

Thomas Greene

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Education: Ph.D., Astronomy, University of Arizona, 1991
B.A., Physics, University of California at Santa Cruz, 1982

Employment Experience:

1998 – present: Astrophysicist (since 1998); Director, Ames Center for Exoplanet Studies (2008 – 2015); and Chief, Astrophysics Branch (1998–2001), NASA Ames

2004 (6 mo): Visiting Program Scientist, Astronomy & Physics Division, NASA HQ

1997 – 1998: Research Scientist, Lockheed Martin Advanced Technology Center, Palo Alto

1996 – 1997: NASA IRTF Director and Associate Astronomer, University of Hawaii

1992 – 1996: NASA IRTF staff and Deputy Director and Assistant Astronomer,
University of Hawaii, Honolulu

1991 – 1992: National Research Council Postdoctoral Associate, Space Science Division,
NASA's Ames Research Center, Moffett Field, CA

1983 – 1985: Research Engineer and Software Engineer, Nanometrics Inc., Sunnyvale, CA

Selected Professional Activities and Positions:

Habitable Worlds Observatory Technical Assessment Group (HWO TAG), 2023 – present

Pandora Astrophysics Pioneers smallsat Co-Investigator, 2021 – present

JWST Users Committee, 2017 – 2023

NAEM Committee on Astronomy and Astrophysics, 2014 – 2022, co-chair 2019 – 2022

Keck Observatory Science Steering Committee, 2005 – 2010 & 2015 – 2022

Chair and co-founder of the quarterly Bay Area Exoplanet Meetings, 2012 – 2021

NASA WFIRST-AFTA Science Definition Team, 2012 – 2015

NASA Keck Observatory and Spitzer TACs: member, panel chair, chair roles, 2004 – 2016

NASA Exoplanet Program Analysis Group executive committee, 2010 – 2014

NAS Astro2010 Decadal Survey Space (EOS) Program Prioritization Panel, 2009 – 2010

NASA Astrophysics Subcommittee and Origins Subcommittee, 2004 – 2008

NASA SOFIA Project Scientist, 2001 – 2005

JWST NIRCAM Instrument Co-Investigator, 2002 – present

JWST Mid-IR Steering Committee and Mid-IR Science Team, 2001 – present

NGST (now JWST) Ad-hoc Science Working Group, 1998 – 2000

Recent Awards: [NASA Ames Associate Fellow](#), 2020

Current and Past Graduate Students and Postdocs:

Valentin Le Gouellec, Taylor Bell, Ben Lew, Laurie Chu, Joshua Schlieder, Kerri Cahoy, Pavel Machalek, Sean Matt, Andy Skemer, Michael Connelley, Kevin Covey, Greg Doppmann, Karl Haisch, Jr.

Research Interests:

Observational studies of exoplanets and protostars, ground and space observatories and instrumentation, scientific strategic planning and policy

International Research Collaborations:

- [JWST MANATEE](#) transiting exoplanets guaranteed time program PI and team leader
- [JWST Observations of Young protoStars \(JOYS\)](#) team member

Selected media:

- [JWST / MANATEE initial exoplanet discoveries](#), plenary address at the National Academies' Space Science Week, March 2023
- [JWST first image release interview, KCRA TV](#), July 2022
- [The JWST: An Awesome New Window on the Universe Opens Wide](#), Planetary Society podcast interview, July 2022
- [Characterizing the atmosphere of TRAPPIST-1 b and other exoplanets with JWST](#) NASA GSFC exoplanet seminar, May 2023
- [An Evening with the Stars: NASA's James Webb Space Telescope](#) outreach presentation to the California State Library, July 2023

Research Funding:

PI and co-I of numerous federal (mostly NASA) successful research proposals in observational science and instrumentation; awarded ~\$8–10M for personal research efforts over the past 20 years. Successfully conceived and executed [NASA Space Act](#) and Visiting Researcher Agreements with non-US institutions.

