Shubho R. Roy

Position and Affiliation

Associate Professor,
Department of Physics, Indian Institute of Technology, Hyderabad.

Contact Information

Block C, Office No. 533
Department of Physics
Indian Institute of Technology, Hyderabad (IITH)
Kandi, Sangareddy, Telangana 502285, India

Email: sroy@phy.iith.ac.in
Cell: +91 938 163 3614

Biographical Information

Born on January 18, 1981, at Kolkata, India.
Citizen of the Republic of India.

Research Interests

- Non-perturbative string theory/quantum gravity, Gauge-Gravity correspondence (Quantum Black Holes and Cosmology),
- Understanding role of computational complexity in emergence of spacetime,
- Higher Spin gravity in (2+1)-dimensions,
- Anomalous dynamics of Non-abelian charged fluids (quark gluon plasma).

Employment History

- **Associate Professor** **October 2023 - present**
Department of Physics, Indian Institute of Technology, Hyderabad, India.

- **Assistant Professor** **March 2016-September 2023**
Department of Physics, Indian Institute of Technology, Hyderabad, India.

- **Postdoctoral Fellow** **October 2014-February 2016**
High Energy Physics Group, Racah Institute of Physics, Hebrew University of Jerusalem, Jerusalem, Israel.

- **Research Associate** **October 2012-July 2014**
Center for High Energy Physics, Indian Institute of Science, Bangalore, India.

- **Postdoctoral Fellow** **March 2010-June 2012**
Theoretical High Energy Physics Group, City College of the CUNY, New York, NY and CUNY Research Foundation.

- **Adjunct Assistant Professor** **September 2010-December 2010**
Department of Physics and Astronomy, Lehman Colllege of the CUNY , Bronx, NY USA.

Professional Preparation

Brown University, Providence, RI USA

Ph.D, Theoretical High Energy Physics **May 2010**

- Thesis: Holographic description of black holes and cosmic inflation in asymptotically anti de Sitter backgrounds
- Advisor: **David A. Lowe (Professor of Physics)**

Sc.M, Physics **May 2006**

Indian Institute of Technology, Kanpur, UP India

- M.Sc, Physics **June 2004**

Presidency College, University of Calcutta, Kolkata, WB India

B.Sc **June 2002**

- Physics (Honors)
- Mathematics and Statistics (General)

Publications

[1] Shubho R. Roy, Jie Ren and G. Katoch. **Quantum complexity and bulk timelike singularities** arXiv:2303.02752 [hep-th] (To appear in JHEP)

[2] Shubho R. Roy, G. Katoch and S. Mitra. **Holographic complexity of LST and single trace $T\overline{T}$, $J\overline{T}$, and $T\overline{J}$ deformations** JHEP 10 (2022) 143

[3] Shubho R. Roy, A. Bhattacharyya and G. Katoch. **Complexity of warped conformal field theory** Eur.Phys.J.C 83 (2023) 33

[4] Shubho R. Roy, S. Chakraborty and G. Katoch. **Holographic Complexity of LST and Single Trace $T\overline{T}$** JHEP 2021 (2021) 276

[5] Shubho R. Roy, E. Rabinovici and S. Bolognesi. **On Some Universal Features of the Holographic Quantum Complexity of Bulk Singularities** JHEP 1806 (2018) 016

[6] Shubho R. Roy and D. Sarkar. **Bulk metric reconstruction from boundary entanglement** Phys.Rev. D98 (2018) no.6, 066017

[7] Shubho R. Roy and D. Sarkar. **Holographic bulk reconstruction with α' corrections** Phys.Rev. D96 (2017) no.8, 086018

[8] Shubho R. Roy and D. Sarkar. **Hologram of a pure state black hole** PhysRevD.92.126003 (2015)

[9] Shubho Roy and C. Krishnan. **Desingularization of the Milne Universe** Phys. Lett. B 734 (2014)

[10] Shubho Roy and C. Krishnan, A. Raju **A Grassmann Path From AdS_3 to Flat Space** JHEP 1403 (2014) 036.

[11] Shubho Roy and C. Krishnan, A. Raju and S. Thakur **Higher Spin Cosmology** Phys. Rev. D89 (2014) 045007.

[12] Shubho Roy and C. Krishnan **Higher Spin Resolution of a Toy Big Bang** Phys.Rev. D88 (2013) 044049.

