

SUPRATIM SENGUPTA

Professor

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Department of Physical Sciences

Indian Institute of Science Education & Research

Kolkata, Mohanpur – 741246

India

EDUCATION

- | | | |
|------------|---|----------------|
| PhD | Physics , Institute of Physics, Bhubaneswar, India
<i>Thesis</i> : “Topological Defect Formation and Other
Consequences of Phase Transitions in Field Theories”
<i>Advisor</i> : Prof. Ajit M. Srivastava | September 2000 |
| MSc | Physics , Indian Institute of Technology, Kharagpur, India | 1994 |
| BSc | Physics (Hons.) , Presidency College, Calcutta, India
Graduated First Class | 1992 |

POST-DOCTORAL RESEARCH EXPERIENCE

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|--|--------------------------------|
| Post-Doctoral Fellow
Department of Physics
University of Alberta
Edmonton, AB T6G 2J1, Canada
Mentor: Prof. F. C. Khanna
Research Topic : Non-equilibrium Field Theory and Stochastic Processes | October 2000 – September 2003 |
| Post-Doctoral Fellow
Department of Physics & Astronomy
McMaster University
Hamilton, ON L8S 4M1, Canada
Mentor: Prof. P.G. Higgs
Research Topic : Evolution of the Genetic Code | October 2003 – September 2005 |
| Post-Doctoral Fellow
Department of Physics & Astronomy
Dalhousie University
Halifax, NS B3H 3J5, Canada
Mentor: Prof. A.D. Rutenberg
Research Topic : Cellular Biophysics | September 2005 – February 2007 |

PAST PROFESSIONAL AFFILIATIONS

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|---|---------------------------|
| Associate Professor (Tenured)
School of Computational and Integrative Sciences,
Jawaharlal Nehru University, New Delhi – 110067, India
Responsibilities : Teaching post-graduate courses and research | March 2007- November 2011 |
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PROFESSIONAL RESPONSIBILITIES

- Editorial Board Member, *Scientific Reports*
- Editorial Board Member, *Science Matters*
- Reviewer for *Nature Communications* (NPG), *Physical Biology* (IOP press), *Origins of Life and Evolution of Biospheres* (Springer), *PLoS Computational Biology*, *Europhysics Letters*.
- International reviewer for a *Human Frontier Science Program (HFSP)* project proposal.
- External PhD thesis examiner of PhD students from JNCASR, Bangalore; JNU, Delhi; NCBS, TIFR Bangalore

GRANTS RECEIVED

Aditi Foundation International Research Fund grant (CAD 2500): Jointly awarded with Prof. Paul G Higgs of McMaster University which allowed my PhD student Prateek Verma to spend one and half months visiting McMaster university to work on a joint research project.

Project Title: Computational Biology of Riboswitches: Pattern detection and Comparative Genomics
Duration: 2014-2017

Description: International Project funded by UGC, India and Israel Science Foundation (ISF); jointly awarded with Prof. Danny Barash of Ben-Gurion University, Israel.

Grant Amount: INR 3.1 million

Project Title: Development of computational methods for Riboswitch detection and prediction in genomic sequences and their functional validation

Duration: 2009-2012

Description: Project funded by Department of Biotechnology, India; jointly awarded with Prof. Sudha Bhattacharya (co-PI) of Jawaharlal Nehru University, New Delhi, India.

Grant Amount: INR 3.3 million

TEACHING AND MENTORING EXPERIENCE

Indian Institute of Science Education and Research, Kolkata December 2011 - Present
Professor, Department of Physical Sciences.

- Taught 4 different undergraduate courses: *Intermediate Quantum Mechanics* (2 times, averaging 65 students per semester), *Basic Statistical Mechanics* (2 times, averaging 60 students per semester), *First year Physics theory* (2 times, averaging 200 students per semester), *First year Physics laboratory* (4 times, averaging 200 students per semester)
- Developed and taught a new inter-disciplinary, post-graduate course on “*Evolutionary Dynamics*”
- *Received 5 commendations for outstanding teaching performance* at both under-graduate and post-graduate levels.

