C. MICHAEL HAYNES

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POSITIONS HELD

Georgia Institute of Technology, School of Earth and Atmospheric Sciences Atlanta, GA
Graduate Research Assistant, Center for Relativistic Astrophysics *August 2022 - Present*

- Developed a comprehensive and highly distributed computational model to study magnetospheric ion precipitation onto icy moons' atmospheres as well as the resultant production & emission of Energetic Neutral Atoms (ENAs)
- Implemented this model at Jupiter's icy moons (Callisto and Europa) to investigate the emission flux intensity and morphology of the emitted ENA population in preparation for the JUICE mission
- Isolated and determined the influence of changes in the magnetospheric configuration, plasma interaction, atmosphere, and the energetic particle distribution function on the ENA emissions
- Utilized the same framework to constrain the observability of plumes at Europa in ENA data
- Applied a hybrid plasma simulation tool to model the interaction of Jupiter's magnetosphere with the persistent oxygen and water vapor exospheres of Europa, as well as to analyze the induced magnetosphere of Pluto due to its atmosphere's interaction with impinging solar wind

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 test ions and cold atmospheric neutrals of the Galilean moons
- This work resulted 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*

- Studied continuum dynamics for the purpose of Direct Air Capture technology development with Dr. Roman Grigoriev (Pattern Formation and Control Lab)
- Performed control volume analysis of the evaporative cooling stage to construct a system of parabolic and hyperbolic PDEs that describe the process
- Formulated Mathematica scripts to analytically generate a series expansion solution to a modified system using the Rayleigh-Ritz technique
- Analyzed dynamics of both advective transport through the porous medium channel and density profile evolution due to phase change
- Responsible for presentation of results to the Funding Entity as well as written technical progress reports to the Department of Energy

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

- Investigated the analytical properties of a class of hyperbolic dynamical systems (Arnold's cat maps) using perturbation theory working with Dr. Federico Bonetto in an REU collaboration
- Devised a convergent perturbative expansion for the Lyupanov spectrum of a coupled set of systems and calculated the expression for the invariant manifold up to several orders
- Utilized symbolic dynamics and combinatorial graph theory to represent this expansion and prove its convergence
- Constructed a computational model (MATLAB) to visualize and compute the phase space density of such hyperbolic dynamical systems in various 2 dimensional geometries
- Responsible for delivery of a seminar talk describing methods and highlighting results to the Georgia Tech School of Mathematics

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 (Dr.) Logan Kageorge in the Pattern Formation and Control Laboratory to experimentally verify the modeled values of critical system parameters
- Utilized the Hall Effect to systematically measure and document the highly variable magnetic field of an experimental setup used to induce quasi-2D turbulent Kolmogorov flow
- Repurposed a machine mill to act as a high-precision spatial positioning system to control the measurement with implementation of system machine code (G-code) interfaced through MATLAB
- Constructed a circuit to operate the high-precision Hall Effect sensor and fabricated/soldered sensitive measurement apparatus components

EDUCATION

Georgia Institute of Technology *August 2022 - Present*
Doctor of Philosophy (Ph.D.), Planetary and Space Physics Expected Graduation: December 2026
Advisor: Sven Simon GPA: 4.0

Georgia Institute of Technology *August 2018 - May 2022*
B.S., Physics, Concentration: Astrophysics High Honors
Minor, Mathematics

PUBLICATIONS

1 First-Authored Publications (1 Total). Citations: 0 (G. Scholar), 0 (ResearchGate)

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 (Accepted), *J.Geophys. Res. (Space Physics)*,
doi: https://doi.org/10.5281/zenodo.8148610

PRESENTATIONS

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.

P. Addison, **C. M. Haynes**, L. Liuzzo, A. Stahl, and S. Simon. **Influence of Asymmetries in Europa's Global Atmosphere on its Plasma Interaction with Jupiter's Magnetosphere**. *AGU Fall Meeting*, San Francisco, USA, 11-15 December, 2023.

R. Ruch, P. Addison, T. Tippens, **C. M. Haynes**, P. Kollmann, S. Simon, and A. Stahl. **Model of Pluto's Induced Magnetosphere and its Interaction with Energetic Heliospheric Ions**. *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*, Liége, Belgium, 11-15 July, 2022.

TEACHING

Advanced Space Plasma Physics Atlanta, GA
Graduate Teaching Assistant *January 2023 - May 2023*

- Graduate course elaborating upon the theoretical framework of advanced plasma-physical topics 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

Introductory Physics I Atlanta, GA
Undergraduate Teaching Assistant *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

ADVISING

Troy Stephens (co-advised) Georgia Institute of Technology
Undergraduate Student August 2023 - Present

Project: Using SPICE kernels to ascertain spacecraft bearing and orientation across pertinent flybys during the Juno extended mission

Brendan McCluskey Georgia Institute of Technology
Undergraduate Student December 2022 - May 2023

Project: Tracing the emission of hydrogen energetic neutral atoms from test particles in Europa's atmosphere

HONORS AND AWARDS

Georgia Tech Presidential Fellowship August 2020 - 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 recognition at the Presidential Banquet.

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 undergraduate students with a GPA greater than 3.0.

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

Session Chair 2023
American Geophysical Union Fall Meeting
Moon-Plasma Interactions Throughout the Solar System- Poster Session

American Geophysical Union November 2021 - Present
Member

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/