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 magnetohydrodynamical processes within stars and planets. Applications include binary stellar evolution, tidal interactions, stellar and planetary structure, asteroseismology, eruptive transients, and supernovae.

EDUCATION:

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

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

TEACHING EXPERIENCE:

2017-, Assistant Professor, Astronomy Department, California Institute of Technology. Classes taught: Ay 101, Ay 123, Ay 141, Ay 215, Ph 106a, Ph 136b.

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:

2022, PI on NSF AAG grant, "Binary Compact Objects and their Progenitors" (AST-2205974)
2021, PI on 3CPE grant, "The seismic and magnetic signatures of Saturn's core"
2021, PI on NASA XRP grant, "The turning tide of exoplanet evolution," (20-XRP20_2-0147)
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

DIVERSITY AND OUTREACH:

"Sounds of the Stars: Journey to the Center of a Star", AAVSO meeting (online), April 2022
Mentoring three students from local community colleges on summer research projects, 2020
"Sounds of the Stars", Griffith Observatory Lecture, August 2020
"Sounds of the Stars: journey to the center of a star", San Diego Astronomy Association, June 2020
Faculty sponsor of Caltech chapter of Towards a More Inclusive Astronomy (TaMIA), 2019-
"Sounds of the Stars", Caltech Public Lecture, November 2019
"The Art of Succeeding in Science", Stem3 Academy, Valley Glen, May 2018
"The Stellar Ultrasound: Journey to the Center of a Star", Astronomy on Tap, Pasadena, January 2018

RECENT TALKS AND PRESENTATIONS:

*Includes science talks given in the last three years

"Big Developments in Little Stars", KITP Blackboard Talk for White Dwarf Program (invited), November 2022
"The Secret Lives of Pulsating Stars", Peter Eggleton 80th Birthday Conference, Cambridge, UK, August 2022
"Pulsations in Binary Stars", KASC Conference (invited), Leuven, Belgium, July 2022
"The Spins of Massive Stellar Cores", AAS Conference, Pasadena, June 2022
"Tidal Interactions and Orbital Evolution", ISSI Workshop on Saturn's Moons (invited), Bern, Switzerland, May 2022
"Drama preceding the deaths of massive stars", Astronomy Seminar, Hebrew University (online), January 2022
"Drama preceding the deaths of massive stars", Astronomy Seminar, Weizmann Institute (online), December 2021
"Surprising impacts of gravity waves", Astronomy Colloquium, Indiana University (online), December 2021
"Angular momentum transport in stars", KITP conference (invited), KITP, November 2021
"Surprising impacts of gravity waves", DAMTP seminar, Cambridge University (online), October 2021
"Transport problems in stars", KITP program talk, KITP, October 2021
"Surprising impacts of gravity waves", Astronomy Colloquium, University of Alberta (online), April 2021
"Surprising impacts of gravity waves", Astronomy Colloquium, University of California, Santa Barbara (online), February 2021
"Fun with Binary Stars", Astronomy Colloquium, Cornell University (online), October 2020

"Sounds of the stars: journey to the center of a star", Los Angeles Astronomy Association (online), August 2020
"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

SELECTED PUBLICATIONS*:

*Includes peer-reviewed papers in which J. Fuller is in the first five authors

1. Ma, L., **Fuller, J.**, "Tidal spin-up of black hole progenitor stars", nearly submitted to *ApJ*

2. **Fuller, J.,** Mathis, S., "Linking the interiors and surfaces of magnetic stars", submitted to *MNRAS*

3. Rui, N., **Fuller, J.**, "Gravity waves in strong magnetic fields", submitted to *MNRAS*

4. Hon, M., Huber, D., Rui, N., **Fuller, J.,** et al., "A close-in Jovian planet orbiting a helium-burning red giant star", submitted to *Nature*

5. Ji, S., **Fuller, J.**, Lecoanet, D., "Magnetohydrodynamic simulations of the Tayler instability in rotating stellar interiors", submitted to *MNRAS*

6. Jermyn, A., **Fuller, J.,** "Wave heating during the helium flash and lithium-enhanced clump stars", submitted to *ApJ*

7. Caiazzo, I., Burdge, K., Tremblay, P., **Fuller, J**, "A rapidly spinning white dwarf exhibits extreme composition variations over its surface", accepted to *Nature*

8. Lu, W., **Fuller, J.,** Quataert, E., "On rapid binary mass transfer -- I. Physical model", accepted to *MNRAS*

9. Scherbak, P., **Fuller, J.,** 2023, "White dwarf binaries suggest a common envelope efficiency $\alpha \sim 1/3$", *MNRAS*, 518, 3966

