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## Lecturers

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**Prof. Dr. Nasser Ashgriz**

Department of Mechanical and Industrial Engineering,  
University of Toronto

**Prof. Dr. Dieter Bothe**

Institute of Mathematical Modeling and Analysis,  
TU Darmstadt

**Prof. Dr.-Ing. Günter Brenn**

Institute of Fluid Mechanics and Heat Transfer,  
TU Graz

**Prof. Dr. Sanjeev Chandra**

Department of Mechanical and Industrial Engineering,  
University of Toronto

**Prof. Dr.-Ing. Udo Fritsching**

Department Multiphase Flow, Heat- and Mass-Transfer,  
Leibniz Institute for Materials Engineering (IWT) Bremen

**Dr.-Ing. Philippe Leick**

Engineering Combustion System,  
Robert Bosch GmbH Stuttgart

**Prof. Dr. Fabrice Lemoine**

Laboratoire d'Energétique et de Mécanique Théorique et Appliquée,  
Université de Lorraine, Nancy

**Prof. Dr. Ilia V. Roisman**

Institute for Fluid Mechanics and Aerodynamics,  
TU Darmstadt

**Prof. Dr. Eran Sher**

Faculty of Aerospace Engineering,  
Technion – Israel Institute of Technology

**Prof. Dr.-Ing. Peter Stephan**

Institute for Technical Thermodynamics,  
TU Darmstadt

**Prof. Dr.-Ing. Cameron Tropea**

Institute for Fluid Mechanics and Aerodynamics,  
TU Darmstadt

**Prof. Dr.-Ing. Bernhard Weigand**

Institute of Aerospace Thermodynamics (ITLR),  
University of Stuttgart

**Prof. Dr. Alexander L. Yarin**

Department of Mechanical and Industrial Engineering,  
University of Illinois at Chicago

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## Who should attend?

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This course is directed towards practicing engineers, researchers involved in R&D and the application of spray systems, and graduate students performing research on the subject of sprays and atomization. For those with little previous background, the course begins with fundamentals of atomization and proceeds through theoretical, experimental, numerical and application topics.

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## Course platform and delivery

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Pre-recorded lectures will be provided using Webex, integrated with the Moodle learning management system. The lecturer will be available during and after the lecture and questions and discussions with lecturers will be moderated through the chat function during the lecture. All lecture slides are available for download and all lectures can be streamed from their time of airing until two weeks after the course closes.

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## Fees and registration

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- **Industry:** 250 EUR
- **Academia:** 150 EUR

Course fees are VAT exempt according to article 132 (i) Council Directive 2006/112/EC. Included is live and download access to all lectures during the week and all accompanying documentation (slides).

Registration for this four-day short course can be made online starting November 2021 on the course website:

[www.tfi.tu-darmstadt.de/as2022](http://www.tfi.tu-darmstadt.de/as2022)

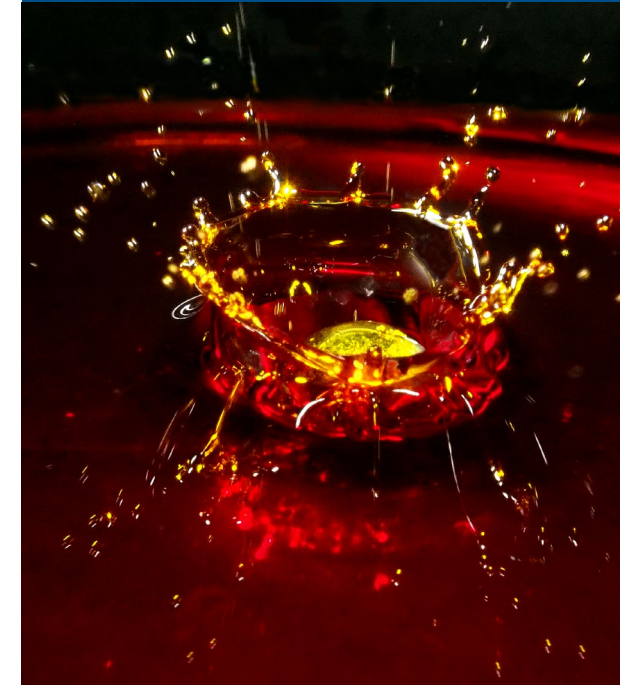
The number of participants will be limited to 100 on a first-come-first-serve basis. For further information, please refer to the course website or contact Prof. Cameron Tropea at:

[atomization@sla.tu-darmstadt.de](mailto:atomization@sla.tu-darmstadt.de)