Doctoral Students Advised

1. **Name:** Dr. Prateek Verma
Thesis: Cooperation and conflict in human and microbial societies

Period: 2014-2019 (Completed)

Current Position: Post-doctoral fellow at MPI, Evolutionary Biology, Plön, Germany.

2. *Name:* Dr. Sumit Mukherjee
Thesis: Computational analysis of Riboswitches: Detection, distribution and patterns of gene regulation.
Period: 2015-2019 (Completed)
Current Position: Post-doctoral fellow at Bar-Ilan University, Israel.
3. *Name:* Mr. Suvam Roy
Thesis: Computational studies on the Origin of Life (Ongoing)
Period: 2018-Present

Masters Students Advised

1. *Name:* Mr. Smruti Ranjan Pradhan (2019-present)
Thesis: Effect of network rewiring and punishment on spread of cooperation in networks
Current Position: Integrated BS-MS student at IISER Kolkata
2. *Name:* Mr. Saptarshi Chakraborty (2018-2019)
Thesis: Third-party punishment
3. *Name:* Mr. Spandan Pathak (2017-2018)
Thesis: Understanding income distribution through a public goods game on a dynamical network
Current Position: PhD student, University of Maryland, College Park, USA.
4. *Name:* Mr. Sumit Kumar Ram (2016-2017)
Thesis: Public goods game on dynamical networks
Current Position: PhD student, ETH Zurich, Switzerland.
5. *Name:* Mr. Shiladitya Swarnakar (2016-2017)
Thesis: Models of Origin of Life
6. *Name:* Dr. Prateek Verma (2013-2014)
Thesis: Analysis of Bribery using Evolutionary Game Theory
Current Position: Post-doctoral fellow at MPI, Evolutionary Biology, Plön, Germany.

Jawaharlal Nehru University, New Delhi, India

March 2007 – November 2012

Associate Professor, School of Computational and Integrative Sciences.

- Taught 7 courses at the post-graduate level.

Doctoral Students Advised (Thesis Defended)

4. *Name:* Dr. Ms. Neha Aggarwal
Thesis: A Finite Population Analysis of the Effects of Code-Sequence Co-evolution and Horizontal Gene Transfer on the Emergence of an Optimal and Universal Genetic Code
Period: 2012-2017

5. *Name:* Dr. Ashutosh Vishwa Bandhu
Thesis: Origin and evolution of the Genetic Code: An *in-silico* study
Period: 2009-2014
6. *Name:* Dr. Ms. Payal Singh
Thesis: Sequence and structure based computational study of regulatory RNA
Period: 2008-2013

Masters Students Advised

7. *Name:* Dr. Ms. Neha Aggarwal (2011-2012)
Thesis: Early (Pre-LUCA) evolution of the Genetic Code: A finite population study
8. *Name:* Dr. Sanjeev K. Dwivedi (2010-2011)
Thesis: Classification of HIV-1 strains using profile Hidden Markov Models.
9. *Name:* Mr. Abhay Pratap Singh (2009-2010)
Thesis: Computational analysis of the Origin of the Genetic Code.
10. *Name:* Dr. Ashutosh Vishwa Bandhu (2008-2009)
Thesis: Mechanism of UGA codon reassignment in Firmicutes.
Current Position: Assistant Professor, ARSD College, New Delhi, India.
11. *Name:* Dr. Rahul (2007-2008)
Thesis: Stochastic modelling of cell-division in *E. coli* using MCELL
Current Position: Data Scientist, Blackrock India.

University of Alberta, Edmonton, Canada
Sessional Lecturer, Department of Physics.

2002 - 2003

- Taught 2 UG courses for 1st year science and engineering major students.

