

Contact Data

Full Name:	Vishnumohan Jejjala	
Address:	School of Physics University of the Witwatersrand Johannesburg, WITS 2050 South Africa	Phone: +27 (0)11 717 6959 FAX: +27 (0)11 717 6879 E-mail: vishnu@neo.phys.wits.ac.za vishnu.jejjala@gmail.com

Current Position

DST/NRF South Africa Research Chair in Theoretical Particle Cosmology

Associate Professor, Centre for Theoretical Physics, School of Physics, University of the Witwatersrand
Appointment start date: 11 October 2011

Education & Research Experience

October 2009 – September 2011: **Queen Mary, University of London**
Postdoctoral Associate, Centre for Research in String Theory, School of Physics and Astronomy

October 2007 – September 2009: **Institut des Hautes Études Scientifiques**
Postdoctoral Associate, Theoretical Physics Division

October 2004 – September 2007: **Durham University**
Postdoctoral Associate, Centre for Particle Theory, Department of Mathematical Sciences

August 2002 – August 2004: **Virginia Polytechnic Institute and State University**
Postdoctoral Associate, Institute for Particle Physics and Astrophysics, Physics Department

August 1996 – August 2002: **University of Illinois at Urbana-Champaign**
Graduate Student, High Energy Physics Group, Department of Physics
Thesis Advisor: Robert G. Leigh
Doctor of Philosophy in Physics, received 15 October 2002
Master of Science in Physics, received 12 May 2002
Ph.D. Thesis: *Topics in String Theory*, defended 6 May 2002

August 1992 – May 1996: **University of Maryland at College Park**
Bachelor of Science in Physics, received 23 May 1996
Bachelor of Science in Mathematics, received 23 May 1996
Bachelor of Science in Astronomy, received 23 May 1996
University Honors Program, *cum laude*, Phi Beta Kappa
Undergraduate Research with the Condensed Matter Theory Group
Research Supervisor: Sankar Das Sarma

Awards & Honors

- B Rated Scientist, National Research Foundation, South Africa
 - Member, South African Young Academy of Sciences
 - Senior Investigator on NSF grant CCF-1048082, 'CiC (SEA-EAGER): A String Cartography,' \$250,000 for using cloud computing to apply algorithmic algebraic geometry to study the vacuum geometry of quantum field theories, 2010–2013
 - Honorable mention, 2004, 2005, 2009, 2010 Gravity Research Foundation Essay Competitions
 - Fourth Prize, 2003 Gravity Research Foundation Essay Competition
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Recent Conferences & Workshops

- Quantum Aspects of Black Holes workshop, Sogang University, Seoul, 2013 (speaker)
- Miami 2011, 2012 (speaker)
- Branes in String and M-theory workshop, Newton Institute, Cambridge, 2012
- Simons Workshop in Mathematics and Physics, Stony Brook University, 2008, 2009, 2010, 2011
- String Vacuum Project Meeting, University of Pennsylvania, 2011
- AdS/CMT workshop, Galileo Galilei Institute, Florence, 2010
- QFT, String Theory, Mathematical Physics workshop, KITP China, Beijing and Zhejiang University, Hangzhou, 2010 (speaker)
- Joburg Workshop on String Theory, University of the Witwatersrand, Johannesburg, 2010 (speaker)
- Spring School on Superstring Theory, ICTP, Trieste, 2008, 2010
- Strings and Higher Dimensions workshop, Benasque, 2009
- Strings at IHÉS meeting, IHÉS, 2009 (speaker)
- Winter School on Supergravity, Strings, and Gauge Theories, CERN, 2009
- Gravitational Thermodynamics workshop, ICMS, Edinburgh, 2008 (speaker)
- Strong Fields, Integrability, and Strings workshop, Newton Institute, Cambridge, 2007 (speaker)

