**THETMATIC AREA A**

**DROP-GAS INTERACTION**

**FOCUS: MODELLING OF DROP VAPORISATION**

**GOAL:** To derive basic models for drop vaporisation accounting for the effects of droplet deformation, compressibility and local non-equilibrium

List of planned sub-projects (principal investigators):

- **SP-A1:** Modelling of Deformed, Multi-Component Liquid Drop Evaporation (G. Cossali, S. Tonini, B. Weigand)
- **SP-A2:** Multi-scale Modelling of the Evaporation Process (C.-D. Muñoz, C. Rohde, M. Dumbser)
- **SP-A3:** Gas-kinetic Simulation of Microdroplet - Gas Interaction (S. Fasoulas, G. Lamanna, F. Bassi)
- **SP-A4:** Numerical Methods for Compressible Multi-phase Flows with Complex Equations of State (M. Dumbser, C.-D. Muñoz)
- **SP-A5:** Modelling of Spray Evaporation (G. Cossali, S. Tonini, V. Schleper)
- **SP-A6:** Mathematical and Numerical Modelling of Droplet Dynamics in Weakly Compressible Multi-Component Flows (V. Schleper, A. Beck, F. Bassi)

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**SP-A1: Modelling of Deformed, Multi-Component Liquid Drop Evaporation**

**GOAL:** Predictive analytical and numerical tools capable of analysing the effect of particle shape and composition on transport processes

**METHODS:**

- Heat and mass transfer from complex particle shapes
- Non-constant properties and second order effects
- Species interaction modelling
- Multi-component deformed particle modelling
- Validation with available experimental data
- Convective effects on transport phenomena from deformed particles

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**SP-A2: Multi-scale Modelling of the Evaporation Process**

**GOAL:** Numerical method that allows a detailed investigation of interfacial phenomena

**METHODS:**

- Study evaporation processes at non-spherical, multi-component droplets and compare results with analytical (SP-A1) and numerical (SP-A5) investigations
- Extend current evaporation models for multiple species
- Improve EOS tabulation method for nearly incompressible fluids at ambient conditions
- Comparison of the sharp interface approximation to the diffuse interface approximation in SP-A4 with complementary validation

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**SP-A3: Gas-kinetic Simulation of Microdroplet - Gas Interaction**

**GOAL:** Analysis of the influence of different gas phase distribution functions on the resulting fluxes on a (micro)droplet

**METHODS:**

- Implementation of an evaporation boundary condition
- Adapt boundary conditions from SP-A2 and SP-A4 for DSMC method
- Add new microscopic boundary condition
- Numerical modelling of the droplet deformation
- Investigate moving mesh and level set method
- Determine best method for DSMC framework
- Simulation of the gas - droplet interaction using the advanced DSMC method

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**SP-A4: Numerical Methods for Compressible Multi-phase Flows with Complex Equations of State**

**GOAL:** Improved resolution of material interface within the diffuse interface approach by one order of magnitude compared to existing standards

**METHODS:**

- Extend current high order DG method with a posteriori subcell limiting
- Include efficient tabulated EOS approach (SP-A2)
- Apply new schemes to isolated droplets and to droplet-droplet interactions
- Compare new diffuse interface approach to sharp interface approach

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**SP-A5: Modelling of Spray Evaporation**

**GOAL:** Comprehensive predictive tool for mass and energy transfer in sprays under conditions typical of combusting environments

**METHODS:**

- Transfer models for single droplets from SP-A1
- Model the effect of neighbouring evaporating drops on vapour diffusion characteristics
- Implement model in CFD codes
- Predict real test case scenarios

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**SP-A6: Modelling of Droplet Dynamics in Weakly Compressible Multi-Component Flows**

**GOAL:** Reliable sharp interface models for weakly compressible dynamics of droplet-gas interactions with multiple components

**METHODS:**

- Development and analysis of coupling conditions for droplet - gas flow with multiple components
- Development of numerical methods for compressible / weakly compressible, compressible / incompressible and weakly compressible / incompressible multi-component multi-phase flows
- Integration of Maxwell-Stein type diffusion
- Comparison with fully incompressible or compressible simulations (SP-A1, SP-A2)

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**References**