Significant Publications

[See ADS](#) or [Google Scholar](#) for all; h-index = 50, 9000+ citations

155. Lawson, Kellen; Schlieder, Joshua E.; Leisenring, Jarron M.; Bogat, Ell, et al., “JWST/NIRCam Coronagraphy of the Young Planet-hosting Debris Disk AU Microscopii,” *The Astronomical Journal*, Volume 166, Issue 4, id.150, 20 pp., October 2023

154. Roy, Pierre-Alexis; Benneke, Björn; Piaulet, Caroline; Gully-Santiago, Michael A.; Crossfield, Ian J. M. et al, “Water Absorption in the Transmission Spectrum of the Water World Candidate GJ 9827 d,” *The Astrophysical Journal Letters*, Volume 954, Issue 2, id.L52, 11 pp., September 2023

153. Sun, Fengwu; Egami, Eiich, Pizkal, Nor, et al., “First Sample of $H\alpha+[O III]\lambda 5007$ Line Emitters at $z > 6$ Through JWST/NIRCam Slitless Spectroscopy: Physical Properties and Line-luminosity Functions,” *The Astrophysical Journal*, Volume 953, Issue 1, id.53, 19 pp.,

August, 2023

152. Gardner, Jonathan P.; Mather, John C.; Abbott, Randy; et al., “The James Webb Space Telescope Mission,” Publications of the Astronomical Society of the Pacific, Volume 135, Issue 1048, id.068001, 24 pp., June 2023

151. Greene, T. P., Bell, T. J., Ducrot, E., Dyrek, A., Lagage, P.O., & Fortney, J. J., “Thermal Emission from the Earth-sized Exoplanet TRAPPIST-1 b using JWST,” Nature, Volume 618, Issue 7963, p.39-42, June 2023

150. Wright, Gillian S.; Rieke, George H.; Glasse, Alistair, et al., “The Mid-infrared Instrument for JWST and Its In-flight Performance,” Publications of the Astronomical Society of the Pacific, Volume 135, Issue 1046, id.048003, 20 pp., April 2023

149. Rigby, Jane; Perrin, Marshall; McElwain, Michael, et al., “The Science Performance of JWST as Characterized in Commissioning,” Publications of the Astronomical Society of the Pacific, Volume 135, Issue 1046, id.048001, 31 pp., April 2023

148. Bouwman, J., Kendrew, S., Greene, T. P., et al., “Spectroscopic time series performance of the Mid-Infrared Instrument on the JWST,” Publications of the Astronomical Society of the Pacific, Volume 135, Issue 1045, id.038002, 16 pp., March 2023

147. Rieke, Marcia J.; Kelly, Douglas M.; Misselt, Karl, et al., “Performance of NIRCcam on JWST in Flight,” Publications of the Astronomical Society of the Pacific, Volume 135, Issue 1044, id.028001, 14 pp., February 2023

146. Espinoza, Néstor; Úbeda, Leonardo; Birkmann, Stephan M., et al., “Spectroscopic Time-series Performance of JWST/NIRSpec from Commissioning Observations,” Publications of the Astronomical Society of the Pacific, Volume 135, Issue 1043, id.018002, 15 pp., January 2023

145. Schlawin, Everett; Beatty, Thomas; Brooks, Brian, Nikolov, Nikolay K., Greene, Thomas P., et al., “JWST NIRCcam Defocused Imaging: Photometric Stability Performance and How It Can Sense Mirror Tilts,” Publications of the Astronomical Society of the Pacific, Volume 135, Issue 1043, id.018001, 17 pp., January 2023

144. Brande, Jonathan; Crossfield, Ian J. M.; Kreidberg, Laura, et al., “A Mirage or an Oasis? Water Vapor in the Atmosphere of the Warm Neptune TOI-674 b,” The Astronomical Journal, Volume 164, Issue 5, id.197, 18 pp., November 2022

143. Kreidberg, Laura; Mollière, Paul; Crossfield, Ian J. M., et al., “Tentative Evidence for Water Vapor in the Atmosphere of the Neptune-sized Exoplanet HD 106315c,” The Astronomical Journal, Volume 164, Issue 4, id.124, 15 pp., October 2022

142. Sun, Fengwu; Egami, Eiichi; Pirzkal, Nor, et al., “First Peek with JWST/NIRCcam Wide-field Slitless Spectroscopy: Serendipitous Discovery of a Strong [O III]/H α Emitter at

$z = 6.11$,” *The Astrophysical Journal Letters*, Volume 936, Issue 1, id.L8, 7 pp., September 2022

141. Skemer, Andrew J.; Stelter, R. Deno; Sallum, Stephanie, et al., “Design of SCALES: a 2-5 micron coronagraphic integral field spectrograph for Keck Observatory,” *Proceedings of the SPIE*, Volume 12184, id. 121840I 19 pp., August 2022

