

## CHRISTIAN R. HAYES

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### CONTACT INFORMATION

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### EDUCATION

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**Ph.D., Astronomy**, University of Virginia Anticipated 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)

### WORK EXPERIENCE

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**APOGEE-2 Target Selection Coordinator**, APOGEE Survey 2019 - present

- Monitored and evaluated the progress of the Northern half of the APOGEE-2 survey to ensure the completion of the survey goals.
- Coordinated the selection of new fields and targets to observe in the APOGEE-2 survey
- Oversaw the execution of action-items identified during survey reviews as necessary to optimize the survey targeting.
- Organized and managed tasks of the APOGEE-2 targeting team

**Research Assistant**, University of Virginia 2015 - present

- Worked with large, multi-dimensional surveys (including photometric, spectroscopic, and astrometric data), data visualization and analysis, and machine learning techniques.
- Developed creative new methods for identifying and isolating patterns in data sets with high contamination.
- Led five first-authored papers published in peer-reviewed journals and wrote scientific justification for a successful NSF/AST competitive research grant (#1908331) as a collaborator to principal-investigators Drs. David Nidever and Steven Majewski (awarded \$351,297).
- Awarded NSF Graduate Research Fellowship (2017) for strong research aptitude and an independent and mature research ability and Jefferson Scholars Foundation Graduate Fellowship (2017) for commitment to intellectual discovery and ability to engage with broader audiences.

**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

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- 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 data 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 (7 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 - present) that evaluates the goals of the program.
  - Managed and operated the DSBK telescopes and portable planetarium.
- Telescope Operator**, Leander McCormick Observatory Public Nights 2015 - present
- 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.
- 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.
- Graduate Admissions Committee Member**, UVA Astronomy Department 2019
- Read UVA astronomy graduate applications and participated in the selection process.
  - Created and managed a spreadsheet of candidates and their qualifications for the committee.
  - Organized, scheduled, and conducted interviews of candidates.
  - Planned and coordinated prospective student visits to the astronomy department.
- 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

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- 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

## RESEARCH GRANTS

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- 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

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### 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
- Ran an IRAF tutorial for graduate students Fall 2017

## REFEREED PUBLICATIONS

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*Summary: 20 total, 7 first author, 2 second or third author*

20. **C. R. Hayes**, S. R. Majewski, S. Hasselquist, B. Anguiano, M. Shetrone, et al. “*Metallicity and  $\alpha$ -element Abundance Gradients along the Sagittarius Stream as Seen by APOGEE*,” in preparation. (2019)
19. **C. R. Hayes**, A. M. Matthews, Y. Song, S. T. Linden, S. E. Liss, et al. 2019 “*First Results from the Dark Skies, Bright Kids Astronomy Club Draw-A-Scientist Test*,” Physical Review Physics Education Research, submitted. (2019)
18. R. Guerço, K. Cunha, V. V. Smith, **C. R. Hayes**, C. Abia, et al. 2019 “*Fluorine Abundances in the Galactic Disk*,” The Astrophysical Journal, accepted. (2019)

17. D. L. Nidever, S. Hasselquist, **C. R. Hayes**, K. Hawkins, S. R. Majewski, et al. 2019 “*The Lazy Giants: APOGEE Abundances Reveal Low Star Formation Efficiencies in the Magellanic Clouds*,” The Astrophysical Journal, submitted, arXiv:1901.03448. (2019)
16. 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)
15. 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)
14. 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)
13. 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)
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. **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)
10. **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)
9. 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)
8. 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)
7. **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)
6. 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)
5. 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)
4. 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)
3. 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- $\alpha$  Chemistry as Seen by*

*APOGEE*,” *The Astrophysical Journal*, 842, 49. (2017)

2. **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)
1. **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

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

## PROFESSIONAL MEMBERSHIPS

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

## SOFTWARE PROFICIENCY

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

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

**Tools and Programs:** TOPCAT, IRAF, L<sup>A</sup>T<sub>E</sub>X, Unix, SuperMongo, Google Documents/Microsoft Office Suites

*Last Updated September 24, 2019*