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Education

2017-2022:	B.S.c. Honours in Physics, Mathematical Specialization, University of Winnipeg
Cumulative GPA:	4.4813/4.5
Major GPA:	4.5/4.5
2022 - Present	MSc in Physics at the University of Toronto.
GPA:	4.0/4.0

Publications

A. R. Frey, M. P. Grehan and M. Srivastava, "Complexity of Scalar Collapse in Anti-de Sitter Spacetime," [arXiv:2110.09630 [hep-th]], published by the Journal of High Energy Physics

Research Experience

2022   My honour's thesis, under the supervision of Dr. Andrew Frey, focused on the calculation of holographic complexity in the Klebanov-Strassler solution. I began with sample calculations of the volume and action forms of holographic complexity in pure AdS_5 and $AdS_5 \times S^5$. I then repeated these calculations in an empty Klebanov-Strassler solution. These calculations were done with numerical methods and analytical approximation methods were used to determine the leading order divergence. The volume complexity and action complexity in the Klebanov-Strassler solution were found to have similar forms to those found in $AdS_5 \times S^5$ with an analogous non-constant curvature of spacetime. Our motivation was twofold: first the KS solution is a 10-dimensional spacetime allowing us to make use of the full dimensionality of string theory, and second the KS solution is dual to a confining field theory. Investigation of spacetimes dual to a confining field theory are particularly interesting because the nuclear strong force is confining and requires non-perturbative methods at particular scales.

2021   I was accepted into the IPP Summer Student Program: Undergraduate Research Experience at CERN & in Canada. Through this program I was able to work with Dr. Ben Page and Dr. Samuel Abreu at CERN. Also, I attended lectures given by world class physicists. My project focused on the calculation of Feynman integrals associated with scattering amplitudes. In particular, we looked primarily at one-loop integrals which we calculated using a mix of symbolic and numeric techniques via Mathematica. We were able to calculate the integration by parts relations (IBPs) for a given process, the master integrals of the process, and form a pure basis of master integrals which would allow us to solve the differential equations of the Feynman integral. (see here)

2021   I continued to work under Dr. Andrew Frey, now with the goal of further generalizing the holographic complexity calculation. Almost all of the literature on the subject does not include the higher dimensions needed for a complete description of string theory. Our goal is to calculate the complexity in a system that includes these extra dimensions along with higher-dimension electromagnetic fields. My work in the summer primarily revolved around learning the necessary material to complete this generalized calculation. This will provide the basis for my honours thesis which I will be beginning in the Fall of 2021. This project will take our previous work and generalize the AdS/CFT correspondence we have been using to the full theory of the correspondence, allowing us to come even closer to a realistic geometry.

2020   I worked under Dr. Andrew Frey, refining previous work and calculating complexity in QFT. I spent the first half of the summer refining the results from our previous years research. This involved cleaning up previous code, running a larger magnitude of simulations to increase our data, and writing new code which allowed us to further analyse our results. This was all done to prepare our work for publication in JHEP. The second half of the summer was spent working on the holographic complexity calculation, but from the other side of the correspondence. This meant I needed to do extensive reading, to understand the previous work that has been done to calculate the complexity of very simple systems in quantum field theory. We built off the existing work to try and gain a better understanding of how complexity can be calculated in QFT, so that we can work towards calculating the complexity of the thermalization state that a collapsing blackhole in AdS corresponds to. Therefore, this project was focused on researching the complexity of basic field theories to build a foundation for understanding the complexity of more complicated systems.

