THOMAS HEPWORTH

CURRICULUM VITAE

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OVERVIEW

I am a fourth-year physics honours student at the University of Winnipeg. I have spent my past three summers gaining research experience and contributing to the internationally recognized physics collaboration TUCAN at the University of Winnipeg and TRIUMF, Canada's particle accelerator centre. TUCAN is the TRIUMF Ultra Cold Advanced Neutron collaboration, and I have worked in the magnetics and neutron guide coating sectors of their neutron electric dipole moment (nEDM) experiment. I plan to complete an undergraduate thesis under TUCAN this upcoming year before graduating and pursuing a Ph.D in nuclear/particle physics. I have also been selected as one of six Canadian Institute of Particle Physics (IPP) summer student fellows and will be spending the second half of the summer of 2024 working on the Baryon Antibaryon Symmetry Experiment (BASE) at CERN. I am passionate about science outreach and work and volunteer in leadership positions to encourage science enrollment by young Canadians in my free time.

EDUCATION

2021-2025	B.Sc Honours (Physics) 4.491/4.5 Major GPA 4.477/4.5 Cumulative GPA	University of Winnipeg

RESEARCH EMPLOYMENT

2024	Summer Student Programme	CERN
2024	NSERC USRA Research Student	The University of Winnipeg/TRIUMF
2023	NSERC USRA Research Student	The University of Winnipeg/TRIUMF
2022	Research Assistant	The University of Winnipeg/TRIUMF

AWARDS

2025-2029 Max Planck Institute of Nuclear Physics (MPIK) International Max Planck Research School (IMPRS) for Precision Tests of Fundamental Symmetries (PTFS) PhD fellowship, University of Heidelberg.
One of the most prestigious PhD fellowships in Nuclear physics in the world which will support my studies at the University of Heidelberg and the Institut Laue-Langevin (ILL) for the PanEDM experiment.

2025 Sir William Stephenson Scholarship ($9000).
Awarded to a top UWinnipeg student exemplifying academic achievement, leadership skills, and the potential to contribute to Canada.

2024 Institute for Particle Physics (IPP) Summer Student Fellowship (approx $7000), one of six Canadian students selected by the IPP to participate in CERN's prestigious summer student program.

2024 **Canadian Association of Physicists Department of Nuclear Physics Best Student Presentation Competition 3^{rd} place winner**, Placed 3^{rd} in the CAP DNP student talk competition as an undergrad in a competition comprised of mostly graduate students.

2024 Donald Kerr Scholarship ($2511), Awarded to the top graduating physics student at the University of Winnipeg.

2024 University of Winnipeg Academic Proficiency Scholarship ($500).

2024 H.V. Rutherford Scholarship ($3000) , Award to a student who expresses interest and talent for teaching at the university level.

2024 Chancellor W. John A. Bulman Scholarship ($4337).

2024 University of Winnipeg Undergraduate Student Research Travel Grant ($750), Awarded to supplement costs of travel to the Japan Proton Accelerator Research Complex (JPARC).

2024 Canadian Institute of Nuclear Physics Undergraduate Research Scholarship (CINP URS) ($6800), awarded to enable gifted undergraduates to work with a supervisor on nuclear physics research in Canada, award was declined.

2024 Natural Sciences and Engineering Research Council Undergraduate Student Research Award (NSERC USRA) ($6000), awarded to provide outstanding students with opportunities in science and engineering research.

2024 University of Winnipeg Research Office Photo competition, Category Winner ($300).

2024 David R. Dyck Prize in History ($1218), awarded for the best essay written in the history of science, technology, or medicine. Essay title: How James Clerk Maxwell's Relationship With Michael Faraday, and Maxwell's Religious Perspectives Shaped His Electromagnetic Field Theory.

2023 Dr. Randy Kobes Memorial Scholarship ($1000), awarded to a student in the faculty of science who demonstrates academic excellence and has made significant contributions to the community, especially in the area of scientific outreach.

2023 Brian J. Hyslop Memorial Scholarship in Physics ($2000), awarded to a student who demonstrates both passion and ability to perform productive research, and is likely to contribute to society.

2023 B. G. Hogg Scholarship in Physics ($541), awarded to outstanding physics major to attend a physics conference.

2023 University of Winnipeg Academic Proficiency Scholarship, Student of Highest Distinction ($400), awarded to students with GPAs exceeding 4.0.

2023 Natural Sciences and Engineering Research Council Undergraduate Student Research Award (NSERC USRA) ($6000), awarded to provide outstanding students with opportunities in science and engineering research.

