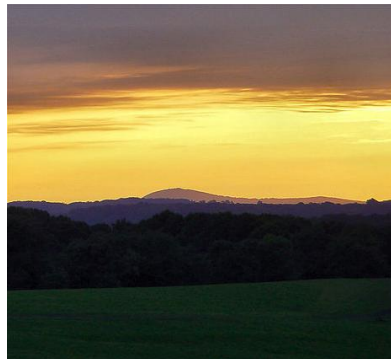

2020 Biophysics Graduate Orientation: Program Overview

Jeffery B. Klauda and Arpita Upadhyaya
Graduate Directors

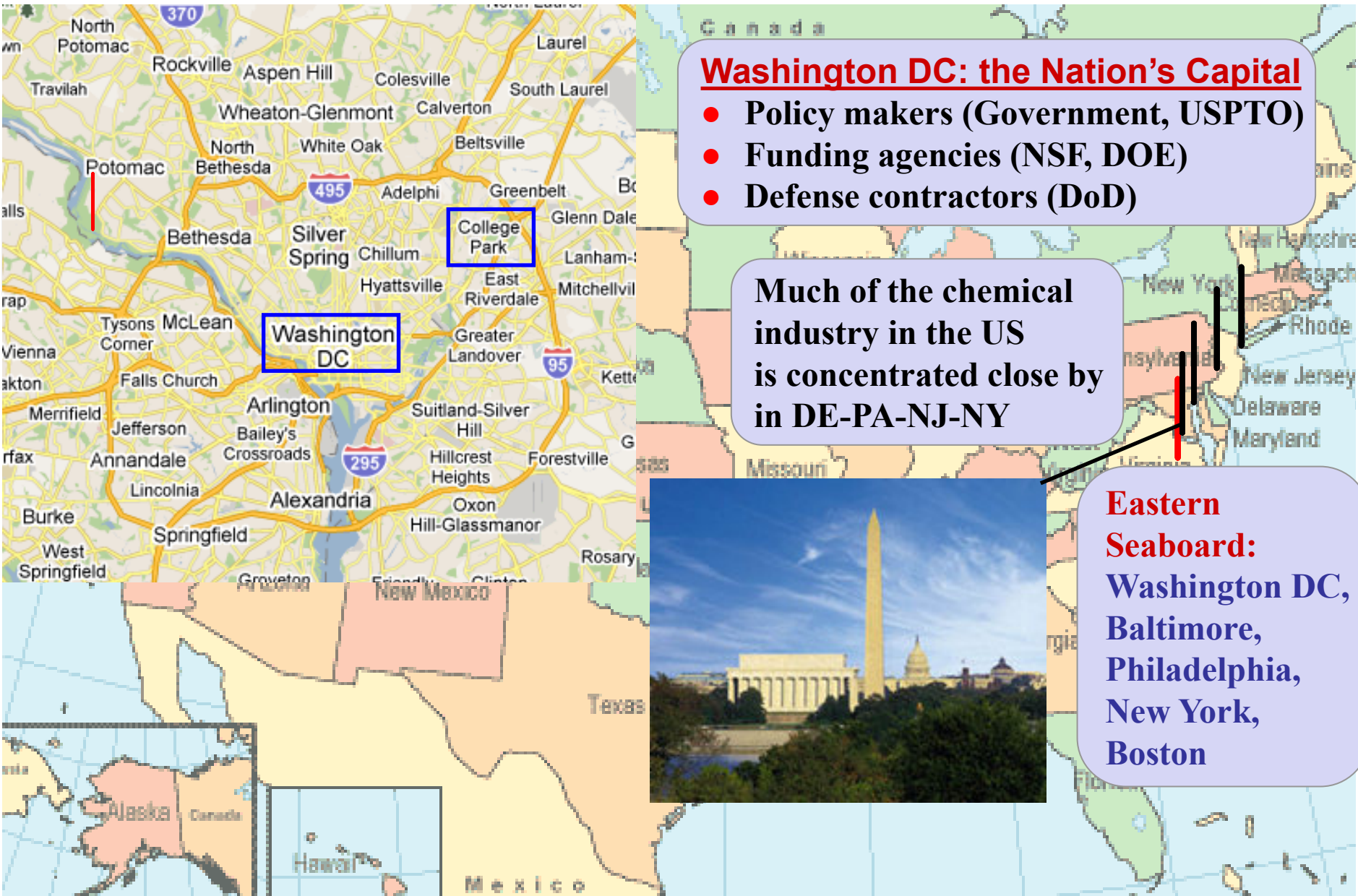


Welcome to Maryland!

