Center for Soft Matter and Biological Physics
Department of Physics, Virginia Tech
Annual Report – Fiscal Year 2019

The Center for Soft Matter and Biological Physics was chartered on February 12, 2016.
This annual report covers the period July 1, 2018 through June 30, 2019.

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 (39) as of June 30, 2019:

- 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. Jonathan Boreyko, Assistant Professor, Department of Mechanical Engineering, 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. Jiangtao Cheng, Associate Professor, Department of Mechanical Engineering, College of Engineering
- 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. Giti Khodaparast, 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, Professor, 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. Herve Marand, Professor emeritus, Department of Chemistry, College of Science
- 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 associates:

- Dr. Saptarshi Chakraborty, since January 2019
- Dr. Priyanka, since January 2018, ARO 450484
- Dr. Abhishek K. Singh, since May 2019, AFOSR 450618

Graduate research assistants:

- Tabassum Ahmed, ½ GRA spring 2019 and full GRA summer 2019, AFOSR 450589
- Ahmadreza Azizi, GRA ½ spring 2019, ½ GRA summer 2019, ½ fall 2020 ARO 450484
- Bart L. Brown, ½ GRA spring 2018, DOE 429262
- Jacob A. Carroll, ½ GRA fall 2018, ARO 450484
- Harshwardhan N. Chaturvedi, GRA summer 2018, partial GRA fall 2018, DOE 429262
- Jason Czak, GRA summer 2018, NSF 479739
- Luan Doan, GRA summer 2019, NSF 418270
- Shadi Esmaeili, summer and fall 2018, spring 2019,NSF 479739
- Negin Forouzexh, GRA spring and summer 2019, NIH R21 432120
- Vinh Ho, GRA summer 2019, NASA 426701 and AFOSR 450618
- Weigang Liu, GRA summer 2018, ½ GRA fall 2018, DOE 429262
- Ruslan I. Mukhamadiarov, GRA summer 2018, ½ GRA fall 2018 and spring 2019, ARO 450484; GRA summer 2019, DOE 429262
- Riya Nandi, GRA summer 2018 and summer 2019, ½ GRA fall 2018, ARO 450484
- Julie Nguyen, GRA summer 2018
- Shannon R. Serrao, GRA summer 2018 and summer 2019, ½ GRA spring 2019, ARO 450484
- James Stidham, GRA spring 2019, NSF 479739,
- Chengyuan Wen, ½ GRA spring 2019, AFOSR 450589; full GRA summer 2019, PRF 443428
- Xiangwen Wang, GRA summer 2018, spring 2019 NSF 478819
- Yifei Wang, GRA summer 2019, AFOSR 450618
- Hong Yao, GRA summer 2019, ARO 450484
- Fan Zhang, GRA summer 2018, ARO 450347
- Husong Zheng, summer 2018, ARO 450347

Undergraduate research students:

- Harrison Andrew, physics, New College of Florida, summer 2018, ARO 450484
- Michael Lazarus Arnau, physics, summer and fall 2018, spring 2019, ARO 450484
- Ryan Baker, systems biology, summer 2018 spring 2019, NSF 479739
- Shreya Dayal, physics, summer 2019, PRF 443428
- Dan Falescu, computer science, summer 2019, NIH R21 432120
- Hayden Hollenbeck, physics, summer 2019, AFOSR 450589

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 (60%) and the Center for Soft Matter and Biological Physics (40%).

Department fiscal staff:

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

III. Amendments to the Center Charter – Not applicable.

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. Gaylon Don Taylor Jr., Professor, Department of Industrial and Systems Engineering, and Vice President for Research and Innovation

V. Major Grants Received in 2018-2019

New grants:

- U.S. Air Force Office of Scientific Research (AFOSR 450589) grant FA9550-18-1-0433, *Understanding enhancement of strength in CNT/NGP-based structural composites*; PI Gary Seidel (Ocean and Aerospace Engineering, 50%), co-PI Shengfeng Cheng (Physics, 50%): June 15, 2018 – June 14, 2021, $ 618, 229 for three years.

- U.S. Department of Defense, Air Force Office of Scientific Research (AFOSR 450618), FA9550-18-1-0263, *Impact of hydration and collective dynamics on protein functions*, PI Vinh Nguyen (Physics, 100 %): July 01, 2018 – June 30, 2021; total volume $ 488,779 for three years.

