Curriculum Vitae

A GENERAL

Full Name: Atsushi Higuchi

Department: Mathematics

Date of appointment to the University: January, 1996

Current position: Professor since October 2017 (full-time)

Previous posts:

- Research Associate with Relativity Group at University of Wisconsin-Milwaukee, September 1986 to May 1989.
- Associate Lecturer, Physics Department, University of Wisconsin-Milwaukee, September 1988 to May 1989.
- Research Associate with Relativity Group at University of Maryland, College Park, September 1989 to August 1991.
- Research Associate with Relativity Group at University of Chicago, November 1991 to August 1993.
- Research Associate at Institute for Theoretical Physics, University of Berne, September 1993 to December 1995.
- Reader in Mathematics at the University of York, United Kingdom, October 2005 to September 2017.
- Lecturer in Mathematics at the University of York, United Kingdom, January 1996 to September 2005.

Qualifications: PhD, Yale University, May 1987

PhD Supervisor: Professor Feza Gürsey (deceased)

Post-doctoral supervisors:

- Professor Leonard E Parker; Professor John L Friedman (University of Wisconsin-Milwaukee)
- Professor Dieter Brill; Professor Theodore A Jacobson (University of Maryland)
- Professor Robert M Wald (University of Chicago)
- Professor Peter Hájíček (University of Bern)

B RESEARCH

B1 Publications, compositions, patents, exhibitions and commissions

(i)

(ii) Chapters in books

1. Higuchi, A. "Quantum linearization instabilities of de Sitter spacetime", in Hu, B.L. and Jacobson, T.A. (ed.) Directions in General Relativity: Vol. 2, Cambridge University: Cambridge, 146–156, 1993.

2. Higuchi, A. and Matsas, G.E.A. "Traces of the Fulling-Davies-Unruh effect in classical field theory", in Eboli, O.J.P. and Rivelles, V.O. (eds.) Proceedings of the 7th A. Swieca Summer School of Particles and Fields (Campos de Jordão-SP, Brazil, 10-23 January, 1993), World Scientific: Singapore, 744-788, 1993.

3. Higuchi, A. "Linearized gravity in 'closed' universes with continuous symmetries", in Aktas, G., Saclioglu C. and Serdaroglu (eds.) Strings and Symmetries, the Proceedings of the Gürsey Memorial Conference I (Istanbul, Turkey, 6-10 June, 1994), Springer: Berlin, 294–296, 1995.

4. Higuchi, A., Matsas, G.E.A., and Sudarsky, D. "Radiation by static sources outside static black hole?" (proceedings of the MG8 Meeting on General Relativity, Jerusalem, Israel, June 22-27, 1997), World Scientific: Singapore, 1999.

5. Crispino, L.C.B., Higuchi, A., Matsas, G.E.A. and Sudarsky, D. "Interaction of Hawking radiation with static scalar sources and electric charges outside Schwarzschild black holes" in Bordag, M. (ed.) The Casimir effect 50 years later-4th workshop on Quantum Field Theory under the influence of external conditions (Leipzig, Germany, 14-18 September, 1998), World Scientific: Singapore, 351-355, 1999.

6. Higuchi, A. "Possible constraints on string theory in closed space" in Duplij, S. (ed.) Noncommutative structures in mathematics and physics (proceedings of the NATO Advanced Research Workshop, Kiev, Ukraine, 24-27 September, 2000), Kluwar Academic Publishers: Dordrecht, 465-473, 2001.

7. Crispino, L.C.B., Higuchi, A., and Matsas, G.E.A. "Radiation emitted from a scalar source rotating around a black hole", (proceedings of the MG9 Meeting on General Relativity, Rome, Italy, 2-8 July 2000), World Scientific: Singapore, 2002.

8. Crispino, L.C.B., Oliveira, E.S., and Higuchi, A. "Bosonic Absorption by Reissner-Nordström black holes", (proceedings of the MG13 Meeting on General Relativity, Stockholm University, Sweden, 1-7 July 2012), World Scientific: Singapore, 20.