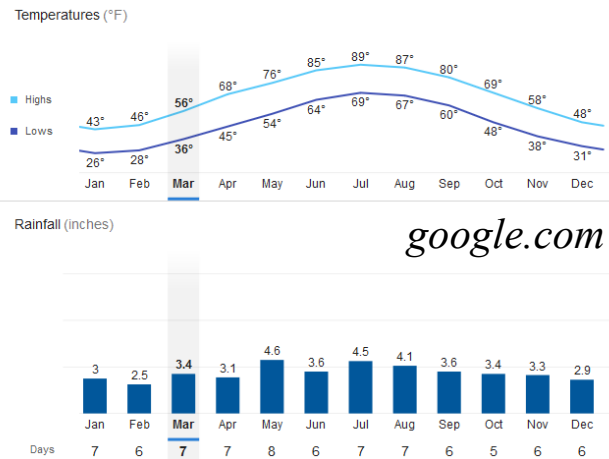


INSTITUTE FOR
PHYSICAL SCIENCE
& TECHNOLOGY

Why UMD? (Location, Location, Location)



Location: Quality of Life



Monuments



Museums (free!)

Seasonal but comfortable
climate year-round

Many cultural events, attractions in the Washington DC
area



Shenandoah Valley, VA

Beaches (MD/DE), mountains (VA) are just 2-3 hours away by car

Total Time to Degree is roughly 4.5-5 Years

- Year 1 (Fall/Spring): Take courses, TA, and Lab rotations
- Year 1 (Summer): Full time focus on research (work hard and make initial progress) & Qualifying exam (August)
- Year 2 (Fall/Spring): Continued focus on research
- Year 2 (Summer): Make significant headway on research
- Year 3 (end of semester 5): Defend Ph.D. proposal
- Year 3: Submit manuscripts and go to conferences
- Year 4-5: Finalize research, write dissertation, find a job and defend your dissertation

Lab Rotations: Overview

Format

- Three lab rotations in the Fall and Spring semester of the first year (with BIPH faculty)
- Research presentations at the end of each rotation

Why?

- Will allow you hands-on experience working in a potential advisor's lab and better understand their research and lab culture
- Faculty will get to know you better
- Help you decide between experimental versus computational research and find a thesis advisor

Research in Biophysics at UMD

Faculty in our Program come from different Departments



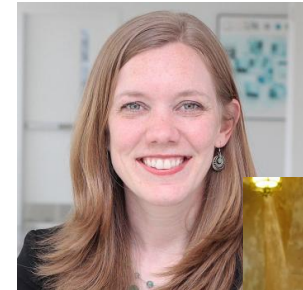
College of Computer, Mathematical, and Natural Sciences

Departments: Biology, Cell Biology, Chemistry/Biochemistry, Mathematics, Physics



A. James Clark School of Engineering

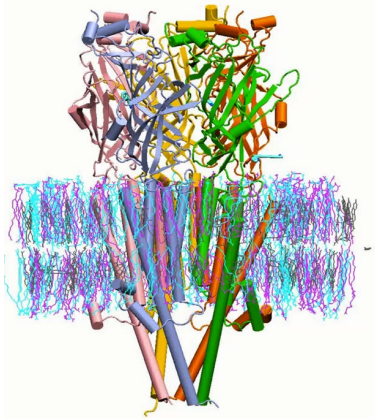
Departments: Bioengineering and Chemical and Biomolecular Engineering



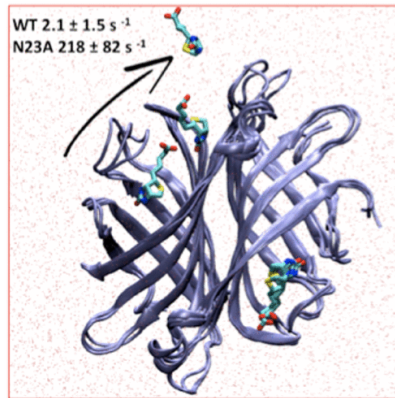
Research areas span a broad range of topics

