Katherine S. Rink

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EDUCATION

University of Massachusetts, Dartmouth *expected May 2022*
M.Sc. in Physics GPA: 4.0

Thesis: *A Discontinuous Galerkin Method for Modeling Extreme Mass Ratio Inspirals with Spin.*

University of British Columbia, Vancouver *May 2020*
B.Sc. in Astronomy, Minor in Physics

Honors Thesis: *Testing General Relativity using Quasi-Periodic Oscillations from X-ray Black Holes.*

PUBLICATIONS

1. The LIGO Scientific, the Virgo, and the KAGRA Collaborations, *GWTC-3: Compact Binary Coalescences Observed by LIGO and Virgo During the Second Part of the Third Observing Run*, November 2021, arXiv: 2111.03606.
2. The LIGO Scientific, the Virgo, and the KAGRA Collaborations, *GWTC-2.1: Deep Extended Catalog of Compact Binary Coalescences Observed by LIGO and Virgo During the First Half of the Third Observing Run*, August 2021, arXiv: 2108.01045.
3. **K. Rink**, I. Caiazzo, J. Heyl, *Testing General Relativity using Quasi-Periodic Oscillations from X-ray Black Holes: XTE J1550-564 and GRO J1655-40*, MNRAS (Submitted), July 2021, arXiv: 2107.06828.
4. The LIGO Scientific, the Virgo, and the KAGRA Collaborations, *All-sky search for short gravitational-wave bursts in the third Advanced LIGO and Advanced Virgo run*, July 2021, arXiv: 2107.03701.
5. D. Davis *et al.*, *LIGO Detector Characterization in the Second and Third Observing Runs*, June 2021, Class. Quantum Grav. 38 135014, arXiv: 2101.11673.
6. The LIGO Scientific, the Virgo, and the KAGRA Collaborations, *Constraints on dark photon dark matter using data from LIGO's and Virgo's third observing run*, May 2021, arXiv: 2105.13085.

Papers in advanced stages of preparation:

7. S. E. Field, K. Gonzalez, T. Islam, G. Khanna, N. E. M. Rifat, **K. Rink**, V. Varma, *A Surrogate Model for Gravitational Wave Signals from Comparable- to Large- Mass-Ratio Black Hole Binaries with Spin*, January 2022 (In prep).
8. R. Macas, J. Pooley, L. Nuttall, D. Davis, M. Dyer, Y. Leocoeuche, J. Lyman, J. McIver, **K. Rink**, *Impact of noise transients on low latency gravitational-wave event localisation.*, December 2021 (In prep).

RESEARCH TALKS

1. *UMass Dartmouth's 2D IMRI/EMRI Surrogate Model*, UMassD & UNH Meeting, virtual, August 2021.
2. *Environmental Trends and Scattered Light in Advanced LIGOs Third Observing Run*, UMass Dartmouth Colloquium (**Invited**), virtual, April 2021.
3. *Environmental Trends and Scattered Light in Advanced LIGOs Third Observing Run*, APS April Meeting, virtual, April 2021.
4. *Seismic Studies at LIGO Hanford*, LIGO Detector Characterization Face-to-Face, virtual, July 2020.
5. *Detector Characterization: Data Quality Studies in LIGO's 3rd Observing Run*, Gravitational Wave Astronomy North West Conference, virtual, June 2020.

6. *Undergraduate Keynote Speaker at the Multi-disciplinary Undergraduate Research Conference*, University of British Columbia (**Invited**), virtual, March 2020.
7. *Building Blocks for the OSI's Space and Environmental Stewardship Index*, Undergraduate 3-Minute Thesis Competition - Final Round (tied for 1st place), University of British Columbia, February 2020.
8. *Investigating Non-stationary Noise in Advanced LIGO's Third Observing Run*, LIGO Detector Characterization Face-to-Face Meeting, January 2020.
9. *Journal Club Presentations*: 10+ papers for the Compact Objects group, University of British Columbia, 2018-2020.
10. *Investigating the Primary Beam Shape of CHIME Using Pulsars*, UBC Summer Student Research Presentations, August 2019.
11. *The Mathematical Motivation for Inflation*, UBC Cosmology Blackboard Talks, July 2019.

OUTREACH TALKS - Invited

1. *My Experience as a Woman in Science*, Women in STEM Interview, Williams Lake High School, April 2021.
2. *Astro + Phys in the Biz* Panelist, Science Undergraduate Society, University of British Columbia, April 2021.
3. *Hunting for Exoplanets Workshop*, Empower the Future: Women in STEM Conference, Simon Fraser University, February 2020.
4. *How do you make a Planet?*, University of British Columbia's Phenomenal Physics Astronomy Camp, June 2019.
5. *Physics and Astronomy Career Night* emcee, University of British Columbia, January 2019.
6. *Talk to the Experts - Childhood Passions*, H.R. MacMillan Space Centre's Birthday Bash for the Universe, July 2018.
7. *The Size of our Universe*, Simon Fraser University Space Camp, July 2018.
8. *The Life and Death of Stars*, Simon Fraser University Space Camp, May 2018.

