Adam D. Helfer
curriculum vitae

Address

Department of Mathematics
University of Missouri – Columbia
Columbia, Missouri 65211
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Education

St. Cross College, Oxford University, 1982–1984

Balliol College, Oxford University, 1980–1982

Washington University, St. Louis, Missouri, 1976–1979

Degrees

D. Phil. in Mathematics, Oxford University, 1986
Thesis: A New Approach to Curved Twistor Spaces
Supervisor: Roger Penrose

A. B. in Mathematics and Physics, Washington University, 1979

Prizes and Scholarships

Fourth Prize, FQXI Essay Contest on The Nature of Time, 2009

Honorable Mention, Gravity Research Foundation Essay Competition, 2009

Honorable Mention, Gravity Research Foundation Essay Competition, 2004

Honorable Mention, Gravity Research Foundation Essay Competition, 1999

Honorable Mention, Gravity Research Foundation Essay Competition, 1998

Honorable Mention, Gravity Research Foundation Essay Competition, 1995

(This is an annual international essay competition, whose past winners include most of the luminaries in the field.)

Rhodes Scholar, Oxford University, 1980–1983

Graduate Scholar of St. Cross College, Oxford, 1982–1984

Arthur Holly Compton Fellow in Natural Sciences and Mathematics (full tuition plus stipend), Washington University, 1976–1979

Employment

Professor, Department of Mathematics, University of Missouri, Columbia, 2003–present

Associate Professor, Department of Mathematics, University of Missouri, Columbia, 1994–2003

Assistant Professor, Department of Mathematics, University of Missouri, Columbia, 1989–1994

Visiting Assistant Professor, Department of Mathematics and Statistics, University of Minnesota, Duluth, 1988–1989

Visiting Assistant Professor, Department of Mathematics, University of Michigan, Ann Arbor, 1987–1988

Visiting Lecturer, Department of Mathematics and Statistics, University of Pittsburgh, 1986–1987

Visiting Instructor, Department of Mathematics and Statistics, University of Pittsburgh, 1984–1986

Post-Doctoral Researcher in Relativity, Department of Physics and Astronomy, University of Pittsburgh, Spring 1985

Teaching Assistant in Graduate Mathematical Physics, Department of Physics and Astronomy, Washington University, Fall 1979

Research Assistant in Hot Atom Chemistry, Department of Chemistry, Washington University, 1977–1979

Reviewing and Refereeing

Reviewer for Mathematical Reviews (inactive)

Referee for Naturwissenschaften

Reviwer for International Journal of Modern Physics D

Referee for New Journal of Physics

Referee for Journal of Physics A

Referee for Classical and Quantum Gravity

Referee for General Relativity and Gravitation

Referee for Physics Letters A

Referee for the Proceedings of the Royal Society

Referee for the Journal of Mathematical Physics

Referee for Speculations in Science and Technology

Referee for Foundations of Physics

Member of the Pennsylvania Selection Committee for Rhodes Scholarships, 1984–1986

Referee for NSF proposals in Gravitational Physics, 1988–1989

Referee for NSF proposals in Geometric Analysis, 1994

Graduate Committees

Ph. D. Exam Committee for Nicholas Okamoto, 2012

Doctoral Committee for Stephanie Kartalopoulos, 2011

Master's Committee for Matthew Sealy, 2011

Doctoral Committee for Zhiyong Shen, 2011

Master's project supervisor for Brock Schmutzler, 2010

Master's project supervisor for Victor Soria, 2010

Doctoral Program Committee for Kevin Easley (student of John Beem), 1991

Doctoral Committee for Ken Littrell (student of Sam Werner, Physics Dept., UMC), 1991

Preliminary Doctoral Committee for Wang Zhao (student of A. Sherif El–Gizawy, Mechanical and Aerospace Engineering, UMC), 1991

Preliminary Doctoral Committee for Andriambola Robdera (student of Paulette Saab, Mathematics Dept., UMC), 1991

Doctoral Program Committee for T.T. Ton (student of John Beem), 1993

Doctoral Program Committee for Jaedong Choi (Student of John Beem)

Doctoral Program Committee for Andres Avila (student of Mark Ashbaugh)

Doctoral Program Committee for Bulent Unal (student of John Beem)

Master's Committee for Vikram Venkatasubramanian (student of Bill Plummer, Computer Science)

