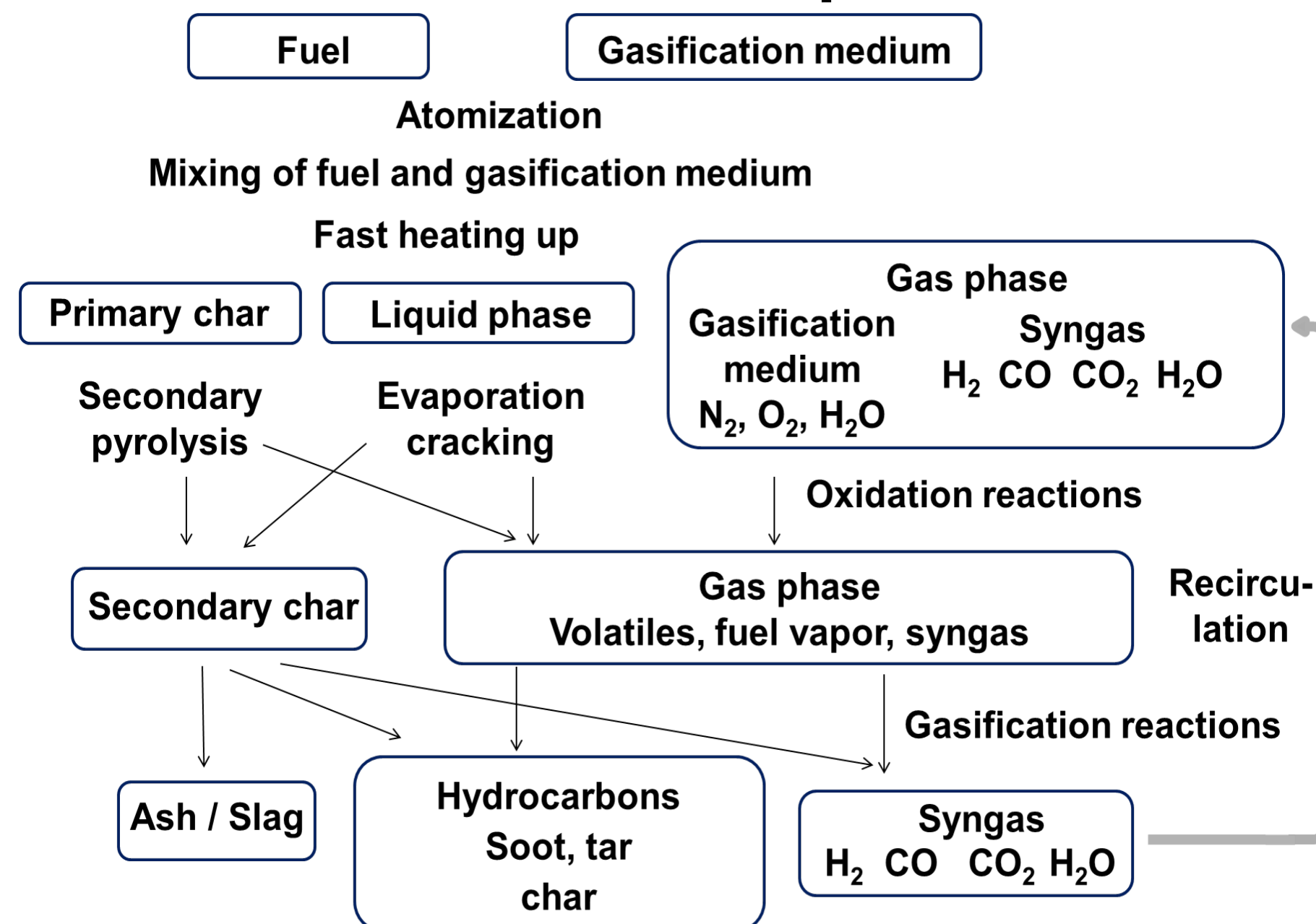


Investigation of Burner Near Processes in Entrained Flow Gasification

Manuel Haas, Sabine Fleck, Christian Hotz, Thomas Kolb

