Cassandra Lochhaas

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Education

PhD in Astronomy — July 2019
The Ohio State University — *Columbus, OH*

Master's of Astronomy — December 2015
The Ohio State University — *Columbus, OH*

Bachelors's of Science in Physics — June 2013
California Institute of Technology — *Pasandena, CA*

Research Interests and Experience

Analytic and computational theory of the circumgalactic medium and galaxy evolution

NASA Hubble Fellowship Program Hubble Fellow — August 2023 - present
Smithsonian Astrophysical Observatory, Center for Astrophysics — *Cambridge, MA*
Developing new suite of cosmological galaxy evolution simulations focusing on the coevolution of galaxies and the circumgalactic medium

Postdoctoral Researcher — September 2019 - August 2023
Space Telescope Science Institute — *Baltimore, MD*
Led projects exploring circumgalactic medium structure in the FOGGIE group (PI Molly S. Peeples, Co-Is Jason Tumlinson & Brian W. O'Shea)

PhD Student — August 2013 - August 2019
The Ohio State University — *Columbus, OH*
Led several research projects on galactic winds, stellar feedback, the circumgalactic medium, and Lyα forest large scale structure with Todd A. Thompson, David H. Weinberg, and Smita Mathur

Kavli Summer Program in Astrophysics Student Fellow — June - August 2018
Center for Computational Astrophysics at the Flatiron Institute — *New York, NY*
Led research project on idealized simulations of circumgalactic medium with Greg Bryan

Highlights

- **Publications:** 8 first-author papers (128 total citations), 6 papers with substantial contributions (87 total citations), 7 papers with contributed observations (394 total citations)
- **Grants, Fellowships, and Awards:** NASA Hubble Fellow starting August 2023, PI of HST Theory grant (Cycle 28, $137,400), AAS Rodger Doxsey Travel Prize (2019), Graduate Student Fellow and Presidential Fellow (OSU 2013 and 2018)
- **Talks:** 17 invited talks and 6 contributed talks since 2019
- **Mentoring:** Primary or secondary mentor for three summer undergraduate research students
- **Teaching/Outreach:** Ran The Ohio State University Planetarium for two years, gave 89 planetarium shows, developed one new show from scratch, and won the first installment of OSU's Ann S. Tuttle Citizenship, Engagement, and Outreach Prize

- **Service:** Refereed 8 papers, organized FOGGIE group meetings (2020-present), reviewed applications for summer undergraduate research program, served as panel support for JWST Cycle 1 review panel, served on NASA Astrophysics Theory Program panel 2023

Proposals and Grants

- **Hubble Space Telescope Cycle 28 Archive Research Theory** January 2021 - December 2022
  *PI: **Cassandra Lochhaas***
  "What Holds Up the CGM?"
  $137,400, 2 years, 9.375 million CPU-hours on NASA Pleiades computer ($146,875)
  Co-Is: Molly S. Peeples, Jason Tumlinson, Brian W. O'Shea, Yong Zheng

- **Hubble Space Telescope Cycle 31 Archive Research Theory Grant** January 2024
  PI: Anna Wright
  "Predicting Dwarf Galaxy Evolution in Resolved Milky Way Halos"
  Co-Is: Molly S. Peeples, Jason Tumlinson, Brian W. O'Shea, **Cassandra Lochhaas**, Raymond Simons, Erik Tollerud, Gregory Snyder

- **Hubble Space Telescope Cycle 28 Archive Research Theory Grant** January 2021
  PI: Raymond Simons
  "On The Rapid Evolution of Galaxy Metallicity Gradients: A Bridge Between Theory and Observations"
  Co-Is: Molly S. Peeples, Jason Tumlinson, Brian W. O'Shea, Gregory Snyder, Ivelina Momcheva, **Cassandra Lochhaas**, Ramona Augustin, Casey Papovich, Jasleen Matharu

Teaching and Mentoring Experience

- **Co-mentor for Space Astronomy Summer Program** June - August 2022, 2023
  Space Telescope Science Institute *Baltimore, MD*
  - Was designated point-of-contact when primary mentor was unavailable
  - Helped undergraduate students with interpretation and presentation of results

- **Mentor for Space Astronomy Summer Program** June - August 2021
  Space Telescope Science Institute *Baltimore, MD*
  - Developed a project for an undergraduate student to investigate the spread of CGM metallicity and inward and outward metal mass fluxes through the CGM using cosmological zoom-in simulations
  - Mentored student through project with minimum twice-weekly meetings, including background on the field, how to read in and analyze simulation data, produce and interpret scientific plots
  - Coached student through final presentation and interpreting main results: hotter CGM gas has higher average and spread of metallicity, and metal mass primarily flows through and out of CGM without being retained

- **Planetarium TA** May 2015 - May 2017
  The Ohio State University *Columbus, OH*
  - Scheduled planetarium shows, trained volunteers, produced software documention and show scripts
  - Presented a total of 89 shows for the public, private field trip groups, and college classes
  - Attended the Spitz Summer Institute workshop in 2015 to learn how to produce effective planetarium shows
  - Developed new content, including an all-new full-length production, "Pluto: The Distant, Icy World"

