Aarynn L. Carter

Space Telescope Science Institute

aacarter@stsci.edu

www.aarynncarter.com

Career Summary

As an Astronomer at the Space Telescope Science Institute, I use the most advanced observatories to detect and characterise the atmospheres of exoplanets through direct imaging and transit spectroscopy, with an overarching goal of improving our understanding planetary formation and evolution across the giant population. Earlier in my career I performed critical formative work on the *JWST* Early Release Science exoplanet programs, and have developed a range of bespoke software for the simulation and analysis of *JWST* exoplanet observations. Recently, I have led, or have been a first author of, publications of the earliest results from these programs, including the first direct detection of an exoplanet beyond 5 μm, and the first definitive detection of CO_2 and SO_2 in an exoplanet atmosphere. Currently, I am heavily involved with many accepted *JWST* programs, and I am the principal investigator of the two largest *JWST* exoplanet direct imaging surveys, which will explore the wide-separation, sub-Jupiter exoplanet population in unprecedented detail.

Research Employment

2024 - Current	Assistant Astronomer, Space Telescope Science Institute • *Lead — NIRISS SOSS Team (2024 - Current)* • *Deputy Lead — JWST Time-Series Observation Coordination Team (2024 - Current)*
2020 - 2024	Postdoctoral Scholar, Univeristy of California, Santa Cruz *Mentors*: Prof. Andy Skemer & Prof. Natalie Batalha

Education

2016 - 2020	PhD Physics, University of Exeter, *Towards Exoplanetary Science in the Era of JWST* *Advisors*: Prof. Sasha Hinkley & Prof. David Sing
2012 - 2016	BSc MPhys (First Class Honours), Physics, University of Warwick

Approved Research Grants

2024	JWST Cycle 3 GO-06005, USA Principal Investigator — **$167,875** *Imaging Young Sub-Jupiter Planets down to Solar-System Scales*
2024	JWST Cycle 3 GO-5835, Principal Investigator — **$896,942** *Into The Spotlight: Unveiling Wide-Separation Sub-Jupiters for Future JWST Characterization*
2024	JWST Cycle 3 GO-05037, USA Principal Investigator — **$114,525** *Confirmation of the closest directly detected exoplanet: a super-Jupiter orbiting Eps Ind A*
2023	JWST Cycle 2 GO-04050, Principal Investigator — **$611,109** *Uncharted Worlds: Towards a Legacy of Direct Imaging of Sub-Jupiter Mass Exoplanets*
2023	JWST Cycle 2 GO-03989, USA Principal Investigator — **$128,646** *Spotting the Perturbers: A Survey of Debris Disk Stars with Common Proper Motion Anomalies*
2022	JWST Cycle 1 GO-02538, USA Principal Investigator — **$94,969** *Using JWST to Search for Planetary Sculptors in an ALMA-Selected Sample of Debris Disks*
2022	JWST Cycle 1 GO-02243, USA Principal Investigator — **$90,439** *A Direct Detection of the Closest Jupiter Analog with JWST/MIRI*
2022	JWST Cycle 1 GO-01668, USA Principal Investigator — **$56,678** *Searching for Low Mass Planets in Debris Disk Gaps*

Observational Programs

Principal Investigator

PI: B. Biller	JWST GO-06005, Survey, *Imaging Young Sub-Jupiter Planets down to Solar-System Scales* (USA PI)
PI: A. Carter	JWST GO-5835, 95 Hours, *Into The Spotlight: Unveiling Wide-Separation Sub-Jupiters for Future JWST Characterization*
PI: E. Matthews	JWST GO-05037, 46 Hours, *Confirmation of the closest directly detected exoplanet: a super-Jupiter orbiting Eps Ind A* (USA PI)
PI: A. Carter	JWST GO-04050, 46 Hours, *Uncharted Worlds: Towards a Legacy of Direct Imaging of Sub-Jupiter Mass Exoplanets*
PI: S. Hinkley	JWST GO-03989, 25 Hours, *Spotting the Perturbers: A Coronagraphic Survey of Debris Disk Stars with Common Proper Motion Anomalies* (USA PI)
PI: A. Carter	Gemini GN(S)-2022A-Q-132(139), 9.5 Hours, *Simultaneous, multi-wavelength variability monitoring of a key directly imaged exoplanet analogue in support of JWST ERS observations*
PI: S. Hinkley	JWST GO-02538, 24 Hours, *Using JWST to Search for Planetary Sculptors in an ALMA-Selected Sample of Debris Disks* (USA PI)
PI: E. Matthews	JWST GO-02243, 14 Hours, *A Direct Detection of the Closest Jupiter Analog with JWST/MIRI* (USA PI)
PI: S. Marino	JWST GO-01668, 11 Hours, *Searching for Low Mass Planets in Debris Disk Gaps* (USA PI)

