Dylan Ross Weaver

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Education

- **University of Missouri** — Columbia, MO, United States
  Doctor of Philosophy - Physics — *August 2019 - May 2024*

  Dissertation Title: *Probing Membrane Protein Dynamics and Interactions with Lipids at the Single Molecule Level*
  Advisor: *Dr. Gavin M. King*

- **University of Missouri** — Columbia, MO, United States
  Master of Science - Physics; GPA: 3.8 — *August 2019 - July 2022*

  Graduate Minor: *College Teaching*
  Courses: *Nonlinear Dynamics, Structural Biology and Biophysics for Life Sciences, Computational Biological Physics, Single Molecule Biophysics, Techniques of Teaching College Physics, College Science Teaching*

- **Murray State University** — Murray, KY, United States
  Bachelor of Science, Magna Cum Laude - Physics, Mathematics; GPA: 3.65 — *August 2015 - May 2019*

Teaching Appointments

- **University of Wisconsin Eau Claire** — On Campus
  Assistant Professor — *Aug 2024 - Present*
  - **Lecture and Laboratory Instructor**: Implemented active learning strategies in courses for both majors and non-majors.
- **University of Missouri** — On Campus and Online
  Graduate Teaching Assistant: In Person and Online — *Aug 2019 - May 2022*
  - **Instructor**: Fulfilled the Minor in College Teaching program as an instructor for PHYS 1200 - Everyday Wonders
  - **Head Teaching Assistant**: Primary contact for all TA's serving in Calculus Based Physics II (PHYS 2760)
  - **Lab/Discussion Teaching Assistant**: Laboratory TA for Calculus Based Physics II, as well as discussion sections for Calc. and Alg. based Physics I/II. This includes regular office hours and grading exams and lab reports.
- **Murray State University** — On Campus
  Undergraduate Teaching Assistant — *Aug 2015 - May 2019*
  - **Online Grading Coordinator**: Implemented online software for TA's to streamline grading tasks each week. This includes developing rubrics for lab reports in all introductory Physics courses.
  - **Laboratory Teaching Assistant**: Primary and/or secondary TA for Calc. and Alg. based Physics I/II courses, as well as Introductory Astronomy.

Teaching Experience by Course Title

- **University of Wisconsin Eau Claire**
  Assistant Professor
  - **PHYS 100 - Introduction to Physical Science**: A conceptual study of physics using ideas of force and energy to understand motion, properties of matter, sound, light, and electricity and magnetism. Enrollment: 50-60 students
- **University of Missouri**
  Instructor
  - **PHYS 1200 - Everyday Wonders: How Ordinary Things Work**: A conceptual course that focuses on how one can use the principles of Physics to describe processes in everyday life. Students completed online assignments along with weekly lab meetings. Average Enrollment: 20-30 students

Teaching Awards

- Harry B. Hammond Award for Excellence in Undergraduate Teaching - May 2022

Current Research: Single Molecule Biological Physics

- **Biological Atomic Force Microscopy (AFM)**: Membrane proteins make up 30% per of proteins in cells, performing various critical functions. Many techniques provide relevant biochemical information, but most only provide static conformations. AFM can be a complementary tool in studying the dynamic structure of these proteins in physiologically relevant conditions and real time. The method can also be used to study how certain peptides disrupt membrane morphology. Along with molecular-scale (10 Å) lateral resolution and ∼1 Å vertical resolution, trace/retrace kymographs can be used to achieve sub-100 ms temporal resolution.
- **Single Molecule Force Spectroscopy**: Studying the interactions between certain peptides and lipid membranes is essential for probing various cellular processes and mechanisms. The challenge in studying these interactions resides in not only the complexity of the system, but the length and time scales that the interactions take place in. Through AFM-based force spectroscopy, we can probe the dissociation forces and free energy profiles of various peptides as they negotiate a membrane. Applying SMFS to peptide-lipid interaction can help to quantify amino-acid contributions with single residue precision, as well as effects due to the hydrophobicity of certain peptides.

Detailed Research Experience

- **University of Wisconsin Eau Claire**
  Assistant Professor *Aug 2024 - Present*
  - **Imaging Lipid Membranes in Presence of Maximin 3**: Maximin peptides are secreted by the Chinese red-belly toad *Bombina maxima*, and possess antimicrobial activity. Through imaging and spectroscopy, one can shed light on the mechanism of action for membrane disruption. One can also determine various mechanical properties of the membrane film, such as the line tension, in the presence and absence of maximins.
  - **The Role of Hydrophobicity on Peptide-Lipid Interactions**: Numerous hydrophobicity scales have been utilized to describe which amino acids readily partition into a membrane or prefer to be in solution. This, in turn, is used in answering questions regarding stability and folding of proteins in membrane. Through spectroscopy and simulations, we probe the energy landscape of host-guest pentapeptides ($WLLLX$, where X is a variable residue).
- **University of Missouri**
  Graduate Research Assistant *Oct 2019 - July 2024*
  - **Visualization of SecDF**: Applied AFM imaging and kymograph (line-scan) analysis to probe the conformational dynamics of protein translocation factor SecDF in the presence and absence of the Sec translocon SecYEG. Comparison to crystal structures and molecular dynamics simulations help bolster confidence in real-time, single-molecule data. These experiments suggest that at a basal level, the conformational dynamics of SecDF change in the presence of SecYEG.
  - **Chain-length Dependence on Peptide-Lipid Interactions**: Applied single molecule force spectroscopy to probe the energetics and k kinetics of various peptides in the presence of a lipid membrane using approach/retract experiments. Peptides consisted of polyleucine constructs (WL_n, where $n = 1...5$), which are sufficiently small to not adopt higher order structures. This allows us to probe the effect of primary structure changes, namely length. Rupture force distributions were collected and analyzed, allowing us to determine the force-dependent dissociation rate, as well as the free energy profile. These parameters are typically hidden from traditional bulk techniques.