Computational Research

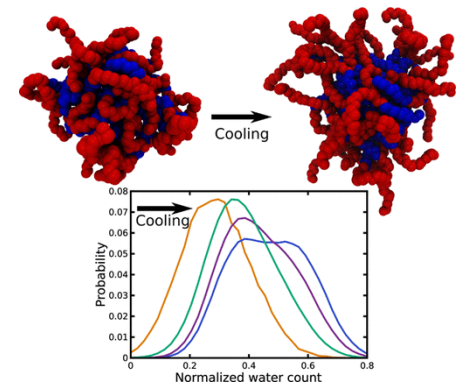
High Resolution: Quantum, atomic detail and molecular levels



Jeff Klauda

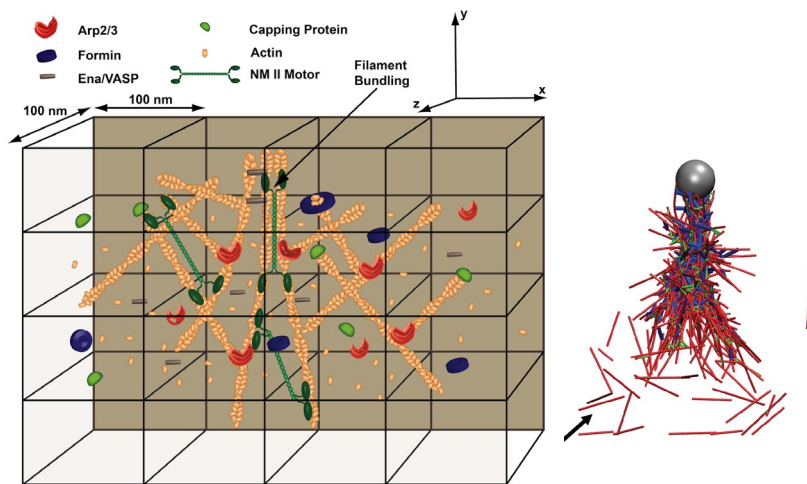


Pratyush Tiwary

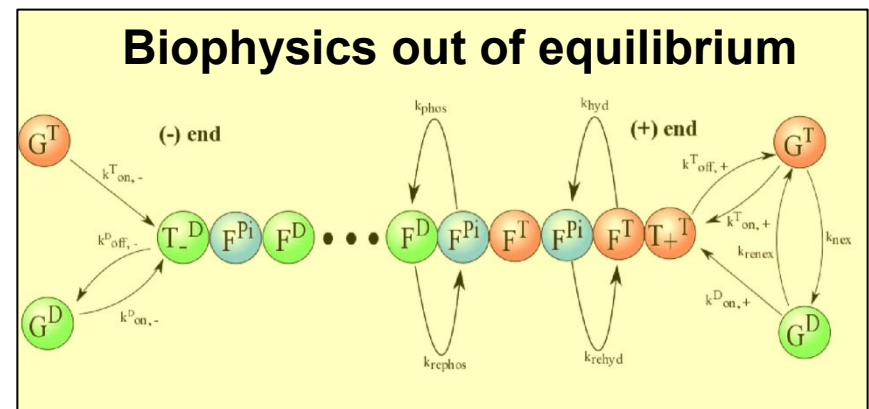


Silvina Matysiak

Coarse Resolution & Theoretical: cell mechanics, systems-level biology and developing theories across levels



Garegin Papoian



Chris Jarzynski

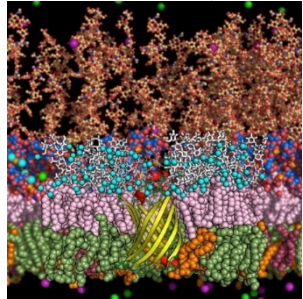


Jeff Klauda

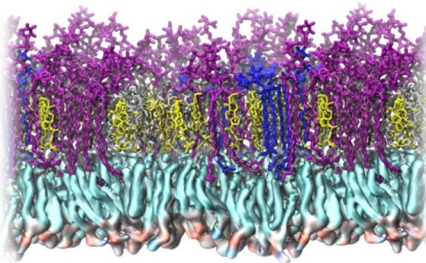
Molecular Modeling: *Cell Membranes and Associated Proteins*