- National Aeronautics and Space Administration (NASA 426703): Earth Science Technology Office (ESTO), *Graphene and plasmonic enhanced long-wavelength photodetectors for Earth radiation budget instruments*, PI Vinh Nguyen (Physics, 100%): September 20, 2018 – June 30, 2021; total volume $ 293,000 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, 2019 – August 14, 2019, $ 4,500 for three months.

Continuing grants:

- 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.

- 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.

- 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, 2019; total volume $ 110,000 for three years.

- 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, 2016 – December 31, 2019; total volume $ 850,985 for 39 months.

- 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 for 22 months.

- 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 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, 2020; total volume $ 290,000 for three 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.

- 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.

- 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 – September 14, 2019; total volume $ 64,446.00 for sixteen months.

- 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.

- National Institutes of Health (NIH), (R21), *Accurate, yet fast implicit solvation*, PI Alexey Onufriev (Computer Science, 100 %): March 1, 2019 – February 28, 2021; total volume $ 422,165 for two years.

VI. Major Proposals Submitted or Pending

- Virginia Tech Institute for Critical Technology and Applied Science (ICTAS), Research Experience for Undergraduates (REU), *Soft Matter Physics, from Theory to Application*; PI Justin Barone (Biological Systems Engineering, 100%): October 1, 2018 – June 30, 2019; total volume $10,000 for one year.

- U.S. National Science Foundation (NSF), Division of Materials Research (DMR), *DMREF: Designing carbon fibers from negative-cost polymer wastes;* PI Guoliang Liu (Chemistry, 38%), co-PI Xi Chen (Industrial and System Engineering, 32%), co-PI Shengfeng Cheng (Physics, 30%): February 4, 2019 - July 31, 2023; total volume $1,376,262 for four years.

- National Institutes of Health (NIH), (R21), Explicit ions in implicit solvent: fast and accurate, PI Alexey Onufriev (Computer Science, 100%): May 1, 2019 – April 30, 2021; total volume $ 423,171.

- 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 %): July 19, 2019 – May 31, 2025; total volume $ 514,786 for five years.

- National Institutes of Health (NIH), *DNA compaction into nucleosom arrays: multi-resolution approach,* PI Alexey Onufriev (Computer Science, 100%): August 1, 2019 – July 31, 2023; total volume $ 1.215,011.

- U.S. National Science Foundation, Division of Electrical, Communications and Cyber Systems (ECCS), *Infrared lasing in rare earth doped III-nitride materials*; PI Vinh Nguyen (Physics, 100 %); August 15, 2019 – August 14, 2022; total volume $ 396,188 for three years.

- National Institutes of Health (NIH), Accurate and efficient polarizable water models for practical simulations, PI Alexey Onufriev (Computer Science, 100%): September 1, 2019 – August 31, 2021; total volume $ 420,698.

- National Institutes of Health (NIH), (R21), *Magnetic field effects on spatial cell in the limbic system*, PI John Phillips (Biological Science, 80 %), co-PI Vinh Nguyen (Physics, 10%), co-PI Eric Smith (Statistics, 10%): April 1, 2020 – March 31, 2022; total volume $ 448,141 for two years.

- U. S. National Science Foundation (NSF), *Deuterium Biomaterials Innovation Network-DBI Net,* PI John Katsaras (Physics, University of Tennessee), co-PI Rana Ashkar (Physics): submitted April 2019.

- U.S. National Science Foundation (NSF), *Establishing the phosphoinositide binding and autoinhibition mechanisms by the endosomal trafficking protein Tom1,* PI Daniel Capelluto (Biological Sciences), co-PI Rana Ashkar (Physics): submitted May 2019.

- U.S. National Science Foundation (NSF), (MRSEC), *Center for Multi-Scale Macromolecular Materials*, PI Robert Moore (Chemistry), co-PI Rana Ashkar (Physics): submitted June 2019.

