

Curriculum Vitae N T Bishop (April 2018)

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1. Awards

- **Chancellor's prize** for the best researcher in the Faculty of Science, University of South Africa, 1999
- **SAMS WMY2000 gold medal**, awarded 2001

2. Appointments

Permanent

- **Professor** Department of Mathematics & Applied Mathematics, Rhodes University (2009 - 2016); **Head of Department** 2009 - 2015
- **Professor**, Department of Mathematical Sciences, University of South Africa (1992 - 2009)
- **Lecturer** (1976-1979), **Senior Lecturer** (1980-1985) and **Associate Professor** (1986-1991), University of the Witwatersrand, Johannesburg

Other

- **Director**, Research Centre for Computational Relativity, Astrophysics and Cosmology (CRAC), University of South Africa (2007 - 2009)
- **Visiting scientist**, Albert Einstein Institute for Gravitational Physics, Berlin, Germany, for up to 8 weeks per year (2001 - 2015)
- **Adjunct Professor**, Department of Physics and Astronomy, University of Pittsburgh, U.S.A. (1997-2000)
- **Faculty Associate**, Binary Black Hole *Grand Challenge Alliance* (1995 - 1998)
- **Project Manager**, University of Southampton; for project Genesis, an EEC funded project to develop a new generation of supercomputers (July 1990 to December 1990, while on leave)
- **Research Fellow**, University of Southampton; for a project *Numerical relativity on a transputer array* (1989, while on leave)
- **External examiner** at various South African universities for courses at all levels, and for various research dissertations
- **Consultant**, on occasion, to engineering and legal firms

3. Current research interests

Due to advances in computer technology, there is now the computational capacity to perform a fully 3-dimensional numerical evolution of the Einstein equations. Also, gravitational wave detectors based on laser interferometry have been developed, and a number of such installations are in use in various parts of the world (e.g. LIGO in the U.S.A.). These two factors underpin the current worldwide interest in numerical relativity: there is both the need, and the capacity, to compute the gravitational waveforms from various astrophysical events, so as to be able to assist with the detection process, and to interpret correctly the data expected from gravitational wave detectors.

My work is mainly concerned with the computation of gravitational wave emission from events involving black holes. Most work in this area uses a formalism in which spacetime is foliated into spacelike hypersurfaces. However, the approach that I am (mainly) using foliates spacetime into null cones, which has the advantage of computational efficiency, as well as leading directly to the gravitational radiation at infinity. In particular, I work on

characteristic extraction, in which the null cone and spacelike hypersurface approaches are combined; the advantage of this hybrid method is both accuracy and efficiency. Also, the null cone approach can be applied in cosmology, in which it is in principle possible to use observed data on the past null cone to compute the past behavior of the universe.

4. Research grants

- NRF *B* rated since 1990 (*C* rated 1985-1989); current rating *B2* (until 2017)
- Current NRF grant: R335 000 p.a.
- NRF collaboration with India grant R100 000 (2016 - 2017)
- NRF / BBF (Germany) collaboration grant: R49 000 p.a. (2009 – 2011)
- NRF / DFG (Germany) collaboration grant: R84 000 p.a. (2007 - 2008)
- SASEN (South African Science Education Network) grant: R200 000 (1999 - 2000)
- FRD *STAC* grant for collaboration with the USA: R18 000 (1997 – 1998); also, foreign party in NSF International Collaboration grants totaling \$40 000
- FRD *ad hoc* grant for mathematics bridging course: R150 000 (1994 – 1995)

5. Publications

Articles

1. N T Bishop & P T Landsberg *Equivalence Principle - 60 years of a misuse?* Nature **252** 459-460 (1974)
2. P T Landsberg & N T Bishop *A principle of impotence allowing for Newtonian cosmologies with a time- dependent gravitational constant* Mon. Not. R. astr. Soc. **171** 279-286 (1975)
3. P T Landsberg & N T Bishop *A cosmological deduction of the order of magnitude of an elementary particle mass and of the cosmological coincidences* Phys. Lett. **A53** 109-110 (1975)
4. N T Bishop & P T Landsberg *Equivalence principle* Nature **257** 517-518 (1975)
5. N T Bishop *Cosmology and a general scalar-tensor theory of gravitation* Mon. Not. R. astr. Soc. **176** 241-247 (1976)
6. N T Bishop & P T Landsberg *Time-varying Newtonian gravity and universal motion* Nature **264** 346-347 (1976)
7. P T Landsberg & N T Bishop *Equivalence principle and gravitational red-shift* Found. Phys. **6** 727-737 (1976)
8. N T Bishop *Time-varying gravity and the abundance of helium* Mon. Not. R. astr. Soc. **188** 839-840 (1979)
9. N T Bishop *A comment on Cosmic censorship, black holes, and particle orbits* Gen. Rel. Grav. **12** 971-972 (1980)
10. N T Bishop *Current thinking on general relativity and gravitation* S. A. Jnl. of Science **76** 395 (1980)
11. N T Bishop *The variational principle of general relativity* Gen. Rel. Grav. **12** 31-36 (1982)
12. N T Bishop *The closed trapped region and the apparent horizon of two Schwarzschild black holes* Gen. Rel. Grav. **14** 717-723 (1982)
13. N T Bishop *Is superluminal travel a theoretical possibility?* Found. Phys. **14** 333-340 (1984)
14. N T Bishop *The horizons of two Schwarzschild black holes* Gen. Rel. Grav. **16** 589-593 (1984)
15. N T Bishop *A comment on Dirac LNH cosmology* Astrophys. Jnl. **289** 1 (1985)

