A NEW KIND OF SUBSTANCE FOR THE RAPID ACTIVATION AND HETEROGENOUS GROWTH OF NANOPARTICLES IN PARTICLE COUNTERS

ETH – NPC 2024

13.06.24 I PATRICK WEBER

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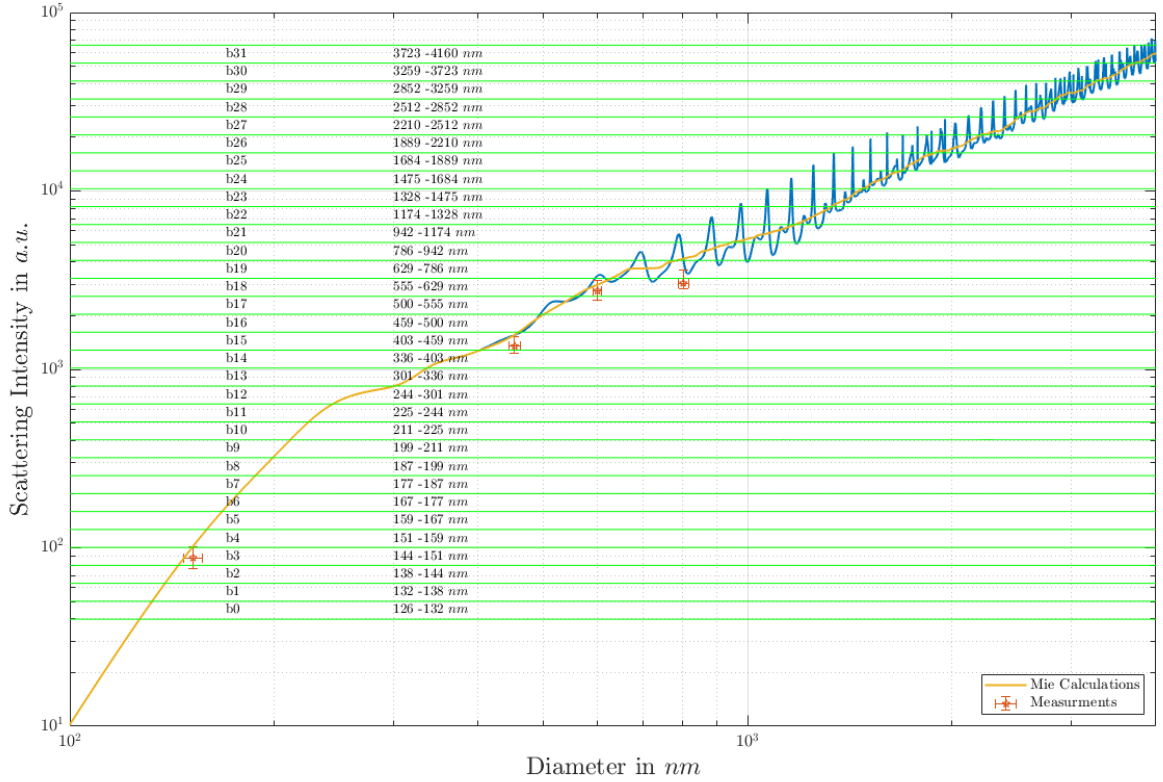
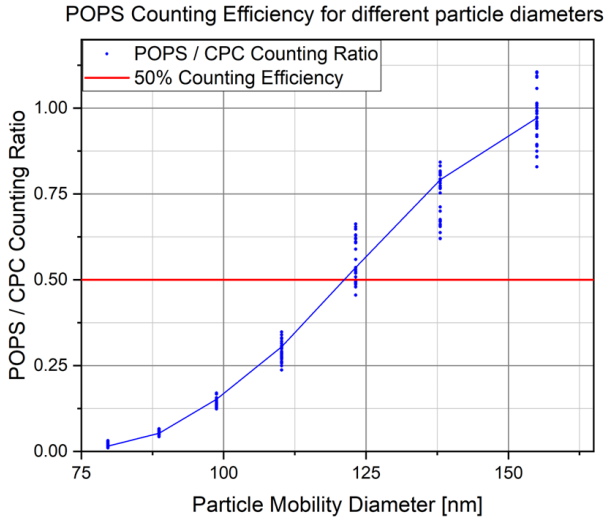
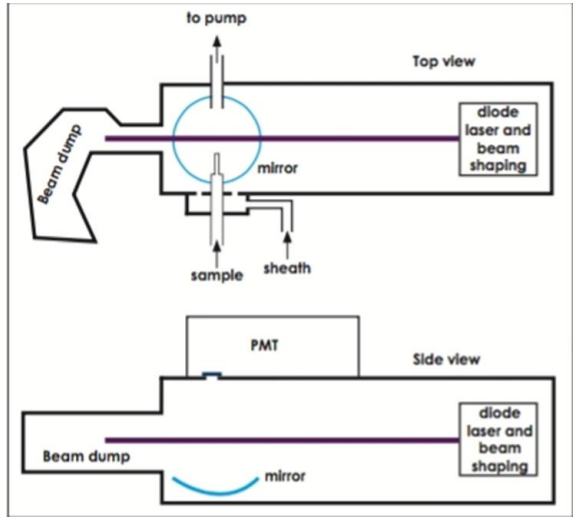
INTRODUCTION

Portable Optical Particle Spectrometer - POPS



EAC 2020 @ Fischer, Weber et al.