140. Girard, Julien, et al., “JWST/NIRCam Coronagraphy: Commissioning and First On-Sky Results,” *Proceedings of the SPIE*, Volume 12180, id. 121803Q 20 pp., August 2022

139. Matsuo, Taro; Greene, Thomas P.; Qezlou, Mahdi, et al., “Densified Pupil Spectrograph as High-precision Radial Velocimetry: From Direct Measurement of the Universe’s Expansion History to Characterization of Nearby Habitable Planet Candidates,” *The Astronomical Journal*, Volume 163, Issue 2, id.63, 27 pp., February 2022

138. Hoffman, Kelsey; Quintana, Elisa V.; Dotson, Jessie L., et al., “The Pandora Small-Sat: a mission to spectroscopically study exoplanet atmospheres,” *Proceedings of the SPIE*, Volume 12180, id. 121800C 9 pp., August, 2022

137. Phillips, Caprice L.; Wang, Ji; Kendrew, Sarah; Greene, Thomas P., “Detecting Biosignatures in the Atmospheres of Gas Dwarf Planets with the James Webb Space Telescope,” *The Astrophysical Journal*, Volume 923, Issue 2, id.144, 15 pp., December 2021

136. Laos, Stefan; Greene, Thomas P.; Najita, Joan R.; Stassun, Keivan G., “The Near-stellar Environment of Class 0 Protostars: A First Look with Near-infrared Spectroscopy,” *The Astrophysical Journal*, Volume 921, Issue 2, id.110, 16 pp., November 2021

135. Schlawin, Everett; Leisenring, Jarron; McElwain, Michael W.; Misselt, Karl; Don, Kenneth; Greene, Thomas P.; Beatty, Thomas; Nikolov, Nikolay; Kelly, Douglas; Rieke, Marcia, “JWST Noise Floor II: Systematic Error Sources in JWST NIRCam Time Series,” *The Astronomical Journal*, 161, 115, March 2021

134. David Leisawitz, Edward Amatucci, Lynn Allen, et al., “The Origins Space Telescope: baseline mission concept,” *Journal of Astronomical Telescopes, Instruments, and Systems*, 7, 011002, January 2021

133. David Leisawitz, Edward Amatucci, Lynn Allen, et al., “The Origins Space Telescope: trades and decisions leading to the baseline mission concept, and future study topics,” *Journal of Astronomical Telescopes, Instruments, and Systems*, 7, 011004, January 2021

132. Itsuki Sakon, Thomas L. Roellig, Kimberly Ennico-Smith, et al., “Mid-infrared Spectrometer and Camera (MISC) for Origins,” *Journal of Astronomical Telescopes, Instruments, and Systems*, 7, 011013, January 2021

131. Thomas Mikal-Evans, Ian J. M. Crossfield, Björn Benneke, Laura Kreidberg, et al., “Transmission spectroscopy for the warm sub-Neptune HD 3167c: evidence for molecular

absorption and a possible high metallicity atmosphere,” *The Astronomical Journal*, 161, 18, January 2021

130. Everett Schlawin, Jarron Leisenring, Karl Misselt, Thomas P. Greene, Michael W. McElwain, Thomas Beatty, and Marcia Rieke, “JWST Noise Floor I: Random Error Sources in JWST NIRC*am* Time Series,” *The Astronomical Journal*, 160, 231, November 2020

129. Thomas L. Roellig, Craig W. McMurry, Thomas Greene, Taro Matsuo, Itsuki Sakon, Johannes Staguhn, “Mid-infrared detector development for the Origins Space Telescope,” *Journal of Astronomical Telescopes, Instruments, and Systems*, 6, 041503, October 2020

128. Matsuo, Taro; Greene, Thomas P.; Johnson, Roy R.; McMurray, Robert E.; Roellig, Thomas L.; Ennico, Kimberly, “Photometric Precision of a Si:As Impurity Band Conduction Mid-infrared Detector and Application to Transit Spectroscopy,” *Publications of the Astronomical Society of the Pacific*, Volume 131, Issue 1006, pp. 124502, December 2019

127. Benneke, Björn, et al., “Water Vapor and Clouds on the Habitable-zone Sub-Neptune Exoplanet K2-18b,” *The Astrophysical Journal Letters*, Volume 887, Issue 1, article id. L14, December 2019

