

# **Jason Hyrum Steffen**

CIERA Fellow and Research Assistant Professor, Northwestern University

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Citizenship: United States of America

## **Education**

2006: Doctor of Philosophy in Physics (*Advisor: Eric Agol*)  
University of Washington, Seattle, Washington  
Dissertation: *Detecting New Planets in Transiting Systems*

2003: Master of Science in Physics  
University of Washington, Seattle, Washington

2000: Bachelor of Science in Physics and in Mathematics, *Summa Cum Laude*  
Weber State University, Ogden, Utah

## **Research Interests**

Extrasolar Planets, Cosmology, Dark Energy, Dark Matter, Gravitation

## **Scientific Employment**

2012–Present: CIERA Fellow and Research Assistant Professor, Northwestern University  
2006–2012: Brinson Postdoctoral Fellow, Fermilab Center for Particle Astrophysics  
2001–2006: Research Assistant, University of Washington, Seattle  
1999: National Science Foundation REU Intern, Inst. for Nuclear Theory, Seattle, WA

## **Grants**

2012–2014: Principal Investigator, NASA Kepler Participating Scientist Program, (\$170,000)  
2009–2011: Principal Investigator, CHASE (Fermilab T-991). (\$300,000)  
2008–2011: Principal Investigator, NASA Kepler Participating Scientist Program, (\$170,000)  
2007: Co-Investigator, Spitzer Space Telescope Cycle 4, “Detecting Mars-mass planets with transit timing”.  
2005–2006: Scientific Lead, Graduate Student Research Program (GSRP) grant from NASA Office of Space Science, “Finding New Planets in Transiting Systems”.

## **Academic Employment**

2012–Present: Lecturer, Northwestern University, Department of Physics  
Courses: Integrated Science Program (ISP) Physics for Scientists and Engineers, ISP Astrophysics  
2007–2012: Adjunct Faculty, Waubonsee Community College, Department of Physics  
Course: Introduction to Astronomy  
2001–2006: Adjunct Faculty, Edmonds Community College, Department of Physics  
Courses: The Solar System, Stars and Galaxies, Physics in Everyday Life  
2005: Adjunct Faculty, Bellevue Community College, Department of Physics  
Course: Physics for Scientists and Engineers

## **Industry/Private Employment**

2000–2001: L-3 Communications, Salt Lake City, Utah

    Embedded Software Engineer

2000: McLeod USA Telecommunications, Salt Lake City, Utah

    Pricing Analyst

## **Awards**

CIERA, NORTHWESTERN UNIVERSITY

    CIERA Fellowship (2012)

FERMILAB CENTER FOR PARTICLE ASTROPHYSICS

    Brinson Postdoctoral Fellowship (2006)

UNIVERSITY OF WASHINGTON, DEPARTMENT OF PHYSICS

    Mellam Fellowship (2001), Physics Department Fellowship (2001)

WEBER STATE UNIVERSITY

    Weber State University Presidential Commendation Scholarship (1993)

WEBER STATE UNIVERSITY, DEPARTMENT OF PHYSICS

    Outstanding Physics Graduate (2000), Paul H. Huish Scholarship (1999), Questar Corporation Scholarship (1998), Jim Bateman Scholarship (1998), Mary Margaret Clarke Scholarship (1997)

WEBER STATE UNIVERSITY, DEPARTMENT OF MATHEMATICS

    Outstanding Mathematics Graduate (2000), Jerry Fields Award (1999)

## **Service**

2011: Chair of the Science Organizing Committee and Local Organizing Committee, *Laboratory Tests of Dark Energy*, Batavia, IL (October 28-29, 2011).

2010–2011: Science Organizing Committee member, *First Kepler Science Conference*, Mountain View, CA (December 5-9, 2011).

Reviewer for: NASA Origins Program 2012, NASA Explorer Program 2011, NASA Origins Program 2009, NASA Origins Program 2008, Department of Energy Non-Accelerator Physics 2010

2006–2012: Fermilab Center for Particle Astrophysics: Chalk Talk organizer, Munch organizer, Seminar organizer, webmaster, and various committees member.

