Soft Matter

Triangle Soft Matter Workshop

Communication. Collaboration. Creation.

18th Annual Triangle Soft Matter Workshop

Monday May 11th, 2026

8:00am – 5:00pm

Note: Poster setup & Registration opens at 7:30am!

University of North Carolina at Chapel Hill

Sonja Haynes Stone Center

https://trianglesoftmatter.com/

Contact us: *Admin@trianglesoftmatter.com*

18th Annual Triangle Soft Matter Workshop

Monday May 11th, 2026

University of North Carolina at Chapel Hill,

Sonja Haynes Stone Center

7:30-8:30 Registration, Coffee, Light Breakfast, Session 1 Poster Setup

8:30-8:45 Welcoming Remarks | Chair: Ronit Freeman

8:45-9:25 Soundbites - Session 1 | Chair: Ronit Freeman

9:25-10:10 Coffee Break & Poster Session 1 (Stone Center Hitchcock Room)

10:10-10:50 Soundbites - Session 2 | Chair: Sergei Sheiko

10:50-11:35 Coffee Break & Poster Session 2 (Stone Center Hitchcock Room)

11:35-12:15 Soundbites - Session 3 | Chair: Cynthia Corley

12:15-1:15 Lunch (Genome Science Building, across the street from Stone Center)

1:15-2:00 Coffee Break & Poster Session 3 (Stone Center Hitchcock Room)

2:00-2:30 Invited talk: **Dr. Kerry Bloom**, Thad L. Beyle Distinguished Professor, Department of Biology, University of North Carolina at Chapel Hill | Chair: Sergei Sheiko
Title: *Shape-Shifting DNA*

2:30-3:00 Invited talk: **Dr. Amir Salahshoor**, Assistant Professor, Thomas Lord Department of Mechanical Engineering and Materials Science / Department of Civil and Environmental Engineering, Duke University | Chair: Ronit Freeman
Title: *Data Driven Design of Multi-material Viscoelastic Lattices*

3:00-3:30 Invited talk: **Dr. Martin Seifrid**, Assistant Professor, Department of Material Science and Engineering, North Carolina State University | Chair: Sergei Sheiko
Title: *Learning from Complexity: Automation, ML, and Metadata for Messy Materials*

3:30-4:00 Sweet treat & Coffee break (Stone Center Hitchcock Room)

4:00-5:00 Plenary lecture: **Dr. Katharina Ribbeck**, Andrew and Erna Viterbi Distinguished Professor, Department of Biological Engineering, Massachusetts Institute of Technology | Chair: Ronit Freeman
Title: *Partners in Slime: How Mucin Polymer Manage Problematic Pathogens*

5:00 Closing remarks | Chair: Ronit Freeman & Sergei Sheiko

Plenary Lecture:

Katharina Ribbeck

Andrew and Erna Viterbi Distinguished Professor
Department of Biological Engineering
Massachusetts Institute of Technology

Title:

Partners in Slime: How Mucin Polymers Manage Problematic Pathogens

Abstract:

Mucus is a ubiquitous yet underappreciated soft material in biology, a hydrated, viscoelastic polymer network that lines all wet epithelia from the lungs to the gut. While often treated as a passive barrier, mucus is in fact a dynamic system whose structure and chemistry actively shape the behavior of embedded microorganisms. Most studies of microbial pathogenesis are carried out in mucus-free environments and therefore miss the physical confinement, polymer-mediated interactions, and complex chemical landscapes that define microbial life in vivo. To address this gap, our laboratory has developed model systems based on purified mucin polymers, the gel-forming building blocks of mucus, together with their associated glycans. Using these systems, we ask how the material properties of mucin networks, including polymer architecture, multivalency, and dynamic crosslinking, translate into biological function. We find that mucins actively regulate microbial behaviors such as surface attachment, toxin production, quorum sensing, and biofilm formation. At the molecular level, mucin-associated glycans act as informational cues that microbes sense and respond to, reprogramming gene expression at the host–microbe interface. These findings suggest that mucus operates as an active, adaptive soft material that couples physical structure with biochemical signaling to control microbial ecosystems. More broadly, they point to a new class of therapeutic strategies that harness host-derived polymers to modulate, rather than eliminate, microbial activity.

Bio:

Prof. Ribbeck obtained her Bachelor’s degree and her PhD in Biology from the University of Heidelberg, Germany. She continued her postdoctoral research at the European Molecular Biology Laboratory, Heidelberg, Germany, and the Department of Systems Biology, Harvard Medical School. Katharina Ribbeck established her independent research group as a Bauer Fellow at the FAS Center for Systems Biology, Harvard University in 2007, and joined the Department of Biological Engineering at MIT as an Assistant Professor in 2010. Her research is focused on mucus, the gel that lines all wet epithelia in the body, and other gels that occur in Nature. Biological gels such as mucus represent a whole class of molecular assemblies that are understudied, with many fascinating and important structure-function problems to investigate and medical/engineering applications to invent. Her focus is on basic mechanisms by which mucus barriers exclude, or allow passage of different molecules and pathogens, and the mechanisms pathogens have evolved to penetrate mucus barriers. One exciting mission of her lab is to implement the lessons learned from nature and create synthetic mucus gels that mimic the basic selective properties of the biological material.

