Robert Caldwell

Contact Information:
Address: Dartmouth College
Department of Physics & Astronomy
Hanover, NH 03755
Telephone: (603) 646-2742
E-Mail: Robert.R.Caldwell@dartmouth.edu

Education:
A.B., Washington University in St. Louis, Physics, French, 1987
M.S., University of Wisconsin–Madison, Physics, 1989
Ph.D., University of Wisconsin–Milwaukee, Physics, 1992

Research & Professional Experience:
2010-present Professor, Dartmouth College
2005-2010 Associate Professor, Dartmouth College
2000-2005 Assistant Professor, Dartmouth College
1998-2000 Postdoctoral Fellow, Princeton University, Physics
1996-8 Postdoctoral Fellow, University of Pennsylvania, Physics & Astronomy
1994-6 Postdoctoral Fellow, Cambridge University, DAMTP
1992-4 Postdoctoral Fellow, Fermilab Theoretical Astrophysics

Awards & Honors:
Fellow of the International Society on General Relativity and Gravitation (since 2022)
Fellow of the American Association for the Advancement of Science (since 2019)
Simons Foundation Fellowship in Theoretical Physics (2017-8)
Outstanding Referee, American Physical Society (recognized in 2014)
John M. Manley Huntington Award for Newly Promoted Faculty, Dartmouth (2010)
Fellow of the American Physical Society (since 2008)

External Funding:
Department of Energy, High Energy Physics 7/13-present (Caldwell, PI)
Templeton Foundation, 1/13-12/14 (Caldwell, Co-PI)
National Science Foundation, Theoretical Physics, 9/11-8/14 (Caldwell, Co-PI)
NASA Jet Propulsion Laboratory SURP, 9/09-8/10, 4/11-3/12 (Caldwell, PI)
National Science Foundation CAREER, 9/04-8/11 (Caldwell, PI)
Research Corporation, 7/02-6/03 (Caldwell, PI)
National Science Foundation, Theoretical Physics, 9/01-8/04 (Caldwell, PI)

PhD Advisor:
Bruce Allen (University of Wisconsin–Milwaukee)

Postdoctoral Advisors:
Rocky Kolb, Joshua Frieman (Fermi National Accelerator Laboratory);
Paul Shellard, Stephen Hawking (Cambridge University);
Paul Steinhardt (University of Pennsylvania and Princeton University)

Graduate Advisees:

Peng Peng Yu (PhD, 2007), Ryan Michney (MS, 2007), Scott Daniel (PhD, 2009), Deanne Dorak (MS, 2011), Leonardo Motta (PhD, 2012), Jannis Bielefeld (PhD, 2015), Giovanni Vizcardo (MS, 2017), Dhrubo Jyoti (PhD, 2018), Chris Devulder (PhD, 2018), Stan Bovenschen (U. Amsterdam, MS, 2019), Vivian Sabla (expected PhD, 2023), Avery Tishue (expected PhD, 2023)

Recent Undergraduate Research Supervision:

Shadi Ali Ahmad '22, Zehua Song '22

Dartmouth Courses Taught: *(since 2018)*

P13 Introductory Physics I: Mechanics (F20, W22, W23)
P14 Introductory Physics II: E & M (S20)
P77 Introduction to General Relativity (F19, F21)
P92 Physics of the Early Universe (W19, W21)

Recent Collaborators: *(since 2018)*

Ludovico Capparelli (Rome, Italy), Jon Gair (Hannover, Germany), Alan Heavens (Imperial, UK), Raul Jimenez (Barcelona, Spain), Dhrubo Jyoti (Dartmouth), Marc Kamionkowski (Johns Hopkins), Ali Rida Khalifeh (Barcelona, Spain), Roy Maartens (Portsmouth, UK), Alessandro Melchiorri (Rome, Italy), Julian Munoz (Harvard), Vivian Sabla (Dartmouth), Tristan Smith (Swarthmore), Lorenzo Speri (Hannover, Germany), Nicola Tamanini (Hannover, Germany), Avery Tishue (Dartmouth), Licia Verde (Barcelona, Spain), Ben Wang (UCLA), CMB-S4 Collaboration, LISA Cosmology Working Group, LISA Science Investigation Working Group, NASA LISA Study Team, Snowmass Cosmic Frontier Collaboration, Snowmass Theory Frontier Collaboration,

