Curriculum Vitae

ANIL SHAJI

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Personal Information

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Nationality:	Citizen of India

Born on 19 May 1976 at Trivandrum, Kerala, India
Married to Neelima Gopinath on 1 June 2005

Education

June 1993 – May 1996:	The University of Kerala, Trivandrum, India B.Sc. in Physics (University College, Trivandrum).
June 1996 – May 1998:	Indian Institute of Technology, Chennai, India. M. Sc. in Physics. Thesis supervisor: Prof. V. Balakrishnan. Title: Statistical measures of chaotic systems.
June 1998 – May 2005:	The University of Texas at Austin Ph.D. in Physics 2005 Thesis supervisor: Prof. E. C. G. Sudarshan Title: Dynamics of initially entangled open quantum systems.

Present position

Assistant professor at the Indian Institute of Science Education and Research - Thiruvananthapuram,
June 2009 – present

Previous positions

Post-doctoral fellow with Prof. Carlton M. Caves, Information Physics Group,

The University of New Mexico, Fall 2005 – Spring 2009.

Graduate research assistant, University of Texas at Austin, Spring 2005

Assistant Instructor, University of Texas at Austin, Summer 2002 to Fall 2004

Teaching assistant, University of Texas at Austin, Fall 1998 – Spring 2002

Research interests

Quantum information theory: Quantum metrology, The fundamental relationship between available measurement resources and the information that can be extracted from physical systems. The characterization and applications of Quantum Entanglement, Non-classical correlations other than entanglement in quantum systems, Quantum discord, The DQC1 model for quantum information processing. Implementation of quantum information processors using quantum waveguide networks

Open quantum systems: The Theory of open quantum systems, Entanglement and other non-classical correlations in open quantum dynamics, Decoherence in quantum metrology, Positive and completely positive stochastic maps, Zeno and anti-Zeno effects. Lorentz transformations on quantum systems. Quantum master equations for systems that are entangled or correlated with the environment.

Statistical mechanics, chemical physics and bio physics: Quantum dynamical semigroups, Kossakowski-Lindblad type master equations. Chaos in low dimensional systems and their quantum analogs. The spin-statistics connection and other direct classical manifestations of quantum properties. Energy transfer processes in chemical and biological systems. Pattern formation in plants

Research Experience

- 2009 - present: Assistant professor at IISER Thiruvananthapuram
- Three years of experience as a postdoctoral researcher at Department of Physics and Astronomy, University of New Mexico working in the Information Physics group
- Four years working with the research group of Prof. E. C. G. Sudarshan as a graduate student at the University of Texas at Austin (2001 – 2005)
- One year working with the research group of Prof. Ilya Prigogine at the University of Texas at Austin (2000 – 2001)
- During the summer of 1999, I worked with the research group of Prof. Harry Swinney at the University of Texas and I built a fluid dynamics experiment from scratch and obtained the preliminary data required to start a larger experimental project.
- In Summer 1997, I participated in the Visiting Student Research Program at the Tata Institute of Fundamental Research, Mumbai, India. I worked with Prof. D. Narasimha of the astrophysics group on numerical simulations of three star collisions in globular clusters
- During Summer 1995, I participated in the The Rajiv Gandhi Research Fellowship program offered by JNCASR, Bangalore, India and gained research experience at the Institute of Mathematical Sciences, India with Prof. R. Parthasarathy.

Teaching Experience

Courses taught at IISER Thiruvananthapuram:

- PHY 211: Quantum mechanics 1 (Varsha 2009)

- PHY 121: Electromagnetic theory (Vasanth 2010, Vasanth 2013)
- PHY 611: Mathematical Methods for Physics (Vasanth 2010)
- PHY 312: Classical Mechanics (Varsha 2010, Varsha 2013)
- PHY 322: Special Theory of Relativity and Electrodynamics (Vasanth 2011)
- PHY 313: Quantum Mechanics 2 (Varsha 2011)
- PHY 422: Atomic and Molecular Physics (Vasanth 2012)

University of Texas at Austin:

- Assistant instructor and head T. A., 2001 – 2005. Developed a new set of lab exercises and a lab manual for the PHY 102M undergraduate laboratory
- Teaching assistant at the department of Physics, University of Texas, 1998 – 2001

Professional activities and memberships

Member, American Physical Society
Referee for Phys. Rev. Lett., Phys. Rev. A, J. Phys. A, Nature Physics, Journal of Mathematical Physics.

