# Insights into Pool Boiling Heat Transfer: Experimental and Numerical Investigations from the Multiscale Boiling Project on the ISS

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# Pool and flow boiling

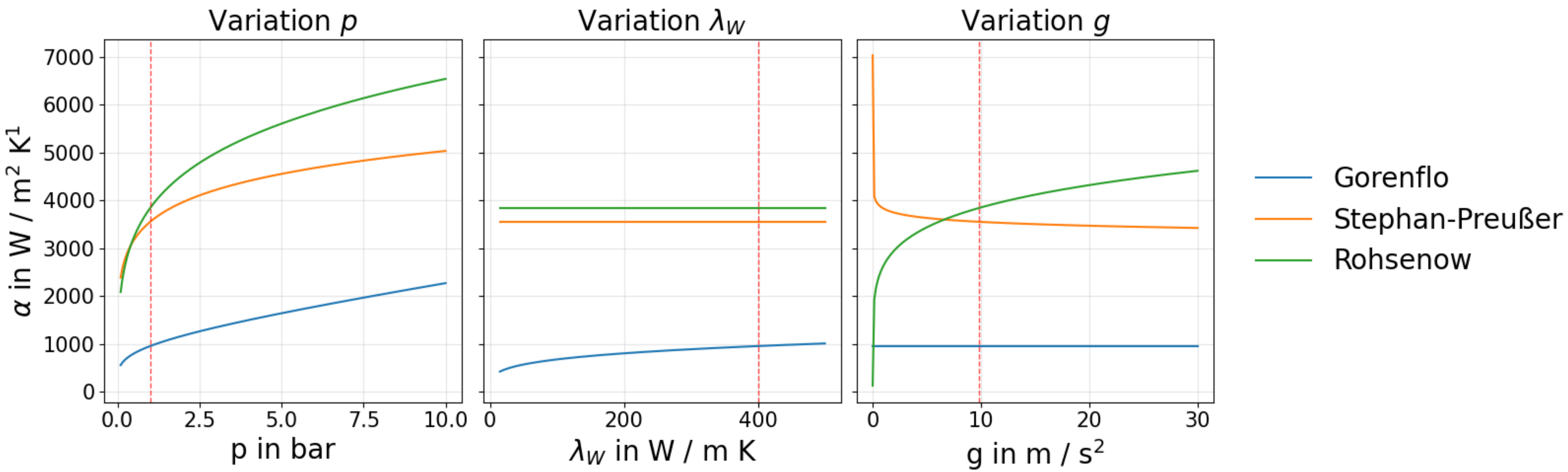
Coffee

Power and Refrigeration Cycles


Electronics Cooling

Thermal Process Engineering

# Design of boiling devices is still a problem




Water, copper heater
1 bar
20 kW/m$^2$
Ra = 0.4µm

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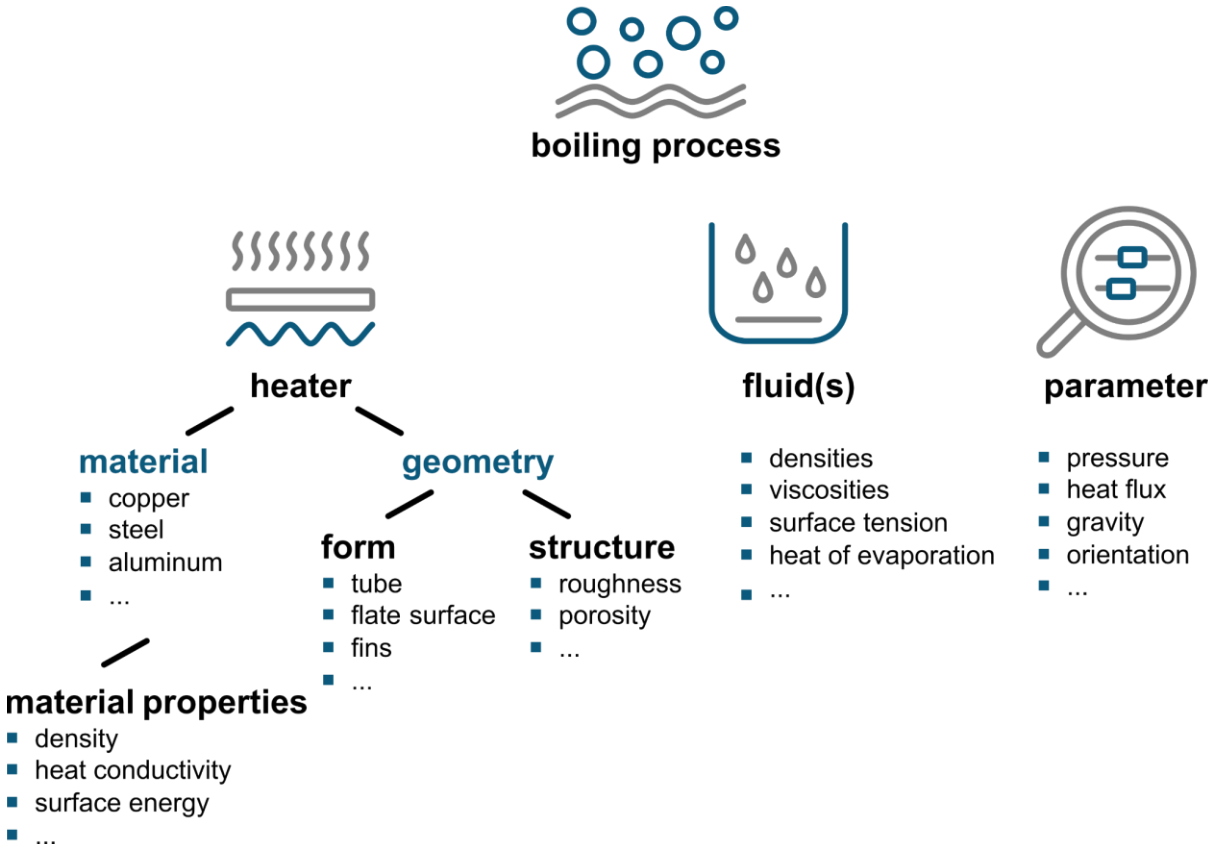
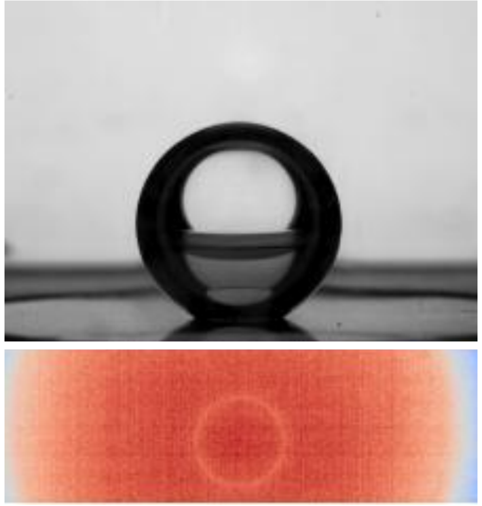