Professional Activities:

Member:	CMB-S4 collaboration (cmb-s4.org) (2016-)
Member:	NASA LISA Study Team (lisa.nasa.gov) (2017-)
Member:	LISA Consortium, Cosmology Co-Chair (lisamission.org) (2018-2022)
Member:	Snowmass Community Planning (snowmass21.org) (2020-2022)
Judge:	Buchalter Cosmology Prize, 2014-2017
Editor:	Division Associate Editor, Physical Review Letters (2007-2013)
Referee:	Physical Review, Astrophysical Journal, many others
Reviewer:	NSF, NASA, DOE, and foreign science agencies
Member:	American Association for the Advancement of Science, American Physical Society (Astrophysics, Gravitation, Particles & Fields, and Physics Education)
Co-Organizer:	8th LISA Cosmology Working Group workshop (virtual), 15-17 July 2020 New England Theoretical Cosmology workshop (virtual), 21 July 2020.

Impact: *(GoogleScholar, March 2023)*
h-index=55, i10-index=109, total citations =21,000

Publications:

1. A. J. Tishue and R. R. Caldwell, "Dark Energy with a Triplet of Classical U(1) Fields," Phys. Rev. D **107**, 043514 (2023).
2. V. I. Sabla and R. R. Caldwell, "The Microphysics of Early Dark Energy," Phys. Rev. D **106**, no.6, 063526 (2022).
3. P. Auclair, *et al.* [LISA Cosmology Working Group], "Cosmology with the Laser Interferometer Space Antenna," arXiv:2204.05434 [astro-ph.CO].
4. N. Bartolo, *et al.* [LISA Cosmology Working Group], "Probing Anisotropies of the Stochastic Gravitational Wave Background with LISA," JCAP **11**, 009 (2022).
5. A. J. Tishue and R. R. Caldwell, "Relic Cosmological Vector Fields and Inflationary Gravitational Waves," Phys. Rev. D **104**, no.6, 063531 (2021).
6. V. I. Sabla and R. R. Caldwell, "No H_0 Assistance from Assisted Quintessence," Phys. Rev. D **103**, no.10, 103506 (2021).
7. L. Speri, N. Tamanini, R. R. Caldwell, J. R. Gair and B. Wang, "Testing the Quasar Hubble Diagram with LISA Standard Sirens," Phys. Rev. D **103**, no.8, 083526 (2021).
8. L. M. Capparelli, R. R. Caldwell and A. Melchiorri, "Cosmic Birefringence Test of the Hubble Tension," Phys. Rev. D **101**, no. 12, 123529 (2020).
9. T. L. Smith and R. R. Caldwell, "LISA for Cosmologists: Calculating the Signal-to-Noise Ratio for Stochastic and Deterministic Sources," Phys. Rev. D **100**, no. 10, 104055 (2019).
10. D. Jyoti, J. B. Munoz, R. R. Caldwell and M. Kamionkowski, "Cosmic Time Slip: Testing Gravity on Supergalactic Scales with Strong-Lensing Time Delays," Phys. Rev. D **100**, no. 4, 043031 (2019).
11. R. R. Caldwell, T. L. Smith and D. G. E. Walker, "Using a Primordial Gravitational Wave Background to Illuminate New Physics," Phys. Rev. D **100**, no. 4, 043513 (2019).
12. R. R. Caldwell and C. Devulder, "Gravitational Wave Opacity from Gauge Field Dark Energy," Phys. Rev. D **100**, no. 10, 103510 (2019).
13. R. Jimenez, R. Maartens, A. R. Khalifeh, R. R. Caldwell, A. F. Heavens and L. Verde, "Measuring the Homogeneity of the Universe," JCAP **1905**, no. 05, 048 (2019).
14. R. R. Caldwell and C. Devulder, "Axion Gauge Field Inflation and Gravitational Leptogenesis: A Lower Bound on B Modes from the Matter-Antimatter Asymmetry of the Universe," Phys. Rev. D **97**, 023532 (2018).
15. R. R. Caldwell, C. Devulder and N. A. Maksimova, "Gravitational wave – gauge field dynamics," Int. J. Mod. Phys. D **26**, 1742005 (2017).
16. R. R. Caldwell, C. Hirata, and M. Kamionkowsi, "Dust-polarization maps and interstellar turbulence," Astrophys. J. **839**, 91 (2017).
17. T. L. Smith and R. R. Caldwell, "Sensitivity to a Frequency-Dependent Circular Polarization in an Isotropic Stochastic Gravitational Wave Background," Phys. Rev. D **95**, 044036 (2017).
18. R. R. Caldwell, C. Devulder, and N. A. Maksimova, "Gravitational wave – Gauge field oscillations," Phys. Rev. D **94**, 063005 (2016).

