# Curriculum Vitae


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## Current Position

- Aug. 2017 – : Infosys Homi Bhabha Chair Professor and Founding Director, International Centre for Theoretical Sciences (ICTS-TIFR) Bangalore
- Aug. 2015 – : Emeritus Distinguished Professor, Tata Institute of Fundamental Research

## Appointments

- Oct. 2007 – July 2015: (Founding) Director, International Centre for Theoretical Sciences (ICTS-TIFR), Tata Institute of Fundamental Research, Bangalore, India
- Aug. 2008 – July 2015 Distinguished Professor, Tata Institute of Fundamental Research, Mumbai, India
- 2007-2009 – Chair, Department of Theoretical Physics, Tata Institute of Fundamental Research, Mumbai, India
- Oct. 1982 – July 2015: Member of Natural Sciences Faculty, Tata Institute of Fundamental Research, Mumbai, India
- Aug. 1980 – May 1982: Staff Scientist, Enrico Fermi Institute, University of Chicago, USA
- Aug. 1978 – July 1980: Postdoctoral fellow, Enrico Fermi Institute, University of Chicago, USA; mentors: Yoichiro Nambu and Leo Kadanoff

## Education

- Doctor of Philosophy, City University of New York,1978; mentor: Bunji Sakita
- Master of Science, Indian Institute of Technology, Kanpur, 1973
- Bachelor of Science, St. Xavier's College, Bombay University, 1971

## Awards and Honours

- Infosys Homi Bhabha Chair Professor, International Centre for Theoretical Sciences (ICTS-TIFR) Bangalore
- Kavli Institute for Theoretical Physics - University of California, Santa Barbara, Simons Distinguished Scientist, 2018-19
- J. C. Bose National Fellow, Govt of India 2006-2011; 2011-16
- TIFR Alumni Association Excellence Award 2016
- Distinguished Alumnus, St. Xavier's College, Bombay University, 2009
- TWAS (The World Academy of Sciences) Physics Prize, 2004
- Steven Weinberg Prize of ICTP (International Centre for Theoretical Physics, Trieste, Italy) 1995

## Fellowship of Professional Societies

- International Honorary Member of the American Academy of Arts & Sciences (AAA&S)
- Fellow, Indian National Science Academy, Delhi, India
- Fellow, TWAS (The World Academy of Sciences), Trieste, Italy
- Fellow, Indian Academy of Sciences, Bangalore, India
- Fellow, National Academy of Sciences, Allahabad, India
- Fellow, New York Academy of Sciences, New York, USA

## Synergistic Activities:

- Vice-President, Indian National Science Academy 2022 - 2024
- Member, Committee on International Scientific Affairs, American Physical Society (APS) 2020-2022
- Member, International Science Council, International Centre for Theoretical Physics Asia Pacific, 2018-
- Member, NITheCS Scientific Advisory Board, South Africa, 2022-
- Member, International Advisory Committee (IAC) of the International Institute of Physics (IIP), Natal, Brazil, 2017 - 2024
- Member, Physical Sciences Jury Panel, Infosys Science Foundation Prize for Physical Sciences, 2015-2017 and 2023-
- Editor, Asian Journal of Mathematics, International Press, Boston, 2015 -
- Member, Commission on Mathematical Physics (C-18), International Union of Pure and Applied Physics (IUPAP), 1997-1999 and 1999-2002
- Member, Mega Sciences Theme Group for Science, Technology and Innovation Policy (STIP) 2020, Govt of India
- Chair, Advisory Board of Bengaluru Science & Technology (BeST) Cluster, Govt of India 2020-
- Member, ICTS International Advisory Board, 2008 -
- Member, ICTS Management Board, 2020 -
- Member Advisory Board, Asia Pacific Mathematics Newsletter, World Scientific, 2010 -
- Editor, European Journal of Physics C, 2012-2015
- Member, Promotions & Assessment Committee, Indian Institute of Science, Bengaluru, 2014-2022
- Member, Science Council of Asia Pacific Centre for Theoretical Physics (APCTP), S. Korea, 2010-2018
- Chair, Sectional Committee for Physics, Indian National Science Academy, New Delhi, 2017-2019
- Council Service, Indian Academy of Sciences, Bangalore, 2013-2015
- Member, Program Advisory Committee, IAS Nanyang Technological University, Singapore 2009-2015
- Organiser “Strings 2001” at TIFR-Mumbai
- Organiser “Strings 2015” at ICTS-TIFR, Bangalore

