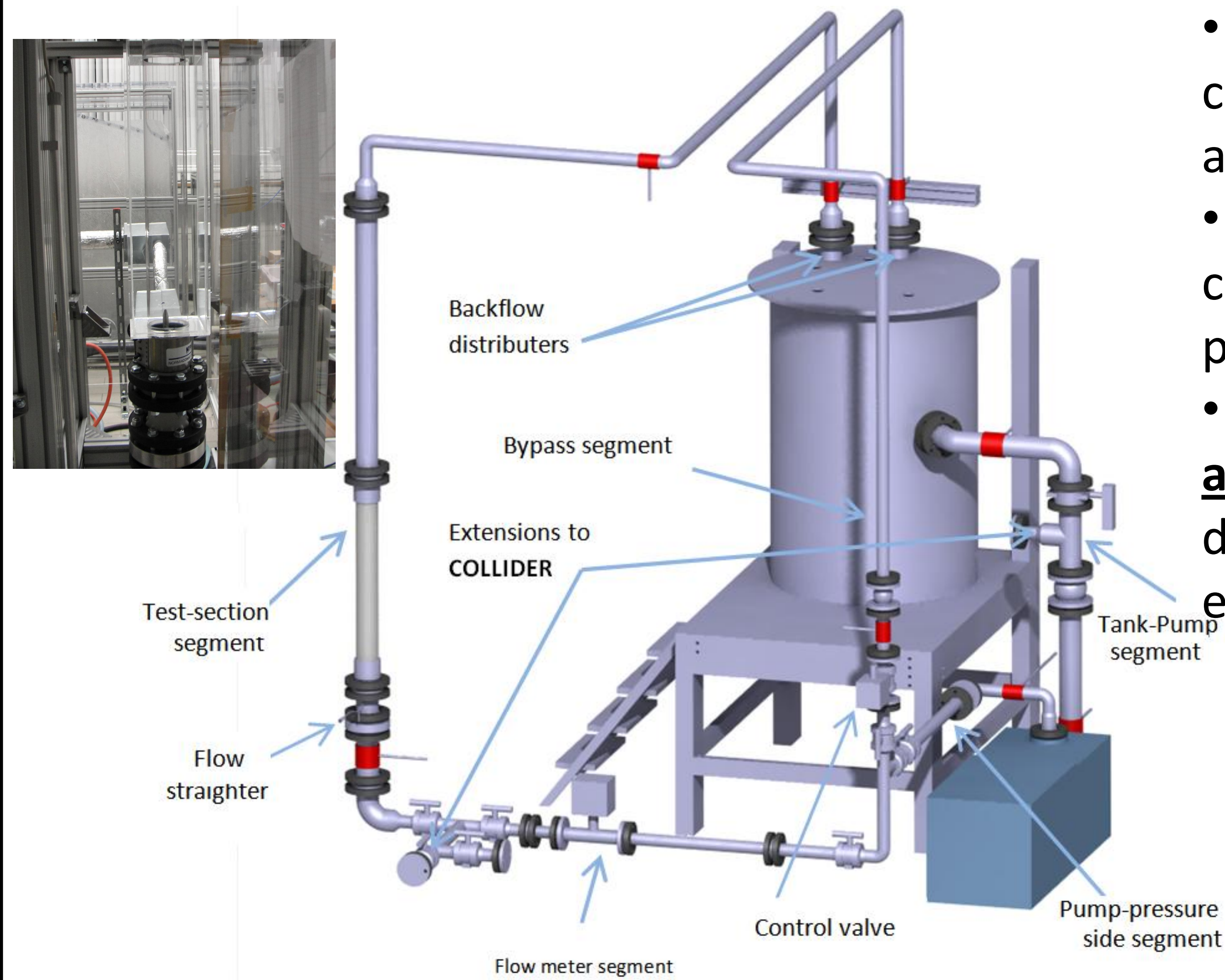


SCUBA test facility (Steam bubble condensation in flowing subcooled water)

