Canadian Institute of Nuclear Physics
Institut canadien de physique nucléaire

Newsletter #25, November 2024

The Canadian Institute of Nuclear Physics (CINP) is a formal organization of the Canadian nuclear physics research community to promote excellence in nuclear research and education, and to advocate the interests and goals of the community both domestically and abroad.

1. SAPES Fall Context Meeting

The NSERC Subatomic Physics Evaluation Section (SAPES) activities for the 2025 competition have recently begun, following the closing date for most applications on Nov 1.

CINP has been asked to make a presentation to SAPES during their Fall Context session on Dec 10. The purpose of the session is to update and familiarize the SAPES about the SAP Canadian funding and research landscape, prior to their review of this year's applications. The CINP presentation is in addition to the Context Document that was updated last year.

Our usual practice is to brief SAPES on the major activities undertaken by the CINP in supporting Canadian subatomic physics research endeavors, and present some slides on the breadth of Canadian nuclear physics research and important current and future priorities. The CINP presentation will be 15 minutes long, leaving time for questions.

If you have something to contribute, such as:

- a major research award or recognition received,
- a recent research highlight, such as a publication in a prestigious journal,
- approval or commissioning of a new research capability or technique,

please let Garth Huber know ASAP, and preferably no later than November 27, so he can send you an example slide using the CINP PPT template. The template is required so that the CINP presentation is visually coherent and professional in appearance.

For your reference, copies of past presentations to SAPES are at: https://cinp.ca/nuclear-physics
The subatomic physics research context document is at: https://cinp.ca/cinp-white-papers

Garth's contact information is on the back page of this newsletter.

2. NSERC Support for CINP

NSERC provides funding for many CINP activities through the Subatomic Physics Major Resources Support (SAP-MRS) program. The installment for 2024-25 is $75,000.

The CINP MRS grant is up for renewal in the coming competition, and an application supporting increased activities was recently submitted by CINP to NSERC. More details will follow once the decision of SAPES on the award for 2025-2030 is known.

3. Canadian Subatomic Physics Long Range Plan 2027-2034

- **CINP and IPP have begun planning the activities for the next Canadian Subatomic Physics Long Range Plan, covering the period 2027-34, with a look ahead to 2041.** As with the most recent plan, the two community-driven institutes, CINP and IPP, will lead the process. Together, we have been drafting the terms of reference for the Long Range Planning Committee (LRPC), and will soon begin nominating potential members.
- **Like last time, the CINP and IPP are also expected to prepare briefs that will be submitted to the LRPC by the fall of 2025.** The LRPC would then lead the consultation of the community up to the summer of 2026, with the intent being to submit its report by fall 2026.

You should anticipate a call to provide your input to CINP this spring, with a possible CINP Town Hall meeting at the 2025 CAP Congress

4. Representation and Input to Various Agencies

The CINP is an advocate and representative of the Canadian nuclear physics community and is asked to attend various meetings or make presentations on its behalf. Some recent and forthcoming activities include:

- **GH and the IPP Director, Carsten Krauss, traveled to Ottawa on November 7-8 for in-person meetings with federal science funding agencies.** The meetings were with:
  - NSERC President Alejandro Adem, Vice President Marc Fortin, and staff
  - CFI Directors Marc Legace and Michael O'Neill, and staff
  - ISED Associate Deputy Minister, Nipun Vats, and staff

We raised various issues with them, including:
  - Future supports for graduate students and PDFs, including the implementation of the new funds announced in the last federal budget for both NSERC Discovery Grants and NSERC scholarships.
  - Recent changes to Innovation Fund expenditure timeline rules that could impact subatomic physics relying on international partners or require additional R&D
  - The likely impacts upon subatomic physics of the new "Capstone Organization" announced in the last federal budget, and the planned Major Research Facilities (MRF) paradigm. e.g. Canada's formal role in future international science projects and how they could fit in the new agency framework
  - Agency input to the next Canadian Subatomic Physics Long Range Plan

It is extremely important for the science community to engage with the federal and provincial governments on the importance of science funding. We encourage you to similarly reach out to your MP or provincial representative.

- GH represents CINP on the Pan-Canadian MRS Coordination Board, which is a national oversight board for all SAP-MRS resources. They meet ~6 times a year to discuss MRS resource requests and the progress of each center on the assigned SAP projects.