## Selected Research Contributions

(Reference numbers refer to Selected Publications)

- The first observation that global gauges like the Coulomb gauge cannot be fixed in a non-abelian gauge theory (usually called the Gribov ambiguity) [Ref.1].
- The discovery of the large N, 3rd order Gross-Witten-Wadia phase transition in soluble models of low dim lattice gauge theory (called the Gross-Witten-Wadia transition [Ref.2,3].
- A unified approach to the large N limit of quantum field theories with global and local symmetry. The derivation of exact equations for Wilson loops in a lattice gauge theory at large N and the 'string equation' in random matrix theory [Ref. 4].
- The first proposal of a Nambu-Jona-Lasinio type phenomenological non-linear fermion model for QCD that describes all low energy properties of low-lying mesons, including their anomalous interactions. This and a preceding paper contains a derivation of the Wess-Zumino-Witten phase as a Berry type phase [Ref. 5].
- The discovery of the black hole solution of 2-dim string theory in which the space direction is born out of the Liouville mode of 2-dim non-critical string theory [Ref 8].
- The exact bosonization of non-relativistic fermions of the c=1 matrix model was achieved using the method of co-adjoint orbits/coherent states of the W(infinity) algebra along with a derivation of the hydrodynamic limit [Ref. 9].
- Extended the D-brane model of Strominger and Vafa to near extremal black supersymmetric black hole that emits Hawking radiation. Demonstrated that the radiation calculated in this model exactly matched Hawking's calculation in gravity [Ref. 10,11].
- The first demonstration of the integrability of N=4 gauge theory in 4-dims using the integrability of the world sheet string theory and the AdS-CFT correspondence [Ref. 12].
- The celebrated Navier-Stokes equation was shown to be an universal limit of all relativistic fluid dynamics [Ref. 13].
- The discovery of dualities involving the partition function and S-matrix of fermions and bosons coupled to 2+1 dim Chern-Simons theories Ref. 14, 15, 16].
- The first detailed dynamical study of black hole formation and evaporation within the Sachdev-Ye-Kitaev model, which is a holographic description of black holes in 2-dim gravity [Ref. 17, 18].
- A general formula for the emergence of the notion of time in Hamiltonian General Relativity [Ref. 20].
- Demonstrated smooth transit across the horizon of a black hole in asymptotically anti-de Sitter space-times.

## Selected Publications:


1. **"The Role of Surface Variables in the Vacuum Structure of Yang-Mills Theory"**
   S. Wadia and T. Yoneya.
   DOI:10.1016/0370-2693(77)90010-7
   Phys. Lett. **66B**, 341 (1977).
2. **"A Study of U(N) Lattice Gauge Theory in 2-dimensions"**
   S. R. Wadia.
   arXiv:1212.2906 [hep-th]
   EFI-79/44-CHICAGO, ICTS-2012-13, TIFR-TH-2012-47
3. **"$N = \infty$ Phase Transition in a Class of Exactly Soluble Model Lattice Gauge Theories"**
   S. R. Wadia.
   DOI:10.1016/0370-2693(80)90353-6
   Phys. Lett. **93B**, 403 (1980).

4. **"On the Dyson-Schwinger Equations Approach to the Large $N$ Limit: Model Systems and String Representation of Yang-Mills Theory"**
S. R. Wadia.
DOI:10.1103/PhysRevD.24.970
Phys. Rev. D **24**, 970 (1981).

5. **"Nambu-Jona-Lasinio Type Effective Lagrangian - 2: Anomalies and Nonlinear Lagrangian of Low-Energy, Large N QCD"**
A. Dhar, R. Shankar and S. R. Wadia.
DOI:10.1103/PhysRevD.31.3256
Phys. Rev. D **31**, 3256 (1985).