126. Sullivan, T., Wilking, B., Greene, T., et al. “A Radial Velocity Survey of Embedded Sources in the Rho Ophiuchi Cluster,” *The Astronomical Journal*, Volume 158, Issue 1, article id. 41, July 2019

125. Berardo, David, et al., “Revisiting the HIP41378 system with K2 and Spitzer,” *The Astronomical Journal*, Volume 157, Issue 5, article id. 185, May 2019

124. Bean, Jacob, et al., “The Transiting Exoplanet Community Early Release Science Program for JWST” *PASP*, 130, 114402, November 2018

123. T. Greene, M. Gully-Santiago, and M. Barsony, “Detection of Photospheric Features in the Near-Infrared Spectrum of a Class 0 Protostar,” *ApJ*, 862, 85, July 2018

122. Schlawin, Everett; Greene, Thomas P.; Line, Michael; Fortney, Jonathan J.; Rieke, Marcia, “Clear and Cloudy Exoplanet Forecasts for JWST: Maps, Retrieved Composition and Constraints on Formation with MIRI and NIRC*am*,” *AJ*, 156, 40, July 2018

121. Blečić, J., Hobbs-Dixon, I., & Greene, T., “The implications of atmospheric 3-D thermal structure on 1-D retrieval,” *ApJ* 848, September 2017

120. Beichman, C., Giles, H., Akeson, R., . . . Greene, T., plus 6 more et al., “Validation and Initial Characterization of the Long-period Planet Kepler-1654 b,” *AJ* 155, 158B, April 2018

119. Christiansen, J. et al., “Three’s company: An additional non-transiting planet in the HD 3167 system, and masses for all three planets,” *Astrophysical Journal* 154, id 122,

September 2017

118. T. Greene, D. Kelly, J. Stansberry, et al., “Design, estimated performance, and simulated observations of the JWST NIRCcam 2.4 – 5 micron spectroscopic modes” *Journal of Astronomical Telescopes and Instrumentation (JATIS - invited)* 3, 035001, July 2017

117. Batalha, Natasha, Mandell, A., Pontoppidan, K., Stevenson, K., Lewis, N., Kalirai, J., Greene, T. et al., “PandExo: A Community Tool for Transiting Exoplanet Science with JWST and HST” *PASP*, 129, pp. 064501, June 2017

116. Sinukoff, Evan; Howard, Andrew W.; Petigura, Erik A., et al., “K2-66b and K2-106b: Two Extremely Hot Sub-Neptune-size Planets with High Densities,” *Astronomical Journal* 153, id 271, June 2017

115. Schlawin, Everett; Rieke, Marcia; Leisenring, Jarron; Greene, Tom; et al. “Two NIR-Cam channels are Better than One: How JWST Can Do More Science with NIRCcam’s Short-Wavelength Dispersed Hartmann Sensor,” *PASP Volume 129*, 971, pp. 015001 January 2017

114. Stevenson, Kevin B.; Lewis, Nikole K.; et al., “Transiting Exoplanet Studies and Community Targets for JWST’s Early Release Science Program.” *Publications of the Astronomical Society of Pacific*, Volume 128, Issue 967, pp. 094401 September 2016

113. C. Beichman et al., “Spitzer Observations of Exoplanets Discovered with The Kepler K2 Mission,” *ApJ* 822, Issue 1, article id. 39 May 2016

112. Greene, T., Chu, L., Hodapp, K. W., et al., “Slitless Spectroscopy with the James Webb Space Telescope Near-Infrared Camera (JWST NIRCcam),” *Proceedings of the SPIE*, 2016 July, Volume 9904, id. 99040E

111. Stevenson, K., et al., “Transiting Exoplanet Studies and Community Targets for JWST’s Early Release Science Program,” 2016 Sep, *PASP*, 128, 094401

110. Beichman, C., et al., “Spitzer Observations of Exoplanets Discovered with the Kepler K2 Mission,” 2016 May, *ApJ* 822, article id. 39

109. Traub, W. A., Breckinridge, J., Greene, T. P.; Guyon, O. Kasdin, N. J., Macintosh, B., “Science yield estimate with the Wide-Field Infrared Survey Telescope coronagraph,” 2016 Jan, *JATIS*, Volume 2, id. 011020

108. Greene, T. P., Line, M. R., Montero, C., Fortney, J. J., Lustig-Yaeger, J., Luther, Kyle, “Characterizing Transiting Exoplanet Atmospheres with JWST,” 2016 Jan, *ApJ* 817, article id. 17, 22 pp.