2006–Present: referee for *Astrophysical Journal*, *Astrophysical Journal Letters*, *Astronomy and Astrophysics*, *Monthly Notices of the Royal Astronomical Society*, *Publications of the Astronomical Society of Japan*, *Astroparticle Physics*, and the *Journal of Air Transport Management*

## **Public Outreach and Media Coverage**

Several public lectures including: Adler Planetarium, Clark Planetarium, Augustana College, Waubonsee Community College, and various private groups.

Several dozen radio interviews, both live and pre-recorded, including: three appearances on NPR's *Clever Apes*, one each on *All Things Considered* and *Marketplace*, multiple interviews with BBC affiliates, and many interviews on a variety of local and syndicated network shows.

Television interviews with Chicago 5 news, CNN, "Rock Center with Brian Williams", as well as coverage on a variety of television, cable, and international news programs, and the premier episode of "This vs. That" by Jon Hotchkiss.

Print and internet coverage of all aspects of my research have appeared in the New York Times (front page), Nature, Science, New Scientist, the Economist, PhysOrg.com, Wired Magazine, Space.com, BBC, and a variety of other outlets around the world. My work was one of Discover Magazine's top 100 science stories for 2011.

# Bibliography

Statistics: 49 reviewed papers (16 first author), >2700 citations, *h* index 27

## Peer Reviewed

- 49 Steffen, J.H., *et al.*, “Transit Timing Observations from Kepler: VII. Confirmation of 27 planets in 13 multiplanet systems via Transit Timing Variations and orbital stability”, MNRAS, in press, (2012) arXiv:1208.3499
- 48 Steffen, J.H., *et al.*, “Transit Timing Observations from Kepler: VI. Potentially interesting candidate systems from Fourier-based statistical tests”, ApJ, 756, 186, (2012) arXiv:1201.1873
- 47 Ford, E.B., *et al.*, “Transit Timing Observations from Kepler: V. Transit Timing Variation Candidates in the First Seventeen Months from Polynomial Models”, ApJ, 756, 185, (2012) arXiv:1201.1892
- 46 Carter, J.A., Agol, E., *et al.*, “Kepler-36: A Pair of Planets with Neighboring Orbits and Dissimilar Densities”, Science, 337, 556, (2012) arXiv:1206.4718
- 45 Upadhye, A., Steffen, J.H., and Chou, A.S., “Designing dark energy afterglow experiments”, PRD, 86, 035006, (2012) arXiv:1204.5476
- 44 Howard, A.W., *et al.*, “Planet Occurrence within 0.25 AU of Solar-type Stars from Kepler”, ApJS, 201, 15, (2012) arXiv:1103.2541
- 43 Steffen, J.H., Upadhye, A., Baumbaugh, A., Chou, A.S., and Tomlin, R., “Anomalous afterglow seen in a chameleon afterglow search”, PRD, 86, 012003, (2012) arXiv:1204.5476
- 42 Hooper, D. and Steffen, J.H., “Dark matter and the habitability of planets”, JCAP, 07, 046, (2012) arXiv:1103.5086
- 41 Steffen, J.H., *et al.*, “Kepler constraints on planets near hot Jupiters”, PNAS, 109, 7982, (2012) arXiv:1205.2309
- 40 Fabrycky, D.C., Ford, E.B., Steffen, J.H., *et al.*, “Transit Timing Observations from Kepler: IV. Confirmation of 4 Multiple Planet Systems by Simple Physical Models”, ApJ, 750, 114, (2012)
- 39 Steffen, J.H., Fabrycky, D.C., Ford, E.B., *et al.*, “Transit Timing Observations from Kepler: III. Confirmation of 4 Multiple Planet Systems by a Fourier-Domain Study of Anti-correlated Transit Timing Variations”, MNRAS, 421, 2342, (2012)
- 38 Ford, E.B., Fabrycky, D.C., Steffen, J.H., *et al.*, “Transit Timing Observations from Kepler: II. Confirmation of Two Multiplanet Systems via a Non-parametric Correlation Analysis”, ApJ, 750, 113, (2012)
- 37 Fabrycky, D.C., *et al.*, “Architecture of Kepler’s Multi-transiting Systems: II. New investigations with twice as many candidates”, ApJ, Submitted, (2012) arXiv:1202.6328
- 36 Batalha, N.M., *et al.*, “Planetary Candidates Observed by Kepler, III: Analysis of the First 16 Months of Data”, ApJ, Submitted, (2012) arXiv:1202.5852
- 35 Borucki, W.J., *et al.*, “Kepler-22b: A 2.4 Earth-radius Planet in the Habitable Zone of a Sun-like Star”, ApJ, 745, 120 (2012) arXiv:1112.1640
- 34 Welsh, W.F., *et al.*, “Transiting circumbinary planets Kepler-34 b and Kepler-35 b”, Nature, 481, 475 (2012)