6. **"Conformal Invariance and String Theory in Compact Space: Bosons"**
S. Jain, R. Shankar and S. R. Wadia.
DOI:10.1103/PhysRevD.32.2713
Phys. Rev. D **32**, 2713 (1985).

7. **"Quantization of the Liouville Mode and String Theory"**
S. R. Das, S. Naik and S. R. Wadia.
DOI:10.1142/S0217732389001209
Mod. Phys. Lett. A **4**, 1033 (1989).

8. **"Classical solutions of two-dimensional string theory"**
G. Mandal, A. M. Sengupta and S. R. Wadia.
DOI:10.1142/S0217732391001822
Mod. Phys. Lett. A **6**, 1685 (1991).

9. **"Nonrelativistic fermions, coadjoint orbits of W(infinity) and string field theory at c = 1"**
A. Dhar, G. Mandal and S. R. Wadia.
hep-th/9207011
DOI:10.1142/S0217732392002512
Mod. Phys. Lett. A **7**, 3129 (1992)

10. **"Absorption versus decay of black holes in string theory and T symmetry"**
A. Dhar, G. Mandal and S. R. Wadia.
hep-th/9605234
DOI:10.1016/0370-2693(96)01127-6
Phys. Lett. B **388**, 51 (1996)

11. **"Microscopic formulation of black holes in string theory"**
J. R. David, G. Mandal and S. R. Wadia.
hep-th/0203048
DOI:10.1016/S0370-1573(02)00271-5
Phys. Rept. **369**, 549 (2002)

12. **"Aspects of semiclassical strings in AdS(5)"**
G. Mandal, N. V. Suryanarayana and S. R. Wadia.
hep-th/0206103
DOI:10.1016/S0370-2693(02)02424-3
Phys. Lett. B **543**, 81 (2002)

13. **"The Incompressible Non-Relativistic Navier-Stokes Equation from Gravity"**
S. Bhattacharyya, S. Minwalla and S. R. Wadia.
arXiv:0810.1545 [hep-th]
DOI:10.1088/1126-6708/2009/08/059
JHEP **0908**, 059 (2009)

14. **"Chern-Simons Theory with Vector Fermion Matter"**
S. Giombi, S. Minwalla, S. Prakash, S. P. Trivedi, S. R. Wadia and X. Yin.
arXiv:1110.4386 [hep-th]

DOI:10.1140/epjc/s10052-012-2112-0
Eur. Phys. J. C **72**, 2112 (2012)

15. **"Phases of large $N$ vector Chern-Simons theories on $S^2 \times S^1$"**
S. Jain, S. Minwalla, T. Sharma, T. Takimi, S. R. Wadia and S. Yokoyama.
arXiv:1301.6169 [hep-th]
DOI:10.1007/JHEP09(2013)009
JHEP **1309**, 009 (2013)

16. **"Unitarity, Crossing Symmetry and Duality of the S-matrix in large N Chern-Simons theories with fundamental matter"**
S. Jain, M. Mandlik, S. Minwalla, T. Takimi, S. R. Wadia and S. Yokoyama.
arXiv:1404.6373 [hep-th]
DOI:10.1007/JHEP04(2015)129
JHEP **1504**, 129 (2015)

17. **"Gravitational collapse in SYK models and Choptuik-like phenomenon"**
A. Dhar, A. Gaikwad, L. K. Joshi, G. Mandal and S. R. Wadia.
arXiv:1812.03979 [hep-th]
DOI:10.1007/JHEP11(2019)067
JHEP **1911**, 067 (2019)

18. **"A Microscopic Model of Black Hole Evaporation in Two Dimensions"**
A. Gaikwad, A. Kaushal, G. Mandal and S. R. Wadia.
arXiv:2210.15579 [hep-th] (2022)
DOI:10.1007/JHEP08(2023)171
JHEP **08**, 171 (2023)

19. **"Meson spectrum of SU(2) QCD$_{1+1}$ with Quarks in Large Representations"**
A. Kaushal, N. Prabhakar and S. R. Wadia.
arXiv:2307.15015 [hep-th] (2023)
DOI: https://doi.org/10.1007/JHEP11(2023)162
JHEP **11**, 162 (2023)