(iii) Articles in journals

a) Refereed contributions (with papers with more than 100 citations indicated)

1. Higuchi, A., Matsuda, S. and Kodaira, J. Photon structure functions and azimuthal asymmetries in two-photon processes. Physical Review D 24, 1191-1206, 1981.

2. Higuchi, A. Comment on azimuthal dependence in leptoproduction. Physics Letters 108B, 131-133, 1982.

3. Higuchi, A. and Kazama, Y. Dynamical breaking of supersymmetry and positivity of vacuum energy density. Nuclear Physics B206, 152-172, 1982.

4. Higuchi, A. and Bars, I. First order formulation and geometrical interpretation of $d = 11$ supergravity. Physics Letters 145B, 329-332, 1984.

5. Higuchi, A. Forbidden mass range for spin-2 field theory in de Sitter spacetime. Nuclear Physics B282, 397-436, 1987.

6. Higuchi, A. Quantisation of scalar and vector fields inside the cosmological event horizon and its application to the Hawking effect. Classical and Quantum Gravity 4, 721-740, 1987.

7. Higuchi, A. Symmetric tensor spherical harmonics on the N-sphere and their application to the de Sitter group $SO(N, 1)$. Journal of Mathematical Physics 28, 1553-1566, 1987. Erratum-ibid. 43, 6385, 2002.

8. Higuchi, A. and Parker, L. Aspects of QED and non-abelian gauge theories in $S^1 \times R^3$ and $S^1 \times R^4$ spacetimes. Physical Review D 37, 2853-2871, 1988.

9. Higuchi, A. Massive symmetric tensor field in curved spacetime. Classical and Quantum Gravity 6, 397-406, 1989.

10. Higuchi, A. Massive symmetric tensor field in spacetimes with a positive cosmological constant. Nuclear Physics B325, 745-765, 1989.

11. Friedman, J.L. and Higuchi, A. Symmetry and internal time on the superspace of asymptotically flat geometries. Physical Review D 41, 2479-2486, 1990.

12. Higuchi, A. and Parker, L. Quantum soliton in QED in $S^1 \times R^2$ spacetime. Journal of Modern Physics A5, 2251-2263, 1990.

13. Friedman, J.L. and Higuchi, A. State vectors in higher-dimensional gravity with quantum numbers of quarks and leptons. Nuclear Physics B339, 491-515, 1990.

14. Higuchi, A., Parker, L. and Wang. Y. Consistency of Faddeev-Popov ghost statistics with gravitationally induced pair creation. Physical Review D 42, 4078-4081, 1990.

15. Higuchi, A. The Schwinger model on a circle with an unconventional boundary condition. Physics Letters B254, 169-172, 1991.

16. Higuchi, A. Gauge symmetry breaking by nontrivial boundary conditions. Physical Review D 43, 3565-3569, 1991.

17. Higuchi, A. Quantum linearization instabilities of de Sitter spacetime. I. Classical and Quantum Gravity 8, 1961-1981, 1991.

18. Higuchi, A. Quantum linearization instabilities of de Sitter spacetime. II. Classical and Quantum Gravity 8, 1983-2004, 1991.

19. Higuchi, A. Linearized gravity in de Sitter spacetime as a representation of SO(4,1). Classical and Quantum Gravity 8, 2005-2021, 1991.

20. Higuchi, A. Linearized quantum gravity in flat space with toroidal topology. Classical and Quantum Gravity 8, 2023-2034, 1991.

21. Higuchi, A., Sudarsky, D. and Matsas, G.E.A. Bremsstrahlung and zero-energy Rindler photons. Physical Review D 45, 3308-3311, 1992.

22. Camporesi, R. and Higuchi, A. Stress-energy tensors in anti-de Sitter spacetime. Physical Review D 45, 3591-3603, 1992.

23. Higuchi, A., Matsas, G.E.A. and Sudarsky D. Bremsstrahlung and Fulling-Davies-Unruh thermal bath. Physical Review D 46, 3450-3457, 1992.

24. Camporesi, R. and Higuchi, A. Arbitrary-spin effective potentials in anti-de Sitter spacetime. Physical Review D 47, 3339-3344, 1993.

25. Higuchi, A. and Matsas, G.E.A. Fulling-Davies-Unruh effect in classical field theory. Physical Review D 48, 689-697, 1993.

