

# **Center for Soft Matter and Biological Physics**

## **Department of Physics, Virginia Tech**

### **Annual Report – Fiscal Year 2018**

The Center for Soft Matter and Biological Physics was chartered on February 12, 2016. This annual report covers the period July 1, 2017 through June 30, 2018.

#### **I. Mission Statement of the Center for Soft Matter and Biological Physics**

The mission of the Center for Soft Matter and Biological Physics is to advance the rapidly growing research areas of soft matter and biological physics, in alignment with the long-range plans of the Department of Physics, the College of Science, and Virginia Tech. Special attention will be extended to how these developments can address many of the most significant problems currently facing society, including effective drug design and delivery, next generation materials, programmable biology, and models for human disease.

Center members will enjoy the benefits of a formal unifying organizational structure that will focus their research projects, and both nucleate new and strengthen already existing cooperative interdisciplinary efforts in soft matter and biological physics across campus. The Center structure will enhance its members' opportunities to attract external research funding, and to propose large collaborative center grants. In addition, the Center will considerably increase its members' visibility both within Virginia Tech and externally and facilitate the establishment of a vibrant Center scientific seminar series.

The objectives of the Center for Soft Matter and Biological Physics are to

- serve as a formal unifying and trans-disciplinary organizational structure that supports the science program in soft matter and biological physics at Virginia Tech;
- increase the number of joint external grants from member investigators of the Center;
- develop collaborative Center proposals that focus on research and education in the areas of soft matter and biological physics and seek expanded external funding from government and foundational sources;
- establish a vibrant scientific seminar series on soft matter and biological physics, and support the weekly Physics Department Condensed Matter Seminar with (mostly) external speakers;
- establish an annual symposium and/or summer school within the Center to promote both research and education in the areas of soft matter and biological physics;
- participate in the organization of local, national, and international conferences and workshops that include the Virginia Soft Matter Workshop series (an annual workshop that rotates among major Virginia institutions); and to attract national and international conferences to Virginia Tech;
- develop an educational module in collaboration with other Virginia Tech Institutes such as the Macromolecules and Interfaces Institute (MII) to provide instruction and training to Virginia Tech students who are interested in or need an exposure to soft matter and biological physics.

## II. Classification of Center and Organizational Structure

### 1. Organization

The Center for Soft Matter and Biological Physics is a department center administered by the Department of Physics in the College of Science.

Department Chair and Center Administrator:

- Dr. Mark Pitt, Professor, Department of Physics, College of Science

Center Director and Contact Person:

- Dr. Uwe C. Täuber, Professor, Department of Physics, College of Science

Center Steering Committee:

- Dr. Daniel Capelluto, Associate Professor, Department of Biological Sciences, College of Science
- Dr. Shengfeng Cheng, Assistant Professor, Department of Physics, College of Science
- Dr. William Ducker, Professor, Department of Chemical Engineering, College of Engineering
- Dr. Vinh Nguyen, Assistant Professor, Departments of Physics and Nanoscience, College of Science

Center Website: <https://csmb.phys.vt.edu>

### 2. List of Faculty Affiliated with the Center

Regular faculty members (40) as of June 30, 2018:

- Dr. Rana Ashkar, Assistant Professor, Department of Physics, College of Science
- Dr. Justin Barone, Professor, Department of Biological Systems Engineering, College of Agriculture and Life Science and College of Engineering
- Dr. Yang Cao, Associate Professor, Department of Computer Science, College of Engineering
- Dr. Daniel Capelluto, Associate Professor, Department of Biological Sciences, College of Science
- Dr. Jing Chen, Assistant Professor, Department of Biological Sciences, College of Science
- Dr. Shengfeng Cheng, Assistant Professor, Department of Physics, College of Science
- Dr. David Dillard, The Adhesive & Sealant Science Professor, Department of Biomedical Engineering and Mechanics, College of Engineering
- Dr. William Ducker, Professor, Department of Chemical Engineering, College of Engineering
- Dr. Alan Esker, Professor and Chair, Department of Chemistry, College of Science
- Dr. James Hanna, Assistant Professor, Department of Biomedical Engineering and Mechanics, College of Engineering

- Dr. Silke Hauf, Associate Professor, Department of Biological Sciences, College of Science
- Dr. Jean Heremans, Professor, Department of Physics, College of Science
- Dr. Sunny Jung, Associate Professor, Department of Biomedical Engineering and Mechanics, College of Engineering (has left Virginia Tech in August 2018)
- Dr. Giti Khodaparast, Associate Professor, Department of Physics, College of Science
- Dr. Shihoko Kojima, Assistant Professor, Department of Biological Sciences, College of Science
- Dr. Tim Long, Professor, Department of Chemistry and Director, Macromolecules and Interfaces Institute, College of Science
- Dr. Louis Madsen, Associate Professor, Department of Chemistry, College of Science
- Dr. Herve Marand, Professor and Associate Chair, Department of Chemistry, College of Science
- Dr. Steve Melville, Associate Professor, Department of Biological Sciences, College of Science
- Dr. Djordje Minic, Professor, Department of Physics, College of Science
- Dr. Reza Mirzaeifar, Assistant Professor, Department of Mechanical Engineering, College of Engineering
- Dr. Vinh Nguyen, Assistant Professor, Department of Physics, College of Science
- Dr. Alexey Onufriev, Professor, Department of Computer Science, College of Engineering
- Dr. Mark Paul, Professor, Department of Mechanical Engineering, College of Engineering
- Dr. John Phillips, Professor, Department of Biological Sciences, College of Science
- Dr. Michel Pleimling, Professor, Department of Physics and Director, Academy of Integrated Science, College of Science
- Dr. David Popham, Professor, Department of Biological Sciences, College of Science
- Dr. Rui Qiao, Professor, Department of Mechanical Engineering, College of Engineering
- Dr. Hans Robinson, Associate Professor, Department of Physics, College of Science
- Dr. Vicki Soghomonian, Associate Professor, Department of Physics, College of Science
- Dr. Carolina Tallon, Assistant Professor, Department of Materials Science and Engineering, College of Engineering
- Dr. Chenggang Tao, Assistant Professor, Department of Physics, College of Science
- Dr. Uwe Täuber, Professor, Department of Physics, College of Science
- Dr. John Tyson, University Distinguished Professor, Department of Biological Sciences, College of Science
- Dr. Layne Watson, Professor, Department of Computer Science, College of Engineering