# Our research approach

**Combine …**

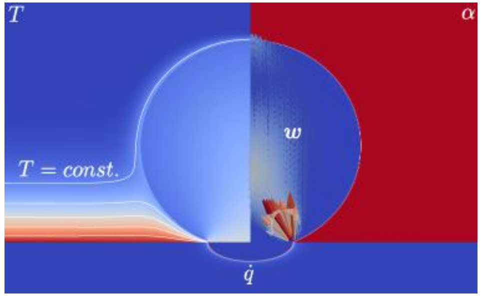
(1) <u>generic boiling experiments</u> to investigate bubble dynamics and local temperature profile with high spatial and temporal resolution

Experiment



(2) <u>simulations</u>, based on a <u>validated CFD model</u>, to describe details of transient flow and heat transfer including phase change

Simulation




→ start with single bubble system

→ **Go to Space !**

# 3 experimental boiling test facilities

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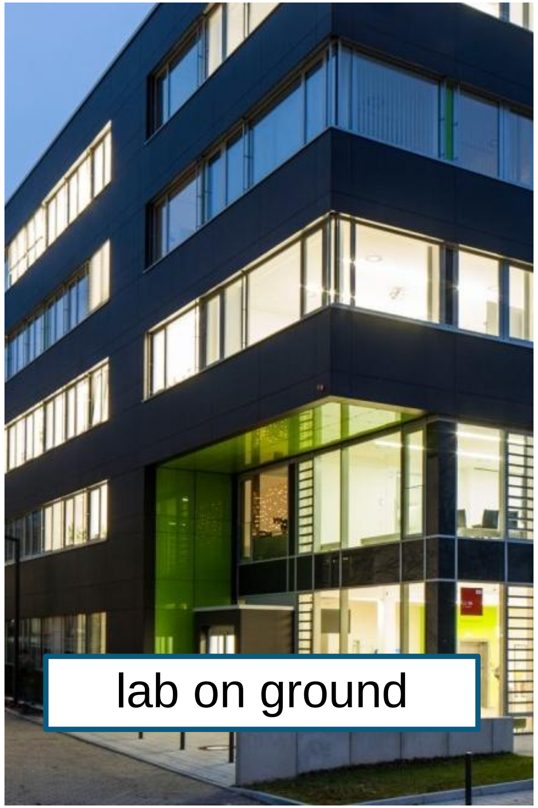
lab on ground

parabolic flights


on-board ISS

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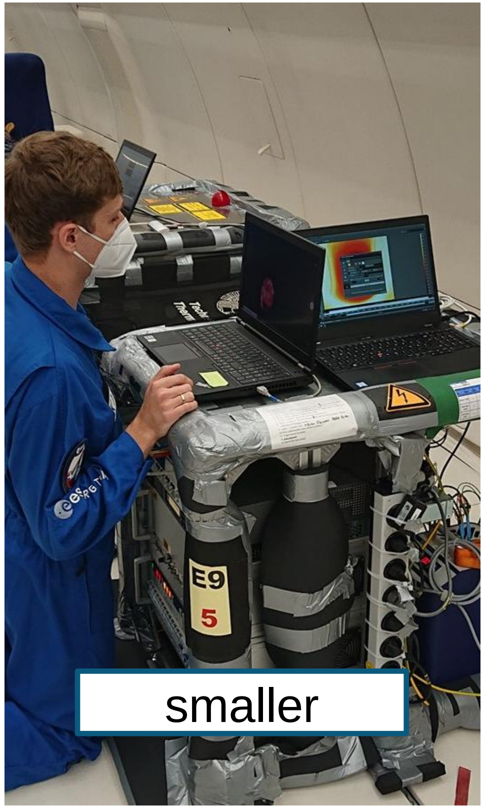
University of Ljubljana

