Emily C. Cunningham

NASA Hubble Fellow

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Employment

NASA Hubble Fellowship, Columbia University *October 2022–Present*

LSSTC Catalyst Fellowship, Columbia University *Beginning October 2025*

Flatiron Research Fellowship, Flatiron Institute *September 2019–September 2022*

Education

UC Santa Cruz, Ph.D. in Astronomy & Astrophysics *June 2019*
Designated Emphasis in Statistics
Thesis title: *HALO7D: Disentangling the Milky Way's Accretion History with Observations in 7 Dimensions*
Advisors: Alis Deason (Durham), Raja Guhathakurta (UCSC), Connie Rockosi (UCSC)

UC Santa Cruz, M.S. Astronomy & Astrophysics *June 2015*

Haverford College, B.S. with High Honors in Physics and Astronomy *May 2012*
GPA: 3.914; graduated *Magna Cum Laude*

Awards

ARCS Foundation Scholar Award, UC Santa Cruz *2018–2019*

NSF Graduate Research Fellowship *September 2014–May 2017*

Whitford Prize, UC Santa Cruz Astronomy Department *2015*
Awarded to 2nd year UCSC student(s) who attains highest achievement in research, coursework, teaching, and the preliminary exam.

Osterbrock Leadership Fellowship, UC Santa Cruz Astronomy Department *August 2013–2017*
Award for students committed to learning leadership skills.

Fulbright Fellowship, Fulbright U.S. Student Program *September 2012–May 2013*
One year of funded research at the Institut d'Astrophysique de Paris, supervised by Gary A. Mamon (IAP) and Andrea Cattaneo (Marseille).

Phi Beta Kappa *2012*

Selected Talks

Selected Recent and Upcoming Seminars and Colloquia

Durham University, Astronomy Department Colloquium, June 14, 2023 (invited).

Haverford College, Young Academic Alumni Lecture, April 5, 2023 (invited).

University of Delaware, Research Seminar, April 4, 2023 (invited).

Indiana University, Astronomy Department Colloquium, March 31, 2023 (invited).

University of Arizona TAP Colloquium, November 7, 2022 (invited).

AMNH Astro Seminar, October 18, 2022 (invited).

CITA Theory Seminar, May 16, 2022 (invited; remote).

Carnegie Observatories Lunch Talk, April 1, 2022 (invited; remote).

University of Wisconsin at Madison Colloquium, November 18, 2021 (invited).

Selected Recent Conference Presentations

Galactic Frontiers: Dwarf Galaxies in the Local Volume and Beyond. Flatiron Institute, July 24, 2023.

EAS Annual Meeting, S1: A holistic view of the Milky Way: linking ages, chemistry and kinematics. July 1, 2021.

GALAH Science Meeting 2021, June 22, 2021 (invited) (video here).

STScI Symposium: The Local Group Assembly and Evolution, September 2, 2020 (video here; beginning at 49:00).

Flatiron-wide Algorithms and Mathematics, New York, NY, October 31, 2019.

Santa Cruz Galaxy Workshop, Santa Cruz, CA, August 9, 2018 (video here).

Teaching

Guest Lecturer

Columbia University: Graduate Course in Galactic Dynamics, Prof. Kathryn Johnston — *October 20, 2022*
University of Pennsylvania: Survey of the Universe, Prof. Robyn Sanderson — *November 20, 2020*
Columbia University: Graduate Course in Galactic Archaeology, Prof. Melissa Ness — *April 2, 2020*

Workshop Leader

Big Apple Dynamics School, Flatiron Institute — *June 2021*

Head Teaching Assistant — *September 2016–August 2017*

Associate Instructor for Astro205 (Fall Quarter 2016).
Responsible for UC Santa Cruz Astronomy Department T.A. training and management.

Instructor, Castilleja School — *September 2015–September 2017*

Co-instructor for research based seminars for high school students.

Instructor, Project for Inmate Education — *September 2014–September 2016*

Instructor for pre-algebra and algebra classes at Santa Cruz County Jail

Teaching Assistant — *Fall 2013*

UCSC ASTR3: The Solar System (Prof. Jonathan Fortney).