107. Gordon, K., et al., “The Mid-Infrared Instrument for the James Webb Space Telescope, X: Operations and Data Reduction,” 2015 July, *PASP* 127, 953, pp.696–711

106. Rieke, G. H., et al., “The Mid-Infrared Instrument for the James Webb Space Telescope, VII: The MIRI Detectors,” 2015 July, PASP 127, 953, pp.665–674
105. Kendrew, S., et al., “The Mid-Infrared Instrument for the James Webb Space Telescope, IV: The Low-Resolution Spectrometer,” 2015 July, PASP 127, 953, pp.623–632
104. Wright, G. S., et al., “The Mid-Infrared Instrument for the James Webb Space Telescope, II: Design and Build,” 2015 July, PASP 127, 953, pp.595–611
103. Rieke, G. H., et al., “The Mid-Infrared Instrument for the James Webb Space Telescope, I: Introduction,” 2015 July, PASP 127, 953, pp.584–594
102. I. Crossfield et al., “A Nearby M Star with Three Transiting Super-Earths Discovered by K2,” 2015 May, ApJ 804, 10
101. N. Cowan, T. Greene, et al., “Characterizing Transiting Planet Atmospheres through 2025,” 2015 March, PASP 127, 949, pp.311–327
100. D. Spergel et al. (AFTA Science Definition Team), Wide-Field InfraRed Survey Telescope - Astrophysics Focused Telescope Assets WFIRST-AFTA Final Report, 2015 <http://adsabs.harvard.edu/abs/2015arXiv150303757S>
99. C. Beichman et al., “Observations of Transiting Exoplanets with the James Webb Space Telescope (JWST),” 2014 December, PASP 126, 946, pp.1134–1173
98. R. Belikov et al., “EXCEDE technology development III: first vacuum tests” 2014 Aug., Proceedings of the SPIE, Volume 9143, id. 914323
97. M. Connelley & T. Greene, “Near-IR Spectroscopic Monitoring of Class I Protostars: Variability of Accretion and Wind Indicators,” 2014 June, AJ 147, 125
96. C. Morely, M. Marley, J. Fortney, R. Lupu, D. Saumon, T. Greene, K. Lodders, “Water Clouds in Y Dwarfs and Exoplanets,” 2014 May, ApJ 787, 78
95. Fortney, J., Mordisini, C., Nettleman, N., Kempton, E., Greene, T., & Zahnle, K., “A Framework for Characterizing the Atmospheres of Low-mass Low-density Transiting Planets,” 2013 September, ApJ 775, 1, 80
94. Greene, T., Noecker, C, and the SAG5 study team, “NASA ExoPAG Study Analysis Group 5: Flagship Exoplanet Imaging Mission Science Goals and Requirements Report,” 2013 March, <http://arxiv.org/abs/1303.6707>
93. C. Beichman, M. Rieke, D. Eisenstein, T. Greene, et al., “Science opportunities with the near-IR camera (NIRCam) on the James Webb Space Telescope (JWST)” 2012 September, Proceedings of the SPIE, 8442, 84422N

