

Center for Soft Matter and Biological Physics Symposium
Scientific Program

Wednesday, May 22, 2019 (Hahn Hall North Auditorium)

- 8:00 – 8:15 Opening speech by Sally Morton (COS Dean)
 Welcome speech by Mark Pitt (Physics Department Chair)
 Welcome speech by Uwe Täuber (CSB Center Director)

Session I: Michel Pleimling, Chair

- 8:15 – 9:05 *Peter Olmsted (Invited: Additive Manufacturing with Polymers: What Can Polymer Physics Tell Us about It?)*
- 9:05 – 9:25 Andrew G. Korovich (Multi-Scale Transport in Polymer Membranes for Water Purification and Energy Conversion)
- 9:25 -- 9:45 Laura Hanzly (Actuation of Gelatin Bilayers)
- 9:45 -- 10:05 William Ducker (Molecules in Confinement)

10:05 – 10:30 Coffee Break

Session II: Rana Ashkar, Chair

- 10:30 – 10:50 Daniel Capelluto (Cargo Trafficking or Lipid-mediated Signaling, a Dilemma for Tom1)
- 10:50 – 11:10 Saptarshi Chakraborty (Phospholipid Bilayer Softening by Hydrophobic Gold Nanoparticle Inclusions)
- 11:10 – 11:30 Igor Tolokh (Modeling of 3D Chromosome Organization in Fruit Fly)
- 11:30 – 12:20 *Raquel Lieberman (Invited: How Does a Protein's Structure Spell the Difference between Health and Disease? The Structure and Misfolding of Glaucoma-Associated Myocilin)*

12:20 – 1:30 Lunch

Session III: Justin Barone, Chair

- 1:30 – 1:50 Jiangtao Cheng (Nanoscale Transport of Confined Liquids Near a Solid Surface)
- 1:50 – 2:10 Vinh Nguyen (Influence of Hydration and Protein Collective Motions on Biological Activities)
- 2:10 – 2:30 Ruslan Mukhamadiarov (Transverse Temperature Interfaces in the Katz--Lebowitz--Spohn Driven Lattice Gas)
- 2:30 – 2:50 Priyanka (Feedback Control of Surface Roughness in the One-dimensional KPZ Growth Process)
- 2:50 – 3:40 *Bulbul Chakraborty (Invited: Fragile Matter)*
- 3:40 – 5:00 Coffee Break, Poster Session (Best Poster Competition) and Refreshments, Collaboration Proposal Competition

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Thursday, May 23, 2019 (Hahn Hall North Auditorium)

8:00 – 8:10 Opening remarks, Uwe Täuber

Session IV: Jiangtao Cheng, Chair

8:10 – 9:10 *Bulbul Chakraborty (Tutorial: Exploring the Edwards Ensemble and its Implications for Athermal Systems)*

9:10 – 9:30 Djordje Minic (Physics of Life and the Universality of the Genetic Code)

9:30 – 9:50 Shengfeng Cheng (Polymer Informatics)

9:50 – 10:20 Coffee Break

Session V: Uwe Täuber, Chair

10:20 – 11:20 *Raquel Lieberman (Tutorial: Experimental Methods to Determine Macromolecular Structures in Atomic Detail)*

11:20 – 12:20 *Peter Olmsted (Tutorial: (Strongly!) Entangled Polymer Dynamics)*

12:20 – 12:25 Concluding remark including award announcement, Uwe Täuber

12:25 – 1:30 Lunch

1:30 Symposium concludes.

Abstract of invited talks:

Peter Olmsted (Department of Physics, Georgetown University)

Additive Manufacturing with Polymers: What Can Polymer Physics Tell Us about It?

Abstract: Numerous methods of Additive Manufacturing make use of polymeric materials ; examples include fused filament fabrication (FFF), selective laser sintering/melting, and bioprinting of hydrogels. These processes and their materials present many opportunities for obtaining a deeper understanding and insight into process and material design through the polymer physics of the processes. I will focus primarily on some of the challenges of FFF, and address whether and how we can understand why parts printed with this common process are often mechanically very weak, and what can potentially be done to enhance these processes. In FFF flows, relaxation, and solidification of entangled polymers under rapid cooling and heating conditions intertwine to yield the final printed parts. I will also touch on some interesting physics issues that arise in other polymer-based AM fabrication methods.

Raquel Lieberman (Department of 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

Abstract: Site-specific mutations introduced into a natively protein that alter biophysical properties can have broad ramifications, from hindering or enhancing biological function to causing human diseases. Mutations in the myocilin OLF domain (mOLF), a 5-bladed β -propeller, are causative for the eye disease glaucoma. Over 30 mutant myocilins we characterized to date exhibit reduced protein stability and non-native structure, leading to increased amyloid aggregation propensity, intracellular accumulation, and cytotoxicity. Yet, not all mutations are destabilizing. We have identified single point mutations that increase mOLF thermal stability, concomitant with abolished calcium binding and aggregation. Paradoxically, crystal structures and supporting biophysical characterization reveal significant loss of structure and shifts, yet these mOLF variants are competent for cellular secretion and can rescue folding and stability defects of several glaucoma-associated mutations. The tolerance of mOLF to selected amino acid substitutions provides new insight into the interrelationship among stability, structure, and aggregation, broadening our understanding of β -propeller folding and evolution.