RESEARCH EXPERIENCE

Computational Relativity and EMRI Waveform Modelling

M.Sc. Research Advised by Dr. Scott Field & Dr. Gaurav Khanna September 2020 - Present

For my thesis, I am developing a C++ code to solve point-particle perturbation theory equations using a discontinuous Galerkin scheme. One of the astrophysical sources we will study with this new code is Extreme Mass Ratio Inspiral (EMRI) systems, whose gravitational wave signal will be observed by the future space-based observatory LISA. My model will be novel in its use of a δ-function, opposed to a Gaussian approximation, to represent the secondary object. In addition, I am collaborating with members of my research group to develop a spinning EMRI surrogate model. On the latter, my contributions include implementing the model into the public database GWSurrogate, and testing the model's robustness by simulating realistic LIGO background noise and performing parameter estimation.

Data Quality Studies with the LIGO Scientific Collaboration

Research Assistant to Dr. Jess McIver January 2020 - Present

As a member of the LIGO Detector Characterization group, I've been injecting GW signals into noisy data over the last year to investigate the impact glitches have on parameter estimation. From January - August 2020 I was a full time researcher with the UBC LIGO team. My work aided in the characterization of Advanced LIGO noise sources that most impact our ability to accurately recover GW signals. I also

contributed to the validation of candidate events in the 3rd observing run. This work will improve the reach and performance of the transient astrophysical analyses in future observing runs.

Dynamics-Informed Modelling of Space Debris with the Outer Space Institute
Directed Study with Dr. Aaron Boley September - December 2019

Inspired by the lack of international policy on orbital debris mitigation, I modelled natural particle de-orbit rates from debris-generating events with a more accurate area-to-mass ratio distribution than any previous study. My research provided scientific justification for the Space and Environmental Stewardship Index currently being developed by the OSI and improved our understanding about the impact that megaconstellations have on our orbital environment. My final report was distributed as reading material and further discussed at the OSI's workshop on orbital debris mitigation in January 2020.

Investigating the Primary Beam Shape of the CHIME Telescope with Pulsars
Research Assistant to Dr. Ingrid Stairs May - August 2019

To map the primary beam shape of the Canadian Hydrogen Intensity Mapping Experiment (CHIME) telescope, I calculated the signal-to-noise ratio (SNR) of hundreds of pulsars across a wide range of declinations to produce polarization-dependent data visualization plots. These SNRs were then used to optimize the Principal Investigator's primary beam shape model. My script was primarily written in Python, with the addition of sub-processed Bash commands, utilizing PSRCHIVE software.

Testing General Relativity using The Relativistic Precession Model for a Kerr-Newman de Sitter Black Hole.
Honors Thesis with Dr. Jeremy Heyl September 2018 - May 2019

Shortened abstract: We use the Relativistic Precession Model (RPM) and quasi-periodic oscillation (QPO) observations from the *Rossi X-ray Timing Explorer* to derive constraints on the properties of the associated black holes and test General Relativity (GR) in the strong field regime. We extend the underlying spacetime metric to constrain potential deviations from the predictions of GR for astrophysical black holes. To do this, we modify the RPM model to a Kerr-Newman-deSitter spacetime. We compare our models with X-ray data of XTE J1550-564 and GRO J1655-40 using robust statistical techniques to constrain the parameters of the black holes and the deviations from GR. For both sources we constrain particular deviations from GR to be less than one part per thousand.

AWARDS

Research Assistantship on a NSF-funded project, UMass Dartmouth	September 2021
Teaching Assistantship & Full Tuition Waiver, UMass Dartmouth	September 2020
Winner of the UBC Undergraduate Three Minute Thesis (3MT) Competition	February 2020
UBC International Community Achievement Award	December 2019
UBC President's Student Leadership Recognition Event (*Invited*)	March 2019
UBC Edward JC Hossie Student Leadership Award (*Nominated*)	March 2019
The Science Undergraduate Society Club Leadership Award *UBC Astronomy Club, President*	March 2019
The Science Undergraduate Society Club Community Impact Award *UBC Astronomy Club, Co-President*	March 2018
Comcast Leaders and Achievers Scholarship	September 2014

GRANTS

NASA Massachusetts Space Grant Fellow — May 2021

Work Learn International Undergraduate Research Award — May 2019

EMPLOYMENT

Research Assistant — May - December 2021
University of Massachusetts — *Dartmouth, MA*

- Supervised by Dr. Scott Field & Dr. Gaurav Khanna, working with the Simulating eXtreme Spacetimes (SXS) Collaboration.
- Employing different numerical techniques for modelling EMRI waveforms using C++, Python, and Matlab.
- Funded by the National Science Foundation (NSF) and the NASA Massachusetts Space Grant.