Mentoring

Undergraduate Mentoring

Ludia Adhikary, City College of New York '23 — *June 2022–Present*
Jennifer Locke, University of Pennsylvania '22 — *March 2021–June 2022*
Matthew Werneken, Columbia '24 — *Nov 2020–Sept 2021*
Madison Harris, UCSC '18 — *October 2016–January 2018*

Graduate Student Mentoring

Aida Behmard, Caltech (Ph.D. Expected 2023) — *February 2022–present*
Alex Riley, Texas A&M University (Ph.D. June 2022; now 1851 Research Fellow, Durham) — *July 2021–present*
Danny Horta, LJMU (Ph.D. August 2022; now Flatiron Research Fellow) — *July 2020–present*
Kevin McKinnon, UCSC (Ph.D. Expected 2023) — *September 2017–present*

High School Student Mentoring

Scientific Internship Program — *Summer 2016–Summer 2018*
Modern High School, Kolkata, India — *Summer 2014*

Service

Scientific Organizing Committee, Big Apple Dynamics Summer School — *Summer 2021*
Referee, Astrophysical Journal, Nature Astronomy
Review Panelist, NSF (2022), NASA (2022)

Publications

1st or 2nd Author Publications:

D. Horta, **E.C. Cunningham**, R.E. Sanderson, K.V. Johnston, A.J. Deason, A. Wetzel, F. McCluskey, N. Garavito-Camargo, L. Necib, C.-A. Faucher-Giguère, A. Arora, P.J. Gandhi. *The proto-galaxy of Milky Way-mass haloes in the FIRE simulations*. arXiv:2307.15741 (submitted to MNRAS, July 2023).

E.C. Cunningham, J.A.S. Hunt, A.M. Price-Whelan, K.V. Johnston, M.K. Ness, Y. Lu, I. Escala, I.A. Stelea. *Chemical Cartography of the Sagittarius Stream with Gaia*. arXiv:2307.08730 (submitted to ApJ, July 2023).

K. McKinnon, **E.C. Cunningham**, C.M. Rockosi, P. Guhathakurta, I. Escala, E.N. Kirby, A.J. Deason. *HALO7D III: Chemical Abundances of Milky Way Halo Stars from Medium Resolution Spectra*. ApJ, 951, 43, 2023.

D. Horta, **E.C. Cunningham**, R.E. Sanderson, K.V. Johnston, et al. *The observable properties of galaxy accretion events in Milky Way-like galaxies in the FIRE-2 cosmological simulations*. ApJ, 943, 158, 2023.

E.C. Cunningham, R.E. Sanderson, K.V. Johnston, N. Panithanpaisal, M.K. Ness, A. Wetzel, S.R. Loebman, I. Escala, D. Horta, and C.-A. Faucher-Giguère. *Reading the CARDs: the Imprint of Accretion History in the Chemical Abundances of the Milky Way's Stellar Halo*. ApJ, 934, 172, 2022.

E.C. Cunningham, N. Garavito-Camargo, A.J. Deason, K.V. Johnston, D. Erkal, C.F.P. Laporte, G. Besla, R. Luger, and R.E. Sanderson. *Quantifying the Stellar Halo's Response to the LMC's Infall with Spherical Harmonics*. ApJ, 898, 4, 2020.

E.C. Cunningham, A.J. Deason, R.E. Sanderson, S.T. Sohn, J. Anderson, P. Guhathakurta, C.M. Rockosi, R.P. van der Marel, S.R. Loebman, and A. Wetzel. *HALO7D II. The Halo Velocity Ellipsoid and Velocity Anisotropy with Distant Main Sequence Stars.* ApJ, 879, 120, 2019.

E.C. Cunningham, A.J. Deason, C.M. Rockosi, P. Guhathakurta, Z.G. Jennings, E.N. Kirby, E. Toloba, and G. Barro. *HALO7D I: The Line of Sight Velocities of Distant Main Sequence Stars in the Milky Way Halo*. ApJ, 876, 124, 2019.