Master's Committee for Shannon Blunt (student of Dominic Ho, Electrical Engineering)

Master's Committee for Amit Kathuria (EE)

Comprehensive Committee for Oksana Bihun

Ph. D. Committee for Michael Heitzman

Ph. D. Committee for Pavel Korobkov (Physics)

Ph. D. Committee for Kane Nashimoto (Statistics)

Ph. D. Committee for Igor Vlasov (Physics)

Ph. D. Committee for Basil McHunu (Physics)

Ph. D. Supervisor for Andrew Lang, 1995–1998

Department Committees

Scheduling Committee, Mathematics Dept., 1991–1992

Masters and Qualifying Committee, 1991–1992

MST Committee, 1992–1993

Curriculum Committee, 1992–1994, 2003–2004

Recruitment Committee, 1991

Undergraduate Research Project Coordinator, 1991–1999

Pi Mu Epsilon faculty advisor, 1992–1994

WWW Committee, 1998–2001

Major Field Assessment Committee, 1998

Qualifying Exam Committee, 2001–2002

Graduate and Doctoral Faculty Review Committee, 2001–2002

Department of Mathematics Executive Committee, 2003–2006

Vice–Chair, 2003–2004

Department of Mathematics Foreign Student Assessment Committee, 2004–present

Department of Mathematics Library Committee, 2002–2003

Department of Mathematics PTR Policy Drafting Committee, 2006

Department of Mathematics Bylaws Committee, 2008–2010

Department of Mathematics Number Theory Search Committee, 2010

Department of Mathematics Hiring Policy Committee, 2010

Department of Mathematics NTT Evaluation Committee, 2010

Department of Mathematics International Student Screening Committee, 2010

Department of Mathematics Instructor Search Committee, 2011

Department of Mathematics Awards Committee, 2012

Department of Mathematics Executive Committee, 2012–2015

Department of Mathematics Annual Review and Promotion (NTT) Committee, 2012

Department of Mathematics Faculty Search Committee, 2013

Department of Mathematics Assistant Professor Review Committee, 2013

Department of Mathematics Associate Professor Review Committee, 2013

Department of Mathematics Graduate Program Committee, 2010

College, University and other Committees

Organizing Committee, Third Midwest Differential Geometry Conference, 1992–1993

Reviewer for Proposals to the MU Research Board, 1993, 1998, 2001, 2004, 2011

Senator, Graduate Faculty Senate, April 1993–1996

Sector Chair, Graduate Faculty Senate, 1994-1996

Membership Committee, Graduate Faculty Senate, 1994-1995

Organizing Committee, Midwest Differential Geometry Conference, 1999.

Campus Committee on Faculty Responsibility, 1999–2002

Student Conduct Committee, 2000–2003, 2007, 2008–2009, 2009–2010

Arts & Sciences Academic Appeals Committee, 2001, 2006

Campus Mediation Oversight Committee, 2007–2008

Publications (+ denotes refereed paper, *denotes invited paper)

1.+ 1-Silacyclopent-3-en-1-ylidene, a cyclic silylene from the reactions of silicon atoms, and a silicon atom synthon, J. Amer. Chem. Soc. **103** (1981) 7344–7345. (With Peter P. Gaspar et al.)

2.+ Manifestly conformally covariant $CP5$ inverse twistor functions, Phys. Lett. **127B**(1983) 345–346.

3.+ Nonlinear connections for curved twistor spaces, Gen. Rel. Grav. **17** (1985) 133–147.

4.+ Sites and googly twistor spaces: I. vacuum, J. Math. Phys. **27** (1986) 2478.–2483.

5.+ Sites and googly twistor spaces: II. Yang-Mills fields, J. Math. Phys. **27** (1986) 2484–2488.

6.+ A formula for the local solution of the self-dual Yang-Mills equations, Proc. Roy. Soc. Lond. **A414** (1987) 135–147.

7.+ Yang-Mills equations and solvable groups, Phys. Rev. **D36** (1987) 1740–1744. (With Hickman, Kozameh, Lucey and Newman.)

8.+ Stein covers for curved twistor spaces, J. Geom. Phys. **4** (1987) 261–275.

9.+ The general solution of Einstein's equations in the limit of strong gravity, Gen. Rel. Grav. **20** (1988) 875–880. (With Hickman, Kozameh, Lucey and Newman.)