Recent Invited Talks

- **“Cosmology and Calabi–Yau Compactifications”**
University of Pretoria (25/9/2013).
- **“Scanning for Swiss Cheese Calabi–Yau Threefolds”**
University of Miami (14/12/2012); Queen Mary, University of London (24/4/2013); Imperial College (29/4/2013).
- **“Black Hole Microstates”**
National Institute for Theoretical Physics, Stellenbosch (14/9/2012); Sogang University (7/1/2013).
- **“Quantum Field Theories and Children’s Drawings”**
Imperial College (2/2/2011); Nordita (21/2/2011); University of Edinburgh (11/5/2011); University of Miami (18/12/2011); École Normale Supérieure de Paris (30/1/2012); Durham University (10/2/2012), University of Cape Town (10/10/2012).
- **“Cardy & Kerr”**
Northeastern University (22/10/2009); Oxford University (20/11/2009); University of the Witwatersrand (26/4/2010); Hangzhou University (14/7/2010); University of Cape Town (7/12/2011).
- **“The Atoms of Spacetime”**
IHÉS, Bures-sur-Yvette (4/3/2009).
- **“The World as String and Representation”**
IHP, Paris (14/4/2009).
- **“SQCD: A Geometric Aperçu”**
IHP, Paris (17/4/2008); Helsinki Institute of Physics (16/5/2008); Virginia Tech (16/7/2008).
- **“Entropy of Non-extremal Black Holes in AdS₅”**
Newton Institute, Cambridge (3/9/2007); LPTHE, Jussieu, Paris VI (27/11/2007); IHÉS, Bures-sur-Yvette (10/3/2008); ICMS, Edinburgh (16/6/2008).

Professional Affiliations

- Associate, National Institute for Theoretical Physics, South Africa
- Member, String Vacuum Project

Teaching History

- Undergraduate Courses at the University of the Witwatersrand
Cosmology for fourth year honors students: 3rd and 4th teaching blocks 2012, 2013.
- Postgraduate Lectures at the University of the Witwatersrand
Lectures on AdS/CFT for Masters and Ph.D. students: 2013.
Lectures on string theory for Ph.D. students: 2012.
Lectures on Calabi–Yau manifolds for Ph.D. students: 2011, 2012.
- African Institute for Mathematical Sciences, Cameroon
Cosmology: January 2014.
- African Institute for Mathematical Sciences, Senegal
Statistical Physics: March–April 2014.
Quantum Mechanics: February–March 2013.
- Undergraduate Courses at Durham University
Tutor, Single Mathematics A: Epiphany/Easter 2005.
Tutor, Single Mathematics B: Michelmas 2005, 2006, Epiphany/Easter 2006, 2007.
- Undergraduate Courses at Virginia Tech
Substitute Lecturer, Physics 4674: Introduction to General Relativity: Spring 2004.
- Postgraduate Courses at Virginia Tech
Substitute Lecturer, Physics 5504: Nuclear and Particle Physics: Fall 2003.
Substitute Lecturer, Physics 6675-6676: General Relativity and Cosmology: Fall 2002, Spring 2003.
- Undergraduate Courses at University of Illinois
Teaching Assistant, Physics 107: Electricity and Magnetism: Fall 1996.
Teaching Assistant, Physics 111: Mechanics: Spring 1997.
Teaching Assistant, Physics 113: Fluids and Thermal Physics: Summer 1998.
Teaching Assistant/Substitute Lecturer, Physics/Philosophy 319: Space, Time, and Matter: Fall 1997, 1998, 1999, 2000, 2001, Spring 1999.
- Postgraduate Courses at University of Illinois
Teaching Assistant, Physics 475: Particle Physics: Spring 2000.
Teaching Assistant, Physics 498: Geometry of Quantum Field Theories: Spring 2002.
- Undergraduate Courses at University of Maryland
Strauss Undergraduate Teaching Fellow, Mathematics 140: Calculus I: Fall 1995.
Strauss Undergraduate Teaching Fellow, Mathematics 141: Calculus II: Spring 1996.

Honors & Postgraduate Supervisions

1. Mr. Lwazi Nkumane, Honors project student, 2013
 2. Mr. Kodjo Mawoussi, Essay supervision, AIMS-Senegal, 2013
 3. Mr. Simon D. Moolman, M.Sc. student, 2012–2013
 4. Mr. Gilad Amar, Honors project student, 2012
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Service Activities

- Member, Executive Committee, School of Physics, University of the Witwatersrand (2013–present)
 - External Examiner, Cosmology (2013), Differential Geometry (2013), Department of Mathematics and Applied Mathematics, University of Cape Town
 - Referee for National Research Foundation, South Africa
 - Referee for *Journal of High Energy Physics*, *Classical and Quantum Gravity*, *Journal of Physics A*, *Advances in High Energy Physics*, *Entropy*, *International Journal of Modern Physics D*
 - Member of editorial board, *Frontiers in Mathematical Physics*
 - Co-organizer, Johannesburg School and Workshop on String Theory (2013)
 - Thesis examiner for Mr. Christopher Mathwin (2013)
 - Journal club organizer, University of the Witwatersrand (2011–present)
 - Seminar organizer for Centre for Research in String Theory, Queen Mary, University of London (2009–2010)
 - Seminar organizer for Centre for Particle Theory, Durham University (2005–2006)
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The custom in high-energy physics is to list authors alphabetically. There is no lead author. All members of a collaboration have made significant contributions to the work.