# 3 experimental boiling test facilities



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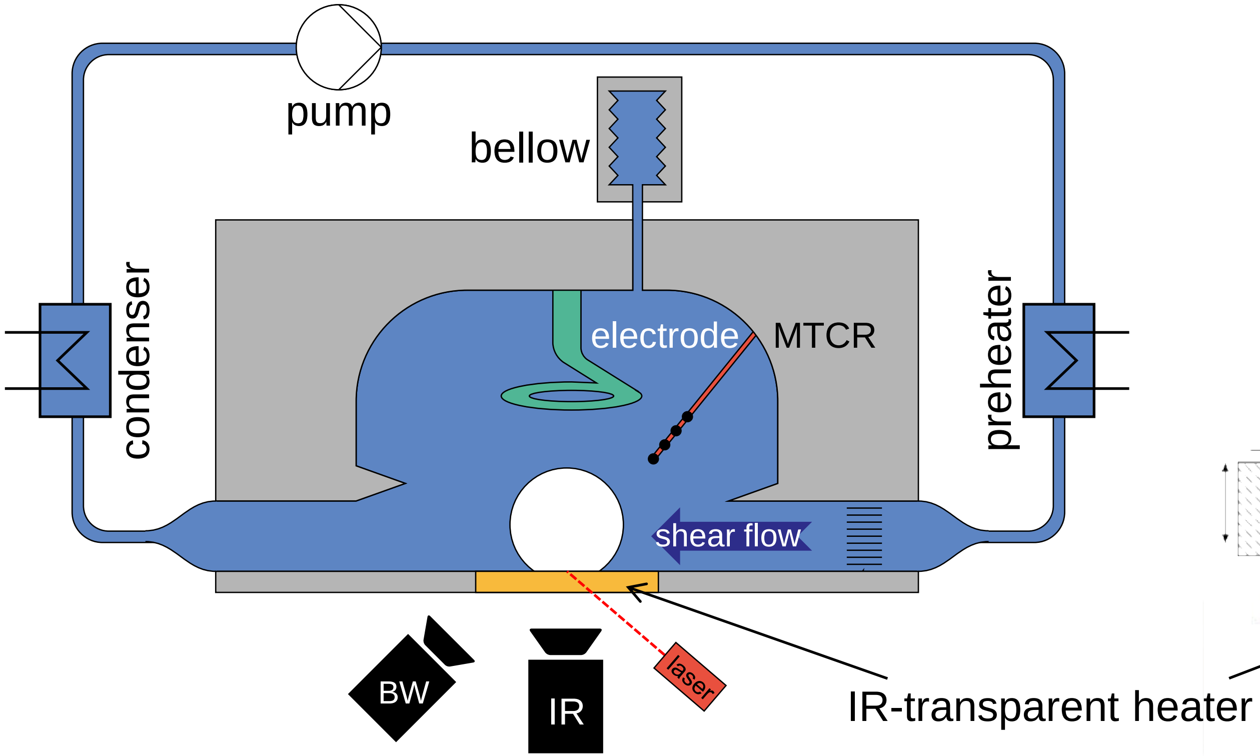
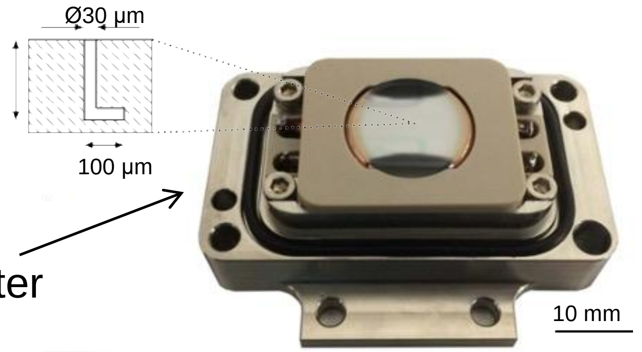
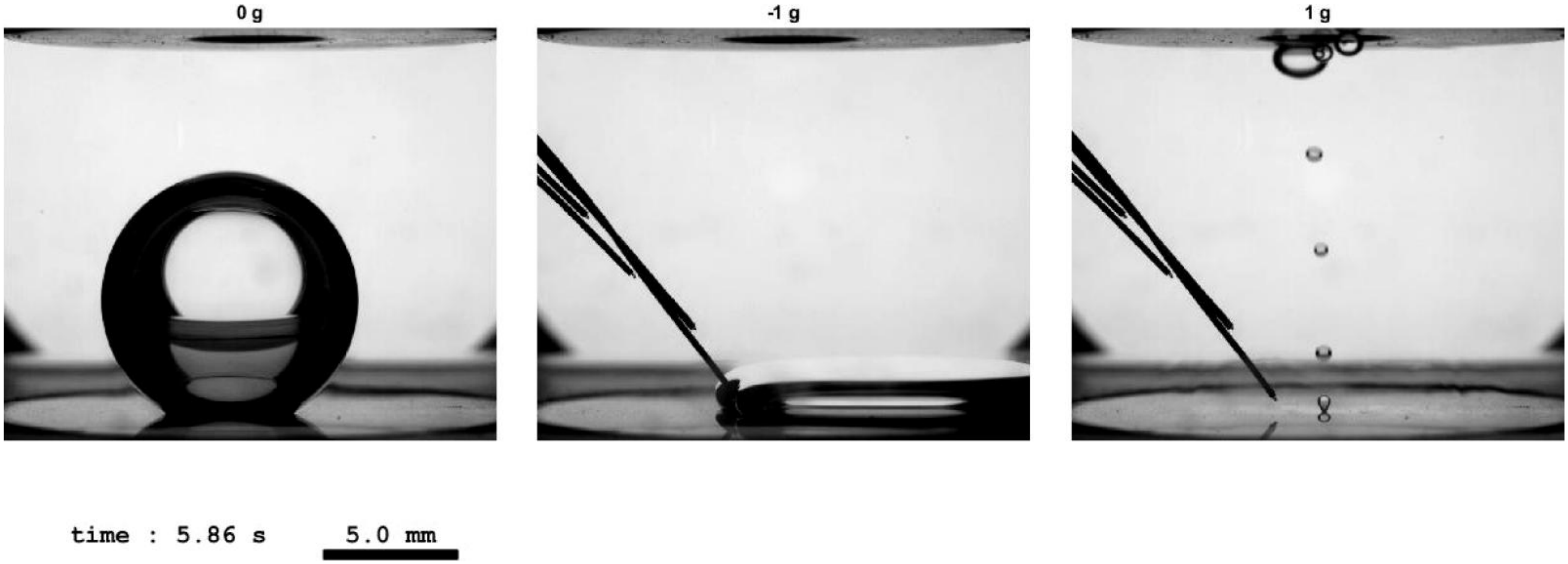
# Schematic of RUBI