10.+ Pick a light ray — any light ray, J. Phys. A. **23** (1990) 2413–2420.

11.+ Note on background-coupled massless fields, in *Further advances in twistor theory*, pp. 52–56 eds. L.J. Mason & L.P. Hughston (Longman Scientific, Haslow, 1990).

12.+ The angular momentum of gravitational radiation, Phys. Lett. A**150** (1990) 342–344.

13.+ Gaussian integrals on Wiener spaces (with Zhongxin Zhao), J. Appl. Prob. **29** (1992) 46–55.

14.+ Difficulties with quasilocal momentum and angular momentum, Class. Quant. Grav. **9** (1992) 1001–1008.

15.+ The kinematics of the gravitational field, Proceedings of Symposia in Pure Mathematics **54** (1993) 297–316.

16.+ Null infinity does not carry massive fields, Journal of Mathematical Physics **34** (1993) 3478–3480.

17.+ How to estimate energy lost to gravitational waves, Phys. Rev. D**48** (1993) 3625–3629.

18.* Three applications of information theory, pp. 559–590 in *Essays on the formal aspects of electromagnetic theory*, ed. A. Lakhtakia, World Scientific, 1993.

19.+ Conjugate points on spacelike geodesics, or pseudo–self–adjoint Morse–Sturm–Liouville systems, Pacific Journal of Mathematics **164** (1994) 321–350.

20.+ Twistors and the BMS group, Class. Quant. Grav. **11** (1994) 733–755.

21.+ Conjugate points and higher Arnol'd-Maslov classes, Contemp. Math., **170** (1994) 135-47.

22.+ A phase space for gravitational radiation, Commun. Math. Phys. **170** (1995) 483-502.

23.+ The stress-energy operator, Class. Quant. Grav. **13** (1996) L129-L134.

24.+ 'Operational' energy conditions, Class. Quant. Grav. **15** (1998) 1169-83.

25.* Negative energies and the limit of classical space–time, Mod. Phys. Lett. **A13** (1998) 1637-43.

26.+ The electromagnetic field near a dielectric half-space (with Andrew Lang), J. Phys. A. **32** (1999) 1937-49.

27. The physics of negative energy densities, pp. 317-326 in *The Casimir effect 50 years later*, ed. Michael Bordag, World Scientific, 1999.

28.* Review of the book *The geometric universe: science, geometry and the work of Roger Penrose* (eds. Huggett et al., Oxford University Press, 1998), Gen. Rel. Grav. **32** (2000) 1961.

29.+ Moving mirrors and thermodynamics paradoxes, Phys. Rev. D **63** (2000) 025016

30.+ A prosaic approach to googlies, pp. 283–6 in *Further advances in twistor theory. III: curved twistor spaces*, eds. L. J. Mason et al., Chapman & Hall/CRC (Boca Raton et al.), 2001.

31.+ More on googlies, , pp. 286–9 in *Further advances in twistor theory. III: curved twistor spaces*, eds. L. J. Mason et al., Chapman & Hall/CRC (Boca Raton et al.), 2001.

32.+ Red–shifts near black holes, Classical and Quantum Gravity **18** (2001) 5413–28.

33.+ Spatially averaged quantum inequalities do not exist in four-dimensional space–time (with L. H. Ford and T. A. Roman), Phs. Rev. **D66** (2002) 124012.

34.+ Differential topology, differential geometry and hyperbolic operators, Contp. Math. **337** (2003) 77–89.

35.+ Do black holes radiate?, Rep. Progr. Phys. **66** (2003) 943–1008 [selected as a "featured article" by the editors]

36.+ Comments on the allowed spatial distributions of negative energy, Proceedings of the Tenth Marcel Grossman Conference (with L. H. Ford and T. A. Roman, to appear

37.+ State reduction and energy extraction from black holes, Phys. Lett. A329 (2004) 277–283

38.+* Quantum nature of black holes, Int. J. Mod. Phys. D13:2299-2305, 2004.

38.+ Angular Momentum of Isolated Systems, Gen. Rel. Grav. 39:2125-2147, 2007.

39.+* Angular Momentum of Isolated Systems in General Relativity, Nonlinear Analysis: Theory, Methods and Applications 71:e494-4501 (2009)

40.+ The Production of Time, http://www.fqxi.org/community/essay/winners, 10 pp., 2009. [These essays have been published in the strict sense of the word by their public appearance on this site; they have not appeared in a journal.]