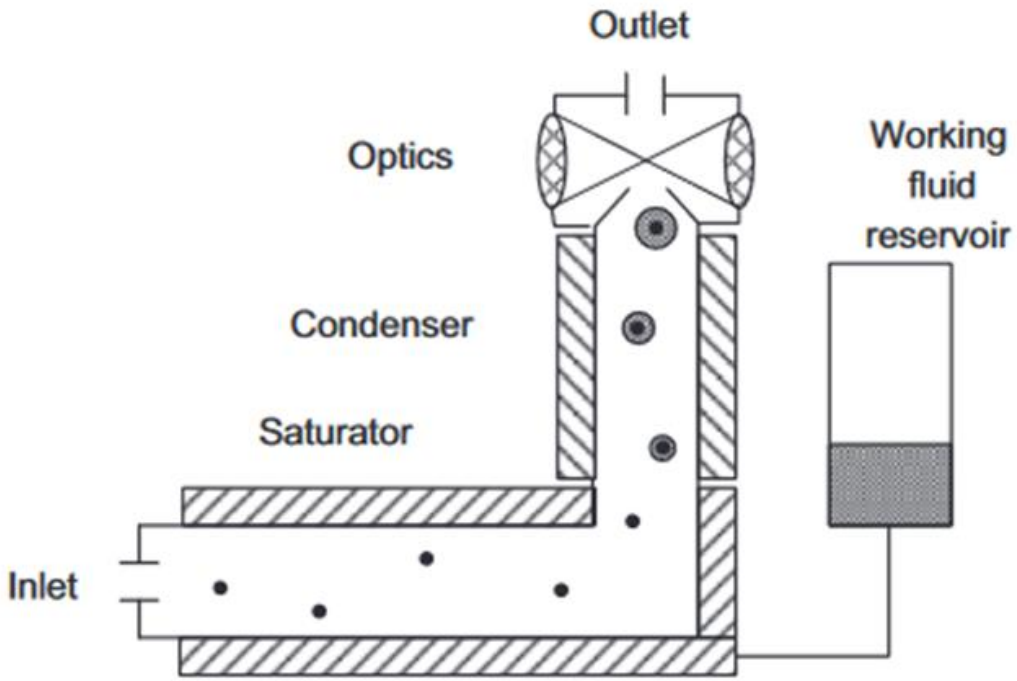




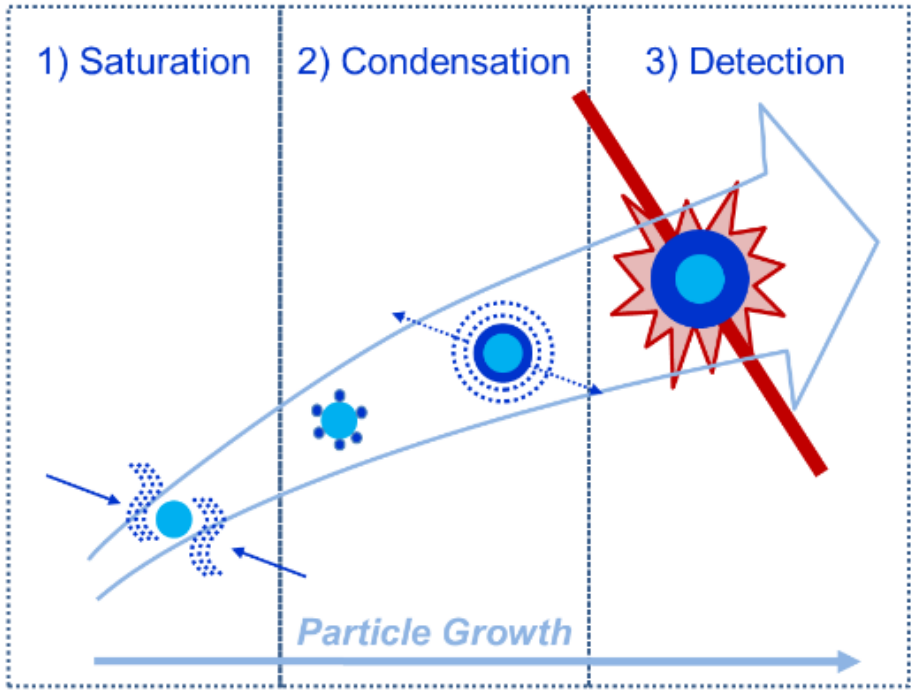
Gao, R. Set al. *Aerosol Science and Technology* **2016,** *50* (1)

INTRODUCTION

Condensation Particle Counter



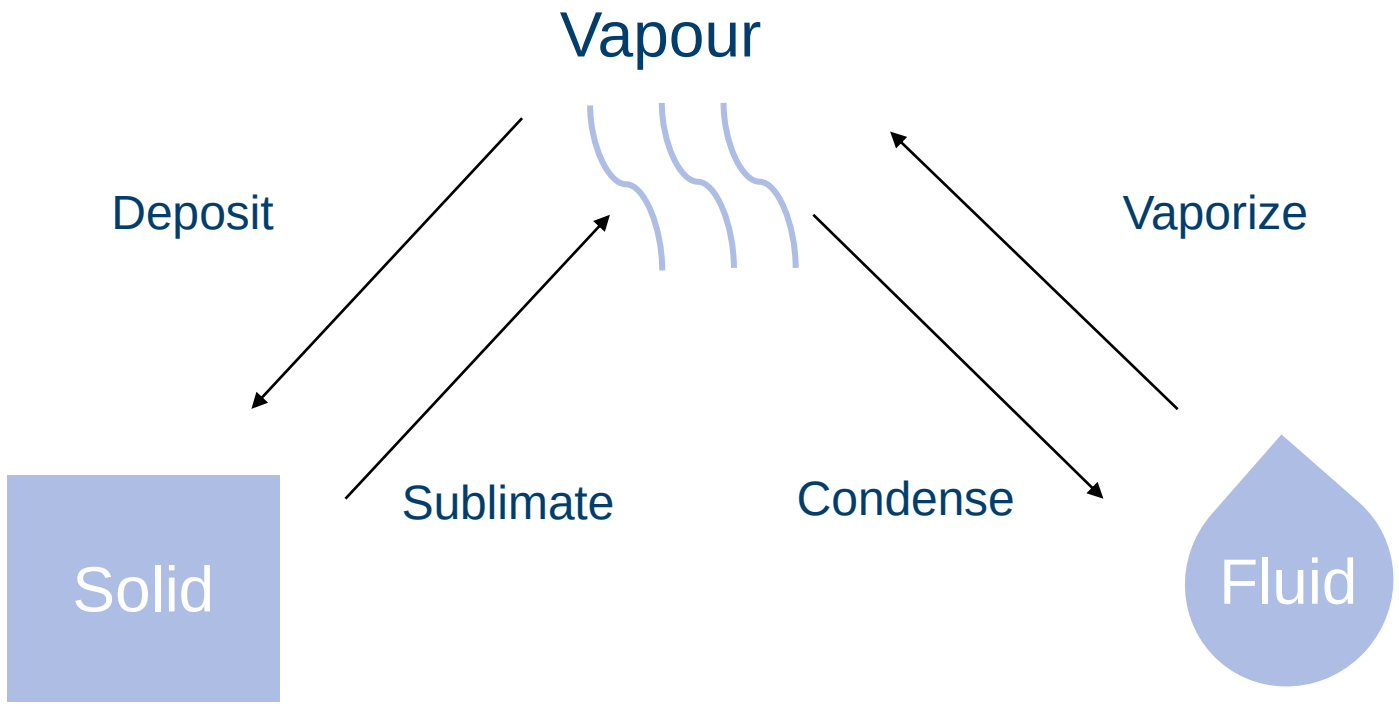
Giechaskiel, B et al. *Journal of Aerosol Science* **2014,** *67*, 48-86.



Bischof, O. F. *Dissertation, Verlag des Forschungszentrums Jülich, Energie & Umwelt*, **2022**, ISBN: 978-3-95806-629-8.