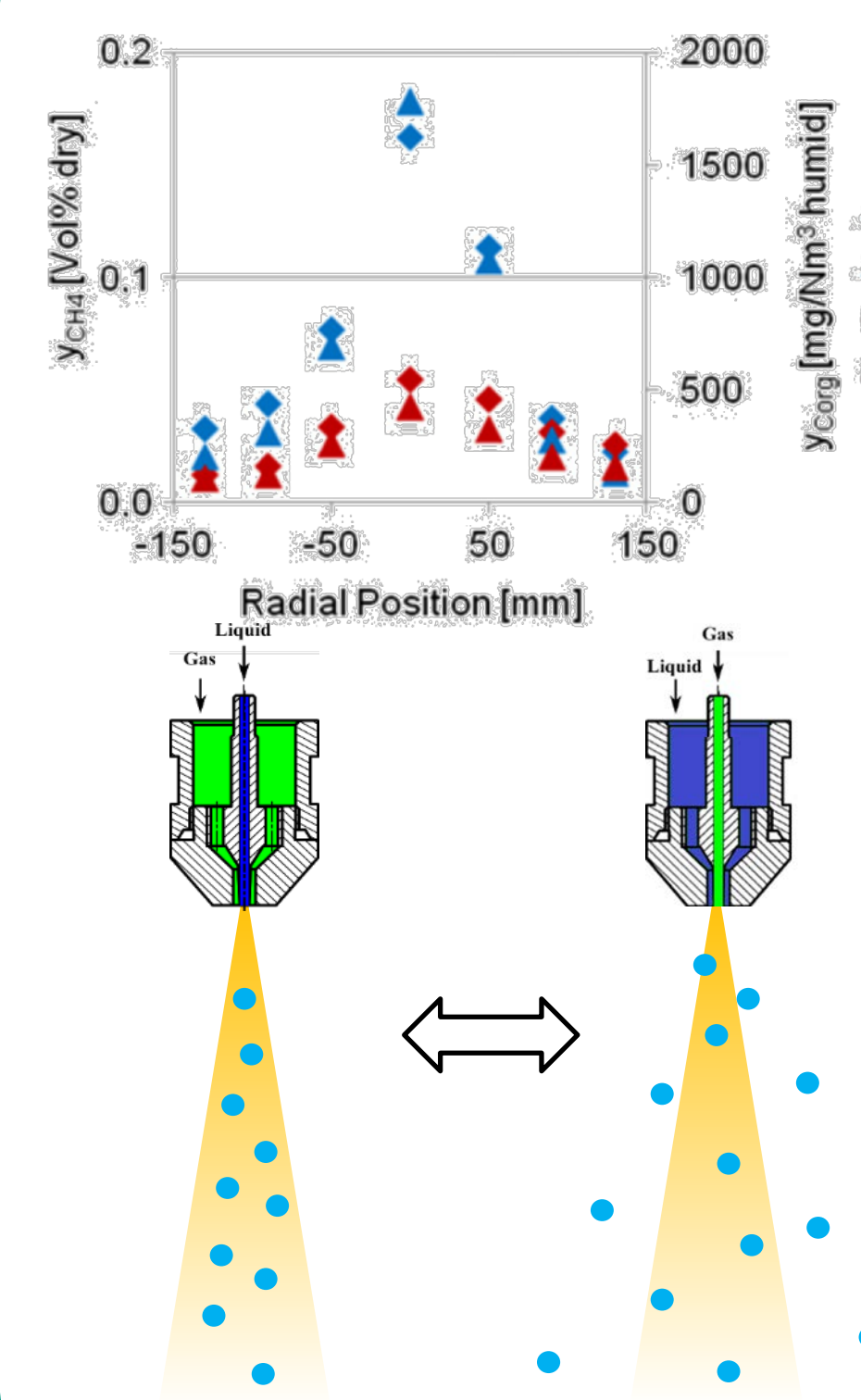
Motivation

Entrained Flow Gasification of Suspension Fuels under elevated pressure conditions