Affiliated emeriti faculty members:

- Dr. Jimmy Ritter, Associate Professor emeritus, Department of Physics, College of Science
- Dr. Dick Zallen, Professor emeritus, Department of Physics, College of Science
- Dr. Royce Zia, Professor emeritus, Department of Physics, College of Science

### 3. List of Postdocs and Students Supported by Center Administered Funds

Postdoctoral research associate:

- Dr. Priyanka, since January 2018, ARO 450484

Graduate research assistants:

- Ahmadreza Azizi, GRA summer 2017 and summer 2018, ½ GRA fall 2017 and spring 2018, ARO 450484
- Fazel Baniasadi, GRA summer 2017 and summer 2018, ARO 450347
- Bart L. Brown, GRA summer 2017, ½ GRA fall 2017 and spring 2018, DOE 429262
- Jacob A. Carroll, ½ GRA fall 2017 and spring 2018, partial GRA (two weeks) summer 2018, ARO 450484
- Harshwardhan N. Chaturvedi, GRA summer 2017 and summer 2018, ½ GRA fall 2017, DOE 429262
- Jason Czak, GRA summer 2018, NSF 479739
- Shadi Esmaeili, GRA fall 2017, spring and summer 2018, NSF 479739
- Weigang Liu, GRA summer 2017 and summer 2018, ½ GRA fall 2017, DOE 429262
- Ruslan I. Mukhamadiarov, GRA summer 2017, ½ GRA fall 2017, ARO 450484
- Riya Nandi, GRA summer 2017 and summer 2018, ½ GRA fall 2017 and spring 2018, ARO 450484
- Shannon R. Serrao, GRA summer 2017 and summer 2018, ½ GRA fall 2017 and spring 2018, ARO 450484
- James Stidham, GRA summer 2017 and summer 2018, ½ GRA fall 2017, ARO 450484
- Xiangwen Wang, ½ GRA summer and fall 2017, GRA summer 2018, NSF 478819
- Fan Zhang, GRA summer 2017 and summer 2018, ARO 450347
- Husong Zheng, GRA summer 2017 and summer 2018, ARO 450347

Undergraduate research students:

- Ryan Baker, systems biology, summer and fall 2017, spring and summer 2018, NSF 479739
- Nathan W. Galliher, physics, summer and fall 2017, spring 2018, DOE 429262
- John (“Jack”) L. Monk, physics, fall 2017 and spring 2018, DOE 429262
- Austin “Ada” Warren, physics, summer and fall 2017, spring and summer 2018, ARO 450484
- Nicholas V. Wilson, physics, spring and summer 2017, spring 2018, DOE 429262

### 4. Classified Staff

- Katrina Loan, Program Support Technician, funded through A-21 program  
During her third year, Ms. Loan’s salary will be provided by the Office of the Vice President for Research (70%) and the Center for Soft Matter and Biological Physics (30%).

Department fiscal staff:

- Jacqueline Woodyard, Business Manager, Department of Physics
- Sherri Collins, Assistant Business Manager, Department of Physics

### **III. Amendments to the Center Charter**

The quorum requirement of 50 % of the Center's regular faculty members for official votes at Center meetings was lowered to 30 %; in addition, the presence of a simple majority (50 %) of the Center's Steering Committee will be required.

### **IV. Stakeholder Committee**

The Center does not currently have a Stakeholder Committee established. We propose as its members:

- Dr. Mark Pitt, Professor and Chair, Department of Physics
- Dr. Randy Heflin, Professor, Department of Physics, and Associate Dean for Research and Graduate Studies, College of Science
- Dr. Theresa Mayer, Professor, Department of Electrical Engineering, and Vice President for Research and Innovation

### **V. Major Grants Received in 2017-2018**

New grants:

- U.S. Department of Energy (DOE 429262), Office of Basic Energy Sciences (BES) grant *DE- FG02-09ER46613, Non-equilibrium relaxation, aging scaling, and critical depinning dynamics of Skyrmions in disordered magnetic films*; PI Uwe C. Täuber (Physics, 50 %), co-PI Michel Pleimling (Physics, 50 %): August 15, 2018 – August 14, 2021; total volume \$ 450,000 for three years.
- U.S. Army Research Office (ARO 450568), Undergraduate Research Apprenticeship Program (URAP) supplement through ARO Broad Agency Announcement (BAA), *Control of universal scaling, noise strength, and pattern formation in critical dynamics*; PI Uwe C. Täuber (Physics, 50 %), co-PI Michel Pleimling (Physics, 50 %), May 15 – August 14, 2018, \$ 9,000 for three months.
- National Aeronautics and Space Administration (NASA 426701): Advanced Component Technology support, *Plasmonic enhanced long-wavelength photodetectors for Earth radiation budget instruments*, PI Vinh Nguyen (Physics, 100 %): May 16, 2018 – December 31, 2018; total volume \$ 64,446.00 for one year.