INTRODUCTION

States of Matter



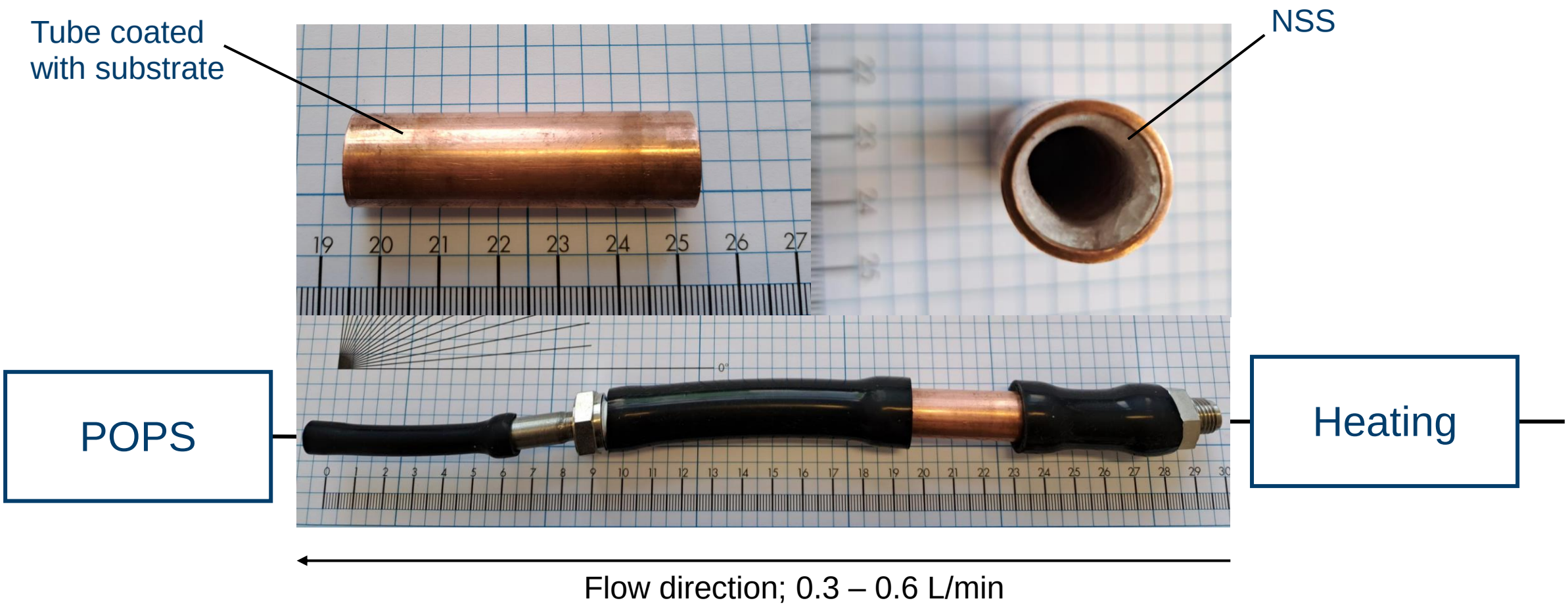
WORKING FLUIDS

Small Comparison

	Butanol	Water	New Solid Substance
GHS Symbols		None	None
Vapour Pressure [mbar]; 28°C	11.38	37.69	~ 0.25
Freezing Temperature	-89°C	0 °C	greater 100 °C

