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RESEARCH INTERESTS

computational hydrodynamics, galaxy formation and evolution, intergalactic and circumgalactic medium, stellar feedback, synthetic observations, high performance computing, data visualization

EDUCATION

Ph.D. Astronomy, Columbia University, 2012

Thesis: “Comparing Simulations and Observations of Galaxy Evolution: Methods for Constraining the Nature of Stellar Feedback”

Advisors: Greg Bryan, David Schiminovich

M.A. Astronomy, Wesleyan University, 2005

B.A. Computer Science, Pomona College, 2001

EMPLOYMENT

Research Scientist, Caltech, 2023 - Present

Director of Astrophysics Outreach, Caltech, 2016 - Present

Senior Postdoctoral Fellow, Caltech, 2019 - 2023

NSF Astronomy and Astrophysics Postdoctoral Fellow, Caltech, 2015 - 2019

Postdoctoral Fellow, University of Arizona, 2012 - 2015

AWARDS AND HONORS

AAAS Early Career Award for Public Engagement with Science, Finalist, 2018

Caltech Astronomy Citizenship Award (*for outreach efforts*), 2016

NSF Astronomy and Astrophysics Postdoctoral Fellowship, 2014

Columbia Astronomy APPLAUSE Award (*best public talk*), 2009

NASA Astronomy Ambassador to New York City & State, 2009

GRANTS AND PROPOSALS (\$1.6 MILLION)

NASA HST 2021 (GO-16703): “Unveiling Multiphase Accretion Flows in a Sample of Truly Edge-on Galaxies.” (Institutional PI, **\$383,940**)

NASA HST 2021 (AR-16633): “Unlocking the Potential of Galactic Outflow Observations” (Institutional PI, **\$126,618**)

NASA HST 2019 (AR-15800): “A Subgrid Model for Simulating the Unresolved Microphysics in the Circumgalactic Medium.” (PI, **\$364,204**)

NSF AAG 2019 (NSF.1911233): “Toward an Accurate Model for the Gas Around Galaxies”, (PI, **\$258,525**)

NSF SPA 2017 (NSF.1764420): “Sixteenth Annual Symposium of the NSF Astronomy and Astrophysics Postdoctoral Fellows”, (Co-PI with Abby Crites, **\$28,746**)

NSF AAPF 2015 (NSF.1501443): “Investigating the Nature of the Circumgalactic Medium Using Realistic Synthetic Observations”, (PI, **\$278,000**)

NASA HST 2014 (AR-13917): “The COS Cold Absorber Puzzle: Understanding the Metallicity and Phase of the Circumgalactic Medium” (PI, **\$112,000**)

NASA HST 2014 (AR-13919): “MAST Interface to Synthetic Telescopes with yt MISTY: Observing Simulations of the Intergalactic Medium”, (Institutional PI, **\$115,000**)

COMPUTING GRANTS NASA High End Computing (Pleiades): “Subgrid Circumgalactic Medium”, (PI, **5,600,000 CPU-hrs**) 2020-present

NSF Petascale Computing Resource Allocations (Blue Waters): “Galaxy Formation at Ultra-High Resolution”, (Co-I with Phil Hopkins, **320,000,000 CPU-hrs**) 2017-2019

NSF Petascale Computing Resource Allocations (Blue Waters): “Petascale Adaptive Mesh Simulations of Milky Way-type Galaxies and Their Environments”, (Co-I with Brian O’Shea, **170,000,000 CPU-hrs**) 2016-2018

NSF XSEDE (Stampede): “The Effects of Stellar Feedback and Gas Accretion on the Evolution of Galaxies”, (PI, **4,000,000 CPU-hrs**) 2012-2016

SOFTWARE DEVELOPMENT COSMOVIS 3D Interactive Viz and Analysis Tool, Lead Theorist, 2020 - present

TRIDENT Synthetic Observation Generator, Lead Developer, 2014 - present

YT Analysis Suite, Core Developer, 2010 - present

ENZO Hydrodynamics Code, Developer, 2007 - present

OBSERVING EXPERIENCE Arecibo (GALEX Arecibo SDSS Survey): 100 hours, 2009-2011

CTIO TLP (Design, Construction & Observation): 100 hours, 2007-2008

KPNO 36” (U-Band SNe Photometry): 5 nights, 2005

LCO Swope 40” (Grid Giant Star Survey): 150 hours, 2001 - 2003

TEACHING & OUTREACH **Director & Lecturer**, Public Outreach, Caltech Astro, 2016 - present