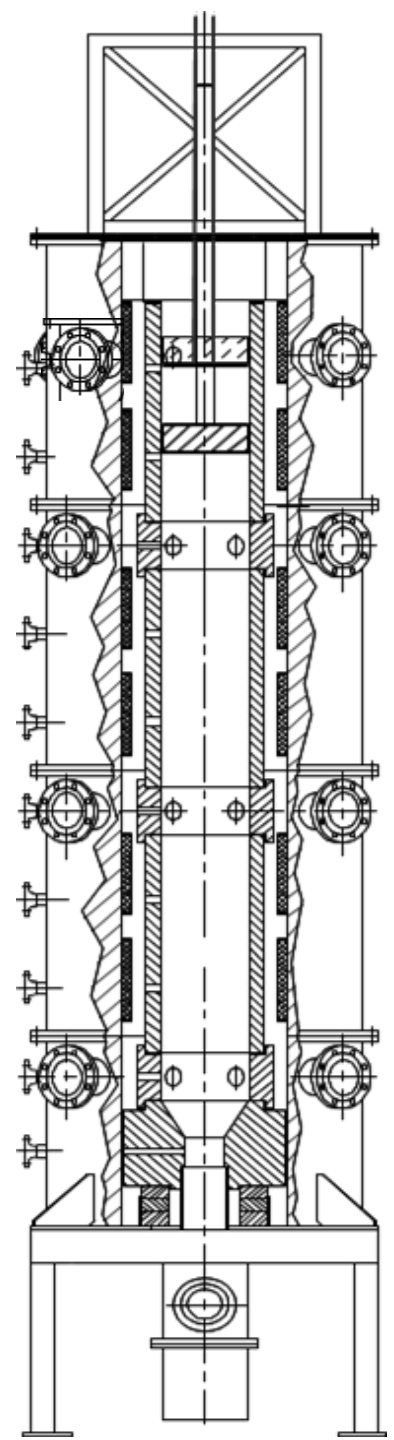
- Descriptions of sub-processes
- Development of numerical models
- Validation of numerical results by detailed experimental data

Challenges and Objectives



- Incomplete carbon conversion
 - Hydrocarbon Formation
 - Influence of flow field, fuel spray distribution and reactand mixing on syngas quality is barely understood
 - No detailed experimental data available from suspension EFG
- Investigate influence of atomization (droplet velocity and size distribution) and flow field
- Validation of sub-process models
- Understand burner near processes

Experimental Methods



Research Entrained Flow Gasifier (REGA)

- Pilot Scale Entrained Flow Gasifier
- Atmospheric pressure ($p = 1$ bar)
- Thermal Power 60 kW
- Optically accessible
- Movable burner
- Single component model fuels, model slurries, technical fuels

