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## Course Description and Aims

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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. Engineering solutions for realizing the different atomization mechanisms are then presented.

The second day is devoted to experimental descriptors and diagnostics of sprays and droplets. Both non-optical and optical techniques are addressed. Focus is placed on drop size and velocity determination, but an overview is also given about more advanced techniques, allowing temperature and composition to be determined.

The third day presents possibilities for simulating atomization and spray processes. Modelling of primary atomization is discussed, as well as transport processes within sprays and spray/wall interactions.

The final day of the course covers a wide variety of applications and how spray systems have been developed and customized to meet specific requirements and constraints.

The program foresees intensive discussions between the participants and the lecturers and also among the participants. The aim is to address on-going development and application problems suggested by the participants. Industrial exhibitors spray diagnostics will be available on the second day for demonstrations and discussions.

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## Who should attend?

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This course is directed towards practicing engineers and researchers involved in R&D and the application of spray systems. 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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## Venue

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*Technische Universität Darmstadt  
Center of Smart Interfaces (Lichtwiese Campus)  
Alarich-Weiss-Straße 10  
64287 Darmstadt, Germany*

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## Fees and Registration

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The registration fee is:

- Industry: 1200 EUR
- Academia: 850 EUR

Early bird registration until 31st December, 2016 offers 20% discount. Fee is VAT free according to §4 Nr. 22a USTG. The fee includes all documentation of the lectures, coffee breaks, lunches and a course dinner on the second day. Participation is limited to 40 people.

Registration for this four-day short course can be made online from November 2016 on the course website under:

[www.tfi.tu-darmstadt.de/as2017](http://www.tfi.tu-darmstadt.de/as2017)

For further information, please refer to the course website or contact Ms. Monika Medina ([medina@tfi.tu-darmstadt.de](mailto:medina@tfi.tu-darmstadt.de)).

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# Short Course on Atomization and Sprays

February 20-23, 2017  
Technische Universität Darmstadt  
Darmstadt, Germany



Offered by the profile area Thermo-Fluids & Interfaces in cooperation with DFG SFB/TRR 75  
[www.tfi.tu-darmstadt.de](http://www.tfi.tu-darmstadt.de)

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## Lecturers

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**Prof. Dr. Dieter Bothe**

heads the Institute of Mathematical Modeling and Analysis at the Center of Smart Interfaces, TU Darmstadt

**Prof. Dr.-Ing. Günter Brenn**

heads the Institute of Fluid Mechanics and Heat Transfer at the TU Graz

**Prof. Dr. Sanjeev Chandra**

Department of Mechanical and Industrial Engineering, University of Toronto

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

heads the group Multiphase Flow, Heat- and Mass Transfer at the IWT, University of Bremen

**Dr.-Ing. Philipp Leick**

Investigates the fundamentals of fuel injection processes at the Bosch central research laboratories in Renningen

**Prof. Fabrice Lemoine**

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

**Priv.-Doz. Dr. Ilia V Roisman**

is a senior researcher at the Institute of Fluid Mechanics and Aerodynamics at the TU Darmstadt

**Prof. Eran Sher**

Faculty of Aerospace Engineering, Technion – Israel Institute of Technology

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

heads the Institute of Technical Thermodynamics at the TU Darmstadt

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

heads the institute of Fluid Mechanics and Aerodynamics at the TU Darmstadt

**Prof. Dr. techn. Peter Walzel**

heads the Institute of Mechanical Process Engineering at the TU Dortmund

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

heads the Institute of Aerospace Thermodynamics at the University of Stuttgart

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

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

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## Day 1: Fundamentals

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- 8:30 Registration, Distribution of Lecture Notes  
9:00 Welcome, Introductions, Overview of the Course (*Tropea*)  
9:30 Techniques of Atomization: Overview of Atomizers and Their Applications (*Tropea*)  
10:30 Coffee  
11:00 Fluid Mechanic Fundamentals (*Brenn*)  
12:00 Lunch  
13:00 Design of Spraying Devices I (*Walzel*)  
13:45 Fundamentals of Atomization (*Roisman*)  
14:30 Coffee  
15:00 Heat and Mass Transfer from Drops: Fundamentals (*Brenn*)  
15:45 Secondary Atomization (*Roisman*)  
16:30 Drop-Drop Interactions (*Brenn*)  
17:15 Close of First Day with Beer and Pretzels
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## Day 2: Characterisation and Diagnostics

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- 9:00 Spray Characterisation – Quantifiers and Standards (*Tropea*)  
9:45 Imaging Techniques (*Leick*)  
10:30 Coffee  
11:00 Phase Doppler Techniques (*Tropea*)  
12:00 Lunch  
13:00 Other Optical Techniques (*Tropea*)  
13:45 Measurement of Drop Temperature and Composition (*Lemoine*)  
14:45 Coffee  
15:15 Atomization of Complex Fluids (*Brenn*)  
16:00 Flash Boiling Atomization (*Sher*)  
17:00 Design of Spraying Devices II (*Walzel*)  
17:45 Close of Second Day

Exhibition of Spray Diagnostic Equipment during lunch and coffee breaks

- 19:00 Short Course Dinner
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## Day 3: Modeling and Simulation

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- 9:00 Fundamentals of Modelling I (*Yarin*)  
9:45 Fundamentals of Modelling II (*Yarin*)  
10:30 Coffee  
11:00 A Survey on Numerical Simulation Methods for Multiphase Flows (*Bothe*)  
11:45 Direct Numerical Simulation of Primary Jet Breakup (*Weigand*)  
12:45 Lunch  
13:45 Volume-of-Fluid Method for Drop Collision (*Bothe*)  
14:30 Characterisation of Drop Evaporation and Drying (*Yarin*)  
15:15 Coffee  
15:45 Powder Production in Spray Processes (*Fritsching*)  
16:45 Close of Third Day
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## Day 4: Applications & Advanced Topics

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- 9:00 Drop/Wall Interaction (Roisman)  
9:45 Spray Painting (*Chandra*)  
10:30 Coffee  
11:00 Atomizers for Fuel Injection (*Leick*)  
12:00 Droplet Impingement Cooling with Evaporation (*Stephan*)  
12:45 Lunch  
13:45 Spray Coating (*Chandra*)  
14:30 Spray/Wall Impact (*Tropea*)  
15:15 Close of Short Course
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