Pritam Kumar Roy (Ph.D.)

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Research Keywords

Fluid Mechanics | Microfluidics | Droplet Dynamics | Surface Engineering | Interfacial Phenomena | Lab-in-a-Liquid-Marble | Advanced Coatings | Non-Contact Droplet Control | Soft Matter Physics | Applied Physics

Experience (+12 years' experience including Ph.D.)

- June 2025 – Present: **Assistant Professor,** Department of Physics, Central University of Rajasthan
  Role: Teaching undergraduate and postgraduate courses and research on soft matter physics.

- May 2023 – May 2025: **JSPS Postdoctoral Researcher,** The University of Tokyo, Japan.
  Host: Prof. Timothée Mouterde
  Role: Controlling hot liquid droplets and non-contact droplet bouncing on lubricant-infused surfaces.

- July 2019 – April 2023: **Postdoctoral Researcher**, Ariel University, Israel.
  Host: Prof. Edward Bormashenko and Prof. Shraga Shoval
  Role: Magnetic field induced liquid droplet motion and liquid marbles.

- July 2013 – May 2019: **Doctor of Philosophy (Ph.D.)**, Indian Institute of Technology, Kanpur, India.
  Supervisor: Prof. Krishnacharya Khare
  Thesis Title: Surface and interfacial phenomena on soft elastomeric surfaces.

Education

- **Doctor of Philosophy in Physics. (2013–2019)**
  Department of Physics, Indian Institute of Technology, Kanpur, India

- **Master of Science in Physics. (2010–2013)**
  Department of Physics, Indian Institute of Technology, Kanpur, India

- **Bachelor of Science**. **(Physics (Honors), Chemistry, Mathematics) (2007–2010)**
  North Bengal University, Raja Rammohanpur, Darjeeling, West Bengal, India

Industry Collaboration & Research Experience

- **2014-2018:** Collaborated with **Hindustan Unilever**, **India**, on developing lubricant-infused slippery surfaces for consumer products, bridging academia and industry.

- **2019-2023:** Collaborated with the **Department of Ophthalmology at Meir Medical Center, Israel**, to study the interaction between silicone oil and retina surfaces, enhancing the understanding of retinal detachment treatments.

Experimental skills

- **Experimental Techniques:**
  - Fabrication of wrinkle surfaces for wetting and droplet behavior control.
  - Development of hydrophobic, superhydrophobic, oleophobic, and lubricant-infused slippery surfaces.
  - Liquid marble fabrication and characterization for droplet manipulation.
  - High-speed imaging for analyzing droplet dynamics and behavior at small scales.
  - Electrowetting on dielectric (EWOD) for electrostatic control of droplets.
  - Photo-lithography for precise surface patterning and surface engineering.
  - Electro-chemical etching for surface property modification.
- **Characterization Techniques:**
  - Contact angle and hysteresis measurements using goniometers.
  - Surface and interfacial tension measurements across various liquid phases.
  - Surface energy characterization of advanced coatings and engineered surfaces.
  - Measurement of slip velocity on lubricant-infused surfaces.
- **Instrumentation Expertise:**
  - Operation of Goniometer OCA-35 for droplet and surface analysis.
  - Plasma cleaner, spin coating, dip coating, and spray coating for surface preparation.
  - Optical microscopy and Total internal reflection microscopy for detailed droplet and surface studies.

Computer skills

- **Numerical Computing:** MATLAB
- **Data Analysis and Plotting:** Origin
- **Image Analysis and Design Software:** ImageJ, Gwyddion, CorelDRAW, Photoshop
- **Symbolic Computation:** Mathematica
- **Programming Languages:** Basic proficiency in C, C++, and Python
- **Documentation and Reporting:** LaTeX, Microsoft Office Suite

Teaching experience

- July 2016- July 2018: **Graduate teaching assistant in Goniometer**, Soft Matter Lab, IIT Kanpur, Worked as an Operator.