Continuing grants:

- U.S. Army Research Office (ARO 450484), Engineering Sciences Directorate, Mechanical Sciences Division, *Control of universal scaling, noise strength, and pattern formation in critical dynamics*; PI Uwe C. Täuber (Physics, 50 %), co-PI Michel Pleimling (Physics, 50 %), with subcontract to P. S. Krishnaprasad (Electrical and Computer Engineering, University of Maryland): April 15, 2017 – April 14, 2021; total volume \$ 1,400,000 for four years.
- U.S. National Science Foundation (NSF 418270), Division of Chemistry – CHE, Structure, Dynamics and Mechanisms B, *Unraveling connections among biomolecular structure, interfacial solvent dynamics, and conformational dynamics*; PI Katie Mitchell-Koch (Wichita State University, 50 %), co-PI Vinh Nguyen (Physics, 50 %); August 1, 2017 – July 31, 2020; total volume \$ 368,000 for three years.
- U.S. National Science Foundation (NSF 479739), Division of Materials Research (DMR), Condensed Matter and Materials Theory, *Systems far from equilibrium: relaxation processes and steady-state properties*; PI Michel Pleimling (Physics, 100 %): June 1, 2017 – May 31, 2019; total volume \$ 290,000 for two years.
- U.S. National Science Foundation (NSF 417942), Division of Materials Research (DMR) grant *DMR-1507371, Non-equilibrium statistical mechanics of co-evolving complex systems*; PI Kevin E. Bassler (Physics, University of Houston, 50 %), co-PI Royce K.P. Zia (Physics, 50 %): January 16, 2016 – December 31, 2018; total volume \$ 324,000 for three years; expected subcontract to Virginia Tech \$ 11,270.
- National Aeronautics and Space Administration (NASA 418127) support, *Clouds and the Earth's radiant energy system (CERES) analytical modeling with the MCRT environment, SSAI/NASA*. PI Bob Mahan (Mechanical Engineering, 60 %), co-PI Vinh Nguyen (Physics, 40 % - 418266): October 1, 2017 – September 30, 2018; total volume \$ 314,614.68 for one year.
- American Chemical Society (ACS 443428), Petroleum Research Fund (PRF), *Computational modeling of ionic polymers: from solution interpolyelectrolyte complexes to solid-state membranes*; PI Shengfeng Cheng (Physics, 100 %): September 1, 2016 – August 31, 2018; total volume \$ 110,000 for two years.
- U.S. Department of Energy (DOE 429262), Office of Basic Energy Sciences (BES) grant *DE-FG02-09ER46613, Non-equilibrium relaxation and aging scaling of driven topological defects in condensed matter*; PI Uwe C. Täuber (Physics, 50 %), co-PI Michel Pleimling (Physics, 50 %): August 15, 2015 – August 14, 2018; total volume \$ 450,000 for three years.
- U.S. Army Research Office (ARO 450347), Engineering Science Directorate, Materials Science Division grant *W911NF-15-1-0414, Fundamental investigation of dynamic*

*phenomena in atomically thin layered materials*; PI Chenggang Tao (Physics, 100 %): August 1, 2015 - July 31, 2018; total volume \$ 389,187 for three years.

- National Aeronautics and Space Administration (NASA 418128) support, *RBI analytical modeling with the MCRT environment support (STARSS III)*, SSAI/NASA. PI Bob Mahan (Mechanical Engineering, 40 %), co-PI Vinh Nguyen (Physics, 30 % - 418129), co-PI Brian Vick (Mechanical Engineering, 30 %): December 1, 2016 – September 30, 2018; total volume \$ 532,992.11.

## **VI. Major Proposals Submitted or Pending**

- U.S. National Science Foundation (NSF), Division of Materials Research (DMR), Condensed Matter and Materials Theory, *CAREER: Self-organization of microtubules as model dynamic materials*; PI Shengfeng Cheng (Physics, 100 %); total volume \$ 582,050 for five years.
- National Aeronautics and Space Administration (NASA) support, *RBI Analytical Modeling with the MCRT Environment*, SSAI/NASA. PI Bob Mahan (Mechanical Engineering, 40 %), Co-PI Vinh Nguyen (Physics, 30 %), co-PI Brian Vick (Mechanical Engineering, 30 %): October 1, 2017 – September 30, 2018; total volume \$ 351,669 for one year.
- National Aeronautics and Space Administration (NASA) support, *engineering long-wavelength infrared photo-detectors based on two-dimensional Materials*, PI Vinh Nguyen (Physics, 100 %): October 15, 2017 – October 14, 2020; total volume \$ 599,445 for three years.
- National Institutes of Health (NIH), (R21), *Accurate, yet fast implicit solvation*, PI Alexey Onufriev (Computer Science, 100 %): September 1, 2018 – August 31, 2020; total volume \$ 422,165 for two years.
- National Institutes of Health (NIH), (R01), *Analytical electrostatics: Methods development and biological applications*, PI Alexey Onufriev (Computer Science, (100 %): August 1, 2017 – July 30, 2021; total volume \$ 1,578,391 for four years.
- U.S. National Science Foundation (NSF), *DNA compaction into nucleosom arrays: multi-resolution approach*, PI Alexey Onufriev (collaborative proposal with NCSU, with separate budgets): August 1, 2017 – July 31, 2020; total volume \$ 479,047 for three years.

