

# Efficiency of Aftertreatment Devices of the Transantiago Bus Retrofit Project

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9th ETH Conference on Combustion Generated Nanoparticles

ETH Zurich, August 15-17, 2005

# Transantiago Filter Efficiency Measurement

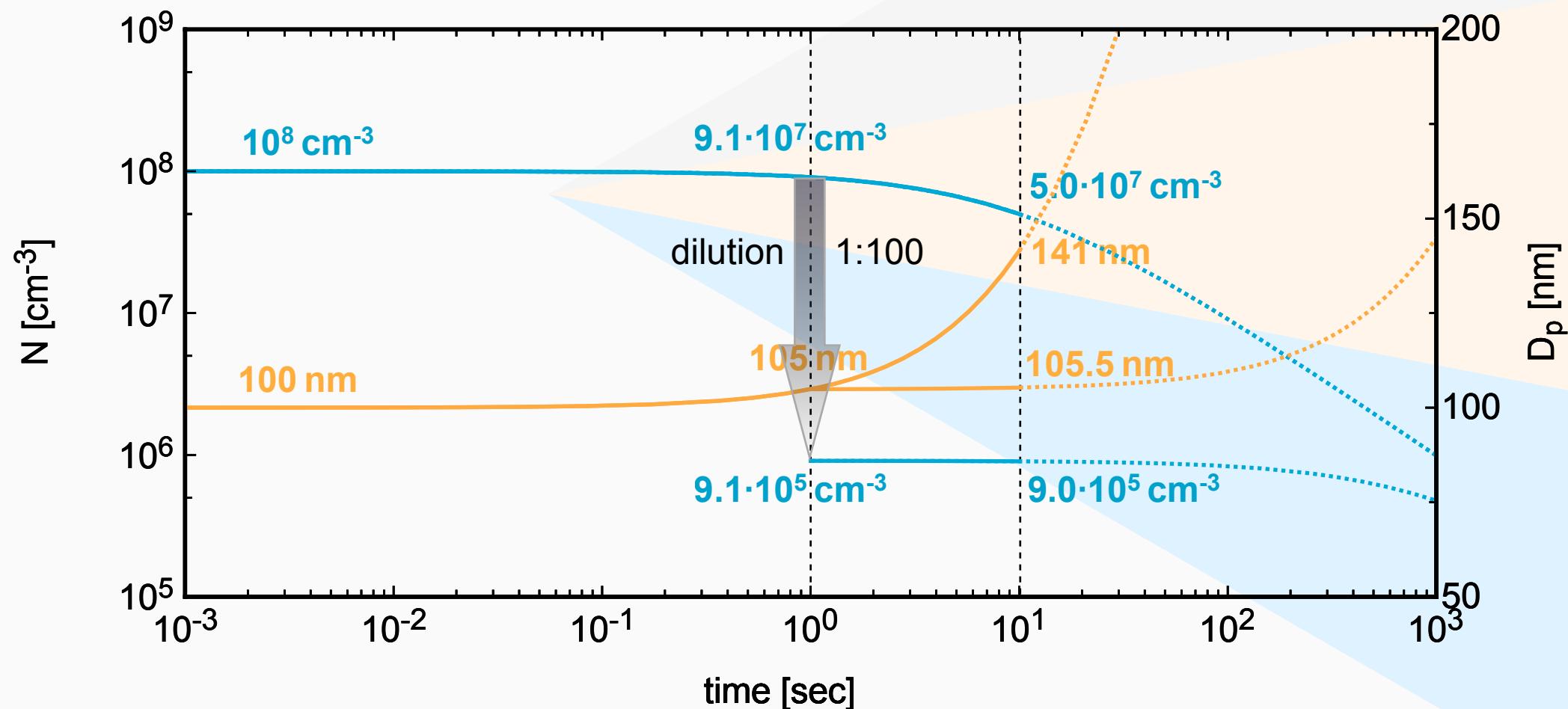
- Dilution and Conditioning
- Particle Characterisation
- Application: DPF Characterisation

