# Ken D. Olum

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## EDUCATION

**Ph.D.** June 1997
Center for Theoretical Physics
Massachusetts Institute of Technology
Advisor: Alan H. Guth
Thesis: "Vacuum-Bounded States and the Entropy of Black-Hole Evaporation"

**B.S.**, with distinction June 1982
Department of Mathematics
Stanford University

## HONORS

Lockett Memorial Award for excellence in theoretical physics at MIT. 1995

Putnam Mathematics Competition: Ninth overall. 1982

## GRANTS

NSF #0457456 2005–2008
"Ultra-high-energy cosmic rays from topological defects"

FQXi #RFP1-06-024 2006–2008
"Does General Relativity Permit Exotic Phenomena?"

## EXPERIENCE

**Research Associate Professor** 2007–present
**Research Assistant Professor** 2001–2007
**Research Associate** 1997–2001
Tufts Institute of Cosmology

*Research*: Cosmic strings, ultra-high-energy cosmic rays, negative energies in quantum field theory, energy conditions and exotic phenomena in general relativity, anthropic reasoning, other issues in cosmology.
*Teaching*: "Wanderers in Space" (Astronomy for non-science majors), summer 1999 and fall 2001. "Galaxies and the Universe", spring 2000.
*Outreach*: Guest teacher in high school and middle school classes as part of the NSF-sponsored "Physics Theory Net" program.

**Research Assistant** 1992–1997
MIT Center for Theoretical Physics

*Research*: Study of black-hole entropy and closed timelike curves.
*Outreach*: Lectured to high-school and junior-high students, one weekend each year from 1990 to 1996, as part of the "Splash" program. Topics included "Introduction to Special Relativity" and "How to Build a Time Machine".

**Computer Programmer** 1982–1990
Lucid, Inc. and Schlumberger Ltd.

Systems programming and software development.

## PUBLICATIONS AND PRESENTATIONS

### Publications pending

J. J. Blanco-Pillado and Ken D. Olum, "Monopole annihilation in cosmic necklaces," arXiv:0707.3460 [astro-ph]

### Refereed journal articles

J. J. Blanco-Pillado, Ken D. Olum and Alexander Vilenkin, "Cosmic string formation by flux trapping," Phys. Rev. D **76**, 103520 (2007)

Noah Graham and Ken D. Olum, "Achronal averaged null energy condition," Phys. Rev. D **76**, 064001 (2007)

Ken D. Olum and Delia Schwartz-Perlov, "Anthropic prediction in a large toy landscape," JCAP **0710**, 010 (2007)

Ken D. Olum and Vitaly Vanchurin, "Cosmic string loops in the expanding universe," Phys. Rev. D **75**, 063521 (2007)

Christopher J. Fewster, Ken D. Olum and Michael J. Pfenning, "Averaged null energy condition in spacetimes with boundaries," Phys. Rev. D **75**, 025007 (2007)

Ken D. Olum and Alexander Vilenkin, "Reionization from cosmic string loops," Phys. Rev. D **74**, 063516 (2006)

Vitaly Vanchurin, Ken D. Olum and Alexander Vilenkin, "Scaling of cosmic string loops," Phys. Rev. D **74**, 063527 (2006)

Vitaly Vanchurin, Ken Olum and Alexander Vilenkin, "Cosmic string scaling in flat space", Phys. Rev. D **72**, 065514 (2005)

Delia Schwartz-Perlov and Ken D. Olum, "Energy conditions for a generally coupled scalar field outside a reflecting sphere", Phys. Rev. D **72**, 065013 (2005)

Noah Graham and Ken D. Olum, "Plate with a hole obeys the averaged null energy condition", Phys. Rev. D **72**, 025013 (2005)

Ken D. Olum and Allen Everett, "Can a circulating light beam produce a time machine?", Found. Phys. Lett. **18**, 379 (2005)

Noah Graham, Ken D. Olum and Delia Schwartz-Perlov, "Energy conditions outside a dielectric ball", Phys. Rev. D **70**, 105019 (2004)

Christian Stephan-Otto, Ken D. Olum and Xavier Siemens "Cosmological stretching of perturbations on a cosmic string", JCAP **0405**, 003 (2004)

Joshua Knobe, Ken D. Olum and Alexander Vilenkin, "Philosophical implications of inflationary cosmology", physics/0302071, British Journal for the Philosophy of Science **57**, 47-67 (2006)

Xavier Siemens and Ken D. Olum, "Cosmic string cusps with small-scale structure: Their forms and gravitational waveforms", Phys. Rev. D **68**, 085017 (2003)