Oversee all aspects of planning, advertising, and executing ~40 outreach events (~8,000 attendees) per year. Includes monthly lecture and stargazing; monthly “Astro on Tap”; sidewalk stargazing; “Science Train” aboard LA Metro; dark sky fests in national parks; etc. See Caltech Outreach [external](#) and [internal](#) websites

Founder & Organizer, [Astronomy on Tap](#), Los Angeles, 2016 - present

Monthly public events hosted at pub in LA and online, each with 50-200 attendees. ~100 events total, including foreign language events in Spanish and Mandarin

Founder & Organizer, [Caltech Astro YouTube Channel](#) 2018 - present

~7,000 subscribers, 100 outreach videos and science live-streams

Co-organizer, [Week of Astronomy](#), Pasadena City of Astronomy, 2016, 2018, 2022

Oversaw planning and executing city-wide astronomy festivals (~2000 attendees) with science demos, observing, and Astronomy on Tap

Director & Lecturer, Public Outreach, Columbia Astro, 2005 - 2012

Oversaw all aspects of planning, advertising, and executing ~40 outreach events (~7000 attendees) per year. See Columbia Outreach [external](#) and [internal](#) websites

Mentor & Organizer, Rooftop Variables, Columbia University, 2008 - 2012

Organized program to mentor elementary teachers in science education; Mentored Scott Misner, 8th grade teacher at Isaac Young MS and class

Founder & Organizer, [Astrophoto Exhibition](#), Columbia University, 2009

Planned and hosted *From Earth to the Universe* photography exhibit on Columbia’s campus for two weeks with 10,000+ attendees

Planned and recorded 16 10-minute educational podcasts for 365DOA

Lab Instructor, Columbia University, 6 Semesters, 2005 - 2008

Astronomy 1403: “Earth, Moon & Planets”

Astronomy 1404: “Beyond the Solar System”

**COLLOQUIA
& INVITED
SEMINARS**

Lowell Observatory Colloquium, November 2022
North Carolina State University Colloquium, March 2022
Yale University Colloquium, September 2021
University of Arizona Invited Seminar, June 2021
Harvard University Invited ITC Seminar, May 2019
University of California, Berkeley, Invited TAC Seminar, February 2019
University of California, Davis, Colloquium, January 2019
University of California, Santa Barbara, Colloquium, November 2018
University of Washington Invited Seminar, October 2018
University of California, San Diego Colloquium, November 2017
Carnegie Observatories Colloquium, October 2017
New Mexico State University Colloquium, April 2017
NOAO Invited Lecturer for LSST Data Science Fellowship Program, April 2017
Center for Computational Astrophysics Invited Seminar, December 2016
Harvard University Invited Seminar, May 2016
Carnegie Observatories Invited Seminar, May 2016
University of California, Santa Cruz Invited Seminar, February 2016
Ohio State Invited CCAPP Seminar, December 2015
Pomona College, Colloquium, November 2015
University of Arizona Colloquium, February 2015
University of California, Santa Cruz Invited Seminar, January 2015
Kavli Institute for Theoretical Physics Invited Feedback Seminar, May 2014
University of California, Santa Cruz Invited Seminar, March 2013
Georgia Tech Invited Seminar, February 2012
University of Chicago Invited Seminar, January 2012
McMaster University Invited Seminar, January 2012

**SELECTED
CONFERENCE
TALKS**

What Matters Around Galaxies Champoluc, Italy, September 2022
Art Wolfe Symposium Santa Cruz, March 2022
What Matters Between Galaxies Spineto, Italy, June 2019
Santa Cruz Galaxy Workshop August 2018
Circumgalactic Medium Workshop Northwestern, August 2018
Intergalactic Interconnections Marseille, July 2018
Astro Visualization Workshop IPAC Caltech, June 2018
Art Wolfe Symposium Big Sur, March 2018
NSF AAPF Symposium Maryland, January 2018
Santa Cruz Galaxy Workshop August 2017
What Matters in Galaxies Durham UK, June 2017
Python in Astronomy Washington, March 2016
Mocking the Universe STSci, July 2015
Santa Cruz Galaxy Workshop August 2014
CGM Workshop Notre Dame, January 2014
Galaxy Evolution Winter School Hebrew University, Israel, January 2013

