

CURRICULUM VITAE

PERSONAL INFORMATION

Name ARUL LAKSHMINARAYAN
Position Professor
Address Department of Physics
Indian Institute of Technology Madras
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E-Mail arul@iitm.ac.in, arul@physics.iitm.ac.in, arul.lata@gmail.com
Nationality Indian
Date of birth 25/March/1967
Marital Status Married since 1996 to Lata Sundaram



PROFESSIONAL EXPERIENCE

- ▷ Permanent Positions
 - 2010-Present: Professor, IIT Madras, Chennai, India
 - 2006-2010: Associate Professor, IIT Madras, Chennai, India
 - 2003-2006: Assistant Professor, IIT Madras, Chennai, India
 - 2000-2003: Reader, Physical Research Laboratory
Ahmedabad, India
 - 1996-2000: Scientist-D, Physical Research Laboratory
Ahmedabad, India

- ▷ Visiting Positions
 - 2007 (Jan.-Dec.): Guest Scientist, Max Planck Institute for the
Physics of Complex Systems, Dresden, Germany
 - 2002 (Oct.-Dec.): Visiting Assistant Professor: Department of
Physics, IIT Kanpur, India
 - 1998-1999: Visiting Assistant Professor, Department of Physics,
Washington State University, Pullman, U.S.A.
 - 1993-1996: Postdoctoral Fellow, P.R.L., Ahmedabad, India

EDUCATION

- ▷ Period 1988-1993
 - Degree obtained Ph. D.
 - University Department of Physics
State University of New York at Stony Brook, Stony Brook, N.Y.
 - Thesis Title Studies in Quantum Maps
 - Advisor (Late) Prof. Nandor L Balazs
 - Remark Thesis accepted with distinction

- ▷ Period 1984-1988
 - Degree obtained Bachelor of Technology (B. Tech., Mechanical Engineering)
 - University Indian Institute of Technology Madras, Chennai, India

AWARDS

- ▷ Recipient Indian National Science Academy's "Young Scientist" award for Theoretical Physics, 1998.

CURRENT RESEARCH INTERESTS

- ▷ Quantum Information, Quantum Chaos, Complex Systems Multipartite entanglement, Entanglement in condensed matter systems, Quenching in nonintegrable-integrable spin systems, Extreme value statistics, Random matrix theory, Entanglement in many-body complex quantum systems.

EDUCATIONAL AND OTHER SERVICES

- ▷ Courses taught at IITM Quantum Physics (UG): 2003, 2004, 2009
Mathematical Physics (PG): 2003
Dynamical Systems (PG): 2004, 2011
Electromagnetism (UG): 2005
Classical Mechanics (PG): 2005
Statistical Physics (PG): 2006, 2010, 2012
Advanced Statistical Mechanics (PG): 2008
Classical Physics (UG): 2008, 2010
Quantum Physics II (PG): 2008
Quantum Computation and Information (PG): 2009, 2011
Advanced Dynamical Systems (PG): 2009, 2012
UG/PG: Undergraduate/Graduate courses
- ▷ Lectures at Schools ISI Winter School on Nonlinear Dynamics, Kolkata, 2003
National Workshop on Nonlinear Dynamics, IIT Kharagpur, 2000
College Teachers Program, Pondichery University, 2004
SERC School on Nonlinear Dynamics: PRL Ahmedabad 2004, IISc Bangalore 2008, Delhi University 2009. ((List incomplete)
- ▷ Conference Organization Associate Editor of the National Conference on Nonlinear Dynamics and Sciences (NCNSD) 2005
Member, National and Local Organizing Committee of NCNSD 2006
Coordinator, First SERC School on Nonlinear Dynamics at PRL Ahmedabad 2003
Treasurer, Perspectives on Nonlinear Dynamics (PNLD) 2005
Convenor, PNLD (Satellite of StatPhys) held at IISc Bangalore, 2010
Convenor, Workshop on Quantum Information and Quantum Chaos, 2010, IIT Madras

