

# Jim Fuller

## Curriculum Vitae

**POSITION:** Assistant Professor of Astronomy, California Institute of Technology

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**CONTACT:**

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**RESEARCH INTERESTS:**

I am interested in theoretical astrophysics, especially stellar and planetary systems. Much of my work focuses on wave propagation within stars and planets. Applications include binary stellar evolution, tidal interactions, stellar and planetary structure, asteroseismology, eruptive transients, and supernovae.

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**EDUCATION:**

Ph.D., 2014	Cornell University	<i>Astronomy and Space Sciences</i> <i>Minor Field: Physics</i> <i>Ph.D. Advisor: Professor Dong Lai</i>
M.S., 2011	Cornell University	<i>Astronomy and Space Sciences</i>
B.A., 2008	Whitman College	<i>Physics-Astronomy</i>

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**RESEARCH EXPERIENCE:**

2017-	Assistant Professor of Astronomy	California Institute of Technology
2013-2017	DuBridge Postdoctoral Fellow	California Institute of Technology
2013-2017	KITP Postdoctoral Scholar	Kavli Institute for Theoretical Physics
2011-2013	NASA Earth and Space Sciences Fellow	Cornell University
2011	Graduate Fellow	Kavli Institute for Theoretical Physics
2009-2011	Research Assistant	Cornell University
2008-2009	First Year Graduate Fellow	Cornell University
2007-2008	Undergraduate Researcher	High Altitude Observatory

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**TEACHING EXPERIENCE:**

2017-, Assistant Professor, Astronomy Department, California Institute of Technology. Classes taught: Ay101, Ay123, Ay141.

2014-16, Guest Lecturer, (various), California Institute of Technology  
2012, Guest Lecturer, Introduction to Astrophysics and Space Sciences, Cornell University  
2009-2011, Teaching Assistant, Astronomy 101/102, Cornell University  
2009, Completed course “Teaching and Learning Physics”, Cornell University  
2006-2008, Teaching Assistant, Astronomy 177/178/179, Whitman College

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#### **AWARDS AND HONORS:**

2018, Alfred P. Sloan Research Fellow  
2017, Rose Hills Foundation Innovator award, Caltech  
2014, Division of Astrophysics Thesis Prize Finalist  
2012, Astronomical Society of New York Graduate Student Prize  
2012, Cranson W. and Edna B. Shelley Award for Outstanding Research, Cornell University  
2007, Outstanding REU Research Award, Laboratory for Atmospheric and Space Physics,  
University of Colorado

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#### **GRANTS AND FELLOWSHIPS:**

2020, PI on XSEDE allocation, “Magnetohydrodynamic simulations of the Tayler instability in rotating stellar interiors,” 220k node hours, (AST200022 New)  
2018, Co-PI on Heising-Simons grant, “Quickening heartbeats: measuring tidal orbital decay in eccentric young binaries” (Grant #2018-1036)  
2018, Sloan Fellowship, (FG-2018-10515)  
2018, PI on NASA ATP Grant, “Pre-supernova Outbursts” (80NSSC18K1017)  
2017, PI on Hubble Space Telescope Theory Grant, “Pre-supernova properties of progenitors detected by HST” (HST-AR-15021.001-A)  
2017, Co-PI on Heising-Simons grant, “Down but not out: the white dwarf survivors of low-luminosity thermonuclear supernovae” (Grant #2017-274)  
2013, DuBridge Postdoctoral Fellowship, California Institute of Technology  
2012, Co-I on Kepler GO proposal, “Heartbeat Stars: A New Class of Binary System with Extreme Periastron Brightenings and Tidally Excited Modes” (11-KEPLER11-0056)  
2011, Graduate Fellowship, Kavli Institute for Theoretical Physics  
2011, NASA Earth and Space Science Fellowship  
2008, First Year Graduate Fellowship, Department of Astronomy, Cornell University  
2004, William O. Douglas Fellowship, Whitman College

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#### **DIVERSITY AND OUTREACH:**

2020, mentoring three students from local community colleges on summer research projects  
2019-, Faculty sponsor of Caltech chapter of Towards a More Inclusive Astronomy (TaMIA)

“Sounds of the Stars”, Griffith Observatory Lecture, August 2020  
“Sounds of the Stars”, San Diego Astronomy Association, June 2020  
“Sounds of the Stars”, Caltech Public Lecture, November 2019  
“The Art of Succeeding in Science”, Stem3 Academy, Valley Glen, May 2018

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#### **RECENT TALKS AND PRESENTATIONS:**

“Fun with Binary Stars”, Astronomy Colloquium, University of Birmingham (online), June 2020  
“More surprising impacts of gravity waves”, Astronomy Colloquium, UCLA, March 2020  
“Massive Star Evolution”, From the Cradle to the Grave Conference, Tokyo, February 2020  
“Surprising impacts of gravity waves”, IPMU Astronomy Colloquium, Tokyo, February 2020  
  
