

CHRISTIAN R. HAYES

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OBJECTIVE

Experienced with analyzing large, high-dimensional data sets, utilizing a variety of techniques, including modeling and machine learning, and adept at reporting results to both expert and general audiences; seeking a Data Scientist position to aid in the analysis and interpretation of data through creative problem solving.

WORK EXPERIENCE

Research Scientist, University of Washington 2020 - present

- Serve as a data processing specialist with the APOGEE-2 data reduction pipeline team to generate survey data products and vet their quality prior to public release.
- Develop physically-motivated, non-linear models of the evolution of dwarf galaxies and develop techniques to fit sparse observations of real systems.
- Oversee and coordinate with the APOGEE-2 survey's targeting team personnel to ensure that the science team's plans are executed, develop modifications to the survey's targeting plan, and assess and communicate the status of the survey to the APOGEE team.

Research Assistant, University of Virginia 2015 - 2020

- Manipulated databases of 100s of thousands to 100s of millions of stars in Python using a variety of analysis and machine learning techniques.
- Developed data visualization methods in matplotlib to interpret and analyze databases with 30-300 dimensions.
- Developed non-linear models of the spatial and velocity distributions of star clusters in Python to detect their orientation and rotation from samples of thousands of stars.
- Using clustering and non-linear models, identified that 0.5% of a 150,000 star sample of the Milky Way originated in dwarf galaxies that were accreted into the Milky Way.
- Discovered that the stellar disk of the Milky Way is about twice the size through the classification of stars and justification with regression techniques.

Cox Research Scholar, Indiana University 2011 - 2015

- Performed image and spectral analysis to identify stars and measure their properties.
- Cataloged archived data and studied the time evolution of systems of star clusters.
- Awarded the Provost's Award for Undergraduate Research and Creative Activity (2014) for research published in a peer-reviewed publication and the Barry M. Goldwater Scholarship (2014).

NSF REU Research Assistant, University of Rochester 2014

- Analyzed images from the *Spitzer Space Telescope* and performed spectral modeling and decomposition.

TEAMWORK, LEADERSHIP, AND VOLUNTEER EXPERIENCE

APOGEE-2 Team Member, APOGEE Survey 2016 - present

- Contributed to targeting and planning of the APOGEE survey and led the evaluation of survey progress for individual programs as a part of yearly survey wide reviews (2018, 2019).
- Vetted databases of 100s of thousands of stars and assisted with documentation for the public data releases of the APOGEE survey.

Dark Skies, Bright Kids Volunteer, Charlottesville, Virginia 2015 - present

- Planned and ran astronomy outreach programs for elementary school students particularly those who are underserved or from under-represented minorities in the STEM fields (8 after-school programs and 4 summer camps).
- After-school program coordinator for two years and summer camp coordinator for one year.
- Member and lead of the “DSBK Assessments Team” (2017 - 2020) that evaluates the goals of the program.

Volunteer Presenter, Fan Mountain Observatory Public Nights 2015 - present

- Gave presentations and demonstrations of astronomical principles, techniques, and instruments to the general public at eight Fan Mountain Observatory Public Nights.
- Taught other volunteers how to set-up demonstrations and what to present to public night tours.

Telescope Operator, Leander McCormick Observatory Public Nights 2015 - 2019

- Operated both modern and antique telescopes to show astronomical objects to the general public.
- Trained volunteers how to use telescopes and how to run telescope viewings for the public.

Graduate Admissions Committee Member, UVA Astronomy Department 2019

- Participated in the selection process and managed the list of candidates and their qualifications.
- Organized, scheduled, and conducted interviews of candidates.
- Planned and coordinated prospective student visits to UVA.

Qualifying Exam Committee Member, UVA Astronomy Department 2017 - 2018

- Developed the astronomy graduate qualifying exam with the other committee members.
- Designed questions for the astronomy graduate qualifying exam.

Head Teaching Assistant, UVA Astronomy Department 2016 - 2017

- Organized and decided the graduate student teaching assistant assignments for the Astronomy department and scheduled lab assignments.
- Archived department teaching assistant resources for ease of future use.

