

C. MICHAEL HAYNES

Doctoral Candidate, Georgia Institute of Technology
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POSITIONS HELD

Georgia Institute of Technology, School of Earth and Atmospheric Sciences Atlanta, GA
Graduate Research Assistant August 2022 - Present

- Developed a modular, scalable, and highly distributed computational model to study energetic ion precipitation onto icy moons' atmospheres and their production of Energetic Neutral Atoms (ENAs)
- Implemented this model at Callisto, Ganymede and Europa to investigate the intensity and morphology of the emitted or observable ENA population in preparation for the (en route) JUICE mission
- Determined the imprint on the ENA emission pattern at a moon from changes in: the magnetospheric field configuration, the plasma interaction, the atmosphere, and the energetic ion spectrum
- Utilized the same framework to constrain the observability of plumes at Europa in ENA data
- Applied a hybrid plasma simulation tool to model both the interaction of Jupiter's magnetosphere with the persistent oxygen and water vapor exospheres of Europa as well as the induced magnetosphere of Pluto due to its atmosphere's interaction with impinging solar wind
- Devised and deployed a backtracing model to efficiently generate high-fidelity synthetic ENA images

Georgia Institute of Technology, School of Earth and Atmospheric Sciences Atlanta, GA
Undergraduate Research Assistant, Center for Relativistic Astrophysics Jan 2022-July 2022

- Studied computational space plasma physics in the Jovian magnetospheric environment with Dr. Sven Simon (Magnetospheres of the Outer Solar System group)
- Developed a charged particle tracing tool to model the process of charge exchange between energetic magnetospheric ions and cold neutral gas in Europa's and Callisto's atmospheres
- Results of this work were shown in a first-authored conference presentation at the 2022 MOP meeting

Georgia Institute of Technology, School of Physics Atlanta, GA
Undergraduate Research Assistant, Center for Nonlinear Sciences May 2021-February 2022

- Analytically and numerically modeled continuum dynamics for the purpose of Direct Air Capture (DAC) technology development with Dr. Roman Grigoriev (Pattern Formation and Control Lab)
- Derived a system of transport PDEs with control volume analysis that describe the evolution of temperature and concentration during evaporative cooling stage; Rayleigh-Ritz technique for solutions
- Responsible for quarterly technical progress reports delivered to the Department of Energy

Georgia Institute of Technology, School of Mathematics Atlanta, GA
Undergraduate Research Assistant, Dynamical Systems REU May 2020-December 2020

- Analytically investigated the Lyapunov spectrum and invariant manifold of a hyperbolic dynamical system (Arnold's cat maps) using perturbation theory working with Dr. Federico Bonetto in an REU
- Responsible for delivery of a seminar talk describing methods and highlighting results to GT Math

Georgia Institute of Technology, School of Physics Atlanta, GA
Undergraduate Research Assistant, Center for Nonlinear Sciences May 2019-December 2019

- Worked with Dr. Mike Schatz and Logan Kageorge to systematically measure (via the Hall Effect) the spatially non-uniform magnetic field of an experimental setup used to induce quasi-2D turbulence
- Fabricated and soldered circuit components to facilitate repurposing a machine mill to act as a high-precision spatial positioning system for the Hall Effect sensor using CNC machine code (G-code)

EDUCATION

Georgia Institute of Technology
Doctor of Philosophy (Ph.D.), Planetary Science
Minor, Physics
Advisor: Sven Simon

August 2022 - Present
Expected Graduation: December 2026

GPA: 4.0

Georgia Institute of Technology
B.S., Physics, Concentration: Astrophysics
Minor, Mathematics

August 2018 - May 2022
High Honors

PUBLICATIONS

3 First-Authored Publications (5 Total). Citations: 27 (Google Scholar). H-index: 3

(*) Indicates that all authors contributed equally to this study.

Emission of Energetic Neutral Atoms From Ganymede's Magnetosphere-Atmosphere Interaction

C. Michael Haynes, Sven Simon, Lucas Liuzzo, *J. Geophys. Res. (Space Physics)*, 130(10), e2025JA034469, doi: 10.1029/e2025JA034469, 2025b

This article was selected as the cover story of the JGR issue (October 2025: Volume 130, Issue 10); **C. Michael Haynes** is credited with the cover figure.

Dynamics of Energetic Heliospheric Ions in Pluto's Induced Magnetosphere

Randall Ruch, Sven Simon, **C. Michael Haynes**, *J. Geophys. Res. (Space Physics)*, 130(1), e2024JA033548, doi: 10.1029/2024JA033548, 2025

Constraints on the Observability of Energetic Neutral Atoms from the Magnetosphere-Atmosphere Interactions at Callisto and Europa

C. Michael Haynes, Tyler Tippens, Sven Simon, Lucas Liuzzo, *J. Geophys. Res. (Space Physics)*, 130(1), e2024JA033391, doi: 10.1029/2024JA033391, 2025

This article was selected as the cover story of the JGR issue (January 2025: Volume 130, Issue 1); **C. Michael Haynes** is credited with the cover figure.