26. Higuchi, A., Matsas, G.E.A. and Peres, C.B. Uniformly accelerated finite-time detectors. Physical Review D 48, 3731-3734, 1993.

27. Camporesi, R. and Higuchi, A. Spectral functions and zeta functions in hyperbolic spaces. Journal of Mathematical Physic 35, 4217-4246, 1994.

28. Camporesi, R. and Higuchi, A. The Plancherel measure for p-forms in real hyperbolic spaces. Journal of Geometry and Physics 15, 57-94, 1994.

29. Higuchi, A. and Wald, R.M. Applications of a new proposal for solving the "problem of time" to some simple quantum cosmological models. Physical Review D 51, 544-561, 1995.

30. Bičák, Cris, C., Hájíček, P. and Higuchi, A. Gauge-symmetry breakdown at the horizon of extreme black holes. Classical and Quantum Gravity 12, 479-498, 1995.

31. Hájíček, Higuchi, A. and Tolar, J. Group quantization of parametrized systems II. Pasting Hilbert spaces. Journal of Mathematical Physics 36, 4639-4666, 1995.

32. Friedman, J.L. and Higuchi, A. Quantum field theory in Lorentzian universes-from-nothing. Physical Review D 52, 5687-5697, 1995.

33. Fewster, C.J. and Higuchi, A. Quantum field theory on certain non-globally hyperbolic spacetimes. Classical and Quantum Gravity 13, 51-62, 1996.

34. Camporesi, R. and Higuchi, A. On the Eigenfunctions of the Dirac operator on spheres and real hyperbolic spaces. Journal of Geometry and Physics 15, 1-18, 1996.

35. Fewster, C.J., Higuchi, A. and Wells, C.G. Classical and quantum initial value problems for models of chronology violation. Physical Review D 54, 3806-3825, 1996.

36. Higuchi, A., Matsas, G.E.A. and Sudarsky, D. Do static sources outside a Schwarzschild black hole radiate?", Physical Review D 56, 6071-6075, 1997.

37. Crispino, L.C.B., Higuchi, A. and Matsas, G.E.A. Interaction of Hawking radiation and a static electric charge. Physical Review D 58, 084027, 1998.

38. Higuchi, A., Matsas, G.E.A., and Sudarsky, D. Interaction of Hawking radiation with static sources outside a Schwarzschild black hole. Physical Review D 58, 104021, 1998.

39. Crispino, L.C.B., Higuchi, A. and Matsas, Scalar radiation emitted from a source rotating around a black hole. Classical and Quantum Gravity 17, 19-32, 2000.

40. Higuchi, A. and Kouris, S.S. Large-distance behaviour of the graviton two-point function in de Sitter spacetime. Classical and Quantum Gravity 17, 3077-3090, 2000.

41. Higuchi, A. and Sudbery, A. How entangled can two couples get? Physics Letters A273, 213-217, 2000.

42. Carteret, H.A., Higuchi, A. and Sudbery, A. Multipartite generalisation of the Schmidt decomposition. Journal of Mathematical Physics 41, 7932-7939, 2000.

43. Higuchi, A., Kay, B.S. and Wood, C.M. The energy of unit vector fields on the 3-sphere. Journal of Geometry and Physics 37, 137-155, 2001.

44. Crispino, L.C.B., Higuchi, A. and Matsas, G.E.A. Quantization of the electromagnetic field outside static black holes and its application to low energy phenomena. Physical Review D 63, 124008, 2001.

45. Higuchi, A. and Kouris, S.S. On the scalar sector of the covariant graviton two-point function in de Sitter spacetime. Classical and Quantum Gravity 18, 2933-2944, 2001.

46. Higuchi, A. and Kouris, S.S. The covariant graviton propagator in de Sitter spacetime. Classical and Quantum Gravity 18, 4317-4328, 2001.

47. Higuchi, A. Low-frequency absorption cross sections for stationary black holes. Classical and Quantum Gravity 18, L139-144, 2001. Addendum-ibid. 19, 599, 2002.