10. Behmard, A., Sevilla, J., **Fuller, J.,** 2023, "Planet engulfment signatures in twin stars", *MNRAS*, 518, 5465

11. El Badry, K., Conroy, C., **Fuller, J.**, et al., 2022, "Magnetic braking saturates: evidence from the orbital period distribution of low-mass detached eclipsing binaries from ZTF", *MNRAS*, 517, 4916

12. Wu, S., **Fuller, J.,** 2022, “Extreme mass loss in low-mass type Ib/c supernova progenitors”, *ApJ Letters*, 940, 27

13. Sevilla, J., Behmard, A., **Fuller, J.,** 2022, “Long-term lithium abundance signatures following planetary engulfment”, *MNRAS*, 516, 3354

14. Dewberry, J., Mankovich, C., **Fuller, J.,** 2022, “Impacts of zonal winds on planetary oscillations and Saturn ring seismology”, *MNRAS*, 516, 358

15. Wu, S., **Fuller, J.**, 2022, “Wave-driven outbursts and variability of low-mass supernova progenitors”, *ApJ*, 930, 119

16. Ginzburg, S., **Fuller, J.,** et al., 2022, “Slow convection and fast rotation in crystallization-driven white dwarf dynamos”, *MNRAS*, 514, 4111

17. Shi, Y.**, Fuller, J.**, 2022, “Viscous and centrifugal instabilities of massive stars”, *MNRAS*, 513, 1115

18. Jayaraman, R., Handler, G., Rappaport, S., **Fuller, J.,** et al., 2022, “Tidally tilted pulsations in HD 265435, a subdwarf B Star with a Close White Dwarf Companion”, *ApJ Letters*, 928, 14

19. **Fuller, J.**, Lu, W., 2022, “The spins of compact objects born from helium stars in binary systems”, *MNRAS*, 511, 3951

20. Burdge, K., Marsh, T., **Fuller, J.,** et al., 2022, “A 62-minute orbital period black widow binary in a wide hierarchical triple”, *Nature*, 605, 41

21. Leung, S.C., Wu, S., **Fuller, J.**, 2021, “Wave-driven Mass Loss of Stripped Envelope Massive Stars: Progenitor-dependence, Mass Ejection, and Supernovae”, *ApJ,* 923, 41

22. Rui, N., **Fuller, J.**, 2021, “Asteroseismic fingerprints of stellar mergers”, *MNRAS*, 229, 1618

23. Mankovich, C., **Fuller, J.**, 2021, “A diffuse core in Saturn revealed by ring seismology”, *Nature Astronomy*, 5, 1103

24. Caiazzo, I., Burdge, K., **Fuller, J.,** et al., 2021, “A highly magnetized and rapidly rotating white dwarf as small as the Moon”, *Nature*, 595, 39

25. van Roestel, J., Creter, L., Kupfer, T., Skody, P., **Fuller, J.,** et al., 2021**,** “A systematic search for outbursting AM CVn systems with the Zwicky Transient Facility”, *AJ,* 162, 113

26. Dewberry, J., Mankovich, C., **Fuller, J.,** Lai, D., Xu, W., 2021, “Constraining Saturn's Interior with Ring Seismology: Effects of Differential Rotation and Stable Stratification”, *PSJ*, 2, 198

27. Jiang, L., Tauris, T., Chen, W., **Fuller, J.**, 2021, "Novel Model of an Ultra-stripped Supernova Progenitor of a Double Neutron Star", *ApJ Letters*, 920, 36

28. Ma, L., **Fuller, J.,** 2021, "Orbital decay of short-period exoplanets via tidal resonance locking", *ApJ*, 918, 16

29. Lu, W., **Fuller, J.,** et al., 2021, "The former companion of the hyper-velocity star S5-HVS1", *MNRAS,* 503, 603

30. Leung, S., **Fuller, J.**, Nomoto, K., 2021, "Fast Blue Optical Transients due to Circumstellar Interaction and the Mysterious Supernova SN 2018gep", *ApJ*, 915, 80

31. Linial, I., **Fuller, J.,** Sari, R., 2021, "Partial stellar explosions—ejected mass and minimal energy", *MNRAS*, 501, 4266

32. Wu, S., **Fuller, J.,** 2021, "A diversity of wave-driven pre-supernova outbursts", *ApJ,* 906, 3

33. Yu, H., **Fuller, J.**, Burdge, K., 2021, "Tidally excited oscillations in hot white dwarfs", *MNRAS*, 501, 1836

34. **Fuller, J.**, 2020, "Inverse tides in pulsating binary stars", *MNRAS*, 501, 483