Magnetic Signatures of the Interaction Between Europa and Jupiter's Magnetosphere During the Juno Flyby

(*) Peter Addison, **C. Michael Haynes**, Aaron Stahl, Lucas Liuzzo, Sven Simon, *Geophys. Res. Lett.*, 57(1), e2023GL106810, doi: 10.1029/2023GL106810, 2024

This article was selected as the cover story of the GRL issue (January 2024: Volume 51, Issue 2); **C. Michael Haynes** is credited with the cover figure.

Emission of Energetic Neutral Atoms from the Magnetosphere-Atmosphere Interactions at Callisto and Europa

C. Michael Haynes, Tyler Tippens, Peter Addison, Lucas Liuzzo, Andrew R. Poppe, Sven Simon, *J. Geophys. Res. (Space Physics)*, 128(10), e2023JA031931, doi: 10.1029/2023JA031931, 2023

PRESENTATIONS

(†) Indicates an oral presentation. (‡) Indicates an *invited* oral presentation.

C. M. Haynes, S. Simon, and L. Liuzzo. **Emission of Energetic Neutral Atoms from Ganymede's Magnetosphere-Atmosphere Interaction**, New Orleans, USA, 15-19 December, 2025.

C. M. Haynes, S. Simon, and T. Tippens. **A Modeling Framework for the Analysis of ENA Images from Cassini's Titan Flybys**, New Orleans, USA, 15-19 December, 2025.

‡ **C. M. Haynes**, S. Simon, and L. Liuzzo. **Detectability of ENA Emissions from the Magnetosphere-Atmosphere Interactions at Europa, Ganymede, and Callisto: Providing Context for the JUICE Mission (Invited)**, New Orleans, USA, 15-19 December, 2025.

C. M. Haynes, T. Tippens, S. Simon, and L. Liuzzo. **Observability of Energetic Neutral Atom Emissions at Europa and Callisto: Predictions for the JUICE Mission.** *AGU Fall Meeting*, Washington D.C., USA, 09-13 December, 2024.

C. M. Haynes, T. Tippens, S. Simon, and L. Liuzzo. **Global Morphology and Detectability of ENA Emissions from the Magnetosphere-Atmosphere Interactions at Callisto and Europa.** *AGU Fall Meeting*, Washington D.C., USA, 09-13 December, 2024.

† **C. M. Haynes**, T. Tippens, S. Simon, and L. Liuzzo. **Observability of ENA Emissions at Europa and Callisto: Predictions for the JUICE Mission.** *EuroPlanet Science Congress*, Berlin, Germany, 08-13 September, 2024.

C. M. Haynes, T. Tippens, P. Addison, L. Liuzzo, A. R. Poppe, and S. Simon. **Global Morphology of ENA Emissions from the Atmosphere-Magnetosphere Interactions at Callisto and Europa.** *EuroPlanet Science Congress*, Berlin, Germany, 08-13 September, 2024.

C. M. Haynes, Peter Addison, Aaron Stahl, Lucas Liuzzo, and Sven Simon. **Magnetic Signatures of the Interaction Between Europa and Jupiter's Magnetosphere During the Juno Flyby.** *EuroPlanet Science Congress*, Berlin, Germany, 08-13 September, 2024.

† **C. M. Haynes**, T. Tippens, P. Addison, L. Liuzzo, A. R. Poppe, and S. Simon. **Global Morphology of ENA Emissions from the Atmosphere-Magnetosphere Interactions at Callisto and Europa.** *Magnetospheres of the Outer Planets Meeting*, Minneapolis, USA, 07-12 July, 2024.

C. M. Haynes, T. Tippens, P. Addison, L. Liuzzo, A. R. Poppe, and S. Simon. **Observability of ENA Emissions at Europa and Callisto: Predictions for the JUICE Mission.** *Magnetospheres of the Outer Planets Meeting*, Minneapolis, USA, 07-12 July, 2024.

C. M. Haynes, T. Tippens, P. Addison, L. Liuzzo, A. R. Poppe, and S. Simon. **Modeling the Detection of Energetic Neutral Atoms at Europa and Callisto: a Tool to Characterize Moon-Magnetosphere Interactions on a Global Scale.** *AGU Fall Meeting*, San Francisco, USA, 11-15 December, 2023.

† **C. M. Haynes**, T. Tippens, P. Addison, L. Liuzzo, A. R. Poppe, and S. Simon. **Emission of Energetic Neutral Atoms from the Magnetosphere-Atmosphere Interactions at Callisto and Europa.** *AGU Fall Meeting*, San Francisco, USA, 11-15 December, 2023.

C. M. Haynes, T. Tippens, P. Addison, L. Liuzzo, A. R. Poppe, and S. Simon. **Emission of Energetic Neutral Atoms at Callisto and Europa.** *AGU Fall Meeting*, Chicago, USA, 12-16 December, 2022.