1. **“Entanglement entropy of extremal BTZ”**
(with P. Caputa, H. Soltanpanahi)
arXiv:1309.7852 [hep-th].
2. **“Necessary conditions on Calabi–Yau manifolds for large volume vacua”**
(with J. Gray, Y.-H. He, B. Jurke, B. Nelson, and J. Simón)
Phys. Rev. D, **86**, 10190 (2012), arXiv:1207.5801 [hep-th].
3. **“Brane geometry and dimer models”**
(with Y.-H. He and D. Rodriguez-Gomez)
JHEP, **1206**, 143 (2012), arXiv:1204.1065 [hep-th].
4. **“Modeling time’s arrow”**
(with M. Kavic, D. Minic, and C.-H. Tze)
Invited Review.
Entropy, **14**, 614 (2012), arXiv:1203.4575 [hep-th].
5. **“Invariants of toric Seiberg duality”**
(with A. Hanany, Y.-H. He, J. Pasukonis, S. Ramgoolam, and D. Rodriguez-Gomez)
Int. J. Mod. Phys. A, **27**, 1250002 (2012), arXiv:1107.4101 [hep-th].
6. **“Calabi–Yau orbifolds and torus coverings”**
(with A. Hanany, S. Ramgoolam, and R.-K. Seong)
JHEP, **1109**, 116 (2011), arXiv:1105.3471 [hep-th].
7. **“The beta ansatz: A tale of two complex structures”**
(with A. Hanany, Y.-H. He, J. Pasukonis, S. Ramgoolam, and D. Rodriguez-Gomez)
JHEP, **1106**, 056 (2011), arXiv:1104.5490 [hep-th].
8. **“Toric CFTs, permutation triples, and Belyi pairs”**
(with S. Ramgoolam and D. Rodriguez-Gomez)
JHEP, **1103**, 065 (2011), arXiv:1012.2351 [hep-th].
9. **“Quantum gravity and turbulence”**
(with D. Minic, Y. J. Ng, and C.-H. Tze)
Honorable Mention in 2010 Gravity Research Foundation Essay Competition.
Int. J. Mod. Phys. D, **19**, 2311 (2010), arXiv:1005.3254 [gr-qc].
10. **“On the physics of the Riemann zeros”**
(with Y.-H. He and D. Minic)
arXiv:1004.1172 [hep-th], to appear in the Proceedings of 6th International Symposium on Quantum Theory and Symmetries (QTS6), Lexington, Kentucky, 20–25 July 2009.
11. **“String theory and turbulence”**
(with D. Minic, Y. J. Ng, and C.-H. Tze)
Mod. Phys. Lett. A, **25**, 2541 (2010), arXiv:0912.2725 [hep-th].

12. **“Cardy and Kerr”**
(with S. Nampuri)
JHEP, **1002**, 088 (2010), arXiv:0909.1110 [hep-th].
13. **“The Big Bang as the ultimate traffic jam”**
(with M. Kavic, D. Minic, and C.-H. Tze)
Honorable Mention in 2009 Gravity Research Foundation Essay Competition.
Int. J. Mod. Phys. D, **18**, 2257 (2009), arXiv:0905.2992 [gr-qc].
14. **“Eigenvalue density, Li’s positivity, and the critical strip”**
(with Y.-H. He and D. Minic)
arXiv:0903.4321 [math-ph], submitted to *Adv. Theor. Math. Phys.*
15. **“Turbulence and holography”**
(with D. Minic, Y. J. Ng, and C.-H. Tze)
Class. Quant. Grav., **25**, 225012 (2008), arXiv:0806.0030 [hep-th].
16. **“On the origin of time and the Universe”**
(with M. Kavic, D. Minic, and C.-H. Tze)
Int. J. Mod. Phys. A, **25**, 2515 (2010), arXiv:0804.3598 [hep-th].
17. **“SQCD: A geometric aperçu”**
(with J. Gray, A. Hanany, Y.-H. He, and N. Mekareeya)
JHEP, **0805**, 099 (2008), arXiv:0803.4257 [hep-th].
18. **“Entropy of near-extremal black holes in AdS₅”**
(with V. Balasubramanian, J. de Boer, and J. Simón)
JHEP, **0805**, 067 (2008), arXiv:0707.3601 [hep-th].
19. **“Time and M-theory”**
(with M. Kavic and D. Minic)
Invited Review.
Int. J. Mod. Phys. A, **22**, 3317 (2007), arXiv:0706.2252 [hep-th].
20. **“Fine structure of dark energy and new physics”**
(with M. Kavic and D. Minic)
Adv. High Energy Phys., **2007**, 21586 (2007), arXiv:0705.4581 [hep-th].
21. **“Why there is something so close to nothing: Towards a fundamental theory of the cosmological constant”**
(with D. Minic)
Int. J. Mod. Phys. A, **22**, 1797 (2007), arXiv:hep-th/0605105.
22. **“Exploring the vacuum geometry of $\mathcal{N} = 1$ gauge theories”**
(with J. Gray, Y.-H. He, and B. D. Nelson)
Nucl. Phys. B, **750**, 1 (2006), arXiv:hep-th/0604208.
23. **“Vacuum geometry and the search for new physics”**
(with J. Gray, Y.-H. He, and B. D. Nelson)
Phys. Lett. B, **638**, 253 (2006), arXiv:hep-th/0511062.
24. **“The Library of Babel: On the origin of gravitational thermodynamics”**
(with V. Balasubramanian, J. de Boer, and J. Simón)
JHEP, **0512**, 006 (2005), arXiv:hep-th/0508023.