- January 2015- May 2015: **Graduate teaching assistant in Physics 103 course**, IIT Kanpur.

- July 2015- December 2015: **Graduate teaching assistant in Physics 441**, IIT Kanpur. Taught 4-hour laboratory sessions, once a week to first-year M.Sc students.
  Experiments taught: **Analog electronics**, **Digital electronics**, **Micro-controller**.

- July 2013 - December 2014: **Graduate teaching assistant in Physics 101 Lab**, IIT Kanpur, Taught 3-hour laboratory sessions, once a week to first-year undergraduate students of B.Tech and integrated M.Sc.
  Experiments taught: **Prism spectrometry**, **Current balance**, **Coupled pendulum**.

Reviewer Activities

Served as a reviewer for the following prestigious journals:

- **ACS Publications**
- **RSC Advances**
- **Surfaces and Interfaces**
- **MDPI Journals**

Research Supervision and Mentorship

- **Mentorship and Student Supervision (2013–2019):**
  Guided and mentored three Master's project students, and two junior doctoral candidates within **Prof. Khare's Research Group** at IIT Kanpur, India. Responsibilities included laboratory training, implementation of safety protocols, project management, and proficient report writing. Research focus included interfacial phenomena such as wetting, surface preparation, and fluid dynamics.

- **Supervision at Ariel University, Israel (2019–2023):**
  Supervised two PhD and one Master's students in **Prof. Bormashenko's Group** at Ariel University, Israel. Managed projects on lubricant-infused surfaces and liquid marbles, emphasizing droplet dynamics and interfacial control.

- **Supervision at The University of Tokyo, Japan (2023–Present):**
  Currently supervising two undergraduate students, two Master's students, and one PhD student in **Prof. Mouterde's Group** at The University of Tokyo, Japan. Leading research on hot liquid droplet control, lubricant-infused surfaces, and advanced liquid marble dynamics, with a focus on project planning and experimental execution.

Research Interest

My research interests encompass both the fundamental and applied aspects of **fluid mechanics**, **microfluidics**, **droplet dynamics**, and **surface coatings**, with a strong emphasis on controlling droplet motion through surface engineering.

During my PhD at IIT Kanpur under Prof. Krishnacharya Khare, I focused on wetting tunability on soft solids and **lubricant-infused surfaces** by engineering surface topography at micro- and nanometer scales. This research advanced the understanding of the fundamental principles of lubricant-infused slippery surfaces and demonstrated their potential applications in **advanced coatings** and **controlled droplet manipulation**.

In my postdoctoral work at Ariel University with Prof. Edward Bormashenko, I explored **magnetic field-induced droplet motion** and **liquid marble dynamics**, developing composite liquid marbles with superior stability and unique behaviors such as **osmosis** and **self-propulsion**, paving the way for innovative applications in droplet-based technologies.

Currently, at The University of Tokyo under Prof. Timothée Mouterde, my research focuses on **non-contact droplet bouncing on lubricant-infused surfaces** and **controlling the motion of hot liquid droplets**, investigating novel strategies for the precise and efficient control of droplet dynamics. My work seamlessly integrates fundamental studies with applied research to develop cutting-edge solutions in **fluid mechanics**, **surface science**, and **microfluidics**, aligning with the interdisciplinary and innovative focus essential for this role.

Grants and Awards

- Received the JSPS KAKENHI Grant (2023)
- Received the "FY2023 JSPS Postdoctoral Fellowship for Research in Japan (Standard)" (2022)
- Received the “Study in Israel” Fellowship for Outstanding Post-Doctoral Researchers from China and India, provided by the Planning & Budgeting Committee (PBC) of the Council for Higher Education (CHE), Israel (2020).
- International travel grants from Department of Science and Technology, Government of India SCIENCE; ENGINEERING RESEARCH BOARD (SERB) (2018).
- Awarded Department excellence grant June (2018).
- Qualified JAM 2010, National Level examination for Joint admission to M.Sc. in IITs.

