

Workshop COSMIC Day (COMplex and Soft Matter InterConnection Day)

Coordinator: Lorène Champougny (Dpt. of Thermal and Fluids Engineering)

Session: 15th of December 2022 | 9:00-18:30 h.

Venue: 3.S1.08, Rey Pastor Buidling (Leganés campus)

Language: English

ECTS: 1 cross-curricular credit

Free registration

Further details: <https://sites.google.com/view/cosmic-day/welcome>

Description

Complex and Soft Matter researchers that develop or have developed their professional career abroad tell us about their research, professional experience and debate on different career-oriented topics with the participants.

Requirements

PhD students will attend the workshop activities (seminars and round table) **in person**. Each student will bring a poster (size A1 or A0) describing their PhD project and results. Using their poster, students must present their PhD project during at least one of the breaks.

A pass grade (APTO) will be granted to students who participate in the activities of the workshop and carry out a presentation of their poster.

Students are allowed to attend the workshop without meeting the requirements above. In this case, no credits will be granted.

Registration

Registration form: <https://sites.google.com/view/cosmic-day/registration>

Places available:

For students presenting a poster: 20

For the rest of students: until full capacity is reached

Deadline: 1st of December (23:59 h.)

Registration free of charge

If the number of application is higher than that of places available, a selection will be carried out based on the scientific relevance of the posters to the topics of the workshop.

Inquiries: gestiondoctorado@uc3m.es

Programme

09:15 - 09:30: Welcome address from the organizer

09:30 - 10:15: Jonas Miguët. Université Libre de Bruxelles (BE)

A Cosmic Object: Antibubbles (strategies for a better control of their stability)

An antibubble is a spherical shell of gas, encapsulating a liquid core, within a liquid medium. The shell is usually of micrometric thickness while the entire object is a few millimeters in radius. Antibubbles feature unique properties: they are gas-containing yet incompressible objects; the gas shell provides an efficient shield to diffusion of chemical species; the surface tension between the inner and outer liquid is very high, even if both media are aqueous. These specificities make antibubbles suitable for potential applications in microfluidics (oil-free encapsulation, gas capture), enhanced ultrasound imaging or drug vectorization. Yet, two main challenges must be addressed: the continuous production of antibubbles down to micrometric sizes and the control of their stability. Indeed, as the inner droplet pushes the thin film of gas by gravity, a draining flow from the bottom to the top of the antibubble leads to its thinning, destabilization, and collapse. I will make a small overview on the present knowledge regarding these problematics and show some recent results regarding (i) the influence of various surfactants on the evolution of the thin film (ii) the influence of gas desorption from the liquid medium, and (iii) the influence of evaporation from the liquid core in a configuration called "encapsulated Leidenfrost" droplets.

10:15 - 11:00: Alesya Mikhailovskaya. CNRS & Institut de Chimie et des Matériaux Paris-Est (FR)

Hydrogel/emulsion hybrids: functional materials with multiscale structure and reinforced mechanical properties

Hybrid materials of a polymer network with inclusions of lyotropic liquid crystalline droplets can provide versatile transport of both hydrophilic and hydrophobic substances through aqueous media. Therefore, such systems have a great potential for biotechnological and food science applications. However, weak mechanical strength of the hydrogel skeleton significantly limits the use of such composites. Haraguchi et al. proposed to prepare hydrogels with improved mechanical properties by free radical polymerization in an aqueous suspension of Laponite clay particles. In this case, the polymer chains adsorb at the surface of the particles so that the cross-linking density of the resulting physical gel network is largely increased. We combine this effect with Pickering stabilization of droplets by Laponite particles to prepare hydrogel/emulsion composites. Due to the droplets acting as multifunctional cross-links, the materials demonstrate an enhanced elastic modulus in comparison with Haraguchi hydrogels. Moreover, we prepare emulsion droplets using L2 liquid crystal phase composed of inverse micelles of phytantriol in dodecane medium, which allows to functionalize the resulting hybrid materials both with hydrophilic and lipophilic agents. We correlate the mechanical properties with the structure by studying the multi-scale organization of the materials with electron microscopy, X-ray Scattering and Small Angle Neutron Scattering (SANS).