## VII. Significant Accomplishments in 2017-2018

### 1. Center for Soft Matter and Biological Physics Seminar Series

The Center runs a regular seminar series in conjunction with the Physics Department's Condensed Matter Seminars (Mondays, 4.00 – 5.00 p.m.), organized by Vinh Nguyen in collaboration with Ed Barnes (both Department of Physics). In the fall term 2017 and spring semester 2018, the Center has organized and financially supported the following seminars (see <https://csmb.phys.vt.edu/events.html>):

- August 28, 2017: Sheng Chen, Physics, Virginia Tech:  
*Computational studies of predator-prey competition models.*
- September 18, 2017: Prof. Lauren Childs, Mathematics, Virginia Tech:  
*Simulating within-vector generation of the malaria parasite diversity.*
- September 25, 2017: Harsh Chaturvedi, Physics, Virginia Tech:  
*Dynamics of driven vortices in type- II superconductors.*
- October 2, 2017: Prof. Xiaowei Wu, Statistics, Virginia Tech:  
*Learning patterns from genomics data through stochastic modeling.*
- October 16, 2017: Dr. Charles Reichhardt, Los Alamos National Laboratory:  
*Skyrmion lattices in random and ordered potential landscapes.*
- October 17, 2017: Dr. Charles Reichhardt, Los Alamos National Laboratory:  
*Jamming and clogging of passive and active particles in disordered media.*
- October 30, 2017: Madhurima Nath, Virginia Tech Biocomplexity Institute:  
*Statistical mechanical applications of graph dynamical systems.*
- November 9, 2017: Prof. Srividya Iyer-Biswas, Physics, Purdue University:  
*Making the right noise.*
- November 27, 2017: Prof. Jiangtao Cheng, Mechanical Engineering, Virginia Tech:  
*Mechanism and universal scaling law for contact line friction of Cassie-state droplets on nano-structured ultra-hydrophobic surface.*
- December 4, 2017: Yanfei Tang, Physics, Virginia Tech:  
*Molecular dynamics simulations of drying colloidal films.*
- December 11, 2017: Prof. Robert S. Hoy, University of South Florida:  
*Thermalized soft glassy rheology.*



- February 19, 2018: Dr. Michael Cooney, NASA Langley Research Center:  
*MEDLI2, ARCSTON and broadband photodetectors for measuring radiative flux.*
- March 14, 2018: Weigang Liu, Physics, Virginia Tech:  
*A study of the complex Ginzburg-Landau equation: analytical and numerical results.*
- March 19, 2018: Chengyuan Wen, Physics, Virginia Tech:  
*Evaporation of liquids and solutions.*
- March 26, 2018: Xiangwen Wang, Physics, Virginia Tech:  
*Data-driven modeling of heavy-tailed distributions and scaling laws in human dynamics.*
- April 2, 2018: Ali Charkhesht, Physics, Virginia Tech:  
*Probing collective motions and hydration dynamics of bio-molecules.*
- April 6, 2018: Prof. Jeff Chen, Physics & Astronomy, University of Waterloo:  
*The Onsager model of liquid crystals.*
- April 9, 2018: Mengsu Chen, Physics, Virginia Tech:  
*Exploring quantum many-body systems via lattice model and exact diagonalization.*
- April 16, 2018: Prof. Mark Dykman, Physics, Michigan State University:  
*Time-translation symmetry breaking in vibrational Floquet systems.*
- April 27, 2018: Prof. Timothy Halpin-Healy, Physics, Columbia University:  
*Within and beyond the realm of KPZ (Kardar, Parisi & Zhang).*
- April 30, 2018: Prof. Juan Vanegas, University of Vermont:  
*Mechanics at the nanoscale: local stress calculations in biomolecular systems.*

## **2. Center for Soft Matter and Biological Physics Symposium**

The Center held its third annual symposium on May 16 and 17, 2018, organized by Shengfeng Cheng (Department of Physics), featuring three invited external keynote speakers on May 16:

- Prof. Markus Deserno, Physics, Carnegie Mellon University:  
*Physical models for dynamin-driven membrane fission.*
- Prof. Nikolay Dokholyan, Biochemistry and Biophysics, UNC Chapel Hill of Medicine:  
*Control of cellular networks by structural disorder.*
- Prof. Connie Roth, Physics, Emory University:

*Perturbations of polymer glasses near interfaces: polymer-polymer interfaces, chain tethering and roughness.*

Other speakers on May 16 were:

- Prof. Louis Madsen, Chemistry, Virginia Tech:  
*A modular electrostatic network material formed from a double helix.*
- Prof. Sunny Jung, Biomedical Engineering and Mechanics, Virginia Tech:  
*Bio-fluid dynamics on plants.*
- Prof. William Ducker, Chemical Engineering, Virginia Tech:  
*Hindering bacterial biofilm formation using surface topography.*
- Prof. Steve Melville, Biological Sciences, Virginia Tech:  
*How can bacteria maintain buoyance if they have no flagella?*
- Prof. Rana Ashkar, Physics, Virginia Tech:  
*The controversial effects of cholesterol in the lipid membranes.*
- Prof. Alexey Onufriev, Computer Science, Virginia Tech:  
*Physical epigenetics at nucleosome level.*
- Wen Xiong, Biological Sciences, Virginia Tech:  
*Structural basis for the commitment to cargo trafficking by endosomal proteins.*
- Prof. Djordje Minic, Physics, Virginia Tech:  
*From universal biology to universal cosmology.*
- Prof. Michel Pleimling, Physics, Virginia Tech:  
*Beyond rock-paper-scissors: novel properties in spatial six species games.*
- Prof. Justin Barone, Biological Systems Engineering, Virginia Tech:  
*Bending, curling, and twisting in soft materials.*

During the poster session on May 16, the poster prize of \$150.00 was awarded to four students:

- Bart Brown, Physics, advisor Prof. Michel Pleimling:  
*Dynamically generated hierarchies in games of completion.*
- Jacob Carroll, Physics, advisor Prof. Uwe C. Täuber:  
*Avalanches in neural networks.*
- Yirui Chen, Biological Sciences, advisor Prof. Jing Chen:  
*Mathematical modeling of adventurous gliding motility in *Myxococcus xanthus*.*

- Yanfei Tang, Physics, advisor Prof. Shengfeng Cheng:  
*Controlling stratification of polydisperse nanoparticles during solvent evaporation.*

The May 17 Graduate Student Workshop featured tutorials by our keynote speakers:

- Prof. Markus Deserno, Physics, Carnegie Mellon University:  
*The physics of self-assembly: from morphology to aggregation thermodynamic.*
- Prof. Nikolay Dokholyan, Biochemistry and Biophysics, UNC Chapel Hill of Medicine:  
*Multiscale modeling and design of biological molecules.*
- Prof. Connie Roth, Physics, Emory University:  
*Polymer glasses and interfacial effects.*

During the Graduate Student Workshop on May 17, the Collaboration Idea Award prize of \$ 100.00 was awarded to seven students:

- Jason Czak, Physics
- Yirui Chen, Biological Sciences
- Ali Charkhesht, Physics
- Juliana Butler, Physics
- John Hittel, Chemical Engineering
- Parviz Shabane, Physics
- Tuo-Xian Tang, Biological Sciences;

the Collaboration Incentive Award prize of \$ 400.00 was shared by two students (\$ 200.00 each):

- Parviz Shabane, Physics
- Tuo-Xian Tang, Biological Sciences.

Katrina Loan provided staff support. More details are listed in our symposium program flyer:

[https://author.ensemble.vt.edu/assetdetails.html/content/dam/csmb\\_phys\\_vt\\_edu/events/CSB%202018%20Symposium%20pg%201-7.pdf](https://author.ensemble.vt.edu/assetdetails.html/content/dam/csmb_phys_vt_edu/events/CSB%202018%20Symposium%20pg%201-7.pdf)

### **3. Center for Soft Matter and Biological Physics Meetings**

Through the semester (Fridays 4.00 – 5.00 p.m.) as well as summer months (Mondays 1.30 – 2.30 p.m.), the Center held informal meetings, organized by Vinh Nguyen (Department of Physics), to promote scientific exchange and incite possible research collaborations

(<https://csmb.phys.vt.edu/events/Discussion.html>):

- July 7, 2017: Prof. Shengfeng Cheng, Physics, Virginia Tech:  
*Evaporation as a phenomenon and a tool.*

- July 14, 2017: Shadi Esmaeili, Physics, Virginia Tech:  
*Breaking of time translation invariance in Kuramoto dynamics.*
- July 21, 2017: Harmeet Singh, Engineering Mechanics, Virginia Tech:  
*Geometric singularities in the mechanics of strings and rods.*
- August 11, 2017: Laura Hanzly, Biological Systems Engineering, Virginia Tech:  
*Protein nanoscale self-assembly and nanofiller applications.*
- August 25, 2017: Parviz Shabane, Physics, Virginia Tech:  
*Intrinsically disordered proteins – what do they look like?*
- October 27, 2017: Jacob Carroll, Physics, Virginia Tech:  
*Sparsely encoding convolutional neural networks, part I.*
- November 3, 2017: Yanfei Tang, Physics, Virginia Tech:  
*Young-Laplace equation.*
- November 10, 2017: Prof. Hildegard Meyer-Ortmanns, Jacobs University Bremen, Germany:  
*About interesting cycles in oscillatory systems and in games of winnerless competition.*
- December 1, 2017: Chengyuan Wen, Physics, Virginia Tech:  
*Evaporation of liquids.*
- February 9, 2018: Jacob Carroll, Physics, Virginia Tech:  
*Sparsely encoding convolutional neural networks, part II.*
- February 16, 2018: Dr. Priyanka, Physics, Virginia Tech:  
*Study of anomalous behavior in one-dimensional harmonic system.*
- February 23, 2018: Weigang Liu, Physics, Virginia Tech:  
*A numerical study of the two-dimensional complex Ginzburg-Landau equation.*
- March 23, 2018: Ali Charkhesht, Physics, Virginia Tech:  
*Probing collective motions of proteins and hydration dynamics by a wide range dielectric spectroscopy.*
- April 13, 2018: Riya Nandi, Physics, Virginia Tech:  
*Short-time dynamics of three-dimensional magnetic systems with Heisenberg interaction.*
- June 22, 2018: Ruslan Mukhamadiarov, Physics, Virginia Tech:  
*Transverse temperature interface in the Katz-Lebowitz-Spohn model.*
- June 29, 2018: Prof. Uwe C. Täuber, Physics, Virginia Tech:  
*Interactive discussion: Manuscript writing.*