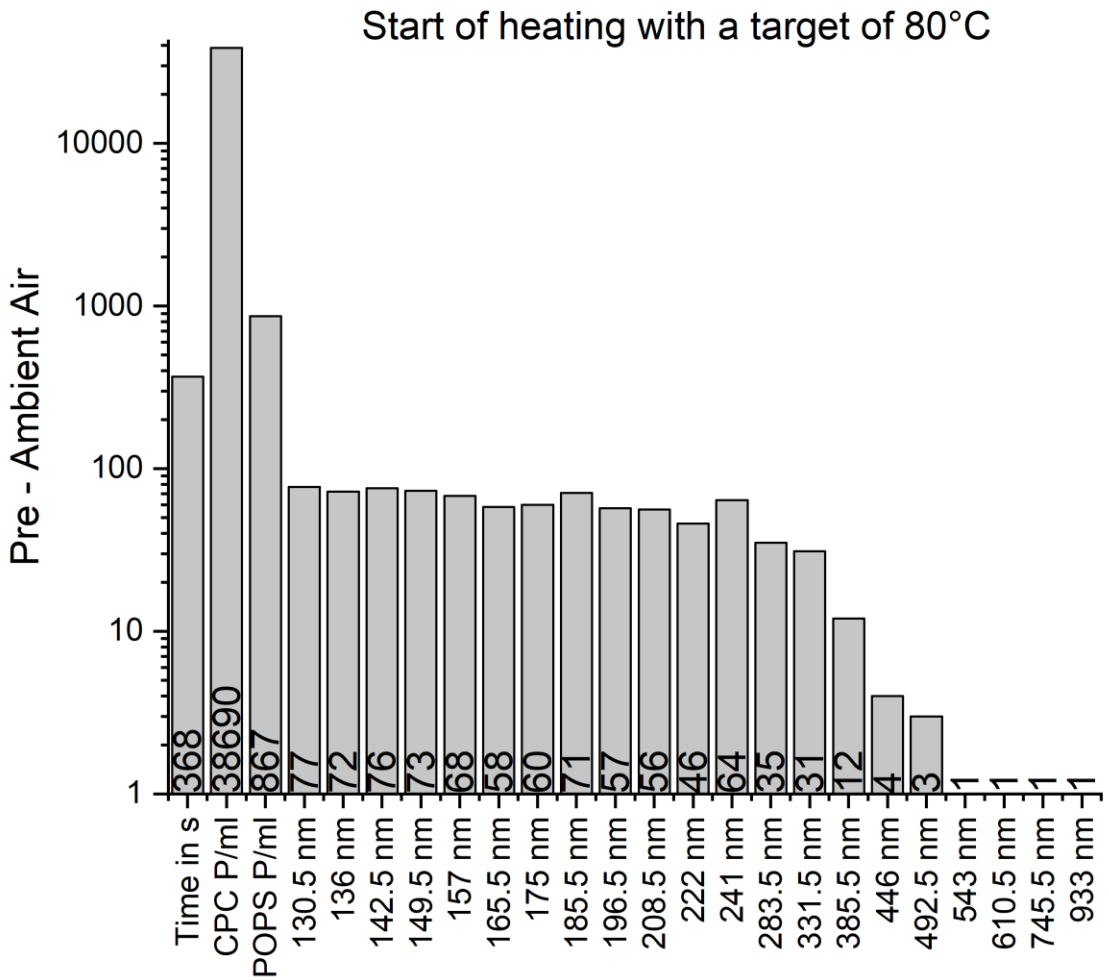
INITIAL EXPERIMENTS

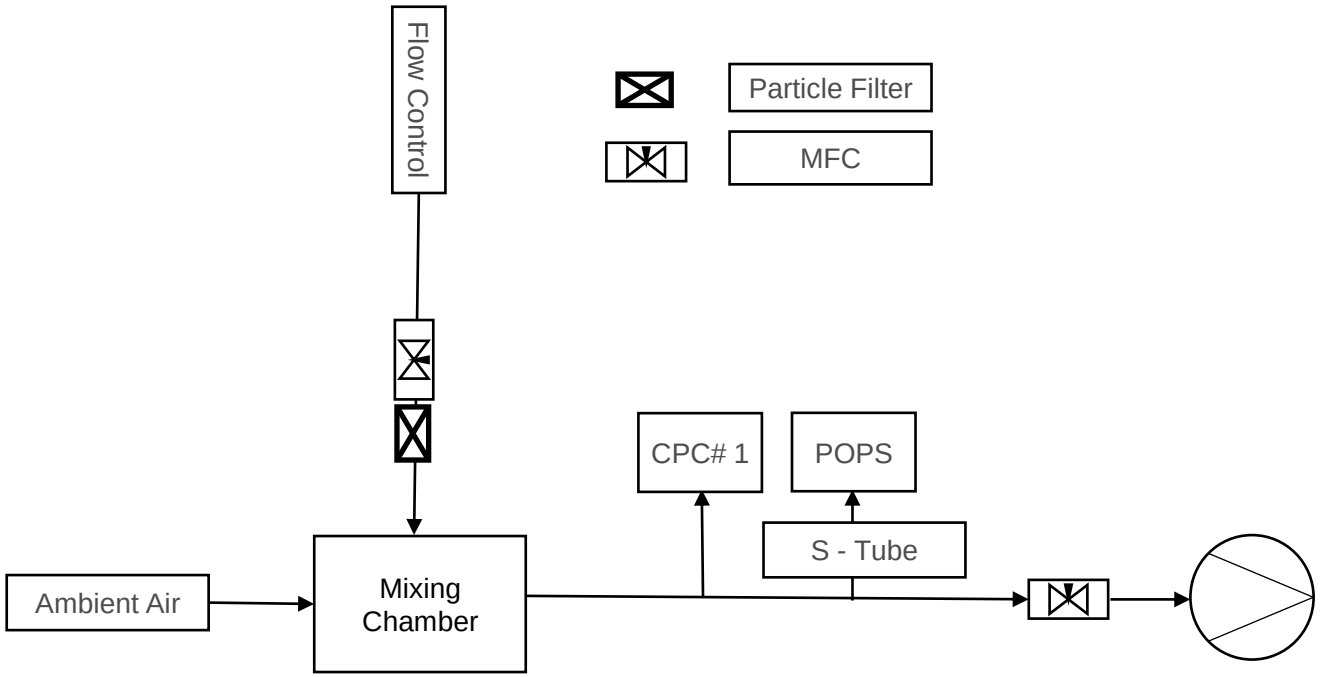
Introducing the Sublimation-tube



INITIAL EXPERIMENT – AMBIENT AEROSOLS

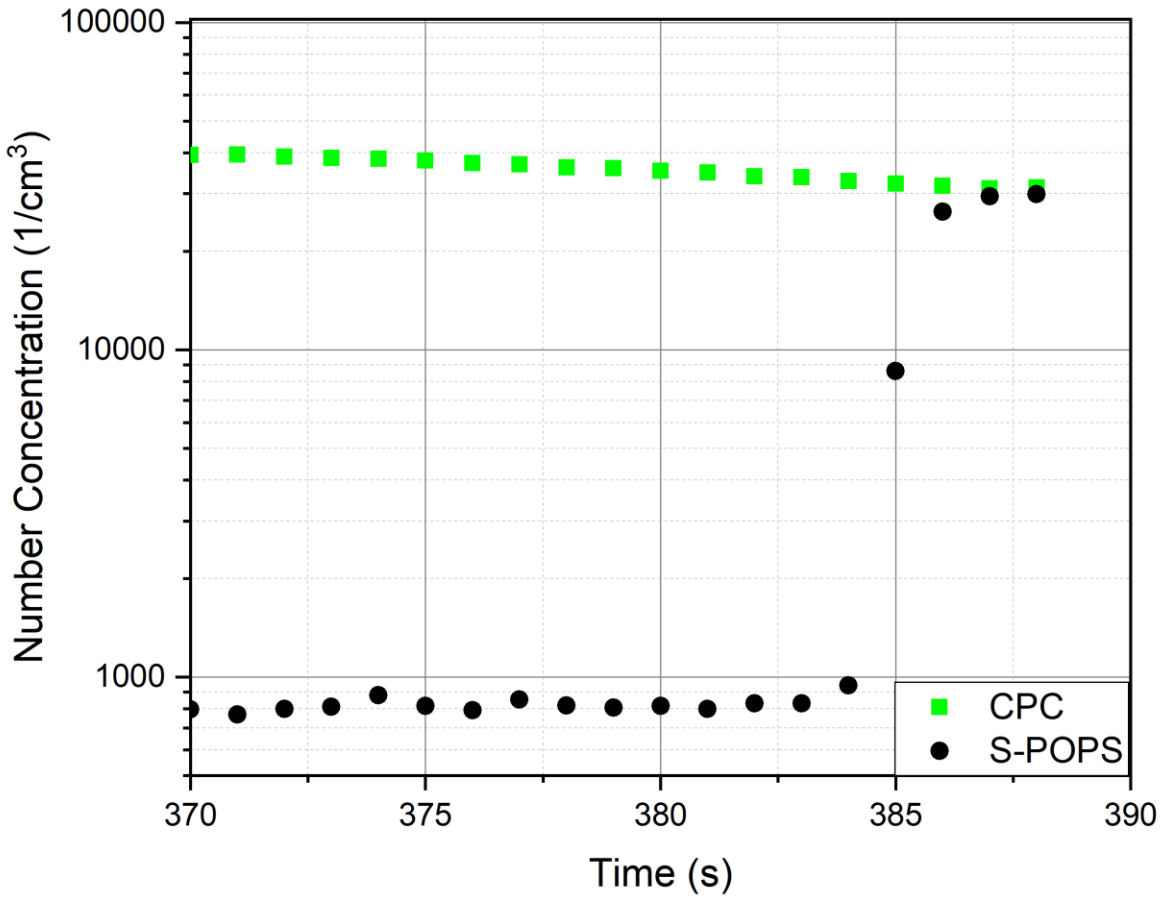
T = 0s





INITIAL EXPERIMENT

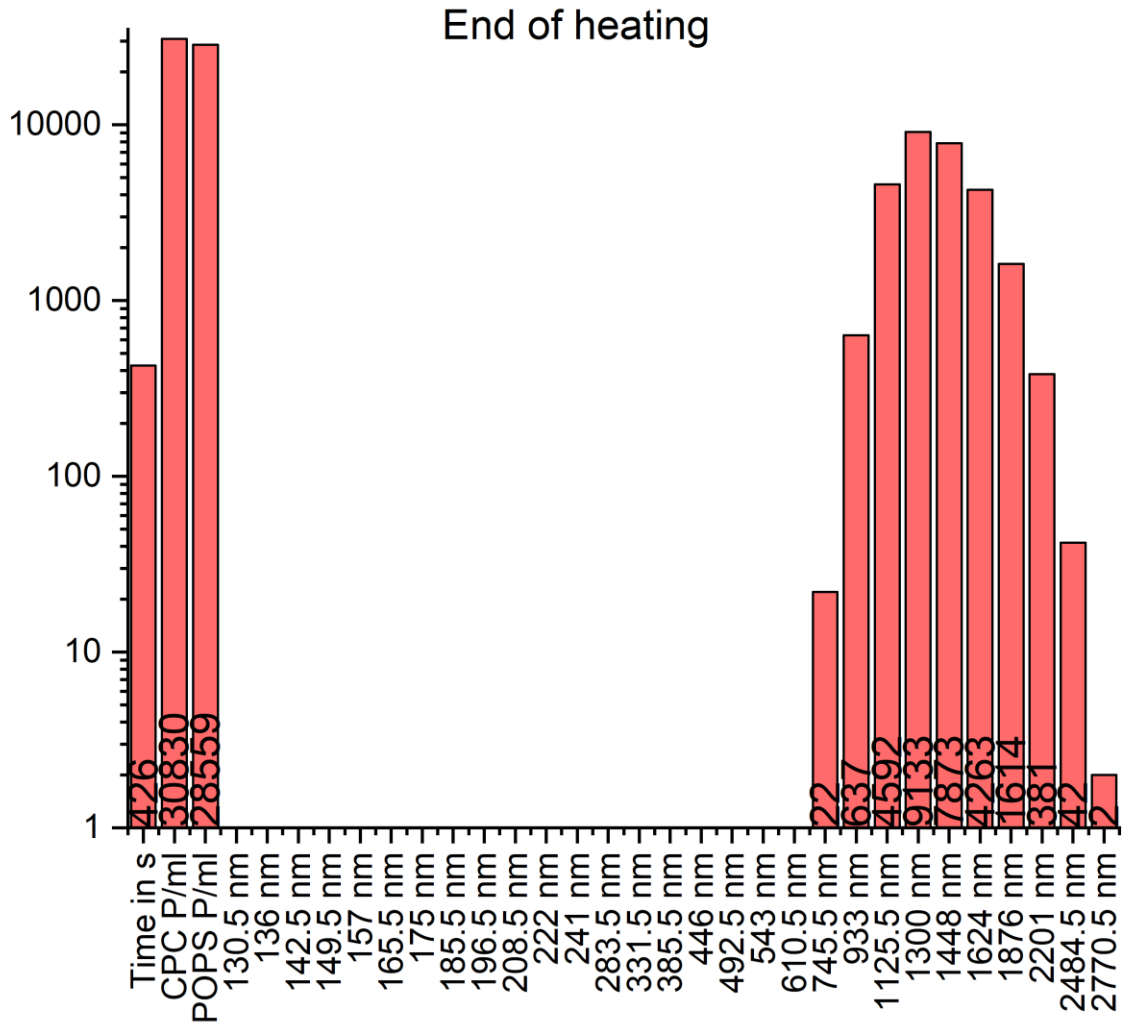
T = 0 – 15 s