VII. Significant Accomplishments in 2018-2019

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 2018 and spring semester 2019, the Center has organized and financially supported the following seminars and colloquia (see https://csmb.phys.vt.edu/events.html):

- August 20, 2018: Prof. Surita Bhatia, Chemistry, Stony Brook University, New York: *Stratification in colloidal films.*

- August 27, 2018: Dr. Kunal Mondal, Chemical and Biomolecular Engineering, North Carolina State University: *Soft-Nanomaterials, interfaces, and micro-Nanofabrication to build tools and functional devices.*

- September 17, 2018: Chengyuan Wen, Physics, Virginia Tech: *Evaporation of liquids and solutions.*

- September 21, 2018: Prof. Gary Grest, Center for Integrated Nanotechnologies, Sandia National Laboratories, Albuquerque: *Going up in time and length scales in modeling polymers.*

- September 28, 2018: Prof. Daniel I Goldman, Physics, Georgia Tech, Atlanta: *Robophysics: Physics meets robotics.*

- October 8, 2018: Prof. David M. Leitner, Chemistry, University of Nevada, Reno: *Watching energy transport in proteins: Identifying dynamics networks and thermodynamic properties.*

- October 15, 2018: Jacob Carroll, Physics, Virginia Tech: *The effects of inhibitory neuron fraction on the dynamics of an avalanching neural network.*

- October 29, 2108: Shadi Esmaeili, Physics, Virginia Tech: *From disorder to self-organization: A cyclic predator-prey system and a system of frustrated coupled oscillators.*

- November 5, 2108: Dr. Brian Skinner, Physics, Massachusetts Institute of Technology: *Percolative phase transition in dynamics of quantum entanglement.*

- November 26, 2018: Shannon Serrao, Physics, Virginia Tech: *Fluctuation effects on cyclic predator-prey system (May-Leonard model).*

- December 3, 2018: Prof. Sarah Perry, Chemical Engineering, University of Massachusetts Amherst: *Molecular engineering of polyelectrolyte complex materials.*

- January 25, 2019: Prof. Xinqi Gong, Mathematical Science, Renmin University, China:
  Mathematical intelligence applications for bio-macromolecular problems.

- January 28, 2019: Dr. Rui Zhang, Molecular Engineering, University of Chicago:
  Structure and dynamics of topological defects in active liquid crystals.

- February 1, 2019: Dr. Ting Ge, Rubinstein Lab, Duke University:
  Rheology and nano-rheology of entangled melts of non-concatenated ring polymers.

- February 4, 2019: Bart Brown, Physics, Virginia Tech:
  Coarsening with non-trivial in-domain dynamics and dynamically generated hierarchies in predator-prey games.

- February 8, 2019: Dr. Daniel Sussman, Physics, Syracuse University:
  Anomalous interfaces in biological matter.

- February 15, 2019: Dr. Antonia Statt, Princeton Center for Complex Materials, Princeton University:
  Pathways to structure formation in colloid and polymer mixtures.

- February 18, 2019: Dr. Cihan Nadir Kaplan, Engineering and Applied Sciences, Harvard University:
  Morphing hard and soft matter by reaction-transport dynamics.

- February 25, 2019: Dr. Trung Dac Nguyen, Materials Science and Engineering, Northwestern University:
  Engineering materials from bottom up for bioremediation applications.

- February 26, 2019: Prof. Nuno Araujo, Physics, University of Lisbon, Portugal:
  Dynamics of colloidal particles on surface and interfaces.

- March 25, 2019: Prof. Shawn Cui, Mathematical Department, Virginia Tech:
  4-dimensional topological quantum field theories from fusion categories.

- April 8, 2019: Prof. Chih Kuan Tung, Physics, North Carolina A&T State University:
  What do bull sperm know about emergent behaviors?

- April 15, 2019: Dr. Ulrich Dobramysl, Welcome Trust / Cancer Research UK Gurdon Institute, Physics, University of Cambridge, U.K.:
  How do cells sense direction?

- May 9, 2019: Prof. Wei Li, Physics, Central China Normal University, Wuhan, China:
  Reinforcement learning in complementarity game and population dynamics.

2. Center for Soft Matter and Biological Physics Symposium

The Center held its fourth annual symposium on May 22 and 23, 2019, organized by Shengfeng Cheng (Department of Physics), featuring three invited external keynote speakers on May 22:

- Prof. Bulbul Chakraborty, Physics, Brandeis University:
  Fragile matter.

- Prof. Raquel Lieberman, Chemistry and Biochemistry, Georgia Tech:
  How does a protein's structure spell the difference between health and disease? The structure and misfolding of glaucoma-associated myocilin.