Awards and Fellowships

Ramanujan Fellowship, Department of Science and Technology, Government of India (2010)

Invited to participate in the Pan American School on the Physics of Information (PASI) 2003, at Buzios, Brazil.

Prof. Chilikuri Rama Sastri memorial gold medal awarded by the Indian Institute of Technology - Chennai for the highest GPA in M.Sc. Physics class of 1998.

Gold medal for best graduating student in B.Sc. physics at university college, Trivandrum, Kerala, 1996.

National talent search scholarship, awarded by the Government of India, 1993 - 98.

The council for industrial and scientific research (CSIR) - India, golden jubilee merit fellowship, 1991.

Tenth rank in the state in the secondary school leaving examination, state of Kerala, India, 1991.

Invited talks and presentations

Saffmann Taylor instability in a Hele-Shaw cell: Invited talk at the center for non-linear dynamics, the University of Texas at Austin, August 1999.

Perturbation theory on generalized quantum systems: Talk at the department of Physics, University of Texas, November 2001

Bell states in resonant quantum waveguide network: Poster presented at 'Nano-night' November 2004, University of Texas

Measurement of quantum systems: the Zeno and anti-Zeno effects: Invited talk at the center for statistical mechanics, University of Texas, March 2004

The dynamics of initially entangled open quantum systems: Invited talk at the Perimeter institute for theoretical physics, Waterloo, Canada, January 2005

The dynamics of initially entangled open quantum systems: Invited talk at the information physics group, University of New Mexico, Albuquerque, January 2005

The dynamics of initially entangled open quantum systems: Thesis defense, the University of Texas at Austin, April 2005

Measuring with qubits: Poster presented at SQuInT 2006, Albuquerque NM

Measuring with qubits: Invited talk at the International School for Photonics, Cochin University of Science and Technology, Cochin, Kerala, India, Sept 1, 2006

An introduction to quantum information theory: Invited talk at the Department of Physics, University of Kerala, Trivandrum, India, Sept 15, 2006

Sudarshan's non-relativistic approach to the spin-statistics connection: Invited talk at the *Sudarshan - 7 Science Quests* conference, Austin, Texas, November 2006

Multiply constrained bounds on measures of entanglement: Invited talk at SQuInT-07, Pasadena, CA, February 2007

Multiply constrained bounds on measures of entanglement: Contributed talk at APS March meeting, Denver CO 2007

Resources and decoherence in qubit metrology: Poster presented at Quantum Workshop, Los Alamos National Laboratory, New Mexico, December 2007.

Resources and decoherence in qubit metrology: Contributed talk at SQuInT 2008, Santa Fe, February 2008

Generalized quantum metrology with BECs: Invited talk at the center for complex quantum systems, University of Texas at Austin, April 2008

Quantum metrology from an information theory perspective: Invited talk at the Institute for mathematical sciences, Chennai, India, July 2008

Quantum metrology from an information theory perspective: Colloquium at the Tata Institute of Fundamental Research, Mumbai, India, August 2008

On the role of entanglement in quantum information processing: invited talk at the Tata Institute of Fundamental Research, Mumbai, India, August 2008

Quantum metrology with Bose-Einstein condensates: Contributed talk at QCMC 2008, Calgary, Canada, August 2008

Heisenberg limited metrology with mode entangled coherent states: Contributed talk at SQuInT 2009 Seattle, USA, February 2009

The Quantum Zeno Effect: Invited talk at the International School of Photonics, Cochin University of Science and Technology, Kerala, India, October 2009

Introduction to Quantum Information Theory: Invited talk at the XXIV UGC refresher course in Physics UGC Staff College, Thiruvananthapuram, India, October 2009

The Quantum Zeno Effect: Invited talk at the XXIV UGC refresher course in Physics UGC Staff College, Thiruvananthapuram, India, October 2009

Measurements and Quantum Mechanics: Invited talk at the XXIV UGC refresher course in Physics UGC Staff College, Thiruvananthapuram, India, October 2009

