

# Aerosol formation from liquid impingement in liquid metal cooled nuclear reactor systems

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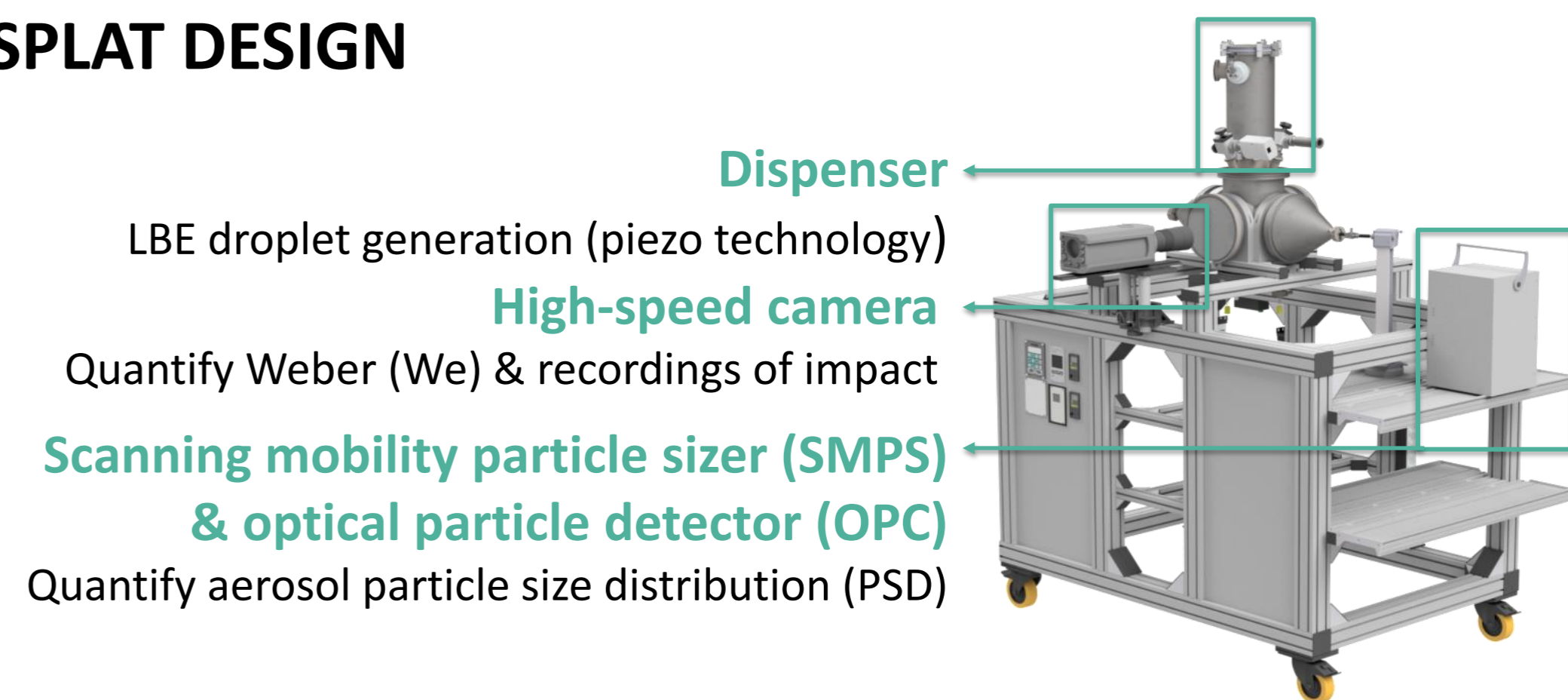
Master of Nuclear Engineering Technology



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**INTRODUCTION** Lead-bismuth eutectic (LBE) is chosen as coolant for the MYRRHA reactor. During reactor operations, LBE aerosols may form, which could jeopardize plant operations and human health. Aerosol mechanisms have not yet been investigated for LBE, yet they are a decisive parameter during nuclear reactor safety assessments and licensing procedures. Therefore, this thesis focuses on characterizing liquid impingement of impacting LBE droplets on surfaces and on the particle size distribution (PSD) of the aerosols, arising from the impact. For this study, a 'liquid impingement' SPLAT setup is built.