- Prof. Peter Olmsted, Physics, Georgetown University:
  Additive manufacturing with polymers: What can polymer physics tell us about it?

Other speakers on May 22 were:

- Andrew Korovich, Chemistry, Virginia Tech:
  Multi-scale transport in polymer membranes for water purification and energy conversion.

- Laura Hanzly, Biomedical Engineering and Mechanics, Virginia Tech:
  Actuation of gelatin bilayers.

- Prof. William Ducker, Chemical Engineering, Virginia Tech:
  Molecules in confinement.

- Prof. Daniel Capelluto, Biological Sciences, Virginia Tech:
  Cargo trafficking of lipid-mediated signaling, a dilemma for Tom1.

- Dr. Saptarshi Chakraborty, Physics, Virginia Tech:
  Phospholipid bilayer softening by hydrophobic gold nano-particle inclusions.

- Dr. Igor Tolokh, Computer Science, Virginia Tech:
  Modeling of 3D chromosome organization in fruit fly.

- Prof. Jiangtao Cheng, Mechanical Engineering, Virginia Tech:
  Nanoscale transport of confined liquids near a solid surface.

- Prof. Vinh Nguyen, Center for Soft Matter and Biological Physics, Virginia Tech:
  Influence of hydration and protein collective motions on biological activities.

- Ruslan Mukhamadiarov, Center for Soft Matter and Biological Physics, Virginia Tech:
  Transverse temperature interfaces in the Katz-Lebowitz-Spohn driven lattice gas.

- Priyanka, Center for Soft Matter and Biological Physics, Virginia Tech:
  Feedback control of surface roughness in the one-dimensional KPZ growth process.

During the poster session on May 22, the poster prize of $150.00 was awarded to four posters:

- Riya Nandi, Physics, advisor Prof. Uwe C. Täuber:
  Non-universal critical aging scaling in three-dimensional Heisenberg antiferromagnets.

- Binghan Liu, Physics, and Chengyuan Wen, Physics, advisor Prof. Shengfeng Cheng:
  Using machine learning to predict the glass transition temperature of polyimides.

- Hyunggon Park, Seungho Kim, Hope Gruszewski, David G. Schmale III, Sunghwan Jung, Mechanical Engineering, advisor Prof. Jonathan Boreyko:
  Leaf-to-leaf spore dispersal induced by rain-splash.

- Tuo-Xian Tang, Biological Sciences, Nataliya Brantly, Biological Sciences, Robert Wallace, Biological Sciences, advisor Prof. Daniel Capelluto:
  The functional basis of Phafin2 in autophagy.

The May 22 Graduate Student Workshop featured tutorials by our keynote speakers:

- Prof. Bulbul Chakraborty, Physics, Brandeis University:
  Exploring the Edwards ensemble and its implications for athermal systems.

- Prof. Raquel Lieberman, Chemistry and Biochemistry, Georgia Tech:
  Experimental methods to determine macromolecular structures in atomic detail.

- Prof. Peter Olmsted, Physics, Georgetown University:
  Strongly entangled polymer dynamics.

During the Graduate Student Workshop on May 22, the Collaboration Idea Awards ($ 100) were awarded to nine students:

- Seyedfarzad Ahmadi, Mechanical Engineering
- Ahmadreza Azizi, Physics
- Jason Czak, Physics
- Shannon Serrao, Physics
- Parviz Shaban, Physics
- Pranav Shukla, Engineering Mechanics
- Tuo-Xian Tang, Biological Sciences
- Catherine E. Wisinger, Chemical Engineering
- Zechen Zhang, Chemical Engineering

Katrina Loan provided staff support. More details are listed in our symposium program flyer: https://csmb.phys.vt.edu/content/dam/csmb_phys_vt_edu/2019-csb-symposium/CSMBP_Symposium_2019_Program_v2.pdf

3. Center for Soft Matter and Biological Physics Meetings

Through the Fall 2018 and Spring 2019 semester (Fridays 4.00 – 5.00 p.m.) as well as Summer 2019 (Fridays 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):

- September 21, 2018: Deepali Shirsekar, Mechanical Engineering, Virginia Tech: *Bidirectional reflectance measurement of black coating Z302 for use in optical instrument design.*

- October 5, 2018: Nazia Munir, Mechanical Engineering, Virginia Tech: *Investigation of the gold-black absorption mechanism.*