For more information on the available MRS resources, please visit the CINP website https://cinp.ca/subatomic-physics-major-resources-support-facilities

The MRS Coordination Board also made a presentation at the last CINP Individual Members meeting, the slides are available from: https://cinp.ca/agm-slides

- The Advisory Committee on TRIUMF (ACOT) is a panel of international experts that meets and reports to the NRC twice a year. Garth Huber represents the CINP as a "community observer". GH is the nuclear physics community representative at ACOT (Advisory Committee on TRIUMF) meetings. Their next in-person meeting scheduled for April 28-29, 2025.

5. Winter Nuclear and Particle Physics Conference (WNPPC 2025)

(submitted by Corina Andreoiu, SFU)

Registration and abstract submission for the 62nd Winter Nuclear and Particle Physics Conference (WNPPC2025) are NOW open!

This conference focuses on the Canadian subatomic physics community, encouraging participation from junior researchers. It includes sessions on both experimental and theoretical research areas relevant to the field.

Conference Dates: February 13-16, 2025
Location: Banff Centre, Banff, Alberta, Canada
Key Details:
Register at:
https://wnppc.triumf.ca/2025/registration.html
Abstract Submission:
https://indico.triumf.ca/event/605/abstracts/

Important Deadlines:

- Abstract Submission Deadline: December 13, 2024
- Feedback on Abstracts: End of 2024
- Early Registration Fee Deadline: January 12, 2025
- Room Booking (Group Rate) Ends: January 13, 2025
- Registration Ends: February 1, 2025

For questions, reach out to wnppc@triumf.ca.

We look forward to seeing you in Banff for WNPPC2025!

The WNPPC Organizing Committee:

Corina Andreoiu, Simon Fraser University (Co-Chair)
Thomas Brunner, McGill University (Past Co-Chair)
Erica Caden, SNOLAB & McGill University (Past Co-Chair)
Alain Bellerive, Carleton University
Tim Friesen, University of Calgary
Gwen Grinyer, University of Regina
Annika Lennarz, TRIUMF (Permanent Member, Co-Chair)
Tony Noble, Queen's University (Permanent Member)
Heather Russell, University of Victoria
Katelin Schutz, McGill University
Jana Thomson, TRIUMF (Conferences Facilitator)

https://wnppc.triumf.ca/2025/

6. 2025 WNPPC Graduate Student Travel Awards

The Canadian Institute of Nuclear Physics (CINP) is making available graduate student travel awards to the 2025 WNPPC. Each award will be for up to $750 towards student travel expenses. Students must be enrolled in graduate studies at a Canadian university and performing research in experimental or theoretical nuclear physics. The application deadline is Monday, January 6. For more information and application forms, please visit:

https://cinp.ca/wnppc-graduate-student-travel-awards

7. Grad classes offered by TRIUMF

(submitted by Marcello Pavan, TRIUMF)

TRIUMF periodically offers a few graduate-level courses, usually in the fall and winter terms, which could be of interest to your students. The courses are run online through UBC or UVic. Typically students would register at their local department in a 'directed studies' or 'special topics' course, though students in western Canada could take advantage of the Western Dean's Agreement to transfer course credit directly.

In Winter 2025, the following courses are planned. **Students are asked to contact the lecturer directly is they are interesting in taking, or want more information about, the course.**

UBC PHYS 505 — Nuclear Physics

https://phas.ubc.ca/~behr/phys505/

Nucleons and their structure, hadrons and isospin, two-nucleon systems, the *NN* interaction; bulk properties of nuclei, nuclear excitations and radioactivity, nuclear models; strong and electromagnetic decay, symmetries and weak interaction; nuclear reactions, nuclear astrophysics.

Prerequisites: PHYS 500 Quantum Mechanics I or equivalent (one semester of grad QM)

Textbook: Samuel S.M. Wong, Introductory Nuclear Physics, 2nd ed. Wiley (.pdf available at publisher with UBC library privileges)

In 2021 and 2023, Phys 505 was taken by an average of 5 UBC students and 10 from other Canadian universities (several under Western Deans' Agreement). It will again be taught entirely remotely.