41.+ Estimating energy–momentum and angular momentum near null infinity, Phys. Rev. D81:084001 (2010)

42.+ Comment on "Insensitivity of Hawking Radiation to an invariant Planck-scale cutoff," Phys. Rev. D81:108501 (2010)

43.* Black holes reconsidered, in Cosmology and Gravitation: XIV Brazilian School of Cosmology and Gravitation, ads. M. Novello and S. E. Perez Bergliaffa (Cambridge Scientific, 2012)

44.+ Light rays, gravitational waves and pulse-time offsets, Monthly Notices of the Royal Astronomical Society, Volume 430 (2013), Issue 1, pp. 305-319

Gravity Research Foundation Prize Essay (unpublished)

1.+ What is the fate of a black hole? (Honorable Mention, 1999)

Support of Research

1. Research at MSRI (Research Leave for Fall Semester 1993). Funding: about $19,378; salary $19,378; no graduate students supported.

2. Quantum Fields in Curved Space-Time, UM Research Board, summer 1993. Funding: $9,000; salary $9,000; no graduate students supported.

3. Midwest Geometry Conference, National Science Foundation (joint with Professors Beem and Segert). Funding: $10,000; no salary support; the award was for participant travel, with priority given to graduate students (we have no records on exactly how much was awarded to graduate students).

Invited Talks

1. Quasi-local mass in general relativity, Department of Mathematics, University of Michigan, Ann Arbor colloquium, 1988. (This developed into a seminar on quasi-local mass.)

2. The General Local Solution of the Self-Dual Yang-Mills Equations, Department of Mathematics Colloquium, University of South Alabama, Mobile, 1988.

3. The Kinematics of the Gravitational Field, Department of Physics, University of Missouri Colloquium, 1990.

4. What can we say about a distant source?, Symposium of the IEEE Electromagnetic Compatibility Society, Los Angeles 1992. (Not given because of scheduling conflicts.)

5. Morse Index Theory for Semi-Riemannian Manifolds, Special Session on Geometric Methods in Mathematical Physics, AMS/CMS Meeting, Vancouver, August 1993.

6. Anomalies and Angular Momentum, General Relativity Seminar, University of Utah, Salt Lake City, 1993.

7. Angular Momentum in General Relativity, Differential Geometry Seminar, MSRI, Berkeley, 1993.

8. Spi from Scri, American Mathematical Society Special Session on Geometry and Geodesics, Stillwater, Oklahoma, October 1994. (Not given due to illness.)

9. The Stress-Energy Operator, AMS Special Session on Differential Geometry and Relativity, Orlando, Florida, January 1996.

10. The Stress-Energy Operator, University of Missouri-Columbia Physics Department Colloquium, 1996.

11. Negative Energies, Quantum Fields, and General Relativity, Albert-Einstein Institut, Potsdam, Germany, September 1998.

12. The Geometry of Hyperbolic Operators, Special Session on Geometry and Geodesics, AMS-SMM conference, Denton, Texas, May 1999.

13. Moving Mirrors, Thermodynamic Paradoxes and Black Holes, Physics Colloquium, Washington University, St. Louis, September 2000.

14. Differential Topology, Differential Geometry and Hyperbolic Equations, Special Session on Riemannian and Lorentzian Geometry, Joint Mathematics Meetings (AMS/MAA/ASL/AWM/NAM), Baltimore, January 2003.

15. Fundamental Issues in the Hawking Process, University of Maryland Relativity Seminar, College Park, Maryland, January 2003.

16. Angular momentum of isolated systems in general relativity, 45 minutes, World Conference of Nonlinear Analysts, Orlando, July 2008

17. Five 90-minute lectures on Theoretical Aspects of Black Holes, XIV Brazilian School on Cosmology and Gravitation, Mangaratiba, Brazil, August–September 2010

Contributed Talks

1. *A new approach to curved twistor spaces*, Amer. Math. Soc. Summer Meeting, Eugene, Oregon, 1984.

2. *Towards the general solution of the Yang-Mills equations*, Amer. Phys. Soc. Division of Particles and Fields Meeting, Santa Fe, New Mexico, 1984.

3. *Sites and quantum space-time*, Syracuse Relativity Conference, 1985.

4. *A quadrature for the local solution of the self-dual Yang-Mills equations*, Amer. Math. Soc. Regional Meeting, Charlotte, North Carolina, 1986.

