

Daniel Thorngren

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Education

University of California, Santa Cruz (2013-2019)

Ph.D. in Physics (Advisor: Jonathan Fortney)

Master of Science in Physics (2015)

University of California, Davis (2008-2013)

Bachelor of Science in Physics, Highest Honors (Advisor: Mani Tripathi)

Research Interests

Giant planets - composition, structure evolution, thermal transport, anomalous heating, and core physics.

Astrostatistics - Bayesian modelling applications to astrophysical data and populations.

Planet formation and its effect on observable outcomes

Skills

Constructing mathematical models of physical systems

Statistical modeling and inference - generalized linear models, parametric inference, Gaussian processes, and hierarchical Bayesian models.

Machine learning techniques - PCA, SVM, and neural networks.

Programming in C, C++, Python, Cython, and R.

Data analysis tools - SQL, Matplotlib, Pandas, Stan.

Working in a Unix environment, high-performance computing

Implementing advanced MCMC techniques (e.g. Hamiltonian Monte Carlo, BPS).

Experience

LUX Dark Matter Detector - Undergraduate Researcher, UC Davis (2011-2013)

Analyzed LUX data and calculated expected detection rates

Wrote, modified, and operated particle physics simulation software

Created optimized approximate simulation module for many-photon events which improved run-time by a factor of > 100 (senior thesis work)

Other Worlds Laboratory (OWL) - Graduate Student, UCSC (2013-Present)

Created computer models of the interior structure of giant planets

Analyzed observed exoplanet data to infer the bulk composition of giant exoplanets and understand their relationship with mass through Bayesian statistics

Analyzed stellar abundance data for the connection with planetary composition

Assisted with MCMC-based inference of planetary interior structures using gravity moment measurements from the Cassini and Juno spacecraft.

Advised two undergraduates for their senior theses.

Taught lab sections for introductory physics classes and graded coursework.

Amazon A9 - Applied Science Intern (June 2018 - September 2018)

Constructed machine-learned models for ranking customer search results, which were subsequently deployed to the Amazon website.

Analyzed Amazon internal books data to construct new features for use in improving the quality of customer search results.

Trottier Fellowship - Postdoctoral Researcher, University of Montréal (2019-present)
Modelled the effect of evolving main-sequence stars on their planets' radii.
Modelling the mass loss of hot Saturn-mass exoplanets.
Studying the effects of tidal circularization on giant planet heating and interior structure.

Honors

Member of Sigma Pi Sigma (Society of Physics Students honors society)
Dean's list five times
Highest Honors from UC Davis for senior thesis work
Trottier Postdoctoral Fellowship 2019

Talks and Presentations

TESS Science Conference 2 (8/3/21)
Exoplanet Interior Physics in the TESS Era

JWST Early Release Science Program Workshop (7/1/21)
What Masses and Radii Tell us About Planets (Review Talk)

Canada Planet Discussion Day (6/10/21)
Giant Exoplanet Interiors (Review Talk)

American Astronomical Society Meeting (6/9/21)
The Diverse Hot Saturn Population: Composition, Thermal Evolution, and Mass Loss

NASA Goddard SFC Exoplanet Seminar (1/6/21)
Slow Cooling and Fast Re-inflation for Hot Jupiters

Chesapeake Bay Area Exoplanet Meeting (12/11/20)
Slow Cooling and Fast Re-inflation for Hot Jupiters

PLATO Extra-Solar Planet Workshop (11/30/20)
Slow Cooling and Fast Re-inflation for Hot Jupiters

NExSci Exoplanet Demographics Conference (11/10/20)
Giant Planet Population Physics (Invited Review Talk)

Caltech Division of Geological and Planetary Sciences Seminar (6/4/19)
Giant Exoplanet Physics From Population Statistics

American Astronomical Society Meeting (1/10/19)
Bayesian Inference of Giant Exoplanet Physics (Thesis Talk)

AAS Division of Planetary Science (10/24/18)
Bayesian Inference of Giant Planet Physics (Thesis Talk)

Bay Area Exoplanets Meeting (6/1/18)
Giant Exoplanet Main Sequence Re-inflation & Atmosphere Metallicity

MIT Kavli Institute Exoplanet Tea Talk (4/4/18)
Bayesian Inference of Giant Planet Physics

Harvard-Smithsonian Center for Astrophysics Stars and Planets Seminar (4/2/18)
Bayesian Inference of Giant Planet Physics

American Astronomical Society Meeting (1/10/18)
Bayesian Inference of Hot Jupiter Radii: Evidence for Ohmic Dissipation?