Invited Talks:

Kerry Bloom

Thad L. Beyle Distinguished Professor
Department of Biology
University of North Carolina at Chapel Hill

Title:

Shape-shifting DNA

Abstract:

The application of polymer physics to molecular biology has revolutionized our understanding of the genome. One key insight is how DNA looping contributes to gene expression. In this talk, we will discuss how DNA is transformed into a mechanical spring—known as a bottlebrush—that plays a central role in ensuring high fidelity during chromosome segregation in cell division. Spring tension modulates the degree of DNA unwinding, which in turn can lead to DNA damage. This property of the bottlebrush structure underlies the rapid evolution of centromeres observed in living systems.

Bio:

Dr. Kerry Bloom is the Thad L. Beyle Distinguished Professor in the Department of Biology at the University of North Carolina at Chapel Hill. His research focuses on the dynamic behavior of the cytoskeleton and chromosomes in living cells. He is widely recognized for his work on chromatin structure and for biophysical studies demonstrating how centromeric chromatin functions as a molecular spring that resists microtubule-generated forces during mitosis. Dr. Bloom received his B.S. from Tulane University in 1975 and his Ph.D. from Purdue University in 1980. After postdoctoral training with Dr. John Carbon at UC Santa Barbara, he joined UNC Chapel Hill in 1982. He has contributed extensively to scientific education and service, including roles with the Marine Biological Laboratory and the American Society for Cell Biology, where he previously served as Secretary. He is a Lifetime Fellow of the American Society for Cell Biology and a member of both the American Academy of Arts and Sciences and the National Academy of Sciences.

Amir (Hossein) Salahshoor

Assistant Professor
Thomas Lord Department of Mechanical
Engineering and Materials Science /
Department of Civil and Environmental Engineering
Duke University

Title:

Data Driven Design of Multi-material Viscoelastic Lattices

Abstract:

While multimaterial additive manufacturing enables finely programmed heterogeneity, there remains no robust and objective-driven framework to assign materials across complex architectures under practical constraints. We introduce Data-Driven-Design (D^3) as a robust computational framework for multi-material lattice design, optimized with respect to a prescribed performance objective. The framework relies on representing physical constraints, material data, and design objectives as sets in a phase space and formulating the material selection problem as a distance minimization problem among the encoded sets. We showcase the approach in multi-material design of viscoelastic lattices provided with measurements of complex moduli as a function of frequency with the design objective of maximizing dissipation. For our numerical experiments, we import dynamic viscoelasticity measurement for twenty five different materials from literature, and show that multi-material designs can match or outperform the dissipation obtained from homogeneous designs made of the *most dissipative material* among the data registry. In a finite lattice example, we show that design yields a mechanical dissipation with 300% increase compared to best homogeneous design from a limited collection of materials. Beyond viscoelastic lattices, the framework generalizes naturally to multi-physics and multi-objective metastructure design, offering a unified, data-driven approach to optimal material selection under complex constraints.

Bio:

Dr. Hossein (Amir) Salahshoor has dual faculty appointment as an Assistant Professor in the Thomas Lord Department of Mechanical Engineering and Materials Science and in the Department of Civil and Environmental Engineering at Duke University. He completed his postdoctoral research at the California Institute of Technology. Prior to that, he earned his Ph.D. in Aerospace Engineering from Georgia Institute of Technology, along with a Master's degree in Mathematics, following his undergraduate studies at the University of Tehran. His research lies at the intersection of mechanics of materials and structures, computational science, biology, and applied mathematics. He develops data-driven and computational frameworks to predict, control, and engineer the behavior of complex material systems, with applications in sustainability and healthcare.

Martin Seifrid

Assistant Professor
Department of Materials Science and Engineering
North Carolina State University

Title:

Learning from Complexity: Automation, ML, and Metadata for Messy Materials

Abstract:

Soft materials are shaped not only by composition, but also by processing, environment, and experimental history. That richness makes them exciting to study, but also difficult to probe systematically and reproduce reliably. In this talk, I will discuss how automation, machine learning, and better metadata practices can help researchers navigate complex experimental spaces, identify hidden sources of variability, and extract more insight from each experiment. The talk will emphasize these approaches as practical tools for improving measurement, interpretation, and discovery—not as replacements for chemical intuition, but as ways to make it more powerful.

Bio:

Dr. Martin Seifrid is an Assistant Professor in the Department of Materials Science and Engineering at North Carolina State University. He received his Ph.D. in Chemistry from the University of California, Santa Barbara in 2019, where he worked in the Center for Polymers and Organic Solids under the supervision of Professor Guillermo C. Bazan. His graduate research combined computational and experimental methods to study molecular design and structure–processing–property relationships in organic semiconductors. Following his Ph.D., Dr. Seifrid conducted postdoctoral research in the Matter Lab at the University of Toronto with Professor Alán Aspuru-Guzik. There, he developed self-driving laboratories for autonomous molecular design, automated synthesis and characterization, and organic laser materials. His current research focuses on leveraging automation and data-driven methods to accelerate discovery in complex materials systems.

Organizing Committee:

Aleksandr Zhukhovitskiy

Ronit Freeman

Sergei Sheiko

Samantha Woodroof

Daniel Valastro

Cynthia Corley