

# FAKHRI S. ZAHEDY

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## CURRENT POSITION

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**Carnegie Fellow** 2019 - present  
Observatories of the Carnegie Institution for Science

## EDUCATION

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**The University of Chicago** 2019  
Ph.D. in Astronomy & Astrophysics  
Thesis: *Multi-Pronged Studies of Diffuse Halo Gas around Massive Quiescent Galaxies*  
Advisor: Prof. Hsiao-Wen Chen

**The University of Chicago** 2015  
M.S. in Astronomy & Astrophysics

**Massachusetts Institute of Technology (MIT)** 2013  
B.S. in Physics, with concentrations in Astronomy and Music  
Cumulative GPA: 5.00/5.00  
Inducted to Phi Beta Kappa and Sigma Pi Sigma

## RESEARCH INTERESTS

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- The co-evolution between galaxies and the circumgalactic medium (CGM) over cosmic time
- Spatially and spectrally resolving the circumgalactic medium using observations of multiply lensed quasars
- Chemical enrichment of diffuse gas within and around distant galaxies
- Feedback processes in massive and quiescent galaxy halos
- The relationship between galaxies and the intergalactic medium (IGM) at high redshifts

## RESEARCH HIGHLIGHTS

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- 7 first-author, 4 second-author, and 15 co-authored journal articles totaling over 550 citations (as of February 2023); h-index: 13
- Awarded \$671k in funding (grants and fellowships) as Science PI since 2016
- PI of three observing programs (and Co-I on four additional programs) on the *Hubble Space Telescope (HST)* in Cycles 24-30 (2016-2022)
- Awarded 40 nights as PI on the 6.5m Magellan Telescopes since 2019 (eight observing semesters)

## SELECTED FELLOWSHIPS AND AWARDS

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Thacher Research Award for Postdoctoral Excellence, Carnegie Observatories	2021
Carnegie Postdoctoral Fellowship, Carnegie Observatories	2019
James W. Cronin Memorial Fellowship, The University of Chicago	2018
William R. Harper Dissertation Fellowship, The University of Chicago	2018
International Travel Grant Award, The American Astronomical Society (AAS)	2017
Brinson Chicago-Carnegie Predoctoral Fellowship, Carnegie Observatories	2016
McCormick Graduate Fellowship, The University of Chicago	2013 - 2015
Phi Beta Kappa, Massachusetts Institute of Technology	2013
Sigma Pi Sigma, Massachusetts Institute of Technology	2013

## AWARDED TELESCOPE TIME (AS PRINCIPAL INVESTIGATOR)

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The 6.5m Magellan Telescopes: 40 nights	2019 - present
HST/STIS Cycle 30, <i>A High-Definition View of the Baryon Cycle in Massive Galaxies</i> (GO-17146): 36 orbits ( <b>\$281k awarded</b> )	2022
HST/COS Cycle 25, <i>Resolving the Multiphase ISM of an Elliptical Galaxy at <math>z\sim 0.4</math></i> (GO-15250): 11 orbits ( <b>\$57k awarded</b> )	2017
HST/STIS Cycle 24, <i>Resolving Fe-rich Neutral ISM in a Massive Quiescent Galaxy at <math>z\sim 0.4</math></i> (GO-14751): 3 orbits ( <b>\$43k awarded</b> )	2016

## AWARDED TELESCOPE TIME (AS CO-INVESTIGATOR)

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The Magellan Telescopes: 70+ nights	2014 - present
ESO/VLT MUSE: 49.5 hours	2016 - 2019
HST COS Cycle 25, <i>COS Ultraviolet Baryon Survey</i> (GO-15163): 169 orbits	2017
HST COS Cycle 25, <i>UV Observation of a QSO Sightline Intersecting an X-ray Identified Filament of the Cosmic Web</i> (GO-15198): 5 orbits	2017
HST ACS Cycle 25, <i>Unveiling Quasar Fueling through a Public Snapshot Survey of Quasar Host Environments</i> (SNAP-15279): 124 targets	2017
HST ACS Cycle 24, <i>Differentiating Gas Infall and Outflows with Resolved Star Formation Morphology</i> (GO-14667): 5 orbits	2016
NOAO Gemini GMOS-N: 2 nights	2015
MMT Hectospec & MAESTRO: 2 nights	2015

