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 #1213930 2012–2015
"Cosmic String Simulation and Analysis"

FQXi #RFP3-10104 2011–2013
"Does general relativity permit time travel?"

NSF #0903889 2009–2012
"Large Parallel Cosmic String Simulation"

FQXi #RFP2-08-23 2008–2010
"Does general relativity permit exotic phenomena?"

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 Professor 2011–present
Research Associate Professor 2007–2011
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

Ken D. Olum, “Does general relativity permit superluminal travel?”, JBIS **68**, 214 (2015)

E. A. Kontou and K. D. Olum, “Proof of the averaged null energy condition in a classical curved spacetime using a null-projected quantum inequality,” Phys. Rev. D **92**, 124009 (2015)

J. J. Blanco-Pillado, K. D. Olum and B. Shlaer, “Cosmic string loop shapes,” Phys. Rev. D **92**, 063528 (2015)

E. A. Kontou and K. D. Olum, “Quantum inequality in spacetimes with small curvature,” Phys. Rev. D **91**, 104005 (2015)

Jeremy M. Wachter and Ken D. Olum, “Electromagnetic back-reaction from currents on a straight string,” Phys. Rev. D **90**, 023510 (2014)

J J. Blanco-Pillado, Ken D. Olum and Benjamin Shlaer, “The number of cosmic string loops,”, Phys. Rev. D **89**, 023512 (2014)

Ken D. Olum, Evan Pierce and Xavier Siemens, “Detectability of gravitational effects of supernova neutrino emission through pulsar timing,” Phys. Rev. D **88**, 043005 (2013)

Mike D. Schneider and Ken D. Olum, “Anomalous Observers in the Subjectively Identical Reference Class,” arXiv:1304.2625

Elena-Alexandra Kontou and Ken D. Olum, “Multi-step Fermi normal coordinates,” Class. Quant. Grav. 30 175018 (2013)

Elena-Alexandra Kontou and Ken D. Olum, “Averaged null energy condition in a classical curved background,” Phys. Rev. **D 87**, 064009 (2013)

Ken D. Olum, “Is there any coherent measure for eternal inflation?,” Phys. Rev. D **86**, 063509 (2012)

J. J. Blanco-Pillado, Ken D. Olum, Benjamin Shlaer, “A new parallel simulation technique,” J. Comput. Phys. **231**, 98-108 (2012)

J. J. Blanco-Pillado, Ken D. Olum, Benjamin Shlaer, “Large parallel cosmic string simulations: New results on loop production,” Phys. Rev. D **83**, 083514 (2011)

Ken D. Olum, "Geodesics in the static Mallett spacetime," Phys. Rev. D **81**, 127501 (2010)

Douglas Urban, Ken D. Olum, "Spacetime averaged null energy condition," Phys. Rev. D **81**, 124004 (2010)

J. J. Blanco-Pillado and Ken D. Olum, "Monopole annihilation in cosmic necklaces," JCAP **1005**, 014 (2010)

Douglas Urban and Ken D. Olum, "Averaged null energy condition violation in a conformally flat spacetime," Phys. Rev. D **81**, 024039 (2010)

Veniamin Berezinsky, Ken D. Olum, Eray Sabancilar and Alexander Vilenkin, "UHE neutrinos from superconducting cosmic strings," Phys. Rev. D **80**, 023014 (2009)

Matthew Davenport and Ken D. Olum, 'Are there Boltzmann brains in the vacuum?", arxiv:1008.0808

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)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Conference proceedings

"Does general relativity permit superluminal travel?", talk given at the "100 Year Starship Study Public Symposium", Orlando, FL, 10/1/11, submitted to J. British Interplanetary Soc.

"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).

Software

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