Co-Investigator

PI: R. Bendahan-West	ALMA 2024.1.00681.S, 22 Hours, *Dynamically determining the origin of gas in debris discs*
PI: J. Kammerer	VLT 0114.C-2386(A), 15 Hours, *Peering into JWST's blind spot: A sphere SAM search for inner companions around JWST Cycle 3 coronagraphy targets*
PI: T. Pearce	JWST GO-03973, 8 Hours, *Using planets to dynamically weigh a debris disc for the first time*
PI: B. Bowler	JWST GO-03947, 20 Hours, *Testing the Giant Planet Hypothesis for Spiral-driven Arms in Protoplanetary Disks*
PI: N. Whiteford	JWST GO-03375, 24 Hours, *Dancing 1 - 14 micron spectra to solve the cloudy and chemical puzzle of brown dwarf variability*
PI: D. Bardalez-Gagliuffi	JWST GO-03337, 7 Hours, *Solving a Solar Neighborhood Crime Scene by Imaging 14 Her c*
PI: K. Stevenson	JWST GO-03273, Archival Research, *Eureka!: An Open-Source Pipeline for JWST Time-Series Observations*
PI: Y. Zhou	JWST GO-03181, 16 Hours, *Monitor a variable planetary mass companion with NIRSpec IFU*
PI: S. Ray	VLT 108.22CD, 18 Hours, *Benchmark PSF References for the JWST Interferometer*
PI: N. Whiteford	NTT 108.22BH, 3 Nights, *VHS 1256ABb SofI Variability Proposal*
PI: P. Loyd	HST GO-16731, 12 Orbits, *Leveraging High Radial Velocities to Get to the Core of Planetary Lyman-alpha Transits*
PI: B. Biller	TNG OPTICON-21B/031, 1 Night, *Multi-wavelength variability monitoring of a key directly imaged exoplanet analogue.*
PI: A. Skemer	JWST GO-02327, 14 Hours, *Water Ice Clouds and Weather on the Coldest Brown Dwarf*
PI: N. Nikolov	HST GO-15469, 10 Orbits, *Characterizing a new prototype Saturn-mass exoplanet with the clearest atmosphere yet.*
PI: S. Hinkley	JWST ERS-1386, 68 Hours, *High Contrast Imaging of Exoplanets and Exoplanetary Systems with JWST.*
PI: N. Batalha	JWST ERS-1366, 81 Hours, *The Transiting Exoplanet Community Early Release Science Program.*
PI: T. Evans	HST GO-15135, 10 Orbits, *An exoplanet with a stratosphere: seeking the unknown absorber.*
PI: N. Nikolov	VLT 199.C-0467, 208 Hours, *From hot gas-giants to cooler rocky exo-Earths: The first large-scale comparative exoplanet atmospheric survey with FORS2.*

Professional Talks

Invited Talks

May 2024	NAOJ-STScI Exoplanet Workshop, Baltimore, USA *"Directly Detecting Exoplanets with JWST"*
Apr 2024	UMD Planetary Seminar, College Park, USA *"First Steps into the Era of Exoplanet Imaging with JWST"*
Jul 2023	Sagan Summer Workshop, Pasadena, USA – (**Review Talk**) *"Direct Imaging and Spectroscopy with JWST"*
Jun 2023	ExoClimes VI, Exeter, UK – (**Review Talk**) *"The Future of Exo-Climes Studies"*
May 2023	AMNH Seminar Series, Virtual *"Towards the Origins and Histories of Giant Exoplanets"*
Mar 2023	UCSC Astrobiology Colloquium, Santa Cruz, USA *"High Contrast Observations with JWST"*
Nov 2022	UT Austin Astronomy Colloquium, Austin, USA *"Kickstarting a New Generation of Exoplanet Observations: Early Release Science with JWST"*
Sep 2022	STScI Dynamical Masses Workshop, Baltimore, USA *"High Contrast Observations with JWST"*
Sep 2022	NASA JPL Exoplanet Talk Series, Virtual *"The First Direct Observations of Exoplanets with JWST"*
Jun 2022	ExoExplorer Science Series – (**$1,000 Paid Talk**) *"Kickstarting a New Generation of Exoplanet Observations: Early Release Science with JWST"*
Mar 2022	STScI ESPF Seminar Series, Baltimore, USA *"High Contrast Imaging of Exoplanets with JWST"*
Feb 2022	UCSC Planetary Lunch (PLUNCH), Santa Cruz, USA *"High Contrast Imaging of Exoplanets with JWST"*
Jan 2021	RAS Specialist Discussion, London, UK *"Exoplanet modelling in the James Webb Era: Observing Exoplanets with JWST"*
Sep 2018	University of Exeter Seminar Series, Exeter, UK *"Early Release Exoplanet Science with JWST"*