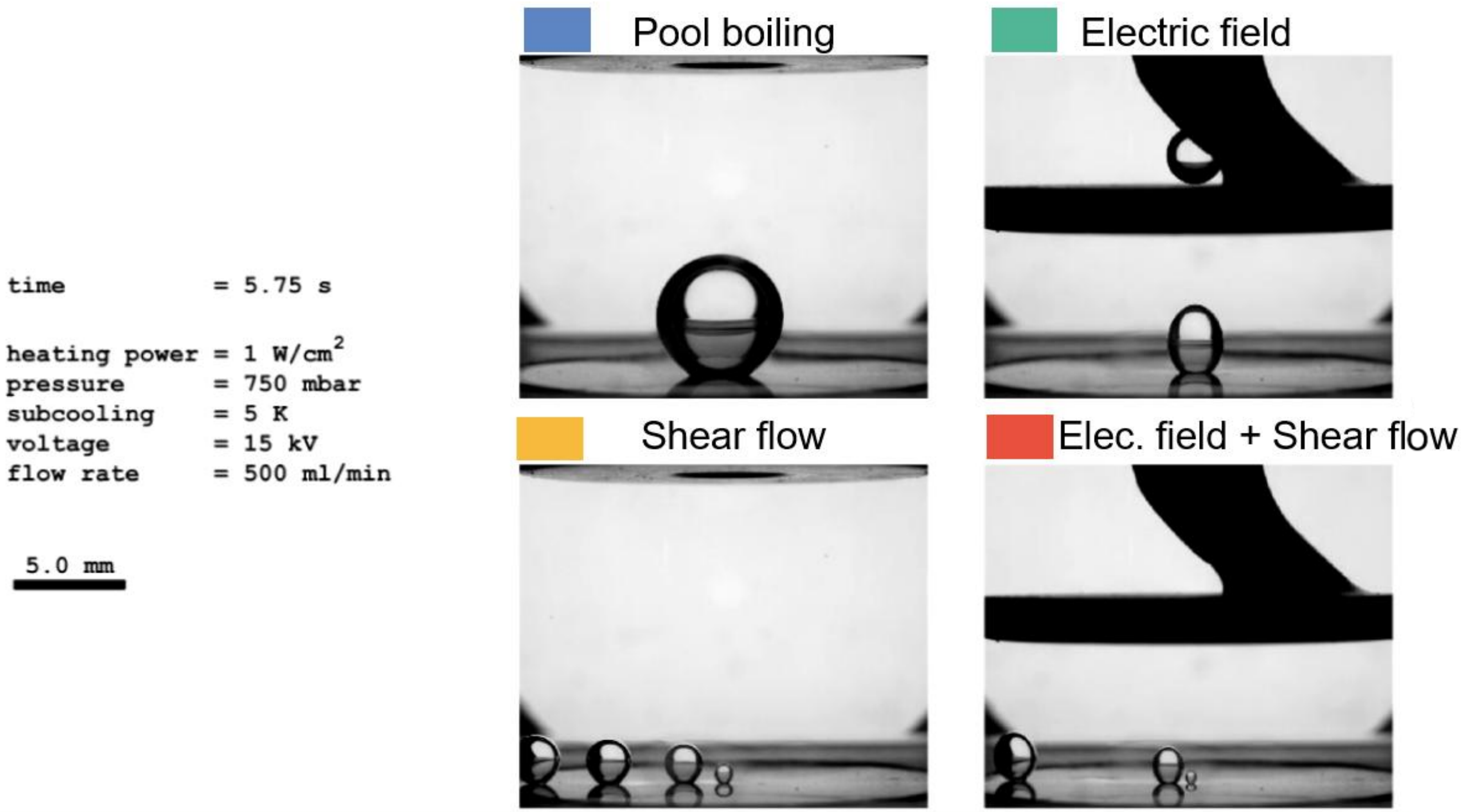


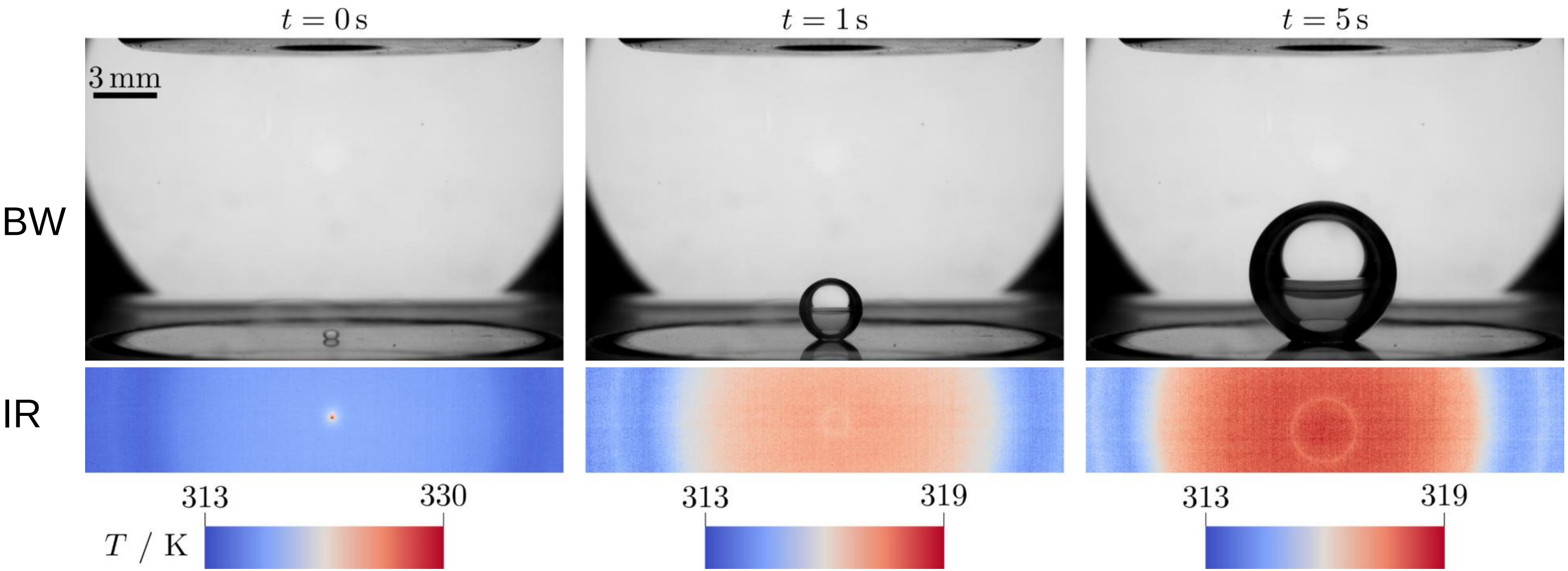
# Results from ISS



# Results during ISS experiments for 4 different situations



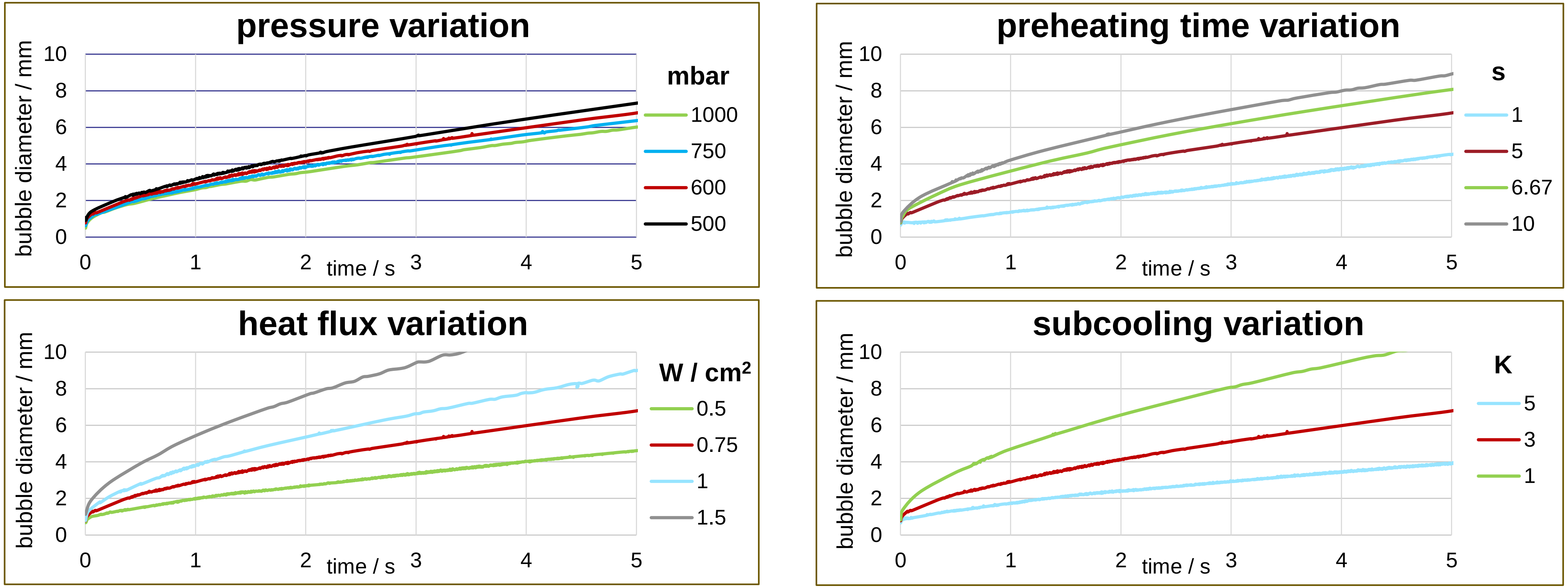