## SPLAT DESIGN



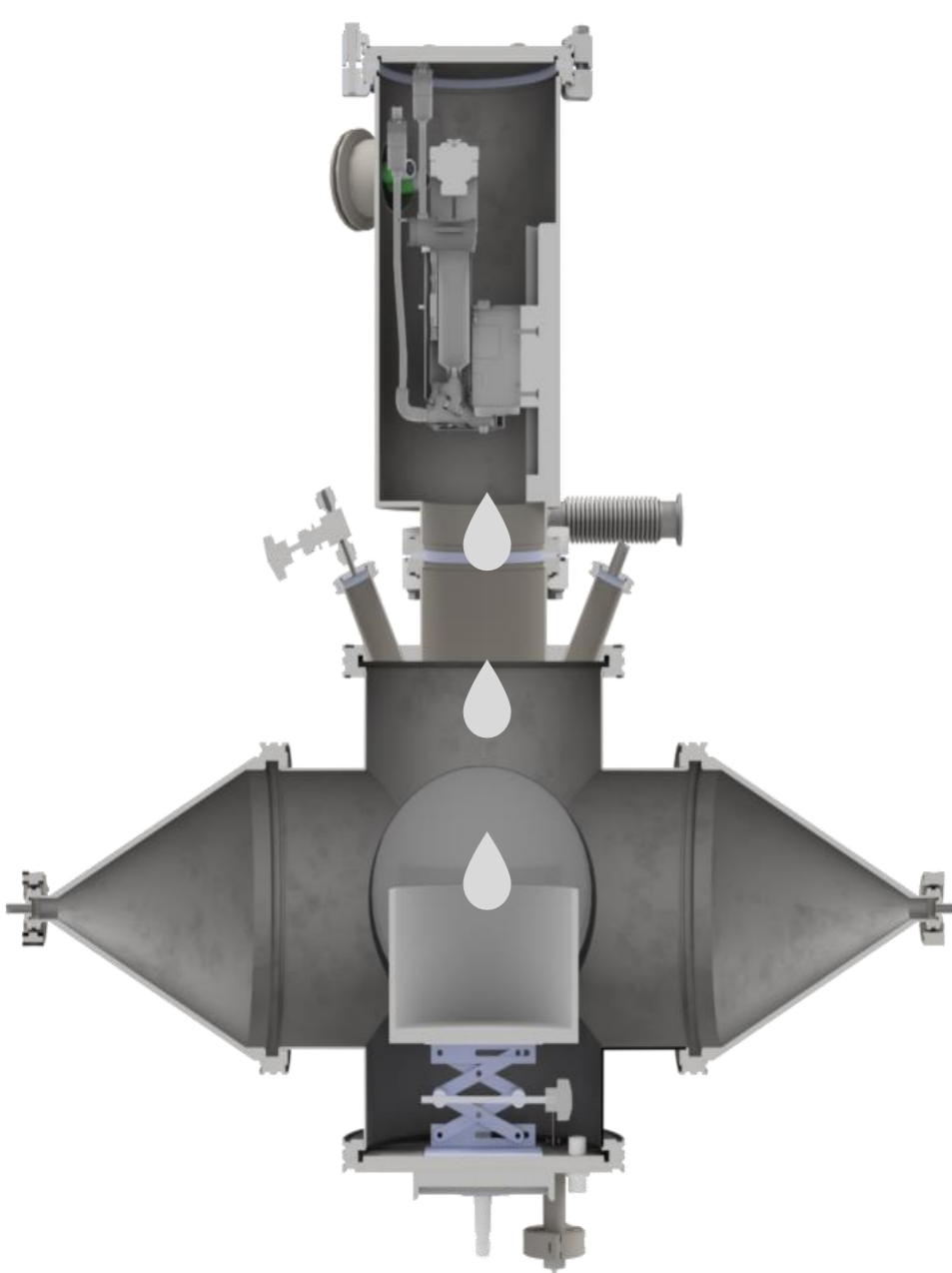