19. P. Lasky, et al., "Gravitational-wave cosmology across 29 decades in frequency," Phys. Rev. X **6**, 011035 (2016).
20. J. Bielefeld and R. R. Caldwell, "Cosmological consequences of classical flavor-space locked gauge field radiation," Phys. Rev. D **91**, 124004 (2015).
21. J. Bielefeld and R. R. Caldwell, "Chiral Imprint of a Cosmic Gauge Field on Primordial Gravitational Waves," Phys. Rev. D **91**, 123501 (2015).
22. J. Bielefeld, R. R. Caldwell, and E. Linder, "Dark energy scaling from dark matter to acceleration," Phys. Rev. D **90**, 043015 (2014).
23. R. R. Caldwell and N. A. Maksimova, "Spectral distortion in a radially inhomogeneous cosmology," Phys. Rev. D **88**, 103502 (2013).
24. J. T. Deskins, J. T. Giblin, and R. R. Caldwell, "Gauge field preheating at the end of inflation," Phys. Rev. D **88**, 063530 (2013).
25. J. Bielefeld, W. L. K. Wu, R. R. Caldwell, and O. Dore, "Freezing out early dark energy," Phys. Rev. D **88**, 103004 (2013).
26. R. R. Caldwell and S. S. Gubser, "Brief History of Curvature," Phys. Rev. D **87**, 063523 (2013).
27. L. Motta and R. R. Caldwell, "Non-Gaussian features of primordial magnetic fields in power-law inflation," Phys. Rev. D **85**, 103532 (2012).
28. R. R. Caldwell, L. Motta and M. Kamionkowski, "Correlation of inflation-produced magnetic fields with scalar fluctuations," Phys. Rev. D **84**, 123525 (2011).
29. R. A. Vanderveld, R. R. Caldwell and J. Rhodes, "Second-order weak lensing from modified gravity," Phys. Rev. D **84**, 123510 (2011).
30. R. R. Caldwell, V. Gluscevic and M. Kamionkowski, "Cross-Correlation of Cosmological Birefringence with CMB Temperature," Phys. Rev. D **84**, 043504 (2011).
31. A.R. Cooray, D.E. Holz, R. R. Caldwell, "Measuring dark energy spatial inhomogeneity with supernova data," JCAP **1011**, 015 (2010).
32. S. F. Daniel, E. V. Linder, T. L. Smith, R. R. Caldwell, A. Cooray, A. Leauthaud and L. Lombriser, "Testing general relativity with current cosmological data," Phys. Rev. **D81**, 123508 (2010).
33. D. G. Figueroa, R. R. Caldwell and M. Kamionkowski, "Non-Gaussianity from self-ordering scalar fields," Phys. Rev. **D81**, 123504 (2010).
34. R. R. Caldwell and M.P. Kamionkowski, "The physics of cosmic acceleration," Ann. Rev. Part. Nuc. Sci. **59**, 397 (2009).
35. S. F. Daniel, R. R. Caldwell, A. Cooray, P. Serra and A. Melchiorri, "A multi-parameter investigation of gravitational slip," Phys. Rev. **D80**, 023532 (2009).
36. P. Serra, A. Cooray, S. F. Daniel, R. R. Caldwell and A. Melchiorri, "Lensed cosmic microwave background constraints on post-general relativity parameters," Phys. Rev. **D79**, 101301 (2009).
37. P. P. Yu and R. R. Caldwell, "Observer dependence of the quasi-local energy and momentum in Schwarzschild space-time," Gen. Rel. Grav. **41**, 559 (2009).
38. R. R. Caldwell and A. Stebbins, "A test of the Copernican principle," Phys. Rev. Lett. **100**, 191302 (2008).
39. S. F. Daniel, R. R. Caldwell, A. Cooray and A. Melchiorri, "Large scale structure as a probe of gravitational slip," Phys. Rev. **D77**, 103513 (2008).