## PREVIOUS RESEARCH EXPERIENCE

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<b>Research Assistant</b> at The University of Chicago, <i>with Prof. Hsiao-Wen Chen</i>	2013 - 2019
<b>Brinson Predoctoral Fellow</b> at Carnegie Observatories, <i>with Dr. Michael Rauch</i>	2016 - 2017
<b>Undergraduate Researcher</b> at MIT, <i>with Prof. Jacqueline Hewitt</i>	2011
<b>Undergraduate Researcher</b> at Lowell Observatory, <i>with Dr. Deidre Hunter</i>	2010
<b>Undergraduate Researcher</b> at MIT, <i>with Prof. James L. Elliot</i>	2010

## SERVICE, MENTORING, AND TEACHING

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<b>Undergraduate Research Mentor</b> , Carnegie Observatories	2021 - present
<ul style="list-style-type: none"><li>• Primary science mentor for Mr. Benjamin Snyder (Cal Poly Pomona), an undergraduate student investigating the impact of galaxy interactions on the cool CGM properties of massive quiescent galaxies. Project resulted in two AAS posters and a student-led paper, scheduled for submission by the end of 2022</li></ul>	
<b>Science Referee</b> for Nature Astronomy, The Astrophysical Journal (ApJ), ApJ Letters, and the Monthly Notices for the Royal Astronomical Society (MNRAS)	2018 - present
<b>External Panelist</b> for the <i>HST</i> Time Allocation Committee (Cycles 28, 29, and 30)	2020 - present
<b>Mentor and Instructor</b> , Carnegie Astrophysics Summer Student Internship (CASSI) program	2020 - present
<ul style="list-style-type: none"><li>• Provided career mentoring to four undergraduate researchers since 2020</li><li>• Organized and led workshops on the astronomy graduate school application process in 2020 and 2021</li></ul>	
<b>Organizer</b> , Carnegie Summer Research Program Talk Series	2022
<b>Organizer</b> , Summer Tea Talks, Carnegie Observatories	2021
<b>External Reviewer</b> for NASA's Future Investigators in Earth and Space Science and Technology (FINESST) Graduate Fellowship	2020-2021
<b>Postdoctoral Representative</b> , Carnegie Observatories	2020 - 2021
<b>Volunteer and Presenter</b> , Carnegie Observatories Annual Open House	2019
<b>Student Member</b> , Graduate Admissions Committee, The University of Chicago	2018 - 2019
<b>Astronomy Conversations Presenter</b> , Adler Planetarium	2015 - 2016
<b>Graduate Student Representative to the Faculty</b> , Department of Astronomy & Astrophysics, The University of Chicago	2014 - 2016
<b>Teaching Assistant</b> , Department of Astronomy & Astrophysics, The University of Chicago (five academic quarters)	2013 - 2015
<b>Teaching Assistant and Peer Mentor</b> , The Experimental Study Group (ESG), MIT	2010-2011

## SCIENTIFIC TALKS

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Department of Physics Colloquium, University of Wisconsin-Milwaukee (Invited)	2023
Oases in the Cosmic Desert: Understanding the Circumgalactic Medium, Tempe, AZ	2023
Department of Physics Colloquium, University of North Texas (Invited)	2023
Department of Physics and Astronomy Colloquium, University of Kentucky (Invited)	2023
Kavli IPMU Astro Seminar, The University of Tokyo, Japan (Invited)	2022
What Matter(s) Around Galaxies 2022, Champoluc, Italy (virtual)	2022
Epoch of Galaxy Quenching, Kavli Institute for Cosmology, Cambridge, UK (virtual)	2022
Astronomy Lunch Talk, The University of Washington, Seattle, CA (Invited)	2022
CIERA Astrophysics Seminar, Northwestern University, Evanston, IL (Invited)	2022
Astronomy Tea talk, California Institute of Technology, Pasadena, CA (Invited)	2021
Carnegie Summer Research Program Colloquium, Carnegie Observatories (Invited)	2021
Cosmology, Galaxies, Intergalactic Medium (CGI) seminar, UC Santa Cruz (Invited)	2021
Radio Lunch Talk, California Institute of Technology, Pasadena, CA (Invited)	2021
Fundamental of Gaseous Halos Workshop, Kavli Institute of Theoretical Physics, UC Santa Barbara, Santa Barbara, CA	2021
Galaxies and Clusters Seminar Series, University of Michigan (Invited)	2020
Epoch of Galaxy Quenching, Kavli Institute for Cosmology, Cambridge, UK	2020
Center for Computational Astrophysics Lunch Talk, Flatiron Institute, NY (Invited)	2020
The Circumgalactic Medium around Galaxies: When Baryons Invest Halos, Annual IAP Colloquium, Paris, France (virtual)	2020
Quenching and Transformation Through Cosmic Time, Aspen Center for Physics, CO	2020
UCSB Astro Lunch, UC Santa Barbara, Santa Barbara, CA (Invited)	2019
The Cosmic Baryon Cycle: 7th GMT Community Science Meeting, Carlsbad, CA	2019
Dissertation Talk, the 233rd American Astronomical Society Meeting, Seattle, WA	2019
Princeton University Astrophysics Galread Seminar, Princeton, NJ	2018
MIT Astrophysics Brown Bag Lunch Talk, Cambridge, MA	2018
Steward Observatory Galaxy Group Talk, Tucson, AZ	2018
Carnegie Observatories Lunch Talk, Pasadena, CA	2018
Northwestern University Circumgalactic Medium Workshop, Evanston, IL	2018