Cell Membranes

Outer Membrane of *E. Coli*¹



Plasma Membrane of Yeast



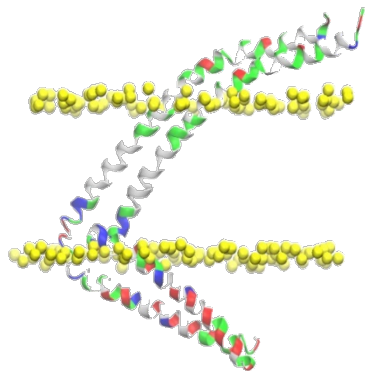
Stratum Corneum
Layer of Skin²



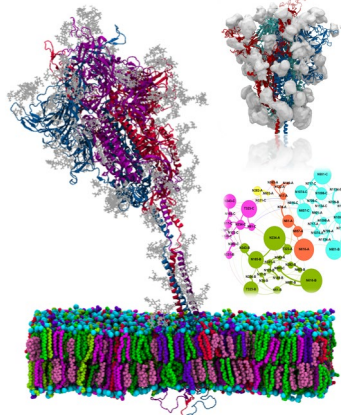
- Modeling of organism and organelle membranes at physiological concentrations^{1,2}
- Dimerization of proteins involved in neuronal, bone and cancer growth³
- COVID-19 Research on Spike Protein⁴
- Activation of the Serotonin Receptor⁵
- Peptide-membrane interactions with applications to anti-microbial peptides (AMPs)⁶

Membrane-Associated Proteins

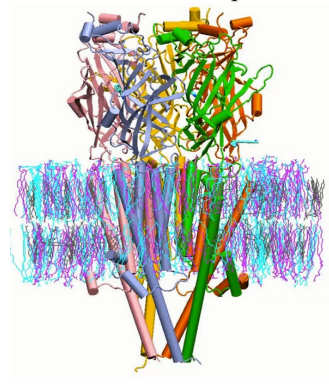
PlexinA3 homodimerization³



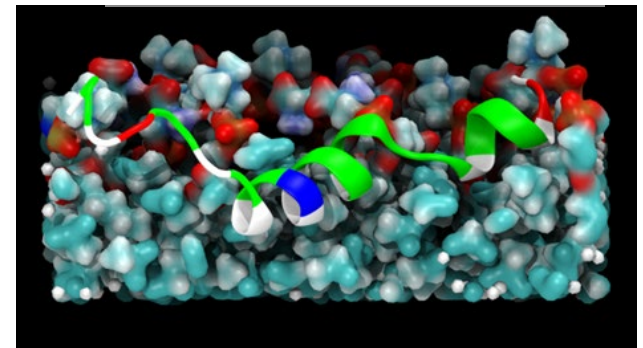
COVID-19 Spike⁴



Serotonin Receptor⁵



Peptide-membrane Binding⁶ and AMPs



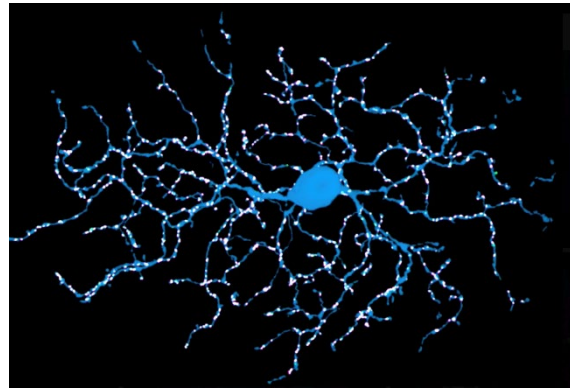
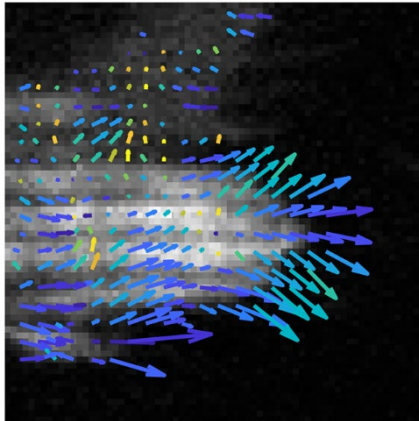
¹*Biophys. J.* **106**: p2493 (2014). ²*JACS.* **141**: p16930 (2019). ³*Biochem.* **55**: 4928 (2016). ⁴<https://doi.org/10.1101/2020.09.28.317206>. ⁵*PNAS.* **117**: p405 (2020). ⁶*JPCB.* **122**: p9713 (2018).