Contributed Talks

July 2024	OWL Exoplanet Summer Program, Santa Cruz, USA *"Searching for Wide-Separation Sub-Jupiter Exoplanets with JWST"*
May 2023	Planetary Systems and the Origins of Life with JWST, STScI, USA *"The Unified Near-Infrared Spectrum of WASP-39b"*
Apr 2023	Bay Area Exoplanet Meeting, NASA Ames, USA *"The Unified Near-Infrared Spectrum of WASP-39b"*
Jan 2023	AAS 241, Seattle, USA *"The First Direct Images of an Exoplanet with JWST"*
Jan 2023	ExoPAG 27, Seattle, USA *"The First Direct Images of an Exoplanet with JWST"*
Nov 2022	Celebrating JWST's First Six Months of Exoplanet Data, Ringberg, Germany *"The First Direct Images of an Exoplanet with JWST"*
Oct 2022	STScI JWebbinar 19, Virtual – (**Service Talk**) *"Reducing and Analysing JWST Coronagraphic Data with spaceKLIP"*
May 2022	Exoplanets IV, Las Vegas, USA *"High Contrast Imaging of Exoplanets and Exoplanetary Systems with JWST"*
Sep 2021	European Planetary Science Congress 2021, Virtual Conference *"Direct imaging of sub-Jupiter mass exoplanets with JWST coronagraphy"*
Aug 2021	SPIE Optics & Photonics 2021, San Diego, USA *"Simulating JWST high contrast observations with PanCAKE"*
Jun 2021	AAS 238, Virtually Anywhere *"High Contrast Imaging of Exoplanets and Exoplanetary Systems with JWST"*

Sep 2020	Bay Area Exoplanet Meeting, Online *"Direct imaging of sub-Jupiter mass exoplanets with JWST coronagraphy"*
Jul 2020	Exo-Webbinar: Online Talk Series *"Directly Imaging Exoplanets with JWST*
Mar 2020	JWST Master Class Workshop, Exeter, UK — (**Lead Organiser & Speaker**) *"Multiple guided presentations on JWST observational planning and simulations"*
Jul 2019	Bay Area Exoplanet Meeting, Santa Cruz, USA *"High Contrast Imaging of Exoplanets and Exoplanetary Systems with JWST"*
Mar 2018	UK Exoplanet Meeting, Oxford, UK — (**Keynote Talk**) *"The JWST Exoplanet Early Release Science Programs"*

Software Development

PanCAKE	Simulation tool for *JWST* coronagraphic observations (**Lead Developer**)
Eureka!	Data analysis pipeline for *HST*/*JWST* time series observations
spaceKLIP	Data analysis pipeline for *JWST* coronagraphic observations (**Co-Lead Developer**)

Service & Honours

2024 - Current	Reviewer for A&A Journals
2023	JWST Cycle 2 External Reviewer
2022	Barbara Walker Best Paper Award
2021 - Current	UCSC Astronomy & Astrophysics Diversity, Equity, and Inclusion Committee Member
2021 - Current	Reviewer for AAS Journals
2022	STScI JWebbinar 19 — *JWST Coronagraphic Observations*
2022	NASA ExoExplorer Cohort Member
2022	Panelist for NASA APRA+SAT
2022	Reviewer for NASA FINESST
2021 - 2022	UCSC Astronomy & Astrophysics Colloquium Committee Member
2020	ESA JWST Master Class Workshop Host & Lead Organiser (United Kingdom)