C. M. Haynes, T. Tippens, P. Addison, L. Liuzzo, A. R. Poppe, and S. Simon. **Emission of Energetic Neutral Atoms at Callisto and Europa.** *Magnetospheres of the Outer Planets Meeting*, Liège, Belgium, 11-15 July, 2022.

ADVISING

Troy Stephens (co-advised)

Undergraduate Student

Georgia Institute of Technology

August 2023 - January 2025

Project: Using SPICE kernels to determine spacecraft position, bearing, altitude and orientation across pertinent satellite flybys during the Juno extended mission

Work selected for PURA undergraduate research funding upon submission of a PURA proposal

Jeremiah Tunis (co-advised)

Undergraduate Student

Georgia Institute of Technology

May 2024 - August 2024

REU Project: Tracing energetic test particles in Io's perturbed electromagnetic environment

REU students are responsible for delivering written and oral research presentations at regular intervals

Brendan McCluskey
Undergraduate Student

Georgia Institute of Technology
December 2022 - May 2023

Project: Tracing the emission of hydrogen energetic neutral atoms from test particles at Europa

TEACHING

Advanced Space Plasma Physics
Graduate Teaching Assistant

Atlanta, GA
January 2023 - May 2023

- Grading, office hours, and teaching support for the graduate course elaborating upon the theoretical framework of advanced plasma-physical techniques in the context of the solar system
- Topics include kinetic plasma theory, multi-fluid and magnetohydrodynamic treatments, cold plasma waves, shocks and discontinuities, planetary plasma interactions, and magnetospheric topology

Instructor/Lecturer

March 2025

- Full-time lecturer for a week of class sessions; taught an overview of nonlinear MHD phenomena

Introductory Physics I
Undergraduate Teaching Assistant

Atlanta, GA
February 2020 - January 2022

- Large undergraduate course on introductory mechanics, involving the supervision of weekly labs and the delivery of experimental and theoretical treatment in recitation-style lectures

HONORS AND AWARDS

Research Excellence Award

April 2025

Awarded annually by the GT School of Earth and Atmospheric Sciences “for excellence in research, as judged primarily on the basis of the creativity and independence exhibited by the student in conduct of the research.”

Best Paper Award

April 2024

Awarded annually by the GT School of Earth and Atmospheric Sciences “for the best refereed paper or series of refereed papers, published by the time of selection, for which the student is the first author.”

Outstanding Student Presenter Award (OSPA), AGU Fall 2023

December 2023

Awarded at the American Geophysical Union (AGU) meeting for the talk: “Emission of Energetic Neutral Atoms from the Magnetosphere-Atmosphere Interactions at Callisto and Europa”. The award is given to the top 2%-5% of early career presenters, determined by senior scientists in the field.

Georgia Tech Presidential Fellowship

August 2022 - Present

Awarded annually to the top 5% of the incoming class of graduate students at Georgia Tech. Fellowship includes an additional \$5500 salary award and annual recognition at the Presidential Banquet.

UPC Silver Medal (contestant no. 434)

November 2021

Awarded to the top 20% of contestants in the international University Physics Competition

Presidential Undergraduate Early Research Award (PURA):

July 2018

Awarded to competitive research prospects within their first two years as undergraduates at Georgia Tech. Includes a \$1500 salary award to fund a semester of original research.

Dean’s List:

Fall 2018 - May 2022

Awarded to any undergraduate student with a GPA greater than 3.0. Recognition provided in local newspapers.

Highest Honors:

Fall 2018 - December 2022

Awarded to undergraduate students with a GPA greater than 3.55.

High Honors:

December 2022 - May 2022

Awarded to undergraduate students with a GPA greater than 3.35.

PROFESSIONAL INVOLVEMENT

Oral Session Chair, Convener	2024
American Geophysical Union Fall Meeting (Washington D.C.) Moon-Plasma Interactions Throughout the Solar System	
Poster Session Chair	2023
American Geophysical Union Fall Meeting (San Francisco) Moon-Plasma Interactions Throughout the Solar System	
American Geophysical Union Member	November 2021 - Present

PROFESSIONAL REFERENCES

Sven Simon, Professor	Ph.D. Advisor
School of Earth and Atmospheric Sciences, Georgia Institute of Technology Email: sven.simon@eas.gatech.edu Phone: (404) 385-1509 Website: https://svensimon.gatech.edu/	
Lucas Liuzzo, Research Scientist	Collaborator
Space Sciences Laboratory, University of California, Berkeley Email: liuzzo@berkeley.edu Website: https://lukeliuzzo.github.io/	
Mike Schatz, Professor	Undergraduate Research Advisor
School of Physics, Georgia Institute of Technology Email: mike.schatz@physics.gatech.edu Website: https://schatzlab.gatech.edu/	