Teaching Assistant — July 2021
MIT Lincoln Laboratory — *Cambridge, MA*

- Teaching assistant for the Lincoln Laboratory Radar Introduction for Student Engineers summer program.
- Responsible for teaching high school students from historically underrepresented-in-STEM groups Python, supplemental lecture material, and how to conduct and present scientific experiments.
- Acted as a mentor for 6 students, demonstrating important skills for succeeding in higher education.

Teaching Assistant — September 2020 - May 2021
University of Massachusetts — *Dartmouth, MA*

- Laboratory instructor for a 2nd and 3rd year electricity and magnetism lab (over 100 students in total).
- Responsibilities included lab preparation, instruction, and grading.
- Recitation instructor for an electricity and magnetism course designed for 2nd and 3rd year students (over 75 students in total). Facilitate discussion on lecture material and guide students through solutions to homework questions.

Research Assistant — January - August 2020
University of British Columbia — *Vancouver, BC*

- Supervised by Dr. Jess McIver with work pertaining to the LIGO Scientific Collaboration.
- Hired for a full time position with the Detector Characterization group initially spanning four months before my employment was extended into the summer.

Open Educational Resources Teaching Assistant — September - December 2019
University of British Columbia — *Vancouver, BC*

- Hired as one of two open educational resources teaching assistants for an introductory physics course.
- Coded random variable generated textbook questions, solved and inputted correct answers, and created diagrams for the online platform WeBWork using LaTeX and Perl languages.
- Adapted curriculum and assignments to be more inclusive and reflective of our diverse student body.

Research Assistant — May - August 2019
University of British Columbia — *Vancouver, BC*

- Supervised by Dr. Ingrid Stairs with work pertaining to the Canadian Hydrogen Intensity Mapping Experiment (CHIME) Pulsar/FRB Collaboration.
- Designed a multi-language program to enhance models of the telescope's primary beam shape using a digitized beam that tracked pulsars in multiple grid configurations across the sky.
- Funded by the Work Learn International Undergraduate Research Award.

Astronomy Instructor May - July 2019
Phenomenal Physics Summer Camp (UBC) *Vancouver, BC*

- Responsible for curriculum design and implementation for over 40 kids aged 8-10 on topics such as exoplanet detection, telescope design, and the scale of our solar system.
- Developed hands-on labs and activities in conjunction with the lectures to facilitate the kids understanding of astrophysical phenomena.

Laboratory Teaching Assistant January - April 2019
University of British Columbia *Vancouver, BC*

- Teaching assistant for a 100-level engineering lab designed to teach students about conducting experiments, analyzing data, calculating uncertainty, and writing lab reports.
- Duties included grading students' lab reports and assisting them with experimental setup and conceptual understanding throughout the weekly three hour lab period.

VOLUNTEER EXPERIENCE

UBC Astronomy Club September 2014 - August 2020
University of British Columbia *Vancouver, BC*

- Served as **President** (2017-19), **Vice President (VP) of Outreach** (2019-20), **VP of Social** (2015-17), **VP of Finance** (2014-15), and as **Advisor** to the Executive Council (2019-20).
- Membership numbers quadrupled from 100 to 400 total members during my first year of presidency.
- Created a telescope donation program for underprivileged students in Metro Vancouver.
- Involved in numerous outreach and educational programs such as; co-leading the Museum of Anthropology's *Blackout: Night Sky Festival*, regularly teaching astronomy lessons at elementary schools, and hosting interactive astronomy booths at many events held by regional parks and entertainment venues.
- Initiated, organized, and managed multiple events within the community with 3,000+ attendees each. This included the 2017 Solar Eclipse Viewing Party in downtown Vancouver which required applying for permits with the city and acquiring event insurance.

Physics and Astronomy Department Volunteer September 2016 - August 2020
University of British Columbia *Vancouver, BC*

- Served as the Astronomy program student representative for informational events such as *Imagine Day* (orientation), *Beyond First Year*, and *Meet your Major*.
- Designed and spearheaded an astronomy lab as a member of the 2019 UBC Physics Olympics planning committee.
- Led Girl Guides of Canada troops (aged 7-9) through hands-on physics activities for over two years.
- Organized Physics & Astronomy Career Night planning for four years as a member of the board, and served as emcee in 2019.