Supervision & Mentorship

2024 - Current	Katie Crotts — **Postdoctoral Researcher**, Space Telescope Science Institute (Co-Supervisor)
2024 - Current	Evelyn Bruinsma — **Graduate Student**, Johns Hopkins University
2024 - Current	Kayli Glidic — **Science Support Analyst**, Space Telescope Science Institute (Co-Supervisor)
2024 - Current	Giovanni Strampelli — **Postdoctoral Researcher**, Space Telescope Science Institute
2022 - Current	Klaus Stephenson — **Undergraduate Student**, University of California, Santa Cruz

Courses & Training

Oct 2022	Setting Personal Boundaries to Support Excellence in Science
Oct 2022	Visceral Change — Inclusive Diversity Trainings Workshop
Jun 2022	Building Inclusive and Productive Collaborations
May 2022	Inclusive Leadership
Jul-Aug 2021	Equity-Minded Mentoring
Feb 2020	ESA JWST Master Class (**Competitive Application**)

Selected Publications

[11] E. C. Matthews, **A. L. Carter**, P. Pathak, C. V. Morley, M. W. Phillips, et al. "A temperate super-Jupiter imaged with JWST in the mid-infrared". In: Nature 633.8031 (Sept. 2024), pp. 789–792.

[10] **A. L. Carter**, E. M. May, N. Espinoza, L. Welbanks, E. Ahrer, et al. "A benchmark JWST near-infrared spectrum for the exoplanet WASP-39 b". In: *Nature Astronomy* 8 (Aug. 2024), pp. 1008–1019. arXiv: 2407.13893 [astro-ph.EP].

[9] **Aarynn L. Carter**, Sasha Hinkley, Jens Kammerer, Andrew Skemer, Beth A. Biller, et al. "The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems I: High-contrast Imaging of the Exoplanet HIP 65426 b from 2 to 16 μm". In: ApJ 951.1, L20 (July 2023), p. L20. arXiv: 2208.14990 [astro-ph.EP].

[8] JWST Transiting Exoplanet Community Early Release Science Team, Eva-Maria Ahrer, Lili Alderson, Natalie M. Batalha, **including Aarynn. L Carter (joint-first author)**, et al. "Identification of carbon dioxide in an exoplanet atmosphere". In: Nature 614.7949 (Feb. 2023), pp. 649–652. arXiv: 2208.11692 [astro-ph.EP].

[7] Taylor Bell, Eva-Maria Ahrer, Jonathan Brande, **Aarynn Carter**, Adina Feinstein, et al. "Eureka!: An End-to-End Pipeline for JWST Time-Series Observations". In: *The Journal of Open Source Software* 7.79, 4503 (Nov. 2022), p. 4503. arXiv: 2207.03585 [astro-ph.IM].

[6] Sasha Hinkley, **Aarynn L. Carter**, Shrishmoy Ray, Andrew Skemer, Beth Biller, et al. "The JWST Early Release Science Program for the Direct Imaging and Spectroscopy of Exoplanetary Systems". In: PASP 134.1039, 095003 (Sept. 2022), p. 095003. arXiv: 2205.12972 [astro-ph.EP].

[5] Jens Kammerer, Julien Girard, **Aarynn L. Carter**, Marshall D. Perrin, Rachel Cooper, et al. "Performance of near-infrared high-contrast imaging methods with JWST from commissioning". In: *Space Telescopes and Instrumentation 2022: Optical, Infrared, and Millimeter Wave*. Ed. by Laura E. Coyle, Shuji Matsuura, and Marshall D. Perrin. Vol. 12180. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. Aug. 2022, 121803N. arXiv: 2208.00996 [astro-ph.EP].

[4] **Aarynn L. Carter**, Andrew J. I. Skemer, Camilla Danielski, Jarron Leisenring, Jason J. Wang, et al. "Simulating JWST high contrast observations with PanCAKE". In: *Techniques and Instrumentation for Detection of Exoplanets X*. Ed. by Stuart B. Shaklan and Garreth J. Ruane. Vol. 11823. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. Sept. 2021, 118230H.

[3] **Aarynn L. Carter**, Sasha Hinkley, Mariangela Bonavita, Mark W. Phillips, Julien H. Girard, et al. "Direct imaging of sub-Jupiter mass exoplanets with James Webb Space Telescope coronagraphy". In: MNRAS 501.2 (Feb. 2021), pp. 1999–2016. arXiv: 2011.07075 [astro-ph.EP].

