71st New England Complex Fluids Workshop

Friday, June 16, 2017
9:00 a.m. – 5:00 p.m.
at Tufts University

Location: All talks will take place in Asean Auditorium (Room 302) of the Cabot Intercultural Center of the Tufts University Fletcher School located at 160 Packard Avenue, Medford, MA 02155.

Tentative Agenda:

Morning Session

9:00 a.m. – 9:30 a.m.	**Registration** (Cabot Hall of Flags)
9:30 a.m. – 10:05 a.m.	**Thibaut Divoux**, CNRS (Cabot Asean Aud.) *"Nonlinear viscoelasticity and generalized failure criteria for polymer gels"*
10:05 a.m. – 10:30 a.m.	**Coffee I** (Cabot Hall of Flags)
10:30 a.m. – 11:45 a.m.	**Sound Bites I** (Cabot Asean Aud.)
11:45 a.m. – 12:20 p.m.	**Christian Franck**, Brown University (Cabot Asean Aud.) *"New kinematic-based metrics for quantifying cell matrix interactions in three dimensions"*
12:20 p.m. – 1:30 p.m.	**Lunch** (Remis Sculpture Court)

Afternoon Session

1:30 p.m. – 2:05 p.m.	**Industry Panel: Stephen Steiner**, Aerogel Technologies **Farshid Mostowfi**, Schlumberger
2:05 p.m. – 2:40 p.m.	**Linda Hirst**, UC Merced (Cabot Asean Aud.) *"Nanoparticle assembly by liquid crystal phase transition templating"*
2:40 p.m. – 3:05 p.m.	**Coffee II** (Cabot Hall of Flags)
3:05 p.m. – 4:20 p.m.	**Sound Bites II** (Cabot Asean Aud.)
4:20 p.m. – 4:55 p.m.	**Anand Oza**, NJIT (Cabot Asean Aud.) *"Antipolar ordering of topological defects in active liquid crystals"*
4:55 p.m. – 5:00 p.m.	**Closing Remarks** (Cabot Asean Aud.)

Invited Talks

Thibaut Divoux, CNRS

Title: "Nonlinear viscoelasticity and generalized failure criterion for polymer gels"

Abstract: Polymer gels display a multiscale microstructure that is responsible for their solid-like properties. Upon external deformation, these soft viscoelastic solids exhibit a generic nonlinear mechanical response characterized by pronounced stress- or strain-stiffening prior to irreversible damage and failure, most often through macroscopic fractures. Here we show on an acid-induced protein gel that the nonlinear viscoelastic properties of the gel can be described in terms of a ``damping function" which predicts the gel mechanical response quantitatively up to the onset of macroscopic failure. Using a nonlinear integral constitutive equation built upon the experimentally-measured damping function in conjunction with power-law linear viscoelastic response, we derive the form of the stress growth in the gel following the start up of steady shear. We further couple the shear stress response with Bailey's durability criteria for brittle solids in order to predict the critical values of the stress and strain for failure of the gel, and how they scale with the applied shear rate. Our work provides a consistent framework to describe the failure of polymer gels in a range of different deformation histories explored under external applied shear rate or shear stress.

Christian Franck, Brown University

Title: "New kinematic-based metrics for quantifying cell matrix interactions in three dimensions"

Abstract: Investigations in mechanobiology rely in large part on correlation of cellular processes with mechanical signals, such as matrix stiffness and cell tractions. Almost all cell traction and force quantification methodologies require knowledge of the underlying mechanical properties of the extracellular matrix to convert displacement data into corresponding traction data. This restricts the use of these techniques to material systems for which the user can accurately determine material properties. To overcome this hurdle, we present a new approach that does not require any knowledge of the underlying matrix properties but rather makes use of the intrinsically recorded kinematic displacement data. We show through rigorous validation and an application to a neutrophil disease model that such an approach produces both accurate and biologically significant information similar to traditional force-focused approaches.

Linda Hirst, UC Merced

Title: "Nanoparticle assembly by liquid crystal phase transition templating"

Abstract: A current goal in nanotechnology focuses on the assembly of different nanoparticle types into 3D organized structures, although producing such materials by a simple, scalable method can be challenging. Recently our group has focused on liquid crystal nanocomposites and new routes to mesoscale structures. In such materials nanoparticles of different types (semiconducting, metallic, magnetic etc) with defined surface properties are dispersed or assembled to produce multifunctional new materials. In this presentation, I will review recent results from our group including the use of a liquid crystal host phase to generate micron-scale vesicle-like nanoparticle capsules stabilized by ligand-ligand interactions and remarkable new foam-like structures. The new assembly methods we describe can be extended to various nanoparticle types, where capsule and other structure formation is controlled by thermally sorting mesogen-functionalized nanoparticles in a liquid crystalline host material at the isotropic to nematic transition boundary.