**SELECTED
PUBLIC
TALKS**

Ongoing biweekly talks as host/organizer of Caltech Astro Outreach since 2016
California Dark Sky Festival, October 2022
Hubble Space Telescope Public Lecture (YouTube), June 2022
Sequoia Dark Sky Festival, September 2022
Eastern Sierra Observatory (three nights), October 2020
Death Valley Dark Sky Festival, February 2020, 2022
Astronomy on Tap, Los Angeles, November 2018
Qatar University, Doha, Qatar, September 2018
Astronomy on Tap, Chicago, July 2018
Solar Eclipse Festival, Fossil, OR, August 2017
Caltech Astronomy, Pasadena, July 2016
Caltech Reel Science, Pasadena, Feb 2016
Pima Community College, Tucson, March 2015
University of Arizona, Tucson, February 2014
Phoenix ComicCon, Phoenix, May 2013
Columbia University, New York, May 2012
Amateur Astronomers Incorporated, New Jersey, January 2010
Columbia University, New York, December 2009

**STUDENTS
MENTORED**

Sam Ponnada (PhD student)
Daria Bonds (Undergrad student at CSU San Marcos)
Iryna Butsky (PhD student, now Hubble Fellow at Stanford)
Andrew Rothstein (Undergrad student, now physics PhD student at Princeton)
Charles Watson (Undergrad student, now software developer)
Gefei Dang (Undergrad student, now math PhD student at MIT)
Rafael Fueyo-Gomez (Undergrad student, now software developer)
Evan Schneider (PhD Student, now faculty at U. Pittsburgh)

**ACADEMIC
SERVICE**

Organizer, KITP Program “Fundamentals of Gaseous Halos”, January - March 2021
Co-Organizer, TMT Science Meeting, Caltech, December 2018
Co-Organizer, NSF AAPF Annual Symposium, January 2018
Co-Organizer, Galaxies and their Halos Conference, Caltech, September 2017
Co-Organizer: YT Users Workshop, University of Chicago, January 2012
Science Advisory Committee, DSA-110, Owens Valley, January 2019
Reviewer, NSF Astronomy and Astrophysics Research Grants (AAG)
Reviewer, NSF Astronomy and Astrophysics Postdoctoral Fellowship (AAPF)
Reviewer, NASA FINESST Program
Reviewer, NASA Astrophysical Theory Program (ATP)
Reviewer, DiRAC High Performance Computing Allocations
Referee, Monthly Notices of the Royal Astronomical Society
Referee, Astrophysical Journal

PUBLICATIONS
(H-INDEX = 30)

LINK TO ADS

1. “Magnetic fields on FIRE: Comparing B-fields in the multiphase ISM and CGM of simulated L^* galaxies to observations”,
Ponnada, S., Panopoulou, G., Butsky, I., and 7 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 516, 4417 (2022)
2. “Constraining Cosmic-ray Transport with Observations of the Circumgalactic Medium”,
Butsky, I., Nakum, S., Ponnada, S., and 3 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, under review (2022)
3. “Galaxies lacking dark matter produced by close encounters in a cosmological simulation”,
Moreno, J., Danieli, S., Bullock, J., and 17 co-authors including **Hummels, C.**, *Nature Astronomy*, 6, 496 (2022)
4. “KODIAQ-Z: Metals and Baryons in the Cool Intergalactic and Circumgalactic Gas at $2.2 < z < 3.6$ ”,
Lehner, N., Kopenhafer, C., O’Meara, J. and 8 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 936, 156 (2022)
5. “The Impact of Cosmic Rays on the Kinematics of the Circumgalactic Medium”,
Butsky, I., Werk, J., Tchernyshyov, K., and 9 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 935, 69 (2022)
6. “Public data release of the FIRE-2 cosmological zoom-in simulations of galaxy formation”,
Wetzel, A., Hayward, C., Sanderson, R., and 23 co-authors including **Hummels, C.**, *The Astrophysical Journal Supplement* submitted (2022)
7. “CosmoVis: An Interactive Visual Analysis Tool for Exploring Hydrodynamic Cosmological Simulations”,
Abramov, D., Burchett, J., Elek, O., and 3 co-authors including **Hummels, C.**, *IEEE Transactions on Visualization and Computer Graphics*, 2022 doi: 10.1109/TVCG.2022.3159630
8. “Probing Hot Gas Components of Circumgalactic Medium in Cosmological Simulations with the Thermal Sunyaev-Zel’dovich Effect”,
Kim, J., Golwala, S., Bartlett, J., and 8 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 926, 179 (2022)
9. “The AGORA High-resolution Galaxy Simulations Comparison Project. III. Cosmological Zoom-in Simulation of a Milky Way-mass Halo”,
Roca-Fàbrega, S., Kim, J., Hausammann, L., and 20 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 917, 64 (2021)
10. “Gas infall and radial transport in cosmological simulations of Milky Way-mass disks”,
Trapp, C., Kereš, D ; Chan, T.K., and 7 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 509, 4149 (2022)
11. “Which AGN jets quench star formation in massive galaxies?”,
Su, K. S. Hopkins, P., Bryan, G., and 12 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 507, 175 (2021)
12. “Virial shocks are suppressed in cosmic ray-dominated galaxy haloes ”,
Ji, S. Kereš, D., Chan, T. K., and 4 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 505, 259 (2021)
13. “Cosmic-Ray Driven Outflows to Mpc Scales from L_* Galaxies”,
Hopkins, P., Chan, T. K., Ji, S., and 4 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 501, 3640 (2021)
14. “The Impact of Cosmic Rays on Thermal Instability in the Circumgalactic Medium”,
Butsky, I., Fielding, D., Hayward, C., and 3 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 903, 77 (2021)