35. Burdge, K., Coughlin, M., **Fuller, J.**, et al., 2020, "An 8.8 minute orbital period eclipsing detached double white dwarf binary", 2020, *ApJ Letters,* 905, 7

36. Burdge, K., Prince, T., **Fuller, J.,** et al., 2020, "A systematic search of Zwicky Transient Facility data for ultracompact binary LISA-detectable gravitational-wave sources", *ApJ,* 905, 32

37. Cheng, S., **Fuller, J.,** Guo, Z., Lehman, H., Hambleton, K., 2020, "Detailed characterization of heartbeat stars and their tidally excited oscillations", *ApJ*, 903, 122

38. O'Grady, A., Drout, M., Shappee, B., Bauer, E., **Fuller, J.**, 2020, "Cool, Luminous, and Highly Variable Stars in the Magellanic Clouds from ASAS-SN: Implications for Thorne-Żytkow Objects and Super-asymptotic Giant Branch Stars", *ApJ*, 901, 135

39. Leung, S., **Fuller, J.**, 2020, "Hydrodynamic simulations of pre-supernova outbursts in red supergiants: asphericity and mass loss", *ApJ,* 900, 99

40. **Fuller, J.**, Kurtz, D., Handler, G., Rappaport, S., 2020, "Tidally trapped pulsations in close binary systems", *MNRAS,* 498, 5730

41. Li, G., Guo, Z., **Fuller, J.,** et al., 2020, "The effect of tides on near-core rotation: analysis of 35 Kepler γ Doradus stars in eclipsing and spectroscopic binaries", *MNRAS*, 497, 4363

42. Yu, H., Weinberg, N., **Fuller, J.**, 2020, "Nonlinear tides in white dwarf binaries", *MNRAS*, 496, 5482

43. Zhao, X., **Fuller, J.,** 2020, "Centrifugally Driven Mass Loss and Outbursts of Massive Stars", *MNRAS*, 495, 249

44. 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*, 4, 1053

45. Kurtz, D., Handler, G., Rappaport, S., Saio, H., **Fuller, J.**, et al., 2020, "The single-sided pulsator CO Camelopardalis", *MNRAS*, 494, 5118

46. Handler, G., Kurtz, D., Rappaport, S., Saio, H., **Fuller, J.,** et al., 2020, "Tidally Trapped Pulsations in HD 74423 discovered by TESS", *Nature Astronomy,* 4, 684

47. 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

48. 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

49. Gossan, S., **Fuller, J.,** Roberts, L., 2020, "Wave heating from protoneutron star convection and the core-collapse supernova explosion mechanism", *MNRAS*, 491, 5376

50. Jermyn, A., Tayar, J., **Fuller, J.,** 2020**,** "Differential rotation in convective envelopes: constraints from eclipsing binaries", *MNRAS*, 491, 690

51. Veras, D., **Fuller, J.,** 2019, "Tidal circularization of gaseous planets orbiting white dwarfs", *MNRAS,* 489, 2941

52. 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

53. Burdge, K., Coughlin, M., **Fuller, J.,** et al., 2019, "General relativistic orbital decay in the shortest period eclipsing binary system known", *Nature,* 571, 528

54. **Fuller, J.,** Ma, L., 2019, "Most black holes are born very slowly rotating", *ApJ Letters,* 881, 1

55. 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

56. Ma, L., **Fuller, J.,** 2019, "Angular momentum transport in massive stars and natal neutron star rotation rates", *MNRAS*, 488, 4338

57. **Fuller, J.,** Piro, A., Jermyn, A., 2019, "Slowing the spins of stellar cores", *MNRAS*, 485, 3661

58. Pablo, H., Shultz, M., **Fuller, J.,** et al., 2019, "ε Lupi: measuring the heartbeat of a doubly-magnetic massive binary with BRITE-Constellation", *MNRAS*, 488, 64

59. Dederick, E., Jackiewicz, J., **Fuller, J.,** 2019, "A new method for probing the deep interior of Saturn", (*submitted*)

60. Zhang, M., **Fuller, J.,** Schwab, J., Foley, R., 2019, "The long-term evolution and appearance of type Iax supernova remnant stars", *ApJ*, 872, 29

61. Kleiser, I., **Fuller, J.**, Kasen, D., 2018, "Helium giant stars as progenitors of rapidly fading Type Ibc supernovae", *MNRAS Letters*, 481, 141

62. **Fuller, J.**, Ro, S., 2018, "Pre-supernova outbursts via wave heating in massive stars II: Hydrogen-poor stars", *MNRAS,* 476*,* 1853

63. Luan, J., **Fuller, J.,** Quataert, E., 2018, "How Cassini can constrain tidal dissipation in Saturn", *MNRAS*, 473, 5002