HONORS AND AWARDS

Raven Society Inductee , Raven Society, UVA	2018
C. Mark Pirrung Family Jefferson Fellow , Jefferson Scholars Foundation	2017
Laurence W. Fredrick Teaching Award , UVA Astronomy	2017
National Science Foundation Graduate Research Fellow , NSF	2017
Graduate STEM Research Fellow , Virginia Space Grant Consortium	2016
Astronomy/Observatory Scholarship , IU Astronomy	2015
Barry M. Goldwater Scholar	2014
Provost’s Award for Undergraduate Research and Creative Activity , IU	2014
Hollis & Greta Johnson Research Scholarship , IU Astronomy	2013, 2014, 2015
Chambliss Astronomy Achievement Student Award , AAS	2013
Edward C. McCreery Undergraduate Research Travel Award , IU Astronomy	2013
Summer Research Partnership Scholarship , Hutton Honors College, IU	2012
Cox Research Scholar , IU	2011 - 2015

RESEARCH GRANTS

NSF/AST Grant #1908331, Collaborator (\$351,297) Sept 2019 - Sept 2022

Wrote the scientific justification for the successful competitive NSF/AST grant proposal titled *The Evolution of Dwarf Galaxies – A Comprehensive View of the Magellanic Clouds*, which was led by the Principal-Investigators, Drs. David Nidever and Steven Majewski.

GSASC Research Grant, Principal-Investigator (\$1,000) 2019

Wrote a successful application for the Graduate School of Arts and Sciences Council competitive research grant to fund research or travel opportunities.

TEACHING EXPERIENCE

Undergraduate Research Mentor

- **Yara Yousef**, University of Virginia 2017 - 2018

Course Instructor

- ASTR 1270: Unsolved Mysteries in the Universe, University of Virginia Summer 2017

Teaching Assistant, University of Virginia

- ASTR 1230: Introduction to Astronomical Observation Spring 2017
- ASTR 1270: Unsolved Mysteries in the Universe Spring 2017
- ASTR 1559: Black Holes Fall 2016
- ASTR 1270: Unsolved Mysteries in the Universe Spring 2016
- ASTR 1230: Introduction to Astronomical Observation Fall 2015
- ASTR 1220: Introduction to Stars, Galaxies, and the Universe Fall 2015
- Night Lab Instructor 2015 - 2017

Miscellaneous Teaching Experiences:

- Course grader for ASTR 5610: Galactic Structure and Stellar Populations (graduate course) Spring 2018
- Session Facilitator at the UVA Center for Teaching Excellence (CTE) Teaching As a Graduate Student (TAGS) Workshop. 2017, 2018, 2019
- Ran an IRAF tutorial for graduate students Fall 2017

REFEREED PUBLICATIONS

Summary: 23 total, 7 first author, 3 second or third author

22. Cheng, X., Anguiano, B., Majewski, S. R., **Hayes, C. R.**, Arras, P., et al. 2020 “*Exploring the Galactic Warp Through Asymmetries in the Kinematics of the Galactic Disk*,” The Astrophysical Journal, accepted. (2020)
21. R. Ahumada, C. Allende Prieto, A. Almeida, F. Anders, S. F. Anderson, **et al.** 2020 “*The Sixteenth Data Release of the Sloan Digital Sky Surveys: First Release from the APOGEE-2 Southern Survey and Full Release of eBOSS Spectra*,” The Astrophysical Journal Supplements, 249, 3. (2020)
20. B. Anguiano, S. R. Majewski, **C. R. Hayes**, C. Allende Prieto, X. Cheng, et al. 2020 “*The Stellar Velocity Distribution Function in the Milky Way Galaxy*,” The Astrophysical Journal, 160, 43. (2020)
19. **C. R. Hayes**, A. M. Matthews, Y. Song, S. T. Linden, S. E. Liss, et al. 2020 “*First Results from the Dark Skies, Bright Kids Astronomy Club Draw-A-Scientist Test*,” Physical Review Physics Education Research, 16, 010131. (2020)
18. D. L. Nidever, S. Hasselquist, **C. R. Hayes**, K. Hawkins, S. R. Majewski, et al. 2020 “*The Lazy Giants: APOGEE Abundances Reveal Low Star Formation Efficiencies in the Magellanic Clouds*,” The Astrophysical Journal, 895, 88. (2020)
17. **C. R. Hayes**, S. R. Majewski, S. Hasselquist, B. Anguiano, M. Shetrone, et al. 2020 “*Metallicity and α -element Abundance Gradients along the Sagittarius Stream as Seen by APOGEE*,” The Astrophysical Journal, 889, 63. (2020)