- October 26, 2018: Harrison Wood, Biomedical Engineering and Mechanics, Virginia Tech: *Geometric singularities in the mechanics of strings and rods.*

- November 9, 2018: Prof. William Ducker, Chemical Engineering, Virginia Tech: *Absorption at confined interfaces.*

- November 30, 2018: Michael Kane, Mechanical Engineering, Virginia Tech: *Topography and Mechanical properties of nanostructured PNIPAM films.*

- January 28, 2019: Dr. Rui Zhang, University of Chicago: *Meeting with students at Virginia Tech.*

- February 1, 2019: Dr. Ting Ge, Physics, Duke University: *Meeting with students at Virginia Tech.*

- February 8, 2019: Dr. Daniel Sussman, Syracuse University: *Meeting with students at Virginia Tech.*

- February 15, 2019: Dr. Antonia Statt, Princeton University: *Meeting with students at Virginia Tech.*

- February 18, 2019: Dr. Cihan Nadir Kaplan, Harvard University: *Meeting with students at Virginia Tech.*

- February 25, 2019: Dr. Trung Dac Nguyen, Northwestern University: *Meeting with students at Virginia Tech.*

- April 12, 2019: Nicole Abaid, Biomedical Engineering and Mechanics, Virginia Tech: *Passive and active sensing in Vicsek model.*

- April 26, 2019: Dr. Saptarshi Chakraborty, Physics, Virginia Tech: *Polymer-stabilized colloidal catalysts: Role of polymers and strategies for recovery and reuse.*

- May 31, 2019: Ruslan Mukhamadiarov and Shengfeng Deng, Physics, Virginia Tech:
  Central concepts of nonlinear dynamics and chaos.

- June 7, 2019: Tuo-Xian Tang, Biological Sciences, Virginia Tech:
  The functional basis of Phafin2 in autophagy.

- June 14, 2019: Shengfeng Deng, Physics, Virginia Tech:
  Phase portraits of two-dimensional flows.

- June 21, 2019: James Stidham, Physics, Virginia Tech:
  Ordering in magnetic skyrmion lattices.

4. Research Publications with Center Affiliation

- Sheng Chen, Ulrich Dobramysl, and Uwe C. Täuber,
  Evolutionary dynamics and competition stabilize three-species predator-prey communities,
  Ecological Complexity **36**, 52-72 (9 July 2018)
  [https://doi.org/10.1016/j.ecocom.2018.05.003].

- Xiangwen Wang and Michel Pleimling,
  Behavior analysis of virtual-item gambling,
  Physical Review E **98**, 012126 – 1-12 (20 July 2018)
  [https://doi.org/10.1103/PhysRevE.98.012126]

- Fridolin Gross, Paolo Bonaiuti, Silke Hauf, and Andrea Ciliberto,
  Implications of alternative routes to APC/C inhibition by the mitotic checkpoint complex,
  Public Library of Science Computational Biology **14**, e1006449 (10 September 2018)
  [https://doi.org/10.1371/journal.pcbi.1006449].

- Deepali Shirsekar, Yifei Wang, J. Robert Mahan, Kory J. Priestley, and Vinh Q. Nguyen,
  Bidirectional reflectance measurement of black absorber layers for use in optical instrument design,
  Proceeding of SPIE **10743**, 10743007 (17 September 2018)
  [https://doi.org/10.1117/12.2320347].

- Vinh X. Ho, Yizhou Wang, Michael. P. Cooney, and Vinh Q. Nguyen,
  Graphene-based photodetector at room temperature,
  Proceeding of SPIE **10729**, 1072907 (20 September 2018)
  [https://doi.org/10.1117/12.2320922].

- Yanfei Tang and Shengfeng Cheng,
  Capillary forces on a small particle at a liquid-vapor interface: Theory and simulation,
  Physical Review E **98**, 032802 (24 September 2018)
  [https://doi.org/10.1103/PhysRevE.98.032802].

- Ahmadreza Azizi, James Stidham, and Michel Pleimling,
  Dynamic critical properties of non-equilibrium Potts models with absorbing states,
  Journal of Statistical Mechanics: Theory and Experiment, 103208 – 1-19
  (24 October 2018) [https://doi.org/10.1088/1742-5468/aae2dd].

