Andrew Valentini

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Education

Carthage College Kenosha, WI

Bachelors in Physics and Mathematics, GPA - 3.988/4.0 *2021 – 2025*

- Physics thesis: (in progress)
- Math honors thesis: 3+1 Decomposition of Scalar-Vector-Tensor Gravity

Research Experience

Research Experience for Undergraduates (REU) May 2024 – August 2024

Mentored by Dr. Sarah Shandera *Pennsylvania State University*

- Wrote a quantum circuit simulation from scratch and tracked its domain of positivity in reference to potential signs of higher-order entanglement. I additionally tracked thermodynamic and information-theoretic properties on the circuit and developed multiple original animations and data visualization techniques.
- Used the LIGO high performance computing grid housed at PSU to generate data from large-qubit simulations and to compare varying kinds of circuit evolution

Cosmic Strings and Materials Theory Research February 2024 – Present

Mentored by Dr. Joseph Anderson *Carthage College*

- Developed a novel method for deriving the pair correlation function for circular defects in a material. I am extending the work to Gaussian and concentric loops.
- Applying this method in the context of cosmic string for my senior thesis

Research Experience for Undergraduates (REU) May 2023 – August 2023

Mentored by Dr. Gabriela González *Louisiana State University*

- Developed methods to determine the causal probability of gravitational wave triggers by glitch type with the goal of improving detection confidence and accuracy
- Used the LIGO high performance computing grid to extract data and generate plots

Theoretical Gravitational Wave Physics and Data Analysis Research January 2022 – Present

Mentored by Dr. Jean Quashnock *Carthage College*

- Have begun examining population differences between LIGO's observing runs through the use of machine learning algorithms and traditional data science techniques
- Analyzed the dependence of overtones on the merger remnant's mass and spin and confirmed that the first overtone dominates the waveform of an event
- Developed models to visualize the infall of merger events using the math governing gravitational wave emission
- Created plots that compare a binary system's component masses and final merger mass to demonstrate the system's radiated energy in the form of gravitational waves

Modal Propellant Gauging-Fiber Optic Sensing System June 2022 – April 2023

Funded by NASA's T2U Program and the WSGC, Mentored by Dr. Kevin Crosby *Carthage College*

- Developed software that translates data packets received from an optical interrogator to be interpreted by the Modal Propellant Gauging framework
- Designed experiments to test the validity of implementing FOSS into MPG framework

Magneto-Active Slosh Control September 2021 – May 2022

Funded by the WSGC, Mentored by Dr. Kevin Crosby *Carthage College*

- Ran CAD simulations to demonstrate the inefficiency of perpendicularly-positioned coils on a propellant tank's wall in suppressing microgravity slosh
- Designed CAD models that were used in the mechanical setup of the experiment

Relevant Coursework

Physics: Quantum Mechanics (Spring 2025) Electricity and Magnetism, Astrophysics, Computational Physics, Thermal Physics, Mechanics, Optics and Waves, Modern Physics, Experimental Physics

Mathematics: Real Analysis, Complex Variables, Abstract Algebra, Senior Research, Mathematics for Scientists and Engineers, Mathematical Computing (Spring 2025) Statistics, Linear Algebra, Differential Equations, Multivariate Calculus, Discrete Structures

Independent Study

[1] **Quantum Field Theory** | July 2024 - Present
Quantum Field Theory for the Gifted Amateur - Tom Lancaster and Stephen J. Blundell

[2] **Quantum Computation and Quantum Information** | April 2024 - Present
Quantum Computation and Quantum Information - Isaac Chuang and Michael Nielsen

[3] **Loop Quantum Gravity** | January 2024 - Present
A First Course in Loop Quantum Gravity - Rodolfo Gambini and Jorge Pullin

[4] **General Relativity** | September 2023 - March 2024
A First Course in General Relativity - Bernard F. Schutz

Presentations

[1] **Non-completely Positive Dynamics as a Probe of Entanglement in Quantum Circuits** | *Washington University* November 2024
Midstates Consortium for Math and Science Undergraduate Research Symposium - Oral Presentation

[2] **3+1 Decomposition in Scalar-Tensor-Vector Gravity** | *St. Norbert's College* November 2024
Pi Mu Epsilon Annual Undergraduate Regional Math Conference - Oral Presentation

[3] **Non-completely Positive Dynamics as a Probe of Entanglement in Quantum Circuits** | *Penn State University* August 2024
PSU REU Research Symposium - Oral & Poster Presentation

[4] **An Analytic Method for Computing the Pair Correlation Functions of Dislocation Loops** | *Carthage College* May 2024
Celebration of Scholars - Poster Presentation

[5] **Estimating the Luminosity Distance and Mass Properties of BBH Merger Events in LIGO O4 Data** | *Carthage College* May 2024
Celebration of Scholars - Poster Presentation