Delia Schwartz-Perlov and Ken D. Olum, "Null energy conditions outside a background potential", Phys. Rev. D **68**, 065016 (2003)

"Conflict between anthropic reasoning and observation", Ken D. Olum, ANALYSIS **64**, 1 (2004), gr-qc/0303070

"Negative energy densities in quantum field theory with a background potential", Noah Graham and Ken D. Olum, Phys. Rev. D **67**, 085014 (2003)

"Static negative energies near a domain wall", Ken D. Olum and Noah Graham, Phys. Lett. B **554**, 175 (2003)

"On the size of the smallest scales in cosmic string networks", Xavier Siemens, Ken D. Olum, and Alexander Vilenkin, Phys. Rev. D **66**, 043501 (2002)

"Quantum tunneling of superconducting string currents", Jose J. Blanco-Pillado, Ken D. Olum, Alexander Vilenkin, Phys. Rev. D **66**, 023506 (2002)

"Chiral superconducting strings and Nambu-Goto strings in arbitrary dimensions", Xavier Siemens and Ken D. Olum, J. Math. Phys. 43, 4819 (2002)

"Gravitational radiation and the small-scale structure of cosmic strings", Xavier Siemens and Ken D. Olum, Nucl. Phys. B **611**, 125 (2001)

"The doomsday argument and the number of possible observers", Ken D. Olum, Philosophical Quarterly **52**, 164 (2002), gr-qc/0009081

"A vorton gun", Ken D. Olum, J. J. Blanco-Pillado, Xavier Siemens, Nucl. Phys. B **599**, 446 (2001)

"Dynamics of superconducting strings with chiral currents", J.J. Blanco-Pillado, Ken D. Olum, A. Vilenkin, Phys. Rev. D **63**, 103513, 2001

"Electromagnetic radiation from superconducting string cusps", J. J. Blanco-Pillado, Ken D. Olum, Nucl. Phys. B **599**, 435 (2001)

"Dynamics of Cosmic Necklaces", Xavier Siemens, Xavier Martin, Ken D. Olum, Nucl. Phys. B **595**, 402 (2001)

"Eternal inflation, black holes, and the future of civilizations", J. Garriga, V. F. Mukhanov, K. D. Olum and A. Vilenkin, Int. J. Theor. Phys. **39**, 1887 (2000)

"Radiation from cosmic string standing waves", Ken D. Olum, J. J. Blanco-Pillado, Phys. Rev. Lett. **84**, 4288 (2000).

"The Ori-Soen time machine", Ken D. Olum, Phys. Rev. D **61**, 124022 (2000).

"Monopole-antimonopole bound states as a source of ultra-high-energy cosmic rays", J.J. Blanco-Pillado, Ken D. Olum, Phys. Rev. D **60**, 083001 (1999).

"Field theory simulation of Abelian-Higgs cosmic string cusps", Ken D. Olum, J. J. Blanco-Pillado Phys. Rev. D **60**, 023503 (1999)

"The form of cosmic string cusps", J. J. Blanco-Pillado, Ken D. Olum, Phys. Rev. D **59**, 063508 (1999).

"Superluminal travel requires negative energies", Ken D. Olum, Phys. Rev. Lett. **81**, 3567 (1998).

"Entropy of very low-energy localized states", Ken D. Olum, Phys. Rev. D **57**, 2486 (1998).

"Entropy of localized states and black hole evaporation", Ken D. Olum, Phys. Rev. D **55**, 6168 (1997).

"Energy momentum restrictions on the creation of Gott time machines", Sean M. Carroll, Edward Farhi, Alan H. Guth, Ken D. Olum, Phys. Rev. D **50**, 6190 (1994).

**Conference presentations**

"Cosmic strings on and off the lattice", Classical Field Theory & Solitons, Cambridge, UK, June 5, 2006

"Cosmic string scaling in flat space", Cosmic Strings and Fundamental Strings, Paris, September 27, 2005.

"Ultra-high-energy cosmic rays from relic topological defects", in *Relativistic Astrophysics: 20th Texas Symposium,* J. Craig Wheeler and Hugo Martel, editors (AIP, New York, 2001).

"The Ori-Soen time machine", Third Eastern Gravity Meeting, Ithaca, NY, March 26, 1999.

"Faster-than-light travel requires negative energies", Eighth Midwest Relativity Meeting, Fargo, ND, September 25, 1998.

**Software**

Contributor to *Numerical Recipes: The Art of Scientific Computing, Code CDROM v 2.06* (Cambridge University Press, 1996)