The optical particle counter amplified with the sublimation tube reaches the counting rate of the condensation particle counter

INITIAL EXPERIMENT

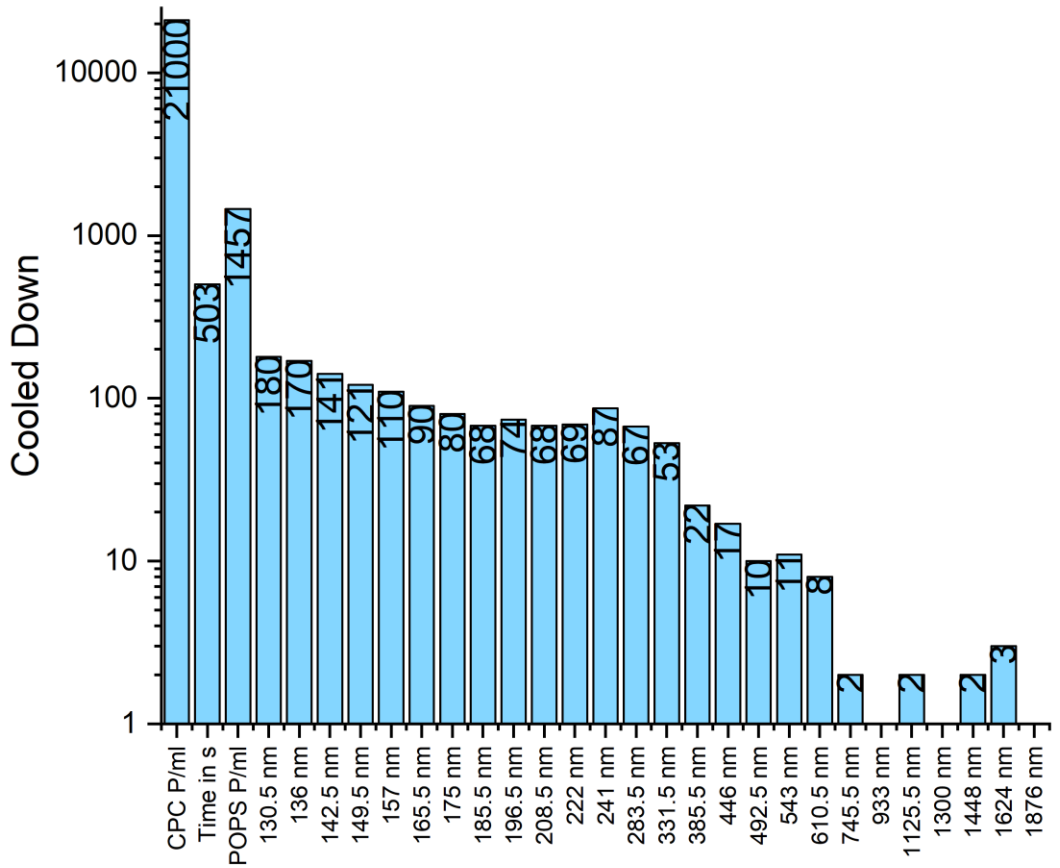
T = 15 - 50 s



The particles reach a final size of 1-2 µm after deposition of the substance. Final size is depended on flow rate and temperature