[13] Shubho Roy, N. Iizuka, D. Kabat, and D. Sarkar **Black Hole Formation in Fuzzy Sphere Collapse** Phys.Rev. D88 (2013) 044019.

[14] Shubho Roy, N. Iizuka, D. Kabat, D. Sarkar **Black Hole Formation at the Correspondence Point** Phys. Rev. D 87, 126010 (2013).

[15] Shubho Roy, D. Kabat, G. Lifschytz, D. Sarkar **Holographic representation of bulk fields with spin in AdS/CFT** Phys. Rev. D 86, 026004 (2012).

[16] Shubho Roy, V.P. Nair, R. Ray. **Fluids, Anomalies and the Chiral Magnetic Effect: A Group-theoretic Formulation** Phys. Rev. D 86, 025012 (2012).

[17] Shubho Roy and D.A. Lowe. **Punctuated Inflation via AdS/CFT** Phys. Rev. D 82, 063508 (2010).

[18] Shubho Roy and D.A. Lowe. **Holographic description of asymptotically AdS_2 collapse geometries.** Phys. Rev. D 78, 124017 (2008).

[19] Shubho Roy and D.A. Lowe. **Chiral Geometries of 3d Gravity.** Phys.Lett.B668:159-162,2008.

Preprints

[1] Shubho R. Roy, A. Bhattacharyya, M. Dogra. **CFT reconstruction of local bulk operators in half-Minkowski space** arXiv:2308.08547 [hep-th]

Teaching Experience

At IIT Hyderabad

Instructor **Mar 2016 - Present**

- Graduate level courses
  - General Relativity and Cosmology special elective course offered to PhD students and advanced undergraduates
  - Quantum Field Theory special elective offered to PhD students and advanced undergraduates
- Undergraduate level courses
  - Thermodynamics and Kinetic Theory offered to second year Engineering Physics major (B.Tech) students
  - Maxwell's Equations and Electromagnetic Waves offered to freshman level B.Tech students of all engineering and science student
  - Introduction to General Relativity offered to advanced undergraduates (BTech) as well as second year postgraduate (M.Sc) students of the Department of Physics
  - Special Relativity offered to sophomore Engineering Physics major (BTech) students

Adjunct Assistant Professor, Lehman College, CUNY **Fall 2010**

- Part of Introductory Physics 166 and Physics 168 instructional team at Lehman College, CUNY.
- Led weekly laboratory sessions.

Student Mentoring

Assistant Professor, IIT Hyderabad **since March 2016**

PhD supervision:

- Gaurva Katoch (PhD completed in Feb. 2023)

M.Sc thesis supervision:

- Manas Dogra (Fall 2022 - Spring 2023)
- Jobil Thomas (Fall 2019 - Spring 2020)
- Kanhu Kishore Nanda (Fall 2018 - Spring 2019)
- Ankita Gupta Roy, Suvashis Maity, and Suruj Jyoti Das (Fall 2017, Spring 2018)
- Aakash Singh Bagga, Anish Ninad Agashe, and Debobrata Rajak (Fall 2016, Spring 2017)

BTech project supervision:

- K. Akshith Kumar (Fall 2021)

Summer Research Intern Mentoring:

- Adheena P (IISER Trivandrum), Gowtham Arumugam (UC Davies) in summer 2019
- Kavya KH (IISER Trivandrum), Silpa Maria (NIT Rourkella), Swayamsiddha Maharana (IISER Kolkata) in summer 2018
- Abdu Subahan (IISER Trivandrum) in summer 2017

Technical Skills

Packages: **Mathematica**

Programming: Fortran 90/95, Python

Applications: TEX, LATEX, BIBTEX, Microsoft Office, and other common productivity packages for Windows, OS X, and Linux platforms

Operating Systems: Microsoft Windows XP/2000, Apple OS X, Linux, Solaris, and other UNIX variants

Schools and Conferences

Workshop on Quantum Information in QFT and AdS/CFT-III (Hybrid mode), September 16-18, 2022, Jointly organized with Arpan Bhattacharyya (IIT Gandhinagar), and Surbhi Khetrapal (Univ. of Hyderabad).

Online Workshop on Quantum Information in QFT and AdS/CFT-II, August 18-20, 2021, Jointly organized with Arpan Bhattacharyya (IIT Gandhinagar), and Aninda Sinha (CHEP, IISc).