48. Higuchi, A. Radiation reaction in quantum field theory. Physical Review D 66, 105003, 2002. Erratum-ibid. D 69, 129903, 2004.

49. Higuchi, A. Sudbery, A. and Szulc J. One-qubit reduced states of a pure many-qubit state: polygon inequalities, Physical Review letters 90, 107902, 2003.

50. Higuchi, A. and Weeks, R.H. The physical graviton two-point function in de Sitter spacetime with S^3 spatial sections, Classical and Quantum Gravity 20, 3005-3022, 2003.

51. Higuchi, A. and Martin, G.D.R. Lorentz-Dirac force from QED for linear acceleration, Physical Review D 70, 081701(R), 2004.

52. Crispino, L.C.B., Higuchi, A. and Matsas, G.E.M. Is the equivalence for the static scalar sources in Rindler and Schwarzschild spacetimes valid only in four dimensions? Physical Review D 70, 127504, 2004.

53. Higuchi, A. and Martin, G.D.R. Classical and quantum radiation reaction for linear acceleration. Foundations of Physics 35, 1149-1179, 2005.

54. Higuchi, A. and Martin, G.D.R. Radiation reaction on charged particles in three-dimensional motion in classical and quantum electrodynamics, Physical Review D 73, 025019, 2006.

55. Higuchi, A. and Martin, G.D.R. Quantum radiation reaction and the Green's function decomposition, Physical Review D 74, 125002, 2006.

56. Friedman, J.L. and Higuchi, A. Topological censorship and chronology protection, Annalen der Physik 15, 109-128, 2006.

57. Brierley, S. and Higuchi, A. On maximal entanglement between two pairs in four-qubit pure states, Journal of Physics A 40, 8455-8465, 2007.

58. Crispino, L.C.B., Oliveira, E.S., Higuchi, A., and Matsas, G.E.A. Absorption cross section of electromagnetic waves for Schwarzschild black holes, Physical Review D 75, 104012, 2007.

59. Crispino, L.C.B., Higuchi, A. and Matsas, G.E.A. The Unruh effect and its applications, Reviews of Modern Physics 80, 787-838, 2008.

60. Faizal, M. and Higuchi, A. Faddeev-Popov-ghost propagators for Yang-Mills theories and perturbative quantum gravity in the covariant gauge in de Sitter spacetime, Physical Review D 78, 067502, 2008.

61. Higuchi, A. and Lee, Y.C. How to use retarded Green's functions in de Sitter spacetime, Physical Review D 78, 084031, 2008.

62. Higuchi, A. Decay of the free-theory vacuum of scalar field theory in de Sitter spacetime in the interaction picture, Classical and Quantum Gravity 26, 072001, 2009.

63. Higuchi, A. and Walker, P.J. Classical and quantum radiation reaction in conformally flat spacetime, Physical Review D 79, 105023, 2009.

64. Higuchi, A. and Lee, Y.C. A conformally coupled massive scalar field in the de Sitter expanding universe with the mass term treated as a perturbation, Classical and Quantum Gravity 26, 135019, 2009.

65. Higuchi, A., Lee, Y.C. and Nicholas, J.R. More on the covariant retarded Green's function for the electromagnetic field in de Sitter spacetime, Physical Review D 80, 107502, 2009.

66. Crispino, L.C.B., Higuchi, A. and Oliveira, E.S. Electromagnetic absorption cross section of Reissner-Nordström black holes, Physical Review D 80, 104026, 2009.

67. Higuchi, A. and Walker, P.J. Quantum corrections to the Larmor radiation formula in scalar electrodynamics, Physical Review D 80, 105019, 2009.

68. Alves, D.T., Crispino, L.C.B., de Lima, M.C., and Higuchi, A. Influence of boundary conditions on the radiation emitted by an accelerated source, Physical Review D 81, 065002, 2010.

69. Crispino, L.C.B., Matsas, G.E.A., and Higuchi, A. Low-frequency absorption cross section of the electromagnetic waves for the extreme Reissner-Nordström black holes in higher dimensions, Physical Review D 82, 124038, 2010.

70. Higuchi, A., Marolf, D., and Morrison, I.A. On the Equivalence between Euclidean and In-In Formalisms in de Sitter QFT, Physical Review D 83, 084029, 2011.