- 33 Ballard, S., *et al.*, “The Kepler-19 System: A Transiting 2.2 R<sub>Earth</sub> Planet and a Second  
Planet Detected via Transit Timing Variations”, ApJ, 743, 200 (2011) arXiv:1109.1561
- 32 Lissauer, J.J., *et al.*, “Architecture and Dynamics of Kepler’s Candidate Multiple Transiting  
Planet Systems”, ApJS, 197, 8 (2011) arXiv:1102.0543
- 31 Cochran, W.D., *et al.*, “Kepler 18-b, c, and d: A System Of Three Planets Confirmed by  
Transit Timing Variations, Lightcurve Validation, Spitzer Photometry and Radial Velocity  
Measurements”, ApJS, 197, 7 (2011) arXiv:1110.0820
- 30 Ford, E.B., *et al.*, “Transit Timing Observations from Kepler: I. Statistical Analysis of the  
First Four Months”, ApJS, 197, 2 (2011) arXiv:1102.0544
- 29 **Steffen, J.H.**, *et al.*, “The architecture of the hierarchical triple star KOI 928 from eclipse tim-  
ing variations seen in Kepler photometry”, MNRAS Letters, 417, L31 (2011) arXiv:1106.4530
- 28 Doyle, L., *et al.*, “Kepler 16: A Transiting Circumbinary Planet”, Science, 16, 333, 6049  
(2011) arXiv:1109.3432
- 27 **Steffen, J.H.** and Hotchkiss, J., “Experimental test of airplane boarding methods”, Jour.  
Air. Trans. Mgmt., 18, 64, (2012) arXiv:1108.5211
- 26 Borucki, W.J., *et al.*, “Characteristics of planetary candidates observed by Kepler, II: Analysis  
of the first four months of data”, ApJ, 736, 19 (2011) arXiv:1102.0541
- 25 Latham, D.W., *et al.*, “A First Comparison of Kepler Planet Candidates in Single and Multiple  
Systems”, ApJ Letters, 732, 24 (2011) arXiv:1103.3896
- 24 Batalha, N.M., Borucki, W.J., *et al.*, “Kepler’s first rocky planet: Kepler-10b”, ApJ, 729, 27  
(2011) arXiv:1102.0605
- 23 Carter, J.A., *et al.*, “KOI-126: a triply-eclipsing hierarchical triple with two low-mass stars”,  
Science, 331, 562 (2011) arXiv:1102.0562
- 22 Lissauer, J.J., *et al.*, “A closely packed system of low-mass, low-density planets transiting  
Kepler-11”, Nature (cover story), 470, 53 (2011) arXiv:1102.0291
- 21 Borucki, B., *et al.*, “Characteristics of Kepler Planetary Candidates Based on the First Data  
Set”, ApJ, 728, 117 (2011) arXiv:1006.2799
- 20 Torres, G., *et al.*, “Modeling *Kepler* Transit Light Curves as False Positives: Rejection of  
Blend Scenarios for Kepler-9, and Validation of Kepler-9d, a Super-Earth-size Planet in a  
Multiple System”, ApJ, 727, 24 (2011) arXiv:1008.4393
- 19 **Steffen, J.H.**, Baumbaugh, A., Chou, A.S., Mazur, P.O., Tomlin, R., Upadhye, A., Weltman,  
A., Wester, W., “Laboratory constraints on chameleon dark energy and power-law fields”,  
Phys. Rev. Lett., 105, 261803 (2010) arXiv:1010.0988
- 18 **Steffen, J.H.**, *et al.*, “Five Kepler target stars that show multiple transiting exoplanet can-  
didates”, ApJ, 725, 1226, (2010) arXiv:1006.2763
- 17 Holman, M., *et al.*, “Kepler-9: A system of Multiple Planets Transiting a Sun-like Star,  
Confirmed by Timing Variations”, Science (cover story), 330, 6000, (2010)
- 16 Agol, E., Cowan, N. B., Knutson, H. A., Deming, D., **Steffen, J. H.**, Henry, G. W., Char-  
bonneau, D., “The climate of HD 189733b from fourteen transits and eclipses measured by  
Spitzer”, ApJ, 721, 1861, (2010), arXiv:1007.4378