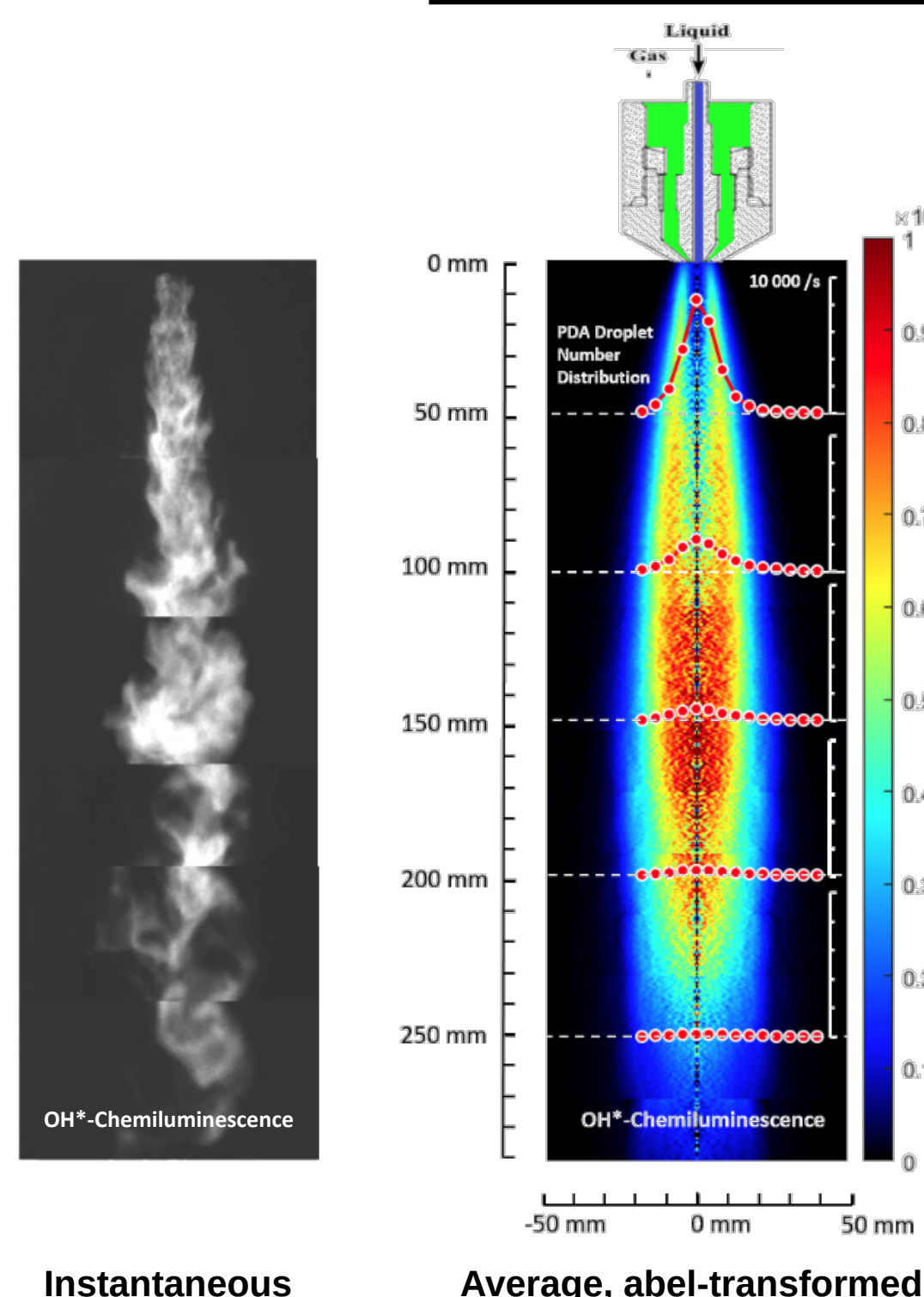
Diagnostic Tools

- High speed camera (spray characteristics)
- OH*-Chemiluminescence (flame structure)
- OH-LIF (flame structure)
- Fuel-Tracer-LIF (fuel conversion)
- LDA/PDA (droplet size and velocity)
- Shadowgraphy (droplet imaging)
- DP-thermocouples Locally resolved temperature
- FID/GC/FTIR Online gas analytics