High School Science Fair Mentor September 2018 - February 2019
Let's Talk Science *Vancouver, BC*

- Advised 7 students one-on-one at an underprivileged inner city high school to assist in the development of their science fair experiments.
- Involved teaching the scientific method on a step by step basis, tailored to each student's needs and abilities.

MENTORSHIP EXPERIENCE

6 High School Students, MIT Lincoln Laboratory	July 2021 - Present
Pritika Vipin, Interlake High School	July 2020 - Present
Robert Beda, University of British Columbia	May - August 2020
7 High School Students, Britannia Secondary School	Sep. 2018 - Feb. 2019

SUMMER SCHOOLS & WORKSHOPS

239th AAS Workshop: How to Give Great Presentations January 2022
American Astronomical Society *Salt Lake City, UT*

Member of the **planning committee** for a workshop on giving scientific presentations aimed at early career scientists. Responsibilities include composing handouts for our participants and assisting in workshop contents and logistics.

ICERM Advances in Computational Relativity September - December 2020
Brown University *Providence, RI*

A semester-long program to discuss current challenges in the field of computational relativity and explore promising solutions amongst physicists and applied mathematicians. As a part of the program, I gained valuable insight into the future of the field through my assigned mentor, Professor Deirdre Shoemaker.

LIGO Detector Characterization Sprint January & July 2020
LIGO Livingston *Livingston, LA*

Attended the LIGO Detector Characterization sprint where we worked in small groups to solve current problems the collaboration is facing relating to noise and data quality studies. Having discovered a new source of noise, I helped lead a working group during the sprint.

National Undergraduate Big Data Challenge June 2020
STEM Fellowship *Virtual*

Competed in a week long coding challenge to use big data for personal and public health decisions. To inform our understanding of efficient COVID-19 vaccine distribution, my group conducted data analysis on the correlation between a country's socioeconomic factors and COVID-19 morbidity rates.

Canadian Astroparticle Physics Summer School May 2019
Queen's University *Kingston, ON*

Was accepted into a week long extensive school combining expert-led instruction in the field of Astroparticle physics, including both concepts and hands on experience with lab experiment in the university setting and SNOLAB environment, a two kilometer underground dark matter detection and neutrino experiment laboratory.

Introduction to Astrophysics and Cosmology Summer 2013
Brown University *Providence, RI*

A three week long pre-college program through Summer@Brown that gave high school students a detailed introduction to all major astrophysics topics and culminated in a final presentation on an astrophysics concept, where I gave a talk on the classification of galactic mergers.

CONFERENCES

Source inference and parameter estimation in GW Astronomy, IPAM UCLA/Virtual	Nov. 2021
Gravitational Wave Astronomy North West Conference Student Workshop, Virtual	June 2021
24th Capra Meeting, Virtual	June 2021
LISA Canada Workshop, Virtual	April 2021
APS April Meeting, Virtual	April 2021
First Cosmic Explorer Meeting, Virtual	Oct. 2020
Advances in Computational Relativity, Brown University	Fall 2020
LISA Symposium XIII, Virtual	Sep. 2020

LIGO Detector Characterization Face-to-Face Meeting, Virtual	July 2020
23rd Capra Meeting, Virtual	June 2020
Gravitational Wave Astronomy North West Conference, Virtual	June 2020
APS April Meeting, Virtual	April 2020
She Leads: Women in STEM, TRIUMF	Feb. 2020
LIGO Detector Characterization Face-to-Face Meeting, LIGO Livingston	Jan. 2020
Canada's Long Range Plan 2020 Town Hall, University of British Columbia	Nov. 2019
GMT Community Science Meeting, University of California San Diego	Sep. 2019
A Richer Universe, University of British Columbia	May 2019
Outer Space Institute Conference, University of British Columbia	Nov. 2018
Astro Northwest X Southwest, University of British Columbia	Nov. 2018
Canadian Conference for Undergraduate Women in Physics, Queen's University	Jan. 2018

TECHNICAL STRENGTHS

Highly proficient - Python, Matlab, Bash, and LaTeX.

Proficient - C++ and HTCondor.

Experience - cluster computing and CPU/GPU parallelization.

AFFILIATIONS

LISA Consortium	May 2021 - Present
Simulating eXtreme Spacetimes (SXS) Collaboration	November 2020 - Present
Cosmic Explorer Consortium	October 2020 - Present
American Physical Society (APS)	September 2020 - Present
LIGO Scientific Collaboration (LSC)	January 2020 - Present
Canadian Association of Physicists (CAP)	January 2018 - August 2020