#### 4. Research Publications with Center Affiliation

- Bart. L. Brown and Michel Pleimling,  
*Coarsening with nontrivial in-domain dynamics: Correlations and interface fluctuations*,  
The Physical Review E **96**, 012147 (24 July 2017)  
[<https://doi.org/10.1103/PhysRevE.96.012147>].
- Shadisadat Esmaeili, Darka Labavić, Michel Pleimling, and Hildegard Meyer-Ortmanns,  
*Breaking of time-translation invariance in Kuramoto dynamics with multiple time scales*,  
EPL (Europhysics Letters) **118**, 40006 – 1-6 (27 July 2017)  
[<http://iopscience.iop.org/article/10.1209/0295-5075/118/40006/meta>].
- Tuo-Xian Tang, Wen Xiong, Carla V. Finkelstein, and Daniel G. S. Capelluto,  
*Identification of ligand-binding modulators using the protein-lipid overlay assay*,  
Humana Press, Springer Science Proteomics for Drug Discovery 197-206; Methods in  
Molecular Biology, **1846**, 1984-2019 (15 August 2017)  
[ <https://link.springer.com/bookseries/7651> ];  
[[https://link.springer.com/protocol/10.1007%2F978-1-4939-7201-2\\_13](https://link.springer.com/protocol/10.1007%2F978-1-4939-7201-2_13)].
- Shannon R. Serrao and Uwe C. Täuber,  
*A stochastic analysis of the spatially extended May-Leonard model*,  
Journal of Physics A: Mathematical and Theoretical **50**, 404005 – 1-16 (7 September  
2017) [<http://arxiv.org/abs/1706.00309>].
- Bassel Heiba, Sheng Chen, and Uwe C. Täuber,  
*Boundary effects on population dynamics in stochastic lattice Lotka-Volterra models*,  
Physica A **491**, 582-590 (4 October 2017) [<http://arxiv.org/abs/1706.02567>].
- Aubrey M. Davis, Laura E. Hanzly, Barbara L. DeButts, and Justin R. Barone,  
*Characterization of dimensional stability in flax fiber reinforced polypropylene  
composites*,  
Polymer Composites (10 October 2017) [<https://doi.org/10.1002/pc.24614>].
- Deepam Maurya, Ali Charkhesht, Sanjeev K. Nayak, Fu-Chang Sun, Deepu George,  
Abhijit Pramanick, Min-Gyu Kang, Hyun-Cheol Song, Marshall M. Alexander, Djamila  
Lou, Giti A. Khodaparast, S. Pamir Alpay, N. Q. Vinh, and Shashank Priya,  
*Soft phonon mode dynamics in Aurivillius type structures*,  
Physical Review B Letters **96**, 134114 (18 October 2017)  
[<https://journals.aps.org/prb/abstract/10.1103/PhysRevB.96.134114>].
- Barbara L. DeButts, Laura E. Hanzly, and Justin R. Barone,  
*Protein-polyisoprene rubber composites*,

Journal of Applied Polymer Science **135**, 12 (22 November 2017)  
[<https://onlinelibrary.wiley.com/doi/abs/10.1002/app.46026>].

- Kevin E. Bassler and Royce K. P. Zia,  
*Emergence of a spectral gap in a class of random matrices associated with split graphs*,  
Journal of Physics A: Mathematical and Theoretical **51**, 014002 – 1-14 (5 December 2017) [<http://iopscience.iop.org/article/10.1088/1751-8121/aa94a9/meta>].
- Barbara L. DeButts, Cara R. Spivey, and Justin R. Barone,  
*Wheat gluten aggregates as a reinforcement for poly (vinyl alcohol) films*,  
ACS Sustainable Chemistry and Engineering, **6**, 2422-2430 (December 2017)  
[<https://pubs.acs.org/doi/10.1021/acssuschemeng.7b03872>].
- Shengfeng Cheng, Mark J. Stevens, and Gary S. Grest,  
*Ordering nanoparticles with polymer brushes*,  
Journal of Chemical Physics **147**, 224901 (8 December 2017)  
[<https://aip.scitation.org/doi/10.1063/1.5006048>].
- Ulrich Dobramysl, Mauro Mobilia, Michel Pleimling, and Uwe C. Täuber,  
*Stochastic population dynamics in spatially extended predator-prey systems*,  
Journal of Physics A: Mathematical and Theoretical **51**, 063001 – 1-47 (5 January 2018)  
[<http://arxiv.org/abs/1708.07055>].
- William A. Ducker,  
*Effects of Colloidal Crystals, Antibiotics, and Surface-bound antimicrobials on Pseudomonas aeruginosa Surface Density*,  
ACS Biomaterials Science and Engineering **4**, 257-265 (8 January 2018)  
[<https://pubs.acs.org/doi/abs/10.1021/acsbmaterials.7b00799>].
- Bart L. Brown, Uwe C. Täuber, and Michel Pleimling,  
*The effect of the Magnus force on Skyrmion relaxation dynamics*,  
The Physical Review B **97** (Rapid Communication), 020405(R) – 1-5 (10 January 2018)  
[<http://arxiv.org/abs/1801.00774>].
- Nicholas Allen Kinney, Igor V. Sharakhov, and Alexey V. Onufriev,  
*Chromosome-nuclear envelope attachments affect interphase chromosome territories and entanglement*,  
Epigenetics & Chromatin **11**, 3 (22 January 2018)  
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Journal of Colloid and Interface Science (25 August 2018)  
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- Fridolin Gross, Paolo Bonaiuti, Silke Hauf, and Andrea Ciliberto,  
*Implications of alternative routes to APC/C inhibition by the mitotic checkpoint complex*,  
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## 5. Submitted Papers with Center Affiliation

- Yanfei Tang and Shengfeng Cheng,  
*Capillary forces on a small particle at a liquid-vapor interface: Theory and simulation*,  
submitted to: The Physical Review E (18 June 2018) [<https://arxiv.org/abs/1806.06493>].
- Harmeet Singh and James A. Hanna,  
*On the planar elastica, stress, and material stress*,  
submitted to: Proceedings of the Royal Society A (9 June 2017 revised 12 June 2018)  
[<http://arxiv.org/abs/1706.03047>].
- Harshwardhan Chaturvedi, Nathan Galliher, Ulrich Dobramysl, Michel Pleimling, and Uwe C. Täuber,  
*Dynamical regimes of vortex flow in type-II superconductors with parallel twin boundaries*,  
submitted to: European Physical Journal B (July 2018) [<http://arxiv.org/abs/1710.03679>].
- Shadisadat Esmaeili, Bart L. Brown, and Michel Pleimling,  
*Perturbing cyclic predator-prey systems: how a six-species coarsening system with non-trivial in-domain dynamics responds to sudden changes*,

submitted to: The Physical Review E (2018).