40. R. R. Caldwell and D. Grin, "Lower limit to the scale of an effective theory of gravitation," Phys. Rev. Lett. **100**, 031301, (2008).
41. T. Smith, A. Erickcek, R. R. Caldwell, and M. Kamionkowski, "The effects of Chern-Simons gravity on bodies orbiting the Earth," Phys. Rev. **D77**, 024015 (2008).
42. S. F. Daniel and R. R. Caldwell, "Consequences of a cosmic scalar with kinetic coupling to curvature," Class, Quant. Grav. **24**, 5573 (2007).
43. R. R. Caldwell, A. Cooray, and A. Melchiorri, "Constraints on a new post-general relativity cosmological parameter," Phys. Rev. **D76**, 023507 (2007).
44. R.J. Michney and R. R. Caldwell, "Anisotropy of the cosmic neutrino background," J. Cosmol. Astropart. Phys. **014**, 0701 (2007).
45. A. Cooray and R. R. Caldwell, "Large-scale bulk motions complicate the Hubble diagram," Phys. Rev. **D73**, 103002 (2006).
46. R. R. Caldwell and P. P. Yu, "Long-lived quintessential scalar hair," Class. Quantum Grav. **23**, 7257 (2006).
47. R. R. Caldwell, W. Komp, L. Parker, and D. Vanzella, "A sudden gravitational transition," Phys. Rev. **D73**, 023513 (2006).
48. R. R. Caldwell and E.V. Linder, "Limits of quintessence," Phys. Rev. Lett. **95**, 141301 (2005).
49. R. R. Caldwell and M. Doran, "Dark-energy evolution across the cosmological-constant boundary," Phys. Rev. **D72**, 043527 (2005).
50. A. Cooray, M. Kamionkowski and R. R. Caldwell, "Cosmic shear of the microwave background: the curl diagnostic," Phys. Rev. **D71**, 123527 (2005).
51. K. Sigurdson, M. Doran, A. Kurylov, R. R. Caldwell, and M. Kamionkowski, "Dark-matter electric and magnetic dipole moments," Phys. Rev. **D70**, 83501 (2004).
52. R. R. Caldwell and M. Kamionkowski, "Expansion, geometry, and gravity," J. Cosmol. Astropart. Phys. **09**, 009 (2004).
53. R. R. Caldwell and M. Doran, "Cosmic microwave background and supernova constraints on quintessence: concordance regions and target models," Phys. Rev. **D69**, 103517 (2004).
54. R. R. Caldwell, M. Kamionkowski, and N.N. Weinberg "Phantom energy and cosmic doomsday," Phys. Rev. Lett. **91**, 071301 (2003).
55. R. R. Caldwell, M. Doran, C.M. Mueller, G. Schaefer, C. Wetterich, "Early quintessence in light of WMAP," ApJ **591**, L75-78 (2003).
56. S. DeDeo, R. R. Caldwell, and P.J. Steinhardt, "Effects of the sound speed of quintessence on the microwave background and large scale structure," Phys. Rev. **D67**, 103509 (2003); Phys. Rev. **D67**, 129902E (2003).
57. P. Schuecker, R. R. Caldwell, H. Bohringer, C.A. Collins, L. Guzzo, and N.N. Weinberg, "Observational constraints on general relativistic energy conditions, cosmic matter density and dark energy from x-ray clusters of galaxies and type-Ia supernovae," Astron. Astrophys. **402**, 53 (2003).
58. R. R. Caldwell, "A Phantom Menace? Cosmological consequences of a dark energy component with super-negative equation of state" Phys. Lett. **B 545**, 23 (2002).
59. R. Dave, R. R. Caldwell, and P.J. Steinhardt, "Sensitivity of the CMB anisotropy to initial conditions in Quintessence Cosmology," Phys. Rev. **D66**, 023516 (2002).

