

# IAN FREEMAN

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## EDUCATION

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### **B.S in Physics / Computational Physics, B.S. in Mathematics**

*Department of Physics, Illinois State University*

August 2019 - May 2023

GPA: 4.0/4.0

### **Awards and Honors**

*Barry Goldwater Scholar*

*Fall 2022*

*Sigma Pi Sigma Physics Honors Society Member*

*Spring 2021 - Spring 2023*

*George Skadron Award for Computational Research*

*Spring 2021*

*George Skadron Computational Physics Award - 2nd Place*

*Spring 2020*

*Illinois State University Presidential Scholar*

*Fall 2019 - Spring 2023*

*Robert D. Young Physics Scholar Award*

*Fall 2019*

## PUBLICATIONS

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3. Caplan, M. E., Bauer, E. B., **Freeman, I. F.**,  
"Accurate Diffusion Coefficients for Dense White Dwarf Plasma Mixtures"  
*MNRAS Letters* 513 (1), L52-L56 (2022)
2. Caplan, M. E., **Freeman, I. F.**,  
"Precise Diffusion Coefficients for White Dwarf Astrophysics"  
*MNRAS* 505 (1), 45-49 (2021)
1. Caplan, M. E., **Freeman, I. F.**, Horowitz, C. J., Cumming, A., Bellinger, E.P.  
"Cooling Delays from Iron Sedimentation and Iron Inner Cores in White Dwarfs"  
*The Astrophysical Journal Letters* 919, no. 1 (2021): L12

## RESEARCH EXPERIENCE

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### ***Precise Diffusion Coefficients of White Dwarf Plasmas***

*Spring 2021*

*Department of Physics, Illinois State University*

*Advisor: Dr. Matt Caplan*

- Redefined an existing diffusion model to more accurately predict diffusion coefficients of elements through plasma
- Fit the model with simulation data to significantly reduce error in diffusion coefficients

### ***Iron Crystallization in White Dwarf MD Simulations***

*Summer 2021 - Present*

*Department of Physics, Illinois State University*

*Advisors: Dr. Matt Caplan, Dr. Charles Horowitz*

- Wrote, modified, and utilized a cluster algorithm to identify crystals in Python3
- Generated 3D animations of simulations using Python3 and GNUplot libraries
- Solved simplified EOS equations to determine the effects of WD core composition on binding energies

### ***Predicting Magnetic Fields of Massive Stars with Asteroseismology (REU)***

*Summer 2022 - Present*

*CIERA, Northwestern University*

*Advisors: Dr. Daniel Lecoanet*

- Used the WKB approximation to resolve eigenmodes of the MHD equations with python package Dedalus3
- Attempted to construct an empirical interpolation scheme between observed frequencies and expected near-core magnetic field strengths

## CODING SKILLS

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- |               |                   |                        |
|---------------|-------------------|------------------------|
| • Arduino     | • Python3         | • Fortran 95           |
| • Mathematica | • Unix OS         | • OriginLab            |
| • GNUplot     | • $\text{\LaTeX}$ | • MPI (Python/Fortran) |

## WORK & TEACHING EXPERIENCE

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### **Teaching Assistant**

*Spring 2020 - Present*

*Department of Physics, Illinois State University*

*Advisors: Dr. Rainer Grobe, Dr. Mahua Biswas, Dr. George Rutherford, Dr. Jay Ansher*

- \* Instructed and graded multiple 3-hour lab sections covering general education level introductory physics (PHY 102, 105, 108), introductory level mechanics (PHY 110), and math methods (PHY 217)

### **Physics Content Tutor — Vector Calculus Content Tutor**

*Spring 2020*

*Julia N. Visor Center, Illinois State University*

- \* Tutored students in algebra based physics courses (PHY 105, 108) and vector calculus (MAT 147)
- \* Independently created review content and practice material for students

### **Resident Assistant**

*Fall 2020 - Spring 2022*

*University Housing Services, Illinois State University*

- \* Developed professional development programs in conjunction with faculty mentors to assist 20+ undergraduate mathematics majors
- \* Facilitated STEM focused communities between 50+ undergraduate mathematics majors

## PRESENTATIONS

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8. **Ian Freeman**<sup>†</sup>, "Neutron Rich Nuclides in Cooling White Dwarfs", **MSU CMSE Data Science Student Conference**, Michigan State University, East Lansing, MI, (2022)
7. **Ian Freeman**<sup>†</sup>, "Challenges of Measuring Magnetic Fields of Massive Stars Using Asteroseismology", **CIERA REU Poster Session**, Northwestern University, Evanston, IL, (2022)
6. **Ian Freeman**<sup>†</sup>, "Neutron Rich Nuclides in Cooling White Dwarfs", **JINA-CEE Frontiers in Nuclear Astrophysics**, University of Notre Dame, Notre Dame, IN, (2022)
5. **Ian Freeman**<sup>\*</sup>, "Diffusion in Coulomb Plasmas Across Coupling Regimes", **APS March Meeting**, Chicago, IL, (2022)
4. **Ian Freeman**<sup>\*</sup>, "Iron Crystallization and Precipitation", **Indiana University Astrophysics Symposium** (2021)
3. **Ian Freeman**<sup>\*</sup>, Matt Caplan, "Precise Diffusion Coefficients for White Dwarf Astrophysics", **APS April Meeting**, (2021)
2. **Ian Freeman**<sup>\*</sup>, Matt Caplan, "Precise Diffusion Coefficients for White Dwarf Astrophysics", **University Research Symposium**, Illinois State University, Normal, IL, (2021)
1. **Ian Freeman**<sup>†</sup>, Brighton Coe, Matt Caplan, "Nuclear Potentials of Simulated Nuclear Collisions", **Fall 2020 Meeting of the Ohio-Region Section of the American Physical Society**, (2020)

[<sup>†</sup>Poster Presentation, <sup>\*</sup>Oral Presentation]