20. **"Emergent Time in Hamiltonian General Relativity"**
A. Kaushal, N. Prabhakar and S. R. Wadia.
arXiv:2405.18486 [hep-th]
DOI:https://doi.org/10.1103/PhysRevD.111.106006
Phys. Rev. D **111**,10, 106006 (2025)

21. **"2+1 dimensional gravity in AAdS spacetimes with spatial wormhole slices: Reduced phase space dynamics and the BTZ black hole"**
A. Kaushal, N. S. Prabhakar and S. R. Wadia,
arXiv:2510.21923

22. **"A gauge invariant Hamiltonian evolution across the black hole horizon in asymptotically AdS spacetimes"**
A. Kaushal, N. S. Prabhakar and S. R. Wadia,
arXiv:2510.21920

## Contribution to Indian and International Science

- Founding Director of the International Centre for Theoretical Sciences of the Tata Institute of Fundamental Research (ICTS-TIFR), a unique institution involved in furthering the boundaries of fundamental research and science education, emphasizing that science is one story. This institution, since 2006, through its programs, research and outreach activities is having an impact on Indian science and education. Contributed significantly to the building of the Department of Theoretical Physics of TIFR especially the creation of the high energy theory and string theory groups since joining the Tata Institute in Mumbai,in 1982. Contributed significantly to the drafting of the detailed project report of the National Research Foundation (NRF) of India, which later metamorphosed into the ANRF.

- One of the founding members of: i) the Asian Winter School in Strings, Particles and Cosmology a meeting that is held every year since 2007 in Korea, Japan, China, and India on a rotation basis; ii) the biennial Crete Regional Meeting in String theory since 2001, where physicists from Iran, Israel, India, and other countries meet. iii) Main organizers of Strings 2001 in Mumbai, the first time this major international meeting in String theory was held outside of North America and Western Europe; and then Strings 2015 in Bangalore, which included celebrating 100 years of General Relativity.

## Selected Recent Talks:

- *A tale of two intertwined histories: Of time and the Fundamental Laws of Physics*, Shaastra: Spotlight lecture Series, IIT-Madras, January 6, 2026
- *Smooth transit across the horizon of a two sided black hole in asymptotically AdS spacetimes*, City College of City University of New York December 12, 2025.
- *The History of Time (and Time Keeping)*, ICTS-TIFR Kaapi with Kuriosty Lecture, Jawaharlal Nehru Planetarium, Bangalore, 23 February 2025.
- *A gauge invariant unitary Hamiltonian evolution across the black hole horizon in asymptotically AdS spacetimes*, Extreme Universe 2025, YITP-Kyoto University, October 29, 2025.
- *2+1 dim gravity in asymptotically AdS spacetime in the maximal slicing gauge and quantum dynamics of a probe scalar*, TIFR-Mumbai, October 13, 2025.
- *2 + 1 dim gravity in asymptotically AdS spacetime in the maximal slicing gauge, and quantum dynamics of a probe scalar*, 14th Crete Regional Meeting on String Theory, Greece, June 26, 2025.
- *The Journey of Time*, Convocation Address, Chennai Mathematics Institute, Chennai, 27 July 2024.
- *A Brief History of a Science Initiative in India - ICTS-TIFR*, Alladi Ramakrishnan Centenary Conference, IMSc Chennai, 16 December 2023.
- *Black Holes, Quantum Mechanics and Space-time*, Abdus Salam Memorial Lecture, Jamia Millia Islamia, New Delhi, 10 March 2023.
- *The Journey of Time*, TDU, Bengaluru, 20 February 2023.
- *Dynamics of Complete Black Hole Evaporation in 2-dim Gravity*, Abu Dhabi Meeting on Theoretical Physics, Abu Dhabi, 10 January 2023.
- *Glimpses of Theoretical Physics at TIFR: 1982-2022*, Landmarks@TIFR, TIFR-Mumbai, 17-18 December 2022.
- *A Microscopic Model of Black Hole Evaporation in in 2-dim.*, New York University, New York, 15 Nov 2022.
- *Modeling Black Hole Formation and Evaporation in the Sachdev-Ye-Kitaev (SYK) Model and its Dual Gravity Theory*, Conference on "The Dual Mysteries of Gauge Theories and Gravity", IIT Madras, Chennai, 21 October 2020.
- *Black Hole Dynamics in the SYK Model Holographic to 2-dim Gravity*, Online Conference on "Frontiers of holographic duality", Steklov Mathematical Institute, Moscow, 6 May 2020
- *Black Holes: Beacons in our Search for a Quantum Theory of Space-time*, India Science Festival, IISER-Pune, 11-12 January 2020.
- *Pure States, Black Hole Formation and Choptuik Scaling in the SYK Model*, Tenth Crete Regional Meeting on String Theory, Kolymbari, 18 September 2019.
- *Black Hole Formation in the Sachdev-Ye-Kitaev (SYK) Holographic Toy Model of Quantum Gravity in 2-dims*, International Conference on Frontiers of Fundamental Physics, The International Centre for Theoretical Physics Asia-Pacific (ICTP-AP), Beijing, China, 14 May 2019.
- *Why Do We Need a Quantum Theory of Gravity?*, IISER Thiruvananthapuram, 20 October 2019; Department of Physics and Astrophysics, University of Delhi, 17 October 2019; BHU, Varanasi, 8 March 2019.
- *Space-time and Gravity: From Newton to Hawking and Beyond*, ICTS Einstein Lecture, Assam University, Silchar, 8 October 2018.
- *Gravitational Collapse in the SYK Model*, Black Holes, Quantum Information and Space-time Reconstruction, CERN, Geneva, 23 August 2018.

