

## MULTI-SCALE PHYSICS



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The Department of Multi-Scale Physics (MSP) is dealing with Industrial and Environmental Processes. MSP aims at a better understanding, a better description and - especially in industry - a better control of these processes. MSP wishes to contribute in this way to more sustainable industrial processes and a more sustainable earth.

The research interests at MSP are organized around five themes. These themes are intended to focus and communicate the research activities of the Department and are in no way indicative of a further subdivision. People in the department may move from one theme to another from time to time, depending on developments in interests. The themes and the contact persons for each theme are:

Clouds and Climate (dr. Harm Jonker)

Computational Reactor Engineering (prof. Harry van den Akker, head of department)

Reactive Flows & Explosions (prof. Dirk Roekaerts)

Thermal & Materials Processes (prof. Chris Kleijn)

Multi-Phase Flows (prof. Robert Mudde)

We consider flow and transport phenomena over a wide range of time and length scales in their mutual dependence. E.g. we study the interaction of molecular transport of heat and mass, chemical reactions, turbulent eddies, bubbles, drops and particles, and flow and convective transport at the scale of the vessel or at a long range. To do so we exploit a wide variety of advanced computational and experimental tools.

The type of industrial processes we have expertise about comprises plants of any commercial scale in which liquids, gases and solids are processed and manufactured. Our expertise relates to the fluid flow aspects and the heat and mass transport phenomena vital to such processes.

Operations such as mixing and separation processes, combustion, heating and cooling, coating, deposition and precipitation processes, adsorption and chemical processes are among our themes of research and teaching. Examples of such plants and processes are abundantly present in the process industries (chemicals, food, pharmaceuticals), but also in the oil and gas industry and in the energy sector (biomass, nuclear, solar). A special topic of interest, associated with the public domain as well as with industrial processes, concerns safety and the risks of explosions.

Many environmental processes have much in common with industrial processes as the same flow and transport phenomena and concepts are at the basis of both. In particular we are dealing with the life cycle of clouds and the dispersion of pollutants in the environment (air quality).

Clouds play a crucial role in climate and the response of clouds in a changing climate is one of the most pressing unknowns. Therefore we do fundamental research on cloud dynamics and cloud microphysics to improve parameterizations in weather and climate models, using detailed numerical simulation, laboratory experiments, analysis of aircraft, and satellite observations.