Quantum Cryptography: Keynote address at the AICTE workshop on advanced computation at College of Engineering - Perumon, India, November 2009

Quantum Information Theory: Theoretical Challenges: Invited talk at the Indian Institute for Space Science and Technology, Thiruvananthapuram, India, February 2010

Quantum Cryptography with Quantum Optics: Invited talk at the International School of Photonics,

Cochin University of Science and Technology, Kerala, India, February 2010

Science on a T-shirt: Invited talk at the annual refresher course for teachers at St. Thomas high school, Thiruvananthapuram, India, May 2010

NonClassical Measures of Correlations in Quantum states: Invited lecture at the National Workshop on Quantum Information, Institute of Mathematical Sciences, Chennai, December 2010

Quantum metrology: Invited lecture at the National Workshop
on Quantum Information, Institute of Mathematical Sciences, Chennai, December 2010

Quantum Cryptology: Invited talk at the Kerala Science Congress, January 2011

Measurements and quantum mechanics: Invited lectures at the discussion meeting on the impact of quantum effects on our classical world view, M. G. University, Kottayam, Kerala, India, January 2011

NonClassical Measures of Correlations in Quantum states: at the National Workshop on Recent trends in theoretical Physics, Department of Physics, Cochin University, Cochin, Kerala, India, March 2011

Quantum computing: Two lectures ad the workshop sponsored by the National Academies at the Amrita Viswa Vidyalaya, Amritapuri, Kerala, India, March 2011

Measurements and quantum mechanics: Invited seminar at the deparatment of Physics, Pondicherry University, India, March 2011

Quantum information theory and quantum computing: Lecture series at the UGC refresher course in computer science, UGC staff college, Thiruvananthapuram, Kerala, India, October 2011

Solid state qubits an overview: Invited talk at the JNC research conference on the Chemistry of Materials, Kochi, Kerala, October 2011

Quantum information theory and quantum computing: Invited talk at the department of computer science, University of Kerala, Thiruvananthapuram, Kerala, India, November 2011

Entropic measures of non classical correlations: Invited talk at the International school and conference on quantum information, Institute of Physics - Bhubaneswar, India, December 2011

Structure of Physics: Invited talk at CPYLS 2011, NIIST-Thiruvananthapuram, December 2011

Non-Classical correlations in quantum systems: Invited talk at the international workshop on quantum discord, National University of Singapore, January 2012

Quantum limited measurements: Invited talk at the workshop on atomic and molecular physics at the Indian Institute of Space Science and Technology Thiruvananthapuram, March 2012

Quantum Information theory: Invited talk at the workshop on recent trends in theoretical physics, Organized by Srinivasa Ramanujan Institute of Basic Sciences, Thiruvananthapuram, August 2013

Publications

1. Book length publications

1. Ph. D. Thesis: *Dynamics of Initially Entangled Open Quantum Systems*,
   The University of Texas at Austin, May 2005.
2. *PHY 102 M Lab Manual*, The University of Texas at Austin (2004)