Online Workshop on Quantum Information in QFT and AdS/CFT, August 6-7, 2020, Jointly organized with Arpan Bhattacharyya (IIT Gandhinagar), and Aninda Sinha (CHEP, IISc).

From Bulk to Boundary: Recent Trends in Holography and Quantum Field Theory, March 12-15, 2020, Dept. of Physics, IIT Gandhinagar, Palaj, Gujarat, India

Workshop on Holography, Entanglement and Complexity, October 18-20, 2019, Dept. of Physics, Ashoka University, Delhi, India

National Strings Meeting 2019, December 22-27 , 2019, IISER Bhopal, India.
Gauge/Gravity duality 2018, 30 July - 03 August 2018, University of Wrzburg, Germany

IV Saha Theory Workshop, Modern Aspects of String Theory, February 19-23, 2018, Saha Institue of Nuclear Physics, Kolkata, India

National String Meeting (NSM)- 2017,December 5-10th, 2017, NISER and IIT Bhubaneswar, Bhubaneswar, India

String Theory: Past and Present, January 13-17, 2017, ICTS, Bangalore, India

Indian Strings Meeting, December 15-21, 2016, IISER, Pune, India

The Institut d't of the LPTENS, August 19-28, 2015, Paris, France

deSitter and Microstates Landscapes in String Theory, June 16-19, 2015, IPhT, CEA-Saclay, Paris, France

32nd Winter School in Theoretical Physics (100 Years of General Relativity: From Theory to Experiment and Back), Dec 29 - Jan 8, 2015, Jerusalem, Israel

US-India Advanced Studies Institute on Thermalization: From Glasses to Black Holes, June 2013 Bangalore, India

Non-perturbative gauge theories, holography and all that, January 2013, Bangalore, India

Indian Strings Meeting 2012, Puri, India

Strings 2011, Uppsala, Sweden

Workshop on Holographic Cosmology, Department of Physics, McGill University, Montreal, Canada

Quantum Theory and Symmetries Department of Physics and Astronomy, University of Kentucky, Lexington, KY USA

New England String Meeting, 2010, 2008, 2007 (Fall and Spring) Brown University, Providence, RI USA

9th Northeast String Cosmology Meeting ISCAP, Columbia University, New York, NJ USA

Prospects in Theoretical Physics (PITP) 2006 IAS, Princeton, NJ USA

Invited Talks

July meeting on OUT OF EQUILIBRIUM PHYSICS, School of Physical Sciences, IIT Mandi, on "**Holographic Complexity of LST With Single Trace $T\overline{T}$, $J\overline{T}$, And $T\overline{J}$ Deformations**", July 06, 2022

Quantum Spacetime Seminar Series, Dept. of Theoretical Physics, TIFR, Mumbai, on "**Quantum Complexity Characteristics of Bulk Gravitational Singularities**", March 09, 2020

Winter School on Astronomy, 2020 (Astrowin20), Birla Science Center, Hyderabad, India on **"Holograms of black holes"**, Feb 18, 2020

Talk at **Gauge/Gravity duality 2018** conference at the University of Wrzburg, Germany on "**Quantum Complexity of CFT states dual to bulk cosmological singularities**", July 31, 2018

Lecture Course at Chennai Mathematical Institute on "**Reconstruction of local bulk physics in AdS/CFT** ", July 16-19, 2018

Talk at **IV Saha Theory Workshop, Modern Aspects of String Theory** at SINP, Kolkata, India on "**Bulk metric reconstruction from boundary entanglement**", Feb. 23, 2018

Talk at **National String Meeting (NSM)- 2017** at NISER IIT Bhubaneswar, Bhubaneswar, India on "**Universal features of Complexity of bulk Singularities**", Dec. 6, 2017

Theory Seminar, Theory Division of Saha Institute of Nuclear Physics (SINP), Kolkata, India **"Holographic (CFT) reconstruction of local asymptotically AdS spacetime"**, June 13, 2017

Talk at **"Strings Attached"** International Workshop on String Theory and Related Topics at IIT Kanpur from Feb 20-23, 2017, Indian Institute of Technology, Kanpur (IITK), India **"Computational Complexity and Cosmological Singularities"**, Feb. 21, 2017

Seminar at Institute of Physics, Bhubaneswar (IOPB), **"Computational Complexity and Cosmological Singularities"**, July 12, 2016.