- 15 Borucki, B., *et al.*, “Kepler Planet Detection Mission: Introduction and First Results”, Science, 327, 5968, 977 (2010)
- 14 Gilliland, R., *et al.*, “Kepler Asteroseismology Program: Introduction and First Results”, PASP, 122, 131 (2010), arXiv:1001.0139
- 13 Upadhye, A., **Steffen, J.H.**, & Weltman, A., “Constraining chameleon field theories using the GammeV afterglow experiment”, Phys. Rev. D, 81 (1), 015013, (2010), arXiv:0911.3906.
- 12 **Steffen, J.H.**, Moore, M.W., & Boynton, P.E. “Optimal Simultaneous Estimation of Several Linear Parameters in the Presence of Lorentzian Thermal Noise”, Classical and Quantum Gravity, 26, 18, 185009, (2009), arXiv:0803.3199.
- 11 **Steffen, J.H.**, Upadhye, A., “The GammeV suite of experimental searches for axion-like particles”, Invited Review, Mod. Phys. Lett. A, 24, 26, 2053, (2009), arXiv:0908.1529.
- 10 Chou, A.S., Wester, W., Baumbaugh, A., Gustafson, H.R., Irizarry-Valle, Y., Mazur, P.O., **Steffen, J.H.**, Tomlin, R., Upadhye, A., Weltman, A., Yang, X., Yoo, J., “Search for chameleon particles using a photon regeneration technique”, Phys. Rev. Lett., 102, 030402, (2009), arXiv:0806.2438.
- 9 **Steffen, J.H.**, “A statistical mechanics model for free-for-all airplane passenger boarding”, Am. J. Phys., Volume 76, No. 12, pp. 1114-1119 (2008), arXiv:0803.3199.
- 8 **Steffen, J.H.** & Valenzuela, O., “Constraints on the angular distribution of satellite galaxies about spiral hosts”, MNRAS, 387, 1199 (2008), arXiv:0712.2363.
- 7 **Steffen, J.H.**, “Optimal boarding method for airline passengers”, Jour. Air. Trans. Mgmt., 14 (3), 146-150 (2008), arXiv:0802.0733.
- 6 Chou, A.S., Wester, W., Baumbaugh, A., Gustafson, H.R., Irizarry-Valle, Y., Mazur, P.O., **Steffen, J.H.**, Tomlin, R., Yang, X., Yoo, J., “Search for axion-like particles using a variable baseline photon regeneration technique”, Phys. Rev. Lett., 100, 080402 (2008), arXiv:0710.3783.
- 5 Agol, E. & **Steffen, J.H.**, “A limit on the presence of Earth-mass planets around a Sun-like star”, MNRAS, Volume 374, p. 941 (2007), arXiv:astro-ph/0610159.
- 4 **Steffen, J.H.** & Agol, E., “An analysis of the transit times of TrES-1b”, MNRAS Letters, Volume 364, Issue 1, p. 96 (2005), arXiv:astro-ph/0509656.
- 3 Moore, M.W., **Steffen, J.H.**, & Boynton, P.E., “Optimal determination of the equilibrium displacement of a damped harmonic oscillator in the presence of thermal noise”, Rev. Sci. Inst., Volume 76, p. 085106 (2005), arXiv:physics/0412102.
- 2 Agol, E., **Steffen, J.**, Sari, R., & Clarkson, W., “On detecting terrestrial planets with the timing of giant planet transits”, MNRAS, Volume 359, Issue 2, pp. 567-579 (2005), arXiv:astro-ph/0412032.
- 1 **Steffen, J.H.**, “Exploring 5th force interactions with 18th century technology”, IJMPD, Volume 13, Issue 10, pp. 2249-2254 (2004), arXiv:gr-qc/0503081.