- **TA for Introductory Astronomy courses** Spring Semester 2015
  The Ohio State University *Columbus, OH*
  - Developed problems for homework sets, generated exams, quizzes, and study guides, graded all student work, held review sessions and office hours

Selected Invited Talks

- **"The Non-Equilibrium and Dynamic Circumgalactic Medium"**
  Circumgalactic Medium at Notre Dame conference September 4, 2023
  Kylemore Abbey, Ireland
- **"Properties of Accretion in the FOGGIE Simulations"**
  Evolution of Gas in and Around Galaxies conference August 3, 2023
  Stanley, ID
- **"The Non-Equilibrium Circumgalactic Medium"**
  Diffuse Gas in Cosmic Ecosystems Special Interest Group June 22, 2023
  NASA Cosmic Origins Program Analysis Group (virtual)
- **"How well do equilibrium theories characterize the CGM?"**
  Oases in the Cosmic Desert conference February 21, 2023
  Arizona State University, Tempe, AZ
- **"Circumgalactic Medium Dynamics are Crucial to Galaxy Evolution"**
  Astronomy Colloquium February 14, 2023
  University of Virginia, Charlottesville, VA
- **"Circumgalactic Medium Dynamics are Crucial to Galaxy Evolution"**
  Physics Colloquium February 1, 2023
  North Carolina State University, Raleigh, NC
- **"Tracking the Fuel for Galaxy Growth"**
  Supercomputing 2022 conference, NASA Exhibit November 14-17, 2022
  Dallas, TX
- **"How Circumgalactic Medium Dynamics Impact Galaxy Evolution"**
  Astronomy Colloquium November 3, 2022
  University of Wisconsin Madison, Madison, WI
- **"Structure of the Circumgalactic Medium in High-Resolution Cosmological Simulations"**
  Astronomy Seminar December 10, 2021
  University of Pittsburgh/Carnegie Mellon University, Pittsburgh, PA
- **"Structure of the Circumgalactic Medium in High-Resolution Cosmological Simulations"**
  Astronomy Seminar December 8, 2021
  Michigan State University, East Lansing, MI
- **"Using Simulations to Understand the Structure of the Circumgalactic Medium"**
  Astrophysics Seminar October 13, 2020
  University of Notre Dame, Notre Dame, IN

Fellowships and Honors

- **NASA Hubble Fellowship** August 2023 - present
  Smithsonian Astrophysical Observatory *Cambridge, MA*
  - Developing new suite of cosmological galaxy evolution simulations focusing on the coevolution of galaxies and the circumgalactic medium with Faculty Contact Alexey Vikhlinin
- **American Astronomical Society Rodger Doxsey Travel Prize** January 2019
  American Astronomical Society 233rd Meeting *Seattle, WA*

- Travel funds awarded to 10 graduating PhD students to present dissertation work at AAS winter meeting

- **Ann S. Tuttle Citizenship, Engagement, and Outreach Prize** December 2018
  The Ohio State University Department of Astronomy *Columbus, OH*
  - Awarded the first installment of this prize for exceptional outreach work

- **Presidential Fellow** August 2018 - July 2019
  The Ohio State University Department of Astronomy *Columbus, OH*
  - Awarded to final-year graduate students for especially promising research in any field

- **Student Fellow, Kavli Summer Program in Astrophysics** June 2018 - August 2018
  Center for Computational Astrophysics, Flatiron Institute *New York, NY*
  - 16 students invited to 6-week intensive summer program in galaxy evolution

- **Graduate Student Fellow** September 2013 - August 2014
  The Ohio State University *Columbus, OH*
  - Awarded to especially promising incoming graduate students in any field

- **Robert L. Blinkenburg Summer Undergraduate Research Fellow** Summers 2011, 2012
  California Institute of Technology *Pasadena, CA*
  - Summer research funding awarded to undergraduate researchers with interesting projects

Service

- Refereed 8 papers
- Organized FOGGIE research group meetings 2020-present: scheduled agenda items for discussion
- Panel Support "Leveler" for JWST Cycle 1: listened to all panel discussions and ensured process remained fully anonymous
- Reviewed student applications for STScI Space Astronomy Summer Program, springs 2020-2022
- Served on NASA Astrophysics Theory Program Review Panel, November 2023
- Organized the Institute for Theory and Computation Discussion series, Center for Astrophysics, August 2023 to present

Cassandra Lochhaas - Publication List

First Author Publications

1. **Cassandra Lochhaas**, Jason Tumlinson, Molly S. Peeples, Brian W. O'Shea, et al., "Figuring Out Gas & Galaxies In Enzo (FOGGIE) VI: The Circumgalactic Medium of $L^\star$ Galaxies is Supported in an Emergent, Non-Hydrostatic Equilibrium", 2023, ApJ, 948, 43