[2] **Aarynn L. Carter**, Nikolay Nikolov, David K. Sing, Munazza K. Alam, Jayesh M. Goyal, et al. "Detection of Na, K, and H_2O in the hazy atmosphere of WASP-6b". In: MNRAS 494.4 (June 2020), pp. 5449–5472. arXiv: 1911.12628 [astro-ph.EP].

[1] Benjamin Drummond, **Aarynn L. Carter**, Eric Hébrard, Nathan J. Mayne, David K. Sing, et al. "The carbon-to-oxygen ratio: implications for the spectra of hydrogen-dominated exoplanet atmospheres". In: MNRAS 486.1 (June 2019), pp. 1123–1137. arXiv: 1903.10997 [astro-ph.EP].

All Publications

[50] Melanie J. Rowland, Caroline V. Morley, Brittany E. Miles, Genaro Suarez, Jacqueline K. Faherty, et al. "Protosolar D-to-H Abundance and One Part per Billion PH_3 in the Coldest Brown Dwarf". In: ApJ 977.2, L49 (Dec. 2024), p. L49. arXiv: 2411.14541 [astro-ph.SR].

[49] E. C. Matthews, **A. L. Carter**, P. Pathak, C. V. Morley, M. W. Phillips, et al. "A temperate super-Jupiter imaged with JWST in the mid-infrared". In: Nature 633.8031 (Sept. 2024), pp. 789–792.

[48] **Aarynn L. Carter**, Rachel Bowens-Rubin, Per Calissendorff, Jens Kammerer, Yiting Li, et al. "Investing in the Unrivaled Potential of Wide-Separation Sub-Jupiter Exoplanet Detection and Characterisation with JWST – Strategic Exoplanet Initiatives with HST and JWST White Paper". In: *arXiv e-prints*, arXiv:2408.07722 (Aug. 2024), arXiv:2408.07722. arXiv: 2408.07722 [astro-ph.IM].

[47] **Aarynn L. Carter**, Munazza. K. Alam, Thomas Beatty, Sarah Casewell, Katy L. Chubb, et al. "The Unrealised Interdisciplinary Advantage of Observing High Mass Transiting Exoplanets and Brown Dwarfs – Strategic Exoplanet Initiatives with HST and JWST White Paper". In: *arXiv e-prints*, arXiv:2408.07723 (Aug. 2024), arXiv:2408.07723. arXiv: 2408.07723 [astro-ph.IM].

[46] Munazza K. Alam, Emily Rickman, Kielan Hoch, Paul Mollière, Josh Lothringer, et al. "Standing on the Shoulders of Giants: A Comprehensive Spectroscopic Survey of Transiting & High-Contrast Giant Planets". In: *arXiv e-prints*, arXiv:2409.00190 (Aug. 2024), arXiv:2409.00190. arXiv: 2409.00190 [astro-ph.IM].

[45] **A. L. Carter**, E. M. May, N. Espinoza, L. Welbanks, E. Ahrer, et al. "A benchmark JWST near-infrared spectrum for the exoplanet WASP-39 b". In: *Nature Astronomy* 8 (Aug. 2024), pp. 1008–1019. arXiv: 2407.13893 [astro-ph.EP].

[44] Néstor Espinoza, Maria E. Steinrueck, James Kirk, Ryan J. MacDonald, Arjun B. Savel, et al. "Inhomogeneous terminators on the exoplanet WASP-39 b". In: Nature 632.8027 (Aug. 2024), pp. 1017–1020. arXiv: 2407.10294 [astro-ph.EP].

[43] Tyler Baines, Néstor Espinoza, Joseph Filippazzo, Kevin Volk, and **Aarynn Carter**. "JWST NIRISS/SOSS: advancements in calibration and observational tools for exoplanetary science". In: *Space Telescopes and Instrumentation 2024: Optical, Infrared, and Millimeter Wave*. Ed. by Laura E. Coyle, Shuji Matsuura, and Marshall D. Perrin. Vol. 13092. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. Aug. 2024, p. 1309212.