16. N T Bishop *The action of a general gauge field theory minimum or stationary* Jnl. Math. Phys. **27** 321-324 (1986)
17. N T Bishop *The action of a general gauge field theory minimum or stationary. Part II* Jnl. Math. Phys. **27** 2568-2569 (1986)
18. N T Bishop & P T Landsberg *The thermodynamics of a system containing two black holes and black-body radiation* Gen. Rel. Grav. **19** 1083-1090 (1987)
19. N T Bishop *Is superluminal travel a theoretical possibility? II* Found. Phys. **18** 571-574 (1988)
20. P T Landsberg & N T Bishop *The thermodynamics of a system containing n identical black holes and black-body radiation* Gen. Rel. Grav. **20** 723-728 (1988)
21. N T Bishop *An extension of Poincaré's inequality* Quaest. Math. **11** 195-199 (1988)
22. N T Bishop *The event horizons of two Schwarzschild black holes* Gen. Rel. Grav. **20** 573-581 (1988)
23. N T Bishop *Do tachyons produce an unacceptable gravitational field?* Found. Phys. **19** 619-624 (1989)
24. N T Bishop, C J S Clarke & R A d'Inverno *Numerical relativity on a transputer array* Class. Quant. Grav. Lett. **7** L23-L27 (1990)
25. N T Bishop, C J S Clarke & R A d'Inverno *Numerical relativity The characteristic initial value problem on a transputer array* S. A. Jnl. of Science, **86** 64 65 (1990)
26. A J Kemball & N T Bishop *The numerical determination of apparent horizons* Class. Quant. Grav. **8** 1361-1367 (1990)
27. N T Bishop *Accuracy evaluation of code for the characteristic initial value problem in general relativity* Quaest. Math. **15** 299-305 (1992)
28. N T Bishop with 14 others *The Genesis distributed memory benchmarks - I. Methodology and general relativity benchmark with results for the Supremum computer* Concurrency: Practice and Experience **5** 1-22 (1993)
29. N T Bishop *Numerical relativity: combining the Cauchy and characteristic initial value problems* Class. Quant. Grav. **10** 333-341 (1993)
30. N T Bishop & P Haines *Observational cosmology and numerical relativity* Quaest. Math., **19** 259-274 (1996)
31. P Haines and N T Bishop *Comparing large-scale cosmological density fluctuations* Quaest. Math., **19** 315-323 (1996)
32. N T Bishop, R Gomez, P R Holvorcem, R A Matzner, P Papadopoulos & J Winicour *Cauchy-characteristic matching: a new approach to radiation boundary conditions* Phys. Rev. Lett. **76** 4303-4306 (1996)
33. N T Bishop, R Gomez, L Lehner & J Winicour *Cauchy-characteristic extraction in numerical relativity* Phys. Rev. D **54** 6153-6165 (1996)
34. N T Bishop, R Gomez, P R Holvorcem, R A Matzner, P Papadopoulos & J Winicour *Cauchy-characteristic evolution and waveforms* Jnl. Comp. Phys. **136** 140-167 (1997)
35. N T Bishop, R Gomez, L Lehner, M Maharaj & J Winicour *High-powered gravitational news* Phys. Rev. D **56** 6298-6309 (1997)
36. N T Bishop, R Gomez, L Lehner, B Szilagyi & J Winicour *Cauchy-characteristic matching* in B Iyer and B Bhawal (Eds.) *Black holes, gravitational radiation and the Universe*, 383-408 (Kluwer Academic, Dordrecht, 1998)
37. The Binary Black Hole Alliance (43 authors including N T Bishop) *Gravitational wave extraction and outer boundary conditions by perturbative matching* Phys. Rev. Lett. **80** 1812-1815 (1998)
38. The Binary Black Hole Alliance (43 authors including N T Bishop) *Boosted 3-dimensional black hole evolutions with singularity excision* Phys. Rev. Lett. **80** 2512-2516 (1998)
39. N T Bishop, R Isaacson, M Maharaj & J Winicour *Black hole data via a Kerr-*