E.C. Cunningham, A.J. Deason, P. Guhathakurta, C.M. Rockosi, R.P. van der Marel, E. Toloba, K.M. Gilbert, S.T. Sohn, and C.E. Dorman. *Isotropic at the Break? 3D Kinematics of Milky Way Halo Stars in the Foreground of M31.* ApJ, 820, 18, 2016.

3rd–4th Author Publications:

A. Behmard, M.K. Ness, **E.C. Cunningham**, M. Bedell. *Elemental Abundances of Kepler Objects of Interest in APOGEE DR17*. AJ, 165, 178, 2023.

N. Panithanpaisal, R.E. Sanderson, A. Arora, **E.C. Cunningham**, J. Baptista. *Constraining the Tilt of the Milky Way's Dark Matter Halo with the Sagittarius Stream*. arXiv:2210.14983 (submitted to ApJ, October 2022).

K. Chamberlain, A.M. Price-Whelan, G. Besla, **E.C. Cunningham** et al. *Implications of the Milky Way travel velocity for dynamical mass estimates of the Local Group*. ApJ, 942, 18, 2023.

E. Kado-Fong, R. Sanderson, J. Greene, **E.C. Cunningham**, et al. *The In-situ Origins of Dwarf Stellar Outskirts in FIRE-2.* ApJ, 931, 152, 2022.

N. Panithanpaisal, R.E. Sanderson, A. Wetzel, **E.C. Cunningham**, J. Bailin, and C.-A. Faucher-Giguère. *The Galaxy Progenitors of Stellar Streams around Milky Way-mass Galaxies in the FIRE Cosmological Simulations.* ApJ, 920, 10, 2021.

J.A.S. Hunt, K.V. Johnston, A.R. Pettitt, **E.C. Cunningham**, D. Kawata, and D.W. Hogg. *The power of co-ordinate transformations in dynamical interpretations of Galactic structure*. MNRAS, 497, 818, 2020.

I. Escala, K.M. Gilbert, E.N. Kirby, **E.C. Cunningham**, J. Wojno, P. Guhathakurta. *Elemental Abundances in M31: A Comparative Analysis of Iron and Alpha Element Abundances in the Outer Disk, Giant Stellar Stream, and Inner Halo of M31* . ApJ, 889, 177, 2020.

I. Escala, E.N. Kirby, K.M. Gilbert, **E.C. Cunningham**, J. Wojno. *Elemental Abundances in M31: Alpha and Iron Abundances from Low-resolution Resolved Stellar Spectroscopy in the Stellar Halo*. ApJ, 878, 42, 2019.

K.A. Plant, B. Margon, P. Guhathakurta, **E.C. Cunningham**, E. Toloba, and J.A. Munn. *Runaway Dwarf Carbon as Candidate Supernova Ejecta.* ApJ, 833, 232, 2016.

5rd–N^{th} Author Publications:

H.R. Foote, G. Besla, P. Mocz, N. Garavito-Camargo, L. Lancaster, M. Sparre, **E.C. Cunningham**, M. Vogelsberger, F.A. Gómez, C.F.P. Laporte. *Structure, Kinematics, and Observability of the Large Magellanic Cloud's Dynamical Friction Wake in Cold vs. Fuzzy Dark Matter*. arXiv:2307.00053 (accepted to ApJ, July 2023).

J. Baptista, R.E. Sanderson, D. Huber, A. Wetzel, O. Sameie, M. Boylan-Kolchin, J. Bailin, P.F. Hopkins, C.-A. Faucher-Giguère, S. Chakrabarti, D. Vargya, N. Panithanpaisal, A. Arora, **E.C. Cunningham**. *Orientations of DM Halos in FIRE-2 Milky Way-mass Galaxies*. arXiv:2211.16382 (accepted to ApJ, July 2023).

N. Shipp, N. Panithanpaisal, L. Necib, R. Sanderson, D. Erkal, T.S. Li, I.B. Santistevan, A. Wetzel, L.R. Cullinane, A.P. Ji, S.E. Koposov, K. Kuehn, G.F. Lewis, A.B. Pace, D.B. Zucker, J. Bland-Hawthorn, **E.C. Cunningham** et al. *Streams on FIRE: Populations of Detectable Stellar Streams in the Milky Way and FIRE*. ApJ, 949, 44, 2023.