Invited Talks (continued)

Anand Oza, NJIT

Title: **"**Antipolar ordering of topological defects in active liquid crystals"

Abstract: Recent experiments in the laboratory of Zvonimir Dogic (Brandeis University) demonstrated that ATP-driven microtubule-kinesin bundles can self-assemble into two-dimensional active liquid crystals that exhibit a rich creation and annihilation dynamics of topological defects. This remarkable discovery has sparked considerable theoretical and experimental interest. I will present and validate a minimal continuum theory for this new class of active matter systems by merging universality ideas with the classical Landau-de Gennes theory. The resulting model agrees quantitatively with recently published data and, in particular, predicts a previously unexplained regime of antipolar order of topological defects. Our results suggest that complex nonequilibrium pattern-formation phenomena might be predictable from a few fundamental symmetry-breaking and scale-selection principles.

Sound Bites

Session I (morning)

1. **Prity Bengani**, Tufts, *Boosting the performance of self-assembling randomzwitterionic copolymers using ionic liquids during membrane formation*
2. **Christopher Burke**, UMass Amherst, *Orientational Coupling in Block Copolymer Melts*
3. **Rui Cao**, UMass Amherst, *Toward Large-scale Fabrication of Lipid and Polymer Vesicles with Controlled Size*
4. **Doug Cleaver**, Sheffield, *Amphiphilic Chromonics*
5. **Jesse Collins**, Harvard, *Collagen millifluidic drops for turning stem cells into neocortical spheroids*
6. **Andrew DeBennedictis**, Tufts, *Self-assembled chaining of nanoparticle shells in a nematic background*
7. **Amin Dehkharghani**, Tufts, *Bacterial Transport in Porous Media Flows*
8. **Maxim Dokukin**, Tufts, *Imaging of Soft Materials with Novel Sub-Resonant "Ringing Mode" of Atomic Force Microscopy*
9. **Zach Gault**, Harvard, *In situ visualization and mechanical study of a transparent filled rubber*
10. **Xuehui Ge**, Harvard, *Amphiphilic Janus self-propelled magnetic micromotor*
11. **Mathew Giso**, Tufts, *Packing Particles on a Sphere Under Gravity*
12. **Vili Heinonen**, MIT, *Hydrodynamic theory for crystalline materials at diffusive time scales*
13. **Robert Keane**, UMass Amherst, *Pickering Emulsions Stabilized by Ion Partitioning at Oil-Water Interface*
14. **Eric Liu**, Tufts, *Porous and chemically functional polymeric hydrogel microspheres for improved biomacromolecular conjugation*
15. **John Liu**, MIT, *Ampoule and Nozzle Development for Needle-Free Injections*
16. **Arash Manafirad**, UMass Amherst, *Micromanipulation Studies of Stimuli-Responsive Giant Unilamellar Vesicles*
17. **Charles Melton**, UC Merced, *Phase-Transition-Driven Nanoparticle Assembly in Liquid Crystal Droplets*
18. **Shima Parsa**, Harvard, *Polymer as permeability modifier in porous media*
19. **Yaniv Edery**, Harvard, *Thin film dynamic and its effect on two phase flow in porous media*
20. **Arthur Michaut**, Harvard Medical School, *For a soft matter daily digest*

Sound Bites (continued)