25. **“The Library of Babel”**
(with V. Balasubramanian and J. Simón)
Honorable Mention in 2005 Gravity Research Foundation Essay Competition.
Int. J. Mod. Phys. D, **14**, 2181 (2005), arXiv:hep-th/0505123.
26. **“Non-supersymmetric smooth geometries and D1-D5-P bound states”**
(with O. Madden, S. F. Ross, and G. Titchener)
Phys. Rev. D, **71**, 124030 (2005), arXiv:hep-th/0504181.
27. **“Alpha-states in de Sitter space”**
(with J. de Boer and D. Minic)
Phys. Rev. D, **71**, 044013 (2005), arXiv:hep-th/0406217.
28. **“Toward a background independent quantum theory of gravity,”**
(with D. Minic and C. H. Tze)
Honorable Mention in 2004 Gravity Research Foundation Essay Competition.
Int. J. Mod. Phys. D, **13**, 2307 (2004), arXiv:gr-qc/0406037.
29. **“Modular matrix models”**
(with Y.-H. He)
arXiv:hep-th/0307293.
30. **“Deconstructing the cosmological constant”**
(with R. G. Leigh and D. Minic)
Fourth Prize in 2003 Gravity Research Foundation Essay Competition.
Gen. Rel. Grav., **35**, 2089 (2003), arXiv:gr-qc/0305072.
31. **“Deconstruction and holography”**
(with R. G. Leigh and D. Minic)
J. Cosmol. Astropart. Phys., **0306**, 002 (2003), arXiv:hep-th/0302230.
32. **“Multi-trace superpotentials vs. Matrix models”**
(with V. Balasubramanian, J. de Boer, B. Feng, Y.-H. He, M.-x. Huang, and A. Naqvi)
Commun. Math. Phys., **242**, 361 (2003), arXiv:hep-th/0212082.
33. **“The cosmological constant and the deconstruction of gravity”**
(with R. G. Leigh and D. Minic)
Phys. Lett. B, **556**, 71 (2003), arXiv:hep-th/0212057.
34. **“Non-commutative Chern–Simons for the quantum Hall system and duality”**
(with E. Fradkin and R. G. Leigh)
Nucl. Phys. B, **642**, 483 (2002), arXiv:cond-mat/0205653.
35. **“The Standard Model on a D-brane”**
(with D. Berenstein and R. G. Leigh)
Phys. Rev. Lett., **88**, 071602 (2002), arXiv:hep-ph/0105042.
36. **“D-branes on singularities: New quivers from old”**
(with D. Berenstein and R. G. Leigh)
Phys. Rev. D, **64**, 046011 (2001), arXiv:hep-th/0012050.
37. **“Non-commutative moduli spaces, dielectric tori, and T-duality”**
(with D. Berenstein and R. G. Leigh)
Phys. Lett. B, **493**, 162 (2000), arXiv:hep-th/0006168.

38. **“Marginal and relevant deformations of $\mathcal{N} = 4$ field theories and non-commutative moduli spaces of vacua”**
(with D. Berenstein and R. G. Leigh)
Nucl. Phys. B, **589**, 196 (2000), [arXiv:hep-th/0005087](#).
39. **“Far from equilibrium nonconserved growth under a surface diffusion bias”**
(with S. Das Sarma and C. J. Lanczycki)
Phys. Rev. E, **54**, 4755 (1996).