2019   Worked under Dr. Andrew Frey calculating holographic complexity in AdS. This project required me to do extensive reading to learn the prerequisite general relativity needed. Following this I performed the analytical work to derive a system of differential equations which maximized a volume integral in AdS. I then had to learn the programming language python, which I used in conjunction with previously written numerical blackhole collapse simulations to solve the differential equations I derived. The program I wrote allowed us to calculate the holographic complexity of a collapsing blackhole in AdS as a function of both origin time and boundary time, for multiple different simulations. Following this I did further reading, to derive the integrals needed to calculate the holographic complexity of a collapsing blackhole in AdS as an action in a particular patch of spacetime. I once again wrote a python program which used results from numerical simulations to calculate the holographic complexity as a function of both origin time and boundary time, for multiple different simulations. Hence, with this project we were able to analyse the holographic complexity of a collapsing blackhole in AdS, via the AdS/CFT correspondence, with two different proposed methods.

2018   Worked under Dr. Russell Mammei developing coated guides for the UCN experiment at TRIUMF. I coated guides with multiple materials, and tested the coatings to determine their effectiveness. These coatings were done on small scale guides, but a method for full size guides was developed.

Awards

2022   Chancellor's Gold Medal for the Highest Standing in Science (Honours). The medals are given to the students who secure the highest overall standing determined by the final grades obtained in the best 90 or 120 credit hours completed, as applicable, that satisfy degree requirements.

2022   Gold Medal for Achievement in a Major (Honours) Physics. This medal is awarded at Convocation to the student with the highest overall average in the major.

2021   Student of Highest Distinction, for achieving a sessional grade point average between 4.00 and 4.50.

2021   Academic Proficiency Scholarship (Winnipeg Rh Institute)

2021   Sir William Stephenson Scholarship awarded annually to one or two students who demonstrate outstanding academic achievement, superior leadership qualities on or off campus, and the potential to make a valuable contribution to Canada.

2021   Brian J. Hyslop Memorial Scholarship in Physics, awarded to a student enrolled at The University of Winnipeg in the honours degree in physics, recipients will have worked under the supervision of a faculty member in the Department of Physics on a research project, further consideration will also be given to students interested in pursuing a master's degree in physics.

2021   Randy Kobes Poster Contest Prize.

2021   IPP Summer Student Program: Undergraduate Research Experience at CERN & in Canada

2021   NSERC Undergraduate Student Research Award to work under the supervision of Dr. Andrew Frey.

2020   Student of Highest Distinction, for achieving a sessional grade point average between 4.00 and 4.50.

2020   Crawford Campbell Memorial Scholarship - It will be awarded to a continuing student in the General, 4-year, or Honours Mathematics program of scholarly ability and entering Advanced Calculus (now known as Introduction to Mathematical Analysis).

2020   William L. Dyker Memorial Scholarship - Awarded annually to a student who has completed 30 credit hours and is continuing at The University of Winnipeg in any undergraduate degree program.

2020   Chancellor W. John A. Bulman Scholarship - Awarded to an outstanding student or students in any undergraduate degree program.

2020   Academic Proficiency Scholarship (Winnipeg Rh Institute)

2020   Randy Kobes Poster Contest Prize - Awarded for placing first in the 15th Annual Randy Kobes Poster Symposium in the Math and Theoretical Physical Science section, presenting my summer 2020 research to a general public audience.

2020   Dr. Herbert Shubin Memorial Scholarship in Physics - Awarded annually to the most promising student entering the final year of the 4-year Physics program.