## SCIENTIFIC TALKS (CONTINUED)

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Intergalactic Interconnections Conference, Marseille, France	2018
The Circle of Life: Connecting the Intergalactic, Circumgalactic, and Interstellar Media, Kruger Park, South Africa	2017
STScI Spring Symposium: Lifecycle of Metals Throughout the Universe, Baltimore, MD	2017
From Wall to Web Conference, Berlin, Germany	2016
Gas/Galaxies on Top of Quasars (GOTOQ) Workshop, Pittsburgh, PA	2016

## ACADEMIC REFERENCES

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**Prof. Hsiao-Wen Chen (Ph.D Advisor)**

Professor, The University of Chicago

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**Dr. John S. Mulchaey**

Director, Carnegie Observatories and Science Deputy, Carnegie Institution for Science

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**Dr. Michael Rauch (Carnegie Fellowship Advisor)**

Staff Scientist, Carnegie Observatories

phone: (626) 304-0262 | email: [mr@carnegiescience.edu](mailto:mr@carnegiescience.edu)

**Dr. Gwen Rudie**

Staff Scientist, Carnegie Observatories

phone: (626) 304-0232 | email: [gwen@carnegiescience.edu](mailto:gwen@carnegiescience.edu)

**Prof. Ann Zabludoff**

Professor, The University of Arizona and Steward Observatory

phone: (520) 626-2509 | email: [azabludoff@as.arizona.edu](mailto:azabludoff@as.arizona.edu)

**Publication Summary:** 26 refereed papers (7 first-author, 4 second author, 15 co-author). 556 total citations (Google Scholar, February 2023). h-index: 13

## First-Author and Second-Author Scientific Publications

11. **Zahedy, F. S.**, Chen, H.-W., Cooper, T. M., Boettcher, E., Johnson, S. D., Rudie, G. C., Chen, M. C., et al., *The Cosmic Ultraviolet Baryon Survey (CUBS) - III. Physical Properties and Elemental Abundances of Lyman Limit Systems at  $z < 1$* , Monthly Notices of the Royal Astronomical Society, Volume 506, Issue 1, p.877-902 (2021; [link](#), 17 citations)
10. **Zahedy, F. S.**, Chen, H.-W., Boettcher, E., Rauch, M., French, K. D., Zabludoff, A. I., *Evidence for Late-Time Feedback from the Discovery of Multiphase Gas in a Massive Elliptical at  $z = 0.4$* , The Astrophysical Journal Letters, Volume 904, Issue 1, L10 (2020; [link](#), 9 citations)
9. Chen, H.-W., **Zahedy, F. S.**, Boettcher E., Cooper T. M., Johnson S. D., Rudie G. C., Chen M. C., et al., *The Cosmic Ultraviolet Baryon Survey (CUBS) - I. Overview and the Diverse Environments of Lyman Limit Systems at  $z < 1$* , Monthly Notices of the Royal Astronomical Society, Volume 497, Issue 1, pp. 498-520 (2020; [link](#), 32 citations)
8. Connor, T., **Zahedy, F. S.**, Chen, H.-W., Cooper, T. J., Mulchaey, J. S., Vikhlinin, A., *COS Observations of the Cosmic Web: A Search for the Cooler Components of a Hot, X-ray Identified Filament*, The Astrophysical Journal Letters, Volume 884, Issue 1, article id. L20 (2019; [link](#), 11 citations)
7. **Zahedy, F. S.**, Rauch, M., Chen, H.-W., Carswell, R. F., Stark, A. A., & Stalder, B., *Probing IGM Accretion onto  $z \sim 2.8$  Ly $\alpha$  Emitters*, Monthly Notices of the Royal Astronomical Society, Volume 486, Issue 1, p.1392-1403 (2019; [link](#), 7 citations)
6. **Zahedy, F. S.**, Chen, H.-W., Johnson, S. D., Pierce, R. M., Rauch, M., Huang, Y.-H., Weiner, B. J., Gauthier, J.-R., *Characterizing Circumgalactic Gas around Massive Ellipticals at  $z = 0.4$ : II. Physical Properties and Elemental Abundances*, Monthly Notices of the Royal Astronomical Society, Volume 484, Issue 2, p.2257-2280 (2019; [link](#), 114 citations)
5. Chen, H.-W., **Zahedy, F. S.**, Johnson, S. D., Pierce, R. M., Huang, Y.-H., Weiner, B. J., & Gauthier, J.-R., *Characterizing Circumgalactic Gas around Massive Ellipticals at  $z = 0.4$ : I. Initial Results*, Monthly Notices of the Royal Astronomical Society, Volume 479, Issue 2, p. 2547-2563 (2018; [link](#), 56 citations)
4. **Zahedy, F. S.**, Chen, H.-W., Rauch, M., & Zabludoff, A. I., *HST Detection of Extended Neutral Hydrogen in a Massive Elliptical at  $z = 0.4$* , The Astrophysical Journal Letters, Volume 846, Issue 2, article id. L29 (2017; [link](#), 10 citations)
3. **Zahedy, F. S.**, Chen, H.-W., Gauthier, J.-R., & Rauch, M., *On the Radial Profile of Gas-phase Fe/ $\alpha$  Ratio Around Distant Galaxies*, Monthly Notices of the Royal Astronomical Society, Volume 466, Issue 1, p. 1071-1081 (2017; [link](#), 19 citations)
2. **Zahedy, F. S.**, Chen, H.-W., Rauch, M., Wilson, M. L., & Zabludoff, A. I., *Probing the Cool Interstellar and Circumgalactic Gas of Three Massive Lensing Galaxies at  $z = 0.4-0.7$* , Monthly Notices of the Royal Astronomical Society, Volume 458, Issue 3, p. 2423-2442 (2016; [link](#), 54 citations)