16. R. Guerço, K. Cunha, V. V. Smith, **C. R. Hayes**, C. Abia, et al. 2019 “*Fluorine Abundances in the Galactic Disk*,” The Astrophysical Journal, 885, 139. (2019)
15. D. H. Weinberg, J. A. Holtzman, S. Hasselquist, J. C. Bird, J. A. Johnson, **et al.**, 2019, “*Chemical Cartography with APOGEE: Multi-element abundance ratios*,” The Astrophysical Journal, 874, 102. (2019)
14. D. S. Aguado, R. Ahumada, A. Almeida, S. F. Anderson, B. Andrews, **et al.**, 2019, “*The Fifteenth Data Release from the Sloan Digital Sky Surveys: First Release of MaNGA Derived Quantities, Data Visualization Tools and Stellar Library*,” The Astrophysical Journal Supplement Series, 240, 23. (2019)
13. S. Hasselquist, J. L. Carlin, J. A. Holtzman, M. Shetrone, **C. R. Hayes**, et al., 2019, “*Tracing the Sagittarius Stream using APOGEE Chemical Abundances*,” The Astrophysical Journal, 872, 58. (2019)
12. J. T. Mackereth, R. P. Schiavon, J. Pfeffer, **C. R. Hayes**, J. Bovy, et al., 2019, “*The origin of accreted stellar halo populations in the Milky Way using APOGEE, Gaia, and the EAGLE simulations*,” Monthly Notices of the Royal Astronomical Society, 482, 3426. (2019)
11. J. J. Andrews, B. Anguiano, J. Chanamé, M. A. Agüeros, H. M. Lewis, **et al.**, 2019 “*Using APOGEE Wide Binaries to Test Chemical Tagging with Dwarf Stars*,” The Astrophysical Journal, 871, 42. (2019)
10. **C. R. Hayes**, D. R. Law, S. R. Majewski, 2018 “*Constraining the Solar Reflex Velocity Using Gaia Observations of the Sagittarius Stream*,” The Astrophysical Journal Letters, 867L, 20H. (2018)
9. **C. R. Hayes**, S. R. Majewski, S. Hasselquist, R. L. Beaton, K. Cunha, et al., 2018, “*Disk-Like Chemistry of the Triangulum-Andromeda Overdensity as Seen by APOGEE*,” The Astrophysical Journal Letters, 859, L8. (2018)
8. B. Abolfathi, D. S. Aguado, G. Aguilar, C. Allende Prieto, A. Almeida, **et al.**, 2018 “*The Fourteenth Data Release of the Sloan Digital Sky Survey: First Spectroscopic Data from the extended Baryon Oscillation Spectroscopic Survey and from the second phase of the Apache Point Observatory Galactic Evolution Experiment*,” The Astrophysical Journal Supplement Series, 235, 42. (2018)
7. E. Fernández-Alvar, L. Carigi, W. J. Schuster, **C. R. Hayes**, N. Ávila-Vergara, et al., 2018, “*Disentangling the Galactic Halo with APOGEE: II. Chemical and Star Formation History for the Two Distinct Populations*,” The Astrophysical Journal, 852, 50. (2018)
6. **C. R. Hayes**, S. R. Majewski, M. Shetrone, E. Fernández-Alvar, C. Allende Prieto, et al., 2018, “*Disentangling the Galactic Halo with APOGEE: I. Chemical and Kinematical Investigation of Distinct Metal-Poor Populations*,” The Astrophysical Journal, 852, 49. (2018)
5. D. L. Nidever, K. Olsen, A. R. Walker, A. K. Vivas, R. D. Blum, **et al.**, 2017, “*SMASH - Survey of MAgellanic Stellar History*,” The Astronomical Journal, 154, 199. (2017)
4. F. D. Albareti, C. Allende Prieto, A. Almeida, F. Anders, S. Anderson, **et al.**, 2017, “*The Thirteenth Data Release of the Sloan Digital Sky Survey: First Spectroscopic Data from the SDSS-IV Survey MAPPING Nearby Galaxies at Apache Point Observatory*,” The Astrophysical Journal Supplement Series, 233, 25. (2017)
3. J. G. Fernández-Trincado, O. Zamora, D. A. García-Hernández, D. Souto, F. Dell’Agli, **et al.**, 2017, “*Atypical Mg-poor Milky Way Field Stars with Globular Cluster Second-generation-like Chemical Patterns*,” The Astrophysical Journal Letters, 846, 2. (2017)
2. S. T. Linden, M. Pryal, **C. R. Hayes**, N. W. Troup, S. R. Majewski, et al., 2017, “*Timing the Evolution of the Galactic Disk with NGC 6791: An Open Cluster with Peculiar High- α Chemistry as Seen by APOGEE*,” The Astrophysical Journal, 842, 49. (2017)