# Exemplary pool boiling results



# Influence of pressure, preheating time, heat flux, subcooling



## bubble growth with time



# CFD model implemented in OpenFOAM

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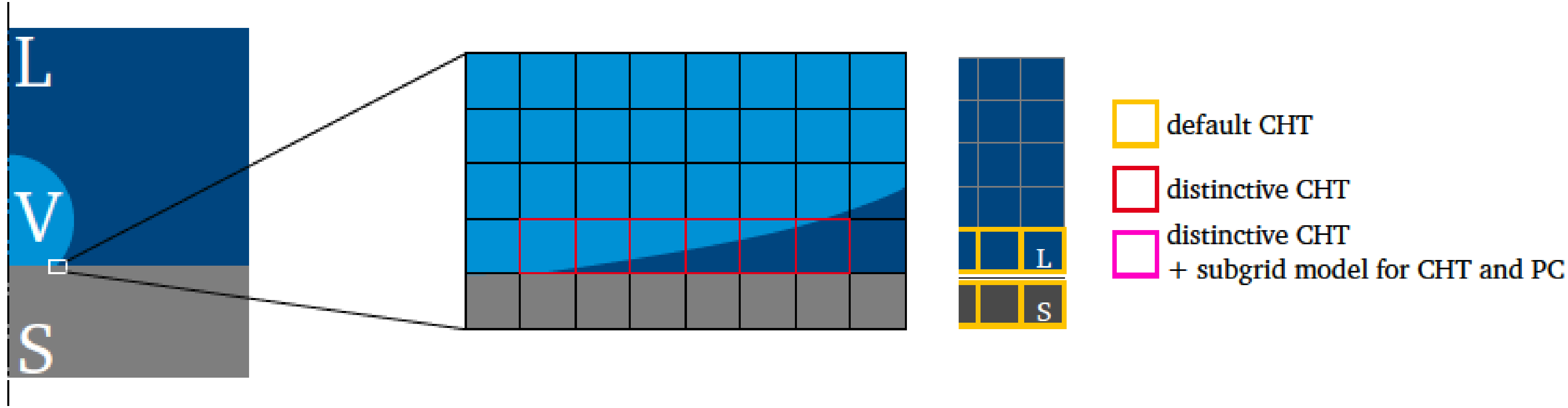