PUBLICATIONS

Journal Publications and Preprints under review

- 33 [How strategy environment and wealth shape altruistic behaviour: Cooperation rules affecting wealth distribution in dynamic networks](#), Spandan Pathak, Prateek Verma, Sumit K Ram, *S. Sengupta**; bioRxiv 2020.05.05.077131; doi: <https://doi.org/10.1101/2020.05.05.077131> (submitted for publication)
- 32 [Emergence of ribozyme and tRNA-like structures from mineral-rich, muddy pools on prebiotic earth](#), Suvam Roy, Niraja V Bapat, Julien Derr*, Sudha Rajamani, *S. Sengupta**; bioRxiv 2020.02.12.944926; doi: <https://doi.org/10.1101/2020.02.12.944926> (submitted for publication)
- 31 [RiboD: A Comprehensive Database for Prokaryotic Riboswitches](#), Sumit Mukherjee*, Sukhen Das Mandal, Nikita Gupta, Matan-Drory Retwitzer, Danny Barash, *S. Sengupta**; Bioinformatics 35(18):3541-3543 (2019).

- 30 [The Evolution of Antibiotic Production Rate in a Spatial Model of Bacterial Competition](#), Jakub Kosakowski, Prateek Verma, *S. Sengupta*, Paul G Higgs; PLoS One 13(10): e0205202 (2018)
- 29 [Bribery games on inter-dependent complex networks](#), Prateek Verma, Anjan K. Nandi and *S. Sengupta**; J. Theor. Biol. 450: 43-52 (2018)
- 28 [Phylogenomic and comparative analysis of the distribution and regulatory patterns of TPP riboswitches in fungi](#), Sumit Mukherjee, Matan Drory-Retwitzer, Danny Barash, *S. Sengupta**; Scientific Reports 8:5563 (2018)
- 27 [Comparative genomics and phylogenomic analyses of lysine riboswitch distributions in bacteria](#), Sumit Mukherjee, Danny Barash and *S. Sengupta**; PLoS One 12(9): e0184314 (2017).
- 26 [Bribery games on inter-dependent regular networks](#), Prateek Verma, Anjan K. Nandi and *S. Sengupta**; Scientific Reports 7:42735 (2017)
- 25 [Interspecific competition as a strategy for coexistence of Bacillus Cereus MSM-S1 and Pseudomonas sp. MSM-M1](#), Brinta Chakraborty, Anish Mallick, Sumana Annagiri, *S. Sengupta* and Tapas K Sengupta; Royal Society Open Science DOI: 10.1098/rsos.160438 (2016)
- 24 [Finite population analysis of the effect of horizontal gene transfer on the origin of an universal and optimal genetic code](#), Neha Aggarwal, Ashutosh Vishwa Bandhu and *S. Sengupta**; Phys. Biol. 13:036007 (2016)
- 23 [Riboswitch Scanner: An efficient pHMM-based web-server to detect riboswitches in genomic sequences](#), Sumit Mukherjee and *S. Sengupta*; Bioinformatics 32(5):776-778 (2016)
- 22 [Exploring the phase explosion of water using SOM-mediated micro-bubbles](#), Basudev Roy, Mayukh Panja, *S. Sengupta*, Dibyendu Nandi and Ayan Banerjee; New Journal of Chemistry 40:1048-1056 (2016)
- 21 [An Efficient Minimum Free Energy Structure-Based Search Method for Riboswitch Identification Based on Inverse RNA Folding](#), Matan Drory Retzwitzer, Ilona Keifer, *S. Sengupta*, Zohar Yakhini and Danny Barash; PLoS One 10(7): e0134262 (2015).
- 20 [Pathways of genetic code evolution in ancient and modern organisms](#), *S. Sengupta* and Paul G. Higgs; J. Mol. Evol. 80:229-243 (2015)
- 19 [Bribe and Punishment: An evolutionary game-theoretic analysis of bribery](#), Prateek Verma and *S. Sengupta**; PLoS One 10(7): e0133441 (2015)
- 18 [Revisiting the Physico-Chemical Hypothesis of Code Origin: An Analysis Based on Code-Sequence Coevolution in a Finite Population](#), Ashutosh Vishwa Bandhu, Neha Aggarwal and *S. Sengupta**; Origins of Life and Evolution of Biospheres 43(6): 465-489 (2013)
- 17 [Phylogenetic analysis and comparative genomics of Purine riboswitch distribution in prokaryotes](#), Payal Singh and *S. Sengupta**; Evolutionary Bioinformatics 8, 589-609 (2012)
- 16 [Stuttering Min oscillations within E. coli bacteria: A stochastic polymerization model](#), *S. Sengupta**, J. Derr, A. Sain and A.D. Rutenberg; Physical Biology, 9, 056003 (2012)