“Surprising impacts of gravity waves”, Astrophysics Colloquium, Institute for Advanced Study,  
December 2019  
“Surprising impacts of gravity waves”, CITA Colloquium, October 2019  
“Magnetic Fields in Stellar Cores”, MJT Conference, Boulder, September 2019  
“Magnetic Fields in Stellar Interiors”, Stars and Space conference, Vienna, July 2019  
“Surprising impacts of gravity waves”, Tsinghua University Colloquium, July 2019  
“Tidal Migration via Resonance Locking”, Astrophysical Dynamics conference, T.D. Lee  
Institute, July 2019  
“Most Black Holes are Born Slowly Rotating”, KITP Gravstar meeting, May 2019  
“Surprising impacts of gravity waves”, Northwestern University Colloquium, May 2019  
“Slowing the Spins of Stellar Cores”, Kepler and K2 Conference, Glendale, March 2019  
“Most Black Holes are Born Slowly Rotating”, Aspen Center for Physics, February 2019  
“Surprising impacts of gravity waves”, Harvard ITC Colloquium, October 2019  
“Linking Tidal, Rotational, and Orbital Evolution”, KISS workshop, Caltech, October 2019  
“Pre-supernova outbursts in massive stars”, Frontiers of the Physics of Massive Stars conference,  
Ensenada, Mexico, July 2018  
“The Art of Succeeding in Science”, Stem3 Academy, Valley Glen, May 2018  
“Surprising impacts of gravity waves”, Astronomy Colloquium, Caltech, Pasadena, April 2018  
“Surprising impacts of gravity waves”, Astronomy Colloquium, University of Texas, Austin,  
March 2018  
“Surprising impacts of gravity waves”, Astronomy Colloquium, University of Amsterdam,  
March 2018  
“Surprising impacts of gravity waves”, Astronomy Colloquium, Radboud University, Nijmegen,  
March 2018  
“Saturn ring seismology”, Astronomy Colloquium, Charles University, Prague, March 2018  
“New insights on tidal queues”, Royal Astronomical Society, London, March 2018  
“The era of bright star astronomy”, NOAO Meeting, Tucson, February 2018

“Surprising impacts of gravity waves”, Astronomy Colloquium, University of Arizona, December 2017

“Surprising impacts of gravity waves”, CCA Colloquium, New York, November 2017

“Tidally excited oscillations in heartbeat stars”, K2 conference, Mountain View, June 2017

“Wave-driven pre-supernova outbursts”, FOE conference, Corvallis, June 2017

“Strong internal magnetic fields revealed by asteroseismology of red giant stars”, Astronomy Colloquium, STScI, Baltimore, May 2017

“Surprising impacts of gravity waves”, Astronomy Colloquium, University of California, Berkeley, May 2017

“Asteroseismic windows into stellar cores”, KITP massive star conference, Santa Barbara, March 2017

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#### SELECTED PUBLICATIONS:

1. Cheng, S., **Fuller, J.**, et al., “Detailed characterization of heartbeat stars and their tidally excited oscillations”, (*submitted to ApJ*)
2. Leung, S., **Fuller, J.**, 2020, “Hydrodynamic simulations of pre-supernova outbursts in red supergiants: asphericity and mass loss”, (*accepted to ApJ*) arXiv:2007.11712
3. **Fuller, J.**, Kurtz, D., Handler, G., Rappaport, S., 2020, “Tidally trapped pulsations in close binary systems”, (*accepted to MNRAS*)
4. Li, G., Guo, Z., **Fuller, J.**, et al., “The effect of tides on near-core rotation: analysis of 35 Kepler  $\gamma$  Doradus stars in eclipsing and spectroscopic binaries”, (*accepted to MNRAS*)
5. Lu, W., **Fuller, J.**, et al., “The former companion of the hyper-velocity star S5-HVS1”, (*accepted to MNRAS*)
6. Yu, H., Weinberg, N., **Fuller, J.**, 2020, “Nonlinear tides in white dwarf binaries”, *MNRAS*, 496, 5482
7. Zhao, X., **Fuller, J.**, “Centrifugally Driven Mass Loss and Outbursts of Massive Stars”, *MNRAS*, 495, 249
8. Lainey, L., Gomez Casajus, L., **Fuller, J.**, et al., 2020, “Resonance locking in giant planets indicated by the rapid orbital expansion of Titan”, *Nature Astronomy*, DOI: 10.1038/s41550-020-1120-5
9. Kurtz, D., Handler, G., Rappaport, S., Saio, H., **Fuller, J.**, et al., 2020, “The single-sided pulsator CO Camelopardalis”, *MNRAS*, 494, 5118