Equipment and Skills Summary

- **Programming Languages**: IgorPro, TCL (For VMD/NAMD), Python, MATLAB, Java
- **Cypher S Atomic Force Microscope**: Tapping Mode Atomic Force Microscopy in Liquid, Force Spectroscopy
- **Molecular Dynamics Software**: VMD, NAMD, GROMACS
- **FEI Scios DualBeam**: Coupled Scanning Electron Microscope/Focused Ion Beam, AFM Cantilever Modification
- **FEI Quanta 600F**: Environmental Scanning Electron Microscope, X-Ray Energy Dispersive Spectroscopy

Research Awards

- **University of Missouri**:
  - Physics Leaders Award: Outstanding Presentation of Graduate Research - 2nd Place - Spring 2022
  - Inaugural Chandrasekhar Fellow - Spring 2024

Academic Awards

- **University of Missouri**:
  - Ernst Landen Fellowship - Summer 2021
  - Anderson Physics Graduate Award - Summer 2021
  - Sigma Pi Sigma Student Inductee - 2018

Professional Organizations

- **University of Missouri**:
  - Physics & Astronomy Grad Student Association: Chair of Educational Communication - 2022 Calendar Year
  - Physics & Astronomy Grad Student Association: Chair of Teaching Excellence - 2021 Calendar Year
  - PhysAssist - Mental Health Counseling - Graduate Student Mentor - 2022 to present

Publications

- [**1**]: R.S. Smith*, **D.R. Weaver***, I. Kosztin, and G.M. King, Chain-length dependence of peptide-lipid bilayer interaction strength and binding kinetics: a combined theoretical and experimental approach, **Langmuir** 40, 28, 14467-14475 (2024). DOI: 10.1021/acs.langmuir.4c01218. (*) equal contribution
- [**2**]: **D.R. Weaver***, K.G. Schaefer*, and G.M. King, Atomic force microscope kymograph analysis: a case study of two membrane proteins, **Methods** 223, 83 (2024). DOI: 10.1016/j.ymeth.2024.01.013. (*) equal contribution
- [**3**]: **D.R. Weaver** and G.M. King, Atomic force microscopy reveals complexity underlying general secretory system activity, **International Journal of Molecular Sciences** 24, 55 (2023). DOI: 10.3390/ijms24010055
- [**4**]: **D.R. Weaver**, D.N. Amin, and G.M. King, The conformations and basal conformational dynamics of translocation factor SecDF vary with translocon SecYEG interaction, **Journal of Biological Chemistry** 298, 102412 (2022). DOI: 10.1016/j.jbc.2022.102412

Presentations

- **Platform: AFM-Based Force Spectroscopy Provides Quantitative Characterization of Single Residue Contributions in Peptide-Lipid Interactions**: Graduate platform presentation at the 2024 Annual Meeting of the Biophysical Society (Feb 2024). Authors: **Dylan Weaver**, Ryan Smith, Ioan Kosztin, and Gavin King

Posters

- **Poster: Atomic Force Microscopy Kymographs Can Provide Robust Access to Conformational Transitions in Membrane Proteins**: Graduate poster presentation at the 2023 Annual Meeting of the Biophysical Society (Feb 2023). Authors: **Dylan Weaver**, Katherine Schaefer, Divya Amin, Arthur Roberts, and Gavin King
- **Poster: Direct Visualization of Conformations and Conformational Dynamics of the Proton-Driven Translocation Factor SecDF in Supported Lipid Bilayers**: Graduate poster presentation at the 2022 Annual Meeting of the Biophysical Society (Feb 2022), and the 2022 Midwest Single Molecule Workshop (Aug 2022). Authors: **Dylan Weaver**, Divya Amin, and Gavin King
- **Poster: Precise Analysis of Kymograph Data for Biological Atomic Force Microscopy using the Line Detection Algorithm**: Graduate poster presentation at the 2021 Annual Meeting of the Biophysical Society (Feb 2021). Authors: **Dylan Weaver**, Lucas Chandler, and Gavin King

External Service

- **Reviewer**: Provided peer review for potential publications at the journal(s) listed below.
  - Scientific Reports