- 15 [Classification of HIV-1 sequences using profile Hidden Markov Models](#), Sanjiv K Dwivedi and *S. Sengupta**; PLoS One 7(5):e36566 (2012)
- 14 [Riboswitch Detection using Profile Hidden Markov Models](#), Payal Singh, P. Bandyopadhyay, S. Bhattacharya, A. Krishnamachari and *S. Sengupta**; BMC Bioinformatics 10:325 (2009)
- 13 [Modeling partitioning of Min proteins between daughter cells after septation in Escherichia coli](#), *S. Sengupta* and Andrew D. Rutenberg; Phys. Biol. 4:145-153 (2007)
- 12 [The Mechanisms of Codon Reassignments in Mitochondrial Genetic Codes](#), *S. Sengupta*, X. Yang and Paul G. Higgs; J. Mol. Evol. 64:662-688 (2007)
- 11 [Stochastic Resonance in Underdamped, Bistable Systems](#), R. Ray* and *S. Sengupta**; Phys. Lett. A353:364-371 (2006)
- 10 [A Unified Model of Codon Reassignment in Alternative Genetic Codes](#), *S. Sengupta* and Paul G. Higgs; Genetics 170:831-840 (2005)
- 9 [Non-equilibrium Evolution of Correlation Functions: A Canonical Approach](#), *S. Sengupta**, F.C. Khanna and S.P. Kim; Phys. Rev. D68, 105014 (2003)
- 8 [Stochastic Production Of Kink-Antikink Pairs In The Presence Of An Oscillating Background](#), R. Ray* and *S. Sengupta**; Phys. Rev. **D65**, 063521 (2002)
- 7 [Multiple-Scale Analysis and Renormalization of Quenched Second Order Phase Transitions](#), S.P. Kim, *S. Sengupta* and F.C. Khanna; Phys. Rev. **D64**, 105026 (2001)
- 6 [Electroweak Baryogenesis in a Cold Universe](#), R. Rangarajan, *S. Sengupta* and A.M. Srivastava; Astroparticle Physics **17**, 167 (2002)
- 5 [Resonant Production of Topological Defects](#), S. Digal, R. Ray, *S. Sengupta* and A.M. Srivastava; Phys. Rev. Lett. **84**, 826 (2000)
- 4 [Possibility of Forming a Large DCC in Ultra-Relativistic Heavy-Ion Collisions](#), S. Digal, R. Ray, *S. Sengupta* and A.M. Srivastava; International Journal of Modern Physics **A15**, 2269 (2000)
- 3 [Simulation of Vortex-Antivortex Pair Production in a Phase Transition with Explicit Symmetry Breaking](#), S. Digal, *S. Sengupta* and A.M. Srivastava; Phys. Rev. **D58**, 103510 (1998)
- 2 [Vortex-Antivortex Pair Production in a First Order Phase Transition](#), S. Digal, *S. Sengupta* and A.M. Srivastava; Phys. Rev. **D56**, 2035-2043 (1997)

- 1 [Defect-Antidefect Pair Production via Field Oscillations](#), S. Digal, **S. Sengupta** and A.M. Srivastava; Phys. Rev. **D55**, 3824-3829 (1997)

Note: * indicates corresponding author

Preprints/Popular science articles

- 1 [The Code of Life: Origin and Evolution](#); **S. Sengupta**; Presidency College Alumni Association Magazine (2013).
- 2 [Testing the viability of the Ambiguous Intermediate Mechanism of codon reassignment with in vitro experiments: A proposal](#); **S. Sengupta** (2010)

Book Chapters

1. [Formation of Vortex-Antivortex Pairs](#), S. Digal, R. Ray, **S. Sengupta** and A. M. Srivastava; (Invited Review Article) in "**Connectivity and Superconductivity**" Eds. Jorge Berger and Jacob Rubinstein; Springer-Verlag, 2001.

