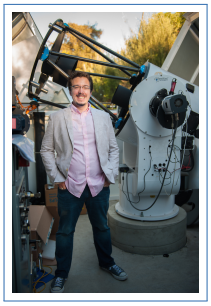

Jonathan Fraine

Exoplanet Characterization and Planet Formation

Work Experience

2017 - **Research Scientist**, *Space Telescope Science Institute*, Instruments Division, James Webb Space Telescope (JWST).

2015 - 2017 **Postdoctoral Research Associate**, *University of Arizona*, Steward Observatory, James Webb Space Telescope (JWST) Near Infrared Camera (NIRCam).

Education

2009 - 2015 **Ph.D. Astronomy**, *University of Maryland*, College Park.
Exoplanet Spectroscopy by Combining HST WFC3 and Magellan IMACS & MMIRS

2013 - 2015 **Predoctoral Fellow**, *California Institute of Technology*, Pasadena, CA.
Exoplanet Spectroscopy with HST WFC3

2013 - 2015 **Predoctoral Fellow**, *Pontificia Universidad Católica de Chile*, Santiago, Chile.
Exoplanet Spectroscopy with Magellan IMACS

2009 - 2011 **M.S. Astronomy**, *University of Maryland*, College Park.
Novel Gravity Solver for Fluid Dynamical Planet Formation Simulations with *ATHENA*

2007 - 2009 **M.S. Mathematics**, *University of Central Florida*, Orlando.
Image Analysis and Machine Learning

2003 - 2006 **B.S. Physics**, *University of Central Florida*, Orlando, Astronomy Specialization.
Condensed Matter Laboratory Research in Magnetic Nanofluids

Instrument Calibration Team

Research Interests

Exoplanet atmospheres, planet formation, and astrobiology.

Planetary population statistics and detection.

Astrophysical fluid dynamics and radiative transfer.

Bayesian inference and statistical modeling.

Big data and machine learning.

Image analysis and information extraction.

Computational and mathematical modeling.

University of Arizona Steward Observatory
933 N Cherry Ave, Tucson, AZ, 85721
239.280.7222 • ☎ 301.244.9285 • ✉ jdfraine@email.arizona.edu
http://mips.as.arizona.edu/~jdfraine

Ph.D. Thesis

Title *Diagnosing Clouds and Hazes in Exoplanetary Atmospheres*

Advisors Drs. Drake Deming, Andrés Jordán, Heather Knutson, Derek Richardson, J. Patrick Harrington

Description By combining multi-epoch, multi-instrument observations from both space and ground based facilities, I constrained exoplanetary atmospheric compositions over a span of planetary masses. My work using Spitzer-IRAC on GJ 1214b, a transiting Super-Earth ($\sim 2.7\ R_\oplus$), precisely constrained the infrared transit depth to ~40 ppm, significantly constraining the lack of any molecular detections. My work on HAT-P-11 b was the first detection of a molecular signature from a small exoplanet ($\sim 4.5\ R_\oplus$), inferring the presence of a hydrogen rich atmosphere for this exo-Neptune. I am one of the founding members of the ACCESS collaboration, a ground based observational campaign to spectroscopically survey a catalogue of exoplanetary architectures using major optical telescopes.

M.S. Thesis

Title *Gas Dynamics in Protoplanetary Disks: Cylindrical MHD Simulations with a Novel Gravity Solver*

Advisors Drs. Eve Ostriker, Derek Richardson, Lee Mundy

Description I developed a novel gravity solver intrinsically in cylindrical coordinates to implement self-gravity with the 3D fluid dynamics package ATHENA and study self-gravitating fluid dynamics for planet formation

Publications

Refereed Journals

2017 **"Statistical Analysis of Hubble/WFC3 Transit Spectroscopy of Extrasolar Planets"**, ApJL, Vol. 847, Issue 22.
Fu, G., Deming, D., Knutson, H., Madhusudhan, N., Mandell, A., Fraine, J.

2017 **"Community targets for JWST's early release science program: evaluation of WASP-63b"**, arXiv, 1704.07421.
Kilpatrick, B.M.; Cubillos, P.E.; Stevenson, K.B.; Lewis, N.K.; Wakeford, H.; Macdonald, R.J.; Madhusudhan, N.; Blecic, J; Bruno, G; Burrows, A; Deming, D; Heng, K.; Line, M.R.; Morley, C.V.; Parmentier, V.; Tucker, G.S.; Valenti, J.A.; Waldmann, I.P.; Bean, J.L.; Beichman, C.; **Fraine, J.D.**; Krick, J.E.; Lothringer, J.D.; Mandell, A.M.

2017 **"ACCESS I: An Optical Transmission Spectrum of GJ 1214b Reveals a Heterogeneous Stellar Photosphere"**, ApJ, Vol. 834, Issue 2.
Rackham, B., Espinoza, N., Apai, D., López-Morales, M., Jordán, A., Osip, D., Lewis, N., Rodler, F., Fraine, J., Morley, C., Fortney, J.