1. Hunter, D. A., **Zahedy, F. S.**, Bowsher, E. C., Wilcots, E. M., Kepley, A. A., & Goad, V., *Mapping the Extended HI Distribution of Three Dwarf Galaxies*, The Astronomical Journal, Volume 142, Issue 5, article id. 173 (2011; [link](#), 15 citations)

## Co-Author Scientific Publications

15. Nishigaki, M. , et al. (incl. **Zahedy, F. S.**), *EMPRESS XI. SDSS and JWST Search for Local and  $z \sim 4 - 5$  Extremely Metal-Poor Galaxies (EMPGs): Clustering and Chemical Properties of Local EMPGs*, ApJ submitted (February 2023; [link](#))
14. Qu, Zhijie, Chen, H.-W., Rudie, G. C., Johnson, S.D., **Zahedy, F. S.**, et al., *The Cosmic Ultraviolet Baryon Survey (CUBS) - VI. Environmental Dependence of Circumgalactic Medium Properties at  $z \sim 1$* , MNRAS submitted (January 2023)
13. Chen, Mandy C., et al. (incl. **Zahedy, F. S.**), *Empirical Constraints on the Turbulence in QSO Host Nebulae from Velocity Structure Function Measurements*, MNRAS, 518, 2354 (2023; [link](#))
12. Qu, Zhijie, Chen, H.-W., Rudie, G. C., **Zahedy, F. S.**, et al., *The Cosmic Ultraviolet Baryon Survey (CUBS) - V. On the Thermodynamic Properties of the Cool Circumgalactic Medium at  $z < 1$* , MNRAS, 516, 4882 (2022; [link](#))
11. Nakajima, K. , et al. (incl. **Zahedy, F. S.**), *EMPRESS V. Metallicity Diagnostics of Galaxies over  $12 + \log(\text{O}/\text{H}) = 6.9 - 8.9$  Established by a Local Galaxy Census: Preparing for JWST Spectroscopy*, ApJS in press (2022; [link](#))
10. Xu, Y., et al. (incl. **Zahedy, F. S.**), *EMPRESS VI. Outflows Investigated in Low-mass Galaxies with  $M_{\text{star}} = 10^4 - 10^7 M_{\odot}$ : Weak Feedback in Low-mass Galaxies?*, ApJ, 929, 134 (2022; [link](#))
9. Boettcher, E. , et al. (incl. **Zahedy, F. S.**), *Discovery of a Damped Ly $\alpha$  Absorber Originating in a Spectacular Interacting Dwarf Galaxy Pair at  $z = 0.026$* , The Astrophysical Journal Letters, Volume 926, Issue 2, article id. L33 (2022; [link](#))
8. Cooper, T. J., Rudie, G. C., Chen, H.-W., Johnson, S. D., **Zahedy, F. S.**, Chen, M. C., et al., *The Cosmic Ultraviolet Baryon Survey (CUBS) - IV. The Complex Multiphase Circumgalactic Medium as Revealed by Partial Lyman Limit Systems*, MNRAS, 508, 4359 (2021; [link](#))
7. Boettcher, E., Chen, H.-W., **Zahedy, F. S.**, Cooper, T. J., Johnson, S. D., Rudie, G. C., et al., *The Cosmic Ultraviolet Baryon Survey (CUBS) - II. Discovery of an H $_2$ -Bearing DLA in the Vicinity of an Early-Type Galaxy at  $z = 0.576$* , ApJ, 913, 18 (2021; [link](#))
6. Huang, Y.-H., Chen, H.-W., Shectman, S. A., Johnson, S. D., **Zahedy, F. S.**, Helsby, J. E., Gauthier, J.-R., Thompson, I. B., *A Complete Census of Circumgalactic Mg II at Redshift  $z < 0.5$* , Monthly Notices of the Royal Astronomical Society, 502, 4743 (2021; [link](#))
5. Gaikwad, P., Rauch, M., Haehnelt, M. G., Puchwein, E., Bolton, J. S., Keating, L. C., Kulkarni, G., Irsic, V., Banados, E., Becker, G. D., Boera, E., **Zahedy, F. S.**, et al., *Probing the Thermal State of the Intergalactic Medium at  $z > 5$  with the Transmission Spikes in High-Resolution Ly $\alpha$  Forest Spectra*, Monthly Notices of the Royal Astronomical Society, 494, 5091 (2020; [link](#))



