

Curriculum Vitae

July 11, 2019 (last update 09/03/2015)

**Anthony Aguirre**

Professor of Physics

RESEARCH INTERESTS

Cosmology of the early and late universe: inflation and the global structure of cosmological models; gravitation; dark matter; foundations of quantum mechanics and statistical mechanics; AI and machine learning

EMPLOYMENT HISTORY

1995	Astronomer, Harvard-Smithsonian Center for Astrophysics
1996 - 2000	Graduate Research and Teaching Assistant, Harvard University
2000 - 2003	Member, Institute for Advanced Study
2004 - 2007	Assistant Professor of Physics, University of California, Santa Cruz
2007 - 2012	Associate Professor of Physics, University of California at Santa Cruz
2004 - Present	Member, SCIPP, University of California, Santa Cruz
2012 - Present	Professor of Physics, University of California at Santa Cruz

EDUCATION

1995	B.S., Mathematics/Physics, Brown University, 1995
1998	M.S., Astronomy, Harvard University, 1998
2000	Ph.D., Astronomy, Harvard University, 2000

HONORS AND AWARDS

2016	University Professor: Faggin Presidential Chair for the Physics of Information
2014	Prize: Third place, 2014 Buchalter Prize in Cosmology
2005	Award: Pre-tenure faculty development award (UCSC)
2004	Award: Non-tenured Faculty development award (UCSC)
2000 - 2003	Fellowship: Keck Fellowship (IAS)
1999 - 2000	Scholarship: John Parker Merit Scholarship (Harvard)
1998 - 1999	Award: Award for Undergraduate Teaching (Harvard)
1995	Award: Finalist, Leroy Apker Prize for Achievement in Physics (Brown)
1995	Award: Bruce Lindsay Award for Physics (Brown)
1994 - 1995	Award: Barry M. Goldwater Scholar (Brown)

SCHOLARLY AND CREATIVE WORK

2019	Aguirre, Anthony. <i>Cosmological Koans: A Journey to the Heart of Physical Reality</i> , New York: Norton (2019) (Mar 21 2019)
2019	Šafránek, D., Deutsch, J.M., and Aguirre, A. Quantum coarse-grained entropy and thermodynamics. <i>Phys. Rev. A</i> 99, 010101 (2019); arXiv Preprint 1707.09722 PEER REVIEWED
2019	Šafránek, D., Deutsch, J.M., and Aguirre, A. Quantum coarse-grained entropy and thermalization in closed systems. <i>PRA</i> , 99, 012103; arXiv preprint 1803.00665 PEER REVIEWED
	Submitted: Schindler, J., Aguirre, A., & Kuttner, A. Understanding black hole evaporation using explicitly computed Penrose diagrams. <i>PRD</i> , submitted PEER REVIEWED