1. **C. R. Hayes**, E. D. Friel, T. J. Slack, & O. M. Boberg, 2015, “*Properties of the Old Open Cluster Czernik 30*,” *The Astronomical Journal*, 150, 69. (2015)
0. **C. R. Hayes** & E. D. Friel, 2014, “*Radial Velocities of Three Poorly Studied Clusters and the Kinematics of Open Clusters*,” *The Astronomical Journal*, 147, 69. (2014)

ORAL PRESENTATIONS

Dwarf Galaxy Accretion in the Milky Way: Viewing Dwarf Galaxy Accretion through the Eyes of Large Surveys 235th Meeting of the American Astronomical Society, Honolulu, HI	January 2020 Contributed Talk
Tracing the Sagittarius Stream with APOGEE SDSS-IV/V Collaboration Meeting, Ensenada, Mexico	June 2019 Contributed Talk
How Do We Know What Stars Are Made of? And What Are They Made of Anyway? Jefferson Fellow’s Symposium, Charlottesville, Virginia	March 2019 Public Talk
The Chemical Abundance Profile of the Milky Way’s Accreted Halo CENAG 2018, Heidelberg Germany	November 2018 Contributed Talk
Chemistry of the Triangulum-Andromeda Overdensity as Seen by APOGEE 232nd Meeting of the American Astronomical Society, Denver, CO	June 2018 Contributed Talk
Chemical Evolution of Metal-Poor Stars in the Milky Way Virginia Space Grant Consortium Student Research Conference, Norfolk, VA	April 2018 Invited Talk
Chemistry of the Triangulum-Andromeda Overdensity APOGEE-2 Winter Workshop, Besançon, France	March 2018 Contributed Talk
Extended Kinematic Structure of the Large Magellanic Cloud Virginia Space Grant Consortium Student Research Conference, Williamsburg, VA	April 2017 Invited Talk
Distinct Metal-Poor Populations in the Milky Way Seen by APOGEE Southeastern Section American Physical Society Conference, Charlottesville, VA	November 2016 Contributed Talk
Metal-Poor Stars Seen by APOGEE SDSS-IV Collaboration Meeting, Madison WI	June 2016 Contributed Lightning Talk
Metal-Poor Stars Seen by APOGEE APOGEE-2 Team Meeting, Madison, WI	June 2016 Contributed Talk
A Photometric Study of the Open Cluster Czernik 30 Undergraduate Honors Thesis Presentation, Indiana University	March 2015 Talk
Dust Mineralogy of T Tauri Stars in NGC 1333 University of Rochester	August 2014 Talk
Kinematics of Open Clusters Indiana University	April 2014 Talk

PROFESSIONAL MEMBERSHIPS

Raven Society	Inducted 2018
APOGEE Team	2016 - present
Phi Beta Kappa Honor Society	Inducted 2014
American Astronomical Society	

SOFTWARE PROFICIENCY

Languages (Proficiency): Python (Advanced), IDL (Intermediate), SQL (Basic), C (Basic)

Packages: scikit-learn, numpy, scipy, matplotlib, astropy, FlexCE

Tools/Programs: TOPCAT, IRAF, L^AT_EX, Unix, SM, Google Documents/Microsoft Office Suites

EDUCATION

Ph.D., Astronomy, University of Virginia May 2020

Advisor: Dr. Steven R. Majewski

GPA: 4.0 (4.0 scale)

M.S., Astronomy, University of Virginia May 2017

GPA: 4.0 (4.0 scale)

B.S., Astronomy/Astrophysics, and B.S., Physics, Indiana University May 2015

Minor: Mathematics

With Departmental Honors and Highest Distinction

GPA: 3.991 (4.0 scale)

Last Updated November 11, 2020