- Leslie A. Maynard, Barbara L. DeButts, and Justin R. Barone.  
*Morphology influence on modulus and elastic recovery in polyolefin thermoplastic elastomers,*  
submitted to: Polymer Engineering and Science (2018).
- Laura E. Hanzly, Barbara L. DeButts, Danielle Shell, and Justin R. Barone,  
*Protein aggregation in aqueous polyvinyl alcohol solutions,*  
submitted to: Journal of Polymer and Environment (2018).
- Barbara L. DeButts, Renee Thompson, and Justin R. Barone  
*Zinc oxide-free synthetic isoprene rubber vulcanizates using wheat protein as an activator,*  
submitted to: Rubber Chemistry and Technology (2018).

## 6. Invited Presentations with Center Affiliation

- Uwe C. Täuber, Sebastian Diehl, Weigang Liu, George L. Daquila, and Sheng Chen,  
*Non-equilibrium relaxation and aging scaling in driven systems,*  
Workshop *Nonequilibrium dynamics: diffusion, populations and aging,*  
TIFR Centre for Interdisciplinary Sciences (TCIS), Hyderabad, India (30 June 2017).
- James Hanna,  
*Some thoughts on multi-stability,*  
Society of Engineering Science 54th Annual Technical Meeting, Boston, MA (July 2017).
- Uwe C. Täuber,  
*Critical dynamics,* five lectures, *Bangalore School on Statistical Physics VIII,*  
International Centre for Theoretical Sciences (ICTS) Bangalore, India (3 – 7 July 2017).
- Uwe C. Täuber, Sebastian Diehl, Weigang Liu, George L. Daquila, and Sheng Chen,  
*Non-equilibrium relaxation and aging scaling in driven systems,*  
Research Seminar, *Bangalore School on Statistical Physics VIII,*  
International Centre for Theoretical Sciences (ICTS) Bangalore, India (11 July 2017).
- Uwe C. Täuber,  
*Stochastic spatial predator-prey models: population oscillations, predator extinction, and the effects of randomness and evolution,*  
Theoretical Sciences Unit Seminar, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, India (12 July 2017).
- Royce K. P. Zia,

*Persistent probability currents and probability angular momentum in non-equilibrium steady states*, Max Planck Institute for Physics of Complex Systems, Dresden, Germany (13 July 2017).

- Alexey Onufriev,  
*Nucleosome—the very special protein-DNA complex*,  
American Chemical Society (ACS), Washington, DC (August 2017).
- Royce K. P. Zia,  
*Climate fluctuations and non-equilibrium statistical mechanics: an interdisciplinary dialogue*, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany,  
(<https://www.pks.mpg.de/caneid17/>) (10 July – 4 August 2017).
- James Hanna,  
*Elastic structures*,  
5th Virginia Soft Matter Workshop, Harrisonburg, VA (September 2017).
- Royce K. P. Zia,  
*Non-equilibrium statistical mechanics: a growing frontier of “pure and applied” theoretical physics*,  
Physics Department, Georgia Tech, Atlanta, GA (25 September 2017).
- Royce K. P. Zia,  
*Prominent and subtle manifestations of persistent probability currents in non-equilibrium steady states*,  
Institute for Physical Science and Technology, U Maryland, College Park, MD (7 November 2017).
- N. A. Corbin, James A. Hanna, W. R. Royston, H. Singh, and R. B. Warner,  
*Chain coiling and impinging*,  
DFD Gallery of Fluid Motion (21 November 2017)  
(<https://gfm.aps.org/meetings/dfd-2017/59ac5a19b8ac316d38841a1a>).
- Justin R. Barone,  
*Early stage amyloid ‘pompons’ are realized in vitro in viscous polymer solutions*,  
ACS Polymer Chemistry Division Polymers and Nanotechnology Workshop, San Diego, CA (18 December 2017).
- Royce, K. P. Zia,  
*The Widom-Rowlinson model: more surprises from Driven Diffusive Systems Workshop on “Correlations, fluctuations and anomalous transport in systems far from equilibrium”*,  
(<http://www.weizmann.ac.il/conferences/SRitp/DecJan2018/>),  
Weizmann Institute of Science, Rehovot, Israel (10 January 2018).
- Royce K. P. Zia,  
*What is Physics? – a personal perspective*,

Physics Department, UNCA, Asheville, NC  
(28 September 2017 and 30 January 2018).

- Justin R. Barone,  
*Materials science opportunities for industrial hemp,*  
Industrial Hemp Summit, Danville, VA (27 February 2018).
- Alexey Onufriev,  
*Physical epigenetics at Nucleosome level,*  
Polyelectrolytes in Chemistry, Biology and Technology 2018, Singapore (March 2018).
- Alexey Onufriev,  
*Challenges in the modeling of solvent,*  
Fields Institute, Toronto, Canada, (June 2018).

## **7. Provisional Patent:**

- James Hanna, T. Yu, W. D. Hartley II, and N. A. Corbin,  
*Mechanism for pure bending of sheets,*  
United States Provisional patent 62/671,154, (14 May 2018).