Contacts: Dr. John Behr <behr@triumf.ca> and Dr. Barry Davids <davids@triumf.ca>

UBC PHYS 560 / UVic PHYS 522 Physics and Engineering of Particle Accelerators

The course will provide an introduction to the physics and technology of particle accelerators concentrating particularly on proton and ion accelerator technology. The course will include a survey of existing accelerator types and an introduction to transverse and longitudinal beam optics. The course will also include an introduction to the physics and technology of ion sources, will give an overview of radioactive ion beam production, of accelerator radio-frequency principles and more detailed aspects of room temperature and superconducting linear accelerators, as well as high energy circular machines. The course should appeal to students of Accelerator Physics, as well as to students of Experimental Nuclear and Particle Physics and other students interested in Particle Accelerators.

Pre-requisites: Classical Mechanics, Classical Electrodynamics

Time: January 10 -April 8, 2025
Tue/Thu 2pm Pacific

- Slides and all other information will be posted on a web-based learning management system like Bright Space at UVic.
- Homework assigned once a week.
- Two exams, mid-term and a final. Both are open-book

Final Grade:
Homework assignment (due one week after assignment) – 50%
Mid-term exam – 20%
Final Exam – 30%

Contact:
Dr. Robert Laxdal <lax@triumf.ca> 604-222-7322

8. Undergraduate Student Conference Support

The CINP awarded four $750 travel grants to support undergraduate students giving talks on nuclear physics related projects at the 2024 Canadian Undergraduate Physics Conference (CUPC) held at the University of British Columbia, Oct 24-27. The applications were evaluated by: Liliana Caballero (Board member—Guelph), Ruben Sandapen (NuclEducation SWG Chair—Acadia) and Garth Huber (ExecDir—Regina).

Student	Supervisor	CUPC Talk Title
Laura Hubbert (Mt Allson)	Dave Hornidge (Mt Allison)	The Compton Slope Parameter and the Compton and Two Photon Spectrometer
Modeste Katotkoa (Winnipeg)	Jeff Martin (Winnipeg)	Shim Coils and their importance in measuring the Neutron Electric Dipole Moment
Karalee Reimer (Manitoba)	Savino Longo (Manitoba)	Anti-proton Interactions at Belle-II
Zachary Saunders (Saint Mary's)	Rituparna Kanungo (Saint Mary's)	Investigating Shell Evolution at the Proton Drip-line through the ^{20}Mg(d,p)^{21}Mg Reaction at IRIS

All students were asked to acknowledge the financial support by the CINP in their presentation.

9. CINP Conference Support

CINP extends partial funding to workshops, meetings and conferences of broad relevance to nuclear physics in Canada. Requests are appraised against the mission and goals of the CINP, and funding is contingent upon satisfactorily showing that the event will further the aims of the CINP and be of benefit to its members. **Application forms for external conference support are available from https://cinp.ca/conference-support**

10. Research Highlight: Long-sought measurement of exotic beta decay in thallium helps extract the timescale of the birth of the Sun

(submitted by Guy Leckenby, Iris Dillmann, TRIUMF)

An international collaboration of scientists succeeded in the measurement of the bound-state beta decay of fully-ionised thallium ($^{205}Tl^{81+}$) ions at the GSI Helmholtzzentrum für Schwerionenforschung (Germany). The experiment, conducted at the Experimental Storage Ring (ESR) of GSI/FAIR, and analysed in partnership with TRIUMF, revealed that the half-life of bare $^{205}Tl^{81+}$ is 291 days. This measurement has profound effects on the production of radioactive lead (^{205}Pb) in asymptotic giant branch (AGB) stars, which were simulated by collaborators at Konkoly Observatory, Budapest, and can be used to help determine how long the Sun took to form in the early solar system. The results have been published in Nature.

Bound-state beta decay is an exotic decay mode that only occurs in highly charged ions where the beta electron is created in a bound-state of the daughter nuclei (i.e. time reverse of EC). It can turn a stable atom like $^{205}Tl^{0+}$ into a radioactive ion when all electrons are removed (as in $^{205}Tl^{81+}$). This unique decay mode has so far only been observed at the ESR, which is currently the only device capable of storing millions of fully stripped ions for several hours.