INITIAL EXPERIMENT

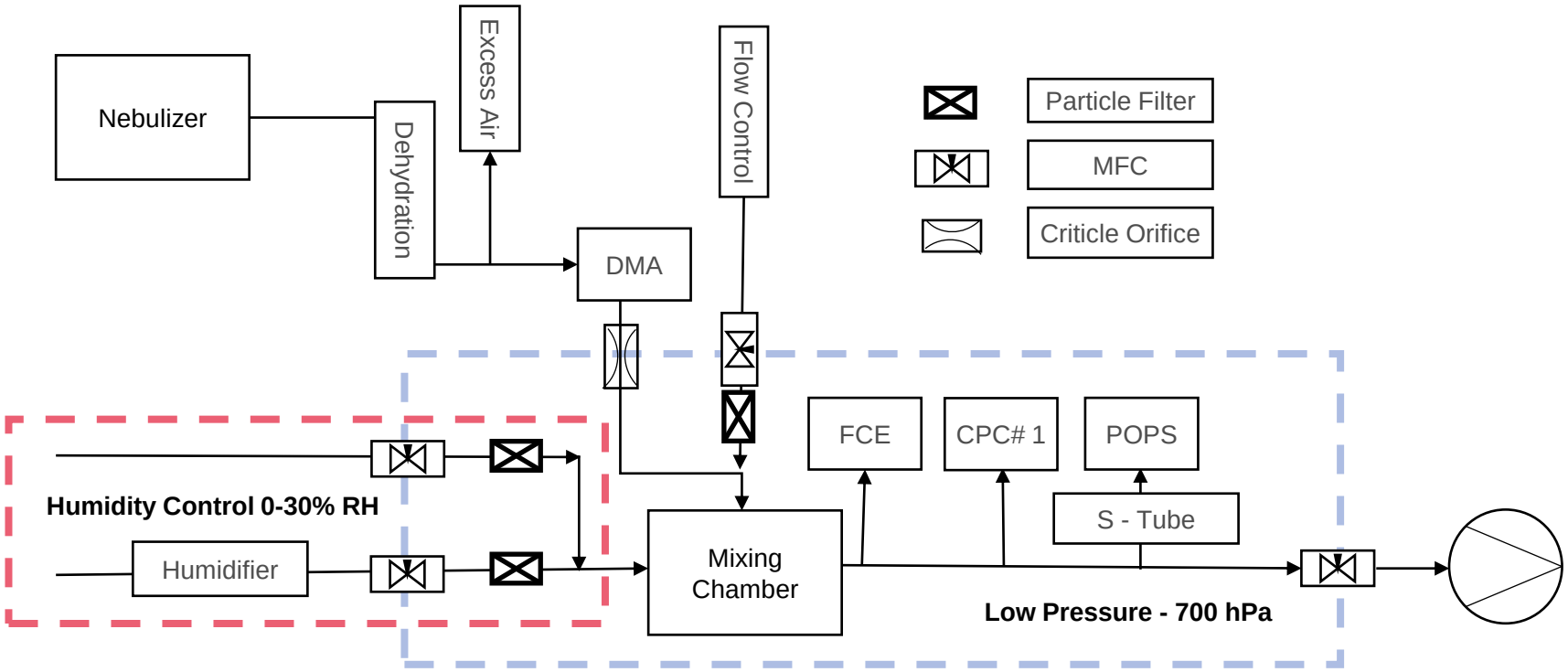
T = 120 s



After the end of active heating, the initial observed particle distribution is restored after two minutes

SECOND APPROACH

Aerosol Calibration set-up



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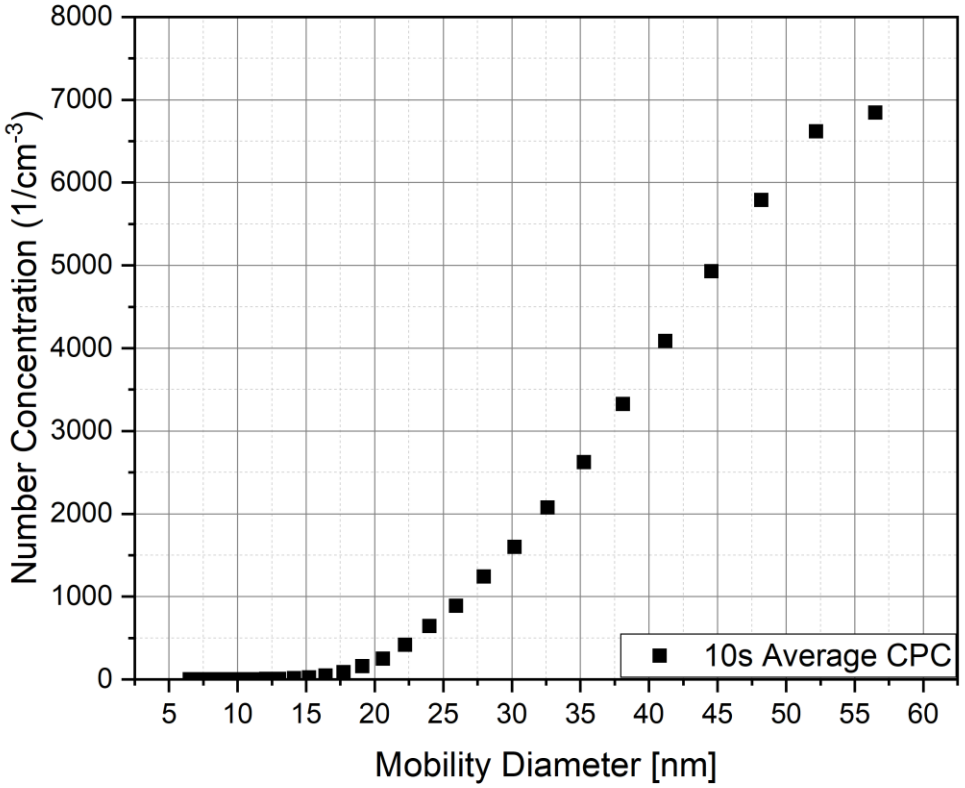
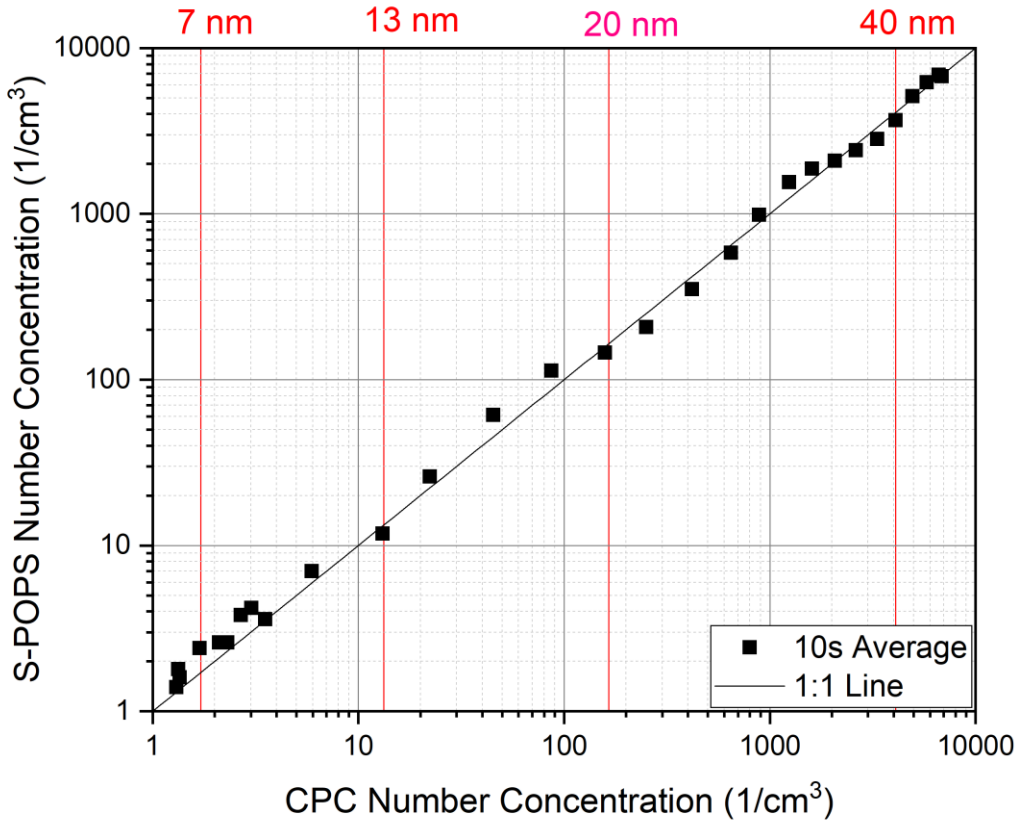
SECOND APPROACH