Reaction Zone Characterization

Flame Structure Analysis

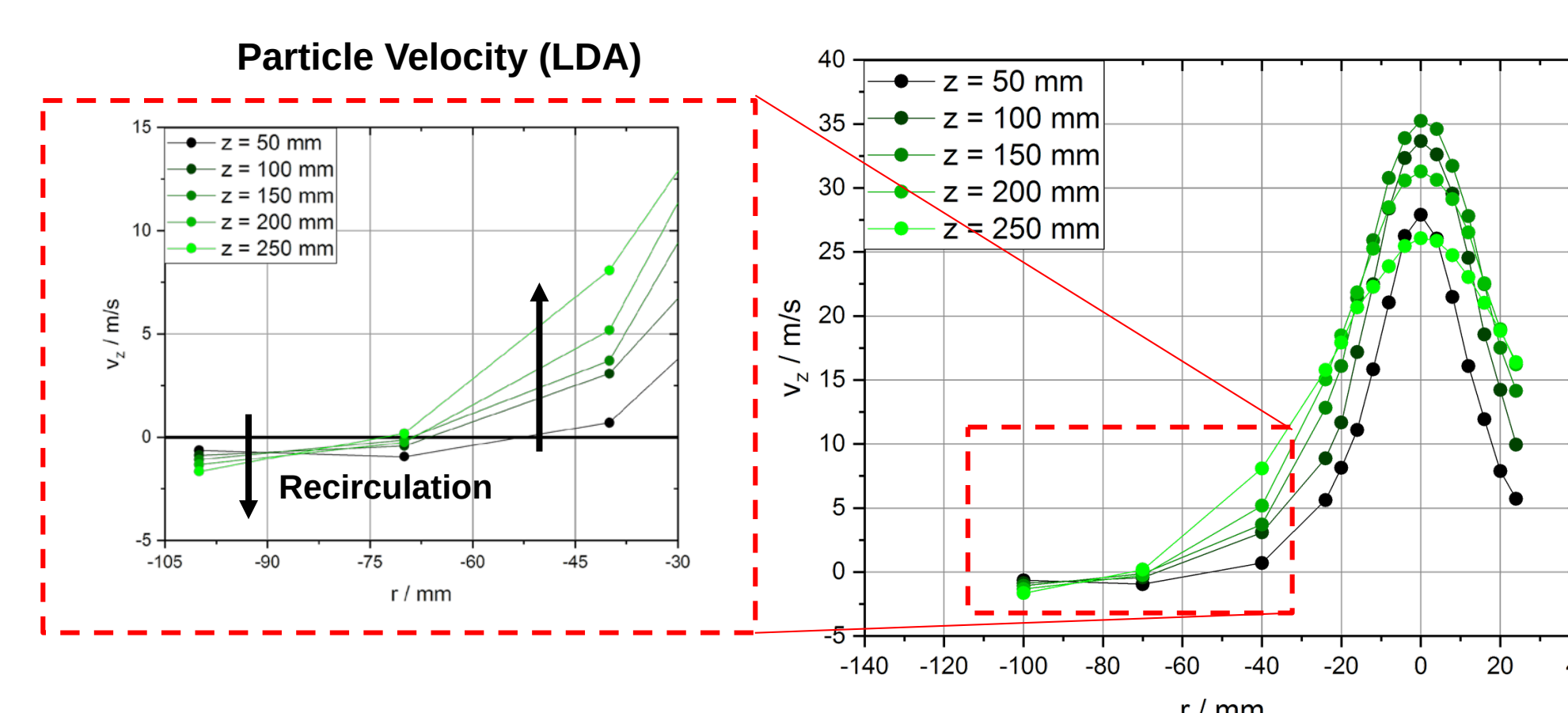


- Oxygen from Gasification medium reacts with hot syngas
- Flame is stabilized at nozzle exit
- Flame envelope around fuel spray
- Structure of main reaction zone can be explained by free-jet-theory

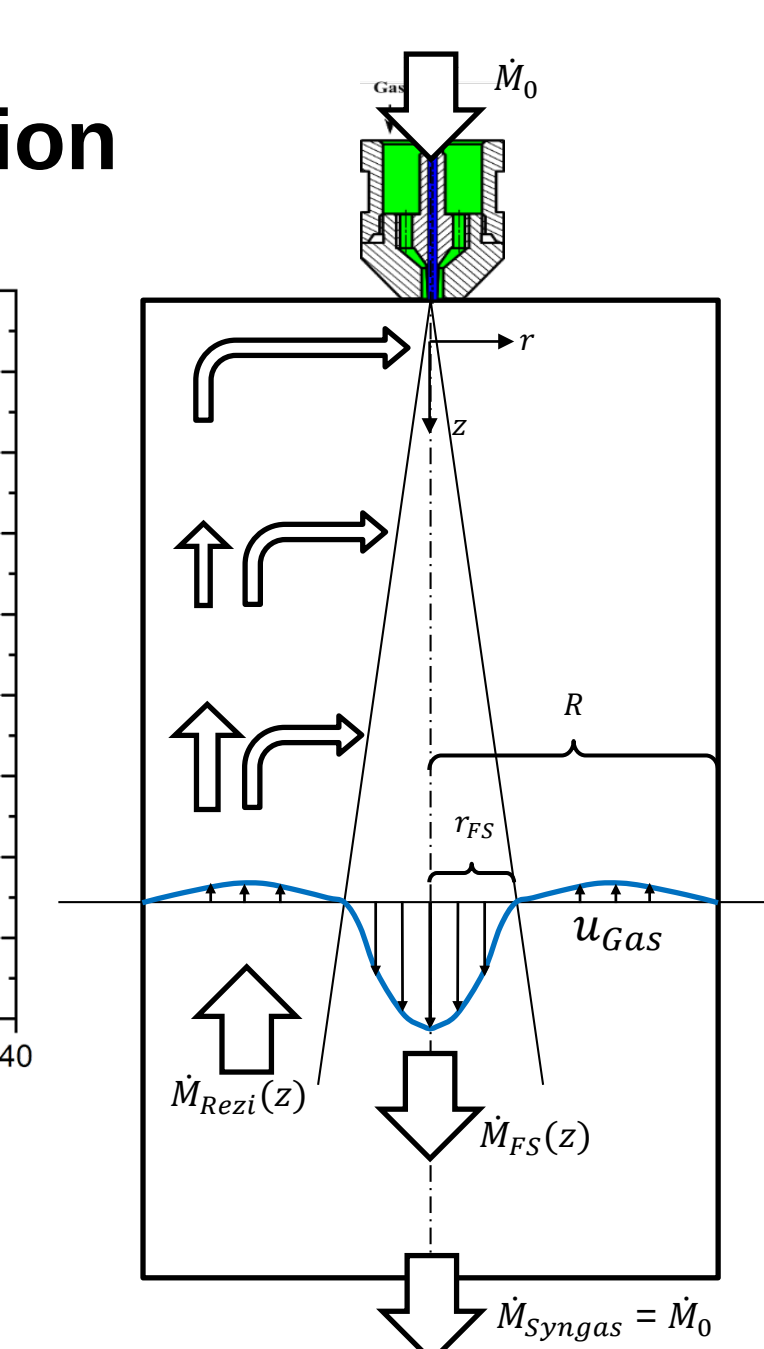
Future work:
→ OH- and CH₂O-LIF to gain detailed insight into reaction zones