▷ Supervisor

Ph. D.:

R. Sankaranarayanan (2000), J. Bandyopadhyay (2005), N. Meenakshisundaram (2010), M. S. Ramkarthik (2013), Udaysinh Bhosale (2014), Shashkant Srivastava (2014, Joint advisor with Dr. Sudhir Jain)

M. Sc., B. Tech. Projects:

H. R. Naren (2004), M. D. Prabha (2005), K. Sreekanth (2005), K. Maity (2006), J. Karthik (2006), Auditya Sharma (2006), V. Ranjini (2009), P. Ravi Kumar (2009), S. Chakrabarti (2010), V. Vikram (2010), K. J. Arun (2011), A. J. Nachikethas (2011), Animesh Sinha (2011), K. V. Shuddhodan (2012), Some Sankar Bhattacharya (2012), Debika Choudhury (2013), Lavisha Jindal (2013).

▷ Journal Referee

All Physical Review Journals, Journal of Physics Series, Pramana, Annals of Physics

INVITED CONFERENCE TALKS/SEMINARS

- Relaxation Fluctuations and Quantum Chaos, at the Golden Jubilee Conference on Non-linear Dynamics and Computational Physics, Physical Research Laboratory, Ahmedabad (Nov. 18-22, 1997).
- Relaxation Fluctuations and Quantum Chaos, at the International Conference on Nonlinear Dynamics: Integrability and Chaos, held at the Bharathidasan University, Tiruchirapalli (Feb. 12-16, 1998).
- Universal Relaxation fluctuations, Talk at the APS conference, A century of physics, at Atlanta, GA, USA. (25-30 March, 1999).
- The Quantum Violations of Ergodicity at the meeting First Winter School on the Foundations of quantum mechanics and quantum optics, S. N. Bose center, Kolkata (Jan. 1-13, 2000).
- Entangling Power of Quantized Chaotic Systems, at the conference on Perspectives in Theoretical Physics, held at Physical Research Laboratory, Ahmedabad (Jan. 7-11, 2001).
- Entanglement and Quantum Chaos, at Second Winter School on the Foundations of quantum mechanics and quantum optics, S. N. Bose center, Kolkata (Jan 2-11, 2002).
- Entanglement measures in quantum and classical chaos, at the National Conference on Nonlinear Systems and Dynamics (IIT, Kharagpur, India, 28-30 Dec, 2003)
- Entanglement production in Quantized Chaotic Systems” Perspectives on Nonlinear Linear Dynamics, (IIT Madras, IMSc, July 12-14, 2004.)
- Multifractal Eigenstates of Quantum chaos and the Thue-Morse Sequence, Resonances and Periodic Orbits: Spectrum and Zeta functions in quantum and Classical Chaos, Poincare Institute, Univ. Pierre et Marie Curie, Paris, France (June 27-July 5, 2005).
- Extreme Statistics and quantum chaotic eigenfunctions at Max Planck Institute for Physics of Complex Systems, Dresden, Germany. (Nov. 6 2007, Seminar).
- Shor’s Algorithm and the Quantym bakers map. At Department of Physics, Univerity Libre Bruxelles, Brussels, Belgium. (September 2007, Seminar).