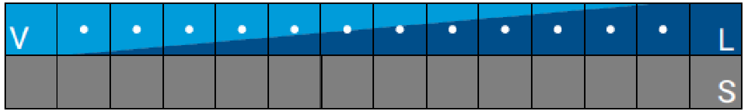
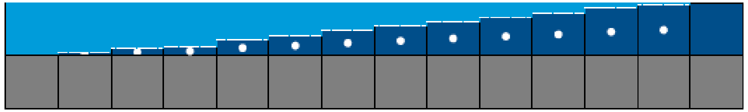



Original situation




Modeling by new temperature BC



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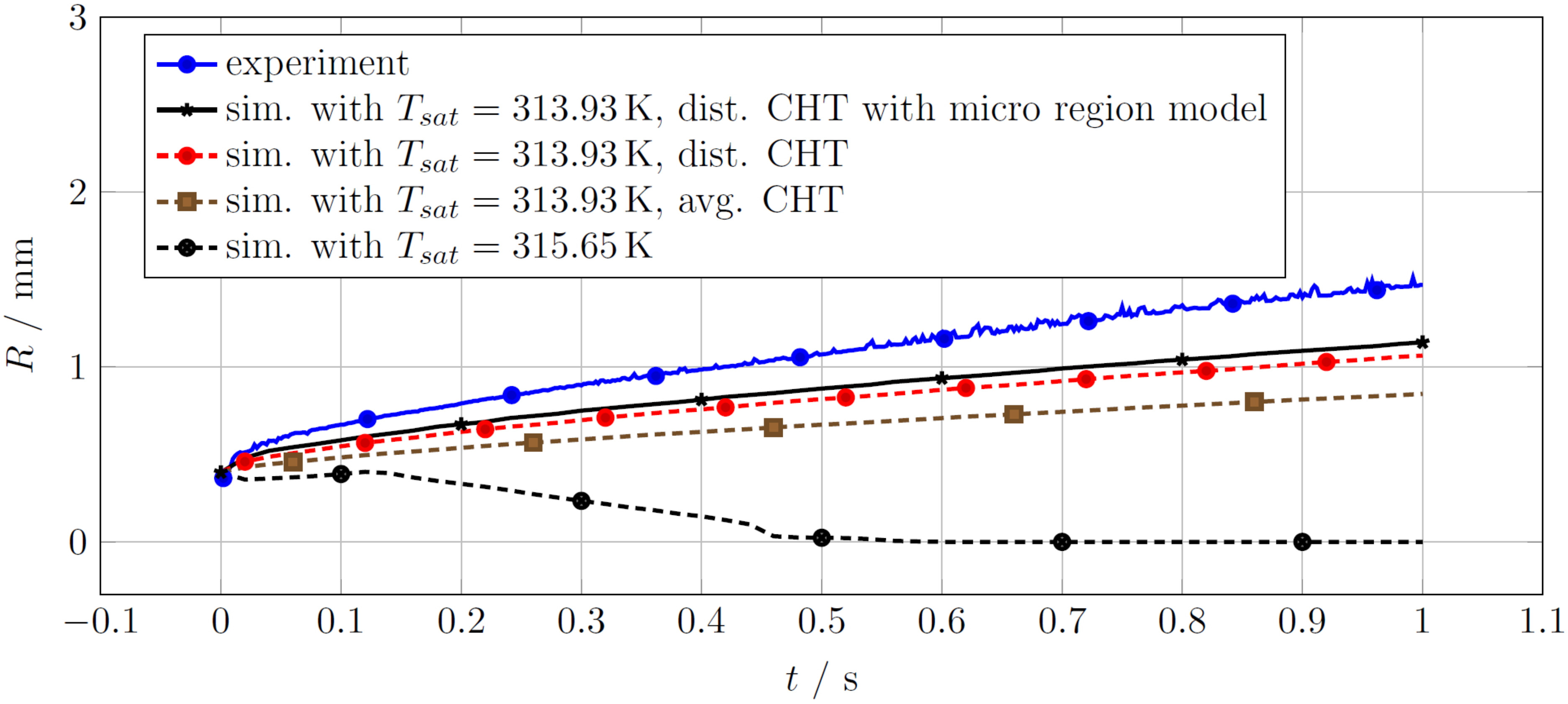

