

# Challenges in Multiphase Flows

**Location :** Monash University Prato Center, Tuscany

**Webpage :** <https://www.cecam.org/workshop-details/152>

**Dates :** 9 - 12 December 2019

**Organizers:** Burkhard Duenweg (Max Planck Institute for Polymer Research), Ravi Prakash Jagadeeshan (Monash University, Melbourne), Ignacio Pagonabarraga (EPFL)

## 1 State of the art

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The topic was mesoscale physics where at least partly a continuum (hydrodynamic) description is appropriate, and where interfaces play an important role. The strength of the meeting was its interdisciplinary approach, bringing together top experts from physics, engineering and mathematics. The school part provided a thorough overview over the existing concepts and methods, while the workshop discussed cutting-edge applications. Some highlights of the school, which provided interesting learning experiences even for us as experienced researchers, were the lucid explanation of the interface width as an adjustable parameter in diffuse-interface models, the systematic application of GENERIC to construct equations of motion, and the systematic upscaling of models for flow in porous media. Interesting developments at the workshop included, for example, the study of surface instabilities for viscoelastic fluids, systematic investigations of bubble nucleation via Fluctuating Hydrodynamics, and a clear outline of the heterogeneous multiscale method, which couples Molecular Dynamics with continuum mechanics.

## 2 Major outcomes

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We believe the most important outcome was the learning experience for everybody, and most prominently so for the students. Highlights have already been mentioned in the previous section.

## 3 Community needs

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We do feel that interdisciplinary networking is beneficial for the field, and our meeting has tried to address that. However, we do not think that the field is developing so rapidly that a series of workshops were appropriate. A clear-cut need of infrastructure in terms of HPC resources and/or codes was not identified. We feel that the conceptual problems in the field still prevail over the infrastructural ones, and routine "push-the-button" applications rarely exist. A somewhat different outlook might have been supplied by the presentation of Hans Fraaije; however, he unfortunately fell ill and could not talk.

## 4 Funding

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The meeting was funded by (i) CECAM Headquarters (this was an ECAM state-of-the-art workshop within the "mesoscale simulations" work package), (ii) the Max Planck Institute for Polymer Research within its commitment for the SMSM node, and (iii) by the Transregio SFB TRR1 46 "Multiscale simulation methods for soft-matter systems" (Deutsche Forschungsgemeinschaft). Beyond this, we do not see obvious funding sources for an event like this.

## 5 Will these developments bring societal benefits?

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This was about basic research. Nevertheless, there is clear industrial interest in this kind of research (for example, most obviously so in the studies of flow in porous media, which are important for oil recovery). However, apparently this does not go so far that industry would commit itself here to any measurable degree (and certainly not in terms of funding). Except for one person (Hans Fraaije), industries would not even send a person to the meeting.

## 6 Participant list

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### Organizers

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#### **Duenweg, Burkhard**

Max Planck Institute for Polymer Research, Germany

#### **Prakash Jagadeeshan, Ravi**

Monash University, Melbourne, Australia

#### **Pagonabarraga, Ignacio**

EPFL, Switzerland

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**Eiser, Erika** – University of Cambridge, UK

**Schmid, Friederike** – Johannes Gutenberg University, Mainz, Germany

**Kreiss, Gunilla** – University Uppsala, Sweden

**Kuipers, Hans** – Eindhoven University of Technology, The Netherlands

**Harting, Jens** – Forschungszentrum Jülich, Germany

**Yeomans, Julia** – University of Oxford

**Hassanizadeh, Majib** – Utrecht University, The Netherlands

**Ellero, Marco** – University of Swansea, UK

**Lukacova, Maria** – Johannes Gutenberg University, Mainz, Germany

**Plapp, Mathis** – Ecole Polytechnique, Palaiseau, France

**Krueger, Timm** – University of Edinburgh, UK

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