- Shor's Algorithm and Quantum baker's map at Department of Physics, University of Toulouse, Toulouse, France (September 2007, Seminar).
- Quantum chaos and entanglement in spin chains, at CEA, Saclay, Paris, France (August 2007, Seminar).
- Quantum chaos and entanglement at Department of Physics, University of Bristol, Bristol, UK (June 2007, Seminar)
- Shors Algorithm and Quantum baker's map at Department of Physics, University of Bristol, Bristol, UK (June 2007, Seminar).
- Quantum Chaos and entanglement at Department of Physics, University College, London, UK (June 2007, Seminar).
- Quantum Chaos and entanglement in spin chains, Technical University, Dresden, Germany (July 2007, Seminar).
- The impact of quantum chaos on entanglement at Current Trends in Physics, IIT Madras (Conference Mar. 1, 2008).
- Extreme value statistics in quantum chaos and entanglement at Recent Trends in Nonlinear Dynamics, Bharathidasan University, Trichy (Conference, Feb. 14, 2008).
- Workshop on Entanglement in Quantum Condensed Matter Systems, Institute of Mathematical Sciences, 17-29 Nov. 2008, Chennai.
- Conference on Frontiers in Quantum Science, Institute of Mathematical Sciences, 1-2 Dec., 2008, Chennai.
- 3rd Workshop on Quantum Chaos: Theory and Applications Laboratorio Tandari, December 1-4, 2009, Buenos Aires, Argentina.
- Quantum-Nano School QANSAS 2009 at DEI, Dayalbagh Dec 15-18, 2009, Agra.
- Workshop on Nonlinear Dynamics at Nehru Memorial College, Puthanampatti, April 1 2010, Trichy.
- International Program on Quantum Information, Institute of Physics, Jan., 2010, Bhubhaneswar.
- 75 Years of Quantum Entanglement: Foundations and Information Theoretic Applications (SN Bose Center, Bose Institute) January 6-10, 2011, Kolkata.
- Conference on Quantum Information Processing and Applications Harishchandra Research Institute 14-20 February, 2011, Allahabad.
- Singapore India Joint Physics Symposium, NUS, Singapore, Feb. 22-25, 2011, Singapore.
- Colloquium at Bhabha Atomic Research Center, July 6, 2011, Mumbai.
- Seminar at LPTMS, Université de Paris, Orsay, Paris, Dec. 6, 2011.
- International School and Conference on Quantum Information, Institute of Physics, Dec. 19-22, 2011, Bhubhaneswar.

(List is not updated!)

PUBLICATIONS

1. ON THE QUANTIZATION OF LINEAR MAPS,
A. Lakshminarayan, N. L. Balazs, *Ann. Phys. (N. Y.)* **212**, 220 (1991).
