Raunak Dey

Physics Graduate student, School of Physics,
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Education

Georgia Institute of Technology, USA, School of Physics August 2021 – Present
PhD. Student in Physics, GPA: 4.0/4.0 *Atlanta, USA*

Indian Institute of Science Education and Research Kolkata, Department of Physical Sciences August 2015– June 2020
BS-MS Dual Degree, Pre-Major: Mathematics and Statistics, Final GPA: 9.41/10.0 *Kolkata, India*

Journal and Conference Publications

Frontiers in Physics, *January 2021*, "Simultaneous random number generation and optical tweezers calibration employing a learning algorithm based on the Brownian dynamics of a trapped colloidal particle", **Raunak Dey**, Subhrokoli Ghosh, Avijit Kundu and Ayan Banerjee. doi: 10.3389/fphy.2020.576948

Soft Matter, *June 2021,* "Active microrheology using pulsed optical tweezers to probe viscoelasticity of Lamin A towards diagnosis of laminopathies" Chandrayee Mukherjee, Avijit Kundu, **Raunak Dey**, Ayan Banerjee, Kaushik Sengupta. *doi.org/10.1101/2021.02.05.429901*

Physical Review Fluids, *December 2021,* "Single-shot wideband active microrheology using multiple-sinusoid modulated Optical Tweezers", Avijit Kundu, **Raunak Dey**, Shuvojit Paul and Ayan Banerjee. *doi: 10.1103/PhysRevFluids.6.123301*

SPIE Nanoscience + Engineering Conference, *August 2021,* "Random number extraction from optically trapped Brownian oscillator in viscous and viscoelastic media using learning algorithms " **Raunak Dey**, Avijit Kundu, Subhrokoli Ghosh and Ayan Banerjee. *doi.org/10.1117/12.2596502*

SPIE Nanoscience + Engineering Conference, *August 2021,* "Microrheology over a broad frequency range probing multiple-sinusoid oscillating optical tweezer" Avijit Kundu, **Raunak Dey** Subhrokoli Ghosh and Ayan Banerjee. *doi.org/10.1117/12.2596296*

Preprint, "Experimental verification of Arcsine laws in mesoscopic non-equilibrium and active systems" , **Raunak Dey**, Avijit Kundu, Biswajit Das and Ayan Banerjee. https://arxiv.org/abs/2104.00127v2 (submitted to PRE)

Preprint, "Non-monotonic skewness of currents in non-equilibrium steady states" , Sreekanth K Manikandan, **Raunak Dey**, Avijit Kundu, Biswajit Das, Ayan Banerjee, Supriya Krishnamurthy https://doi.org/10.48550/arXiv.2201.06563

Bulletin of the American Physical Society, *March 2021,* "Probing medium viscoelasticity using signal transmission through coupled harmonic oscillators" Avijit Kundu, **Raunak Dey**, Shuvojit Paul and Ayan Banerjee

Technical Skills

Experimental Skills: Experimental Optics and Photonics, Optical Tweezers, microrheology, micromanipulation, microscopy and imaging, Quantum tomography, Fiber optics, SLM, AOM, PID controllers, Lock-In detection, DAQs, cryogenics
Machine control: Labview and MATLAB Simulink environment machine control, multi-channel fast data acquisition, multiple device synchronization
Image/Video Processing, Optical simulations: OpenCV, particle detection algorithms, (Hough transform, contour mapping, connected maps), image and video processing tools for Optical Tweezers projects, Fourier domain image analysis. Transfer matrix and FTDT methods for optical simulations – higher order HG/LG beams, diffraction gratings.
Data analysis/ Signal Processing: Wavelets Analysis, Fourier Analysis, Fast Bayesian Analysis, autoregressive analysis of non-Markov and correlated datasets with Facebook AR-Net.
CS: Optimization algorithms, Deep learning with FFNN and ARNN for time series analysis, FB AR-Net
Coding/Tools: Python, MATLAB, LABVIEW, LaTeX

Work Experience

Graduate Research Assistant, Weitz group, Georgia Tech August 2022-Present

Working on parametric inference of host-virus networks dynamics from time-series

Graduate student (first rotation), School of Physics, Georgia Tech January 2021 – May 2022

Worked on new generation Quantum tomography setup (Quantum Optics), Developed a part of single photon coincidence count pipelines through Labview and MATLAB)

Graduate Teaching Assistant, School of Physics, Georgia Tech August 2021 – July 2022

Responsible for teaching and grading undergraduate Math courses for 100+ students so far, for two different courses

MS Researcher, IISER Kolkata, India May 2018 – July 2021

- Built hardware and Labview controls for Optical Tweezers system, with microscopy and Lock-In detection
- **Physics problems:** Used my apparatus to perform **microrheology** experiments on Biological and Soft matter samples; developed a higher order **Jeffrey viscoelastic model** to study **hydrodynamic coupling** in viscoelastic fluids; developed a **finite element approach** to model disintegration of Lamin polymers after mutation, modeled **stochastic non equilibrium thermodynamics** of optically trapped microscopic heat engines.
- **CS problems:** Developed a new framework for autoregressive Neural Network modelling, time series forecasting, Bayesian learning parametric estimation of correlated time series, and non-Markov time series modifying FB-AR NET algorithm
- Developed new software for image detection for highly pixelated images
- Mentored 2 undergrads in a lab setting for 1 year
- Published 5 papers and 2 preprints.

Content reviewer, Subject matter expert, Vaidik Eduservices, India July 2020 – September 2020

Managed a group of 10 content creators to make marketable solutions to Physics textbook problems, reviewed LaTeX heavy Physics writings of our employees before submitting to clients.

Teaching assistant, IISER Kolkata August 2019 - December 2019

Taught undergrad Quantum Mechanics course, responsible for tutorial sessions and grading

Summer Fellow, University of British Columbia, Canada May 2019 – August 2019

Built a fully remote controlled Optical trap (which even can autodetect particles to trap them) to perform experiments on DNA-dynamics, set up the optics, Instrumentation and the Labview Code for the project

Summer Intern, National Center for Radio Astrophysics, India May 2018 – July 2018

Built an interface to detect and eliminate Radio frequency interference from GMRT data, characterise microstructures of Pulsars

Awards and Achievements

SPIE and MKS Instruments Conference author support, August 2021
Mitacs Globalink Research Award - highly prestigious award contributing to fully summer internship in Canada
DST Inspire Scholarship provided by Dept. of Science and Technology, GOVT. OF INDIA, to fully fund BS-MS tuition and living expenses.
Levinstein Fellowship, from Syracuse University, (declined)
CEFIPRA award, Strasbourg University, (declined)

Leadership and Organizations

SPIE Ambassador & IISER Kolkata student chapter secretary: organized outreach events to popularize science among local underprivileged children

Public speaking + Poster Presentations:
1. “Mesoscopic dynamics in Viscoelastic fluids”, University of Konstanz, Germany (February 2020)
2. "Light-Talk" for SPIE international day of light, IISER-K, (May 2018)
3. RAWSC Astro winter School talk on "Johnson Noise in radio-detectors" NCRA Pune (December 2017)

In the press:
1. Research Matters – A natural process may hold the clue to secure encryption of communications
2. Cogito-137: A Generation of Lost Researchers

Links:
Google Scholar
Research-Gate