## Doctoral Students:

1. **Sanjay Jain**, Thesis: *Conformally Invariant Field Theory in 2-dims and Strings in Curved Space, 1987*
   Presently Professor, Department of Physics and Astronomy, University of Delhi; Current research: Complexity theory, Evolutionary networks.

2. **R. Shankar**, Thesis: *Nambu-Jona-Lasinio Type Effective Actions for Large N Quantum Chromodynamics, 1987*
   Professor, The Institute for Mathematical Sciences, Chennai; Current research: Field theory applications to condensed matter systems; study of Himalayan glaciers.
3. **Gautam Mandal**, Thesis: *An Approach to the Theory of Strings Based on the Space of 2-dim. Field Theories, 1989*
   Presently Senior Professor and Chair, Department of Theoretical Physics, TIFR; Current research: String theory, Quantum Gravity.
4. **Anirvan Sengupta**, Thesis: *String Backgrounds in 1+1 Dims., 1992*
   Presently, Professor, Dept. of Physics and Astronomy, Rutgers University, USA; Current research: Biophysics, Systems Neuroscience, and Machine Learning.
5. **Porus Lakdawala**, Thesis: *Complexity at the Edge of Order and Chaos, 1996*
   Presently, Senior System Administrator, Oracle Corporation, California, USA.
6. **Justin Raj David**, Thesis: *String Theory and Black Holes, 1999*
   Presently, Professor and Chair Centre for High Energy Physics, Indian Institute of Science, Bangalore; Current research: String theory, Quantum Gravity.
7. **Pallab Basu**, Thesis: *Black Holes and the Finite Temperatures Gauge Theory, 2007*
   Presently, Senior Lecturer, University of the Witwatersrand, Johannesburg; Current research: String theory, Quantum Gravity.

## Mentoring of Students at ICTS for MSc Degree and Summer Projects

1. Anup Anand Singh, IISER Pune, MSc project title: "Chaos in Field Theory and Gravity", 2017-18
2. Vivek Vishwakarma, IISER Pune, MSc project title: "Coset CFT and Bosonic String Propagation in de Sitter Space-time", 2018-19; ICTS Long Term Visiting Student Program, project title: "Entanglement Entropy in various systems", 2019-20
3. Anirudh Deb, IIT Kharagpur, summer project title: "A Detailed Study of SYK Mode", 2019
4. Namhita Nandakumar, Calicut University, project title: "Studies in Basic Physics: Classical Mechanics, Electrodynamics, Quantum Mechanics and Mathematical Methods", 2023-24