- Schild approach* Phys. Rev. D, **57** 6113-6118 (1998)
40. The Binary Black Hole Alliance (43 authors including N T Bishop) *Stable characteristic evolution of generic 3-dimensional single-black-hole spacetimes* Phys. Rev. Lett. **80** 3915-3918 (1998)
 41. N T Bishop, R Gomez, L Lehner, M Maharaj & J Winicour *The incorporation of matter into characteristic numerical relativity* Phys. Rev. D **60** 024005-1-10 (1999)
 42. L Lehner, N T Bishop, R Gomez, B Szilagyi & J Winicour *Exact solutions for the intrinsic geometry of black hole coalescence* Phys. Rev. D **60** 044005-1-10 (1999)
 43. B Szilagyi, R Gomez, N T Bishop, L Lehner & J Winicour *Cauchy boundaries in linearized gravitational theory* Phys. Rev. D **62** 104006-1-10 (2000)
 44. N T Bishop & S S Deshingkar *New approach to calculating the News* Phys. Rev. D **68** 024031-1-7 (2003)
 45. N T Bishop, R Gomez, S Husa, L Lehner & J Winicour *A numerical relativistic model of a massive particle in orbit near a Schwarzschild black hole* Phys. Rev. D **68** 084015-1-12 (2003)
 46. N T Bishop, F Beyer & M Koppitz *Black hole initial data from a non-conformal decomposition*, Phys. Rev. D **69** 064010-1-5 (2004)
 47. N T Bishop *Linearized solutions of the Einstein equations within a Bondi-Sachs framework, and implications for boundary conditions in numerical simulations*, Class. Quant. Grav. **22** 2393-2406 (2005)
 48. N T Bishop, R Gomez, L Lehner, M Maharaj & J Winicour *On characteristic initial data for a star orbiting a black hole*, Phys. Rev. D **72** 024002-1-16 (2005)
 49. N T Bishop and L R Venter *The Kerr metric in Bondi-Sachs form* Phys. Rev. D **73** 084023 (2006)
 50. C Reisswig, N T Bishop, C W Lai, J Thornburg and B Szilagyi, *Characteristic evolutions in numerical relativity using six angular patches*, Class. Quantum Grav., **24**, S327-S339 (2007)
 51. A S Kubeka and N T Bishop, *On the Ricci Tensor of Non-Stationary Axisymmetric Space-Times*, Int. J. Theor. Phys., **47** 765-771 (2008)
 52. M C Babiuc, N T Bishop, B Szilagyi and J Winicour, *Strategies for the Characteristic Extraction of Gravitational Waveforms*, Phys. Rev. D, **79** 084011 (2009)
 52. N T Bishop and A S Kubeka, *Quasi-normal modes of a Schwarzschild white hole*, Phys. Rev. D, **80** 064011 (2009)
 53. C Reisswig, N T Bishop, D Pollney and B Szilagyi, *Unambiguous determination of gravitational waveforms from binary black hole mergers*, Phys. Rev. Lett., **103** 221101 (2009)
 54. N T Bishop *Gravitational radiation* Notices S.A. Math. Soc., **40** 107-124 (2009)
 55. C Reisswig, N T Bishop, D Pollney and B Szilagyi, *Characteristic extraction in numerical relativity: binary black hole merger waveforms at scri*, Class. Quantum Grav., **27** 075014 (2010)
 56. P J van der Walt and N T Bishop, *Observational cosmology using characteristic numerical relativity*, Phys. Rev. D, **82** 084001 (2010)
 57. N T Bishop, D Pollney and C Reisswig, *Initial data transients in binary black hole evolutions*, Class. Quantum Grav., **28** 155019 (2011)
 58. P J van der Walt and N T Bishop, *Observational cosmology using characteristic numerical relativity: Characteristic formalism on null geodesics*, Phys. Rev. D, **85** 044016 (2012)
 59. C Reisswig, N T Bishop and D Pollney, *General relativistic null-cone evolutions with a high-order scheme*, <http://arXiv.org:1208.3891>, Gen. Rel. Grav., **45** 1069-1094 (2013)
 60. N T Bishop and C Reisswig, *The gravitational wave strain in the characteristic formalism of numerical relativity*, <http://arXiv.org:1308.1521>, Gen. Rel. Grav., **46**

- 1643 (2014)
61. H L Bester, J Larena, P J van der Walt and N T Bishop, *What's inside the cone? Numerically reconstructing the metric from observations*, <http://arXiv.org:1312.1081> J.C.A.P., **02**, 009 (2014)
 62. H L Bester, J Larena & N T Bishop *Towards the geometry of the Universe from data* Mon. Not. R. astr. Soc. **453**, 2364-2377 (2015)
 63. N T Bishop *Gravitational waves in a de Sitter universe*, <http://arXiv.org:1512.05663>, Phys. Rev. D **93** 044025 (2016)
 64. N T Bishop & L Rezzolla *Extraction of Gravitational Waves in Numerical Relativity* Living Rev. Relativity, <http://dx.doi.org/10.1007/s41114-016-0001-9> (2016)
 65. O Sheik Amamuddy, N T Bishop & Ö Tastan Bishop *Improving fold resistance prediction of HIV-1 against protease and reverse transcriptase inhibitors using artificial neural networks* BMC Bioinformatics **18** 369 (2017)

Published conference proceedings

66. N T Bishop *The characteristic initial value problem of general relativity as a benchmark for MIMD machines* in A Tenner (Ed.) *The CP90 Europhysics conference on computational physics*, World Scientific, Singapore (1991)
67. N T Bishop *Numerical relativity: combining the Cauchy and characteristic initial value problems* in H Sato & T Nakamura (Eds.) *The Sixth Marcel Grossmann meeting*, World Scientific, Singapore (1992)
68. N T Bishop *Some aspects of the characteristic initial value problem in numerical relativity* in R d'Inverno (Ed.) *Approaches to Numerical Relativity*, Cambridge University Press (1992)
69. N T Bishop *Observational cosmology as a characteristic initial value problem* in Yu N Gnedin, A A Grib & V M Mostepanenko (Eds.) *Proceedings of the second Alexander Friedmann International Seminar on Gravitation & Cosmology*, Central Astronomical Observatory at Pulkovo of Russian Academy of Sciences and Friedmann Laboratory Publishing, Saint Petersburg (1994)
70. N T Bishop *Gravitational wave calculations on null cones* in W F Wargau & B Cunow (Eds.) *Second Symposium of the Astronomical Society of Southern Africa*, Unisa Press, Pretoria (1994)
71. J M Bishop & N T Bishop *Object-orientation in Java for scientific programmers*, in *The Proceedings of the Thirty-first SIGCSE Technical Symposium on Computer Science Education*, Association for Computing Machinery, New York, 2000
72. N T Bishop *The construction of exact solutions for the intrinsic geometry of black hole horizons*, in V G Gurzadyan, R T Jantzen & R Ruffini (Eds.) *The Ninth Marcel Grossmann meeting*, World Scientific, Singapore (2002)
73. N T Bishop *The black hole and neutron star problem in characteristic numerical relativity*, in V G Gurzadyan, R T Jantzen & R Ruffini (Eds.) *The Ninth Marcel Grossmann meeting*, World Scientific, Singapore (2002)
74. N.T. Bishop, *Analytic solutions to the linearized Einstein equations used to test and develop a characteristic code* in H. Kleinert, R.T. Janzen and R. Ruffini (Eds.), *Proceedings of the Eleventh Marcel Grossmann Meeting on General Relativity* 1630–1632 (World Scientific, Singapore, 2008)
75. L.R. Venter and N.T. Bishop, *The Kerr metric in Bondi-Sachs form* in H. Kleinert, R.T. Janzen and R. Ruffini (Eds.), *Proceedings of the Eleventh Marcel Grossmann Meeting on General Relativity* 1633–1635 (World Scientific, Singapore, 2008)
76. C Reisswig, N T Bishop and D Pollney, *Numerical relativistic null-cone evolutions at fourth order accuracy*, R.T. Janzen, K Rosquist and R. Ruffini (Eds.), *Proceedings of the Thirteenth Marcel Grossmann Meeting on General Relativity*