[42] Klaus Subbotina Stephenson, **Aarynn L. Carter**, and Andrew Skemer. "The effects of binary reference stars on JWST NIRCam coronagraphy". In: *Space Telescopes and Instrumentation 2024: Optical, Infrared, and Millimeter Wave*. Ed. by Laura E. Coyle, Shuji Matsuura, and Marshall D. Perrin. Vol. 13092. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. Aug. 2024, p. 1309253.

[41] Taylor J. Bell, Nicolas Crouzet, Patricio E. Cubillos, Laura Kreidberg, Anjali A. A. Piette, et al. "Nightside clouds and disequilibrium chemistry on the hot Jupiter WASP-43b". In: *Nature Astronomy* 8 (July 2024), pp. 879–898. arXiv: 2401.13027 [astro-ph.EP].

[40] Simon Petrus, Niall Whiteford, Polychronis Patapis, Beth A. Biller, Andrew Skemer, et al. "The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems. V. Do Self-consistent Atmospheric Models Represent JWST Spectra? A Showcase with VHS 1256–1257 b". In: ApJ 966.1, L11 (May 2024), p. L11. arXiv: 2312.03852 [astro-ph.EP].

[39] Steph Sallum, Shrishmoy Ray, Jens Kammerer, Anand Sivaramakrishnan, Rachel Cooper, et al. "The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems. IV. NIRISS Aperture Masking Interferometry Performance and Lessons Learned". In: ApJ 963.1, L2 (Mar. 2024), p. L2. arXiv: 2310.11499 [astro-ph.EP].

[38] Diana Powell, Adina D. Feinstein, Elspeth K. H. Lee, Michael Zhang, Shang-Min Tsai, et al. "Sulfur dioxide in the mid-infrared transmission spectrum of WASP-39b". In: Nature 626.8001 (Feb. 2024), pp. 979–983. arXiv: 2407.07965 [astro-ph.EP].

[37] Rachel Bowens-Rubin, Joseph M. Akana Murphy, Philip M. Hinz, Mary Anne Limbach, Andreas Seifahrt, et al. "A Wolf 359 in Sheep's Clothing: Hunting for Substellar Companions in the Fifth-closest System Using Combined High-contrast Imaging and Radial Velocity Analysis". In: AJ 166.6, 260 (Dec. 2023), p. 260. arXiv: 2309.03402 [astro-ph.EP].

[36] Zhoujian Zhang, Paul Mollière, Keith Hawkins, Catherine Manea, Jonathan J. Fortney, et al. "ELemental abundances of Planets and brown dwarfs Imaged around Stars (ELPIS). I. Potential Metal Enrichment of the Exoplanet AF Lep b and a Novel Retrieval Approach for Cloudy Self-luminous Atmospheres". In: AJ 166.5, 198 (Nov. 2023), p. 198. arXiv: 2309.02488 [astro-ph.EP].

[35] Shrishmoy Ray, Steph Sallum, Sasha Hinkley, Anand Sivamarakrishnan, Rachel Cooper, et al. "The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems III: Aperture Masking Interferometric Observations of the star HIP 65426 at 3.8 um". In: *arXiv e-prints*, arXiv:2310.11508 (Oct. 2023), arXiv:2310.11508. arXiv: 2310.11508 [astro-ph.EP].

[34] Louis-Philippe Coulombe, Björn Benneke, Ryan Challener, Anjali A. A. Piette, Lindsey S. Wiser, et al. "A broadband thermal emission spectrum of the ultra-hot Jupiter WASP-18b". In: Nature 620.7973 (Aug. 2023), pp. 292–298. arXiv: 2301.08192 [astro-ph.EP].

[33] **Aarynn L. Carter**, Sasha Hinkley, Jens Kammerer, Andrew Skemer, Beth A. Biller, et al. "The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems I: High-contrast Imaging of the Exoplanet HIP 65426 b from 2 to 16 μm". In: ApJ 951.1, L20 (July 2023), p. L20. arXiv: 2208.14990 [astro-ph.EP].

[32] Shang-Min Tsai, Elspeth K. H. Lee, Diana Powell, Peter Gao, Xi Zhang, et al. "Photochemically produced SO_2 in the atmosphere of WASP-39b". In: Nature 617.7961 (May 2023), pp. 483–487. arXiv: 2211.10490 [astro-ph.EP].