- Submitted:** Deutsch, J. M., Safranek, D., & Aguirre, A. Anything can happen, but only given half a chance: a quantum bound on large fluctuations away from equilibrium. *arXiv preprint arXiv:1806.08897*. PEER REVIEWED
- 2018 Aguirre, A., Foster, B., & Merali, Z. (Eds.). (2018). *Wandering Towards a Goal: How Can Mindless Mathematical Laws Give Rise to Aims and Intention?*. Springer.
- 2018 Schindler, J. C., & Aguirre, A. (2018). Algorithms for the explicit computation of Penrose diagrams. *Classical and Quantum Gravity*, 35(10), 105019. PEER REVIEWED
- 2017 Jonathan Braden, Matthew C. Johnson, Hiranya V. Peiris, Anthony Aguirre. **Constraining cosmological ultralarge scale structure using numerical relativity. Phys.Rev. D96 (2017) no.2, 023541** PEER REVIEWED
- 2017 Bozkurt, I. N., Aguirre, A., Chandrasekaran, B., Godfrey, P. B., Laughlin, G., Maggs, B., & Singla, A. (2017, March). Why is the Internet so slow?!. In *International Conference on Passive and Active Network Measurement* (pp. 173-187). Springer, Cham.
- 2016 MC Johnson, CL Wainwright, A Aguirre, HV Peiris. Simulating the Universe (s) III: Observables for the full bubble collision spacetime. **JCAP 1607 (2016) no.07, 020**; arXiv:1508.03641 PEER REVIEWED
- 2016 Aguirre, A., Foster, B., & Merali, Z. (2016). *Trick or Truth?*. Springer International Publishing
- 2016 Aguirre, A., Foster, B., & Merali, Z. (Eds.). (2016). *How Should Humanity Steer the Future?*. Springer.
- 2015 Aguirre, Anthony, and Alberto Diez-Tejedor. "Asymmetric condensed dark matter." **JCAP 1604 (2016) no.04, 019**; arXiv:1502.07354 (2015). PEER REVIEWED
- 2015 Aguirre, Anthony, Brendan Foster, and Zeeya Merali, eds. *It From Bit or Bit From It?: On Physics and Information*. Springer, 2015.
- 2015 Aguirre, Anthony, Brendan Foster, and Zeeya Merali, eds. *Questioning the Foundations of Physics: Which of Our Fundamental Assumptions are Wrong?*. Springer, 2015.
- 2014 Laughlin, G., Aguirre, A., & Grundfest, J. (2014). Information transmission between financial markets in Chicago and New York. *Financial Review*, 49(2), 283-312. PEER REVIEWED
- 2014 Wainwright, C. L., Johnson, M. C., Peiris, H. V., Aguirre, A., Lehner, L., & Liebling, S. L. (2014). Simulating the universe (s): from cosmic bubble collisions to cosmological observables with numerical relativity. *Journal of Cosmology and Astroparticle Physics*, 2014(03), 030. PEER REVIEWED
- 2014 Wainwright, C. L., Johnson, M. C., Aguirre, A., & Peiris, H. V. (2014). Simulating the universe (s) II: phenomenology of cosmic bubble collisions in full General Relativity. *Journal of Cosmology and Astroparticle Physics*, 2014(10), 024. PEER REVIEWED
- 2014 What Does Our Understanding of Time Suggest About the Nature of Reality?, Contribution to Big Questions Online INVITED
- 2013 Bertone, S., Aguirre, A., & Schaye, J. (2013). How the diffuse Universe cools. *Monthly Notices of the Royal Astronomical Society*, 430(4), 3292-3313. PEER REVIEWED
- 2013 Aguirre, A., & Kozaczuk, J. (2013). Multiple cosmic collisions and the microwave background power spectrum. *Physical Review D*, 87(2), 023506. PEER REVIEWED
- 2013 Aguirre, A., & Kehayias, J. (2013). Quantum instability of the emergent universe. *Physical Review D*, 88(10), 103504. PEER REVIEWED
- 2012 Aguirre, A., Carroll, S. M., & Johnson, M. C. (2012). Out of equilibrium: understanding cosmological evolution to lower-entropy states. *Journal of Cosmology and Astroparticle Physics*, 2012(02), 024. PEER REVIEWED
- 2012 Shen, S., Madau, P., Aguirre, A., Guedes, J., Mayer, L., & Wadsley, J. (2012). The Origin of Metals in the Circumgalactic Medium of Massive Galaxies at $z=3$. *The Astrophysical Journal*, 760(1), 50. PEER REVIEWED
- 2012 "Multiverse", Encyclopedia Britannica (2012) INVITED
- 2012 How Big is the Universe, Web piece to accompany BBC documentary
- 2011 Aguirre, A. (2011). Cosmological Intimations of Infinity. Anthony Aguirre, contribution to "Infinity: New Research Frontiers", Ed. Michael Heller and W. Hugh Woodin, Cambridge