- PUBLICATIONS** 15. “Probing the CGM of Low-redshift Dwarf Galaxies Using FIRE Simulations”,
(**H-INDEX = 30**) Li, F., Rahman, M., Murray, N., and 7 co-authors including **Hummels, C.**,
Monthly Notices of the Royal Astronomical Society, 500, 1038 (2021)
- LINK TO ADS**
16. “The Keck Baryonic Structure Survey: using foreground/background galaxy pairs to trace the structure and kinematics of circumgalactic neutral hydrogen at $z \sim 2$ ”,
Chen, Y., Steidel, C., **Hummels, C.**, and 13 co-authors, *Monthly Notices of the Royal Astronomical Society*, 499, 1721 (2020)
17. “Properties of the Circumgalactic Medium in Cosmic Ray-Dominated Galaxy Halos”,
Ji, S., Chan, T. K., **Hummels, C.**, and 6 co-authors, *Monthly Notices of the Royal Astronomical Society*, 496, 4221 (2020)
18. “On the Survival of Cool Clouds in the Circumgalactic Medium”,
Li, Z., Hopkins, P., Squire, J., and **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 3180 (2019)
19. “But What About Cosmic Rays, Magnetic Fields, Conduction, & Viscosity in Galaxy Formation”,
Hopkins, P., Chan, T. K., Garrison-Kimmel, S., and 6 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 2993 (2019)
20. “The Nature of Ionized Gas in the Milky Way Galactic Fountain”,
Werk, J., Rubin, K., Bish, H., and 6 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 887, 89 (2019)
21. “The Column Density, Kinematics, and Thermal State of Metal-Bearing Gas within the Virial Radius of $z \sim 2$ Star-Forming Galaxies in the Keck Baryonic Structure Survey”,
Rudie, G., Steidel, C., Pettini, M., and 5 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 885, 61 (2019)
22. “ENZO: An Adaptive Mesh Refinement Code for Astrophysics (Version 2.6)”,
Brummel-Smith, C., Bryan, G., Butsky, I., and 52 co-authors including **Hummels, C.**, *The Journal of Open Source Software*, 4, 1636 (2019)
23. “The Origins of the Circumgalactic Medium in the FIRE Simulations”
Hafen, Z., Faucher-Giguère, C.A., Anglés-Alcázar, D., and 10 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 488, 1248 (2019)
24. “The Impact of Enhanced Halo Resolution on the Simulated Circumgalactic Medium”,
Hummels, C., Smith, B., Hopkins, P., and 7 co-authors, *The Astrophysical Journal*, 882, 156 (2019)
25. “Figuring Out Gas and Galaxies in Enzo (FOGGIE). I. Resolving Simulated Circumgalactic Absorption at $2 < z \leq 2.5$ ”,
Peeples, M., Corlies, L., and Tumlinson, J., and 8 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 873, 129 (2019)
26. “FIRE-2 simulations: physics versus numerics in galaxy formation”,
Hopkins, P., Wetzel, A., Keres, D., and 24 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 480, 800 (2018)
27. “A VLT/MUSE galaxy survey towards QSO Q1410: looking for a WHIM traced by BLAs in inter-cluster filaments”,
Pessa, I., Tejos, N., Barrientos, L., and 7 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 477, 2991 (2018)
28. “xGASS: total cold gas scaling relations and molecular-to-atomic gas ratios of galaxies in the local Universe”,
Catinella, B., Saintonge, A., Janowiecki, S., and 10 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 476, 875 (2018)