Sublimation Particle Counter compared against the Condensation Particle Counter





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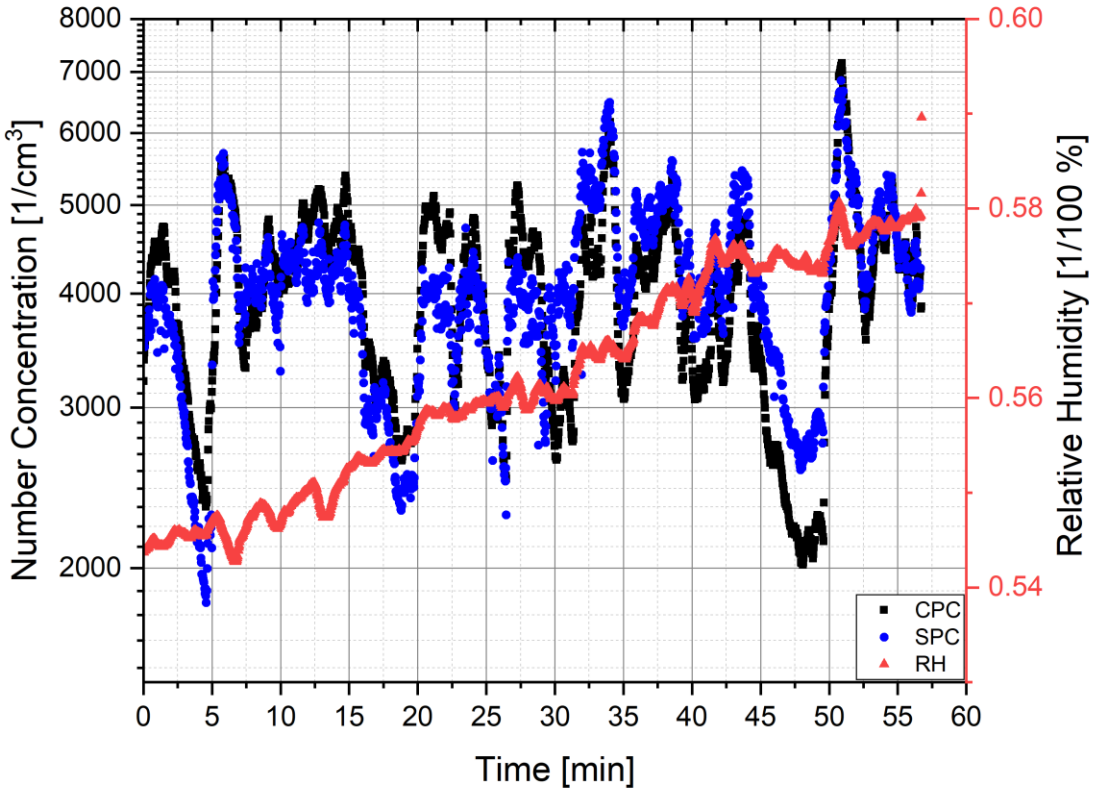
AMBIENT - STABILITY

Preliminary Data - Sublimation Particle Counter compared against the Condensation Particle Counter



Differences arise from: cut-off efficiencies, flow path (15 cm to 1 meter) and flow rate (0.6 to 2 l/min)

SUMMARY AND OUTLOOK

- Initial concept of what we named “Sublimation Particle Counter” SPC
- Particle counting concept without liquids or cooling / condensor
- Switch from total concentration to size distribution within a minute
- Promising results for ambient and low-pressure measurements
- Appropriate for application in critical working areas

Next Steps:

- ❑ Optimisations for flow, temperatures and tube dimensions
- ❑ Improved Design for operation down to 200 hPa

THANK YOU FOR LISTENING

QUESTIONS?

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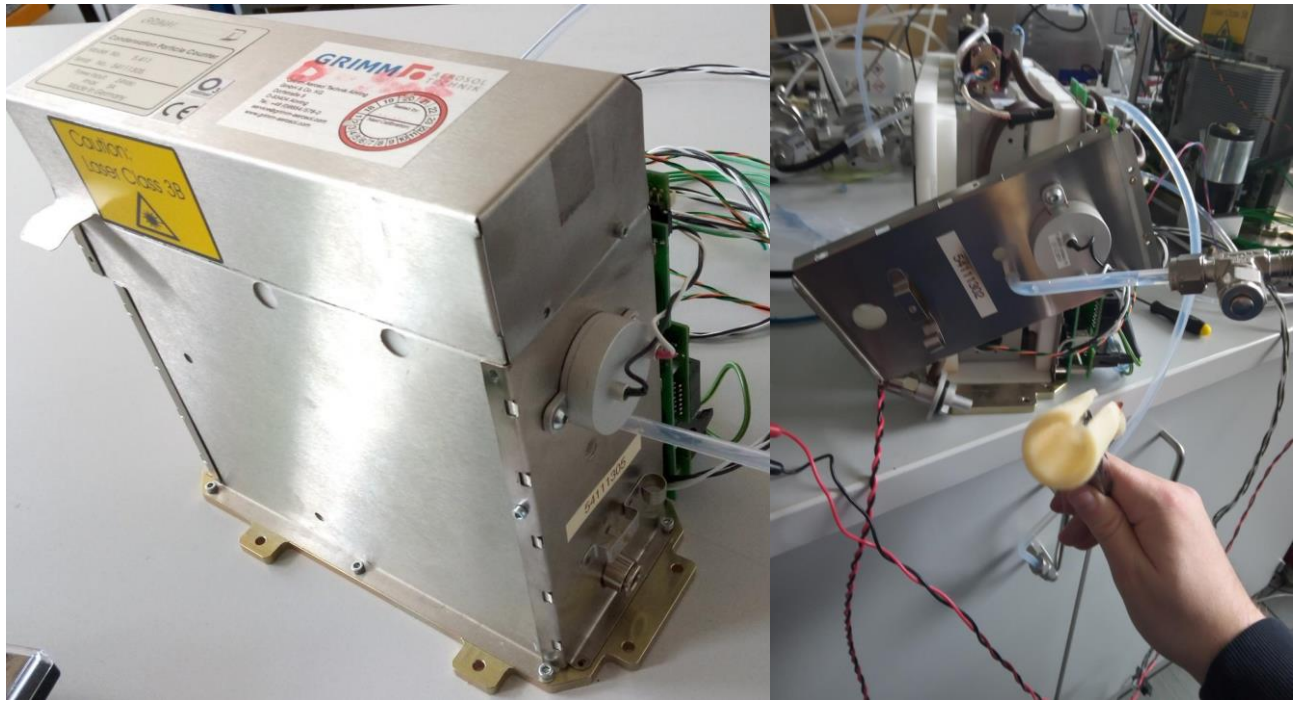
INITIAL EXPERIMENTS