# Coagulation:

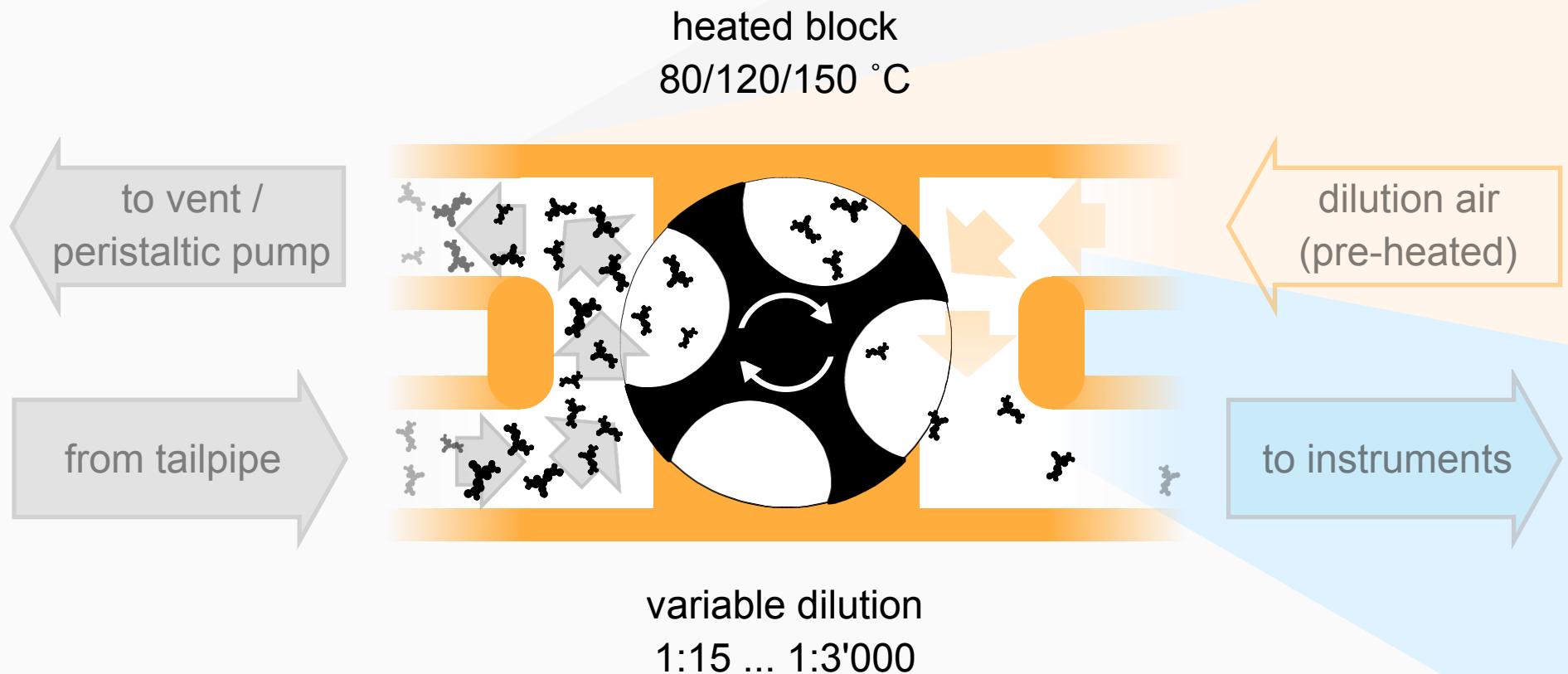
## Number Decreases, Size Increases with Time