- 986–988 (World Scientific, Singapore, 2015)
77. P J van der Walt and N T Bishop, *Modelling the past null cone using characteristic numerical relativity*, R.T. Janzen, K Rosquist and R. Ruffini (Eds.), *Proceedings of the Thirteenth Marcel Grossmann Meeting on General Relativity* 2569–2571 (World Scientific, Singapore, 2015)
78. N T Bishop & L Rezzolla *Extraction of GWs from a numerical simulation*, C F Sopuerta (Ed.) *Gravitational Wave Astrophysics* 209–215 (Springer 2015)

Books

79. J M Bishop & N T Bishop *Pascal Precisely for Engineers and Scientists* Addison-Wesley (1990)
80. J M Bishop & N T Bishop *Java Gently for Engineers and Scientists* Addison-Wesley (2000)
81. N T Bishop & S D Maharaj (Eds.) *Proceedings of the 16th International Conference on General Relativity and Gravitation*, World Scientific, Singapore (2002)

6. Conference presentations

International conferences

1. First Marcel Grossmann meeting, Trieste, Italy (1975)
2. *Time-varying gravity* GR8, Waterloo, Canada (1977)
3. *When does a particle enter a black hole?* GR9, Jena, East Germany (1980)
4. *The horizons of two Schwarzschild black holes* GR10, Padua, Italy (1983)
5. *Is superluminal travel a theoretical possibility?* GR11, Stockholm, Sweden (1986)
6. 300 years of gravity, Cambridge, U.K. (1987)
7. *Numerical calculation of the apparent horizon of two Schwarzschild black holes* Frontiers in numerical relativity, Urbana-Champaign, Illinois, U.S.A. (1988)
8. *Numerical relativity on a transputer array* GR12, Boulder, Colorado, U.S.A. (1989)
9. *The characteristic initial value problem of general relativity as a benchmark for MIMD machines* Second International Conference on Computational Physics, Amsterdam, Netherlands (1990)
10. *Numerical relativity: combining the Cauchy and characteristic initial value problems* Sixth Marcel Grossmann meeting, Kyoto, Japan (1991)
11. *Some aspects of the characteristic initial value problem in numerical relativity* Approaches to Numerical Relativity, Southampton, U.K. (1991)
12. *The numerical calculation of gravitational radiation on a Bondi sphere* GR13, Huerta Grande, Argentina (1992)
13. *Observational cosmology as a characteristic initial value problem* Alexander Friedmann International Seminar on Gravitation and Cosmology, Saint Petersburg, Russia (1993)
14. *Numerical relativity on null cones* IAGRG Silver Jubilee meeting, Pune, India (1994)
15. *Numerical relativity and observational cosmology* Numerical relativity conference, University of Illinois, U.S.A. (1994)
16. *Cauchy-characteristic matching in numerical relativity* GR14, Florence, Italy (1995)
17. *Cauchy-characteristic matching in numerical relativity* 7th Gregynog Relativity Workshop, Wales (1995)
18. *Computational efficiency of extraction and matching* Third Texas workshop on 3-dimensional numerical relativity, University of Texas at Austin, U.S.A. (1995)