Conference Papers (Peer-Reviewed)

1. [Two perspectives on the origin of the standard genetic code](#), **S. Sengupta***, Neha Aggarwal and Ashutosh Vishwa Bandhu; Origins of Life and Evolution of Biospheres **44**(4):287-291 (2014). Proceedings of the conference on "**Open Questions on the Origin of Life**" held in July 2014, Kyoto, Japan.
2. [Nonequilibrium evolution of Correlation Functions](#), **S. Sengupta** in "**Fundamental Interactions**" - **Proceedings of the Sixteenth Lake Louise Winter Institute**. " Eds., A. Astbury, B.A. Campbell, F.C. Khanna, M.G. Vinciter; World Scientific, 2004.
3. [Kink-Antikink Pair Production in the Presence of a Stochastic and Oscillating background](#), **S. Sengupta** in "**Fundamental Interactions**" - **Proceedings of the Sixteenth Lake Louise Winter Institute**. " Eds., A. Astbury, B.A. Campbell, F.C. Khanna, M.G. Vinciter; World Scientific, 2003.
4. [Non-Equilibrium Phase Transition Dynamics Beyond the Gaussian Approximation](#), **S. Sengupta** in "**Fundamental Interactions**" - **Proceedings of the Sixteenth Lake Louise Winter Institute**. " Eds., A. Astbury, B.A. Campbell, F.C. Khanna, M.G. Vinciter; World Scientific, 2002
5. [A new mechanism of Formation of Topological Defects](#), **S. Sengupta**; Proc. of the workshop on cosmology titled "**Observations Confront Theories**.", held at the Indian Institute of Technology, Kharagpur, India in January '99; Pramana Journal of Physics, Vol.**53**, No.**6**; December '99.

SELECTED INVITED LECTURES

Conference/Seminar

Title

Year

1.	Evolutionary Perspectives on Mechanisms of Cellular Organization held at KITP, Santa Barbara, USA	Evolution of the Genetic Code	2010
2.	Conference on Condensed Matter and Biological Systems (CMBS 13) conference held in BHU, India	Sub-cellular Min Oscillation Dynamics in <i>E. coli</i> : A Stochastic Polymerization Model	2013
3.	Open Questions on the origin of life (OQOL 2014, Japan)	Two perspectives on the origin of the standard genetic code	2014
4.	Genome analysis and protein interaction networks (Bose Institute, Kolkata, India)	Detection, Distribution and Comparative Genomics of Riboswitches	2016
5.	Invited Talk at the Department of Computer Science, Ben-Gurion University of the Negev, Israel	Origin and Evolution of the Genetic Code	2016
6.	Emergence and Evolution of Biological Complexity, Bangalore, India	Perspectives on the origin of the standard genetic code	2017
7.	Invited Colloquium in the “Centre for Theoretical Sciences”, IIT Kharagpur	Bribe and Punishment: A Quantitative Analysis of Harassment Bribery	2017
8.	Dynamics of social behaviour and phenomena on networks held at Acharya Bhavan, Bose Institute, Kolkata	Bribe and Punishment: an analysis of harassment bribery	2017
9.	Indo-French workshop on EVOLUTIONARY DEVELOPMENTAL and CELL biology (EVODECE) in Banyuls sur Mer, France	Riboswitches from prokaryotes to eukaryotes: Insights from comparative genomics analysis	2018
10.	Understanding Behavior, IISER Kolkata, India	Conflict and Cooperation: From Microbial to Human Societies	2019
11.	Dynamics of Complex Systems, ICTS, Bangalore, India	Games people play: Individual decisions and collective outcomes	2019
12.	Conference on non-linear systems and dynamics (CNSD2019)	Cooperation rules affecting wealth distribution in dynamical social networks	2019