Experimental results and CFD validation data

Dipl.-Ing. Suleiman Al Issa issa@ntech.mw.tum.de

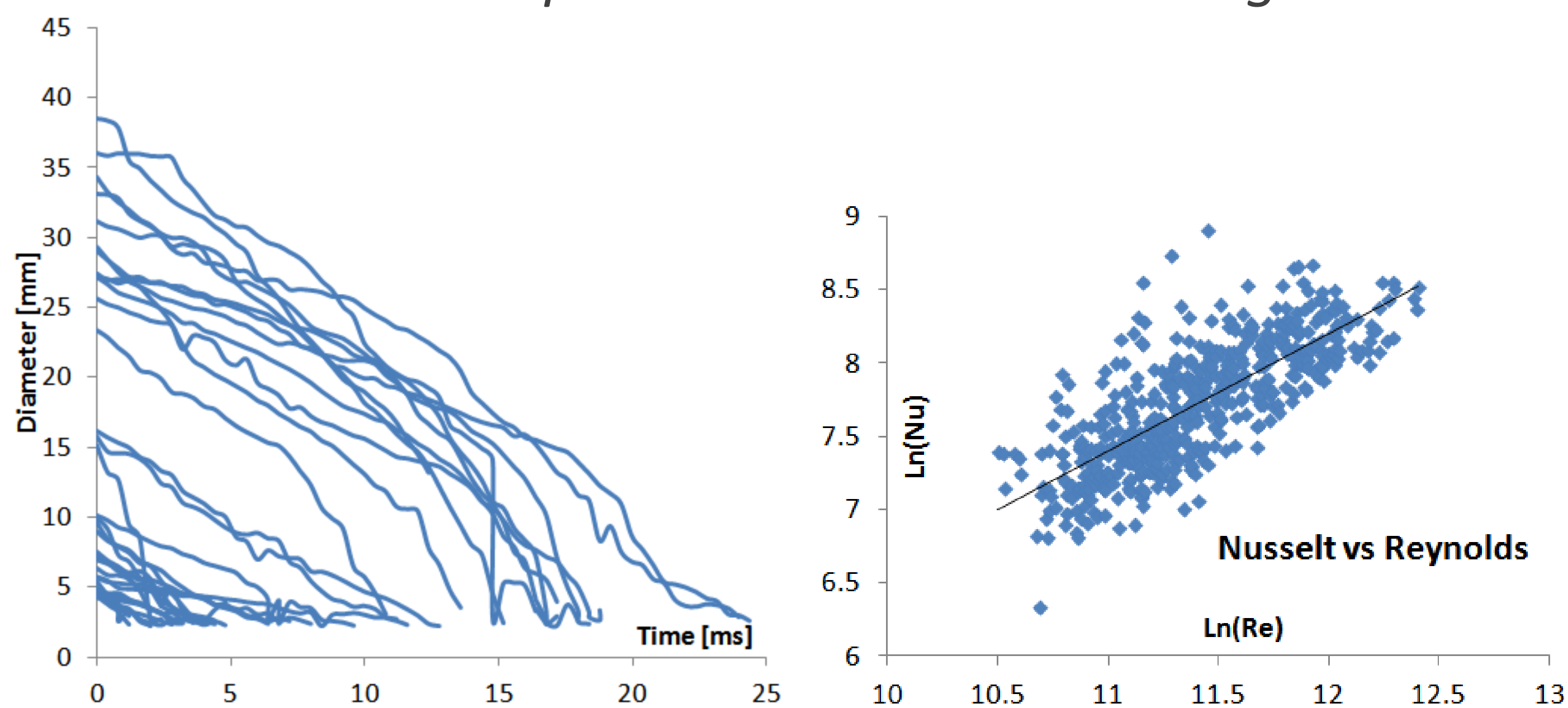
Facility Schema and test section



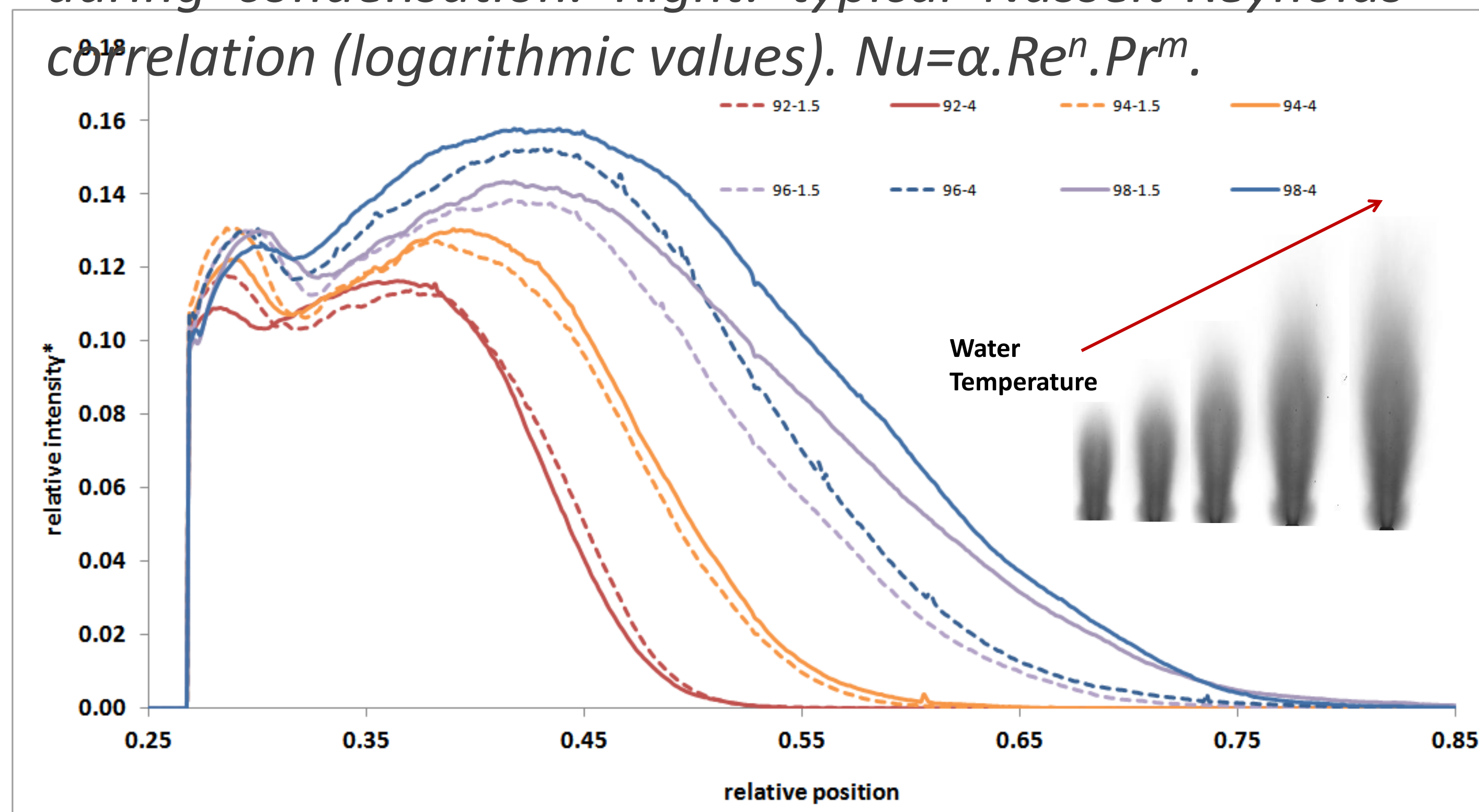
Measurements

- Temperatures, pressures, steam and water flow rates are controlled and measured in test section via automated data acquisition system and LabVIEW-based program.
- Bubble diameter along time is captured via high-speed camera recording and own-developed algorithms for image processing and parameters calculations (3000 frame/sec).
- The program recognize and detect **each condensing bubbles after detachment** and track its position, relative velocity and diameter along time. As a result it delivers **(Nu,Re)** value for each condensing bubble.