- Vinh X. Ho, Talal M. Al Tahtamouni, Yizhou Wang, Hongxing X. Jiang, Jingyu Y. Lin, John M. Zavada, and Nguyen Q. Vinh,
  Telecommunication-wavelength lasing in Er-doped GaN multiple quantum wells at room temperature, Conference paper, Laser Congress, ATu4A.2 (4 November 2018)
  [https://doi.org/10.1364/ASSL.2018.ATu4A.2].

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  Mechanical and thermal properties of polyolefin thermoplastic elastomer blends,
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  Dynamically generated hierarchies in games of competition,
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  Agricultural proteins as multifunctional additives in ZnO-free synthetic isoprene rubber vulcanizates,
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5. **Submitted Papers with Center Affiliation**

- Barton L. Brown, Uwe C. Täuber, and M. Pleimling,
  Skyrmion relaxation dynamics in the presence of quenched disorder,
  The Physical Review B **100**, 024410 – 1-8 (published 9 July 2019)
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- Wei Li, Jan-Michael Y. Carrillo, John Katsaras, Bobby G. Sumpter, Rana Ashkar, and Rajeev Kumar,
  The influence of curvature on domain distribution in binary mixture membranes,
  Soft Matter **15**, 6642-6649 (published 12 July 2019)
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- Uwe C. Täuber,
  Fluctuations and correlations in chemical reaction kinetics and population dynamics,

Chemical kinetics beyond the textbook, K. Lindenberg, R. Metzler, and G. Oshanin (Eds.), Chap. 1 (World Scientific Publ., published September 2019) [https://www.worldscientific.com/worldscibooks/10.1142/q0209].

- Chengyuan Wen, Roy Odle, and Shengfeng Cheng,
  Polymerization of Branched Polyetherimides: Comparison between Monte Carlo simulation and Flory-Stockmayer theory,
  submitted to: Journal of Polymer Science Part B: Polymer Physics (25 January 2019) [https://arxiv.org/abs/1901.08737v1].

- Vinh Xuan Ho, Yizhou Wang, Luke Patrick, Hongxing Jiang, Jingyu Lin, and Nguyen Quang Vinh,
  Room-temperature telecommunication wavelength lasing from GaN,Er epilayers,
  submitted to: Journal of Luminescence (13 February 2019).

- Ali Charkhesht, Djamila Lou, Ben Sindle, Chengyuan Wen, Shengfeng Cheng, and Nguyen Quang Vinh,
  Insights into hydration dynamics and cooperative interactions in glycerol-water mixtures by terahertz dielectric spectroscopy,
  submitted to: Journal of Physical Chemistry B (27 February 2019).

- Barbara L. DeButts, Renee V. Thompson, and Justin R. Barone,
  Hydrolyzed wheat protein as a self-assembled reinforcing filler in synthetic isoprene rubber vulcanizates,
  submitted to: Industrial Crops and Products (27 March 2019).

- Weigang Liu, and Uwe C. Täuber,
  Nucleation of spatio-temporal structures from defect turbulence in the two-dimensional complex Ginzburg–Landau equation,
  submitted to: Physical Review E (17 May 2019) [http://arxiv.org/abs/1905.07317].

- Samuel Schiffhauer, Rebecca McDevitt, Liang Jiang, Daniel G. S. Capelluto, and Carla V. Finkielstein,
  Multilevel regulation of the iron metabolic network by circadian factor,
  submitted to: Science Reports (15 June 2019).

- Barbara L. DeButts and Justin R. Barone,
  Processing-property relationships in wheat protein-isoprene rubber composites,
  to appear in: Rubber Chemistry and Technology (22 June 2019).

- Ahmadreza Azizi and Michel Pleimling,
  Critical phenomena in presence of symmetric absorbing states: a microscopic model with tunable parameters,
  submitted to: Physical Review E (25 June 2019).

6. Invited Presentations with Center Affiliation

- Michel Pleimling, Barton L. Brown, and Uwe C. Täuber,
  Relaxation processes in systems of interacting skyrmions,
  Department of Energy 2018 Theoretical Condensed Matter Physics Principal Investigators' Meeting, Gaithersburg, MD (16 August 2018).

- Rana Ashkar,
  Nanoscale structure and dynamics in nanoparticle-polymer composites,
  Virginia Soft Matter Workshop VI, Virginia Tech, VA (22 September 2018).