64. Van Reeth, T., Mombarg, J., Mathis, S., Tkachenko, A., **Fuller, J.**, et al., 2018, "Sensitivity of gravito-inertial modes to differential rotation in intermediate-mass main-sequence stars", *A&A*, 618, A24

65. Hambleton, K., **Fuller, J.,** et al., 2018, "KIC 8164262: a heartbeat star showing tidally induced pulsations with resonant locking", *MNRAS*, 473, 5165

66. **Fuller, J.**, Hambleton, K., Shporer, A., Isaacson, H., Thompson, S., 2017, "Accelerated tidal circularization via resonance locking in KIC 8164262", *MNRAS Letters*, 472, 25

67. **Fuller, J.**, 2017, "Heartbeat stars, tidally excited oscillations, and resonance locking", *MNRAS*, 472, 1538

68. **Fuller, J.**, 2017, "Pre-supernova outbursts via wave heating in massive stars - I. Red supergiants", *MNRAS*, 470, 1642

69. Zimmerman, M., Thompson, S., Mullally, F., **Fuller, J.**, et al., 2017, "The Pseudosynchronization of Binary Stars Undergoing Strong Tidal Interactions", *ApJ,* 846, 147

70. 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

71. Guo, Z., Gies, D., **Fuller, J.,** 2017, "Tidally induced pulsations in Kepler eclipsing binary KIC 3230227", *ApJ*, 834, 59

72. Pablo, H., Richardson, N., **Fuller, J.**, et al., 2017, "The most massive heartbeat: an in-depth analysis of ι Orionis", *MNRAS*, 467, 2494

73. Lecoanet, D., Vasil, G., **Fuller, J.,** Cantiello, M., Burns, K., 2017, "Conversion of internal gravity waves into magnetic waves", *MNRAS*, 466, 2181

74. de Wit, J., Lewis, N., Knutson, H., **Fuller, J.**, 2017, "Planet-induced Stellar Pulsations in HAT-P-2's Eccentric System", *ApJ Letters*, 836, 17

75. Hambleton, K., Kurtz, D., Prsa, A., Quinn, S., **Fuller, J.**, et al., 2016, "KIC 3749404: a heartbeat star with rapid apsidal advance indicative of a tertiary component", *MNRAS*, 463, 1199

76. **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

77. Shporer, A., **Fuller, J.**, et al., 2016, "Radial velocity monitoring of Kepler heartbeat stars", *ApJ*, 829, 34

78. Cantiello, M., **Fuller, J.,** Bildsten, L., 2016, "Asteroseismic signatures of evolving internal stellar magnetic fields", *ApJ*, 824, 14

79. 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

80. 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

81. **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

82. **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

83. Belyaev, M., Quataert, E., **Fuller, J.**, 2015, "The properties of g-modes in layered semiconvection", *MNRAS*, 452, 2700

84. **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

85. **Fuller, J.**, Klion, H., Abdikamalov, E., Ott, C., 2015, "Supernova seismology: gravitational wave signatures of rapidly rotating core collapse", *MNRAS*, 450, 414

86. **Fuller, J.**, Lecoanet, D., Cantiello, M., and Brown, B., 2014, "Angular momentum transport via internal gravity waves in evolving stars", *ApJ*, 796, 17

87. **Fuller, J.**, 2014, “Saturn ring seismology: Evidence for stable stratification in the deep interior of Saturn”, *Icarus*, 242, 283

88. 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

89. **Fuller, J.,** and Lai, D., 2014, “Dynamical tides in compact white dwarf binaries: influence of rotation”, *MNRAS*, 444, 3488

90. **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

91. **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

92. **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

93. **Fuller, J.,** and Lai, D., 2012, “Tidal novae in compact binary white dwarfs”, *ApJL*, **756**, 17

94. **Fuller, J.,** and Lai, D., 2012, “Dynamical tides in compact white dwarf binaries: tidal synchronization and dissipation”, *MNRAS*, **421**, 426

95. **Fuller, J.,** and Lai, D., 2012, “Dynamical tides in eccentric binaries and tidally-excited stellar pulsations in *Kepler* KOI-54”, *MNRAS*, **420**, 3126

96. **Fuller, J.,** and Lai, D., 2011, “Tidal excitation of oscillation modes in compact white dwarf binaries: I. Linear theory", *MNRAS*, **412**, 1331

97. **Fuller, J.,** and Gibson, S., 2009, “A survey of coronal cavity density profiles”, *ApJ*, **700**, 1205

98. **Fuller, J.**, Gibson, S., de Toma, G., and Fan, Y., 2008, “Observing the unobservable? Modeling coronal cavity densities”, *ApJ*, **678**, 515