SHUBHAM SINHA

Contact

PhD Candidate, Department of Physics
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Education

- **PhD, Physics,** (2021-present)
  University of Miami
  Advisor: Prof. Vivek Prakash
  Collaborator: Prof. Takashi Mikawa (UC San Francisco)
  CGPA: 3.94

- **BS MS Dual Degree (Physics)**, (2015-2020)
  Indian Institute of Science Education and Research (IISER) Tirupati, India
  Dissertation Topic: Bacteria motility in porous media.
  Advisor: Prof. Dileep Mamapallil

Research Interests

- Biophysics, Tissue Mechanics, Microfluidics and Soft Matter Physics.

Publications

1. Reiko Asai*, **Shubham Sinha***, Vivek N. Prakash and Takashi Mikawa, *Bilateral cellular flows display asymmetry prior to left-right organizer formation in amniote gastrulation* **PNAS** 122(6), e2414860122 (2025).
   (https://doi.org/10.1073/pnas.2414860122)
   *Equal contribution

2. Reiko Asai, Vivek N. Prakash, **Shubham Sinha**, Manu Prakash, and Takashi Mikawa, *Coupling and uncoupling of midline morphogenesis and cell flow in amniote gastrulation,* **eLife** 12, RP89948 (2023)
   (https://doi.org/10.7554/eLife.89948.3)

3. Catherine Tom, **Shubham Sinha**, Nidhi Joshi, and Ravi Kumar Pujala, *Tuning aerogel properties for aerospace applications*, **Aerospace Polymeric Materials**, 1-28 (2022)
   (https://doi.org/10.1002/9781119905264.ch1)

4. Akanksha Agarwal, **Shubham Sinha**, Raju Mukherjee, and Dileep Mampallil, *Dynamics of Bacterial Deposition in Evaporating Drops*, **Phys. Fluids** 32, 093308 (2020)
   (https://doi.org/10.1063/5.0024078)

5. Dileep Mampallil, Meenakshi Sharma, Ashwini Sen, and **Shubham Sinha**, *Beyond the coffee-ring effect: Pattern formation by wetting and spreading of drops*, **Physical Review E** 98, 043107 (2018).
   (https://doi.org/10.1103/PhysRevE.98.043107)

Awards and Scholarships

- Media Coverage, University of Miami News (2025): "Illuminating the beginnings of animal development."
- Dean's Summer Research Fellowship (2024), College of Arts and Sciences, University of Miami: Highly competitive award given based on the proposed research and academic performance of the student.
- INSPIRE Fellowship, Government of India (2015-2020): A fellowship by Department of Science and technology to talented students in Science.

Conferences and seminars

- APS March Meeting 2024, Minneapolis, Minnesota
  Oral Talk: *Bilateral cellular flows initiate left-right asymmetry during early gastrulation in amniotes.*
  (https://meetings.aps.org/Meeting/MAR24/Session/K38.6)
- Invertebrate Neuroscience Meeting (9 June 2023)
  Oral Talk: *Cell flows in a developing chick embryo*
- Research Symposium, University of Miami (25 March 2025)
  Oral Talk: *Cell movements display left-right asymmetry in early chick embryo development*

Research Experience

PhD Project

Cellular flows during early chick embryo development, (2022-present)
Prakash Lab, University of Miami
Advisor: Dr. Vivek N. Prakash
Collaborators: Dr. Takashi Mikawa, University of California, San Francisco, *Dr. Rieko Asai*, Kumamoto University, IRCMS, Kumamoto, Japan.
Summary: We studied the cellular flow in the early stage of development (polonaise movements) of the chicken embryo. These coordinated cellular movements during the formation of the primitive streak were quantified using the Particle Image Velocimetry (PIV) technique. We found that the bilateral cell movements display LR asymmetry prior to the LR organizer formation in amniotes. This project led to publications in PNAS (2025) and eLife (2023).

Master's Thesis

Bacteria Motility in Porous Media, (2019-2020)
Microfluidics Group, Indian Institute of Science Education and Research Tirupati, India.
Advisor: Dr. Dileep Mampallil
Summary: We made two-dimensional porous media by filling microchannels with colloidal particles. We studied bacterial dynamics in this confinement generated between the colloidal particles. The swimming velocity, tumbling frequency, and entrapment time of bacteria were studied under different confinements. This project led to publication in Phys. Fluids (2020).

Undergrad Internships

Applied Thermodynamics, (Summer 2018)
Indian Institute of Science Education and Research Tirupati, India.
Advisor: Dr. Raghunath O Ramabhadran
Summary: The project aimed to understand the fundamentals of thermodynamics and its applications in chemical reactions. Thermodynamics of ideal gas reactions, heterogeneous systems and phase transitions were investigated.

Drop Bouncing on a Super-hydrophobic Surface, (Fall 2017)
Microfluidics Group, Indian Institute of Science Education and Research Tirupati, India.
Advisor: Dr. Dileep Mampallil
Summary: We studied the impact and spreading of water drops on powder layers. The

experiments involved high-speed imaging of the dynamics of the drop edge. Similar measurements were also performed on super-hydrophobic surfaces. A collaborative project on the coffee-ring effect got published in Physical Review E (2018). ***Structural and Magnetic Characterisation of Barium Doped Cobalt Ferrite***, (Summer 2017)
Indian Institute of Technology Patna, India
Advisor: Dr. Manoranjan Kar
Summary: Barium doped Cobalt ferrite nanoparticles were synthesised using citrate sol-gel method. The structural analysis done using XRD showed the phase purity of spinel structure. The magnetic characterisation was done using VSM and the analysis showed the reduction in saturation magnetisation and coercivity due to the substitution of non-magnetic Ba^{+2} with Co^{+2} and also reduced magnetocrystalline anisotropy.***Introduction to Solid State Physics***,(Summer 2016)
Indian Institute of Science Education and Research Tirupati, India.
Advisor: Dr. Sudipto Dutta
Summary: The project aimed to study the crystal structure, characterisation techniques, and the energy states in a crystal. A brief study on the structure of Graphene and its energy states was also performed.

Teaching

At the University of Miami

- Undergraduate Physics Labs, 2 labs per semester, No. of student per lab = 18
- PHY108 (Electricity and magnetism): Spring 2025
- PHY225 (Electricity and magnetism): Fall 2024
- PHY106 (Classical mechanics): Spring 2022, Fall 2023, Spring 2024

Graduate Coursework

1. Quantum Mechanics I
2. Quantum Mechanics II
3. Classical Mechanics I
4. Statistical Mechanics I
5. Electromagnetic Theory I
6. Electromagnetic Theory II
7. Quantum Theory I
8. Quantum Theory II
9. Biological Physics I
10. Introduction to Astrophysics
11. Introduction to Quantum Computation
12. Oral Communications

Technical Skills

- **Computational**: Particle Image Velocimetry (PIV), Particle Tracking, Compucell3D, Python, MATLAB, Image analysis (ImageJ), Origin, Latex
- **Experimental**: Fluorescence Microscopy, Stereo Microscopy, 3D printing, Soft-lithography (UV), Contact angle measurement, spin coating, Oxygen plasma glass-polymer bonding, XRD, NMR
- **Undergraduate experimental training**: PCR, Plasmid isolation, Gel electrophoresis, Thin Layer Chromatography, Column Chromatography, Recrystallization, Rotor evaporator.

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Dr. Dileep Mampallil
Assistant Professor,
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Dr. Sudipta Dutta
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