3D water loop and real test section image

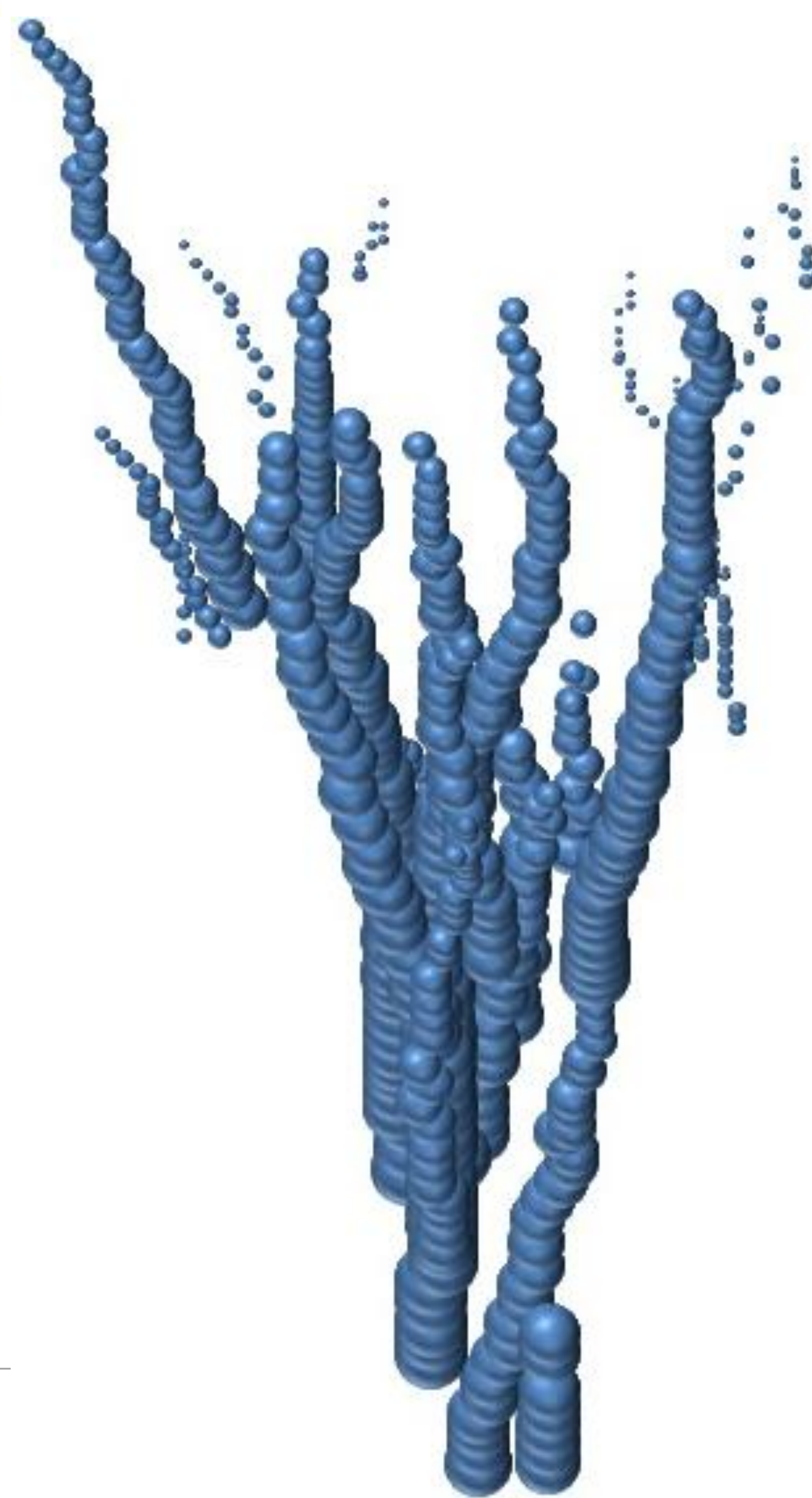


Left: development of bubble diameter along time during condensation. Right: typical Nusselt-Reynolds correlation (logarithmic values). $Nu = \alpha \cdot Re^n \cdot Pr^m$.

