Shreya Ray

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Education:

Arizona State University (current)	• Doctoral Student, advisor: Dr. Steve Presse • Enrolled Fall 2014 (GRE: Quant 166, Verbal 161, AW 4)
Indian Institute of Science Education and Research, Pune	• B.S.-M.S. Dual Degree in Physics with Biology minor, May 2014 • Awarded INSPIRE scholarship by the Department of Science and Technology, Govt. of India. • All-India Rank secured in CSIR-NET exam (2013) in Physical Sciences: 35 • Vijyoshi Camp 2009, IISc, Bengaluru

Current Research:

- **Bdellovibrio bacteriovorus as a living antibiotic**
  Doctoral research under the supervision of Dr. Steve Presse, Arizona State University, Tempe
  In the biological arms race between lethal bacteria and humans, we continue to develop new antibiotics while bacteria continue to evolve and develop antibiotic resistance. One promising way to control the population of many species of disease-causing bacteria is by playing bacteria against bacteria: Bdellovibrio bacteriovorus is a gram-negative bacterial predator that hunts other bacteria and can potentially be used as a living antibiotic. Bdellovibrio populations have already been found in the human gut, where they help control the population of other bacteria. We try to test the potential of bdellovibrio in medical applications using the model organism Caenorhabditis elegans. We let the C. elegans feed on mildly lethal bacteria that colonizes their gut, and then try to rescue the worms by feeding them bdellovibrio. We also perform fluorescence imaging of live worms in order to study the dynamics between the bdellovibrio predators and their bacterial prey inside the gut of a living worm, and use Bayesian statistics to learn the underlying principles.

Past Research Projects:

- **Studying the Effects of Mutation and Charge on the Dynamics of CGRP**
  2014-2016, Research rotation under the supervision of Dr. Sara Vaiana, Arizona State University, Tempe

CGRP, a disordered hormone peptide of the Calcitonin family, is involved in vasodilation and relaying pain signals. CGRP also triggers migraine attacks and recently it has become a major therapeutic target for the prevention of migraines. Understanding the behaviour of unbound CGRP will give important insights into its receptor binding and activation, and help develop antagonists to make better drugs for migraine. We use a relatively novel technique called Tryptophan Triplet Quenching (TTQ), which gives us information about the structural (radius of gyration) and dynamical (reconfiguration rates) properties of disordered proteins – which are otherwise very difficult to study. I am currently studying the effect of charge on wild-type human CGRP and another mutated version of the same protein. It has been shown that charge could play a very important role in modulating the structure and dynamics of disordered proteins. These studies will also help us address broader questions regarding the physics and biology of disordered proteins which have been elusive to investigation so far. I am currently involved in writing a manuscript, as co-author, titled **"*Charge patterning, salt screening and denaturant expansion in the CGRP neuropeptide*".** I have also given a talk about my research: *Shreya Ray, Sara M. Sizemore, Andrea Soranno, Sara M. Vaiana. "**Modelling Electrostatic Interactions in Intrinsically Disordered Proteins.**" BioPhest, University of Arizona, Tuscon. 16th April, 2016.*

- **Triple-Slit Interference Experiment in the Microwave Regime**
  2013 Visiting Students Programme, under the supervision of Dr. Urbasi Sinha, Raman Research Institute (RRI), Bengaluru
  This was my thesis project for graduation where we were trying to experimentally find a correction term to the existing Wave Function Hypothesis in interference experiments that arises from the Feynman Path Integral Formalism. We used a triple-slit experiment analogue in the microwave region. Quantum Mechanical experiments are typically not performed in the macroscopic regime, but this novel approach seems promising.

- **Multilevel Selection on a Quantitatively Selfish Trait**
  2012-2013, project, under the supervision of Dr. Milind Watve, Department of Biology, Indian Institute of Science Education and Research (IISER), Pune
  In this biostatistics project, done in parallel to my other course works, I tried to explore a novel way of solving the group selection problem that has been going on between evolutionary biologists for a long time. We quantified 'selfishness' and ran simulations which has led to many interesting results that intuitively match those systems we see in around us in nature. This project resulted in a manuscript that has been submitted for publication in an International Journal and is currently being reviewed.

- **NMR Spectroscopy and its application in the study of Effect of Polar Organic solvents on a mutant of *Bacillus subtilis* Lipase (6B)**
  May-July 2012, summer project, under the supervision of Dr. Mandar V Deshmukh, Centre for Cellular and Molecular Biology (CCMB), Hyderabad
  The 6B lipase had an unusual stability in polar organic solvents and my task was to find out the extreme limits of this tolerance, and how the lipase behaves as we increase the concentration of the organic solvent. Interestingly, some amino acid residues of the lipase were more susceptible to change while others were relatively resistant. I had to identify and

locate these residues on the lipase from the chemical shifts of the residues in 2-dimensional spectroscopic data, and try to explain the reasons for the observed shifts. The results were represented on a 3D structural model of the protein built using PyMOL.

- **Optical Trapping of Rubidium atoms**
  June-July 2011, under the supervision of Dr. Umakant Rapol, Department of Physics, Indian Institute of Science Education and Research (IISER), Pune
  Over a period of two months I observed and assisted the ongoing process where the complex apparatus was set up in order to create the Optical Trap for the purpose of trapping ultra cold rubidium atoms and achieving the Bose-Einstein condensate.

- **Hartree-Fock Approximation in Quantum Chemistry**
  May-June 2010, under the supervision of Dr. Sourav Pal, Director, National Chemical Laboratory (NCL), Pune
  This was mainly a reading project about the rigorous theory leading to the Hartree-Fock Approximation, and its application in simple cases.