AAS Division of Planetary Sciences Meeting (10/19/17)
Bayesian Inference of Hot Jupiter Radii: Evidence for Ohmic Dissipation?

Exoclipse Conference, Boise (8/21/17)
Bayesian Inference of Hot Jupiter Radii Points to Ohmic Dissipation

American Astronomical Society Meeting (1/5/17)
Bayesian Inference of Giant Planet Physics

Bay Area Exoplanets Meeting (12/9/16)
Bayesian Inference of Giant Planet Physics

AAS Division of Planetary Sciences Meeting (10/17/16)
Bayesian Inference of the Composition and Inflation Power of Hot Jupiters

Giant Magellan Telescope Meeting (9/26/16)
Bayesian Inference of Giant Planet Physics (Poster)

Linking Exoplanet and Disk Compositions, Space Telescope Science Institute (9/12/16)
Examining the Bulk Metallicity of Giant Planets

Exoplanets I Meeting (7/3/16)

Giant Planet Composition and Inflation: Breaking the Degeneracy (Poster)

Extreme Solar Systems Meeting (11/29/15) - The Metallicity of Giant Planets (Poster)

Bay Area Exoplanets Meeting (9/30/15) - The Metallicity of Giant Planets

Publications

- Thorngren, D. P., Fortney, J. J., Lopez, E. D., Berger, T. A., et al. (2021)
Slow Cooling and Fast Reinflation for Hot Jupiters
The Astrophysical Journal; 1, L16
- Thorngren, D., Gao, P., & Fortney, J. J. (2019)
The Intrinsic Temperature and Radiative-Convective Boundary Depth in the Atmospheres of Hot Jupiters
The Astrophysical Journal; 1, L6
- Thorngren, D., & Fortney, J. J. (2019)
Connecting Giant Planet Atmosphere and Interior Modeling: Constraints on Atmospheric Metal Enrichment
The Astrophysical Journal; 2, L31
- Thorngren, D. P., & Fortney, J. J. (2018)
Bayesian Analysis of Hot-Jupiter Radius Anomalies: Evidence for Ohmic Dissipation?
The Astronomical Journal; 5, 214
- Thorngren, D. P., Fortney, J. J., Murray-Clay, R. A., & Lopez, E. D. (2016)
The Mass-Metallicity Relation for Giant Planets
The Astrophysical Journal; 1, 64
- Dalba, P. A., Kane, S. R., Li, Z., MacDougall, M. G., et al. (2021)
Giant Outer Transiting Exoplanet Mass (GOT 'EM) Survey. II. Discovery of a Failed Hot Jupiter on a 2.7 Yr, Highly Eccentric Orbit
The Astronomical Journal; 4, 154
- Hobson, M. J., Brahm, R., Jordán, A., Espinoza, N., et al. (2021)
A Transiting Warm Giant Planet around the Young Active Star TOI-201
The Astronomical Journal; 5, 235
- Baxter, C., Désert, J.-M., Tsai, S.-M., Todorov, K. O., et al. (2021)
Evidence for disequilibrium chemistry from vertical mixing in hot Jupiter atmospheres. A comprehensive survey of transiting close-in gas giant exoplanets with warm-Spitzer/IRAC
Astronomy and Astrophysics; A127
- Piaulet, C., Benneke, B., Rubenzahl, R. A., Howard, A. W., et al. (2021)
WASP-107b's Density Is Even Lower: A Case Study for the Physics of Planetary Gas Envelope Accretion and Orbital Migration
The Astronomical Journal; 2, 70
- Mikal-Evans, T., Crossfield, I. J. M., Benneke, B., Kreidberg, L., et al. (2021)
Transmission Spectroscopy for the Warm Sub-Neptune HD 3167c: Evidence for Molecular Absorption and a Possible High-metallicity Atmosphere
The Astronomical Journal; 1, 18
- Fortney, J. J., Visscher, C., Marley, M. S., Hood, C. E., et al. (2020)
Beyond Equilibrium Temperature: How the Atmosphere/Interior Connection Affects the Onset of Methane, Ammonia, and Clouds in Warm Transiting Giant Planets
The Astronomical Journal; 6, 288
- Mayorga, L. C., Charbonneau, D., & Thorngren, D. P. (2020)
Reflected Light Observations of the Galilean Satellites from Cassini: A Test Bed for Cold Terrestrial Exoplanets
The Astronomical Journal; 5, 238
- Díaz, M. R., Jenkins, J. S., Feng, F., Butler, R. P., et al. (2020)
The Magellan/PFS Exoplanet Search: a 55-d period dense Neptune transiting the bright ($V = 8.6$) star HD 95338
Monthly Notices of the Royal Astronomical Society; 4, 4330
- Gao, P., Thorngren, D. P., Lee, E. K. H., Fortney, J. J., et al. (2020)
Aerosol composition of hot giant exoplanets dominated by silicates and hydrocarbon hazes
Nature Astronomy; 951