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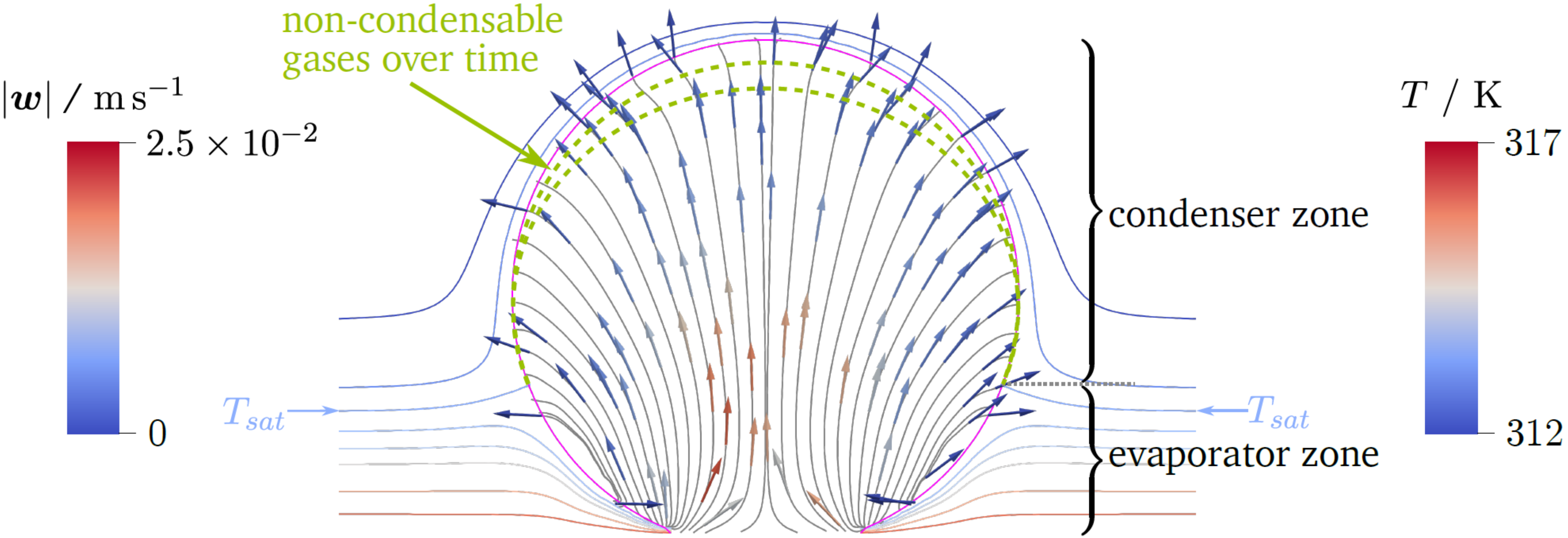
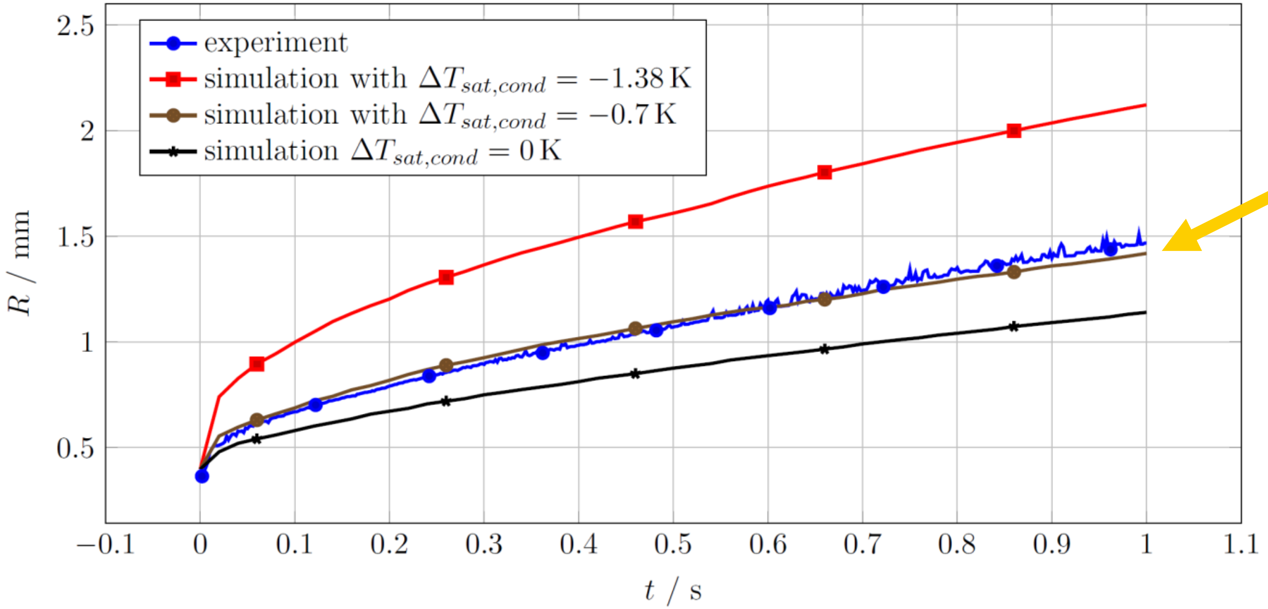