71. Higuchi, A., Marolf, D., and Morrison, I.A. de Sitter invariance of the dS graviton vacuum, Classical and Quantum Gravity 28, 245012, 2011.

72. Oliveira, E.S., Crispino, L.C.B., and Higuchi, A. Equality between gravitational and electromagnetic absorption cross sections of extreme Reissner-Nordström black holes, Physical Review D 84, 084048, 2011.

73. Crispino, L.C.B., Higuchi, A., and Matsas, G.E.A. Comment on "Hawking radiation, Unruh radiation, and the equivalence principle", Physical Review Letters 108, 049001, 2012.

74. Faizal, M., and Higuchi, A. Physical equivalence between the covariant and physical graviton two-point functions in de Sitter spacetime, Physical Review D 85, 124021, 2012.

75. Crispino, L.C.B., Higuchi, A., Oliveira, E.S., and Rocha, J.V. Greybody factors for non-minimally coupled scalar fields in Schwarzschild-de Sitter spacetime, Physical Review D 87, 104034, 2013.

76. Fröb, M.B., and Higuchi, A. Mode-sum construction of the two-point functions for the Stueckelberg vector fields in the Poincaré patch of de Sitter space, Journal of Mathematical Physics 55, 062301, 2014.

77. Bernar, R.P., Crispino, L.C.B., and Higuchi, A. Infrared-finite graviton two-point function in static de Sitter space, Physical Review D 90, 024045, 2014.

78. Crispino, L.C.B., Dolan, S.R., Higuchi, A., and Oliveira, E.S. Inferring black hole charge from backscattered electromagnetic radiation, Physical Review D 90, 064027, 2014.

79. Gibbons, J., and Higuchi, A. Removing the Faddeev-Popov zero modes from Yang-Mills theory in spacetimes with compact spatial sections, Physical Review D 91, 024006, 2015.

80. Crispino, L.C.B., Dolan, S.R. Higuchi, A., and Oliveira, E.S. Scattering from charged black holes and supergravity, arXiv:1507.03993, Physical Review D 92, 084056, 2015.

81. Crispino, L.C.B., Higuchi, A., Oliveira, L.A., de Oliveira, E.S., Tidal forces in Reissner-Nordström spacetimes, European Journal of Physics C76, 168, 2016.

82. Fröb, M.B., Higuchi, A., Lima, W.C.C., Mode-sum construction of the covariant graviton two-point function in the Poincaré patch of de Sitter space, Physical Review D 93, 124006, 2016.

83. Bernar, R.P., Crispino, L.C.B., Higuchi, A., Gravitational waves emitted by a particle rotating around a Schwarzschild black hole: A semi-classical approach, Physical Revew D 95, 064042.

84. Fröb, M.B., Hack T.-P., Higuchi, A., Compactly supported linearised observables in single-field inflation, Journal of Cosmology and Astroparticle Physics, 043 (2017).

(iv) Papers published in refereed conference proceedings

1. Bernar, R.P., Crispino, L.C.B., Higuchi, A. Graviton two-point function in 3+1 static de Sitter spacetime, International Journal of Modern Physics D25, 1641016 (2016) [refereed contribution to conference proceedings]

(v)(vi)

(vii) All other works

Unpublished preprints

1. Higuchi, A., "Some topics in quantum field theory in curved spacetime" in Proceedings of the 18th Brazilian National Meeting on Particles and Fields, 1997.

2. Higuchi, A., On the one-particle reduced density matrices of a pure three-qutrit quantum state, arXiv: quant-ph/0309186.

3. Higuchi, A., Equivalence between the Weyl-tensor and gauge-invariant graviton two-point functions in Minkowski and de Sitter spaces, arXiv:1204.1684.

B2 Research Funding

(i) Successful applications for research support

- Corrigan, E., Delius, G., Fewster, C.J., Higuchi, A., Kay, B.S., MacKay, N.J. 2005-2007, a PPARC grant to hire a research assistant (Charles Young).

- Royal Society Travel Grant for a research visit to Professor Donald Marolf at UC Santa Barbara in 2010, £2,735.