Conferences

- **International:**
  - *APS DFD 2024, November 23-26 held at Salt lake city, US,* Oral presentation on “**Hot Liquid Marbles**”.
  - *61st Japan Heat Transfer Symposium 2024, May 29-31, held at Kobe, Japan,* Oral presentation on “**Self-propelling Leidenfrost Liquid marbles**”.
  - *IUTAM Symposium Tokyo 2023, Decebmber 3-5 held at Tokyo, Japan,* Poster Presentation on “**Hot Liquid Marbles**”.
  - *Thermal Engineering Conference 2023, October 14-15, held at Kobe, Japan,* Oral presentation on “**Self-propelling Leidenfrost Liquid marbles**”.
  - *European Materials Research Society (E-MRS) Spring Meeting 2018, June 18-22, 2018, held at Strasbourg, France,* Poster Presented on **“Isotropic and Anisotropic Surface Morphology Controlled Wetting and Slippery Phenomena”**.
- **National:**
  - *Recent Trends in Condensed Matter Physics, October 31 - November 3, 2017, held at Bose Institute, India* Poster presentation on **“Surface Morphology Controlled Wetting and Slippery Phenomena”**.
  - *Complex Fluids- CompFlu-2016, January 2-4, 2016, held at IISER Pune, India,* Poster Presented on **“Mechanical tunablity of superhydrophobicity and slippery behavior on PDMS based wrinkles”**.
  - *8th India Singapore Symposium in Condensed Matter Physics, February 25-27, 2015, held at IIT Kanpur, India,* Poster Presented on **“Mechanically tunable superhydrophobic and slippery surface based on PDMS wrinkles”**.
  - *A cluster of topical meetings on Current Trends in Condensed Matter Physics, February 19-22, 2015, held in NISER Bhubaneswar, India,* Oral presented on **“Mechanical tunablity of superhydrophobicity and slippery behavior on PDMS based wrinkles”**.

List of Patent

[1] **Pritam Kumar Roy,** Timothée Mouterde, Liquid marble processing equipment, sensing systems, and liquid marble processing methods. *Japan Patent*, J64681A1, filed June 20, 2024. Patent pending.

List of Book Chapters

[1] **Pritam Kumar Roy,** Shraga Shoval, Leonid A. Dombrovsky and Edward Bormashenko, Oscillatory Reversible Osmotic Growth of Sessile Saline Droplets on a Floating Polydimethylsiloxane Membrane, *In **Fluids and Surfaces** (pp. 34–41). MDPI. Reprinted from: Fluids, 232,* ***6*** (2021).

List of Publications

27. **Pritam Kumar Roy**, Yui Takai, Rui Matsubara, Mizuki Tenjimbayashi, Timothée Mouterde, Hot Liquid Marbles, *PNAS* e2500619122, **120** (2025).

26. Anfisa Ayalon, Fidaa El Zhalka, Alexander Rubowitz, **Pritam Kumar Roy**, Shraga Shoval, Irina Legchenkova, Edward Bormashenko, Interfacial behavior of intravitreally injected drugs simulated by models of the silicone oil filled eye, *Surf. Innov.* 1-9 (2024).

25. Mizuki Tenjimbayashi, Timothée Mouterde, **Pritam Kumar Roy**, Koichiro Uto, Liquid Marble: Review of Recent Progress in Physical Properties, Formation Techniques, and Lab-in-a-Marble Applications in Microreactors and Biosensors, *Nanoscale* 18980-18998, **15** (2023).

24. Pritam Kumar Roy, Shraga Shoval, Nir Shvalb, Leonid A Dombrovsky, Oleg Gendelman, Edward Bormashenko, Apple-like Shape of Freezing Paraffin Wax Droplets and Its Origin, *Materials.* 5514, 1**6** (2023).

23. Pritam Kumar Roy, Shraga Shoval, Syuji Fujii and Edward Bormashenko, Interfacial crystallization in the polyhedral liquid marbles, *J. Colloid Interface Sci.* 685-694, **630** (2022).