# CFD model implemented in OpenFOAM





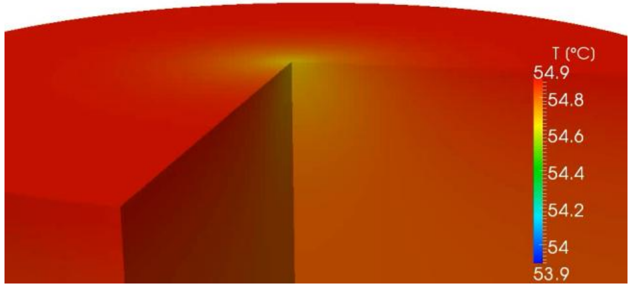

Molar fraction:

2.5% in the vapor
0.008% in the liquid

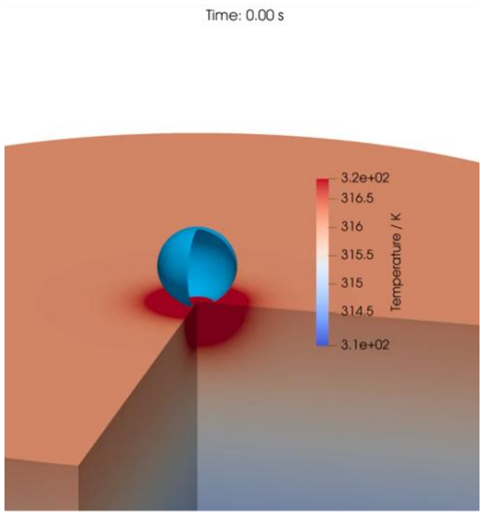
# Simulation results and comparison with RUBI data



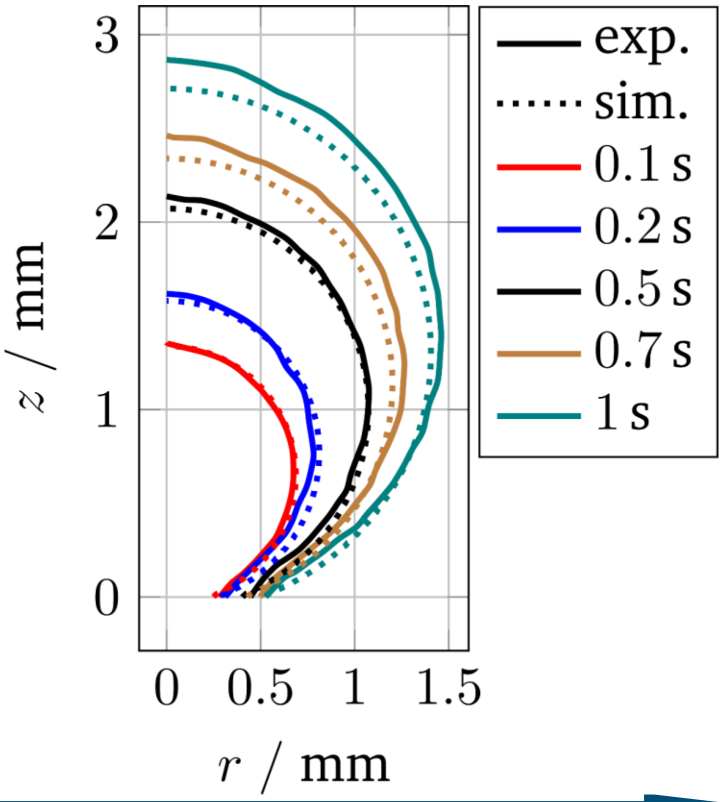
1g




0g




RUBI - 0g



# Acknowledgement

esa

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