2020 Biophysics Graduate Orientation: Program Overview

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Graduate Directors

Welcome to Maryland!
Why UMD? (Location, Location, Location)

Washington DC: the Nation’s Capital
- Policy makers (Government, USPTO)
- Funding agencies (NSF, DOE)
- Defense contractors (DoD)

Much of the chemical industry in the US is concentrated close by in DE-PA-NJ-NY

Location: Quality of Life

Seasonal but comfortable climate year-round

Many cultural events, attractions in the Washington DC area

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

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

Biophysics out of equilibrium
Molecular Modeling: Cell Membranes and Associated Proteins

Cell Membranes
- Outer Membrane of E. Coli
- Plasma Membrane of Yeast
- Stratum Corneum Layer of Skin

Membrane-Associated Proteins
- PlexinA3 homodimerization
- COVID-19 Spike
- Serotonin Receptor
- Peptide-membrane Binding and AMPs

- Modeling of organism and organelle membranes at physiological concentrations
- Dimerization of proteins involved in neuronal, bone and cancer growth
- COVID-19 Research on Spike Protein
- Activation of the Serotonin Receptor
- Peptide-membrane interactions with applications to anti-microbial peptides (AMPs)

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Experimental Research

Biophysics research at the interface: across multiple scales

Kimberley Stroka
• Cellular microenvironment engineering
• Interplay of chemical and mechanical cues in disease

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

Sergei Sukharev
• Biophysics of mechano-sensation and osmoregulation
• Structure function relationships in mechanosensitive channels

Wolfgang Losert
• Dynamics of complex biological systems
• How topography and electric fields modulate cell migration

Gregg Duncan
• Lung airway microphysiology
• Nanomaterials and soft matter approaches for interfacial interactions in lung airway surfaces
How do cells sense and respond to physical cues?

**Immune receptor dynamics**
Regulation of T & B cell signaling

*Biophys J. 2012, Nature Comm., 2020*

**Cellular Force generation**

*Mol. Biol. Cell 2015 PNAS, 2018*

**Gene regulation**
Imaging of transcription factor dynamics in live cell nuclei

*Molecular Cell, 2019*

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

*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
Biophysics opportunities and communities in and around UMD

NCI-UMD PARTNERSHIP FOR INTEGRATIVE CANCER RESEARCH

Small-angle neutron scattering (SANS) at NIST
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