2. Technical articles in peer reviewed journals

1. E. C. G. Sudarshan and Anil Shaji, *Structure and parameterization of stochastic maps of density matrices*, J. Phys. A. **36**, 5073-5081 (2003) [arXiv:quant-ph/0205051]
2. Gursoy Akguc, Linda Reichl, Anil Shaji and Michael Snyder, *Bell States in a resonant waveguide network*, Phys. Rev. A., **69** 042303 (2004)
3. Anil Shaji, *Appendix to 'The promise of quantum computing'* by E. C. G. Sudarshan, Current Science (India), **84**, 511 (2003). http://www.ias.ac.in/currsci/feb252003/504.pdf
4. Anil Shaji, *The quantum Zeno effect: A solvable model for indirect pre-measurement*, J. Phys. A. **37**, 11285-11308 (2004)
5. Kavan Modi and Anil Shaji, *Quantum Zeno and anti-Zeno effects in an unstable system with two bound states*, Phys. Lett. A **368**, 215-221 (2007) [arXiv:quant-ph/0502075]
6. Thomas F. Jordan, Anil Shaji and E. C. G. Sudarshan, *Dynamics of initially entangled open quantum systems*, Phys. Rev. A **70**, 052110 (2004) [arXiv:quant-ph/0407083]
7. Olga V. Manko, V. I. Manko, G. Marmo, Anil Shaji, E. C. G. Sudarshan and F. Zaccaria, *Partial positive scaling transform: a separability criterion*, Phys. Lett. A **339**, 194-206 (2005) [arXiv:quant-ph/0502089]
8. Anil Shaji and E. C. G. Sudarshan, *Who's afraid of not completely positive maps?*, Phys. Lett. A **341**, 48-54 (2005)
9. Thomas F. Jordan, Anil Shaji and E. C. G. Sudarshan, *Mapping the Schrodinger picture for open quantum systems*. Phys. Rev. A **73**, 012106 (2006) [arXiv:quant-ph/0505123]
10. Thomas F. Jordan, Anil Shaji and E. C. G. Sudarshan, *Maps for Lorentz transformations of spin*, Phys. Rev. A **73**, 032104 (2006) [arXiv:quant-ph/0511067]
11. Sergio Boixo, Carlton M. Caves, Animesh Datta and Anil Shaji, *On Decoherence in Quantum Clock Synchronization* Laser Physics, **16**, 1 (2006) [arXiv:quant-ph/0605013]
12. Thomas F. Jordan, Anil Shaji and E. C. G. Sudarshan, *Lorentz transformations that entangle spin and entangle momenta*, Phys. Rev. A **75**, 022101 (2007) [arXiv:quant-ph/0608061]
13. Thomas F. Jordan, Anil Shaji and E. C. G. Sudarshan, *One qubit almost completely reveals the dynamics of two*, Phys. Rev. A **76** 012101 (2007) [arXiv:quant-ph/0611141]
14. Animesh Datta, Steven T. Flammia, Anil Shaji and Carlton M. Caves, *Constrained bounds on measures of entanglement*, Phys. Rev. A **75** 062117 (2007) [arXiv:quant-ph/0612049]
15. Thomas F. Jordan, Anil Shaji and E. C. G. Sudarshan, *Entanglement increase from local interactions and not completely positive maps*, Phys. Rev. A **76**, 022102 (2007) [arXiv:0704.0461]
16. Anil Shaji and Carlton M. Caves, *Qubit metrology and decoherence*, Phys. Rev. A **76**, 032111 (2007) [arXiv:0705.1002]
17. Animesh Datta Anil Shaji and Carlton M. Caves, *Quantum discord and the power of one qubit*, Phys. Rev. Lett. **100**, 050502 (2008) [arXiv:0709.0548]
18. Sergio Boixo, Animesh Datta, Steven T. Flammia, Anil Shaji, Emilio Bagan and Carlton M. Caves, *Quantum-limited metrology with product states*, Phys. Rev. A **77**, 012317 (2008) [arXiv:0710.0285]
19. Cesar A. Rodriguez, Kavan Modi, Aik-meng Kuah, Anil Shaji and E. C. G. Sudarshan, *Completely Positive Maps and Classical Correlations*, J. Phys. A: Math. Theor. **41**, 205301 (2008) [arXiv:quant-ph/0703022]
20. Thomas F. Jordan, Anil Shaji and E. C. G. Sudarshan, *A hazard of open quantum dynamics: Markov*

approximations encounter map domains, Phys. Rev. A **77**, 032104 (2008) [arXiv:0711.4370]

21. Sergio Boixo, Animesh Datta, Matthew J. Davis, Steven T. Flammia, Anil Shaji and Carlton M. Caves, *Quantum Metrology: Dynamics vs. Entanglement*, Phys. Rev. Lett **101**, 040403 (2008) [arXiv:0805.2180]

22. Sergio Boixo, Animesh Datta, Matthew J. Davis, Anil Shaji, Alexandre B. Tacla and Carlton M. Caves *Quantum-limited metrology and Bose-Einstein condensates*, Phys. Rev. A **80**, 032103 (2009) [arXiv:0906.0962]

23. Thomas F. Jordan and Anil Shaji, *Repeatable procedures and maps in open quantum dynamics*, Phys. Lett. A **373**, 4219 (2009) [arXiv:0903.4690]