## **8. Awards and Recognitions**

Graduate students:

- Bart L. Brown,  
*2018 Clayton D. Williams Graduate Fellowship in Theoretical Physics, Department of Physics*  
*2018 Center for Soft Matter and Biological Physics Symposium, Outstanding Poster Award*
- Jacob Carroll,  
*2018 Ray F. Tipword Graduate Scholarship in both General and Condensed Matter Physics, Department of Physics*
- Shadisadat Esmaili,  
*2018 Clayton D. Williams Graduate Fellowship in Theoretical Physics, Department of Physics*
- Riya Nandi,  
*2018 Ray F. Tipword Graduate Scholarship in both General and Condensed Matter Physics, Department of Physics*

## 9. Student Travel Grants

In January 2017, the Center established a grant to support conference travel for graduate students whose advisers who are affiliated with the Center, but do not have current external funding available for this purpose. The students are requested to submit a brief application with presentation title, abstract, and conference description, all connected with research related to the Center's mission. The students can be awarded up to \$ 400 for conference travel. Five student travel grants may be issued for each spring and fall semester per year, totaling up to \$ 4,000. This year's recipients were:

- Brian Chang, Biomedical Engineering and Mechanics:  
*Effects of geometry and kinematics on animals leaping out of water,*  
American Physical Society Division of Fluid Dynamics, Denver, CO, November 2017.
- Ali Charkhesht, Physics:  
*Probing collective motions of proteins and hydration dynamics in aqueous solutions by a wide range dielectric spectroscopy,*  
Biophysical Society 62<sup>nd</sup> Annual Meeting, San Francisco, CA, February 2018.
- Harrison Wood, Engineering Mechanics:  
*The saturation bifurcation in coupled oscillators,*  
American Physical Society March Meeting, Los Angeles, CA, March 2018.
- Tuo-Xian Tang, Biological Sciences:  
*The functional basis of PHAFIN2 in autophagy,*  
VA Academy Science 96<sup>th</sup> Annual Meeting, Farmville, VA, May 2018.
- Prudhvidhar Gaddam, Chemical Engineering:  
*Adsorption at confined interfaces,*  
92<sup>nd</sup> ACS 2018 Colloid & Surface Science Symposium, State College, PA, June 2018.

## 10. Student New Collaboration Incentive Awards

In January 2017, the Center established a grant for graduate students supporting new research collaborations related to the Center's mission, aiding planned or ongoing research involving students from different research groups. The students are to submit a brief application with a description of their planned research. If accepted they can be awarded up to \$ 400, possibly later supplemented with a student travel grant. Two grants may be issued in each spring and fall semester per year, totaling up to \$ 800.00. The summer 2018 recipients were:

- Tuo-Xian Tang (Biological Sciences) and Parviz Seifpanahi (Physics),  
*Simulation studies for the function of a conserved aspartic acid motif in Phafin proteins.*

**VIII. Industrial Affiliates Program** – Not applicable.

**IX. Report of Financial Condition**

Center Financial Report Fiscal Year 2018		Center Financial Projection Fiscal Year 2019	
<b>Operations Account (176188)</b>		<b>Operations Account (176188)</b>	
Starting Balance	\$ 36,366.47	Starting Balance	\$ (3,861.94)
	<b>Income</b>		<b>Income</b>
Starts FY2018	\$ (40,228.41)	A21 Award	\$ 28,350
	<b>Expenses</b>		<b>Expenses</b>
		70% Staff Salary (Katrina Loan)	\$ (25,617)
<b>Ending Balance</b>	<b>\$ (3,861.94)</b>	<b>Ending Balance</b>	<b>\$ (1,129.14)</b>
<b>Overhead Account (235052)</b>		<b>Overhead Account (235052)</b>	
Starting Balance	\$ 27,744.95	Starting Balance	\$ 37,483.20
	<b>Income</b>		<b>Income</b>
Overhead Earnings	\$ 27,480.04	Overhead Earnings	\$ 35,000
	<b>Expenses</b>		<b>Expenses</b>
Salary	\$ (4,469.83)		
Seminar Travel	\$ (1,578.30)	Seminar	\$ (4,700)
Seminar Supplies	\$ (2,061.73)	Symposium	\$ (5,200)
Student Travel	\$ (1,994.01)	Sowers Symposium Speaker	\$ (2,000)
Centers Symposium Travel	\$ (1,822.23)	Student Travel	\$ (2,000)
Centers Symposium Supplies	\$ (2,792.32)	Center's Awards	\$ (1,010)
Centers Symposium Awards	\$ (1,050.00)	Supplies & Budget	\$ (362)
Supplies & Budget	\$ (78.15)		
Center Collaboration Awards	\$ (400.00)	30% Staff Salary (Katrina Loan)	\$ (10,979)
Center's Summer workshop	\$ (315.90)		
Other Charges	\$ (1,179.32)		
<b>Ending Balance</b>	<b>\$ 37,483.20</b>	<b>Ending Balance</b>	<b>\$ 46,232.70</b>

**X. Major Issues of the Center**

The Center's financial standing remains very solid.

The Center maintains a very lively and successful seminar series and regular discussion meetings. We shall continue to organize annual symposia with external speakers, and to support other related conferences. We are organizing this year's Virginia Soft Matter Workshop, to be held at Virginia Tech on September 22, 2018.

Our principal task over the next few years remains to generate new interdisciplinary research collaborations leading to several collaborative grant proposals.

We intend to also explore new course developments, ideally across departments and colleges, and to possibly establish a summer school related to the Center's research mission.

In the Physics Department, we hope to soon hire a new tenure track faculty member in Theoretical / Computational Soft Matter and/or Biological Physics.