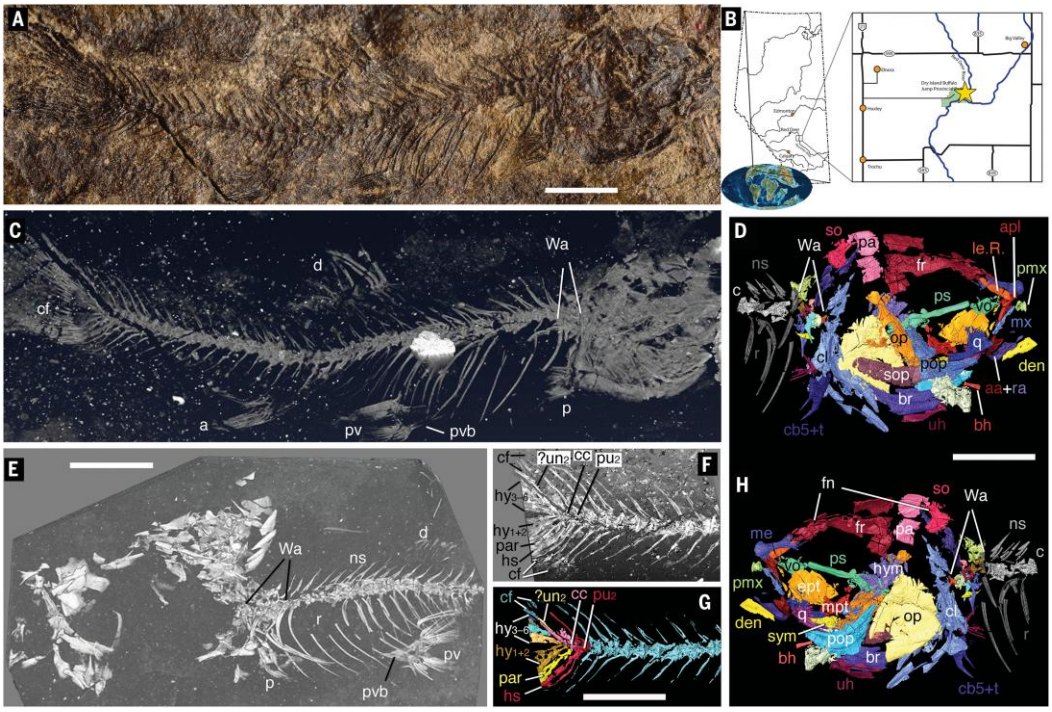


Figure. Photograph, x-ray image, 3D segmentation, and locality map of †*A. maccagnoi*. (**A** and **C**) Photograph and x-ray–based computational tomography (CT) image rendering of the holotype, TMP 2012.020.1506. (**B**) Fossil locality (yellow star) of **†***A. maccagnoi*. It was located well inland from the shoreline of the Western Interior Seaway indicated on the paleomap. (**D** and **H**) Left and right view of CT image–based three-

dimensional (3D) segmentations of the skull of the paratype TMP 2019.022.0003. (**E**) X-ray image of a partially disarticulated specimen, paratype TMP 2012.020.1474. (**F** and **G**) CT image rendering and segmentation of the caudal bones, digitally reconstructed to remove the crack in the fossil of TMP 2012.20.1506 shown in (A) and (C). a, anal fin; aa+ra, articular and retroarticular; apl, autopalatine; bh, basihyal; br, branchiostegal ray; c, centrum (pl. centra); cb_5+t, the fifth ceratobranchial with minute dentition; cc, caudal compound centrum (a fusion of preural 1, ural 1, and ural 2); cf, caudal fin; cl, cleithrum; d, dorsal fin; den, dentary; ept, ectopterygoid; fn, fontanelle; fr, frontal; hs, haemal spine; hy_{1+2}, hypural 1 and 2; $hy_{3–6}$, hypural 3 through 6; hym, hyomandibulaa; le, lateral ethmoid; me, mesethmoid; mpt, metapterygoid; mx, maxilla; ns, neural spine; op, opercle; p, pectoral fin; pa, parietal; par, parhypural; pmx, premaxilla; pop, preopercle (with interopercle that was inseparable during segmentation); ps, parasphenoid; pu_2, second preural centrum; pv, pelvic fin; pvb, pelvic bone; q, quadrate; r, rib; R., right; so, supraoccipital; sop, subopercle; sym, symplectic; uh, urohyal; un2, uroneural 2; vo, vomer; Wa, bony elements of Weberian apparatus. “?” indicates tentative identification. Scale bar, 5 mm.