11:00 – 11:45: Coffee break & Posters

11:45 - 12:30: Uddalok Sen. University of Twente (NL) & Wageningen University and Research (NL)

Drying – from a broken printer to a salt-rimmed glass

Evaporation in multi-component liquid mixtures is ubiquitous in applications such as inkjet printing and desalination. Although evaporation in inkjet printing is absolutely essential for the printing of graphics on paper, it is detrimental for the performance of the printing nozzle, and can lead to clogging. In this talk, first I'll demonstrate how can one "listen" to an inkjet printhead to estimate the concentration of the ink present in it. Thereafter, we study the drying of ink in a printhead by looking at the dynamics of evaporation of a binary liquid in a capillary. We identify three different regimes of evaporation, and also shed some light on the question: "Is evaporation really a slow process?" Finally, we will also take a look at how the presence of salt affects the dynamics of such evaporation.

12:30 - 13:15: Idan Tuval. CSIC & University of Balearic Islands (ES)

The fluid mechanics of light management in microalgae: metabolism, motility and communication

Microorganismal motility is often characterized by complex responses to environmental physico-chemical stimuli. Light, in particular, is essential for autotrophic microorganisms and it plays two roles: it provides spatiotemporal information used by the cell to regulate its biology; and it provides energy through an intracellular mechanism known as photosynthesis. To thrive, cells integrate these two functions but only in a few cases have the strands been teased apart to see exactly how fluid forces operate to guide these processes.

13:15 – 15:00: Lunch break & Posters

15:00 – 15:45: Pierre Lidon. Université de Bordeaux (FR)

Microviscosity mapping in microfluidic systems using molecular rotors

Molecular rotors are fluorescent probes whose fluorescence properties are sensitive to local viscosity of the environment. While they have been used regularly in bioimaging studies, studies are scarce in the context of soft materials and chemical engineering. In this talk, after a general presentation of these molecules, I will present experimental results on the use their use for mapping viscosity in microfluidic flows (simple co-flow and passive micromixers) and in confined geometries (suspended liquid film and sessile droplet). We show that, provided that viscosity-sensitivity of fluorescence is carefully calibrated, molecular rotors allow for reliable and quantitative mapping of viscosity in these systems.

**15:45 – 16:30: Corinna Maass. University of Twente (NL) & MPI for Dynamics and Self-Organization, Göttingen (DE)
Hovercrafts and helicopters - cooperative states in active emulsions**

Active emulsions, or ensembles of self-propelling droplets driven by interfacial tension gradients, are a versatile and well-controllable experimental system to mimic and model the rich emergent dynamics of bio-microswimmers. The behaviour of individual droplets can be tuned from persistent to helical to unsteady swimming both exploiting nonlinear chemohydrodynamics, as well as by exploiting broken topological symmetries in liquid crystal swimmers. Uniquely, active emulsions are able to self-assemble into two-dimensional hexagonally ordered ‘hovercraft’ clusters when placed in deep reservoirs under gravity. Moreover, the chemohydrodynamic instabilities that make individual droplets oscillate can cooperate to make clusters rotate as well.

16:30 – 17:15: Coffee break & Posters

17:15 – 18:15: Round table with all the speakers

Like a rolling stone: opportunities and challenges of mobility in research

Circulation of ideas is certainly a key ingredient of research and innovation. In big part, this circulation relies on the mobility of scholars between institutions and countries, but also between research areas or academic and industrial sectors. Be they temporary or permanent, these mobilities shape researchers’ professional trajectories, with also strong implications in their personal lives. In this round table, we bring together researchers at different stages of their career to share their mobility experiences and reflect on the impact this had on their lives and professional trajectory. Hoping to establish a dialog with the audience – in particular junior members, such as undergrad, grad and PhD students – we will touch upon a variety of topics, including

- Mobility and research careers: balancing risks and opportunities,
- Mobility and personal life: how to solve the equation?
- Mobility and mental health: who to prepare yourself to leave... and to come back!
- Mobility and sustainability: the environmental cost of moving around.

18:15 – 18:30: Closing remarks by the organizer