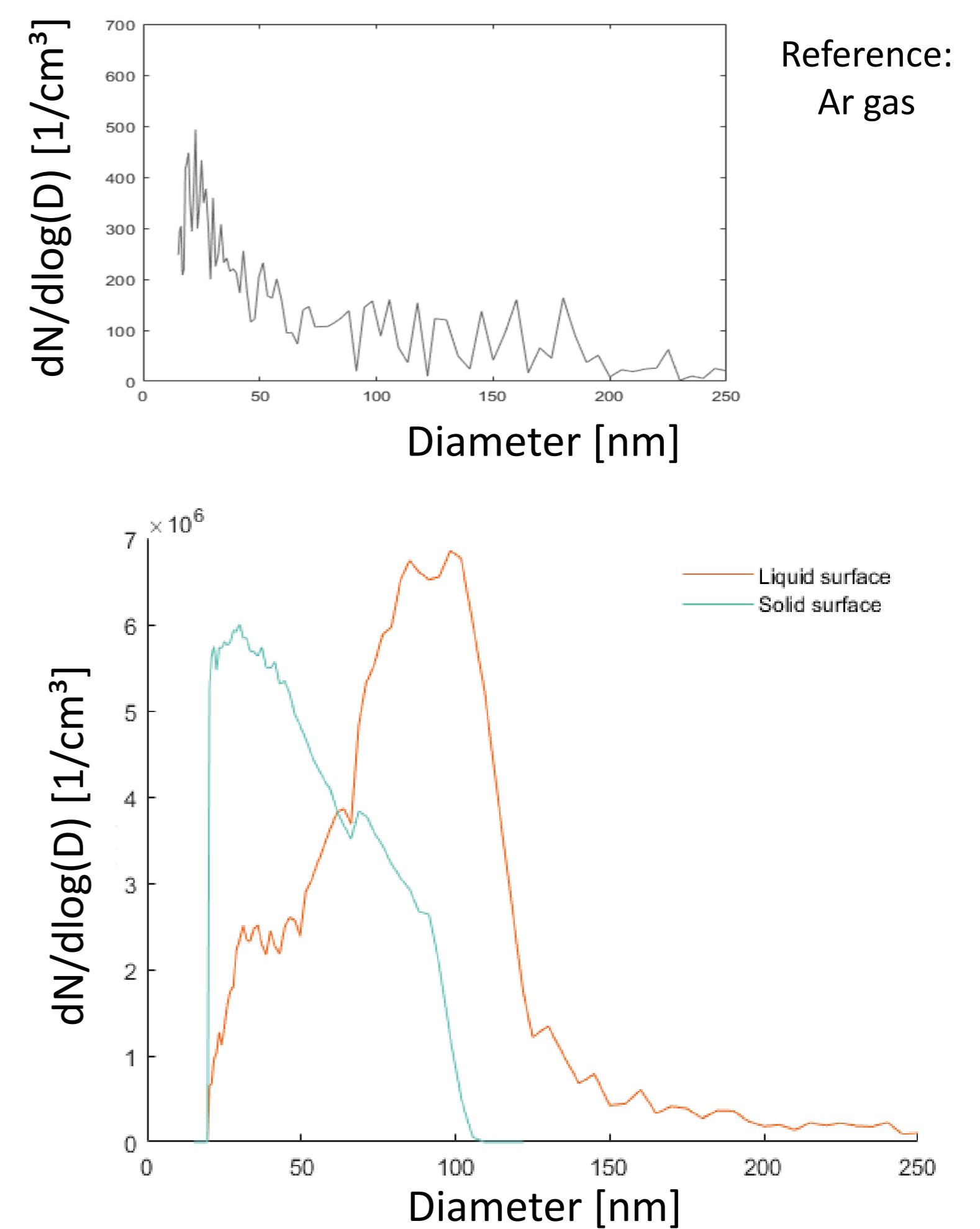
## RESULTS AND DISCUSSION