Particle and Fields Seminar, Ben Gurion University, Beersheeba, Israel **"A hologram for pure state AdS black holes"** May 4, 2015

Hebrew University, Jerusalem, Israel and Humboldt University, Berlin, Germany meeting in Jerusalem on Gravitation and High Energy Physics, **"Holograms of pure state**

black holes" March 22-23, 2015

Quantum Universe ICORE meeting, Tel Aviv University **"Black hole formation in Matrix Models"** Mar. 1, 2015

High Energy Theory Group Seminar, Hebrew University, **"Resolution of cosmological singularities in Higher Spin Theory"** Nov. 12, 2014

Journal Club Seminar, Department of Particle Physics, Tel Aviv University, Tel Aviv, Israel **"Resolution of cosmological singularities in Higher Spin Theory"** Nov. 6, 2014

Theory Seminar, Theory Division of Saha Institute of Nuclear Physics (SINP), Kolkata, India **"Resolution of cosmological singularities in Higher Spin Theory"** Sept. 24, 2014

String Theory and Mathematical Physics Seminar (STMP), Department of Theoretical Physics (DTP), Tata Institute of Fundamental Research (TIFR), Mumbai, India **"Resolution of cosmological singularities in Higher Spin Theory"** Sept. 15, 2014

Theory Seminar, International Center for Theoretical Physics (ICTS-TIFR), Bangalore, India **"Holographic bulk reconstruction, beyond (super)gravity"** Sept. 11, 2014

In House Symposium 2013, Center for High Energy Physics, IISc, **"Black Hole Formation in a Fuzzy Sphere Collapse"** (Nov. 2, 2013)

Math-Phys Journal Club, Center for High Energy Physics, IISc, **"Black Hole Formation at the Correspondence Point"**, (April 10, 2013)

Math-Phys Journal Club Seminar, Center for High Energy Physics, IISc, **"Holographic presentation of local physics in AdS (part II) : Maxwell fields and Gravitons"** (Nov. 21, 2012)

In House Symposium 2012, Center for High Energy Physics, IISc, **"Thermalization in BFSS matrix model and dual M-theory black holes"** (Nov. 16, 2012)

Math-Phys Journal Club Seminar, Center for High Energy Physics, IISc, **"Holographic presentation of local physics in AdS (part I)"** (Nov. 14, 2012)

High Energy Theory Special Seminar, City College of New York, City University of New York, **"Holographic Cosmology"** (Nov. 23, 2009)

Visitorships

- **Visitor** **May 20-June 4, 2019**

High Energy Section, Abdus Salam International Center for Theoretical Physics (ICTP), Trieste, Italy.

- **Visitor** **July 26-Aug 4, 2017**

Institute of Physics (ITP), Albert Einstein Center for Fundamental Physics (AEC), University of Bern, Bern, Switzerland.

- **Visitor** **June 1-15, 2017; Aug. 1- Sept. 30, 2014**

Theory Division, Saha Institute of Nuclear Physics (SINP), Kolkata, India.

- **Visitor** **July 11 - 15, 2016**
Institute of Physics (IOP), Bhubaneswar, India.

- **Visitor** **Aug. 19 - Sept. 2, 2015**
Laboratoire de Physique Thorique et Hautes Energies (LPTHE) and Ecole Normale Suprieure (ENS), Paris, France.

- **Visitor** **Sept. 13, 2014 - Sept. 18, 2014**
Department of Theoretical Physics, Tata Institute of Fundamental Research (DTP, TIFR), Mumbai, India.

- **Visitor** **Sept. 9, 2014 - Sept. 13, 2014**
International Centre for Theoretical Sciences, Bangalore, India.

Professional References

V. Parameswaran Nair
Distinguished Professor of Physics
Physics Department
City College of the CUNY
160 Convent Avenue, NY 10031
Phone: 212-650-5572
vpn@optonline.net

Daniel N. Kabat
Professor and Chair
Physics and Astronomy
Lehman College of the CUNY
250 Bedford Blvd., NY 10468
Phone: 718-960-7832
Dan.Kabat@lehman.cuny.edu

David A. Lowe
Professor of Physics
Physics Department,
Box 1843, Brown University
Providence, RI 02912
Phone: (401) 863-2618
Fax: (401) 863-2024
lowe@brown.edu