2017 **"Two NIRCam Channels are Better Than One: How JWST Can Do More Science With NIRCam's Short-Wavelength Dispersed Hartman Sensor"**, ApJ, Vol. 129, Issue 971.
Schlawin, E., Rieke, M., Leisenring, J., Walker, L.M., **Fraine, J.**, Kelly, D., Misselt, K., Greene, T., Line, M., Lewis, N., Stansberry, J.

2016 **"Transiting Exoplanet Studies and Community Targets for JWST's Early Release Science Program"**, ApJ, Vol. 128, Issue 967.
Stevenson, K., Lewis, N., Bean, J., Beichman, C., **Fraine, J.**, and 47 other authors

2015 **"Spitzer Secondary Eclipses of the Dense, Modestly-irradiated, Giant Exoplanet HAT-P-20b Using Pixel-level Decorrelation"**, ApJ, Vol. 805, Issue 2.
Deming, D., Knutson, H., Kammer, J., Fulton, B., Ingalls, J., Carey, S., Burrows, A., Fortney, J.J., Todorov, K., Agol, E., Cowan, N., Desert, J-M., **Fraine, J.**, Langton, J., Morley, C., Showman, A.P.

*2014 **"Water Vapour Absorption from the Clear Atmosphere of an Exo-Neptune"**, Nature, Vol. 513, Issue 7519, pp. 526-529.
Fraine J.D., Deming, D., Benneke, B., Knutson, H., Jordán, A., Espinoza, N., Madhusudhan, N., Wilkins, A., Todorov, K.

2014 **Search for a habitable terrestrial planet transiting the nearby red dwarf GJ 1214**, A&A, Vol. 563, id.A21, 13 pp..
Gillon, M., Demory, B.-O., Madhusudhan, N., Deming, D., Seager, S., Zsom, A., Knutson, H. A., Lanotte, A. A., Bonfils, X., Désert, J.-M., Delrez, L., Jehin, E., **Fraine J.D.**, Magain, P., Triaud, A.

*2013 **"*Spitzer* Transits of the Super-Earth GJ 1214 b and Implications for Its Atmosphere"**, ApJ, Vol. 765, Issue 2, article id. 127.
Fraine J.D., Deming D., Gillon M., Jehin E., Demory B.O., Benneke B., Seager S., Lewis N.K., Knutson H., and Désert J.M.

2012 **"Infrared Eclipses of the Strongly Irradiated Planet WASP-33b, and Oscillations of Its Host Star"**, ApJ, Vol. 754, Issue 2, article id. 106.
Deming D, **Fraine J.D.**, Sada P.V., Madhusudhan N., Knutson H.A., Harrington J., Blecic J., Nymeyer S., Smith A.M.S., Jackson B.

2012 **"Extrasolar Planet Transits Observed at Kitt Peak National Observatory"**, PASP, Vol. 124, Issue 913, pp.212-229.
Sada P.V., Deming D., Jennings D.E., Jackson B.K., Hamilton C.M., **Fraine J.D.**, Peterson S.W., Haase F., Bays K., Lunsford A., O'Gorman E.

Invited Talks

2017 "JWST's Capabilities and Limitations for Time Series Observations"
JWST Proposal Planning Workshop
Jonathan D. Fraine

2017 "How to propose for and use NIRISS for JWST"
JWST Proposal Planning Workshop
Jonathan D. Fraine

2017 "Exoplanets in the Era of James Webb"
Space Telescope Science Institute Community Lectures
Jonathan D. Fraine

2016 "Exoplanets in the Era of James Webb"
NASA Earths in Other Solar Systems Institute
Jonathan D. Fraine

2016 "Time Series Observations with the James Webb Space Telescope"
Canadian National Research Council
Jonathan D. Fraine

2016 "Lessons Learned from HST to Optimize JWST"
Canadian National Research Council
Jonathan D. Fraine

2015 "Diagnosing Clouds and Hazes in Exoplanet Atmospheres"
University of Maryland Department of Astronomy
Jonathan D. Fraine

2015 "Transmission Spectroscopy for Exoplanet Atmospheres"
American University of Beirut Department of Physics
Jonathan D. Fraine

2014 "Exoplanets: Super-Earths, Warm Neptunes, and Hot Jupiters" (Plenary)
MEARIM III: The Third Middle-East and Africa Regional IAU Meeting
Jonathan D. Fraine (http://www.mearim3.org/)

2014 "Transmission Spectroscopy for Comparative Planetology"
NASA Infrared Processing and Analysis Center
IPAC Lunch Talk (Dec. 17th), Fraine J.D., Deming D., Jordán, A., Knutson, H.

2014 "Transmission Spectroscopy for Comparative Planetology"
California Institute of Technology Division for Geological and Planetary Sciences
Kliegel Lecture in Planetary Science, Fraine J.D., Deming D., Jordán, A., Knutson, H.

2014 "Molecular Absorption from an Exo-Neptune"
California Institute of Technology Division for Geological and Planetary Sciences
Yuk Lunch Talk (Feb. 4th), Fraine J.D., Deming D., Benneke, B., Knutson, H., Jordán, A., Espinoza, N., Madhusudhan, N., Wilkins, A., Todorov, K.