A. Arora, R.E. Sanderson, N. Panithanpaisal, A. Wetzel, N. Garavito-Camargo, **E.C. Cunningham**, and J. Baptista. *On the stability of tidal streams in action space*. ApJ, 939, 2, 2023.

W. Wang, S. Kassin, S.M. Faber, D.C. Koo, **E.C. Cunningham** et al. *The Baltimore Oriole's Nest: Cool Winds from the Inner and Outer Parts of a Star-Forming Galaxy at $z = 1.3$*. ApJ, 930, 146, 2022.

M.K. Ness, A.J. Wheeler, K. McKinnon, D. Horta, A.R. Casey, **E.C. Cunningham**, A.M. Price-Whelan. *The homogeneity of the star forming environment in the Milky Way disk over time.* ApJ, 926, 144, 2022.

S.K. Grunblatt, J.C. Zinn, A.M. Price-Whelan, R. Angus, N. Saunders, M. Hon, A. Stokholm, E.P. Bellinger, S.L. Martell, B. Mosser, **E.C. Cunningham**, J. Tayar, D. Huber, J. Lysgaard Rørsted, V. Silva Aguirre. *Age-Dating Red Giant Stars Associated with Galactic Disk and Halo Substructures*. ApJ, 916, 88, 2021.

S. Tacchella, C. Conroy, S.M. Faber, B.D. Johnson, J. Leja, G. Barro, **E.C. Cunningham**, A.J. Deason, P. Guhathakurta, Y. Guo, L. Hernquist, D. C. Koo, K. McKinnon, C.M. Rockosi, J. S. Speagle, P. van Dokkum, H. M. Yesuf. *Fast, Slow, Early, Late: Quenching Massive Galaxies at $z \sim 0.8$*. ApJ, 926, 134.

N. Garavito-Camargo, G. Besla, C.F.P. Laporte, A.M. Price-Whelan, **E.C. Cunningham**, K.V. Johnston, M.D. Weinberg, F.A. Gomez. *Quantifying the impact of the Large Magellanic Cloud on the structure of the Milky Way's dark matter halo using Basis Function Expansions.* ApJ, 919, 109, 2021.

I. Escala, E.N. Kirby, K.M. Gilbert, J. Wojno, **E.C. Cunningham**, and P. Guhathakurta. *Elemental Abundances in M31: Properties of the Inner Stellar Halo.* ApJ, 902, 51, 2020.

H.M. Yesuf, D.C. Koo, S.M. Faber, J.X. Prochaska, Y. Guo, F.S. Liu, **E.C. Cunningham**, A.L. Coil, and P. Guhathakurta. *No Evidence for Feedback: Unexceptional Low-ionization Winds in Host Galaxies of Low Luminosity Active Galactic Nuclei*

at Redshift $z \sim 1$. ApJ, 841, 83, 2017.

C. Liu, E.W. Peng, E. Toloba, J.C. Mihos, L. Ferrarese, K. Alamo-Martinez, H.-X. Zhang, P. Cote, J.-C. Cuillandre, **E.C. Cunningham**, P. Guhathakurta, S. Gwyn, G. Herczeg, S. Lim, T.H. Puzia, J. Roediger, R. Sánchez-Janssen, and J. Yin. *The Most Massive Ultra-compact Dwarf Galaxy in the Virgo Cluster.* ApJL, 812, L2, 2015.

A.J. Deason, V. Belokurov, K.M. Hamren, S.E. Koposov, K.M. Gilbert, R.L. Beaton, C.E. Dorman, P. Guhathakurta, S.R. Majewski, and **E.C. Cunningham**. *TriAnd and its Siblings: Satellites of Satellites in the Milky Way Halo.* MNRAS, 444, 3975, 2014.

E. Boettcher, B. Willman, R. Fadely, J. Strader, M. Baker, E. Hopkins, T. Tasnim Ananna, **E.C. Cunningham**, T. Douglas, J. Gilbert, A. Preston, A.P. Sturner. *A Search for RR Lyrae Stars in Segue 2 and Segue 3.* AJ, 146, 94, 2013.