2022 The University of Winnipeg General Bursary ($1000).

2022 Duckworth Scholarship in Physics ($1000), awarded to physics major of outstanding academic promise.

2022 Transcona Collegiate Alumni Scholarship ($500), awarded to an outstanding student from the previous graduating class of Transcona Collegiate.

2021 Royal Canadian Legion Transcona Branch #7 Poppy Trust Fund Award ($500).

2021 Stella Wujek Scholarship for Science ($1000), awarded to student demonstrating academic excellence in the sciences.

2021 River East Transcona School Division Medal Award ($1500), awarded to the top graduating student of Transcona Collegiate.

2021 Helen Shandruk Memorial Award ($2000), awarded to a top graduating student of Transcona Collegiate.

2021 The University of Winnipeg Special Entrance Scholarship ($2250), awarded to student with high school grade average greater than 95%.

2021 Casera Credit Union Memorial Bursary ($750).

PHYSICS EXPERIENCES

2024-2025 TUCAN (TRIUMF Ultra Cold Advanced Neutron Collaboration .

Currently I am completing a bachelor's thesis in the Neutron Guide Coating Facility at the University of Winnipeg. The facility employs pulsed laser ablation and e-beam evaporation to apply thin film coatings onto the inside of Ultracold Neutron (UCN) transport tubes and storage vessels. I am completing Monte Carlo simulations to predict the material properties of these UCN guides. In January, I will travel to the Japan Proton Accelerator Research Complex to test these guides at their UCN source. My results will be published, and used for future simulations of the UCN experiment at TRIUMF. This project involves advanced 3D modelling of experimental geometries and coding and data analysis for my simulations. Work ongoing.

2024 CERN - Baryon Antibaryon Symmetry Experiment.

The BASE collaboration is specialized in the use of advanced Penning trap setups as well as cryogenic superconducting detection systems with single particle resolution to perform world-leading measurements on protons and antiprotons. Past measurements include the comparison of antiproton and proton charge-to-mass ratio with a fractional precision of 16 parts per trillion (ppt) and the antiproton g-factor with a fractional precision of 1.5 parts per billion (ppb). I am working on the development of superconducting electric joints to allow for better performance of BASE superconducting coil systems..

2022-2024 TUCAN (TRIUMF Ultra Cold Advanced Neutron Collaboration).

TUCAN is an international collaboration of physicists from Canada, the United States, and Japan. They have received over $30 million in Canadian and Japanese funding since 2009. TUCAN plans to measure the neutron electric dipole moment (nEDM) with an uncertainty of 10^{-27}ecm, a level of precision an order of magnitude more precise than current generation nEDM experiments. Measuring the nEDM probes new physics beyond the standard model (BSM). More specifically, a new precise measurement can help investigate the baryon asymmetry problem, the matter-antimatter imbalance in the universe. I have spent the past two summers working for the TUCAN collaboration. I have been involved in multiple projects, mostly focusing on precision magnetic field control and characterization of the nEDM experiment. I was responsible for the characterization of the magnetically shielded room (MSR) during its construction. I wrote codes to analyze, simulate, and collect data related to the MSR. I also characterized magnetic sensors that were used in the MSR. In addition, I characterized a new neutron detector before its testing with neutrons in Japan, and I designed components to adapt to the beam-line at the Japan Proton Accelerator Research Complex (JPARC). I traveled to TRIUMF in Vancouver British Columbia to complete this research throughout the past two summers. A publication is expected to arise from the magnetic field research of which I will be a co-author. In 2024 I transitioned to working on the UCN source at TRIUMF. I have taken several shifts supervising our cool-down, and I analyzed cryostat data in Python after identifying issues worth investigating further during my shifts. Work ongoing.

2023 University of Winnipeg Neutron Guide Coating facility.

The Neutron Guide Coating Facility employs pulsed laser ablation and ebeam evaporation to apply thin film coatings onto the inside of UCN transport tubes and storage vessels. The facility specializes in hydrogen-free diamond-like carbon. I helped arrange the lasers and vacuum chambers into their final alignments, installed compressed cylinder gas and water lines for the equipment, and assisted in excimer laser testing. This work was done in conjunction with my research with TUCAN and was supported by an NSERC USRA. A publication is expected to arise from this work in the winter of 2024, and I will be continuing this work in an undergraduate thesis.