10. Handler, G., Kurtz, D., Rappaport, S., Saio, H., **Fuller, J.**, et al., 2020, “Tidally Trapped Pulsations in HD 74423 discovered by TESS”, *Nature Astronomy*, DOI: 10.1038/s41550-020-1035-1
11. Morozova, V., Piro, A., **Fuller, J.**, Van Dyk, S., 2020, “The influence of late-stage nuclear burning on red supergiant supernova light curves”, *ApJ Letters*, 891, 32
12. Veras, D., **Fuller, J.**, 2020, “The dynamical history of the evaporating or disrupted ice giant planet around white dwarf WD J0914+1914”, *MNRAS*, 492, 6059
13. Gossan, S., **Fuller, J.**, Roberts, L., 2020, “Wave heating from protoneutron star convection and the core-collapse supernova explosion mechanism”, *MNRAS*, 491, 5376
14. Jermyn, A., Tayar, J., **Fuller, J.**, 2020, “Differential rotation in convective envelopes: constraints from eclipsing binaries”, *MNRAS*, 491, 690
15. Veras, D., **Fuller, J.**, 2019, “Tidal circularization of gaseous planets orbiting white dwarfs”, *MNRAS*, 489, 2941
16. Burdge, K., **Fuller, J.**, et al., 2019, “Orbital decay in a 20 minute orbital period detached binary with a Hydrogen Poor Low Mass White Dwarf”, *ApJ Letters*, 886, 12
17. Burdge, K., Coughlin, M., **Fuller, J.**, et al., 2019, “General relativistic orbital decay in the shortest period eclipsing binary system known”, *Nature*, 571, 528
18. **Fuller, J.**, Ma, L., 2019, “Most black holes are born very slowly rotating”, *ApJ Letters*, 881, 1
19. Guo, Z., **Fuller, J.**, et al., 2019, “KIC 4142768: An Evolved Gamma Doradus/Delta Scuti Hybrid Pulsating Eclipsing Binary with Tidally Excited Oscillations”, *ApJ*, 885, 46
20. Ma, L., **Fuller, J.**, 2019, “Angular momentum transport in massive stars and natal neutron star rotation rates”, *MNRAS*, 488, 4338
21. **Fuller, J.**, Piro, A., Jermyn, A., 2019, “Slowing the spins of stellar cores”, *MNRAS*, 485, 3661
22. Pablo, H., Shultz, M., **Fuller, J.**, et al., 2019, “ $\epsilon$  Lupi: measuring the heartbeat of a doubly-magnetic massive binary with BRITE-Constellation”, *MNRAS*, 488, 64
23. Dederick, E., Jackiewicz, J., **Fuller, J.**, 2019, “A new method for probing the deep interior of Saturn”, (*submitted*)
24. Zhang, M., **Fuller, J.**, 2019, “The long-term evolution and appearance of type Iax supernova remnant stars”, *ApJ*, 872, 29

25. Kleiser, I., **Fuller, J.**, Kasen, D., 2018, “Helium giant stars as progenitors of rapidly fading Type Ibc supernovae”, *MNRAS Letters*, 481, 141
26. **Fuller, J.**, Ro, S., 2018, “Pre-supernova outbursts via wave heating in massive stars II: Hydrogen-poor stars”, *MNRAS*, 476, 1853
27. Luan, J., **Fuller, J.**, Quataert, E., 2018, “How Cassini can constrain tidal dissipation in Saturn”, *MNRAS*, 473, 5002
28. **Fuller, J.**, Hambleton, K., Shporer, A., Isaacson, H., Thompson, S., 2017, “Accelerated tidal circularization via resonance locking in KIC 8164262”, *MNRAS Letters*, 472, 25
29. **Fuller, J.**, 2017, “Heartbeat stars, tidally excited oscillations, and resonance locking”, *MNRAS*, 472, 1538
30. Hambleton, K., **Fuller, J.**, et al., 2017, “KIC 8164262: a heartbeat star showing tidally induced pulsations with resonant locking”, *MNRAS*, 473, 5165
31. **Fuller, J.**, 2017, “Pre-supernova outbursts via wave heating in massive stars - I. Red supergiants”, *MNRAS*, 470, 1642
32. Vick, M., Lai, D., **Fuller, J.**, 2017, “Tidal dissipation and evolution of white dwarfs around massive black holes: an eccentric path to tidal disruption,” *MNRAS*, 468, 2296
33. Guo, Z., Gies, D., **Fuller, J.**, 2017, “Tidally induced pulsations in Kepler eclipsing binary KIC 3230227”, *ApJ*, 834, 59
34. Pablo, H., Richardson, N., **Fuller, J.**, et al., 2017, “The most massive heartbeat: an in-depth analysis of  $\iota$  Orionis”, *MNRAS*, 467, 2494
35. Lecoanet, D., Vasil, G., **Fuller, J.**, Cantiello, M., Burns, K., 2017, “Conversion of internal gravity waves into magnetic waves”, *MNRAS*, 466, 2181
36. **Fuller, J.**, Luan, J., Quataert, E., 2016, “Resonance locking as the source of rapid tidal migration in the Jupiter and Saturn moon systems”, *MNRAS*, 458, 3867
37. Shporer, A., **Fuller, J.**, et al., 2016, “Radial velocity monitoring of Kepler heartbeat stars”, *ApJ*, 829, 34
38. Cantiello, M., **Fuller, J.**, Bildsten, L., 2016, “Asteroseismic signatures of evolving internal stellar magnetic fields”, *ApJ*, 824, 14
39. Stello, D., Cantiello, M., **Fuller, J.**, García, R., Huber, D., 2016, “Suppression of quadrupole and octupole modes in red giants observed by Kepler”, *PASA*, 33, 11