2020	Manitoba Scholarship and Bursary Initiative - Scholarship for the Fall/Winter 2019-20 academic year for academic excellence.
2020	NSERC Undergraduate Student Research Award to work under the supervision of Dr. Andrew Frey.
2019	Student of Highest Distinction, for achieving a sessional grade point average between 4.00 and 4.50.
2019	Academic Proficiency Scholarship (Herbert L. Draper Fund).
2019	Lawson Scholarship in Mathematics, awarded to a student of outstanding academic promise who is entering or continuing Major work in the Mathematics Major at The University of Winnipeg.
2019	Brian J. Hyslop Memorial Scholarship in Physics, awarded to a student enrolled at The University of Winnipeg in the honours degree in physics, recipients will have worked under the supervision of a faculty member in the Department of Physics on a research project, further consideration will also be given to students interested in pursuing a master's degree in physics.
2019	Isbister Undergraduate Scholarship, two scholarships are offered to two top students in Arts and two to two top students in Science.
2019	Rev. John H. and Mrs. Myrtle (Webster) Shemilt Scholarship, awarded annually to a full-time student in any undergraduate degree program of The University of Winnipeg. Preference will be given to student from Manitoba or northwestern Ontario.
2019	NSERC Undergraduate Student Research Award to work under the supervision of Dr. Andrew Frey.
2018	Sandra and Harvey Secter Scholarship, awarded to one or more outstanding students in any Faculty who demonstrate a commitment to their community.
2018	Henry Doidge Memorial Scholarship in Physics, awarded to a student with standing in first year Physics who is entering the second year of the Physics Major program.
2018	Donald S. Grant Memorial Scholarship for Excellence in Mathematics, given to a continuing student in Mathematics and Statistics who has attained a high standing in 6 credit hours of introductory calculus.
2017	Crystal Lake Developers, Ltd. Award, for outstanding marks in both Pre-Calculus and Physics.
2017	Casera Credit Union Limited Bursary.
2017	Oakbank Credit Union Peer Tutor Recognition Award, for tutoring peers in mathematics.
2017	Special Entrance Scholarship, for having an average greater than 95 between Pre-Calculus, English, and one other course.

Accomplishments

2021	Placed third in the 16th Annual Randy Kobes Poster Symposium in the Math and Theoretical Physical Science section, presenting my summer 2021 research with CERN to a general public audience.
2021	Spoke on behalf of the science department at the 2021 University of Winnipeg Awards Night of Excellence.
2020	Competed in the University Physics Competition in the Fall of 2020, and received a bronze medal. Of the 346 teams that competed, 99 teams (29%) were ranked as Bronze Medal Winners.
2020	Held a 20 minute virtual seminar at the 2020 Winnipeg Institute for Theoretical Physics annual Summer Student Symposium, where I presented my 2019/2020 research to a group of theoretical physicists and research students.

2020	Placed first in the 15th Annual Randy Kobes Poster Symposium in the Math and Theoretical Physical Science section, presenting my summer 2020 research to a general public audience.
2019	Presented at the Summer Student Colloquium, where I shared my work experience from summer 2019 to encourage other students to participate in summer research.
2019	Competed in the University Physics Competition in the Fall of 2019, and received a silver medal. Of the 305 teams that competed, 60 teams (20%) were ranked as Silver Medal Winners.
2019	Competed in the 14th Annual Randy Kobes Poster Symposium in the Math and Theoretical Physical Science section, presenting my summer 2019 research to a general public audience.
2019	Presented at the NSERC USRA Celebration Luncheon, where I gave a brief presentation explaining the research I had conducted during the summer.
2018	Competed in the University Physics Competition in the Fall of 2018, and received a silver medal. Of the 281 teams that competed, 50 teams (18%) were ranked as Silver Medal Winners.

Work Experience

University of Toronto

| 2023 | TA for PHY132. |
| 2022 | TA for PHY131. |

University of Winnipeg

2019-2022	Ran weekly tutorial lectures and marked for Foundations of Physics 1.
2022	Marking for the Quantum Mechanics lecture.
2022	Marking for the Mathematical Physics lecture.
2021	Marked for the Thermal & Statistical Physics lecture.
2021	Marked for the Advanced Mechanics lecture.
2020	Marked for the Intermediate Mechanics lecture.
2020	Demonstrated and marked for the Modern and Thermal Physics Lab.
2019	Demonstrated and marked for the Electricity and Magnetism Lab.
2018-2019	Demonstrated and marked for the Introduction to Physics Lab.

Student Involvement

2020-2022	Elected Vice President of the University of Winnipeg Physics Student Association (UWPSA).
2017-2022	Member of UWPSA.
2017-2018	Member of the UWPSA Treasury Committee.