19. *Multiple black hole data via a Kerr-Schild approach* Binary black hole alliance meeting, Pennsylvania State University, U.S.A. (1997)
20. *Cauchy-characteristic matching in numerical relativity* GR15, Pune, India (1997)
21. *Analytic data for close black holes in the Kerr-Schild gauge* Binary black hole alliance meeting, University of Pittsburgh, U.S.A. (1998)
22. *Characteristic evolution of matter falling into black holes* Binary black hole alliance meeting, University of Texas at Austin, U.S.A. (1998)
23. *A review of the characteristic approach to numerical relativity, including recent results* IUCAA decennial meeting, Pune, India (1999)
24. *Black hole data via a Kerr-Schild approach* Workshop on initial data for binary black holes, Albert Einstein Institute, Potsdam, Germany (1999)
25. *Overview of the GRACE project and Initial data for a polytope in orbit around a Schwarzschild black hole* GRACE workshop, Albert Einstein Institute, Potsdam, Germany (1999)
26. *Object-orientation in Java for scientific programmers*, SIGCSE 2000, Austin, Texas, U.S.A. (2000)
27. *The black hole and neutron star problem in characteristic numerical relativity and The construction of exact solutions for the intrinsic geometry of black hole horizons* Ninth Marcel Grossmann meeting, Rome, Italy (2000)
28. *The initial value problem in characteristic numerical relativity* GR16, Durban, South Africa (2001)
29. *Initial data in characteristic numerical relativity* nr2001, Krugersdorp, South Africa (2001)
30. *A numerical model for a massive particle in a black hole spacetime* Gravitational Interaction of Compact Objects, Kavli Institute of Theoretical Physics, University of California at Santa Barbara, U.S.A. (2003)
31. *Black hole initial data from a non-conformal decomposition* Numeric and analytic properties of the vacuum Einstein equations, University of Tübingen, Germany (2003)
32. *Initial data from a non-conformal decomposition of the constraints* Sources of Gravitational Waves, I.C.T.P., Trieste, Italy (2003)
33. *The evolution of a massive particle in the characteristic gravity code II* Workshop on formulations of Einstein's equations for numerical relativity, U.N.A.M., Mexico City, Mexico (2003)
34. *Gravitational radiation in characteristic (null-cone) numerical relativity* GR17, Dublin, Ireland (2004)
35. *Using analytic solutions of the linearized Einstein equations to test a characteristic code*, New Frontiers in Numerical Relativity, Potsdam, Germany (2006)
36. *Analytic solutions of the linearized Einstein equations used to test and develop a characteristic code*, Eleventh Marcel Grossmann meeting, Berlin, Germany (2006)
37. With B. Szilagyi, *Characteristic extraction in numerical relativity*, 18th International Conference on General Relativity and Gravitation, Sydney, Australia, 8-14 July 2007
38. *A general purpose approach to Cauchy-Characteristic Extraction*, Post Newton 2008 International Workshop, University of Jena, Germany, 11 to 14 June 2008
39. (With C Reisswig, D Pollney and B Szilagyi) *Determination of unambiguous binary black hole merger waveforms at scri*, Numerical relativity data analysis meeting, Potsdam, Germany (2009)
40. (With C Reisswig, D Pollney and B Szilagyi) *Determination of unambiguous binary black hole merger waveforms at scri*, Twelfth Marcel Grossmann meeting, Paris, France (2009)
41. (With M Khumalo, A Kubeka, M Naidoo, D Pollney, C Reisswig and B Szilagyi) *Characteristic extraction, and initial data for Cauchy-characteristic matching*,

- 19th International Conference on General Relativity and Gravitation, Mexico City, Mexico, 5-9 July 2010
42. (With C Reisswig and D Pollney) *Initial data transients in binary black hole evolutions*, Advances and challenges in computational general relativity, Brown University, USA, 20-22 May 2011
 43. (With C Reisswig and D Pollney) *Initial data transients in binary black hole evolutions*, Numerical relativity data analysis, University of Wales, Cardiff, UK, 10-12 July 2011
 44. (With C Reisswig and D Pollney) *Numerical relativity null cone evolutions at 4th order accuracy*, 13th Marcel Grossman meeting, Stockholm, Sweden 1-7 July 2012
 45. (With C Reisswig) *Calculation of gravitational radiation in characteristic numerical relativity*, 20th International Conference on General Relativity and Gravitation, Warsaw, Poland, 7-13 July 2013
 46. (With L Rezzolla) *Extraction of GWs from a numerical simulation* Sant Cugat Forum on Astrophysics, Barcelona, Spain, 22–25 April 2014
 47. *Applications of analytic methods in the characteristic formalism: Initial data, QNMs and GWs from EMRIs* Gravitational Wave Astronomy workshop, Jena, Germany, 1 – 5 December 2014
 48. *Gravitational waves in de Sitter spacetime* FTAG XI, Bose Centre, Kolkata, India, 22–26 February 2016
 49. *Gravitational waves in de Sitter spacetime* 21st International Conference on General Relativity and Gravitation, New York, USA, 10 – 15 July 2016

South African Mathematical Society annual conferences

50. *Quantum gravity* Pretoria (1978)
51. *Time-varying gravity and the abundance of Helium* Cape Town (1979)
52. *Recent progress in general relativity* Durban (1980)
53. *On the variational principle of general relativity* Port Elizabeth (1981)
54. *The horizons of a pair of Schwarzschild black holes* Pretoria (1982)
55. *The action integral of Yang-Mills field theories* Grahamstown (1984)
56. *Poincaré's inequality and the action of gauge field theories* Pretoria (1985)
57. *Something out of nothing particle production in curved space-times* Stellenbosch (1987)
58. *Do tachyons produce an unacceptable gravitational field?* Kruger National Park (1988)
59. *The Cauchy and characteristic initial value problems in numerical relativity* Pretoria (1991)
60. *Numerical relativity with Bondi coordinates at future null infinity* Cape Town (1992)
61. *The characteristic initial value problem in observational cosmology* Pietermaritzburg (1993)
62. *The Cauchy-characteristic matching problem* Durban-Westville (1995)
63. *The in-spiral and coalescence of two black holes* Western Cape (1996)
64. *A new approach to radiation boundary conditions* Pretoria (1997)
65. *Numerical relativity in a Bondi-Sachs coordinate system* Johannesburg (1998)
66. *The initial value problem in general relativity* Pietersburg (1999)
67. *The intrinsic geometry of black hole horizons* Unisa (2000)
68. *Explicit construction of a transformation from ingoing to outgoing Bondi-Sachs coordinates* Durban-Westville (2001)
69. *A numerical relativity code for evolving a neutron star near a massive black hole* Stellenbosch (2002)
70. *Linearized solutions of the Einstein equations for the Bondi-Sachs metric* Grahamstown (2005)