60. J.K. Erickson, R. R. Caldwell, P.J. Steinhardt, C. Armendariz-Picon, and V. Mukhanov, "Measuring the sound speed of quintessence," Phys. Rev. Lett. **88**, 121301 (2002).
61. L. Boyle, R. R. Caldwell, and M. Kamionkowski, "Spintessence! New models for dark matter and dark energy," Phys. Lett. **B 545**, 17 (2002).
62. A.D. Miller, et al., "The QMAP and MAT/TOCO experiments for measuring anisotropy in the cosmic microwave background," ApJS **140**, 115 (2002).
63. J.L. Puchalla, R. R. Caldwell, K.L. Cruz, M.J. Devlin, W.B. Dorwart, T. Herbig, A.D. Miller, M.R. Nolta, L.A. Page, E. Torbet, H.T. Tran, "Millimeter-Wavelength Galactic Observations with the Mobile Anisotropy Telescope," AJ **123**, 1978 (2002).
64. R. R. Caldwell and D. Langlois, "Shortcuts in the fifth dimension," Phys. Lett. **B 511**, 129 (2001).
65. R. R. Caldwell, R. Juszkiewicz, P.J. Steinhardt, and F.R. Bouchet, "A simple method for computing the non-linear correlation function with implications for stable clustering," ApJ **547**, L93-96 (2001).
66. L. Wang, R. R. Caldwell, J. P. Ostriker, and P. J. Steinhardt, "Cosmic concordance and quintessence," ApJ **530**, 17-35 (2000).
67. A.D. Miller, R. R. Caldwell, M.J. Devlin, W.B. Dorwart, T. Herbig, M.R. Nolta, L.A. Page, J. Puchalla, E. Torbet, H.T. Tran, "A measurement of the angular power spectrum of the CMB from ℓ=100 to 400," ApJ **524**, L1-4 (1999).
68. C.-P. Ma, R. R. Caldwell, P. Bode, and L. Wang, "The mass power spectrum in quintessence cosmological models," ApJ **521**, L1-4 (1999).
69. P. P. Avelino, R. R. Caldwell, and C.J.A.P. Martins, "Cosmological consequences of string-forming open inflation models," Phys. Rev. **D 59**, 123509 (1999).
70. R. R. Caldwell, M. Kamionkowski, and L. Wadley, "The first space-based gravitational-wave detectors," Phys. Rev. **D 59**, 027101 (1999).
71. G. Huey, L. Wang, R. Dave, R. R. Caldwell, and P.J. Steinhardt, "Resolving the cosmological missing energy problem," Phys. Rev. **D 59**, 063005 (1999).
72. R. R. Caldwell and P.J. Steinhardt, "The imprint of gravitational waves in models dominated by a dynamical cosmic scalar field," Phys. Rev. **D 57**, 6057 (1998).
73. R. R. Caldwell, R. Dave, and P.J. Steinhardt, "Cosmological imprint of an energy component with general equation of state," Phys. Rev. Lett. **80**, 1582 (1998).
74. B. Allen, R. R. Caldwell, S. Dodelson, L. Knox, E.P.S. Shellard, and A. Stebbins, "CMB Anisotropy induced by cosmic strings on angular scales greater than 15-minutes," Phys. Rev. Lett. **79**, 2624 (1997).
75. P. P. Avelino, R. R. Caldwell, and C.J.A.P. Martins, "Cosmic strings in an open universe: quantitative evolution and observational consequences," Phys. Rev. **D 56**, 4568 (1997).
76. R. R. Caldwell, R. A Battye, and E.P.S. Shellard, "Relic gravitational waves from cosmic strings: updated constraints and opportunities for detection," Phys. Rev. **D 54**, 7146 (1996).
77. B. Allen, R. R. Caldwell, E.P.S. Shellard, A. Stebbins, and S. Veeraraghaven, "Large angular scale CMB anisotropy induced by cosmic strings," Phys. Rev. Lett. **77**, 3061 (1996).
78. R. R. Caldwell, "On the evolution of scalar metric perturbations in an inflationary cosmology," Class. Q. Grav. **13**, 2437 (1996).