22. Pritam Kumar Roy, Bernard P Binks, Shraga Shoval, Leonid A. Dombrovsky and Edward Bormashenko, Hierarchical Liquid Marbles Formed Using Floating Hydrophobic Powder and Levitating Water Droplets, *J. Colloid Interface Sci.* 466-474, **626** (2022).

21. Pritam Kumar Roy, Bernard P Binks, Shraga Shoval, Leonid A Dombrovsky and Edward Bormashenko, Levitating Clusters of Fluorinated Fumed Silica Nanoparticles Enable Manufacture of Liquid Marbles: Co-Occurrence of Interfacial, Thermal and Electrostatic Events, *Colloids Surf. A.* 129453, **649** (2022).

20. Anfisa Ayalona, Alexander Rubowitza, **Pritam Kumar Roy**, Shraga Shoval, Irina Legchenkova and Edward Bormashenko, Interfacial behavior of intravitreally injected drugs simulated by models of the silicone oil filled eye, *Surf. Innov.* 1-7 (2022).

19. Pritam Kumar Roy, Irina Legchenkova, Leonid A Dombrovsky, Vladimir Yu Levashov, Bernard P Binks, Nir Shvalb, Shraga Shoval, Viktor Valtsifer and Edward Bormashenko, Thermophoretic Levitation of Solid Particles at Atmospheric Pressure, *Adv Powder Technol.* 103497, **33** (2022).

18. Pritam Kumar Roy, Shraga Shoval, Leonid A. Dombrovsky and Edward Bormashenko, Oscillatory Reversible Osmotic Growth of Sessile Saline Droplets on a Floating Polydimethylsiloxane Membrane, *Fluids*, 232, **6** (2021).

17. Pritam Kumar Roy, Irina Legchenkova, Shraga Shoval, Leonid A. Dombrovsky and Edward Bormashenko, Osmotic evolution of composite liquid marbles, *J. Colloid Interface Sci.*, 167-173, **592** (2021).

16. **Pritam Kumar Roy**, Irina Legchenkova, Shraga Shoval and Edward Bormashenko, Interfacial Crystallization within Janus Saline Marbles, *J. Phys. Chem.C*, 14141420, **125** (2021).

15. Edward Bormashenko, **Pritam Kumar Roy**, Shraga Shoval and Irina Legchenkova, Interfacial Crystallization within Liquid Marbles, *Condens. Matter*, 62, **5** (2020).

14. **Pritam Kumar Roy**, Shraga Shoval, Mirit Sharabi and Edward Bormashenko, Soft lithography with liquid marbles, *Colloids Surf. A*, 125488, **607** (2020).

13 Alexander Rubowitza, Anfisa Ayalona, **Pritam Kumar Roy**, Shraga Shoval, Irina Legchenkova and Edward Bormashenko, Study of wetting of the animal retinas by Water and organic liquids and its Implications for ophthalmology, *Colloids Surf. B*, 111265, **195** (2020).

12. **Pritam Kumar Roy**, Bernard P. Binks, Syuji Fujii, Shraga Shoval and Edward Bormashenko, Composite Liquid Marbles as a Macroscopic Model System Representing Shedding of Enveloped Viruses, *J. Phys. Chem. Lett.*, 4279-4285, **11** (2020).

11. **Pritam Kumar Roy**, Bernard P. Binks, Edward Bormashenko, Irina Legchenkova, Syuji Fujii and Shraga Shoval, Manufacture and Properties of Composite Liquid Marbles, *J. Colloid Interface Sci.*, 35-41, **575** (2020).

10. **Pritam Kumar Roy**, Mark Frenkel, Irina Legchenkova, Shraga Shoval, Bernard P. Binks and Edward Bormashenko, Liquid Marble-Induced Dewetting, *J. Phys. Chem. C*, 9345-9349, **124** (2020).