2. THE CLASSICAL AND QUANTUM MECHANICS OF LAZY BAKER MAPS,
A. Lakshminarayan, N. L. Balazs, *Ann. phys. (N. Y.)* **226**, 350 (1993).
3. ON THE NONCOMMUTATIVITY OF QUANTIZATION AND DISCRETE TIME EVOLUTION,
A. Lakshminarayan, N. L. Balazs, *Nucl. Phys. A* **572**, 37 (1994).
4. SEMICLASSICAL THEORY OF THE SAWTOOTH MAP,
A. Lakshminarayan, *Phys. Lett. A* **192** (1994) 345.
5. RELAXATION AND LOCALIZATION IN INTERACTING QUANTUM MAPS,
A. Lakshminarayan, N. L. Balazs, *J. Stat. Phys.* **77**, 311 (1994).
6. ON THE QUANTUM BAKER'S MAP AND ITS UNUSUAL TRACES,
A. Lakshminarayan, *Ann. Phys. (N. Y.)* **239**, 1995 272.
7. THE QUANTUM CAT AND SAWTOOTH MAPS : RETURN TO GENERIC BEHAVIOUR,
A. Lakshminarayan, N. L. Balazs, *Chaos, Solitons and Fractals (Osaka, Japan),
Special Issue on Quantum Chaos*, **5**, (1995) 1169.
8. ON THE IDENTIFICATION OF LOCALISED STATES IN QUANTUM CHAOTIC SYSTEMS ,
M. S. Santhanam, V. B. Sheorey, A. Lakshminarayan, *Molec. Phys.* **88** (1996) 325.
9. LOCAL SCALING IN HOMOGENEOUS HAMILTONIAN SYSTEMS,
A. Lakshminarayan, M. S. Santhanam, V. B. Sheorey, *Phys. Rev. Lett.* **76** (1996) 396.
10. ACCURACY OF TRACE FORMULAS,
A. Lakshminarayan, *Pramana (Special Issue on Nonlinearity in the Sciences)* **48** (1997) 517.
11. CHAOS AND LOCALIZATION IN COUPLED QUARTIC OSCILLATORS,
M. S. Santhanam, V. B. Sheorey, A. Lakshminarayan, *Pramana (Special Issue on Nonlin-
earity in the Sciences)* **48** (1997) 439.
12. RELAXATION FLUCTUATIONS ABOUT AN EQUILIBRIUM IN QUANTUM CHAOS,
A. Lakshminarayan, *Phys. Rev. E.*, **56** (1997) 2540.
13. CHAOS AND EXPONENTIALLY LOCALIZED STATES IN SMOOTH HAMILTONIAN SYSTEMS,
M. S. Santhanam, V. B. Sheorey, A. Lakshminarayan, *Phys. Rev. E.*, **57** (1998) 345.
14. CLASSICAL DIFFUSION AND QUANTUM LEVEL VELOCITIES: SYSTEMATIC DEVIATIONS
FROM RANDOM MATRIX THEORY,
A. Lakshminarayan, N. R. Cerruti, S. Tomsovic, *Phys. Rev. E.*, **60** (1999) 3992.
15. EXPLORING PHASE SPACE LOCALIZATION OF CHAOTIC EIGENSTATES VIA PARAMETER
VARIATION,
N. R. Cerruti, A. Lakshminarayan, J. H. Lefebvre, S. Tomsovic, *Phys. Rev. E.*, **63** (2000)
016208.
16. PHASE SPACE LOCALIZATION OF CHAOTIC EIGENSTATES: VIOLATING ERGODICITY,
A. Lakshminarayan, N. R. Cerruti, S. Tomsovic, *Phys. Rev. E.*, **63** (2000) 016209.
17. BARNETT-PEGG FORMALISM OF ANGLE OPERATORS, REVIVALS AND FLUX LINES ,
A. Lakshminarayan, *Phys. Rev. A.*, **62** (2000) 042110.