- Supervisor for a Marie-Skłodowska-Curie Fellow (Markus B Fröb), "Quasi-local observables in quantum gravity", £114,090, July 2016 to June 2018.

(ii)

B3 Research students

(i) Supervision

1. Spyros S Kouris, from October 1998 to August 2002 (awarded a PhD, sole supervisor).

2. Richard H Weeks, from October 2000 to September 2004 (awarded a PhD, sole supervisor).

3. Giles D R Martin, from October 2003 to September 2007 (awarded a PhD, sole supervisor).

4. Emily King, from January 2004 to September 2006 (awarded an MPhil, sole supervisor).

5. Yen Cheong Lee, from October 2006 to September 2009 (awarded a PhD, sole supervisor).

6. Philip J Walker, from October 2006 to August 2010. (awarded a PhD, sole supervisor).

7. Mir Faizal, from June 2008 to January 2011 (awarded a PhD, sole supervisor).

8. Jos Gibbons, from October 2012 to 2016 (awarded a PhD, sole supervisor).

9. Callum King, from October 2015 to 2016 (submitted for an MSc by Research, co-supervisor).

10. Nicola Rendell, from October 2015 to present (continuing, co-supervisor for PhD).

11. Rafael Bernar, from January to July 2016 (visiting PhD student from Federal University of Pará, Brazil).

(ii) Examining

Internal Examining

Claes Cramer (DPhil, 1999), Hilary Carteret (Dphil, 2001), Jason Szulc (PhD, 2003), Alan George (PhD, 2004), Joseph Hilling (PhD, 2007), Lutz Osterbrink (PhD, 2007), Simon Dawson (PhD, 2007), Peter Larkin (PhD, 2007), Leonard Ortiz (PhD, 2011), David Hunt (PhD, 2012), Maxwell Strachan (MSc by Research, 2015).

External Examining

Andras Kaiser at Yale University (PhD, 1998; External Reader);
Alberto Molgado at University of Nottingham (PhD, 2006);
Sarah Marr at Imperial College, London (PhD, 2007);
Raj Kanagaraj at University of Newcastle (MPhil, 2009);
Samuel James at University of Newcastle (PhD, 2010);
Jose Roberto Vidal Madrid at Universidad Autonoma de Madrid (PhD, 2011);
Ahmed Youssef at University Denis Diderot-Paris 7 (PhD, 2011);
Eric Martinez Pascual at University of Nottingham (PhD, 2011);
Paul Mackay at University of Newcastle (for PhD, 2012);
Fernando Aguayo Fellay at University of Nottingham(PhD, 2013);
Markus Benjamin Fröb at University of Barcelona (PhD, 2013);
Carl Kent at University of Sheffield (PhD, 2014);
David Dempsey at University of Sheffield (PhD, 2017).

B4 Other research activities and distinctions

(i)

(ii) Invited conference talks since 2007 ("major lectures and conference papers")

1. "Infra-red properties of quantum field theories in de Sitter space-time", 23 July, 2007, at Low-Energy Quantum Gravity meeting, York.

2. "Radiation reaction from QED", 28 June, 2008, at 11th Capra Meeting on Radiation Reaction, Orléans, France.

3. "Interacting quantum fields in de Sitter space", 29 June, 2010, at 26th North British Mathematical Physics Seminar, York.

4. "On the Equivalence between Euclidean and In-In Formalisms in de Sitter QFT", 28 October, 2011, at Workshop on "IR Issues and Loops in de Sitter Space", Perimeter Institute, Waterloo, Canada, 2010.

5. "In what sense is radiation reaction a quantum effect?", 7 July, 2011, at 14th Capra Meeting on Radiation Reaction in General Relativity, Southampton.

6. "dS invariant vacua/propagators for linearized gravity", 15 September, 2011, Workshop on "Quantum Gravity: from UV to IR", CERN, Geneva, Switzerland.

7. "Are the graviton and Weyl-tensor two-point functions equivalent?", 23 August, 2011, at the Second Workshop on Quantum Field Theory, São Luís, Brazil.

8. "Do infrared gravitons modify inflation?", 25 September, 2012 at The First Physics Meeting in Amazonia, Belém, Brazil.