79. R. R. Caldwell, H.A. Chamblin, and G.W. Gibbons, "Pair creation of black holes by domain walls," Phys. Rev. **D 53**, 7103 (1996).
80. P. P. Avelino and R. R. Caldwell, "Entropy perturbations from cosmic strings," Phys. Rev. **D 53**, R5339 (1996).
81. R. R. Caldwell and P. Casper, "Formation of black holes from collapsed cosmic string loops," Phys. Rev. **D 53**, 3002 (1996).
82. A. Stebbins and R. R. Caldwell, "No very large scale structure in an open universe," Phys. Rev. **D 52**, 3248 (1995).
83. B. Allen, R. R. Caldwell, and S. Koranda, "CBR Temperature fluctuations induced by gravitational waves in a spatially-closed inflationary universe," Phys. Rev. **D 51**, 1553 (1995).
84. R. R. Caldwell, "Green's functions for gravitational waves in FRW spacetimes," Phys. Rev. **D 48**, 4688 (1993).
85. R. R. Caldwell and E. Gates, "Constraints on cosmic strings due to black holes formed from collapsed cosmic string loops," Phys. Rev. **D 48**, 2581 (1993).
86. R. R. Caldwell and B. Allen, "Cosmological constraints on cosmic string gravitational radiation," Phys. Rev. **D 45**, 3447 (1992).
87. R. R. Caldwell and J.L. Friedman, "Evidence against a strange ground state for baryons," Physics Lett. **B 264**, 143 (1991).
88. B. Allen and R. R. Caldwell, "Small scale structure on a cosmic string network," Phys. Rev. **D 43**, 3173 (1991).
89. B. Allen and R. R. Caldwell, "Kinky structure on strings," Phys. Rev. **D 43**, R2457 (1991).
90. B. Allen and R. R. Caldwell, "Generation of structure on a cosmic string network," Phys. Rev. Lett. **65**, 1705 (1990).

Conference Proceedings:

1. R. R. Caldwell, "Cosmic Parity Violation due to a Flavor-Space Locked Gauge Field," Int. J. Mod. Phys. D, **25**, 1640011 (2016).
2. R. R. Caldwell, "Dark Energy Models," in "TASI 2012: Searching for New Physics at Small and Large Scales," eds. E. Pierpaoli and M. Schmaltz, World Scientic (2013).
3. R. R. Caldwell, "Gravitational Screening: Geometry and Superposition," AIP Conf. Proc. 1514, pp. 169-178 (2013).
4. R. R. Caldwell, "A Gravitational Puzzle," Phil. Trans. R. Soc. **A369** 4998 (2011).
5. R. R. Caldwell, "Dark energy phenomena as gigaparsec voids: constraints due to spectral distortion," in "Proceedings, 4th Mexican Meeting on Mathematical and Experimental Physics," eds. A. Macias, M. Maceda, AIP Conf. Proc. 1318 (2010).
6. R. R. Caldwell "Perspectives on Dark Energy," Space Science Reviews **148**, 347 (2009); DOI 10.1007/s11214-009-9552-3.
7. P. Serra, A. Cooray, S. F. Daniel, R. Caldwell and A. Melchiorri, "Lensed cosmic microwave background constraints on post-general relativity parameters," Nucl. Phys. Proc. Suppl. **194**, 320 (2009).
8. R. Caldwell and L. Dias Da Motta, "Electro- and magnetostatics of a cosmic pseudoscalar field coupled to electromagnetism," Nucl. Phys. Proc. Suppl. **194**, 202 (2009).