### Dispensed LBE droplets

Small LBE droplets	Large LBE droplets
d: 0.8 - 1.5 mm	d: 1.6 - 3.2 mm
We: 91 - 244	We: 260 - 499
v: 1.81 - 2.52 m/s	v: 2.48 - 2.53 m/s

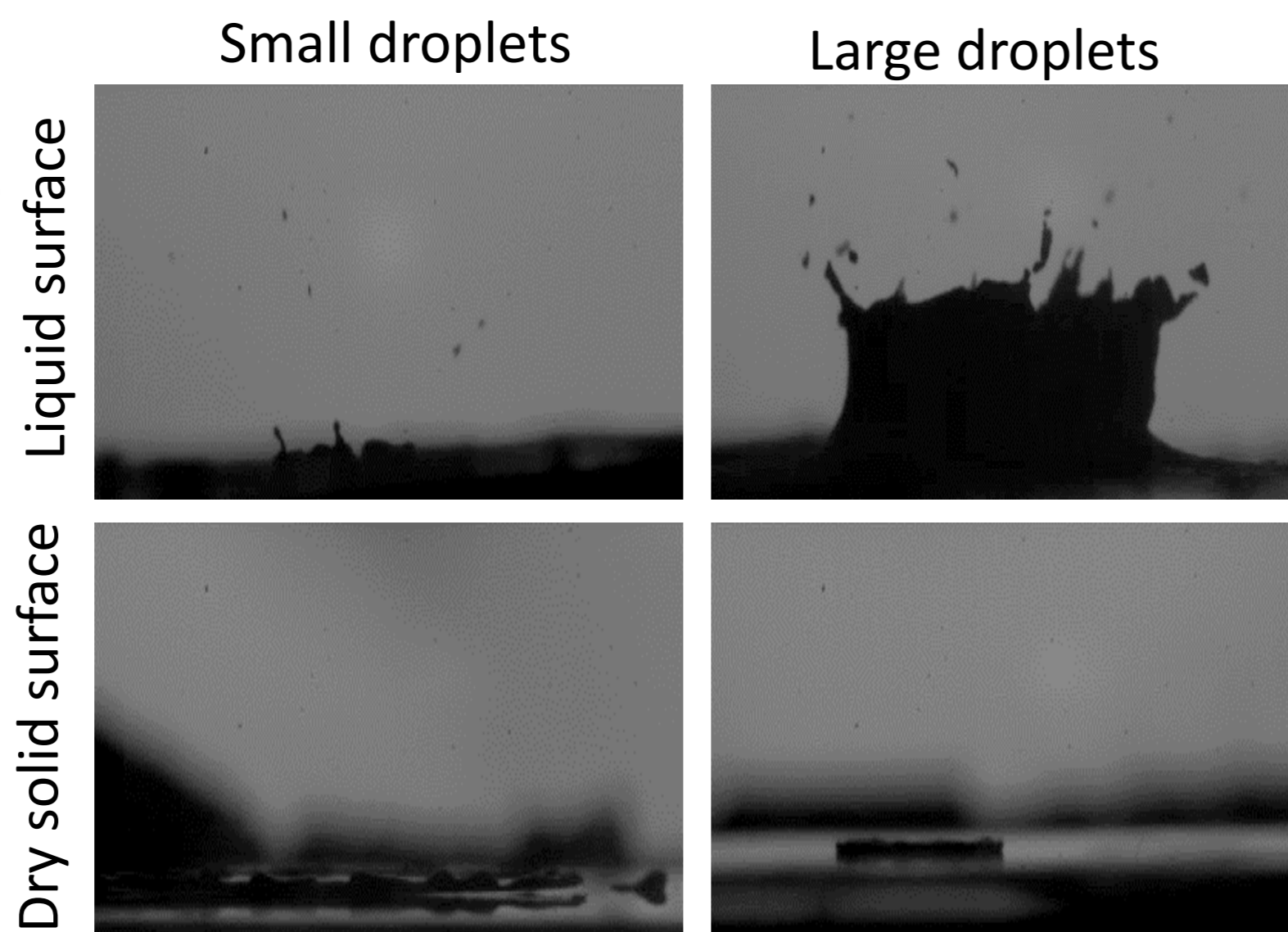
$$\text{With } We = \frac{\text{inertial forces}}{\text{surface tension}} = \frac{\rho v^2 d}{\sigma}$$

### SMPS and OPC: particle size distribution (PSD)



SPLAT impingement chamber with impacting dry solid & liquid surface

### High-speed camera: impacting images



**CONCLUSION** LBE is expected to cause more significant splashing than water, owing to LBE's significantly higher Weber number, which is quasi double that of water for a given droplet size. The dispenser was able to dispense the required LBE droplets within millimeter diameter range. The high-speed camera images show crown splash patterns during liquid surface impingement. Dry solid surface impingement led to a spreading lamella without visible secondary ejected droplets. The PSD of liquid surface impingement shows a distribution shift to larger particle size bins. Our preliminary results indicate that both types of impingement can lead to the formation of significant amounts of sub  $\mu\text{m}$  particles that can pose a hazard as they are difficult to filter out and may migrate deep into the human body.

To make more precise claims about LBE within the framework of aerosol formation, more experiments and parameters are required. Additionally, technical difficulties caused by the dispenser should be further examined.

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