71. *The calculation of gravitational radiation*, Bloemfontein (2006)
72. *The wave form of the head-on collision of two black holes by characteristic extraction*, Cape Town (2007)
73. *Gravitational radiation*, **Plenary lecture**, Durban (2008)
74. (With A S Kubeka) *Quasi-Normal Modes of a Schwarzschild White Hole*, Johannesburg (2009)
75. (With D Pollney, B Szilagy and C Reisswig) *The gravitational radiation from a binary black hole merger*, Pretoria (2010)
76. *Gravitational wave astronomy*, Port Elizabeth (2011)
77. (With C Reisswig and D Pollney) *Characteristic numerical relativity at fourth order accuracy*, Stellenbosch (2012)
78. *Compactification, asymptotic vacuum Einstein equations, and gravitational radiation*, Pietermaritzburg (2013)
79. *The characteristic formalism of numerical relativity in cosmology*, Unisa Florida (2014)

Other South African conferences

80. *The action integral minimum or stationary* “Hanno Rund” colloquium, Durban (1984)
81. *Is superluminal travel a theoretical possibility?* “W B Bonnor” Relativity Workshop, Cape Town (1985)
82. *Numerical relativity* Fourteenth South African symposium on numerical mathematics (1988)
83. *The characteristic initial value problem in numerical relativity* Seventeenth South African symposium on numerical mathematics (1991)
84. *Progress with the characteristic initial value problem in numerical relativity* Eighteenth South African Symposium on numerical mathematics (1992)
85. *Gravitational wave calculations on null cones* Symposium of the Astronomical Society of Southern Africa (1993)
86. *Numerical relativity and observational cosmology* “Hanno Rund” colloquium on general relativity and cosmology, Durban (1994)
87. *The characteristic formulation of numerical relativity* Gravity theory and its applications to cosmology, Cape Town (1995)
88. *The 3d wave equation with Cauchy-characteristic matching* Twenty-first South African Symposium on numerical mathematics (1995)
89. *Cauchy-characteristic matching in numerical relativity* National Relativity Workshop, Zululand (1995)
90. *The binary black hole problem* “Hanno Rund” colloquium on general relativity and cosmology, Durban (1996)
91. *Cauchy-characteristic matching in numerical relativity* Second conference of the Southern African Relativity Society, Pretoria (1997)
92. *General relativity as a characteristic initial value problem* Third conference of the Southern African Relativity Society, Cape Town (1999)
93. *Boundary conditions and stability in linearized gravitation theory* SANUM 2000, Stellenbosch (2000)
94. *Initial data in the characteristic formulation of relativity* “Hanno Rund” Conference on differential equations and applications, Durban (2000)
95. *Gravitational radiation: numerical code, and series solution by means of computer algebra* SANUM, Stellenbosch (2005)
96. *Computer algebra* **Plenary address** at AMESA 11th National Congress, Kimberley (2005)
97. *The Kerr solution in Bondi-Sachs form* Southern African Relativity Society Einstein

- Centennial Meeting, Durban (2005)
98. *Using analytic solutions of the linearized Einstein equations to test a characteristic code* Conference of the Southern African Relativity Society, Pretoria (2006)
 99. *Gravitational radiation from an equal mass binary* Differential Equations and Symmetries with Applications, Durban (2006)
 100. *Computation of gravitational radiation using Cauchy-characteristic extraction* Conference of the Southern African Relativity Society, Cape Town (2008)
 101. *Characteristic extraction in numerical relativity*, Conference of the South African Gravity Society, Durban (2009)
 102. *Gravitational radiation: Detectors, astrophysical sources, data analysis, and template computation*, Conference of the South African Gravity Society, Grahamstown (2011)
 103. *The mathematics of gravitational radiation*, **Invited address** at East Cape Postgraduate Seminar, Port Elizabeth (2012)
 104. *Gravitational wave astronomy*, Astronomy Town Meeting, Cape Town (2013)
 105. *Calculation of gravitational radiation in characteristic numerical relativity*, Conference of the South African Gravity Society, Durban (2013)
 106. *Observations on past null cones, numerical relativity, and cosmology* Conference of the South African Gravity Society, Cape Town (2014)
 107. *The gravitational wave event GW150914* Conference of the South African Gravity Society, Durban (2016)
 108. *Introduction to Gravitational Wave Astronomy*, **Invited address** at HEASA, Cape Town (2016)
 109. *The gravitational wave event GW150914 (and GWGW151226, LVT151012)*, Conference of the South African Institute of Physics, Cape Town (2016)
 110. *The numerical calculation of gravitational waves*, **Invited address** at SANUM, Johannesburg (2017)
 111. *Current status of gravitational wave observations*, **Invited address** at HEASA, Johannesburg (2017)

7. Sabbaticals

- Department of Applied Mathematics and Theoretical Physics, University of Cambridge, U.K. with Professor S W Hawking (December 1980 - April 1981)
- Department of Mathematics, University of Southampton, U.K. with Professor P T Landsberg (December 1985 - December 1986)
- Department of Physics and Astronomy, University of Pittsburgh, U.S.A. with Professor J Winicour (August 1994 - February 1995)
- Department of Physics and Astronomy, University of Pittsburgh, U.S.A. with Professor J Winicour (September 1998 - February 1999)
- Albert Einstein Institute for Gravitational Physics, Berlin, Germany with Professor Ed Seidel's group (June 2003 - October 2003)
- Department of Physics and Astronomy, Louisiana State University, U.S.A. with Professor Luis Lehner (October 2003 - January 2004)

8. Refereeing

Journals

- Physical Review D
- Classical and Quantum Gravity
- General Relativity and Gravitation
- Astronomy and Astrophysics

Funding agencies

- National Research Foundation (South Africa)
- National Science Foundation (U.S.A.)