- Komacek, T. D., Thorngren, D. P., Lopez, E. D., & Ginzburg, S. (2020)
Reinflation of Warm and Hot Jupiters
 The Astrophysical Journal; 1, 36
- Movshovitz, N., Fortney, J. J., Mankovich, C., Thorngren, D., et al. (2020)
Saturn's Probable Interior: An Exploration of Saturn's Potential Interior Density Structures
 The Astrophysical Journal; 2, 109
- Vissapragada, S., Jontof-Hutter, D., Shporer, A., Knutson, H. A., et al. (2020)
Diffuser-assisted Infrared Transit Photometry for Four Dynamically Interacting Kepler
 (2021)
 A Transiting Warm Giant Planet around the Young Active Star TOI-201
The Astronomical Journal; 5, 235 Systems
 The Astronomical Journal; 3, 108
- Teske, J. K., Thorngren, D., Fortney, J. J., Hinkel, N., et al. (2019)
Do Metal-rich Stars Make Metal-rich Planets? New Insights on Giant Planet Formation from Host Star Abundances
 The Astronomical Journal; 6, 239
- Wallack, N. L., Knutson, H. A., Morley, C. V., Moses, J. I., et al. (2019)
Investigating Trends in Atmospheric Compositions of Cool Gas Giant Planets Using Spitzer Secondary Eclipses
 The Astronomical Journal; 6, 217
- Kreidberg, L., Line, M. R., Thorngren, D., Morley, C. V., et al. (2018)
Water, High-altitude Condensates, and Possible Methane Depletion in the Atmosphere of the Warm Super-Neptune WASP-107b
 The Astrophysical Journal; 1, L6
- Yadav, R. K., & Thorngren, D. P. (2017)
Estimating the Magnetic Field Strength in Hot Jupiters
 The Astrophysical Journal; 1, L12
- Espinoza, N., Fortney, J. J., Miguel, Y., Thorngren, D., et al. (2017)
Metal Enrichment Leads to Low Atmospheric C/O Ratios in Transiting Giant Exoplanets
 The Astrophysical Journal; 1, L9
- Morley, C. V., Knutson, H., Line, M., Fortney, J. J., et al. (2017)
Forward and Inverse Modeling of the Emission and Transmission Spectrum of GJ 436b: Investigating Metal Enrichment, Tidal Heating, and Clouds
 The Astronomical Journal; 2, 86
- Szydagis, M., Fyhrie, A., Thorngren, D., & Tripathi, M. (2013)
Enhancement of NEST capabilities for simulating low-energy recoils in liquid xenon
 Journal of Instrumentation; 10, C10003