92. R. Belikov, E. Pluzhnik, F. Witteborn, T. Greene, et al., “EXCEDE technology development I: first demonstrations of high contrast at $1.2\lambda/D$ for an Explorer space telescope mission” 2012 September, Proceedings of the SPIE, 8442, 844209
91. Matt, S., MacGregor, K., Pinsonneault, M., & Greene, T., “Magnetic Braking Formulation for Sun-like Stars: Dependence on Dipole Field Strength and Rotation Rate” 2012 August, ApJ 754, L26
90. Cowan, N. B., Machalek, P., Croll, B., Shektman, L., Burrows, Al, Deming, D., Greene, T., & Hora, J., “Thermal Phase Variations of WASP-12b: Defying Predictions,” 2012 March ApJ, 747, 82
89. Matt, S. P., Pinzon, G., Greene, T., & Pudritz, R., “Spin Evolution of Accreting Young Stars. II. Effect of Accretion-powered Stellar Winds,” 2012, ApJ, 745, 101
88. Skemer, A., Close, L., Greene, T., Hinz, P., Hoffmann, W., Males, J., “Dust Grain Evolution in Spatially Resolved T Tauri Binaries,” 2011 October ApJ, 740, 43
87. R. Belikov, E. Pluzhnik, F. Witteborn, T. Greene, et al., “Laboratory demonstration of high-contrast imaging at inner working angles $2\lambda/D$ and better” 2011 October, Proceedings of the SPIE, 8151, 815102
86. J. Chiar et al., “Ices in the Quiescent IC 5146 Dense Cloud,” 2011 ApJ 731, 9
85. M. Shabram, J. Fortney, T. Greene, R. Freedman, “Transmission Spectra of Transiting Planet Atmospheres: Model Validation and Simulations of the Hot Neptune GJ 436b for the James Webb Space Telescope,” 2011 February ApJ, 727, 65
84. T. Greene, M. Barsony, D. Weintraub, “Near-IR H₂ Emission of Protostars: Probing Circumstellar Environments,” 2010 December, ApJ, 725, 1100
83. M. Connelley & T. Greene, “A Near-infrared Spectroscopic Survey of Class I Protostars,” 2010 Nov AJ, 140, 1214
82. T. Greene et al., “Testing PIAA Coronagraphs at NASA Ames” 2010 in “Pathways Towards Habitable Planets,” proceedings of a workshop held 14 to 18 September 2009 in Barcelona, Spain. Edited by Vincent Coudé du Foresto, Dawn M. Gelino, and Ignasi Ribas. San Francisco: Astronomical Society of the Pacific, p.453
81. M. Gully-Santiago, W. Wang, C. Deen, D. Kelly, T. Greene, J. Bacon, D. T. Jaffe, “High-performance silicon grisms for 1.2-8.0 μm : detailed results from the JWST-NIRCam devices,” 2010 July, Proceedings of the SPIE, 7739, 77393S
80. U. Mueller, J. Stone, B. Peters, J. Daniel, T. Greene, R. Belikov, O. Guyon, “Narrow ion-beam figuring: a new tool to address extreme slopes on small surfaces located near telescope pupils,” 2010 July, Proceedings of the SPIE, 7739, 77390B

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78. L. Keller et al., “Progress report on FORCAST grism spectroscopy as a future general observer instrument mode on SOFIA,” 2010 July, Proceedings of the SPIE, 7735, 77356N
77. R. Belikov et al., “Laboratory demonstration of high-contrast imaging at $2\lambda/D$ on a temperature-stabilized testbed in air,” 2010 July, Proceedings of the SPIE, 7731, 77312D
76. G. Wright et al., “Progress with the design and development of MIRI, the mid-IR instrument for JWST,” 2010 July, Proceedings of the SPIE, 7731, 77310E
75. T. Greene et al., “NIRCam: development and testing of the JWST near-infrared camera” 2010 July, Proceedings of the SPIE, 7731, 77310C
74. A. Skemer et al., “ISM Dust Grains and N-band Spectral Variability in the Spatially Resolved Subarcsecond Binary UY Aur” 2010 ApJ, 711, 1280
73. P. Machalek, T. Greene, et al., “Thermal Emission and Tidal Heating of the Heavy and Eccentric Planet XO-3b,” 2010 ApJ, 711, 111
72. “Spin Evolution of Accreting Young Stars. I. Effect of Magnetic Star-Disk Coupling” S. Matt, G. Pinzon, R. de la Reza, T. Greene 2010 ApJ, 714, 989
71. “Thermal Emission and Tidal Heating of the Heavy and Eccentric Planet XO-3b” P. Machalek, T. Greene, P. McCullough, et al. 2010 ApJ, 711, 111
70. “Imaging Young Giant Planets From Ground and Space” C. Beichman, J. Krist, J. Trauger, T. Greene, B. Oppenheimer, et al. 2010 PASP, 122, 162
69. “Discovery and Characterization of Transiting SuperEarths Using an All-Sky Transit Survey and Follow-Up by the James Webb Space Telescope” D. Deming, S. Seager, J. Winn, E. Miller-Ricci, M. Clampin, D. Lindler, T. Greene, D. Charbonneau, et al. 2009, PASP, 121, 952
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Objects” 2007, AJ, 113, 1321

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