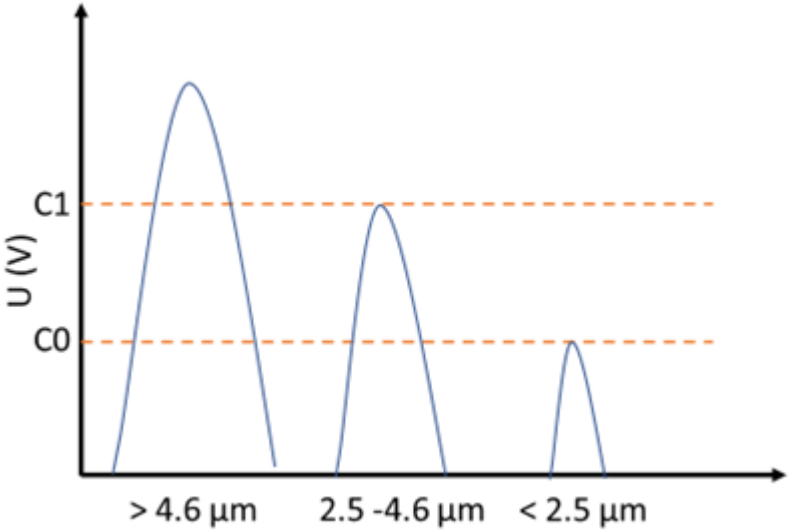
Replacement for a Wick

- 5411 Sky-CPC

GRIMM Aerosol Technik, Ainring, Germany



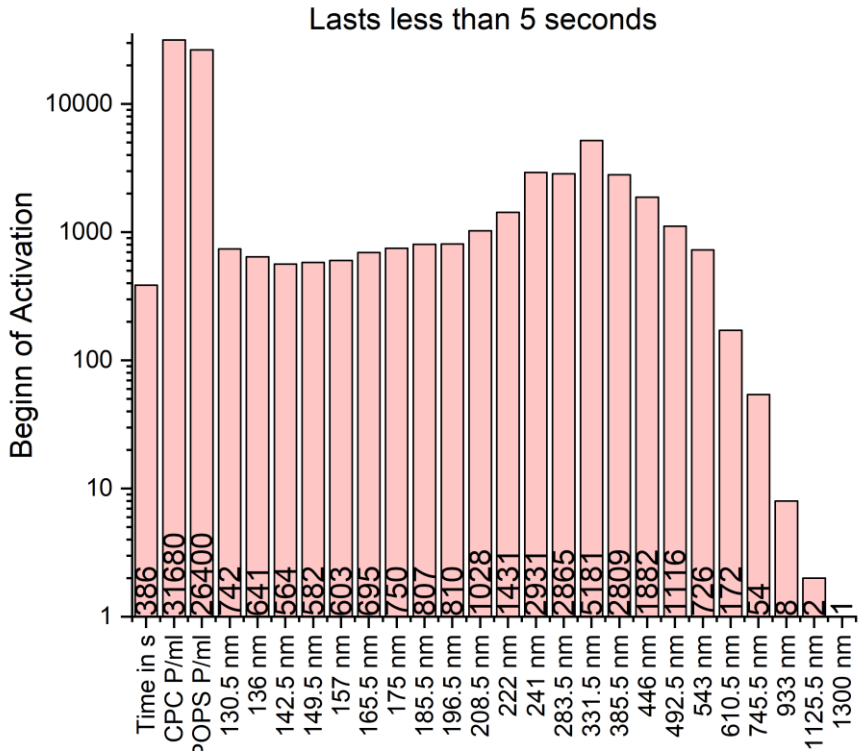
First Try with a CPC



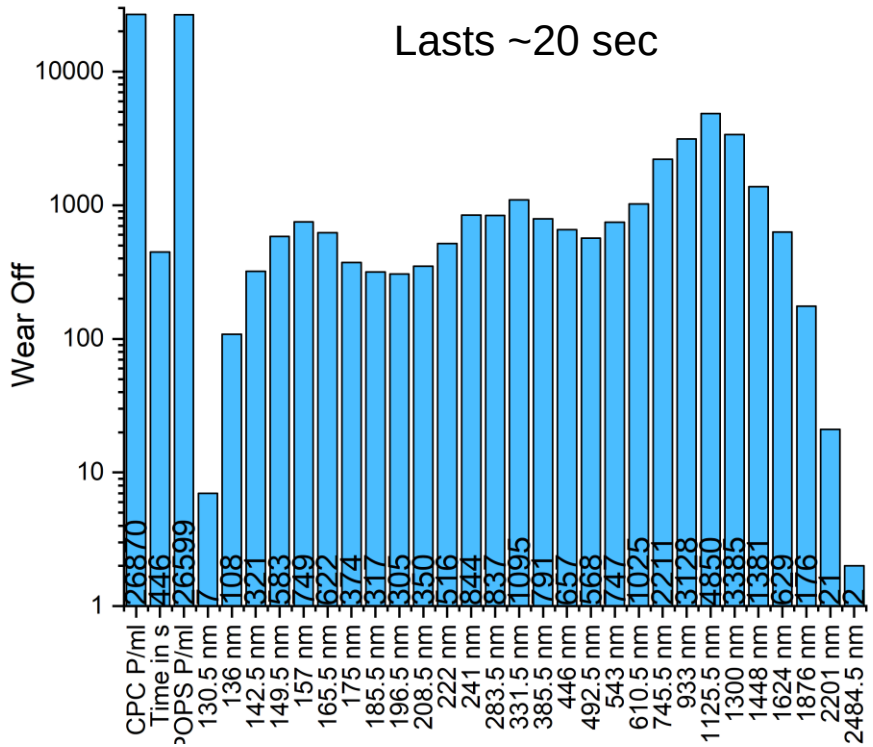
To small for efficient counting

BACKUP SLIDES

T= 15s



T= 76s



BACKUP SLIDES