[31] Brittany E. Miles, Beth A. Biller, Polychronis Patapis, Kadin Worthen, Emily Rickman, et al. "The JWST Early-release Science Program for Direct Observations of Exoplanetary Systems II: A 1 to 20 μm Spectrum of the Planetary-mass Companion VHS 1256-1257 b". In: ApJ 946.1, L6 (Mar. 2023), p. L6. arXiv: 2209.00620 [astro-ph.EP].

[30] Shrishmoy Ray, Sasha Hinkley, Steph Sallum, Mariangela Bonavita, Vito Squicciarini, et al. "Detecting planetary mass companions near the water frost-line using JWST interferometry". In: MNRAS 519.2 (Feb. 2023), pp. 2718–2735. arXiv: 2211.09830 [astro-ph.EP].

[29] JWST Transiting Exoplanet Community Early Release Science Team, Eva-Maria Ahrer, Lili Alderson, Natalie M. Batalha, **including Aarynn. L Carter (joint-first author)**, et al. "Identification of carbon dioxide in an exoplanet atmosphere". In: Nature 614.7949 (Feb. 2023), pp. 649–652. arXiv: 2208.11692 [astro-ph.EP].

[28] Eva-Maria Ahrer, Kevin B. Stevenson, Megan Mansfield, Sarah E. Moran, Jonathan Brande, et al. "Early Release Science of the exoplanet WASP-39b with JWST NIRCam". In: Nature 614.7949 (Feb. 2023), pp. 653–658. arXiv: 2211.10489 [astro-ph.EP].

[27] Z. Rustamkulov, D. K. Sing, S. Mukherjee, E. M. May, J. Kirk, et al. "Early Release Science of the exoplanet WASP-39b with JWST NIRSpec PRISM". In: Nature 614.7949 (Feb. 2023), pp. 659–663. arXiv: 2211.10487 [astro-ph.EP].

[26] Lili Alderson, Hannah R. Wakeford, Munazza K. Alam, Natasha E. Batalha, Joshua D. Lothringer, et al. "Early Release Science of the exoplanet WASP-39b with JWST NIRSpec G395H". In: Nature 614.7949 (Feb. 2023), pp. 664–669. arXiv: 2211.10488 [astro-ph.EP].

[25] Adina D. Feinstein, Michael Radica, Luis Welbanks, Catriona Anne Murray, Kazumasa Ohno, et al. "Early Release Science of the exoplanet WASP-39b with JWST NIRISS". In: Nature 614.7949 (Feb. 2023), pp. 670–675. arXiv: 2211.10493 [astro-ph.EP].

[24] Bin B. Ren, Nicole L. Wallack, Spencer A. Hurt, Dimitri Mawet, **Aarynn L. Carter**, et al. "Planet search with the Keck/NIRC2 vortex coronagraph in the M_s band for Vega". In: A&A 670, A162 (Feb. 2023), A162. arXiv: 2301.07714 [astro-ph.EP].

[23] Sasha Hinkley, Beth Biller, Andrew Skemer, **Aarynn L. Carter**, Julien Girard, et al. "The JWST Early Release Science Program for Direct Observations of Exoplanetary Systems: Best Practices for Data Collection in Cycle 2 and Beyond". In: *arXiv e-prints*, arXiv:2301.07199 (Jan. 2023), arXiv:2301.07199. arXiv: 2301.07199 [astro-ph.IM].

[22] Taylor Bell, Eva-Maria Ahrer, Jonathan Brande, **Aarynn Carter**, Adina Feinstein, et al. "Eureka!: An End-to-End Pipeline for JWST Time-Series Observations". In: *The Journal of Open Source Software* 7.79, 4503 (Nov. 2022), p. 4503. arXiv: 2207.03585 [astro-ph.IM].

[21] Sasha Hinkley, **Aarynn L. Carter**, Shrishmoy Ray, Andrew Skemer, Beth Biller, et al. "The JWST Early Release Science Program for the Direct Imaging and Spectroscopy of Exoplanetary Systems". In: PASP 134.1039, 095003 (Sept. 2022), p. 095003. arXiv: 2205.12972 [astro-ph.EP].

[20] Nikolay K. Nikolov, David K. Sing, Jessica J. Spake, Barry Smalley, Jayesh M. Goyal, et al. "Solar-to-supersolar sodium and oxygen absolute abundances for a 'hot Saturn' orbiting a metal-rich star". In: MNRAS 515.2 (Sept. 2022), pp. 3037–3058. arXiv: 2206.00017 [astro-ph.EP].

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