$$N(t) = N_0 / (1 + N_0 K_{\text{tot}} t)$$

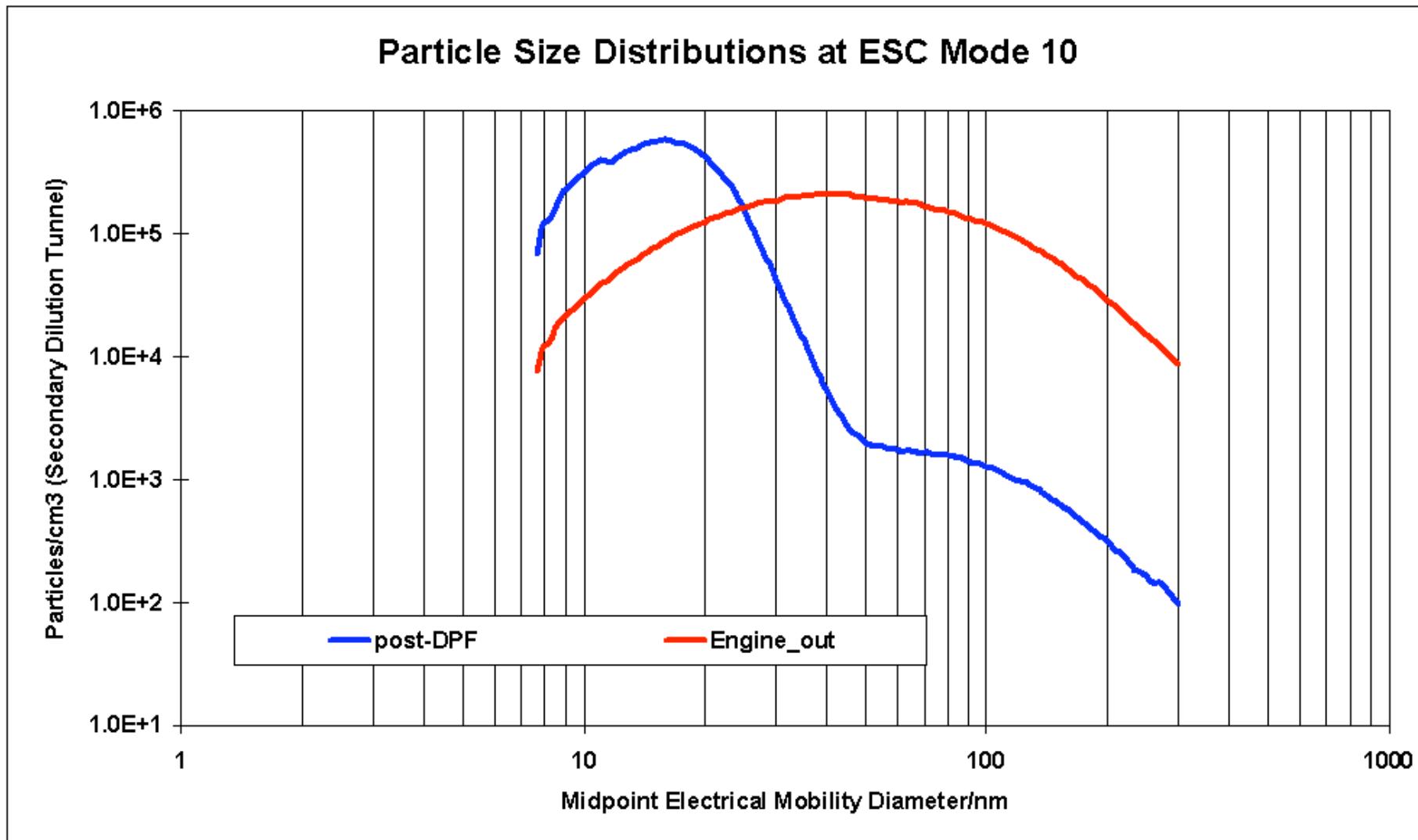
$$D_p(t) = D_{p,0} * (1 + N_0 K_{\text{tot}} t)^{1/\text{df}}$$