9. **Pritam Kumar Roy**, Edward Bormashenko, Mark Frenkel, Irina Legchenkova and Shraga Shoval, Magnetic Field Induced Motion of Water Droplets and Bubbles on the Lubricant Coated Surface, *Colloids Surf. A*, 124773, **597** (2020).

8. Meenaxi Sharma, Samrat Sohel Mondal, **Pritam Kumar Roy** and Krishnacharya Khare, Evaporation Dynamics of Pure and Binary Mixture Drops on Dry and Lubricant Coated Slippery Surfaces, *J. Colloid Interface Sci.*, 244-253, **569** (2020).

7. **Pritam Kumar Roy**, Sanjeev Kumar Ujjain, Sneha Dattatreya, Sumana Kumar, Reeta Pant and Krishnacharya Khare, Mechanically Tunable Single Component Soft Polydimethylsiloxane (PDMS) Based Robust and Sticky Superhydrophobic Surfaces, *Appl. Phys. A*, 535, **125** (2019).

6. Meenaxi Sharma, **Pritam Kumar Roy**, Jitesh Barman and Krishnacharya Khare, Mobility of Aqueous and Binary Mixture Drops on Lubricating Fluid- Coated Slippery Surfaces, *Langmuir*, 7672-7679, **35** (2019).

5. Meenaxi Sharma, **Pritam Kumar Roy**, Reeta Pant and Krishnacharya Khare, Sink Dynamics of Aqueous Drops on Lubricating Fluid Coated Hydrophilic Surfaces*, Colloids Surf. A*, 377-382, **562** (2019).

4. Jitesh Barman, Sumit Kumar Majumder, **Pritam Kumar Roy**, and Krishnacharya Khare, Tunable Superoleophobicity via Harnessing the Surface Chemistry of UV Responsive Titania Coatings, *RSC Adv.*,13253-13258, **8** (2018).

3. Reeta Pant, **Pritam Kumar Roy**, Arun Kumar Nagarajan and Krishnacharya Khare, Slipperiness and stability of hydrophilic surfaces coated with a lubricating fluid, *RSC Adv.*,15002, **6** (2016).

2. **Pritam Kumar Roy**, Sanjeev Kumar Ujjain, Sumana Kumar, Subhash Singha and Krishnacharya Khare, Uniting Superhydrophobic, Superoleophobic and Lubricant Infused Slippery Behavior on Copper Oxide Nano-structured Substrates, *Sci. Rep.*, 35524, **6** (2016).

1. **Pritam Kumar Roy**, Reeta Pant, Arun Kumar Nagarajan and Krishnacharya Khare, Mechanically Tunable Slippery Behavior on Soft Poly(dimethylsiloxane)-Based Anisotropic Wrinkles Infused with Lubricating Fluid, *Langmuir*, 5738, **32** (2016).

Academic Collaborations

- Dr. Mizuki Tenjimbayashi, Research Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), Japan
- Prof. Bernard P. Binks, Department of Chemistry and Biochemistry, University of Hull, United-Kindgom
- Prof. Syuji Fujii, Department of Applied Chemistry, Faculty of Engineering, Osaka Institute of Technology, Japan
- Prof. Leonid A. Dombrovsky, Heat Transfer Department, Joint Institute for High Temperatures, Moscow, Russia
- Prof. Oleg Gendelman, Faculty of Mechanical Engineering, Technion-Israel Institute of Technology, Israel
- Prof. Nir Shvalb, Department of Mechanical Engineering & Mechatronics, Faculty of Engineering, Ariel University, Israel
- Prof. Mirit Sharabi, Mechanical Engineering and Mechatronics Department, Engineering Faculty, Ariel University, Israel
- Prof. Jitesh Barman, Department of Physics, Institute of Science, BHU, UP, India.
- MD. Anfisa Ayalona, Retina Service, Department of Ophthalmology, Meir Medical Center, Kfar Saba, Israel
- MD. Alexander Rubowitza, Retina Service, Department of Ophthalmology, Meir Medical Center, Kfar Saba, Israel