PRESENTATIONS AND ARTICLES

2024 University of Winnipeg Research Week
"Traveling the World Doing Research" (Invited talk)

2024 University of Winnipeg Research Week
"Experiences in Undergraduate Research" (Invited talk)

2024 19^{th} Randy Kobes Poster Symposium (Placed 3^{rd})
"Superconducting Joints for the BASE Superconducting Coil System" (Poster)

2024 University of Winnipeg News
"Pump up the Neutrons" (Article)

2024 University of Winnipeg News
"Physics Student off to Switzerland" (Article)

2024 CERN Summer Student Talks
"Superconducting Joints for the BASE Superconducting Coil System" (Contributed talk)

2024 Canadian astroparticle summer student talk competition
"Measurements of a Magnetically Shielded Room for a Neutron EDM Experiment" (Contributed talk)

2024 Canadian Association of Physicists Congress
"Measurements of a Magnetically Shielded Room for a Neutron EDM Experiment" (Contributed talk - 3rd place winner in nuclear physics oral competition)

2023 Research Week - The University of Winnipeg
"Experiences in Undergraduate Research" (invited panelist)

2023 University of Winnipeg physics colloquium series
"Summer student research opportunities" (Contributed talk)

2023 University of Winnipeg NSERC USRA event
"Simulations of Magnetic Fields Inside a Magnetically Shielded Room for the TUCAN nEDM Experiment" (Poster)

2023 18^{th} Randy Kobes Poster Symposium
"Simulations of Magnetic Fields Inside a Magnetically Shielded Room for the TUCAN nEDM Experiment" (Poster)

2023 Canadian astroparticle summer student talk competition
"Simulations of Magnetic Fields Inside a Magnetically Shielded Room for the TUCAN nEDM Experiment" (Contributed talk)

2023 University of Winnipeg News
"Celebrating excellence in undergraduate research" (Article)

2022 University of Winnipeg physics colloquium series
"Summer student research opportunities" (Contributed talk)

2022 17^{th} Randy Kobes Poster Symposium
"Characterization of Optically Pumped Total Field Magnetometers" (Poster)

TEACHING

2022-Ongoing	Head Teaching Assistant and Marker	Foundations of Physics
2024-2025	Marker	Foundations of Physics Lab
2024	Marker	Math Physics 1
2024	Head Teaching Assistant and Lab Marker	Optics and Waves
2024	Lab material development	Optics and Waves
2022-Ongoing	Exam Invigilator	Foundations of Physics, Introduction to Physics, Astronomy, Concepts in Science

2022-2023	Head Teaching Assistant and Marker	Introduction to Physics Lab
2023	Marker and Teaching Assistant	Electricity and Magnetism
2023	Marker and Teaching Assistant	Electricity and Magnetism Lab
2023	Teaching Assistant/Instructor	High school enrichment Astronomy course

SCIENCE OUTREACH AND OTHER VOLUNTEERING

2024-2025	President, University of Winnipeg Physics Student Association (UWPSA).
2024, 2025	Presented about magnets for third grade class at Joseph Teres Elementary School. 5 classes total to date.
2022-2023	Wii Chiiwaakanak Learning Centre STEM camp, science camp to encourage indigenous enrollment in science. Uwinnipeg won the 2023 STEAM Big! Award.
2022-2023	University of Winnipeg Future Student Night, represented the physics department to encourage physics enrollment at the University of Winnipeg.
2023-2024	University of Winnipeg Open House,represented the physics department to encourage physics enrollment at the University of Winnipeg.
2023	High school physics presentations, travelled to Winnipeg high schools to encourage physics enrollment at the University of Winnipeg on behalf of the physics department.
2023-2024	Treasurer, University of Winnipeg Physics Student Association (UWPSA).
2018-Ongoing	Tutoring, casually tutored middle and high school students in science and math classes. Also have done tutoring at the University level, some of which is paid work and some as a volunteer.
2015-2020	Flag Football Coach for an after school program at Joseph Teres School. This involved going to a tournament each year with the students. Program was shutdown in this form in 2020.

SKILLS

Languages	English (native). Python, LaTeX, LabView
Certifications	Canadian Nuclear Energy Worker (NEW).
Experimental	Magnetics, Magnetometers, experimental design, Vacuum systems, pressurized gas handling, Swagelok, fine tip soldering.
Computational	Magnetic simulations in python, NumPy, Pandas, remote instrument control.
Engineering	CAD, 3D printing.
Teaching	Tutoring, marking, undergraduate lab demonstration, study skills coaching, lab course material development.
Soft Skills	Leadership, organization, communication, presentations, time management, task delegation.
Other Skills	Using industrial and machining equipment, soldering, tool and assembly skills.