24. Carlton M. Caves and Anil Shaji, *Quantum-circuit guide to optical and atomic interferometry*, Optics communications **283**, 695 (2010) [arXiv:0909.0803]

25. Alexandre B. Tacla, Sergio Boixo, Animesh Datta, Anil Shaji, and Carlton M. Caves, *Nonlinear Interferometry with Bose-Einstein Condensates*, Phys. Rev. A **82**, 053636 (2010) [arXiv:1008.1551]

26. Matthias D. Lang, Carlton M. Caves, and Anil Shaji, *Entropic measures of nonclassical correlations*, International Journal of Quantum Information **9**, 1553 (2011) [arXiv:1105.4920]

27. Animesh Datta and Anil Shaji, *Quantum Discord and Quantum Computing - An Appraisal*, International Journal of Quantum Information **9**, 1787 (2011) [arxiv:1109.5549]

28. Rijo T. Cheriya, Jimmy Joy, Alex P. Andrews, Anil Shaji and Mahesh Hariharan, *Energy Transfer in Near-Orthogonally Arranged Chromophores Separated through a Single Bond*, J. Phys. Chem C **116**, 12489-12498 (2012)

29. Thejasvi Beleyur, Valiya Kadavu Abdul Kareem, Anil Shaji, and Kalika Prasad *A mathematical basis for plant patterning derived from physico-chemical phenomena*, BioEssays **35**, 366 (2013)

30. Salini Jose, Noufal Jaseem and Anil Shaji *Probe readout and quantum-limited measurements* Phys. Rev. A **87**, 022330 (2013) [arXiv:1212.4581]

31. Jimmy Joy, Rijo T. Cheriya, Kalaivanan Nagarajan, Anil Shaji and Mahesh Hariharan, *Breakdown of Exciton Splitting through Electron DonorAcceptor Interaction: A Caveat for the Application of Exciton Chirality Method in Macromolecules*, J. Phys. Chem C **117**, 17927-17939 (2013)

32. Salini Jose and Anil Shaji, *Corrections to the expected signal in quantum metrology using* em highly anisotropic Bose-Einstein Condensates, arXiv-eprint 1309.3404 [Submitted]

3. Articles in conference proceedings

1. L. E. Reichl, Gursoy Akguc, Anil Shaji, and Michael Snyder, *Conduction and entanglement in nanometer-scale ballistic electron waveguides*, Proceedings of the 20th symposium on Energy Engineering Science, Argonne National Laboratory, May 20-21, 2002

2. Anil Shaji, *Sudarshan's non-relativistic approach to the spin-statistics connecton*, Contribution to the proceedings of the *Sudarshan - 7 Science Quests* Conference, Austin, TX, November 2006.*

3. Sergio Boixo, Animesh Datta, Matthew J. Davis, Steven T. Flammia, Anil Shaji and Carlton M. Caves, Quantum metrology from an information theory perspective, Proceeding of QCMC 2008, AIP conference series **1110**, Editor(s): Alexander Lvovsky, pp. 427-432

4. Sergio Boixo, Animesh Datta, Matthew J. Davis, Steven T. Flammia, Anil Shaji and Carlton M. Caves, Quantum metrology with Bose-Einstein condensates, Proceeding of QCMC 2008, AIP conference series **1110**, Editor(s): Alexander Lvovsky, pp. 423-426*

4. Other technical articles

1. Anil Shaji, E. C. G. Sudarshan, *Non-relativistic proofs of the spin-statistics connection*, quant-ph/0306033*
2. E. C. G. Sudarshan and Anil Shaji, *Note on Non-relativistic proof of the spin-statistics connection in the Galilean frame*, arXiv:quant-ph/0409205
3. Animesh Datta, Steven T. Flammia, Anil Shaji and Carlton M. Caves, *Doubly constrained bounds on the entanglement of formation*, arXiv:quant-ph/0608086
4. Cesar A. Rodriguez, Anil Shaji and E. C. G. Sudarshan, *Dynamics of Two Qubits: Decoherence and an Entanglement Optimization Protocol*, arXiv:quant-ph/0504051.

References

1. Prof. Carlton M. Caves
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