New Publications

Publications are an important factor in our funding and taken into consideration by the peer review committee. Users are encouraged to add their publications to the CLS database. Please review the publications list and ensure that all of your publications are included:

http://bmit.lightsource.ca/publications

To add new or missing publications to the CLS database use the CLS User Portal System:

https://user-portal.lightsource.ca

After you log in, click on 'Publications', then 'All Publications', then simply click on the **green + icon** in the top right corner to add your publication. Papers are easily added using the DOI.

Acknowledgements

All Users and CLS Staff are required to acknowledge the work they performed, in whole or in part, at the Canadian Light Source. Authors are requested to include the following Acknowledgement when submitting or presenting results from the CLS:

"Part or all of the research described in this paper was performed at the Canadian Light Source, a national research facility of the University of Saskatchewan, which is supported by the Canada Foundation for Innovation (CFI), the Natural Sciences and Engineering Research Council (NSERC), the National Research Council (NRC), the Canadian Institutes of Health Research (CIHR), the Government of Saskatchewan, and the University of Saskatchewan."

Acknowledgement of any beamline staff who may have assisted in optimization and preparation of the experimental setup as well as data acquisition or data processing is very welcomed.

Moreover, if users would like to refer to technical specifications of BMIT beamlines, they may cite the following articles:

- To refer to technical specifications of the BMIT-BM beamline (i.e., 05B1-1 POE-2 endstation):

Wysokinski, T. Chapman, D. Adams, G., Renier, M. Suortti, P. Thomlinson, W. Beamlines of the biomedical imaging and therapy facility at the Canadian Light SourcePart 1. Nuclear Instruments and Methods in Physics Research A, vol. 582, iss. 1 pp. 73-76, 2007.

- To refer to technical specifications of the BMIT-ID beamline (i.e., 05ID2 SOE-1 endstation):

Wysokinski, T. Chapman, D. Adams, G., Renier, M. Suortti, P. Thomlinson, W. Beamlines of the biomedical imaging and therapy facility at the Canadian Light SourcePart 3. Nuclear Instruments and Methods in Physics Research A, vol. 775, iss. 1 pp. 1-4, 2015.

- To cite the UFO-KIT reconstruction software you may cite:

Vogelgesang, M.; Farago, T.; Morgeneyer, T. F.; Helfen, L.; dos Santos Rolo, T.; Myagotin, A.; Baumbach, T. Real-time image-content-based beamline control for smart 4D X-ray imaging. Journal of synchrotron radiation, Vol. 23, iss. 5, pp. 1254-1263. 2016.

Reported Publications using BMIT Beamlines – September to December 2025

1. Chadwick, Eric A.; Derebaşı, Beste; Schulz, Volker P.; Bazylak, Aimy (2025). *Influence of gravity on water management and mass transport losses in polymer electrolyte membrane fuel cells*. Scientific Reports 15(1). 10.1038/s41598-025-09067-y.

2. Dahlan, Nuraina Anisa; Chiok, Kim Lam R.; Tabil, Xavier L.; Duan, Xiaoman; Banerjee, Arinjay et al. (2025). *Development and characterization of a decellularized lung ECM-based bioink for bioprinting and fabricating a lung model*. Biomaterials Advances 177, 214428. 10.1016/j.bioadv.2025.214428.

3. Dobson, S.; Marangoni, A.G. (2025). *Evaluating the effect of plant protein functionalities on the performance of high-protein plant-based cheese*. Food Chemistry 492, 145553. 10.1016/j.foodchem.2025.145553.