"The measurement of $^{205}Tl^{81+}$ had been proposed in the 1980s, but it has taken decades of accelerator development and the hard work of many colleagues to bring to fruition," says Professor Yury Litvinov of GSI/FAIR, spokesperson of the experiment. *"The ^{205}Tl beam had to be created in GSI/FAIR's Fragment Separator (FRS) via projectile fragmentation of a ^{206}Pb primary beam because a direct ^{205}Tl source would have produced highly toxic vapors. Around 100 injections of secondary beam were stacked in the ESR per storage run to reach a sufficient number of stored ions. The FRS team developed a groundbreaking new setting to achieve the required beam intensity for a successful experiment."*

The experiment was conducted in 2020 during the opening weeks of the COVID-19 lock downs. *"COVID definitely threw a spanner in the works, but the dedication of the local team saved the day,"* says Guy Leckenby, PhD student from TRIUMF and first author of the publication. *"We perfected the analysis over three years, which was a worthwhile effort as the measured half-life of 291(+33)(-27) days is 5 times longer than what was previously being used for the weak decay rates. This highlights the importance of making an experimental measurement."*

"By knowing the half-life, we can now accurately calculate the weak decay rates for ^{205}Tl and ^{205}Pb and across a variety of stellar plasma conditions," says Dr. Riccardo Mancino, who computed the rates as a postdoctoral fellow in theoretical physics at TU Darmstadt.

The asymptotic giant branch (AGB) refers to stars of ½ to eight times the mass of our Sun at the end of their life cycle, where alternating H-shell burning and He-shell flashes drive the slow neutron capture (s) process that produces half of the heavy elements. Researchers from the Konkoly Observatory in Budapest (Hungary), the INAF Osservatorio d'Abruzzo (Italy), and the University of Hull (UK),

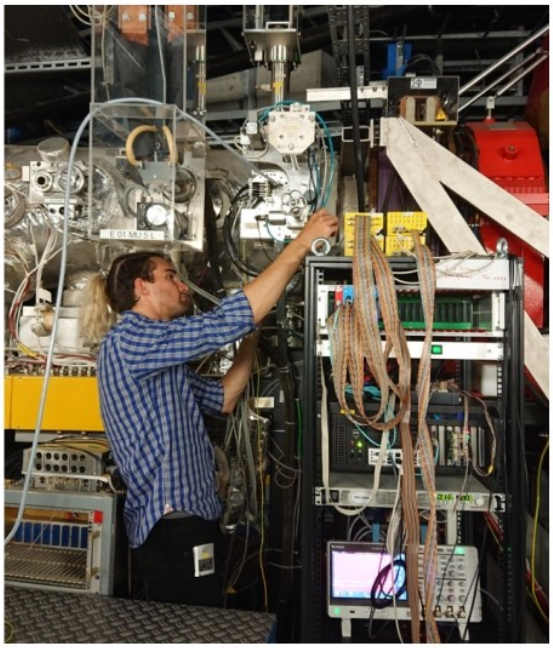


Fig 10-1: Guy Leckenby working at the Experimental Storage Ring at GSI/FAIR

Fig 10-2: An AGB star (top right) sheds material that is incorporated into the early Solar System (center). ^{205}Pb is one these nuclei that the researchers have used to time the formation of the early Solar System. credit: Danielle Adams, TRIUMF

implemented the new ^{205}Tl/^{205}Pb stellar decay rates in their state-of-the art AGB astrophysical models. *"Whilst the different models see slightly different results, the confidence in the new decay rates means we can be sure that AGB stars produced the ^{205}Pb that once made its way into the gas cloud which formed our Sun,"* explains Dr. Maria Lugaro, researcher at Konkoly Observatory. *"Given the uncertainties in the amount of extinct ^{205}Pb we currently see in meteorites, it seems that our new ^{205}Pb result is giving a time interval for the collapse of the presolar gas cloud that is consistent with other radioactive species produced by the s process. In short, we are starting to assemble evidence for exactly how long it took for our Sun to form over 4.5 billion years ago."*

The impact of the measurement was visualized by artist Danielle Adams in artwork commissioned for TRIUMF (Fig 10-2). The artwork shows the flow of material from a thermally pulsing AGB star shedding its layers (top right) into the early Solar

System (center) that is still full of gas and dust with only the first solids beginning to form. Whilst inspired by real images of AGB stars and realistic depictions of the early Solar System, especially the assembly of planets along ring-like orbits, Danielle wanted to capture a 1950s sci-fi style for the work.