5. *Quasilocal Kinematics*, NSF/Amer. Math. Soc. Summer Institute on Differential Geometry, Los Angeles 1990.

6. The Kinematics of the Gravitational Field, Midwest Relativity Conference, Chicago 1992.

7. The Stress-Energy Operator, Midwest Relativity Conference, Milwaukee 1995.

8. Warp Drives or Warped Physics? Time Machines or Stymied Machinations?, Midwest Relativity Conference, St. Louis 1997.

9. The Physics of Negative Energy Densities, Workshop on Quantum Field Theory under the Influence of External Conditions, Leipzig, Germany 1998.

10. Moving Mirrors and Thermodynamic Paradoxes, Midwest Relativity Conference, Champaign 1999.

11. What is the Fate of a Black Hole?, Amer. Phys. Soc. Annual Meeting, Long Beach, 2000.

12. What is the Fate of a Black Hole?, Black Holes III, Kananaskis, Canada, May 2001.

13. The Energetics of the Hawking Process, Midwest Relativity Conference, September 2002.

14. The Angular Momentum of Radiating Systems, Midwest Relativity Conference, October 2007

15. Angular Momentum at Null Infinity, American Physical Society, April 2008

16. Single pulsar timing and gravitational waves, American Physical Society, Prairie Section Meeting, November 2013

17. Exchange of energy-momentum between matter and gravitational waves, Texas Symposium on Relativistic Astrophysics, December 2013

Twistor Newsletter Articles

(Twistor Newsletter is an informal publication for workers in the field.)

1. *Geometry of the Ward construction*, T.N. **13**, 35–37.

2. *A manifestly conformally covariant contour integral formula*, T.N. **14**, 53–54.

3. *A prosaic approach to googlies*, T.N. **16**, 35–38.

4. *Manifestly conformally invariant inverse twistor functions*, T.N. **15**, 34–35.

5. *Remarks on pure spinors*, T.N. **16**, 40.

6. *More on googlies*, T.N. **17**, 45–47.

7. *A note on background-coupled massless fields*, T.N. **20**, 65–69.

8. *Stein covers for curved twistor spaces*, T.N. **22**, 14–19.

Mathematical Reviews

1. B. Jeffryes, *Two-surface twistors and conformal embedding*, in **Asymptotic behaviour of mass and spacetime geometry**, Lecture Notes in Physics 202, Springer, Berlin-New York 1984.

2. P.R. Law, *Twistor theory and the Einstein equations*, Proc. Roy. Soc. Lond. **A399** (1985) 111.

3. R. Penrose and W. Rindler, **Spinors and space-time**, Cambridge University Press, 1984–1986 (two volumes).

4. P.E. Jones and K.P. Tod, *Minitwistor spaces and Einstein-Weyl space*, Class. Quant. Grav. **2** (1985) 565.

5. A. Karlhede, *Classification of Euclidean metrics*, Class. Quant. Grav. **3** (1986) L1.

6. J. Harnad and S. Shnider, *Constraints and field equations for ten-dimensional super Yang-Mills theory*, Comm. Math. Phys. **106** (1986) 183.

7. J.R. Urani and F.J. Kutchko, *Consistent spinor equations*, Lett. Math. Phys. **13** (1987) 41.

8. C. LeBrun, *Thickenings and gauge fields*, Class. Quant. Grav. **3** (1986) 1039.

9. N.A. Doughty and D.L. Wiltshire, *Weyl field strength symmetries for arbitrary helicity and gauge invariant Fierz-Pauli and Rarita-Schwinger wave equations*, J. Phys. **A19** (1986) 3727.

10. B.P. Jeffryes, *2-surface twistors, embeddings and symmetries*, Proc. Roy. Soc. Lond. **A411** (1987) 59.

11. K.P. Tod, *More on Penrose's quasi-local mass*, Class. Quant. Grav. **3** (1986) 1169.

12. L.P. Hughston and W.T. Shaw, *Minimal curves in six dimensions*, Class. Quant. Grav. **4** (1987) 869.

13. M.G. Eastwood and J.W. Rice, *Conformally invariant differential operators on Minkowskip space and their curved analogs*, Comm. Math. Phys. **109** (1987) 207.

14. A. Ashtekar, **Asymptotic quantization**, Bibliopolis, Naples, 1987.