40. Stello, D., Cantiello, M., **Fuller, J.**, García, R., Bildsten, L., Huber, D., Bedding, T., and Silva Aguirre, V., 2016, “A prevalence of dynamo-generated magnetic fields in the cores of intermediate-mass stars”, *Nature*, 529, 364
41. **Fuller, J.**, Cantiello, M., Stello, D., García, R., and Bildsten, L., 2015, “Asteroseismology can reveal strong internal magnetic fields in red giant stars”, *Science*, 350, 423
42. **Fuller, J.**, Cantiello, M., Lecoanet, D., and Quataert, E., 2015, “The spin rate of pre-collapse stellar cores: wave-driven angular momentum transport in massive stars”, *ApJ*, 810, 101
43. Belyaev, M., Quataert, E., **Fuller, J.**, 2015, “The properties of g-modes in layered semiconvection”, *MNRAS*, 452, 2700
44. **Fuller, J.**, Ott, C., 2015, “Dark matter-induced collapse of neutron stars: a possible link between fast radio bursts and the missing pulsar problem”, *MNRAS Letters*, 450, 71
45. **Fuller, J.**, Klion, H., Abdikamalov, E., Ott, C., 2015, “Supernova seismology: gravitational wave signatures of rapidly rotating core collapse”, *MNRAS*, 450, 414
46. **Fuller, J.**, Lecoanet, D., Cantiello, M., and Brown, B., 2014, “Angular momentum transport via internal gravity waves in evolving stars”, *ApJ*, 796, 17
47. **Fuller, J.**, 2014, “Saturn ring seismology: Evidence for stable stratification in the deep interior of Saturn”, *Icarus*, 242, 283
48. Borkovits, T., Derekas, A., **Fuller, J.**, et al., 2014, “HD 183648: a Kepler eclipsing binary with anomalous ellipsoidal variations and a pulsating component”, *MNRAS*, 443, 3068
49. **Fuller, J.**, and Lai, D., 2014, “Dynamical tides in compact white dwarf binaries: influence of rotation”, *MNRAS*, 444, 3488
50. **Fuller, J.**, Lai, D., and Storch, N., 2014, “Non-radial oscillations in rotating giant planets with solid cores: application to Saturn and its rings”, *Icarus*, 231, 34
51. **Fuller, J.**, and Lai, D., 2013, “Dynamical tides in compact white dwarf binaries: helium core white dwarfs, tidal heating, and observational signatures”, *MNRAS*, 430, 274
52. **Fuller, J.**, Derekas, A., Borkovits, T., Huber, D., Bedding, T., and Kiss, L., 2013, “Tidally induced oscillations and orbital decay in compact triple star systems”, *MNRAS*, 429, 2425
53. **Fuller, J.**, and Lai, D., 2012, “Tidal novae in compact binary white dwarfs”, *ApJL*, 756, 17
54. **Fuller, J.**, and Lai, D., 2012, “Dynamical tides in compact white dwarf binaries: tidal synchronization and dissipation”, *MNRAS*, 421, 426

55. **Fuller, J.**, and Lai, D., 2012, “Dynamical tides in eccentric binaries and tidally-excited stellar pulsations in *Kepler* KOI-54”, *MNRAS*, **420**, 3126
56. **Fuller, J.**, and Lai, D., 2011, “Tidal excitation of oscillation modes in compact white dwarf binaries: I. Linear theory”, *MNRAS*, **412**, 1331
57. **Fuller, J.**, and Gibson, S., 2009, “A survey of coronal cavity density profiles”, *ApJ*, **700**, 1205
58. **Fuller, J.**, Gibson, S., de Toma, G., and Fan, Y., 2008, “Observing the unobservable? Modeling coronal cavity densities”, *ApJ*, **678**, 515