Looking to the future, the measured bound-state beta decay half-life is essential to analyze the accumulation of ^{205}Pb in the interstellar medium. However, more research accounting for the full history of the galaxy is needed to fully comprehend it. In addition to planned simulations of galactic chemical evolution, a further measurement of the neutron capture rate on ^{205}Pb by utilizing the surrogate reaction method in the ESR has been proposed. Numerous additional high-impact experiments are proposed for the new heavy-ion storage rings planned at the future accelerator facility FAIR, which is currently under construction at GSI.

The work is dedicated to deceased colleagues Fritz Bosch, Roberto Gallino, Hans Geissel, Paul Kienle, Fritz Nolden, and Gerald J. Wasserburg, who were supporting this research for many years.

Reference: G. Leckenby, R.S. Sidhu, R.J. Chen, R. Mancino, B. Szanyi et al., Nature 635:8038 (2024) https://www.nature.com/articles/s41586-024-08130-4

11. Academic Honor: Juliette Mammei elected to the Royal Society of Canada

CINP congratulates Juliette Mammei, who was recently elected to the College of the Royal Society of Canada (RSC). The RSC recognizes excellence in arts, social sciences and sciences, while promoting knowledge and innovation both in Canada and globally. Election to the RSC College is one of Canada's highest academic honors.

Dr. Mammei is an Associate Professor at the University of Manitoba. Her research is in the field of parity-violating electron scattering, focusing on nucleon structure and testing critical theories of the standard model of particles and interactions.

"I think that the recognition is partially from my research, I am a world-known researcher in subatomic physics or nuclear physics, but I think it's also partially because of my outreach work," said Mammei.

Mammei actively engages in outreach programs aimed at introducing Indigenous students in Canada to nuclear physics and broader science concepts. One of her main goals is to increase indigenous representation in science by addressing a significant barrier — meeting the requirement to entering the physics program. According to her, many rural high schools lack teachers for physics, math and science as they "have a hard time keeping teachers."

Her proposed program aims to substitute high school physics requirements with university-offered alternatives to help students overcome this hurdle. "One of my goals would be to increase the numbers of Indigenous students particularly in science because I am a scientist," said Mammei, reflecting on her passion for the field. Mammei also highlighted the gender imbalance in her field, specifically noting that within the MOLLER Collaboration of around 100 collaborators, she is one of only two female professors.

Currently, Mammei is preparing for the MOLLER experiment at Jefferson Lab, largely funded by the U.S. Department of Energy, the National Science Foundation and the Canada Foundation for Innovation. The experiment intends to measure the weak charge of the election, which has previously

been measured, but the experiment will measure it five times more precisely.

Further reflecting on her journey, she credits a high pre-SAT score that earned her a full tuition scholarship as a key turning point. *"I was quite lucky to score very high on a test in the U.S. called the pre-SAT […], I scored so high on that and got a full tuition scholarship to a college and if that hadn't happened, I am not sure where I would be."*

12. New Book: The Dark Matter Discoverer's Guidebook

(submitted by Stephen Sekula, SNOLAB)

Jodi Cooley and Stephen Sekula recently co-authored and published their first textbook, on strategies and techniques at the nuclear and astrophysical levels to discover dark matter: https://darkmatterdiscoverer.org

We were very fortunate to benefit from technical review from several members of our Canadian physics community, including in axion physics, collider physics, and theoretical particle physics, astrophysics and cosmology. The book is intended for an advanced undergraduate or graduate-level audience, at a minimum.

The goal of the book is to introduce the reader to the evidence for dark matter as a quantum phenomenon (particle-like or wave-like). Then the idea is to give them a sense of the multidisciplinary details of actual searches for dark matter, as well as nudges about novel ideas that may or may not work (e.g., lead to a runnable experiment).