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# Short Course on Atomization and Sprays

14 – 18 February 2022  
Technical University of Darmstadt  
Darmstadt, Germany



Offered by the Research Area  
Thermo-Fluids & Interfacial Phenomena  
in cooperation with DFG CRC/TRR 75

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**PROGRAM**

Monday 14 February 2022

**Fundamentals of Atomization**

- 10:45** Session open for joining
- 11:00 Welcome, Introductions, Overview, Use of Webex and guidelines for discussions (*Tropea*)
- 11:30 Techniques of Atomization: Overview of Atomizers and their Applications (*Tropea*)
- 12:30** Screen break
- 12:45 Stability Analysis of Liquid Jets and Sheets (*Brenn*)
- 14:00** Screen break
- 14:30 Fundamentals of Atomization (*Roisman*)
- 15:30** Screen break
- 15:45 Breakup and Atomization Models (*Ashgriz*)
- 17:00** Screen break
- 17:15 Secondary Atomization (*Tropea*)
- 18:00** Close of first day

Tuesday 15 February 2022

**Characterization and Diagnostics**

- 9:45** Session open for joining
- 10:00 Spray Characterization – Quantifiers and Standards (*Tropea*)
- 10:45** Screen break
- 11:00 Imaging Techniques (*Leick*)
- 11:45** Screen break
- 12:00 Measurement Techniques (*Tropea*)
- 13:00** Screen break
- 13:30 Measurement of Drop Temperature and Composition (*Lemoine*)
- 14:30** Screen break
- 14:45 Nozzle Designs and their Spray Characteristics (*Ashgriz*)
- 15:45** Screen break
- 16:00 Manufacturers' Presentations
- 17:00** Close of Second Day

**PROGRAM**

Wednesday 16 February 2022

**Modeling and Simulation**

- 9:45** Session open for joining
- 10:00 A Survey on Numerical Simulation Methods for Multiphase Flows (*Bothe*)
- 10:45** Screen break
- 11:00 Direct Numerical Simulation of Primary Jet Breakup (*Weigand*)
- 12:30** Screen break
- 13:00 Volume-of-Fluid Method for Drop Collision (*Bothe*)
- 14:00** Screen break
- 14:15 Heat and Mass Transfer from Drops: Fundamentals (*Brenn*)
- 15:00** Screen break
- 15:15 Powder Production in Spray Processes (*Fritsching*)
- 16:15** Close of Third Day

Thursday 17 February 2022

**Spray and Drop Interactions with a Wall**

- 10:45** Session open for joining
- 11:00 Fundamentals of Modelling (*Yarin*)
- 11:45** Screen break
- 12:00 Drop/Wall Interactions (*Yarin*)
- 13:00** Screen break
- 13:15 Spray Painting (*Chandra*)
- 14:00** Screen break
- 14:30 Spray Coating (*Chandra*)
- Droplet Impingement Cooling with Evaporation (*Stephan*)
- 15:15** Screen break
- 15:30 Droplet Impingement Cooling with Evaporation (*Stephan*)
- 16:15** Screen break
- 16:30 Spray Cooling (*Roisman*)
- 17:15** Close of Fourth Day

**PROGRAM**

Friday 18 February 2022

**Applications & Advanced Topics**

- 10:45** Session open for joining
- 11:00 Atomizers for Fuel Injection (*Leick*)
- 12:00** Screen break
- 12:15 Drop Combustion (*Sher*)
- 13:00** Screen break
- 13:30 Atomization of Complex Fluids (*Brenn*)
- 14:15** Screen break
- 14:30 Flash Boiling Atomization (*Sher*)
- 15:15** Screen break
- 15:30 Atomization in Forensic and High Power Applications (*Yarin*)
- 16:30** Closing Remarks

**Course description and aims**

This short course has the aim to present the current understanding and state of the art of atomization fundamentals, their realization in atomizer systems and their application in a wide variety of engineering branches, including spray drying, spray coating, spray cooling, fuel injection, etc.

These aspects are first addressed theoretically in terms of hydrodynamic instabilities of liquid jets and sheets – primary atomization. This is followed by considerations about the break-up of single droplets – secondary atomization.

These fundamentals are followed by topics on diagnostics, numerical simulations, drop/wall interactions and further advanced topics and applications. In a manufacturers' session several vendors of diagnostic equipment related to atomization and sprays will make presentations and be available for discussions.

The program foresees discussions among the participants and the lecturers. The aim is to address ongoing development and application problems suggested by the participants.