- University Press, (2011) INVITED
- 2011 Next Step: Infinity. Aguirre, A., Contribution to M. Brockman (ed.): "Future Science: Essays from the Cutting Edge", Vintage Original, 2011 INVITED
- 2011 Aguirre, A., & Tegmark, M. (2011). Born in an infinite universe: a cosmological interpretation of quantum mechanics. *Physical Review D*, 84(10), 105002. PEER REVIEWED
- 2011 Aguirre, A., & Johnson, M. C. (2011). A status report on the observability of cosmic bubble collisions. *Reports on Progress in Physics*, 74(7), 074901. PEER REVIEWED
- 2010 Wiersma, R. P., Schaye, J., Dalla Vecchia, C., Booth, C. M., Theuns, T., & Aguirre, A. (2010). The enrichment history of cosmic metals. *Monthly Notices of the Royal Astronomical Society*, 409(1), 132-144. PEER REVIEWED
- 2010 Aguirre, A., Johnson, M. C., & Larfors, M. (2010). Runaway dilatonic domain walls. *Physical Review D*, 81(4), 043527. PEER REVIEWED
- 2009 Aguirre, A., Johnson, M. C., & Tysanner, M. (2009). Surviving the crash: assessing the aftermath of cosmic bubble collisions. *Physical Review D*, 79(12), 123514. PEER REVIEWED
- 2009 Spolyar, D., Freese, K., Gondolo, P., Aguirre, A., Bodenheimer, P., Sellwood, J. A., & Yoshida, N. (2009). Dark Stars: Dⁿ od och\ AA teruppst\ aa ndelse. *arXiv preprint arXiv:0901.4574*.
- 2009 Gondolo, P., Freese, K., Spolyar, D., Aguirre, A., Bodenheimer, P., Sellwood, J. A., & Yoshida, N. (2009). Dark Stars: Begynnelsen. *arXiv preprint arXiv:0901.4578*.
- 2008 Eternal Inflation, past and future. Aguirre, A. Contribution to R. Vaas (ed.): Beyond the Big Bang. Springer 2008; arXiv:0712.0571
- 2008 Aguirre, A., Dow-Hygelund, C., Schaye, J., & Theuns, T. (2008). Metallicity of the Intergalactic Medium Using Pixel Statistics. IV. Oxygen. *The Astrophysical Journal*, 689(2), 851. PEER REVIEWED
- 2008 Freese, K., Spolyar, D., & Aguirre, A. (2008). Dark matter capture in the first stars: a power source and limit on stellar mass. *Journal of Cosmology and Astroparticle Physics*, 2008(11), 014. PEER REVIEWED
- 2008 Aguirre, A., & Johnson, M. C. (2008). Towards observable signatures of other bubble universes. II. Exact solutions for thin-wall bubble collisions. *Physical Review D*, 77(12), 123536. PEER REVIEWED
- 2008 Aguirre, A. (2008). Dark matter in cosmology. *Dark Matter in the Universe*, 10, 9789812567185_0012. INVITED
- 2007 Bouché, N., Lehnert, M. D., Aguirre, A., Péroux, C., & Bergeron, J. (2007). The missing metals problem—III. How many metals are expelled from galaxies?. *Monthly Notices of the Royal Astronomical Society*, 378(2), 525-540. PEER REVIEWED
- 2007 Aguirre, A., Johnson, M. C., & Shomer, A. (2007). Towards observable signatures of other bubble universes. *Physical Review D*, 76(6), 063509. PEER REVIEWED
- 2007 Aguirre, A., Gratton, S., & Johnson, M. C. (2007). Hurdles for recent measures in eternal inflation. *Physical Review D*, 75(12), 123501. PEER REVIEWED
- 2007 Aguirre, A., Gratton, S., & Johnson, M. C. (2007). Measures on transitions for cosmology from eternal inflation. *Physical review letters*, 98(13), 131301. PEER REVIEWED
- 2007 Aguirre, A. (2007). Eternal Inflation, past and future. *arXiv preprint arXiv:0712.0571*.
- 2007 Aguirre, A., Schaye, J., Aguirre, A., & Schaye, J. (2007). How Did the IGM become Enriched?. *EAS Publications Series*, 24, 165-175.
- 2006 Aguirre, A., Johnson, M.C., Two Tunnels To Inflation., *Physical Review D* 73, 123529 PEER REVIEWED
- 2006 Tegmark, M., Aguirre, A., Rees, M., Wilczek, F., Dimensionless Constants, Cosmology And Other Dark Matters., *Physical Review D* 73, 023505 PEER REVIEWED
- 2006 A. Aguirre *Where Did it All Come From?*, Sky & Telescope, November 2006
- 2006 Aguirre, A. *On Making Predictions in a Multiverse: Conundrums, Dangers, and Coincidences*, Invited article for the book "Universe or Multiverse," Cambridge University Press INVITED
- 2006 Pieri, M. M., Schaye, J., & Aguirre, A. (2006). The spatial distribution of metals in the intergalactic medium. *The Astrophysical Journal*, 638(1), 45. PEER REVIEWED
- 2006 Aguirre, A., Banks, T., & Johnson, M. (2006). Regulating Eternal Inflation II: The Great

