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<th>TIME</th>
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<td>June 30</td>
<td>Morozov</td>
<td>Squires</td>
<td>Marenduzzo</td>
<td>Pouliquen</td>
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FLOWING SOFT MATTER: BRIDGING THE GAP BETWEEN STATISTICAL PHYSICS AND FLUID MECHANICS

Polymer solutions, colloidal suspensions, emulsions, gels, granular matter, biological materials such as the cytoskeleton, bacterial suspensions, and cellular tissues are all complex materials lying at the interface between fluids and soft solids. Their mechanical properties result from the subtle interplay between their microstructure at the mesoscales, and the forces driving the fluids either at the macroscale (e.g. sheared, and advected fluids) or at the microscale (e.g. thermal fluctuations, or local self-propulsion).

Much research efforts have been devoted to understand the flow properties of these soft materials, in fields as diverse as soft-condensed matter physics, biophysics, materials science, chemical and mechanical engineering. Two main complementary descriptions have emerged in these different communities: on the one hand, these complex fluids can be described as continua using the equations of fluid mechanics with phenomenological constitutive laws; on the other hand, they can also be described using non-equilibrium statistical physics. In this context the constitutive laws and the mesoscale fluctuations are accurately described, but only yield minimalistic mechanical models. Both approaches have their merits, and their combination has proven to yield outstanding advances in the understanding of the large-scale mechanical properties of some complex systems such as polymeric fluids. However, over the last 20 years, interactions between the fluid-mechanics, soft-condensed-matter and statistical-physics communities have been scarce.

The objectives of this Summer School are twofold: first, present the participants with an overview of the exciting field of flowing soft matter, with focus on a few topics of active research interest; second, reconcile the statistical-physics and fluid-mechanics descriptions of these systems, by bringing together lecturers from both communities to discuss similar problems from the perspective of their own discipline. The contents of the School will articulate around three main themes: (1) Fluctuations at all scales in Viscoelastic Fluids, (2) Mechanics and Structure of Active Fluids, (3) Flows and Arrest in Dense Suspensions and Granular Materials.

These themes have been selected to reflect current interests in soft-matter research, while being distinct enough from one another to provide a broad and general introduction of the field to the participants. Our purpose is to provide the Summer School participants with two complementary lectures on each theme: two researchers of different backgrounds will give 5 lectures each on a subject related to their research interests. The targeted audience for this Summer School will be advanced PhD students as well as postdoctoral researchers in departments of Physics, Biophysics, Engineering, and Materials Science. The participants are also invited to give a short oral presentation on their research.

PRELIMINARY SUGGESTED READINGS


INVITED LECTURERS

Alexander Morozov - University of Edinburgh, UK
5 lectures on: Non-Newtonian Fluid Mechanics and Elastic Instabilities.
Basics of non-Newtonian fluid mechanics will be reviewed, with emphasis on viscoelastic fluids and the effects of fluid elasticity on the emergence of large hydrodynamic fluctuations (viscoelastic instabilities, and transition to chaos and turbulence).

Todd Squires - University of California, Santa Barbara, CA, USA
5 lectures on: Micro rheology of Complex Fluids.
This section will focus on the microscopic basis for non-Newtonian behavior, and more specifically on the theory of micro rheology as a tool for the measurement of complex rheological properties and small-scale fluctuations.

Davide Marenduzzo - University of Edinburgh, UK
5 lectures on: Active Liquid Crystals and Active Soft Matter.
This section will focus on the microscopic basis for non-Newtonian behavior, and more specifically on the theory of micro rheology as a tool for the measurement of complex rheological properties and small-scale fluctuations.

David Saintillan - University of California San Diego, La Jolla, CA, USA
5 lectures on: Fluid Mechanics of Active Suspensions.
Recent models for the fluid mechanics of suspensions of self-propelled microorganisms will be presented, from the description of individual swimmers to the modeling of collective dynamics.

Olivier Pouliquen - IUSTI, Polytech Marseille, France
5 lectures on: Fluid Mechanics of Dense Suspensions.
Flow properties of dense particulate suspensions and wet granular materials will be discussed, with an emphasis on hydrodynamics and rheological behavior.

Matthieu Wyart - New York University, NY, USA
5 lectures on: Jamming and Unjamming Transitions in Disordered Solids.
This section will also consider dense suspensions and granular matter, but will focus on the statistical physics of the (un)jamming transition in these systems.

LECTURES

All lectures will be given in English. Lecture notes can be downloaded from the CISM web site, instructions will be sent to accepted participants.
FLOWING SOFT MATTER: BRIDGING THE GAP BETWEEN
STATISTICAL PHYSICS AND FLUID MECHANICS

Udine, June 30 - July 4, 2014
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(Please print or type)

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Affiliation _________________________________________
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