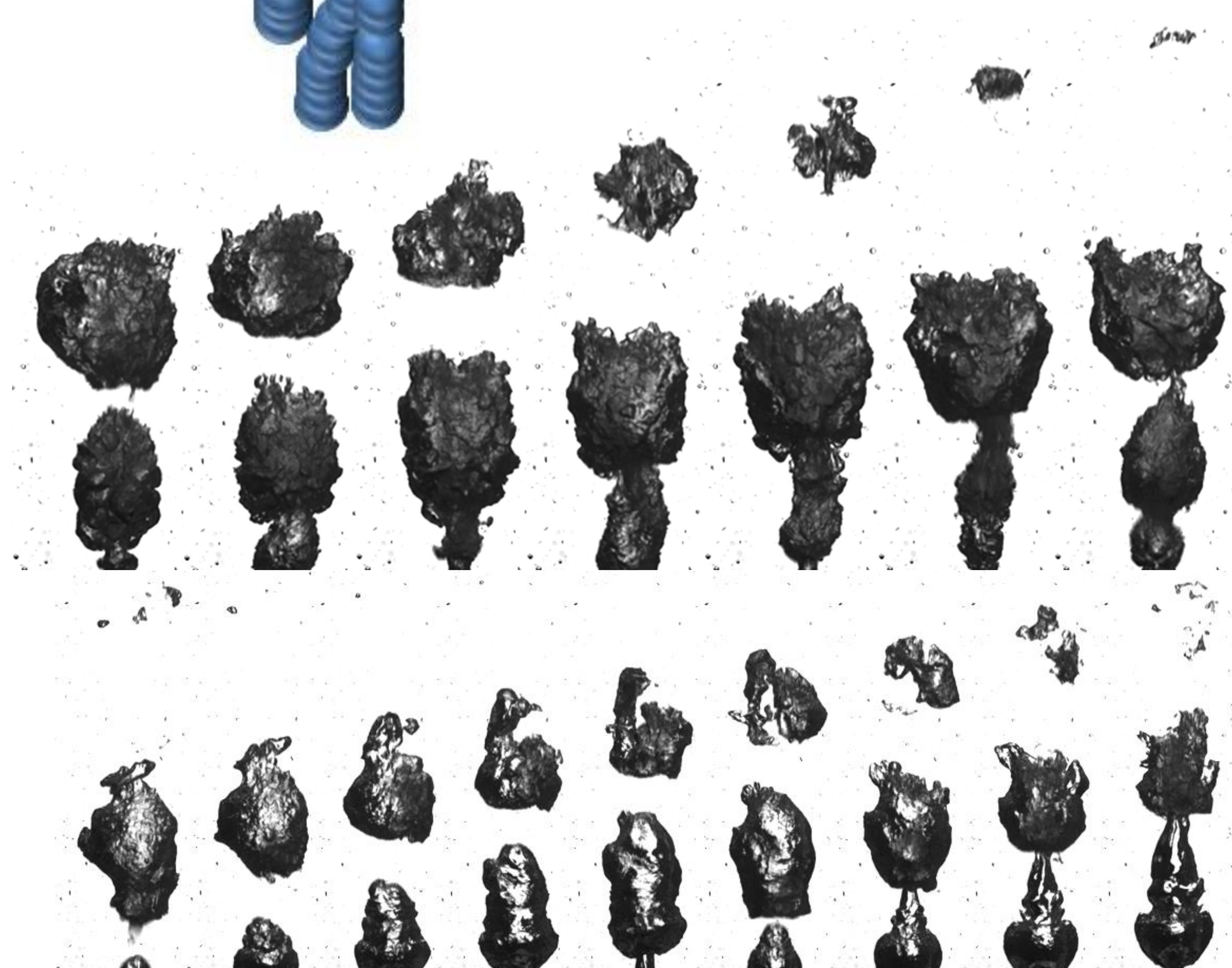


Development of relative void fraction along vertical axis from injection. Legend : temperature[C]-steam mass flow rate[kg/h].

Steam plumes to the right represent average void fraction over 2 seconds of camera recording, these results can be used for CFD validation and comparison.



← Reconstruction of condensing bubbles during 0.5 seconds coming out of 4mm injection nozzle in 98°C / ~0.5 m/s water superficial velocity/temperature and ~0.21 m/s Steam superficial velocity. Bubble position, and diameter data from HSC recording and our processing programs were used to produce this image.



Snapshots of a condensing bubble in low-(lower image) and high-(higher image) steam flow rate.[unprocessed raw images]