[6] **Analyzing Causes of Gravitational Wave False Alarms** | *St. Norbert's College* November 2023
Pi Mu Epsilon Annual Undergraduate Regional Math Conference - Oral Presentation

[7] **Analyzing Causes of Gravitational Wave False Alarms** | *University of Chicago* November 2023
Midstates Consortium for Math and Science Undergraduate Research Symposium - Poster Presentation

[8] **Analyzing Causes of Gravitational Wave False Alarms** | *Virtual* August 2023
APS National Physics REU Poster Symposium - Poster Presentation

[9] **Analyzing Causes of Gravitational Wave False Alarms** | *Louisiana State University* August 2023
Summer Undergraduate Research Forum - Poster Presentation

[10] **Measuring Quasinormal Modes of Simulated Binary Black Hole Mergers in the SXS Catalog** | *Carthage College* May 2023
Celebration of Scholars - Poster Presentation

[11] **Modeling Binary Compact Object Merger Events Detected by the LIGO and Virgo Gravitational Wave Observatories** | *Argonne National Laboratory* January 2023
CUWiP - Poster Presentation

[12] **Modeling Binary Compact Object Merger Events Detected by the LIGO and Virgo Gravitational Wave Observatories** | *Washington University* November 2022
Midstates Consortium for Math and Science Undergraduate Research Symposium - Poster Presentation

[13] **Carthage Space Sciences: MPG-FOSS** | *Washington, D.C.* October 2022
Society of Physics Students Physcon - Poster Presentation

[14] **Carthage Space Sciences: MPG-FOSS** | *Carthage College* September 2022
Fall Research Presentation - Poster Presentation

[15] **Modal Propellant Gauging Projects Overview** | *Carroll University* August 2022
Wisconsin Space Grant Conference - Oral Presentation

[16] **Carthage Space Sciences: MPG-FOSS** | *Carroll University* August 2022
Wisconsin Space Grant Conference - Poster Presentation

[17] **Determining the Masses of Black Holes and Neutron Stars Seen in LIGO and Virgo Merger Events** | *Carthage College* April 2022
Celebration of Scholars - Poster Presentation

[18] **The Bible as Interpreted through Jean-Jacques Rousseau's Second Discourse** | *Carthage College* April 2022
Celebration of Scholars - Poster Presentation

Technical Skills

Languages: Python, MATLAB, R, HTML/CSS
Tools: Mathematica, LaTeX, Git, Fusion 360, Qiskit, Inventor

Honors and Awards

[1] **2022 Atlas Shrugged Essay Competition** | *Semifinalist* April 2023
Ayn Rand Institute – Received for my essay entitled "Hank Rearden and the Exaltation of the Individual"

[2] **Intellectual Foundations Scholarship** | *First Place* April 2022
Carthage College – Received for my essay entitled "The Bible as Interpreted through Jean-Jacques Rousseau's Second Discourse"

[3] **Minnesota State History Day** | *Fourth Place* May 2021
Received for my poster entitled "Carl Sagan and the Communication of Scientific Knowledge"

[4] **Minnesota State History Day** | *Sixth Place* May 2020
Received for my poster entitled "The Dark Lady of DNA-Rosalind Franklin"

Extracurricular

Philosophy Club Vice President | *Carthage College* September 2022 – May 2023
I conducted the reading and research on philosophical topics necessary to lead our club's weekly meetings and construct slideshows to facilitate the group's discussion

Brainard Writing Center Fellow | *Carthage College* January 2022 – Present
I assist students from various disciplines by discussing the texts their papers are often based on and suggest how to develop the arguments presented throughout them. I additionally taught a one-credit course during the spring of 2024 called Writer's Workshop where students developed their general writing and critical thinking skills.

Outreach & Volunteering

Astrofest Volunteer | *Pennsylvania State University* July 2024
Helped run educational stations and gave three talks on the science and history of gravitational waves to a combined audience of ∼50 attendees of varying age.

Physics Demonstration Planning & **Building** | *Carthage College* October 2023 - Feburary 2024
Planned a repository of physics demonstrations for public engagement and built a Ruben's Tube.

Summer Astronomy Night Volunteer | *Louisiana State University* June 2023
Helped organize a public outreach event focused on astronomy education and gave a Ruben's tube demonstration to an audience of 50+ attendees of varying age.

NASA Summer High School Intern Program | *University of Texas at Austin (Virtual)* July 2022
Gave an overview of Carthage College's Modal Propellant Gauging projects being worked on in the summer of 2022 to an audience of 70+ high school students.

Certifications

[1] The Complete Quantum Computing Course | August 2023
[2] Linux Command Line Bootcamp | July 2022
[3] Fusion 360 Beginners Course | June 2022
[4] Gravitational Wave Open Data Workshop #5 | May 2022