## Conference Proceedings and Other

Hewett, J.L., *et al.*, “Fundamental Physics at the Intensity Frontier”, Proceedings of the 2011 workshop on Fundamental Physics at the Intensity Frontier, (2011), arXiv:1205.2671.

**Steffen, J.H.**, *for the CHASE collaboration*, “The CHASE laboratory search for chameleon dark energy”, Proceedings of Identification of Dark Matter (IDM 2010) Conference, (2010), arXiv:1011.3802v2.

**Steffen, J.H.**, for the *CHASE* collaboration, “The CHASE laboratory search for chameleon dark energy”, Proceedings of International Conference for High Energy Physics (ICHEP 2010), (2010), arXiv:1011.3802v1.

Peterson, J. B., et al., “21-cm Intensity Mapping”, white paper submitted to the Astronomy 2010 Decadal Survey, (2009), arXiv:0902.3091.

**Steffen, J.H.**, for the *GammeV* collaboration, “Constraints on Chameleons and Axion-like Particles from the GammeV Experiment”, Proceedings of Identification of Dark Matter (IDM 2008), (2008), arXiv:0810.5070.

Agol, E., Cowan, N.B., Bushong, J., Knutson, H., Charbonneau, D., Deming, D., & **Steffen, J.H.**, “Transits and secondary eclipses of HD 189733 with Spitzer”, Proceedings of IAU Symposium No. 253 ”Transiting Planets”, (2008), arXiv:0807.2434.

**Steffen, J.H.** & Agol, E., ASP Conference Series, “Developments in Planet Detection using Transit Timing Variations”, *Transiting Extrasolar Planets Workshop* MPIA Heidelberg Germany, Eds: Cristina Afonso, David Weldrake & Thomas Henning, ASPC, Volume 366, p. 158 (2007), arXiv:astro-ph/0612442.

**Steffen, J.H.**, Gaudi, B.S., Ford, E.B., Agol, E., Holman, M.J., “Detecting and Characterizing Planetary Systems with Transit Timing”, White paper submitted to the Exoplanet Task Force, (2007), arXiv:0704.0632.

Boynton, P.E., Bonicalzi, R.M., Kalet, A.M., Kleczewski, A.M., Lingwood, J.K., McKenney, K.J., Moore, M.W., **Steffen, J.H.**, Berg, E.C., Cross, W.D., Newman, R.D., Gephart, R.E., “Gravitation Physics at BGPL”, Proceedings of the Francesco Melchiorri Memorial Conference, New Astronomy Reviews, Volume 51, p. 334 (2007), arXiv:gr-qc/0609095.

**Steffen, J.H.**, Ph.D. Dissertation, “Detecting new planets in transiting systems”, (2006), arXiv:astro-ph/0609492.

Berg, E.C., Cross, W.D., Newman, R.D., Boynton, P.E., Moore, M.W., & **Steffen, J.H.**, “Planned tests of the equivalence principle with a cryogenic torsion pendulum”, Contribution to *Testing The Equivalence Principle on Ground and in Space*, Ed. Lammerzahl, C., Everitt, C.W.F., & Ruffini, R., (Springer-Verlag: London), (2005).

**Steffen, J.H.**, “Symmetry in a perturbed optical system”, (2005), arXiv:physics/0503129.

Berg, E.C., Bantel, M.K., Cross, W.D., Inoue, T, Newman, R.D., **Steffen, J.H.**, Moore, M.W., & Boynton, P.E., “Laboratory tests of gravitational physics using a cryogenic torsion pendulum”, Proceedings of 10th Marcel Grossman Meeting, Ed. Ruffini, R., et al. (World Scientific: Singapore), (2005), arXiv:gr-qc/0403021.