18. CHAOS IN A WELL: EFFECTS OF COMPETING LENGTH SCALES,
R. Sankaranarayanan, A. Lakshminarayan, V. B. Sheorey, *Phys. Lett. A.*, **279** (2001) 313.
19. ALGEBRAIC APPROACH IN THE STUDY OF TIME-DEPENDENT NONLINEAR INTEGRABLE SYSTEMS: CASE OF THE SINGULAR OSCILLATOR,
J. N. Bandyopadhyay, A. Lakshminarayan, V. B. Sheorey, *Phys. Rev. A.*, **63** (2001) 042109.
20. ENTANGLING POWER OF QUANTIZED CHAOTIC SYSTEMS,
A. Lakshminarayan, *Phys. Rev. E.*, **64** (2001) 036207.
21. QUANTUM CHAOS OF A PARTICLE IN A SQUARE WELL: COMPETING LENGTH SCALES AND DYNAMICAL LOCALIZATION,
R. Sankaranarayanan, A. Lakshminarayan, V. B. Sheorey,
Phys. Rev. E, **64** (2001) 046210.
22. TESTING STATISTICAL BOUNDS ON ENTANGLEMENT USING QUANTUM CHAOS,
J. N. Bandyopadhyay, A. Lakshminarayan, *Phys. Rev. Lett.* **89** (2002) 060402.
23. CYCLIC IDENTITIES INVOLVING JACOBI ELLIPTIC FUNCTIONS - II,
A. Khare, A. Lakshminarayan, U. Sukhatme, *J. Math. Phys.* **44** (2003) 1822.
24. ENTANGLEMENT SHARING IN ONE PARTICLE STATES
A. Lakshminarayan, V. Subrahmanyam, *Phys. Rev. A* **67** (2003) 052304.
25. RECURRENCE OF FIDELITY IN NEARLY INTEGRABLE SYSTEMS
R. Sankaranarayanan, A. Lakshminarayan, *Phys. Rev. E*, **68** (2003) 036216.
26. ENTANGLEMENT PRODUCTION IN COUPLED CHAOTIC SYSTEMS: CASE OF THE KICKED TOPS,
J. N. Bandyopadhyay, A. Lakshminarayan, *Phys. Rev. E*, **69** (2004) 016201.
27. LOCAL IDENTITIES INVOLVING JACOBI ELLIPTIC FUNCTIONS
A. Khare, A. Lakshminarayan, U. Sukhatme, *Pramana*, **62** (2004) 1201-1230.
28. ENTANGLEMENT PRODUCTION IN QUANTIZED CHAOTIC SYSTEMS,
J. N. Bandyopadhyay, A. Lakshminarayan, *Pramana*, **64**, 577 (2005)
29. MULTIPARTITE ENTANGLEMENT IN A ONE-DIMENSIONAL TIME DEPENDENT ISING MODEL,
A. Lakshminarayan, V. Subrahmanyam, *Phys. Rev. A.*, **71**, 062334 (2005).
30. MULTIFRACTAL EIGENSTATES OF QUANTUM CHAOS AND THE THUE-MORSE SEQUENCE,
N. Meenakshisundaram, A. Lakshminarayan,
Phys. Rev. E. **71**, 065303 (Rapid Comm.) (2005).
31. SHUFFLING CARDS; FACTORING NUMBERS; AND THE QUANTUM BAKER'S MAP,
A. Lakshminarayan, *J. Phys. A* **38**, L597-L605 (2005).
32. TRANSPORT OF ENTANGLEMENT THROUGH A HEISENBERG-XY SPIN CHAIN,
V. Subrahmanyam, A. Lakshminarayan, *Phys. Lett. A* **349**, 164 (2006).
33. THE FOURIER TRANSFORM OF THE HADAMARD TRANSFORM: MULTIFRACTALS, SEQUENCES AND QUANTUM CHAOS,
N. Meenakshisundaram, A. Lakshminarayan, *Proc. of National Conference on Nonlinear Systems and Dynamics*, ed. M. Lakshmanan, R. Sahadevan, Allied Publishers (Chennai, India, 2006).
34. USING THE HADAMARD AND RELATED TRANSFORMS FOR SIMPLIFYING THE SPECTRUM OF THE QUANTUM BAKER'S MAP,
Arul Lakshminarayan, N. Meenakshisundaram, *J. Phys. A* **39** 11205-11216 (2006).