Bulbul Chakraborty (Department of Physics, Brandeis University)

Fragile Matter

Abstract: Systems that have been relatively unexplored in statistical physics are collections of macroscopic particles for which both quantum and thermal fluctuations are irrelevant. In these systems, typified by sandpiles, external forces such as gravity create rigid and flowing states. Surprisingly, the fluid states can also self-organize in response to external stresses to resist the stress and become more rigid. The mechanical integrity of these marginal solids is reliant on a filamentary network of stress-bearing structures. Recent experimental and numerical observations in dry grains and dense suspensions have highlighted the role played by such networks on jamming and flow. In this talk, I will give an overview of my recent work, which has been a quest to establish robust physical principles that govern fluctuations and response in Athermal, disordered systems where friction and dissipation are important, thermal motion is absent, and cohesion is induced by imposed mechanical stresses.

List of Posters:

1. C. Wisinger, J. Barone, "Bending, curling, and twisting of polymeric bilayers".
2. S. Deng, W. Li, "Spreading dynamics of forget-remember mechanism".
3. J W. Liu, U. C. Täuber, "A numerical study of the two-dimensional complex Ginzburg-Landau equation".
4. R. Nandi, U. C. Täuber, "Non-universal critical aging scaling in three-dimensional Heisenberg antiferromagnets".
5. Serrao, D. Labavic, H. Meyer-Ortmanns, "Rare-event extinction phenomena in cyclic predator-prey (May-Leonard) games".
6. Y. Chang, W. Ducker, "Effect of step topography on bacterial surface motility".
7. Z. Zhang, W. Ducker, "Molecular diffusion in nanometer films of liquid".

8. C. Wen, R. Odle, S. Cheng, "Molecular modeling of polyetherimides".
9. C. Wen, H. Hollenbeck, R. Romero, G. Seidel, S. Cheng, "Coarse-grained molecular dynamics modeling of epoxy/CNT nanocomposites".
10. Y. Tang, G. S. Grest, S. Cheng, "Stratification in drying particle suspensions".
11. B. Liu, C. Wen, S. Cheng, "Using machine learning to predict the glass transition temperature of polyimides".
12. Lei Zhao, J. Cheng, "Molecular kinetic study of contact line friction and contact angle hysteresis".
13. W. Cheng, J. Cheng, "High Q factor meridian whispering gallery modes sensing in an EWOD-tuned water droplet on nanostructured surfaces".
14. X. He, L. Zhao, J. Cheng, "The effect of surface curvature on coalescence-induced jumping of nanodroplets".
15. R. Zhang, Y. Chen, D. Troya, L. A. Madsen, "Relating water and ion diffusion in polymer membranes to nanoconfinement and intermolecular interactions".
16. C. Zanelotti, D. Yu, R. J. Fox, Y. Wang, Z. Yu, T. J. Dingemans, R. Qiao, L. A. Madsen, "Molecular ionic composites: A modular materials system for stiff and conductive electrolytes".
17. X. Li, T. J. Cooksey, B. E. Kidd, M. L. Robertson, L. A. Madsen, "Block-copolymer micelles for tunable cargo delivery: Structure, dynamics and molecular partitioning".
18. A. Charkhesht, L. Doan, D. Lou, B. Sindle, N. Q. Vinh, "Impact of hydration and collective dynamics on protein functions".
19. L. Doan, V. Ho, Y. Wang, A. Charkhesht, N. Q. Vinh, "Terahertz spectroscopy of nanoscale systems and biomaterials".
20. V. Ho, Y. Wang, Y. Wang, P. Pradhan, N. Q. Vinh, "Graphene-based photodetector at room temperature".
21. F. Ahmadi, S. Nath, C. Kingett, P. Yue, J. B. Boreyko, "Freezing bubbles".
22. H. Park, S. Kim, H. Gruszewski, D. G. Schmale III, S. Jung, J. B. Boreyko, "Leaf-to-leaf spore dispersal induced by rain-splash".
23. W. Shi, R. M. Dalrymple, C. J. McKenny, D. S. Morrow, Z. T. Rashed, D. A. Surinach, J. B. Boreyko, "Self-Stabilizing Transpiration in Tall Synthetic Trees".
24. P. Shukla, T. Jagdhari, A. P. Fugaro, S. D. Jones, J. B. Boreyko, "Super-Absorbent Hygroscopic Hydrogels."
25. R. Mukherjee, A. S. Berrier, K. R. Murphy, J. R. Vieitez, J. B. Boreyko, "How Surface Orientation Affects Jumping-Droplet Condensation".
26. T. Tang, N. Brantly, R. Wallace, D. Capelluto, "The functional basis of Phafin2 in autophagy".
27. A. Azizi, M. Pleimling, "Machine learning: the Ising model with conserved magnetization".
28. J. Czak, M. Pleimling, "Control theory applied to reaction-diffusion systems".
29. J. Stidham, M. Pleimling, "Ordering in magnetic skyrmion lattices".
30. P. Shabane, S. Izadi, A. Onufriev, "A general purpose water model can improve atomistic simulations of intrinsically disordered proteins".