Experimental Research

Biophysics research at the interface: across multiple scales

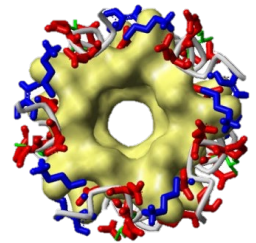
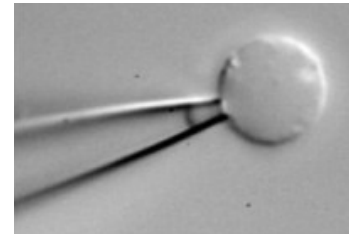
Colenso Speer

- Molecular and structural basis of developing neural circuits
- Super-resolution imaging of synaptic connectivity and function in neurons



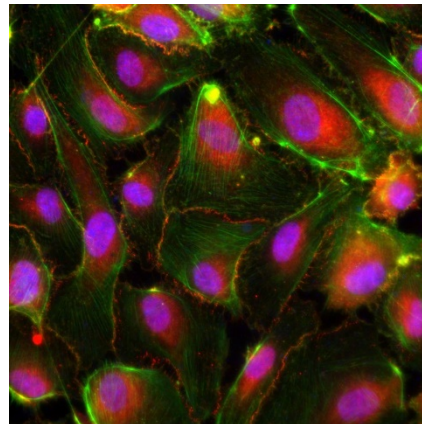
Sergei Sukharev

- Biophysics of mechanosensation and osmoregulation
- Structure function relationships in mechanosensitive channels



Wolfgang Losert

- Dynamics of complex biological systems
- How topography and electric fields modulate cell migration

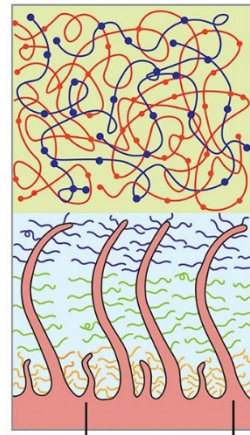


Kimberley Stroka

- Cellular microenvironment engineering
- Interplay of chemical and mechanical cues in disease

Gregg Duncan

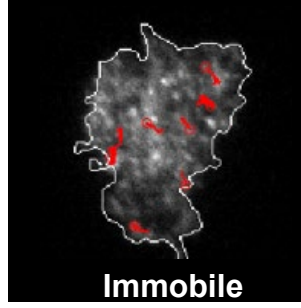
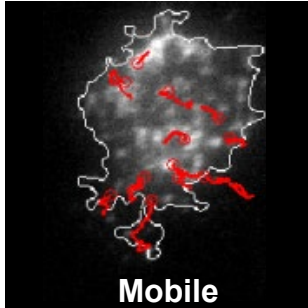
- Lung airway microphysiology
- Nanomaterials and soft matter approaches for interfacial interactions in lung airway surfaces



Mechanobiology of immune response and gene regulation

Immune receptor dynamics

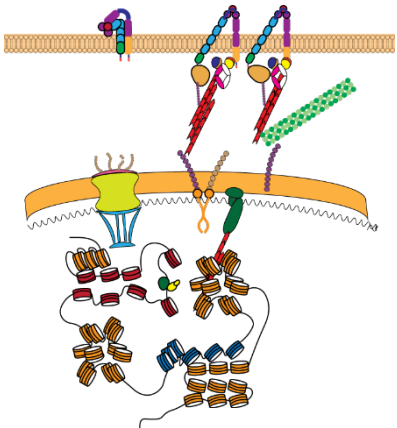
Regulation of T & B cell signaling



Biophys J. 2012, Nature Comm., 2020

Gene regulation

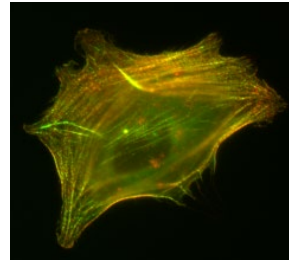
Imaging of transcription factor dynamics in live cell nuclei