35. QUANTUM CHAOS IN THE SPECTRUM OF OPERATORS USED IN SHOR'S ALGORITHM,
Krishnendu Maity, Arul Lakshminarayan,
Phys. Rev. E. **74**, 035203 (Rapid Comm.) (2006).
36. ENTANGLEMENT, AVOIDED CROSSINGS, AND QUANTUM CHAOS IN AN ISING MODEL WITH
A TILTED MAGNETIC FIELD
J. Karthik, A. Sharma, and A. Lakshminarayan, Phys. Rev. A **75**, 022304 (2007)
37. FLUCTUATIONS OF FINITE-TIME STABILITY EXPONENTS IN THE STANDARD MAP AND
THE DETECTION OF SMALL ISLANDS,
Steven Tomsovic and Arul Lakshminarayan, Phys. Rev. E **76**, 036207 (2007).
38. MODULAR MULTIPLICATION OPERATOR AND QUANTIZED BAKER MAPS
Arul Lakshminarayan, Phys. Rev. A **76**, 042330 (2007).
39. EXTREME STATISTICS OF COMPLEX RANDOM AND QUANTUM CHAOTIC STATES
Arul Lakshminarayan, Steven Tomsovic, Oriol Bohigas, Satya N. Majumdar,
Phys. Rev. Lett. **100**, 044103 (2008).
40. EXACT MINIMUM EIGENVALUE DISTRIBUTION OF AN ENTANGLED RANDOM PURE STATE,
Satya N. Majumdar, Oriol Bohigas, Arul Lakshminarayan, J. Stat. Phys. **131**, 33 (2008).
41. EFFECT OF CLASSICAL BIFURCATIONS ON THE QUANTUM ENTANGLEMENT OF TWO COU-
PLED QUARTIC OSCILLATORS,
M. S. Santhanam, V. B. Sheorey, Arul Lakshminarayan, Phys. Rev. E. **77**, 026213 (2008).
42. FLUCTUATIONS IN CLASSICAL SUM RULES,
Elton John R.; Lakshminarayan Arul, Tomsovic Steven, Phys. Rev. E. **82**, 046223 (2010).
43. KOLMOGOROV-SINAI ENTROPY OF MANY-BODY HAMILTONIAN SYSTEMS,
Lakshminarayan Arul, Tomsovic Steven, Phys. Rev. E. **84**, 016218 (2011).
44. ENTANGLEMENT OPTIMIZING MIXTURES OF TWO-QUBIT STATES,
Shuddhodan K. V, Ramkarthik M. S., Lakshminarayan A, J. Phys. A **44**, 345301 (2011).
45. ENTANGLEMENT TRANSITIONS IN RANDOM DEFINITE PARTICLE STATES,
Vijayaraghavan Vikram S, Bhosale Udaysinh T., Lakshminarayan Arul,
Phys. Rev. A **84**, 032306 (2011).
46. LOCALISED ZERO-ENERGY MODES IN THE KITAEV MODEL WITH VACANCY-DISORDER,
Santhosh G., V. Sreenath, Arul Lakshminarayan, Rajesh Narayanan,
Phys. Rev. B **85**, 054204 (2012).
47. ENTANGLEMENT BETWEEN TWO SUBSYSTEMS, THE WIGNER SEMICIRCLE AND
EXTREME VALUE STATISTICS,
Udaysinh T. Bhosale, Steven Tomsovic, Arul Lakshminarayan,
Phys. Rev. A **85**, 062331 (2012).(*)
48. ENTANGLEMENT SIGNATURES FOR THE DIMERIZATION TRANSITION IN THE MAJUMDAR-
GHOSH MODEL,
M. S. Ramkarthik, V. Ravi Chandra, and Arul Lakshminarayan,
Phys. Rev. A **87**, 01230 (2013).
49. RECORD STATISTICS FOR RANDOM VECTORS AND QUANTUM CHAOS,
Shashi C. L. Srivastava, Arul Lakshminarayan, Sudhir R. Jain,
Euro. Phys. Letts. **101**, 10003 (2013).
50. ON THE NUMBER OF REAL EIGENVALUES OF PRODUCTS OF RANDOM MATRICES AND AN
APPLICATION TO QUANTUM ENTANGLEMENT,
Arul Lakshminarayan,
J. Phys. A: Math. Theor. **46** 152003 (2013). (*)

51. QUENCHING AND GENERATION OF RANDOM STATES IN A KICKED ISING MODEL,
Sunil K. Mishra, and Arul Lakshminarayan,
Euro. Phys. Lett., **105**, 10002 (2014).
52. DIAGONAL UNITARY ENTANGLING GATES AND CONTRADIAGONAL QUANTUM STATES,
Arul Lakshminarayan, Zbigniew Puchala, and Karol Zyczkowski,
Phys. Rev. A **90**, 032303 (2014).
53. PROTOCOL USING KICKED ISING DYNAMICS FOR GENERATING STATES WITH MAXIMAL
MULTIPARTITE ENTANGLEMENT,
Sunil K. Mishra, Arul Lakshminarayan, and V. Subrahmanyam ,
arXiv:1408.1677, Under review at *Phys. Rev. Lett.*.
54. LOCALIZED EIGENSTATES WITH ENHANCED ENTANGLEMENT IN QUANTUM HEISENBERG
SPIN-GLASSES,
Arun Kannawadi, Auditya Sharma, and Arul Lakshminarayan,
arXiv:1407.5090, Under review at *Phys. Rev. E.*