

# Andrew Valentini

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## EDUCATION

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### Carthage College

Kenosha, WI

*Bachelors in Physics and Mathematics, GPA - 3.985/4.0*

*2021 – 2025*

- Physics thesis: (in progress)
- Math thesis: (in progress)

## RESEARCH EXPERIENCE

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### Research Experience for Undergraduates (REU)

May 2024 – August 2024

*Mentored by Dr. Sarah Shandera*

*Pennsylvania State University*

- Created a simulation of a quantum circuit and tracked the domain of positivity throughout its evolution. I defined various thermodynamic and information-theoretic properties on this circuit and additionally tracked their quantities over the evolution with multiple animations and data visualization techniques which I additionally created.
- I 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 a method 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

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

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

## INDEPENDENT STUDY

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- [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

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- [1] **Non-completely Positive Dynamics as a Probe of Entanglement in Quantum Circuits** | *Penn State University* August 2024  
PSU REU Research Symposium - Oral & Poster Presentation
- [2] **An Analytic Method for Computing the Pair Correlation Functions of Dislocation Loops** | *Carthage College* May 2024  
Celebration of Scholars - Poster Presentation
- [3] **Estimating the Luminosity Distance and Mass Properties of BBH Merger Events in LIGO O4 Data** | *Carthage College* May 2024  
Celebration of Scholars - Poster Presentation
- [4] **Analyzing Causes of Gravitational Wave False Alarms** | *St. Norbert's College* November 2023  
Pi Mu Epsilon Annual Undergraduate Regional Math Conference - Oral Presentation
- [5] **Analyzing Causes of Gravitational Wave False Alarms** | *University of Chicago* November 2023  
Midstates Consortium for Math and Science Undergraduate Research Symposium - Poster Presentation
- [6] **Analyzing Causes of Gravitational Wave False Alarms** | *Virtual* August 2023  
APS National Physics REU Poster Symposium - Poster Presentation
- [7] **Analyzing Causes of Gravitational Wave False Alarms** | *Louisiana State University* August 2023  
Summer Undergraduate Research Forum - Poster Presentation
- [8] **Measuring Quasinormal Modes of Simulated Binary Black Hole Mergers in the SXS Catalog** | *Carthage College* May 2023  
Celebration of Scholars - Poster Presentation
- [9] **Modelling Binary Compact Object Merger Events Detected by the LIGO and Virgo Gravitational Wave Observatories** | *Argonne National Laboratory* January 2023  
CUWiP - Poster Presentation
- [10] **Modelling 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
- [11] **Carthage Space Sciences: MPG-FOSS** | *Washington, D.C.* October 2022  
Society of Physics Students Physcon - Poster Presentation
- [12] **Carthage Space Sciences: MPG-FOSS** | *Carthage College* September 2022  
Fall Research Presentation - Poster Presentation
- [13] **Modal Propellant Gauging Projects Overview** | *Carroll University* August 2022  
Wisconsin Space Grant Conference - Oral Presentation
- [14] **Carthage Space Sciences: MPG-FOSS** | *Carroll University* August 2022  
Wisconsin Space Grant Conference - Poster Presentation
- [15] **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
- [16] **The Bible as Interpreted through Jean-Jacques Rousseau's Second Discourse** | *Carthage College* April 2022  
Celebration of Scholars - Poster Presentation

## TECHNICAL SKILLS

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**Languages:** Python, MATLAB, R, HTML/CSS  
**Tools:** Mathematica, L<sup>A</sup>T<sub>E</sub>X, Fusion 360, Qiskit, Inventor

## HONORS AND AWARDS

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- [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

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- 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

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- 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 - February 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

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- [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