- Divide. *Journal of High Energy Physics*, 2006(08), 065. PEER REVIEWED
- 2005 Aguirre, A., Johnson, M.C., Dynamics And Instability Of False Vacuum Bubbles., *Physical Review D* 72, 103525 PEER REVIEWED
- 2005 Pieri, M. M., Schaye, J., Aguirre, A., The Spatial Distribution Of Metals In The Intergalactic Medium., *Astrophysical Journal* 638, 45-51 PEER REVIEWED
- 2005 Aguirre, A., Schaye, J., Hernquist, L., Kay, S., Springel, V., Theuns, T., Confronting Cosmological Simulations With Observations Of The Intergalactic Medium., *Astrophysical Journal* 620, L13-8 PEER REVIEWED
- 2005 Aguirre, A., Tegmark, M., Multiple Universes, Cosmic Coincidences, And Other Dark Matters., *JCAP* 2005-1, 3 PEER REVIEWED
- 2005 Schaye, J., & Aguirre, A. (2005). Abundances in the high-redshift Intergalactic Medium. *Proceedings of the International Astronomical Union*, 1(S228), 557-568.
- 2005 Schaye, J., & Aguirre, A. (2005). Abundances in the high-redshift Intergalactic Medium. *Proceedings of the International Astronomical Union*, 1(S228), 557-568.
- 2004 Aguirre, A., Schaye, J., Kim, T., Theuns, T., Rauch, M. Sargent, W. L.W., Metallicity of the Intergalactic Medium Using Pixel Statistics. III. Silicon., *Astrophysical Journal* 602, pp. 38-50 PEER REVIEWED
- 2004 Dark Matter in Cosmology, Aguirre, A., in Dark Matter in the Universe: Jerusalem Winter School for Theoretical Physics, by Jerusalem Winter School for Theoretical Physics 1986-87 Jerusalem, Piran, T., Weinberg, S., Bahcall, J., pp. 1 - 17 INVITED
- 2003 Schaye, J., Aguirre, A., Kim, T., Theuns, T., Rauch, M., Sargent, W.L.W., Metallicity of the Intergalactic Medium Using Pixel Statistics. II. The Distribution of Metals as Traced by C IV., *Astrophysical Journal* 596, pp. 768-796 PEER REVIEWED
- 2003 Aguirre, A., Gratton, S., Inflation Without A Beginning: A Null Boundary Proposal, *Physical Review D* 67083515, pp. 1-16 PEER REVIEWED
- 2003 Aguirre, A., Schaye, J., & Theuns, T. (2003). Recovering Intergalactic Metallicity Using Pixel Optical Depths. In *The IGM/Galaxy Connection* (pp. 243-248). Springer Netherlands.
- 2003 A. Aguirre, Alternatives to Dark Matter, Proceedings of IAU Symposium 220, Sydney, Australia, July 22 - 25, 2003
- 2002 A. Aguirre, J. Schaye, T. Theuns, Metallicity of the Intergalactic Medium Using Pixel Statistics: I. Method *Astrophysical Journal* 576, 1 PEER REVIEWED
- 2002 A. Aguirre, S. Gratton, Steady-State Eternal Inflation, *Physical Review D* 65, 083507 PEER REVIEWED
- 2002 2002, August A. Aguirre, Not a Bad Idea, *Scientific American* p. 36
- 2002 Enrichment of the High-Redshift IGM by Galactic Winds, ASP Conf. Ser. 253: Chemical Enrichment of Intracluster and Intergalactic Medium, pp. 381 - 393.
- 2001 A. Aguirre, Cold Big-Bang Cosmology as a Counter-example to Several Anthropic Arguments, *Physical Review D* 64, 083508 PEER REVIEWED
- 2001 A. Aguirre, J. Schaye, E. Quataert, Problems for MOND in Clusters and the Ly- α Forest, *Astrophysical Journal* 561, 550 PEER REVIEWED
- 2001 A. Aguirre, C. P. Burgess, A. Friedland, D. Nolte, Astrophysical Constraints on Modifying Gravity at Large Distances., *Classical and Quantum Gravity, Class. Quantum Grav.* 18, R223-R232 PEER REVIEWED
- 2001 A. Aguirre, L. Hernquist, J. Schaye, N. Katz, D. H. Weinberg, J. Gardner, Metal Enrichment of the Intergalactic Medium in Cosmological Simulations, *Astrophysical Journal* 561, 521 PEER REVIEWED
- 2001 A. Aguirre, L. Hernquist, N. Katz, J. Gardner, and D. Weinberg, Enrichment of the Intergalactic Medium by Radiation Pressure-Driven Dust Efflux, *Astrophysical Journal Letters* 556, L11 PEER REVIEWED
- 2001 A. Aguirre, J. Schaye, L. Hernquist, D. Weinberg, N. Katz, J. Gardner, Metal Enrichment of the Intergalactic Medium at $z = 3$ by Galactic Winds, *Astrophysical Journal* 560, 599 PEER REVIEWED
- 2001 Enrichment of the High-Redshift IGM by Galactic Winds, Aguirre, A., Schaye, J., Hernquist, L.,