- Shengfeng Cheng,
  Evaporation of polymer and colloidal solutions,
  Universidad Adolfo Ibáñez Physics Seminar, Santiago, Chile (24 September 2018).

- Shengfeng Cheng,
  Self-assembly of cytoskeletal filaments,
  Annual Meeting of Chilean Biochemistry and Molecular Biology Society, Iquique, Chile (27 September 2018).

- Rana Ashkar,
  Playing hide and seek with neutrons,
  Keynote at WoPhys' 18, University of Nebraska, NA (12 October 2018).

- Shengfeng Cheng,
  Evaporation of polymer and colloidal solutions,
  North Carolina A&T State University Physics Colloquium, Greensboro, NC (17 October 2018).

- Alexey Onufriev,
  Physical epigenetics at the nucleosome level,
  Laufer Center for Structural Biology, Stony Brook University, NY (16 November 2018).

- Alexey Onufriev,
  The nucleosom: from structure to function through physics,
  University of Maryland, MD (November 2018).

- Alexey Onufriev,
  From small to large to very large, on multi-scale modeling,
  Symposium of the Materials Research Society, Boston, MA (December 2018).

- Rana Ashkar,
  It's all about the interface: Neutron scattering insights into polymer nanocomposites,
  Seminar, at Solvay Seminar, Virginia Tech, VA (30 January 2019).

- Justin R. Barone
  Shape-shifting and textured foods: a soft matter perspective,
  Food Science and Technology Department, Virginia Tech, Blacksburg, VA
  (February 2019).

- Alexey Onufriev,
  The nucleosome: from structure to function through physics,
  Iowa State University, Iowa City, IA (February 2019).

- Alexey Onufriev,
  The nucleosome: from structure to function through physics,
  University of Connecticut, Mansfield, CT (February 2019).

- Rana Ashkar,
  Interfacial Structure and Dynamics in Nanoparticle-Polymer Composites,
  2019 American Physical Society March Meeting, Boston, MA (2 March 2019).

- Royce Zia,
  Understanding the extreme Thouless effect in a simple, dynamic social network - the XIE model,
  2019 American Physical Society Meeting, Boston, MA (5 March 2019).

- Rana Ashkar,
  Effects of Cholesterol on DOPC Lipid Membranes,
  Spring 2019 American Chemical Society, Orlando, FL (3 April 2019).

- Ruslan I. Mukhamadiarov, Priyanka, and Uwe C. Täuber,
  Temperature interfaces in the Katz–Lebowitz–Spohn driven lattice gas,
  Statistical Physics Seminar, University of Maryland, College Park, MD (23 April 2019).

- Alexey Onufriev,
  The nucleosome: insights from physics,
  Wilhelm Bernhard's Workshop, Dijon, France (May 2019).

- Shannon R. Serrao, Michael Lazarus Arnau, and Uwe C. Täuber,
  Spatially extended stochastic rock-paper-scissors and May–Leonard models,
  SIAM Conference on Applications of Dynamical Systems (SIAM-DS19), Snowbird, UT
  (19 May 2019).

- Uwe C. Täuber,
  Stochastic spatial predator-prey models,
  Colloquium, Universidade de Lisboa, Lisbon, Portugal (29 May 2019).

- Uwe C. Täuber,
  Stochastic spatial predator-prey models,
  Colloquium, Universidade do Minho, Braga, Portugal (5 June 2019).

- Rana Ashkar,
  Polymer dynamics in percolated nanoparticle networks,
  Colloquium, 93rd American Chemical Society Colloid & Surface Science Symposium, Atlanta, GA (16 June 2019).

- Uwe C. Täuber,
  Critical dynamics,
  Four lectures, Universidade de Lisboa, Lisbon, Portugal (18, 19, 25, 27 June 2019).