## Invited Talks (2010 – Present)

### PARTICLE ASTROPHYSICS

*Laser Probes of the Dark Sector*, Jefferson National Laboratory Physics Seminar, Newport News, VA (September 2012).

*Fermilab Holometer Status Report*, 8th Annual Patras workshop on Axions, WIMPs, and Wisps, Chicago, IL (July 2012).

*Laser Probes of the Dark Sector*, Particle Astrophysics Seminar, Penn State University, State College, PA (January 2012).

*Laser Probes of the Dark Sector*, Physics Department Colloquium, University of Central Florida, Orlando, FL (February 2012).

*The Fermilab searches for light scalars*, Physics Seminar, CERN, Geneva, Switzerland (January 2012).

*Illuminating the Dark Sector*, Physics Colloquium, Northwestern University, Evanston, IL (November 2012).

*Illuminating the Dark Sector*, Particle Astrophysics Seminar, Fermilab, Batavia, IL (November 2012).

*The Fermilab searches for light scalars*, Physics Seminar, DESY, Hamburg, Germany (January 2012).

*Laser Probes of the Dark Sector*, Physics Department Theory Seminar, Washington University, St. Louis, MO (September 2011).

*Laser Probes of the Dark Sector*, High Energy Physics Seminar, Northwestern University, Evanston, IL (April 2011).

*Laboratory constraints on chameleon dark energy from CHASE*, UCLA Physics Department Seminar, Los Angeles, CA (October 2010).

*Laboratory constraints on chameleon dark energy from CHASE*, LBL INPA Journal Club Talk, Berkeley, CA (September 2010).

*Results of the GammeV-CHASE probe for chameleon dark energy*, Fermilab Joint Experimental-Theoretical Seminar, Batavia, IL (August 2010).

*The CHASE probe for chameleon dark energy*, Invited Talk, The Dark Side of the Universe, Leon, Mexico, (June 2010).

*GammeV-CHASE: A Laboratory Search for Dark Energy*, University of Utah Physics Colloquium, Salt Lake City, UT. (February 2010).

## EXTRASOLAR PLANETS

*Exoplanet Science from NASA's Kepler Mission*, Northern Illinois University physics colloquium, Dekalb, IL (October 2012).

*Exoplanet Science from NASA's Kepler Mission*, Fermilab Colloquium, Batavia, IL (September 2012).

*NASA's Kepler Mission*, CIPANP Conference 2012, St. Petersburg, FL (May 2012).

*Kepler's multi-object systems*, Goddard Space Flight Center Astrophysics Colloquium, Greenbelt, MD (March 2012).

*Transit Timing Variation Studies from NASA's Kepler Mission*, Penn State Astronomy Colloquium, State College, PA (January 2012).

*Exoplanets: Searching for the Companions of Distant Suns*, Public Lecture, Adler Planetarium, Chicago, IL (October 2011).

*Insight into planetary systems from the NASA Kepler mission*, Physics Deparment Colloquium, Washington University, St. Louis, MO (September 2011).

*Kepler systems with multiple transiting objects*, Astrophysics Colloquium, JPL, Pasadena, CA (April 2011).

*Insight into planetary systems from the Kepler mission*, Lecture for Chicago Astronomical Society, Adler Planetarium, Chicago, IL (May 2011).

*Insight into planetary systems from the Kepler mission*, Physics and Astronomy Departmental Colloquium, Northwestern University, Evanston, IL (March 2011).

*Insight into planetary systems from the Kepler mission*, Theoretical Astrophysics Seminar, Northwestern University, Evanston, IL (February 2011).

*Finding Other Earths*, Harry Nelson Lecture in Astronomy, Public Lecture, Augustana College, Rock Island, IL (October 2010).

*New frontiers in exoplanet science in the Kepler era*, Stanford/SLAC Astrophysics Colloquium, Palo Alto, CA (September 2010).

*Planetary System Characterization via Transit Timing Variations*, Invited Talk, Putting our Solar System in Context, Obergurgl, Austria (April 2010).

*Finding Other Earths*, Public Lecture, Clark Planetarium, Salt Lake City, UT (February 2010).

*Recent results from the Kepler mission*, Weber State University Physics Seminar, Ogden, UT (February 2010).