- Weinberg, D., Katz, N., Gardner, J., Chemical Enrichment of Intracluster and Intergalactic Medium, Vulcano, Italy, ASP Conference Series, May 14 - 18
- 2000 R. Perna, A. Aguirre, Gamma-Ray Burst Afterglows as Probes of Galactic and Intergalactic Dust, *Astrophysical Journal* 543, 56 PEER REVIEWED
- 2000 A. Aguirre, The Cosmic Background Radiation in a Cold Big-Bang, *Astrophysical Journal* 533, p. 1-18 PEER REVIEWED
- 2000 A. Aguirre, On the Superradiance of Spin-1 Waves in an Equatorial Wedge around a Kerr Hole, *Astrophysical Journal Letters* 529, L9 PEER REVIEWED
- 2000 A. Aguirre, Z. Haiman, Cosmological Constant or Intergalactic Dust? Constraints from the Cosmic Far Infrared Background, *Astrophysical Journal* 532, 28 PEER REVIEWED
- 2000 Intergalactic Dust and Observations of Type Ia Supernovae, Aguirre, A., Energy Densities in the Universe, XVth Rencontres de Moriond, Les Arcs, France, Viet Nam: Thê' Giói publishers, ed. Reza Ansari, Yannick Giraud-Iteraud, Jean Trần Thanh Vân. January 22 - 29.
- 1999 A. Aguirre, Intergalactic Dust and Observations of Type Ia Supernovae, *Astrophysical Journal* 525, 583 PEER REVIEWED
- 1999 A. Aguirre, Cold Big-Bang Nucleogenesis, *Astrophysical Journal* 521, p. 17-29
- 1999 A. Aguirre, Dust Versus Cosmic Acceleration, *Astrophysical Journal Letters* 512, L19 PEER REVIEWED
- 1995 A. Aguirre, R. Brandenberger, Accretion Of Hot Dark Matter Onto Slowly Moving Cosmic Strings, *International Journal of Modern Physics D* 4, 711
- 1994 D. Balamuth et al., Importance Of Nuclear Effects In The Dissociation Of ${}^6\text{He}$ And ${}^6\text{Li}$ At $E/A=85$ Mev, *Physical Review Letters* 72, 2355 PEER REVIEWED
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