4. Chen H.-W., Boettcher, E., Johnson, S. D., **Zahedy, F. S.**, Rudie G. C., Cooksey K. L., Rauch M., Mulchaey, J. S., *A Giant Intragroup Nebula Hosting a Damped Ly $\alpha$  Absorber at  $z = 0.313$* , The Astrophysical Journal Letters, Volume 878, article id. L33 (2019; [link](#))
3. Voit, G. M., Donahue, M., **Zahedy, F. S.**, Chen, H.-W., Werk, J. K., Bryan, G. L., O'Shea, B. W., *Circumgalactic Pressure Profiles Indicate Precipitation-Limited Atmospheres for  $M_{\text{star}} \sim 10^9 - 10^{11.5} M_{\odot}$* , The Astrophysical Journal Letters, Volume 879, article id. L1 (2019; [link](#))
2. Chen, H.-W., Johnson, S. D., Straka, L. A., **Zahedy, F. S.**, Schaye, J., Muzahid, S., Bouche, N., et al., *Characterizing Circumgalactic Gas around Massive Ellipticals at  $z \sim 0.4$ : III. The Galactic Environment of a Chemically Pristine Lyman Limit Absorber*, Monthly Notices of the Royal Astronomical Society, 484, 431 (2019;[link](#))
1. Chen, H.-W., Johnson, S. D., **Zahedy, F. S.**, Rauch, M., & Mulchaey, J. S., *Gauging Metallicity of Diffuse Gas under an Uncertain Ionizing Radiation Field*, The Astrophysical Journal Letters, Volume 842, Issue 2, article id. L19 (2017; [link](#))

## Astro 2020 Decadal Survey Science White Papers

3. Voit, G. M., et al. (incl. **Zahedy, F. S.**), *Circumgalactic Gas and the Precipitation Limit*, Astro2020: Decadal Survey on Astronomy and Astrophysics, science white papers, Bulletin of the American Astronomical Society, Vol. 51, Issue 3, id. 405 (2019)
2. Chen, H.-W., et al. (incl. **Zahedy, F. S.**), *Tracking the Baryon Cycle in Emission and in Absorption*, Astro2020: Decadal Survey on Astronomy and Astrophysics, science white papers, Bulletin of the American Astronomical Society, Vol. 51, Issue 3, id. 329 (2019)
1. Rudie, G. C., et al. (incl. **Zahedy, F. S.**), *Observing Galaxies and Dissecting their Baryon Cycle at Cosmic Noon*, Astro2020: Decadal Survey on Astronomy and Astrophysics, science white papers, Bulletin of the American Astronomical Society, Vol. 51, Issue 3, id. 148 (2019)