9. R. R. Caldwell, "The Imprint of Dark Energy," in *CosPA 2003: Cosmology and Particle Astrophysics*, ed. W.-Y. Pauchy Hwang (World Scientific, Singapore, 2004).
10. R. R. Caldwell *et al.*, "Cosmological Parameters, Dark Energy, and Large Scale Structure," in *Snowmass 2001: The Future of Particle Physics*, 2001.
11. R. R. Caldwell, "An Introduction to Quintessence," in *Dark Matter 2000: Sources and detection of dark matter and dark energy in the universe*, ed. D. B. Cline, 74-91 (2000).
12. R. R. Caldwell, "An Introduction to Quintessence," Brazilian Journal of Physics, vol. 30, no. 2, 215-229, June (2000).
13. R. R. Caldwell, R. Dave, and P.J. Steinhardt, "Quintessential Cosmology: Novel Models of Cosmological Structure Formation," Astrophysics and Space Science, vol. 261, 303-310 (1999).
14. P. P. Avelino, R. R. Caldwell, and C.J.A.P. Martins, "The Promise of Structure Formation with Cosmic Strings in an Open Universe," Astrophysics and Space Science, vol. 261, 319-320 (1999).
15. R. R. Caldwell and P.J. Steinhardt, "Introduction to Quintessence" in *Cosmic Microwave Background and Large Scale Structure of the Universe*, eds. Y.-I. Byun and K.-W. Ng (Astronomical Society of the Pacific, 1998).
16. R. R. Caldwell, R. Dave, and P. J. Steinhardt, "Quintessential Cosmology" in *The Non-Sleeping Universe*, eds. Alain Blanchard and M. Teresa V.T. Lago (1998).
17. R.A. Battye, R. R. Caldwell, and E.P.S. Shellard, "Gravitational waves from cosmic strings" in *Topological Defects in Cosmology*, eds. F. Melchiorri and M. Signore (1996).
18. B. Allen, R. R. Caldwell, E.P.S. Shellard, A. Stebbins and S. Veeraraghavan, "CMB Anisotropy due to cosmic strings: large angular scale," in *Proceedings of the 18th Texas Symposium*, eds. A. Olinto, J. Frieman and D. Schramm (1996).
19. B. Allen, R. R. Caldwell, E.P.S. Shellard, A. Stebbins and S. Veeraraghavan, "Cosmic strings confront COBE," in *Birth of the Universe and Fundamental Physics*, ed. Franco Occhionero (Springer-Verlag, Berlin, 1995).
20. B. Allen, R. R. Caldwell, E.P.S. Shellard, A. Stebbins and S. Veeraraghavan, "Cosmic microwave radiation anisotropy induced by cosmic strings," in *CMB Anisotropies: Two Years After COBE*, ed. Lawrence Krauss (World Scientific, Singapore, 1994).
21. R. R. Caldwell, "The current status of observational constraints on cosmic strings," in *Proceedings of the 5th Canadian Conference on General Relativity and Relativistic Astrophysics*, eds. R. McLenaghan and R. Mann (World Scientific, Singapore, 1993).
22. B. Allen and R. R. Caldwell, "Formation of kinks," in *Proceedings of the 1990 Florida Conference on Non-Linear Problems in Astrophysics*, eds. J. Buchler, S. Detweiler, and J. Ipser (New York Academy of Sciences, 1991).
23. B. Allen and R. R. Caldwell, "Kinky strings: Evolution of kinks as small-scale structure on a cosmic string network," in *Proceedings of the 1990 Banff Summer School on Gravitation*, eds. R. Mann and P. Wesson (World Scientific, Singapore, 1991).

White or Community Papers:

1. R. Adhikari, *et al.* [Snowmass Cosmic Frontier], "Report of the Topical Group on Cosmic Probes of Fundamental Physics for Snowmass 2021," arXiv:2209.11726 [hep-ph].
2. D. Green, *et al.* [Snowmass Theory Frontier], "Snowmass Theory Frontier: Astrophysics and Cosmology," arXiv:2209.06854 [hep-ph].