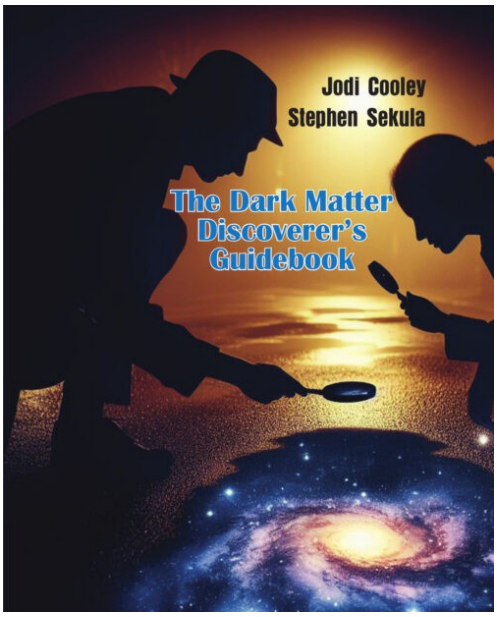
After an introductory chapter that summarizes useful units and the standard model, Chapter 2-3 review the observational evidence for dark matter. Chapter 2 focuses on astronomical observations and Chapter 3 on the cosmological observations inferred from astronomical ones.

Chapters 4-5 review a wide range of experimental approaches from direct detection (dark matter scattering), indirect detection (dark matter annihilation and decay), and collider production.

The goal here is to get the reader familiar with what has been tried but avoids presuming that these methods are all that should be tried. There are seeds planted here for novel ideas.

Chapter 6 looks at the detection of a more wave-like phenomenon using axions as an example. Again, seeds are planted here for novel approaches that are not yet (and may not be ever) mainstream approaches.

Chapter 7 is devoted to sampling across a space of possible ways to go beyond current approaches and develop new techniques to observe dark matter outside of its gravitational interactions (or, in two cases, perhaps only using those interactions). These are small case studies meant to tease directions the reader might want to pursue as a career option (or encouraging them to try coming up with their own ideas).



13. Junior Scientist Travel Support Program (JSci)

The goal of the JSci program is to allow graduate students and PDFs to broaden their research horizons and become more mature scientists. Two types of expenditures are supported:

1) Funding to allow graduate students and PDFs to attend specialized workshops and schools not directly related to their research project, such as workshops or training opportunities on the practical applications of subatomic physics detector techniques, new computer or digitization technologies, advanced computation techniques, or technology transfer training.

2) Funding to enable PDFs to present their work at conferences or workshops. Conferences and workshops already receiving funds from CINP will not be eligible. Preference will be given to international meetings held either in Canada or abroad.

How to Apply:

The application form can be obtained from the CINP website at: https://cinp.ca/junior-scientist-travel-support-program-jsci

Applications are accepted on a continuing basis. A standing committee consisting of: CINP Executive Director, Chair of the Education & Training SWG, and one representative of the CINP Board will evaluate applications as they are submitted and provide prompt feedback or decision to the applicant (typically within 2 weeks).

The program funds available for 2023-24 have already been allocated. We encourage applications for travel occurring in the next financial year, i.e. after April 1, 2025.

14. CINP Board of Directors

The affairs of the CINP are managed by a Board of Directors, which is selected by the Institutional Members in a staggered manner to provide continuity.

Name	Institution	Role	Email	Term Ends
Thomas Brunner	McGill	Secretary	thomas.brunner @ mcgill.ca	June, 2025
Olga (Liliana) Caballero	Guelph		ocaballe @ uoguelph.ca	June, 2026
Gwen Grinyer	Regina	President	gwen.grinyer @ uregina.ca	June, 2027
Rituparna Kanungo	TRIUMF		ritu @ triumf.ca	June, 2025
Russell Mammei	Winnipeg	Vice-President	r.mammei @ uwinnipeg.ca	June, 2026
Chris Ruiz	TRIUMF		ruiz @ triumf.ca	June, 2027

15. CINP Contact Information

CINP Executive Director:

If you require information about any CINP programs, please do not hesitate to contact:

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CINP Treasurer:

Greg Hackman
TRIUMF
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CINP Institutional Members:

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Fundamental Symmetries:
Jeff Martin (Winnipeg)
Hadronic Physics/QCD:
Svetlana Barkanova (Memorial)
Nuclear Astrophysics: Nicole Vassh (TRIUMF)
Nuclear Education and Training:
Ruben Sandapen (Acadia)
Nuclear Structure: Paul Garrett (Guelph)
Nuclear Theory: Alexandros Gezerlis (Guelph)

This Newsletter was edited by Garth Huber. Email regarding the content of this newsletter, or suggestions for content in future CINP newsletters should be sent to huberg@cinp.ca