9. Invited seminars

Austria

- Erwin Schroedinger Institute, Vienna

Canada

- Département de Physique, Université du Québec à Trois-Rivières
- Department of Applied Mathematics, University of Waterloo
- Perimeter Institute, Waterloo

France

- Institut d'astrophysique de Paris, Paris

Germany

- Albert Einstein Institute for Gravitational Physics, Berlin
- Institute of Theoretical Physics, Goethe University, Frankfurt

India

- Indian Institute of Astrophysics, Bangalore
- Inter-University Centre for Astronomy and Astrophysics, Pune
- Tata Institute for Fundamental Research, Bombay
- Department of Mathematics, University of Pune
- Department of Physics, University of North Bengal
- SN Bose Centre for the Basic Sciences, Kolkatta

Japan

- Faculty of Science and Engineering, Kinki University, Osaka

South Africa

- Numerous

Spain

- Department of Physics, Universitat de les Illes Balears. Palma de Mallorca

Swaziland

- University of Swaziland

Turkey

- Koç Üniversitesi, Istanbul
- Bogaziçi Üniversitesi, Istanbul
- Sabanci Üniversitesi, Istanbul

U.K.

- Department of Mathematics, University of Birmingham

- D.A.M.T.P., University of Cambridge
- Department of Physics, University College, Cardiff
- Department of Mathematics, Queen Mary College, London
- Mathematical Institute, University of Oxford
- School of Mathematical Studies, University of Portsmouth
- Department of Mathematics, University of Southampton
- Department of Mathematics, University of Surrey
- Institute of Astronomy, University of Sussex

U.S.A.

- Department of Physics, University of Florida at Gainesville
- NCSA, University of Illinois at Urbana-Champaign
- Department of Physics and Astronomy, Louisiana State University
- Center for Relativity, Penn State University, State College
- Department of Physics and Astronomy, University of Pittsburgh
- Center for Relativity, University of Texas at Austin
- Department of Physics, University of Texas at Brownsville
- Department of Physics, Washington University, St. Louis

Zimbabwe

- Department of Mathematics, University of Zimbabwe, Harare

10. Presentation of research schools

- *Numerical relativity*, Inter-University Centre for Astronomy and Astrophysics, Pune, India, June 1994
- *Numerical relativity*, Inter-University Centre for Astronomy and Astrophysics, Pune, India, January 2002
- *The dark side of the Universe*, “Chris Engelbrecht” Summer School, Drakensberg, South Africa, January 2006
- *Gravitational Wave Astronomy* “Chris Engelbrecht” Summer School, Rhodes University, South Africa, January 2013

11. Public lectures

- *Black holes and other recent developments in relativity* on Einstein's centenary, 1979
- *Frontiers of relativity: black holes and the creation of the Universe* Inaugural lecture, 1992

12. Professional societies

Membership

- Fellow of the Royal Astronomical Society 1977
- Member of the International Society on General Relativity and Gravitation 1980
- Member of the South African Mathematical Society 1980
- Member of the American Mathematical Society 1995
- Member of the Southern African Relativity Society 1996
- Member of the Academy of Science of South Africa 2001

Posts

- South African Mathematical Society: Council member 1995 - 2015; Treasurer 1996-1998, 2001 - 2003; **President** 2003 - 2007
- Southern African Relativity Society: Council member 1996- 2011; **President** 2006 – 2011
- International Society on General Relativity and Gravitation: Council member 2007 – 2013; Election officer 2013

13. Conference organization

- Organizer of the 2nd Southern African Relativity Society Conference at the University of South Africa, Pretoria, South Africa, 1997
- Organizer of the workshop on General Relativistic Astrophysics by Characteristic Evolution (GRACE), University of Pittsburgh, U.S.A., 1999
- Member of the Local Organizing Committee, and also of the International Scientific Organizing Committee, for the 16th International Conference on General Relativity and Gravitation, Durban, South Africa, 2001
- Organizer of the nr2001 Workshop, Krugersdorp, South Africa, 2001
- Member of the organizing committee for the SAMS Congress, University of Durban-Westville, 2001
- Organizer of the Southern African Relativity Society Conference at the University of South Africa, Pretoria, South Africa, 2006
- Organizer of the South African Gravity Society Conference at Rhodes University, Grahamstown, South Africa, 2011
- Organizer of Workshop on Gravitational Wave Astronomy, St George’s Hotel, Pretoria, South Africa, 2012

14. Research students

Completed MSc

- R W Janse van Rensburg *Classical gauge theory* 1982
- S D Maharaj *Invariant distribution functions for collision-free gases in locally rotationally symmetric space-times with distinction* 1984
- A J Kemball *The numerical determination of apparent horizons with distinction* 1989
- H H Coetzee *Numerical solutions of the nonlinear scalar wave equation as a characteristic initial value problem* 1994
- J Leach *An analysis of geodesics in the brane world scenario with distinction* 2004
- W Wright *The ADM approach to numerical relativity with distinction* 2004
- J P Adamiak *Static and dynamic traversable wormholes with distinction* 2005
- A S Kubeka *Linear perturbations of a Schwarzschild black hole with distinction* 2006
- M Naidoo *Tidal distortion of a neutron star in the vicinity of a black hole* 2008