- PUBLICATIONS** 29. “TRIDENT: a universal tool for generating synthetic absorption spectra from astrophysical simulations”,
(H-INDEX = 30) **Hummels, C.**; Smith, B.; and Silvia, D.; *The Astrophysical Journal*, 847, 59 (2017)
- LINK TO ADS**
30. “GRACKLE: a Chemistry and Cooling Library for Astrophysics”,
Smith, B., Bryan, G., Glover, S., and 11 co-authors including **Hummels, C.**,
Monthly Notices of the Royal Astronomical Society, 466, 2217 (2017)
31. “The AGORA High-Resolution Galaxy Simulations Comparison Project. II: Isolated Disk Test”
Kim, J., Agertz, O., Teyssier, R., and 40 co-authors including **Hummels, C.**, *The Astrophysical Journal*, 833, 202 (2016)
32. “The ASTROPY Problem”
Muna, D., Alexander, M., ; Allen, A., and 151 co-authors including **Hummels, C.**, *eprint arXiv:1610.03159* (2016)
33. “Kinetic energy from supernova feedback in high-resolution galaxy simulations”,
Simpson, C., Bryan, G., **Hummels, C.**, & Ostriker, J., *The Astrophysical Journal*, 809, 69 (2015)
34. “Cosmological simulations of galaxy formation with cosmic rays”,
Salem, M., Bryan, G. L., & **Hummels, C.**, *The Astrophysical Journal Letters*, 797, L18 (2014)
35. “ENZO: an adaptive mesh refinement code for astrophysics”,
Bryan, G., Norman, M., O’Shea, B., and 26 co-authors including **Hummels, C.**,
Astrophysical Journal Supplements, 211, 19 (2014)
36. “The AGORA high-resolution galaxy simulations comparison project”,
Kim, J., Abel, T., Agertz, O., and 44 co-authors including **Hummels, C.**, *Astrophysical Journal Supplements*, 210, 14 (2014)
37. “The GALEX Arecibo SDSS Survey - VIII. Final data release. The effect of group environment on the gas content of massive galaxies”,
Catinella, B., Schiminovich, D., Cortese, L., and 8 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 436, 34 (2014)
38. “Constraints on hydrodynamical subgrid models from quasar absorption line studies of the simulated circumgalactic medium”,
Hummels, C., Bryan, G., Smith, B., and Turk, M., *Monthly Notices of the Royal Astronomical Society*, 430, 1548 (2013)
39. “The GALEX Arecibo SDSS Survey. VI. Second data release and updated gas fraction scaling relations”,
Catinella, B., Schiminovich, D., Kauffmann, G., and 7 co-authors including **Hummels, C.**, *Astronomy & Astrophysics*, 544, A65 (2012)
40. “Adaptive mesh refinement simulations of galaxy formation: exploring numerical and physical parameters”,
Hummels, C., and Bryan, G., *Astrophysical Journal*, 749, 140 (2012)
41. “The GALEX Arecibo SDSS Survey - IV. Baryonic mass-velocity-size relations of massive galaxies”,
Catinella, B., Kauffmann, G., Schiminovich, D., and 12 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 420, 1959 (2012)
42. “The GALEX Arecibo SDSS Survey. V. The Relation between the H I Content of Galaxies and Metal Enrichment at Their Outskirts”,
Moran, S., Heckman, T., Kauffmann, G., and 14 co-authors including **Hummels, C.**, *Astrophysical Journal*, 745, 66 (2012)

- PUBLICATIONS** 43. “The GALEX Arecibo SDSS Survey - II. The star formation efficiency of massive galaxies”,
(**H-INDEX = 30**) Schiminovich, D., Catinella, B., Kauffmann, G., and 23 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 408, 919 (2010)
- LINK TO ADS**
44. “The GALEX Arecibo SDSS Survey - I. Gas fraction scaling relations of massive galaxies and first data release”,
Catinella, B., Schiminovich, D., Kauffmann, G., and 23 co-authors including **Hummels, C.**, *Monthly Notices of the Royal Astronomical Society*, 403, 683 (2010)
45. “Lunar outgassing, transient phenomena, and the return to the moon. II. predictions and tests for outgassing/regolith interactions”,
Crotts, A. and **Hummels, C.**, *Astrophysical Journal*, 707, 1506 (2009)
46. “A two micron all sky survey view of the Sagittarius Dwarf Galaxy. II. Swope Telescope spectroscopy of M giant stars in the dynamically cold Sagittarius Tidal Stream”,
Majewski, S., Kunkel, W., Law, D., and 10 co-authors including **Hummels, C.**, *Astronomical Journal*, 128, 245 (2004)
47. “Exploring halo substructure with giant stars. III. first results from the Grid Giant Star Survey and discovery of a possible nearby Sagittarius tidal structure in Virgo”,
Kundu, A., Majewski, S., Rhee, J., and 14 co-authors including **Hummels, C.**, *Astrophysical Journal Letters*, 576, L125 (2002)

REFERENCES

Philip Hopkins

Current Supervisor

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