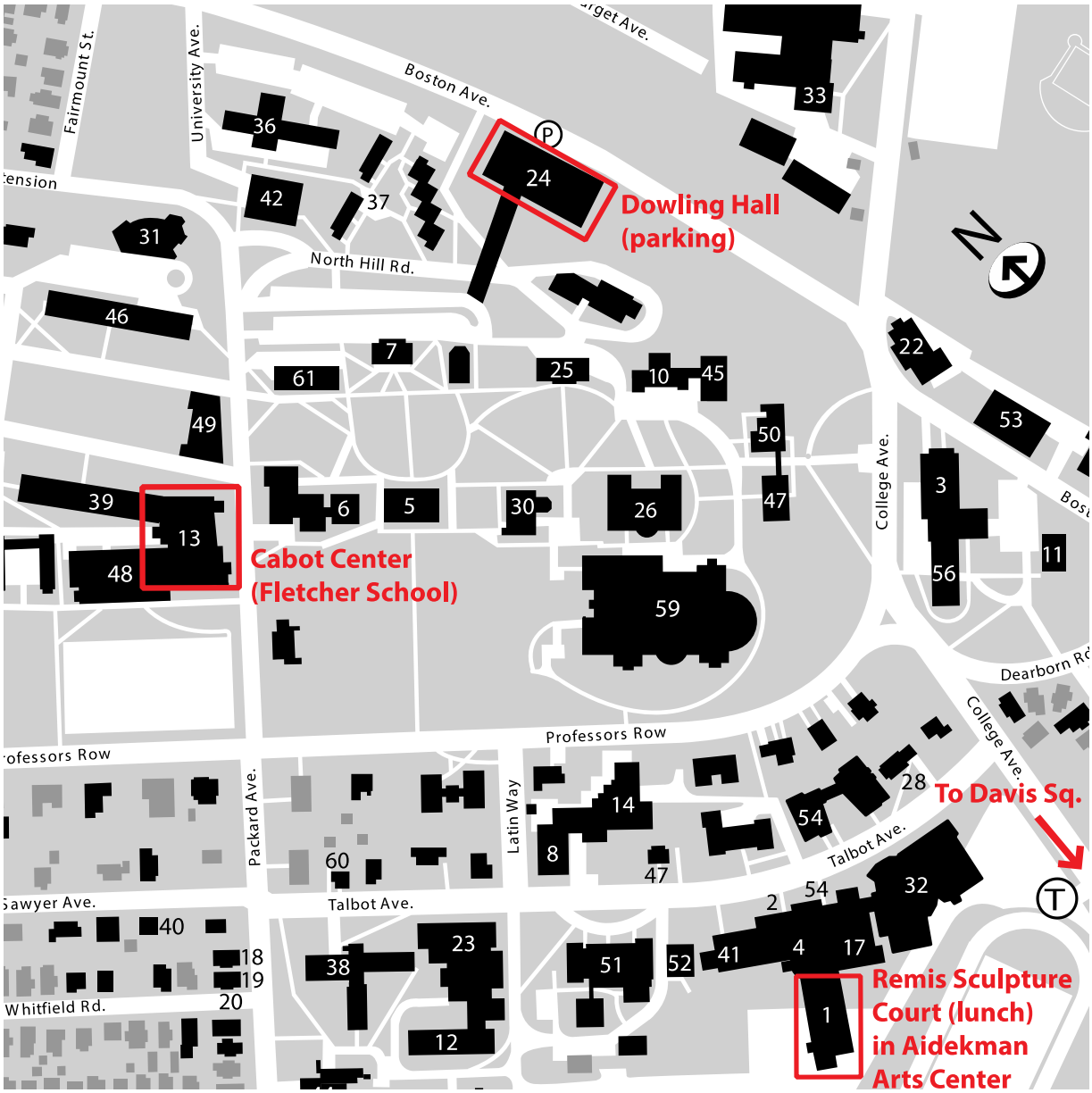
Session II (afternoon)

1. **Saquib Peerzade**, Tufts, *Ultrabright ratiometric pH sensor based on FRET*
2. **Weichao Shi**, Harvard, *Phase separation in microcapsule shells*
3. **Jesse Silverberg**, Wyss Institute, *This is Not a Dance (or is it?): A Dynamic Mode Analysis of High-Density Crowds*
4. **Jonasz Slomka**, MIT, *Stokes' second problem and an Einstein–de Haas analogue effect in active fluids*
5. **Michael Stehnach**, Tufts, *Bacterial accumulation in viscosity gradients*
6. **Elad Stolovicki**, Harvard, *Drop chemostats: White biotechnology on a chip*
7. **Zsolt Terdik**, Harvard, *Traction force rheology of colloidal solids*
8. **Sheida Triahinasab**, UC Merced, *Nanoparticle foams formed by liquid crystal phase transition templating*
9. **Nicolas Waisbord**, Tufts, *Percolation of a yield stress fluid flowing in porous media*
10. **Debora Walker**, Harvard, *Crystal nucleation kinetics in hard-sphere colloidal suspensions*
11. **Derek Walkama**, Tufts, *Pattern formation in viscoelastic flow through a model porous medium*
12. **Joerg Werner**, Harvard, *Dynamically and Reversibly Responsive Microcapsules*
13. **Zhaoyu Xie**, Tufts, *Packing particles on surfaces of variable Gaussian curvature*
14. **David Yllanes**, Syracuse, *Thermal crumpling of perforated two-dimensional sheets*
15. **Roy Ziblat**, Harvard, *Membrane Decoys as Anti-Viral Nanomedicine*
16. **Sarah Zuraw**, Amherst, *Nanospheres, Rod-Shaped Viruses and Lipid Vesicles: From Soft Solids to Liposome Disruption*
17. **Ian Hunter**, Brandeis, *Finding patterns in complex non-linear networks*
18. **Alexandre Ponomarenko**, Harvard, *Spread of gas embolism in plants*

Tufts UNIVERSITY

complexfluids

TUFTS UNIVERSITY
MEDFORD/SOMERVILLE CAMPUS



Parking Reminder: The visitor parking garage is located at Dowling Hall at 419 Boston Avenue, and the rate is $8 per day. After the conference, upon returning to the Dowling Hall garage, please pay at a kiosk on the 3rd, 5th or 7th floor. You will need to know your license plate number. Kiosks accept VISA, MASTERCARD, and DISCOVER. When exiting the garage, a camera will automatically read your license plate and raise the gate arm.