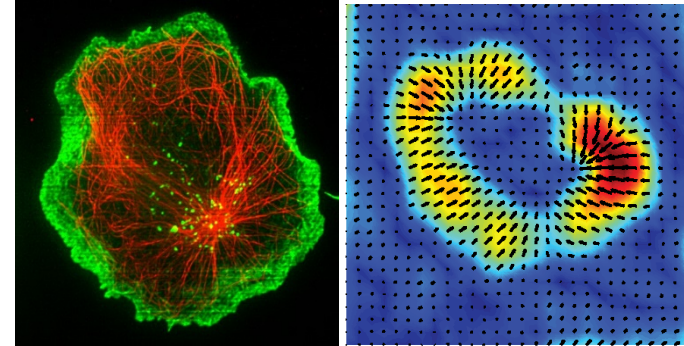
Molecular Cell, 2019

Arpita Upadhyaya

arpitau@umd.edu



Cellular Force generation



*Mol. Biol. Cell 2015
PNAS, 2018*

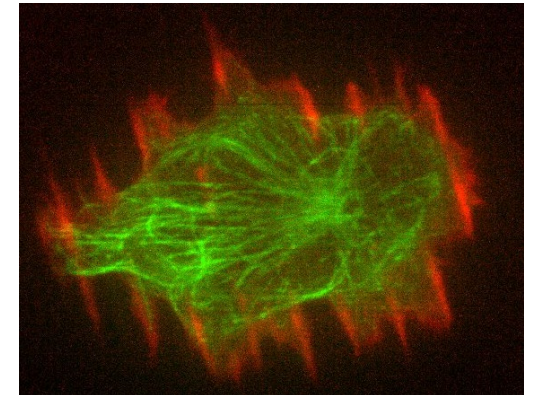
How do cells sense and respond to physical cues?

- Stiffness
- Topography
- Mobility

Techniques:

Single molecule imaging
Traction force microscopy
Super-resolution microscopy
Computational image analysis

Cytoskeletal dynamics



Mol. Biol. Cell 2018

<http://www2.physics.umd.edu/~arpitau/>

Weekly Biophysics Seminars

- **Biophysics Seminars** on cutting edge research from top scientists in the field
- Student lunch with speaker on the day of the seminar
- Opportunity for students to interact with national and international scientists from many institutes



Where Biophysics students have gone after graduation

Hongdian Yang – Faculty member at University of California, Riverside

Ruillang Bai – Faculty position at Zhejiang University, China

Shaon Chakraborty – Faculty position at National Center for Biological Sciences, India

Kyemyung Park – Faculty member at Yonsei University, Korea

Xue Fei – Postdoctoral Fellow at MIT

Eleanor Ory – Postdoctoral Fellow at University of Maryland School of Medicine

Huong Vu – Postdoctoral Associate at University of Texas, Austin

Jonathan Cwik - Postdoctoral Associate at MRC Laboratory of Molecular Biology, UK

Haiqing Zhao – Postdoctoral Associate at Columbia University

Alison Leonard – Postdoctoral Associate at University of Delaware

Hongcheng Xu – Software Engineer at Google

Hao Wu – Postdoctoral Position at Cornell Medical School

Stephanie Miller – Postdoctoral Researcher at University of California San Francisco

Simona Patange – Postdoctoral Research Associate at NIST

Deborah Hemingway – CEO at Leon Scientific

John Giannini – Postdoctoral fellow at National Eye Institute

NCI-UMD PARTNERSHIP FOR INTEGRATIVE CANCER RESEARCH

NIST
**National Institute of
Standards and Technology**
U.S. Department of Commerce



**Small-angle neutron
scattering (SANS) at NIST**



COMBINE

Computation and Mathematics for Biological Networks



Contact Info

Our Contact Info:



Dr. Jeffery (Jeff) Klauda
Phone: (301)405-1320
Email: jbklauda@umd.edu



Dr. Arpita Upadhyaya
Phone: (301)405-9939
Email: arpitau@umd.edu