

Ryan Raikman | CV

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Education

Sep 2020 - Ongoing | **Carnegie Mellon University - GPA 4.0/4.0**
Pittsburgh PA, US
B.S. Physics, Astrophysics Track
Minor - Machine Learning

Research Experience

May 2022 - Ongoing	MIT LIGO Laboratory Cambridge, MA, US <ul style="list-style-type: none">• Researching and training unsupervised learning models to make inference on anomalous gravitational wave signals, such as core-collapse supernovae and cosmic strings• Developing a pipeline for training autoencoder models on various signal types seen in gravitational wave detector data• Implementing an online algorithm to search for unmodeled transient gravitational wave bursts• Helping develop a repository for general application of machine learning to gravitational wave data analysis
May 2023 - Oct 2023	University of Geneva, Observatory Versoix, Switzerland <ul style="list-style-type: none">• Researched the observable properties of stellar evolution channels which lead to binary black hole mergers• Developed an algorithm to discover the formation channels and their corresponding prevalence in the universe from population synthesis data from gravitational wave detectors• Used normalizing flows, a machine learning model, to accelerate learning and sampling probability distributions
May 2021 - May 2023	CMU Physics Department Pittsburgh, PA, US <ul style="list-style-type: none">• Derived observables for spin-triplet superconductivity with varying external magnetic fields• Built new theoretical approaches for computing various expressions
Jan 2021 - May 2023	CMU Physics Department Pittsburgh, PA, US <ul style="list-style-type: none">• Investigated gravitational microlensing in galactic subhalos to determine dark matter density distributions• Modified and integrating gravitational lensing formalism• Applied various numerically estimated dark matter density profiles
April 2023 - Oct 2023	CMU Machine Learning Department Pittsburgh, PA, US <ul style="list-style-type: none">• Researching techniques for artificial intelligence based learning of physical phenomena• Combining methods from language processing, automatic code generation, and symbolic regression
Sep 2020 - May 2022	CMU McWilliams Center for Cosmology Pittsburgh, PA, US <ul style="list-style-type: none">• Researched novel methods for low-frequency gravitational wave analysis• Generated gravitational wave signals by integrating governing equations with advanced numerical methods.• Converted signals to frequency domain, and performed analysis using various machine learning techniques.

Research Experience

Sep 2020 - Jan 2021	CMU Physics Department <i>Pittsburgh, PA, US</i> <ul style="list-style-type: none">• Applied machine learning techniques for hadronic jets tagging at the LHC• Worked with tools for accelerating computation
Sep 2019 - Oct 2020	MIT LIGO Laboratory <i>Cambridge, MA, US</i> <ul style="list-style-type: none">• Developed neural networks to analyze gravitational wave detector data.• Applied frequency domain analysis techniques, such as Spectrogram and PSD.

Leadership and Teaching Experience

Sep 2022 - Ongoing	Tartan Cycling <i>Pittsburgh, PA, US</i> <ul style="list-style-type: none">• President of Tartan Cycling Club• Work to organize group rides and general cycling-based events• Collaborate with other executive members to organize and promote the club• Organize attendance to collegiate road cycling races
Sep 2022 - Dec 2022	CMU 33-224 Stars, Galaxies, and the Universe - TA <i>Pittsburgh, PA, US</i> <ul style="list-style-type: none">• Reviewed class material in recitation sections• Taught computational techniques for programming assignments• Helped grade homework and exam papers from 40 students.
Sep 2021 - Dec 2021	CMU 33-224 Stars, Galaxies, and the Universe - TAA <i>Pittsburgh, PA, US</i> <ul style="list-style-type: none">• Helped grade homework and exam papers from 40 students.
Nov 2018 - Oct 2020	MIT Astrogazers <i>Cambridge, MA, US</i> <ul style="list-style-type: none">• Organized astronomy outreach events for underprivileged high school and middle school students• Hosted outreach events for the general public• In charge of equipment including telescopes and lenses
Sep 2019 - Mar 2020	MIT Teen Programming Council <i>Cambridge, MA, US</i> <ul style="list-style-type: none">• Organized science-themed events for other high-school students.• Reached out to MIT professors and research scientists, inviting them to explain their work at various events.

Working Experience

Aug 2022 - May 2023 Aug 2021 - May 2022	CMU Residential Education - Residential Assistant (RA) <i>Pittsburgh, PA, US</i> <ul style="list-style-type: none">• Supervised a floor of 20 freshman students• Hosted floor-wide events to foster community development• Integrated new students to the Carnegie Mellon community• Provided support for students in academic, social, and emotional aspects
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Honors and Awards

- Nov 2023 | Early Election into Phi Beta Kappa
- Feb 2023 | ISURF (International Summer Undergraduate Research Fellowship)
- Nov 2022 | Goldwater Scholarship Nomination
- May 2021 | SURF (Summer Undergraduate Research Fellowship)

Publications

- 2023 | **R. Raikman**, E. Moreno, K. Govorkova, P. Harris, E. Katsavounidis, "GWAK: Gravitational Wave Anomalous Knowledge with Recurrent Autoencoders", <https://arxiv.org/abs/2309.11537>
- 2023 | **R. Raikman**, S. Bavera, T. Fragos "Detecting the Undetected: Overcoming Biases in Gravitational-Wave Population Studies", <https://arxiv.org/abs/2310.10736>
- 2023 | Agarwal et. al "Applications of Deep Learning to physics workflows", <https://arxiv.org/abs/2306.08106>
- 2023 | Saleem et. al "Demonstration of Machine Learning-assisted real-time noise regression in gravitational wave detectors", <https://arxiv.org/abs/2306.11366>
- 2021 | **R. Raikman**, A. M. Holgado, C. L. Rodriguez, "Deep-Learning for Midband Gravitational-Wave Data Analysis"

Presentations

- Oct 2023 | GWAK: Gravitational Wave Anomalous Knowledge with Recurrent Autoencoders, MIT IAIFI Journal Club
- Sep 2023 | GWAK: Gravitational Wave Anomalous Knowledge with Recurrent Autoencoders, A3D3 Monthly Telecon
- Aug 2023 | GWAK: Gravitational Wave Anomalous Knowledge with Recurrent Autoencoders, LIGO Burst Group
- Apr 2023 | GWAK: Gravitational Wave Anomalous Knowledge with Recurrent Autoencoders, APS April
- Jan 2023 | Quasi-Anomalous Gravitational-Wave Detection with Recurrent Autoencoders, Accelerating Physics with ML@MIT
- Oct 2022 | Autoencoder-based anomaly detection for LIGO signal morphologies, CMU NSF AI Seminar
- Mar 2022 | Deep-Learning for Midband Gravitational-Wave Data Analysis, American Astronomical Society, High Energy Astrophysics Division - 19th meeting
- Oct 2021 | Gravitational Wave Parameter Estimation with Deep Learning, CMU McWilliams Center for Cosmology

Relevant Coursework

Physics: Extragalactic Astrophysics and Cosmology, Advanced Computational Physics, Thermal Physics I and II, Electricity and Magnetism I and II, Physical Mechanics, Advanced Quantum Physics, Quantum Mechanics, Nuclear and Particle Physics, General Relativity, Stellar Astrophysics

Machine Learning and Computer Science: Deep Reinforcement Learning and Control, Machine Learning, Probability, Principles of Imperative Computation

Textbooks: Landau and Lifshitz: Course of Theoretical Physics: Volumes 1 - 5: Mechanics, Electromagnetic Field Theory, General Relativity, Quantum Mechanics, Quantum Electrodynamics, Statistical Physics; Gabriel Lugo: Differential Geometry in Physics