Flow Field Analysis

- Detailed mapping of flow field inside gasifier for model-based description of free jet and recirculation zone
- Investigate influence of flow field on fuel conversion

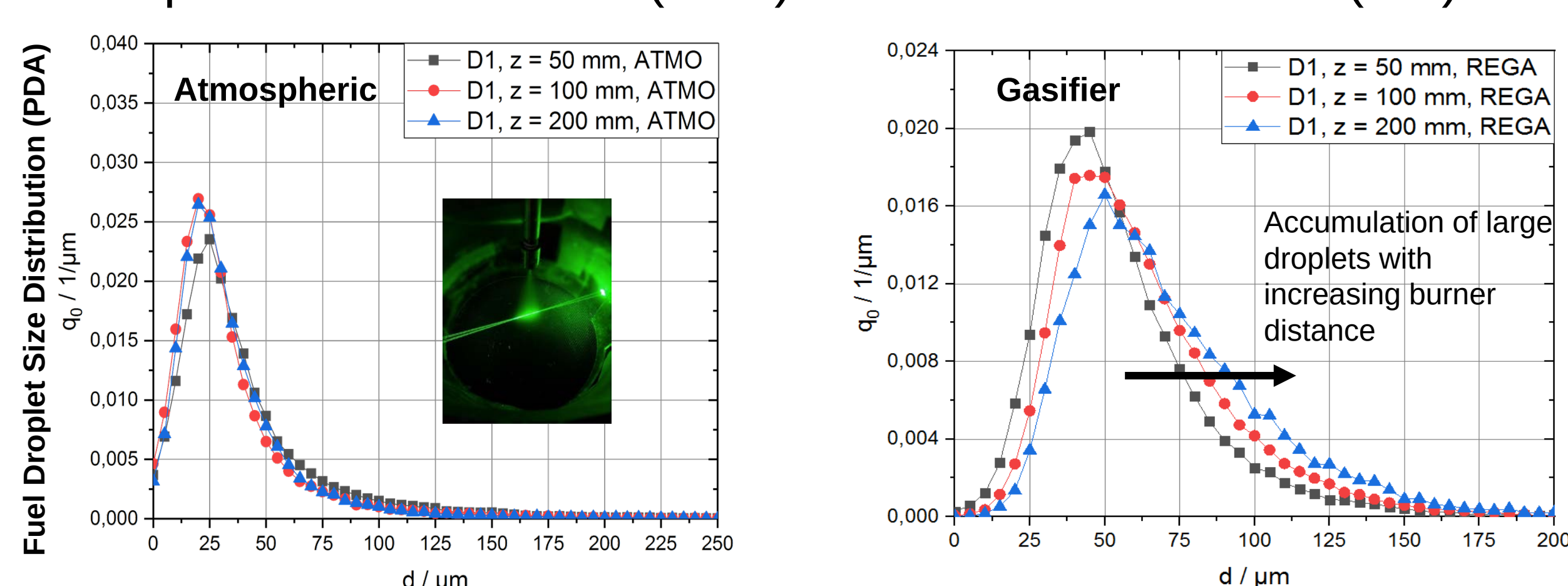


- Enclosed free-jet with recirculation zone
- High centerline velocity due to thermal expansion



Fuel Conversion Analysis

- Comparison of cold-flow and gasification experiments
- Droplet size distribution (PDA) and fuel concentration (LIF)



- Validation of sub process models for evaporation
- Determine influence of flame structure on fuel conversion

Modeling of Suspension Fuel Conversion

- Gasification experiments of model slurries with variable solid content and particle size
- Detailed in-situ data from shadowgraph
- Particle extraction to determine solid fuel conversion
- Model based description of suspension fuel gasification