2. **Cassandra Lochhaas**, Jason Tumlinson, Brian W. O'Shea, Molly S. Peeples, et al., "Figuring Out Gas & Galaxies In Enzo (FOGGIE) V: The Virial Temperature Does Not Describe Gas in a Virialized Galaxy Halo", 2021, ApJ, 922, 121

3. **Cassandra Lochhaas**, Todd A. Thompson, & Evan E. Schneider, "The Characteristic Momentum of Radiatively Cooling Energy-Driven Galactic Winds", 2021, MNRAS, 504, 3412

4. **Cassandra Lochhaas**, Greg L. Bryan, Yuan Li, et al., "Properties of the Simulated Circumgalactic Medium." 2020, MNRAS 493, 1461

5. **Cassandra Lochhaas**, Smita Mathur, Stephan Frank, et al., "A High Signal-to-Noise HST Spectrum Toward J1009+0713: Precise Absorption Measurements and the Origin of O VI." 2019, MNRAS 489, 78

6. **Cassandra Lochhaas**, Todd A. Thompson, Eliot Quataert, et al., "Fast Winds Drive Slow Shells: A Model for the CGM as Galactic Wind-Driven Shells." 2018, MNRAS, 481, 1873

7. **Cassandra Lochhaas** & Todd A. Thompson, "Second Generation Stars in Globular Clusters from Rapid Radiative Cooling of Pre-Supernova Massive Star Winds." 2017, MNRAS, 470, 977

8. **Cassandra Lochhaas**, David H. Weinberg, Sébastien Peirani, et al. "Modeling Lyman-α Forest Cross-Correlations with LyMAS." 2016, MNRAS, 461, 4353

Significant Contribution Publications

1. Alison L. Coil, Serena Perrotta, David S. N. Rupke, et al. (**Cassandra Lochhaas** 4th author of 12), "Detection of Spatially Extended Ionized Gas in an Odd Radio Circle", accepted to *Nature*, 2023

2. Hyeonmin Lee, Ayan Acharyya, Anna C. Wright, et al. (**Cassandra Lochhaas** 5th author of 7), "Evolution of Galaxy Size in the FOGGIE Simulations", 2023, Research Notes of the AAS, 7, 202

3. Anna C. Wright, Jason Tumlinson, Molly S. Peeples, et al. (**Cassandra Lochhaas** 5th author of 10), "Figuring Out Gas & Galaxies In Enzo (FOGGIE) VII: The (Dis)Assembly of Stellar Halos", submitted to ApJ, 2023, arXiv:2309.10039

4. Raymond C. Simons, Molly S. Peeples, Jason Tumlinson, et al. (**Cassandra Lochhaas** 7th author of 12), "Figuring Out Gas & Galaxies In Enzo (FOGGIE). IV. The Stochasticity of Ram Pressure Stripping in Galactic Halos", 2020, ApJ 905, 167

5. Yong Zheng, Molly S. Peeples, Brian W. O'Shea, et al. (**Cassandra Lochhaas** 5th author of 9), "Figuring Out Gas & Galaxies In Enzo (FOGGIE). III. The Mocky Way: Investigating Biases in Observing the Milky Way's Circumgalactic Medium", 2020, ApJ 896, 143

6. Yuan Li, Marie-Lou Gendron-Marsolais, Irina Zhuravleva, et al. (**Cassandra Lochhaas** 7th author of 19), "Direct Detection of Black Hole-driven Turbulence in the Centers of Galaxy Clusters", 2020, ApJL 889, 1

Contributed Observations Publications

1. Keith Horne, G. De Rosa, B. M. Peterson, et al., "Space Telescope and Optical Reverberation Mapping Project. IX. Velocity-Delay Maps for Broad Emission Lines in NGC 5548", 2021, ApJ 907, 76

2. Williams, P. R., Pancoast, A., Treu, T., et al., "Space Telescope and Optical Reverberation Mapping Project. XII. Broad-Line Region Modeling of NGC 5548", 2020, ApJ 902, 74

3. G. A. Kriss, G. De Rosa, J. Ely, et al., "Space Telescope and Optical Reverberation Mapping Project. VIII. Time Variability of Emission and Absorption in NGC 5548 Based on Modeling the Ultraviolet Spectrum", 2019, ApJ 881, 153

4. G. De Rosa, M. M. Fausnaugh, C. J. Grier, et al., "Velocity-resolved Reverberation Mapping of Five Bright Seyfert 1 Galaxies." 2018, ApJ 866, 133

5. M. M. Fausnaugh, D. A. Starkey, Keith Horne, et al., "Continuum Reverberation Mapping of the Accretion Disks in Two Seyfert 1 Galaxies." 2018, ApJ, 854, 107

6. M. M. Fausnaugh, C. J. Grier, M. C. Bentz, et al., "Reverberation Mapping of Optical Emission Lines in Five Active Galaxies." 2017, ApJ, 840, 97

7. L. Pei, M. M. Fausnaugh, A. J. Barth, et al., "Space Telescope and Optical Reverberation Mapping Project. V. Optical Spectroscopic Campaign and Emission-line Analysis for NGC 5548." 2017, ApJ, 837, 131