9. "Is radiation reaction a quantum effect?", 19 March, 2014, at a Physics Meeting in Belém, Brazil, 2014.

10. "Quantum field theory on de Sitter space", 27 November, 2014, at the Second Physics Meeting in Amazonia, Belém, Brazil.

11. "A discussion on the graviton correlator in de Sitter space", 28 April, 2015, at KITP Programme, "Quantum Gravity Foundations: UV to IR", Santa Barbara, USA (this was more like leading a discussion).

12. "Eliminating the infrared divergences in the Faddeev-Popov sector of gauge theory and perturbative gravity in spacetimes with closed spatial sections", 30 May, 2015, at Workshop "Foundations and Constructive Aspects of Quantum Field Theory (LQP36)", Leipzig, Germany.

13. "Covariant graviton and Faddeev-Popov propagators in de Sitter space", 30 July, 2015, at Workshop "Quantum Fields and IR Issues in de Sitter space", Natal, Brazil.

14. "Scattering from charged black holes and supergravity", 22 September, 2015, at 44th North British Mathematical Physics Seminar, York.

(iii)(a) Selected research visits ("Visiting research posts")

- Department of Physics, Federal University of Pará (UFPA), Belém, Brazil
  As a Visiting Scholar supported by International Centre for Theoretical Physics (ICTP)
  15 February – 20 March, 2010; 2 August – 2 September, 2011; 2 September – 4 October, 2012; 11 June – 27 June, 2015; 5 December – 23 December, 2016.
  As a Visiting Scholar supported by Science Without Border grant to UPFA
  17 May – 16 April, 2014; 18 July – 20 August, 2015; 13 May – 12 April, 2016.

- Department of Physics, UC Santa Barbara, USA, 26 April – 28 May, 2010.

- Kavli Institute for Theoretical Physics, Santa Barbara, USA, 12 April – 2 May, 2015.

(b) Invited lectures/seminars outside of the university since 2007

- "Semi-classical approximation in radiation processes in QED", 7 December, 2007, University of Nottingham.

- "Linearised gravity in de Sitter spacetime", 29 October, 2008, University of Cambridge.

- "Radiation reaction in quantum electrodynamics", 13 November, 2008, University of Southampton.

- "Is the Euclidean vacuum the same as the in-vacuum at the horizon for de Sitter and other spacetimes?" 25 May, 2010, University of California at Santa Barbara, USA

- "Compatibility of 'particle creation' and de Sitter invariance", 23 May, 2011, Albert Einstein Institute, Golm, Germany.

- "Supersymmetry and electromagnetic and gravitational scattering and conversion by extremely charged black holes", 13 May, 2015, University of Aveiro, Portugal.

Lectures/Seminars at Federal University of Pará in Belém, Brazil
(pedagogical lectures will be listed under C2 (v))

- "Bose-fermi correspondence and partition identities", 29 September, 2009.

- "Topics in linearized gravity in de Sitter spacetime", during my visit 15/2-20/3, 2010.

- "Low-frequency scalar absorption cross sections for stationary black holes", 8 August, 2011.

- "Are the graviton and Weyl-tensor two-point functions equivalent?", 29 August, 2011.

- "Quantum field theory meets complex analysis in very early universe", 16 September, 2013.

- "Supersymmetry and electromagnetic and gravitational scattering and conversion by the extremely charged black holes", 25 June, 2015.
- "A simple example of Bose-Fermi correspondence", 22 March, 2016.
- "Forbidden mass range for spin-2 field theory in de Sitter spacetime", 15 December, 2016.

(iv)

(vi) Invitations to referee for peer-reviewed outputs

- Regular refereeing for Physical Review D and for Classical and Quantum Gravity.
- Refereeing for Physical Review Letters, Physics Letters A, Journal of Mathematical Physics, Journal of High Energy Physics (JHEP), Journal of Physics A, Foundations of Physics and European Journal of Physics.

(vii)(viii)

(ix) Award: Selected as an Outstanding Referee by the American Physics Society, publisher of Physical Review and Physical Review Letters, in 2008.