3. K. Abazajian, *et al.* [CMB-S4], "Snowmass 2021 CMB-S4 White Paper," arXiv:2203.08024 [astro-ph.CO].
4. A. Achúcarro, *et al.*, "Inflation: Theory and Observations," arXiv:2203.08128 [astro-ph.CO].
5. R. Caldwell, *et al.*, "Detection of Early-Universe Gravitational Wave Signatures and Fundamental Physics," Gen. Rel. Grav. **54**, 12, 156 (2022).
6. E. Abdalla, *et al.* "Cosmology Intertwined: A Review of the Particle Physics, Astrophysics, and Cosmology Associated with the Cosmological Tensions and Anomalies," arXiv:2203.06142 [astro-ph.CO].
7. P. A. Seoane, *et al.* [LISA Science Group], "The effect of mission duration on LISA science objectives," Gen. Rel. Grav. **54**, no.1, 3 (2022).
8. J. Bellovary *et al.* [NASA LISA Study Team], "Getting Ready for LISA: The Data, Support and Preparation Needed to Maximize US Participation in Space-Based Gravitational Wave Science," arXiv:2012.02650 [astro-ph.IM].
9. K. Abazajian *et al.* [CMB-S4], "CMB-S4: Forecasting Constraints on Primordial Gravitational Waves," Astrophys. J. **926**, no.1, 54 (2022).
10. K. Holley-Bockelmann *et al.* (R. R. Caldwell), "Building A Field: The Future of Astronomy with Gravitational Waves, A State of The Profession Consideration for Astro2020," Astro2020: Decadal Survey on Astronomy and Astrophysics, APC white papers, no. 228; Bulletin of the American Astronomical Society, Vol. 51, Issue 7, id. 228 (2019), arXiv:1912.07642 [astro-ph.IM].
11. J. Baker *et al.* (R. R. Caldwell), "Space Based Gravitational Wave Astronomy Beyond LISA," Astro2020: Decadal Survey on Astronomy and Astrophysics, APC white papers, no. 243; Bulletin of the American Astronomical Society, Vol. 51, Issue 7, id. 243 (2019), arXiv:1907.11305 [astro-ph.IM].
12. J. Baker *et al.* (R. R. Caldwell), "The Laser Interferometer Space Antenna: Unveiling the Millihertz Gravitational Wave Sky," Astro2020: Decadal Survey on Astronomy and Astrophysics, APC white papers, no. 77; Bulletin of the American Astronomical Society, Vol. 51, Issue 7, id. 77 (2019), arXiv:1907.06482 [astro-ph.IM].
13. K. Abazajian *et al.* (R. R. Caldwell), "CMB-S4 Science Case, Reference Design, and Project Plan," arXiv:1907.04473 [astro-ph.IM].
14. K. Abazajian *et al.* (R. R. Caldwell), "CMB-S4 Decadal Survey APC White Paper," Astro2020: Decadal Survey on Astronomy and Astrophysics, APC white papers, no. 209; Bulletin of the American Astronomical Society, Vol. 51, Issue 7, id. 209 (2019), arXiv:1908.01062 [astro-ph.IM].
15. R. R. Caldwell *et al*, "Astro2020 Science White Paper: Cosmology with a Space-Based Gravitational Wave Observatory," Astro2020: Decadal Survey on Astronomy and Astrophysics, science white papers, no. 67; Bulletin of the American Astronomical Society, Vol. 51, Issue 3, id. 67 (2019), arXiv:1903.04657 [astro-ph.CO] (2019).
16. S. McWilliams *et al* (R. R. Caldwell), "Astro2020 Decadal Science White Paper: The State of Gravitational-Wave Astrophysics in 2020," Astro2020: Decadal Survey on Astronomy and Astrophysics, science white papers, no. 455; Bulletin of the American Astronomical Society, Vol. 51, Issue 3, id. 455 (2019), arXiv:1903.04592 [astro-ph.HE] (2019).
17. K. N. Abazajian *et al.* [CMB-S4 Collaboration], "CMB-S4 Science Book, First Edition," arXiv:1610.02743 [astro-ph.CO].

Scientific Talks (Colloquia, Seminars, Conferences, Etc): *(since 2018)*

2021 CMB-S4 Summer Meeting, online, invited presentation
University of Padua, online, Physics seminar
LISA Board of Directors, online, invited presentation
LISA Canada, online, invited presentation
LISA Consortium, online, invited presentation

2020 LISA Consortium, online, invited presentation
University of Massachusetts - Amherst, Physics Colloquium

2019 University of Chicago, Cosmology workshop, Invited speaker
American Astronomical Society, St Louis, conference
University of California - Irvine, Cosmology workshop, Invited speaker

2018 Simon Fraser University, Canada, Physics colloquium
University of British Columbia, Canada, Physics colloquium
University of Victoria, Canada, Physics colloquium
Washington University - St. Louis, Physics seminar
University of Helsinki, Cosmology workshop
Washington University - St. Louis, Physics colloquium
Albert Einstein Institute, Hannover, Germany, physics colloquium
LISA Consortium meeting, Hannover, Germany, presentation
University of California - San Diego, Cosmology seminar