2014 "Molecular Absorption from an Exo-Neptune"
University of California Santa Cruz FLASH Talk (Jan. 31st)
Fraine J.D., Deming D., Benneke, B., Knutson, H., Jordán, A., Espinoza, N., Madhusudhan, N., Wilkins, A., Todorov, K.

2014 "Clouds and Haze in the Atmosphere of the Super-Earth Gj1214b Using Spitzer"
Harvard-Smithsonian Center for Astrophysics, Optical and IR Astronomy Lecture (Jan. 29rd), Fraine J.D., Deming D., Benneke, B., Knutson, H., Jordán, A., Espinoza, N., Madhusudhan, N., Wilkins, A., Todorov, K.

2014 "Molecular Absorption from an Exo-Neptune"
Massachussetts Institute of Technology, Kavli Institute for Astrophysics
Brown Bag Lunch (Jan. 27rd) Fraine J.D., Deming D., Benneke, B., Knutson, H., Jordán, A., Espinoza, N., Madhusudhan, N., Wilkins, A., Todorov, K.

2013 "Constraining an Organic Haze on a Super Earth with Spitzer"
Space Telescope Science Institute, Star and Planet Formation Seminar Series

(Feb. 15th), Jonathan D. Fraine, Drake Deming

Conference Presentations

2015 "USING JWST NIRCam for Exoplanet Observations"
Enabling Transiting Exoplanet Science with JWST
Baltimore, MD, Fraine, J.D., Rieke, M., Greene, T., Line, M., Leisenring, J.

2015 "Transmission Spectroscopy for Comparative Planetology"
225^{th} American Astronomical Society Conference
Seattle, WA, Fraine, J.D., Deming, D., Jordán, A., Knutson, H.

2014 "Transmission Spectroscopy for Comparative Planetology"
46^{th} American Astronomical Society Division for Planetary Sciences Conference
Tucson, AZ, Fraine J.D., Deming D., Jordán, A., Knutson, H.

2014 "Atmosphere of exo-Neptune HAT-P-11b"
Exoclimes III: The Diversity of Planetary Atmospheres
Davos, Switzerland, Fraine J.D., Deming D., Benneke, B., Knutson, H., Espinoza, N., Jordán, A., Madhusudhan, N., Wilkins, A., Todorov, K.

2013 "Molecular Absorption from an Exo-Neptune"
45^{th} American Astronomical Society Division for Planetary Sciences Conference
Denver, CO, Fraine J.D., Deming D., Benneke, B., Knutson, H., Madhusudhan, N., Wilkins, A., Todorov, K.

2013 "*Spitzer* Transits of the Super-Earth GJ1214b and Implications for Its Atmosphere"
44^{th} American Astronomical Society Division for Planetary Sciences Conference
Reno, NV, Jonathan D. Fraine, Drake Deming

2011 "Twelve Consecutive Transits of GJ1214b in 20 Days of Continuous Observations by Spitzer", Extreme Solar Systems II, Jackson Hole, Wy, Jonathan Fraine, D. Deming, M. Gillon, B. Demory, S. Seager

2007 "Magnetic-Force Enhanced Temperature Gradient"
American Physical Society, APS March Meeting, Jonathan Fraine and Weili Luo

Awards and Honors

2014 Plenary Speaker at The Third Middle-East and Africa Regional IAU Meeting
2013 NASA Review Panel Executive Secretary
2013 California Institute of Technology Pre-doctoral Fellowship Program
2013 University of Maryland - Pontificia Universidad de Católica Joint Degree Program
2010 UMD Center for Teaching Excellence Distinguished Teaching Assistants Award
2009 Pi Mu Epsilon Mathematics Honor Society Univ. Central Florida Chapter Member
2008 JHU Applied Physics Laboratory Summer Internship Program
2005 Sigma Pi Sigma Physics Honor Society Univ. Central Florida Chapter Member

Outreach

2015 American University of Beirut Department of Physics Public Talk: "What Can Exoplanets Teach Us About Where We Came From?"

2015 Lebanese American University Astronomy Club Public Talk: "What Can Exoplanets Teach Us About Where We Came From?"

2014 Press Coverage: Conducted 20 distinct, international interviews related to the publication of my first authored **Nature** paper; a few examples: Washington Post, NASA News, Nature News, National Geographic, NPR Chico Campus, Naples Daily News, Daily Star Lebanon, Folha de S.Paulo Brazil

2014 University of Maryland Observatory Public Talk: "Astrobiology"

2012 Assisted ∼200 members of the public to view the Venus Transit via local telescopes at the Univ. of Maryland and remote viewing from the Keck Observatories

2003 - 2009 Conducted biweekly astronomical viewing for the public at the Robinson Observatory at the University of Central Florida

University of Arizona Steward Observatory
933 N Cherry Ave, Tucson, AZ, 85721
239.280.7222 • ☎ 301.244.9285 • ✉ jdfraine@email.arizona.edu
http://mips.as.arizona.edu/∼jdfraine