C TEACHING, SCHOLARSHIP and PROFESSIONAL PRACTICE

C1 Teaching undertaken and evidence of teaching quality

(i)

(ii) Modules taught (undergraduate)

- Calculus II (Year 1) from 1996 to 2002 [This module was called Calculus III in 1996.]
- Mathematical Physics Part C (Year 3) from 1998 to 2000 and Topics in Mathematical Physics Parts A and B (Year 3) from 2002 to 2006.
- Mechanics II (Year 2) from 1997 to 1998.
- Differential Equations (Year 2) in 1999.
- Fourier Series and Transforms (Year 3, renamed Integral Transforms in 2008) from 2007 to 2008 and in 2011.
- Introduction to Quantum Field Theory (Year 4) from 1999 to 2001 and from 2005 to 2008.
- Directed Learning in Mathematics (Year 4) in 2007.
- Vector Calculus I (Year 2) from 2007 to 2010.
- Introduction to General Relativity (Year 4) in 2008.

- Electromagnetism (Year 3) in 2011.
- Advanced Quantum Mechanics (Year 4) from 2011 to 2015 (renamed Quantum Mechanics III in 2014).
- Complex Analysis and Integral Transforms (Year 2) in 2012; second half of this module in 2013 and 2014.
- Quantum Mechanics II in 2015 and 2016.
- Quantum Mechanics I in 2015.
- BA/BSc (Year 3) and MMath (Year 4) Projects from 1998 to present.

(iii) Teaching informed by research

- The MMath Project with Stephen Brierley in 2004 led to publication in a refereed journal [item 57 in B1(iii)(a)];
- The Nuffield Undergraduate Bursary Project with Jack Nicholas in 2008 (URB/35537) entitled "Covariant Green's function for electromagnetism in de Sitter spacetime" led to publication in a refereed journal [item 65 in B1(iii)(a)];
- Supervision of the Nuffield Undergraduate Bursary Project (URB/37867) with Mathew Robinson (a Physics student) in 2010 entitled "The Gibbons-Hawking effect for spin-2 field in de Sitter spacetime" was related to my current research.

(iv)

(v) Involvement in teaching beyond the institution

I gave the following lecture courses, each consisting of four to five one-hour lectures at Federal University of Pará in Belém. The audience consisted of graduate as well as undergraduate students in physics.

- "Introduction to black holes", during my visit 15/2-20/3, 2010.
- "Introduction to Quantum Field Theory on de Sitter Spacetime", 4, 9, 11, 16, 18 August, 2011.
- "The Standard Model of elementary particle physics", 5, 19, 12, 14 September, 2012.
- "Introduction to Supersymmetry", 16, 18 and 23 June, 2015.
- "Black Hole Thermodynamics", 12, 13, 14 and 15 December, 2016.

C3 Continuing professional development and reflective practice

(i) Evidence that the applicant has completed a recognised course for teaching in HE: I have a TLHE Certificate of Attendance dated 11 March 1998.

(ii)(iii)(iv)

(v) Confirmation of active involvement in the evaluation of teaching practices: I have actively participated in the peer observation of teaching.

C4 Income, awards and other distinctions

(i)

(ii) Nominations for awards: I was nominated for Supervisor of the Year in 2011 and 2012.

(iii)

C5

D ACADEMIC CITIZENSHIP

D1 Departmental administrative posts

- Assistant Collator of examination results from 1998 to 2003.
- Assistant to Undergraduate Admissions Tutor from 1999 to 2003.
- Display Equipment User Assessor and Safety Officer from September 2000 to September 2010.
- Visiting student coordinator from 2001 September to 2012.
- Secretary of the Board of Studies from April 2002 to July 2003.
- **Chair of the Board of Studies from August 2003 to July 2007.**
- Member, Mathematics/Physics Executive Committee from October 2002 to present.
- Departmental Disability Officer, from October 2005 to December 2015.
- Member, Mitigating Circumstances Committee from January 2011 to present.
- **Chair of the Board of Examiners from September 2011 to September 2014.**
- Member, Departmental Assessment Committee from October 2014 to present.
- Member, Departmental Graduate School Committee from October 2015 to September 2016.