7. Provisional Patents: – Not applicable.

8. Awards and Recognitions

Faculty:

- Prof. Rana Ashkar,
  Elected chair for APS Site Visits Committee 2019-2020, September 21, 2018

- Prof. Rana Ashkar,
  Received Ralph E. Powe Junior Faculty Enhancement Award, Oak Ridge National Lab, TN, June 16, 2019

- Prof. Alexey Onufriev,
  Excellence in Research (COE), Virginia Tech, VA, May 2019

Graduate students:

- Tuo-Xian Tang,
  2018 Noel Krieg Graduate Fellowship, Department of Biological Sciences, Virginia Tech, VA, August 2018

- Wen Xiong,
  2018 Graduate Student Fellowship, Department of Biological Sciences, Virginia Tech, VA, November 2018

- Teshani Omanthika,
  2019 College of Science's Graduate Opportunity Fellowship Award, February 2019

- Jacob Carroll,
  Finalist, *American Physical Society (APS) Topical Group of Statistical and Nonlinear Physics (GSNP) Outstanding Graduate Student Speaker Award*, March 2019

- Shadi Esameili,
  Ladies of Robeson Award, Department of Physics, Virginia Tech, VA, April 2019

- Riya Nandi,
  2019 Jamie Dunn Award, Department of Physics, Virginia Tech, VA, April 2019

- James Stidham,
  2019 Hassinger Graduate Fellowship, Department of Physics, Virginia Tech, VA, April 2019

Undergraduate students:

- Julie Nguyen,
  Best Poster Award, WoPhys'18 conference, University of Nebraska, October 2018

- Evan Littleton,
  2018 Virginia Academy of Science Undergraduate Grant Award ($750), Ferrum College, VA, November 2018

- Julie Nguyen,
  Best Poster Award, APS CUWIP conference, January 2019

- Julie Nguyen,
  Interviewed for College of Science, video,
  [https://www.youtube.com/watch?v=FK2gd3bjCfc], March 2019

- Julie Nguyen,
  2019 Daniel C. & Delisa F. Grant Scholarship, Physics, Virginia Tech, April 2019

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:

- Evan Littleton, Biological Sciences
  Autoinhibition mechanism of the endosomal trafficking protein Tom1
  Virginia Academy of Science 97th Annual Meeting, Ferrum College, VA, November 3, 2108.

- Wen Xiong, Biological Sciences
  Phosphatidylinositol 5-phosphate binding contributes to local destabilization on the VHS domain structure of Tom1
  Virginia Academy of Science 97th Annual Meeting, Old Dominion University, VA, May 21-23, 2109.

- Zechen Zhang, Chemical Engineering
  Diffusion Behavior of fluorescein in nanoscale confinement
  93rd ACS Colloid & Surface Science Symposium, Georgia Tech, GA, June 16-19, 2019

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 2019 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 – see below

IX. Report of Financial Condition

Center Financial Report Fiscal Year 2019

Operations Account (176188)	
Starting Balance	$ 31,969.39
Income	
Starts FY2019	$ (33,945.34)
Expenses	
Ending Balance	**$ (1,975.95)**

Overhead Account (235052)	
Starting Balance	$ 37,483.02
Income	
Overhead Earnings	$ 22,778.87
Expenses	
Salary	$ (12,947.06)
AEOP Program	$ (132.70)
VA Soft Matter Workshop Donation	$ (138.87)
Seminar Travel	$ (2,337.76)
Facutly Travel	$ (926.63)
Seminar Supplies and Meals	$ (1,917.12)
Student Travel	$ (1,658.22)
Centers Symposium Travel	$ (544.28)
Centers Symposium Awards	$ (250.00)
Supplies & Budget	$ (350.00)
Center's Summer workshop	$ (531.59)
Other Charges	
Ending Balance	**$ 38,527.66**

Center Financial Projection Fiscal Year 2020

Operations Account (176188)	
Starting Balance	$ (1,975.95)
Income	
A21 Award	$ 25,200
Expenses	
60% Staff Salary (Katrina Loan)	$ (24,411)
Ending Balance	**$ (1,186.95)**

Overhead Account (235052)	
Starting Balance	$ 38,527.66
Income	
Overhead Earnings	$ 35,000
Expenses	
Seminar	$ (4,700)
Symposium	$ (5,700)
Sowers Symposium Speaker	$ (2,000)
Student Travel	$ (2,000)
Center's Awards	$ (1,010)
Supplies & Budget	$ (362)
40% Staff Salary (Katrina Loan)	$ (24,370)
Ending Balance	**$ 33,386.16**

X. Major Issues of the Center

The Center's financial standing remains very solid.

In the Physics Department, we have successfully completed our tenure track faculty search in Theoretical / Computational Soft Matter and/or Biological Physics, and hired Dr. Nadir Kaplan as assistant professor, to start his position in August 2019.

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.

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.