Completed PhD

- R A Anguelov *Aspects of interval analysis applied to initial-value problems for ordinary differential equations and hyperbolic partial differential equations* 1999 (Jointly supervised with C Wright)
- P J van der Walt *Numerical relativity on cosmological past null cones* 2013
- A S Kubeka *Applications of linearized perturbations of the Schwarzschild geometry within the Bondi-Sachs formalism* 2013
- H L Bester *Observational cosmology from imperfect data* 2016 (Jointly supervised

with J Larena)

Postdoctoral

- P Haines 1994 – 1996
- S Deshingkar 2002 – 2004
- C-W Lai 2005 – 2006
- C Stevens 2017 –

Current MSc

- T A Dyeyi
- M Nabatanzi

Current PhD

- O S Amamuddy
- M Naidoo

15. Lecturing experience

University of the Witwatersrand

- Mechanics, 1st year
- Modelling and O.R., 1st year
- Mechanics (Engineering), 1st year
- Electrodynamics, 2nd year
- Elasticity (Engineering), 2nd year
- Methods of applied mathematics, 3rd year
- Vectors and tensors, 3rd year
- Numerical methods (Engineering), 3rd year
- Complex variable theory, Honours
- Cosmology, Honours
- Fluid dynamics, Honours
- General relativity, Honours
- Nonlinear differential equations, Honours
- Advanced gravitation theory, MSc
- Advanced cosmology, MSc

University of South Africa

- Applied linear algebra, 1st year
- The dynamic cosmos, 1st year
- Particle mechanics, 1st year
- Applied dynamical systems, 2nd year
- Computer algebra, 2nd year
- Numerical methods 2, 3rd year
- Finite elements, 3rd year
- Partial differential equations, 3rd year
- Numerical analysis, Honours
- General relativity, Honours

University of Pittsburgh

- Thermodynamics and electromagnetism, 1st year

Rhodes University

- Linear algebra, differential equations, Mathematics 1, 1st year
- Programming with MATLAB, Mathematics and Applied Mathematics 2, 2nd year
- Numerical analysis, Applied Mathematics 3, 3rd year
- Dynamical systems, Applied Mathematics 3, 3rd year
- General relativity, Honours

16. Managerial and administrative experience

University of the Witwatersrand

- **Department of Computational and Applied Mathematics**
 - Implementation of the REDUCE computer algebra system 1978-1980
 - Editor of *The Applied Mathematician* -a magazine for schools 1979-1980
- **Faculty of Science**
 - Chairperson of the Mathematical Sciences Committee 1985
 - Chairperson of the Senior Common Room Management Committee 1987-1988
 - Jointly responsible for restructuring 1st year mathematical science courses 1982-1983
 - Jointly responsible for funding policy 1983-1985
 - Responsible for liaison with schools 1984-1985
 - **Assistant Dean (financial planning)** 1988, 1990-1991

University of South Africa

- **Department of Mathematical Sciences**
 - Responsible for the applied mathematics sub-department
 - At times, Acting Chair
- **Faculty of Science / College of Science, Engineering and Technology**
 - Member of the Research and Ethics Committee 2006 -
 - Chairman of the Computer Committee 1993-2000
 - Chairman of the Publicity Committee 1993-2000
 - Chairman of the Tuition Committee 1994-2000
 - Chairman of the Review Committee for bridging mathematics 1994-1995
 - **Vice-Dean** (and at times **Acting Dean**) and member of all Faculty committees 1994-2000, and as such
 - Responsible for introducing a joint 1st year Engineering programme with Potchefstroom University
 - Responsible for introducing Faculty Open Day, and various Faculty marketing initiatives
 - Responsible for simplifying Faculty course structures
 - Responsible for re-organizing research support within the Faculty
- **Department of Chemistry**
 - **Acting Head** of the Department 2000
- **Member of University committees (at various times)**
 - Appointment committees (various)
 - Building advisory committee
 - Deans committee
 - Disciplinary committees (various)
 - Library committee
 - Personnel formula committee
 - Policy council

- Research and bursaries committee
- Research output committee
- Senate
- Senate executive committee
- Senate committee on integrated learner support
- Transformation steering committee
- Tuition committee
- University broad transformation forum
- University representative, **National Science and Technology Forum** 1995-2000

Rhodes University

- Head of Department of Mathematics (Pure & Applied) 2009 – 2015
- Various appointment committees
- Senate
- Information Technology Steering Committee 2010 – 2011
- University Research Committee 2010

African Institute of Mathematical Sciences

- Member of the Advisory Board 2004 - 2007

South African Mathematical Foundation

- Member of the Board of Directors 2004 – 2015
- Deputy Chairperson 2005, 2007 – 2008, 2011 – 2012
- **Chairperson** 2006, 2009 – 2010, 2013 – 2014

Department of Science and Technology, South Africa

- Member of a delegation to Russia for a meeting of the General Science and Technology Joint Committee, July 2005
- Chairperson of the Review Oversight Committee for an international review of research in mathematical sciences in South Africa, 2008

17. Qualification details

A Levels

- Rutlish Grammar School, Merton, London (1963-1970)

Undergraduate

- Gonville and Caius College, University of Cambridge (1970-1973) reading Mathematics
- Graduated to **BA Honours** 1973 and to **MA** 1977

Doctorate

- Department of Mathematics, University of Southampton (1973-1976) under Professor P T Landsberg for a thesis *A trip through gravitation theory*
- Graduated to **PhD** 1977

18. Personal

Born	11 September 1951 in London
Nationality	South African, United Kingdom
Marital status	Married to A. Ozlem Tastan Bishop