4. Dykstra, Emelie; Stobbs, Jarvis A.; Galeano, Esteban; Thomas, Barb R. (2025). *Revealing the Application of Synchrotron‐Based X‐Ray Computed Tomography in Healthy Versus Unhealthy Interior Lodgepole Pine (Pinus contorta var. latifolia) Conelets*. Plant Direct 9(11). 10.1002/pld3.70117.

5. Falua, Kehinde James; Babaei-Ghazvini, Amin; Olughu, Onu Onu; Stobbs, Jarvis A.; Leontowich, Adam F.G. et al. (2025). *Expanding the Applications of High-amylose Fava Bean Starch: Optimization Strategies for Sustainable Valorization Into Aerogels*. ACS Sustainable Chemistry and Engineering. 10.1021/acssuschemeng.5c07319.

6. Foroughi, Farangis; Aulakh, Gurpreet Kaur; Krapohl, David; Norlin, Börje; Menk, Ralf Hendrik et al. (2025). *A Gaussian fitting-based analysis method for multiple image radiography with integrated angular calibration, MIR2*. Physics in Medicine and Biology. 10.1088/1361-6560/ae22ba.

7. Hedberg, Yolanda Susanne; Biesinger, Mark C.; Wang, Zhiqiang (2025). Solid and liquid state speciation of chromium of relevance for health. Canadian Journal of Chemistry. 10.1139/cjc-2025-0118.

8. Leontowich, Adam F. G.; Panahifar, Arash; Chen, Si; Barlow, Burke; Gurney, Kirsty E. B. et al. (2025). Lead micro- and nanoparticles directly observed within gunshot wounds in hunted game meat. Scientific Reports 15(1). 10.1038/s41598-025-20285-2.

9. Liu, Juan; Brinkman, Donald B.; Murray, Alison M.; Newbrey, Michael G.; Zhou, Zehua et al. (2025). *Marine origins and freshwater radiations of the otophysan fishes*. Science 390(6768), 65-69. 10.1126/science.adr4494.

10. Parekh, Dhruvi; Ranieri, Salvatore; Seip, Tess; Chadwick, Eric A.; Derebaşı, Beste et al. (2025). *Dominating impact of microporous layer thickness on gas diffusion layer oxygen transport resistance*. Journal of Power Sources 656, 238031. 10.1016/j.jpowsour.2025.238031.

11. Pumputis, Patrick G.; Xu, Ran; Gopaul, Josh; Panahifar, Arash; Erfani, Vida et al. (2025). *Oxidative stress-induced intervertebral disc remodelling and elevated stiffness drive idiopathic scoliosis in preclinical models*. Nature Communications 16(1). 10.1038/s41467-025-63742-2.

12. Yin, Runrong; Shen, Jianheng; Martinez Soberanes, Edgar E.; Popiel, Jeffrey; Gao, Pan et al. (2025). *From microstructure to macroseparation: Synchrotron X-ray microtomography analysis to guide efficient canola dehulling*. Innovative Food Science and Emerging Technologies 106, 104303. 10.1016/j.ifset.2025.104303.

13. Coker, Oluwafemi Jeremiah (2025). *Development of Hybrid Meat Products by Replacing Animal Fats with Faba bean Protein Isolate-Stabilized Canola Oil-In-Water Emulsion Gel*. Supervisor: Shand, Phyllis J; Ghosh, Supratim. Saskatchewan, Canada: University of Saskatchewan. https://harvest.usask.ca/items/14037876-5070-4f4e-b952-ac34ef4673d9.

14. Eric Alexander Chadwick (2025). *Microscale Transport in Polymer Electrolyte Membrane Fuel Cells: Impact of Gravity and Flow Field Design*. Supervisor: Bazylak, Aimy; Schulz, Volker P. Canada: University of Toronto. https://utoronto.scholaris.ca/items/c7e11d74-3f52-4f07-adbe-64706badbff9.

15. Qianyi Ma (2025). *Electrolytes Design for Metal-based Anode Batteries*. Supervisor: Yu, Aiping. Ontario, Canada: University of Waterloo. https://hdl.handle.net/10012/22751.

https://bmit.lightsource.ca/