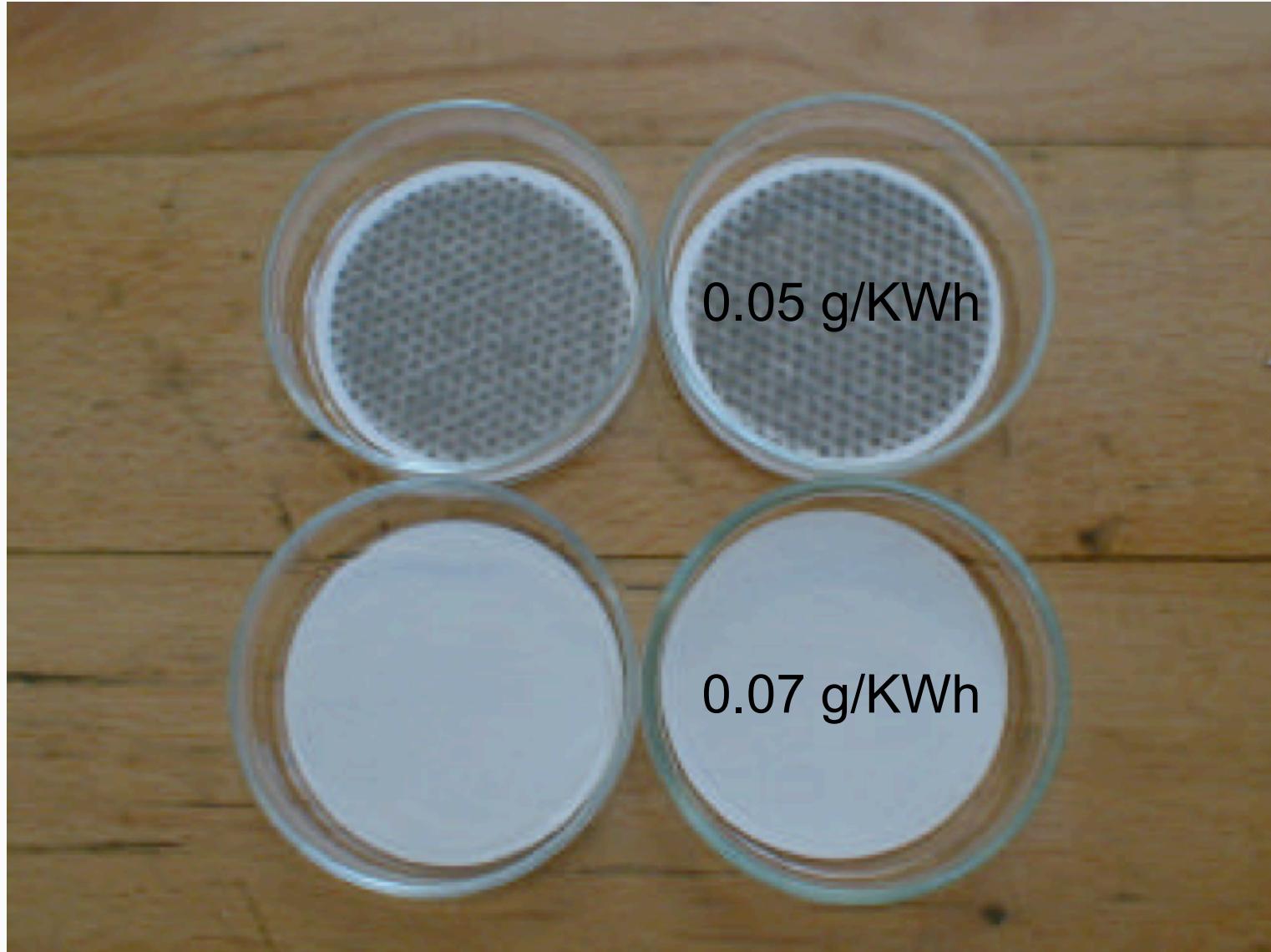
# Rotating Disc Diluter Revolving Door for Aerosol Particles



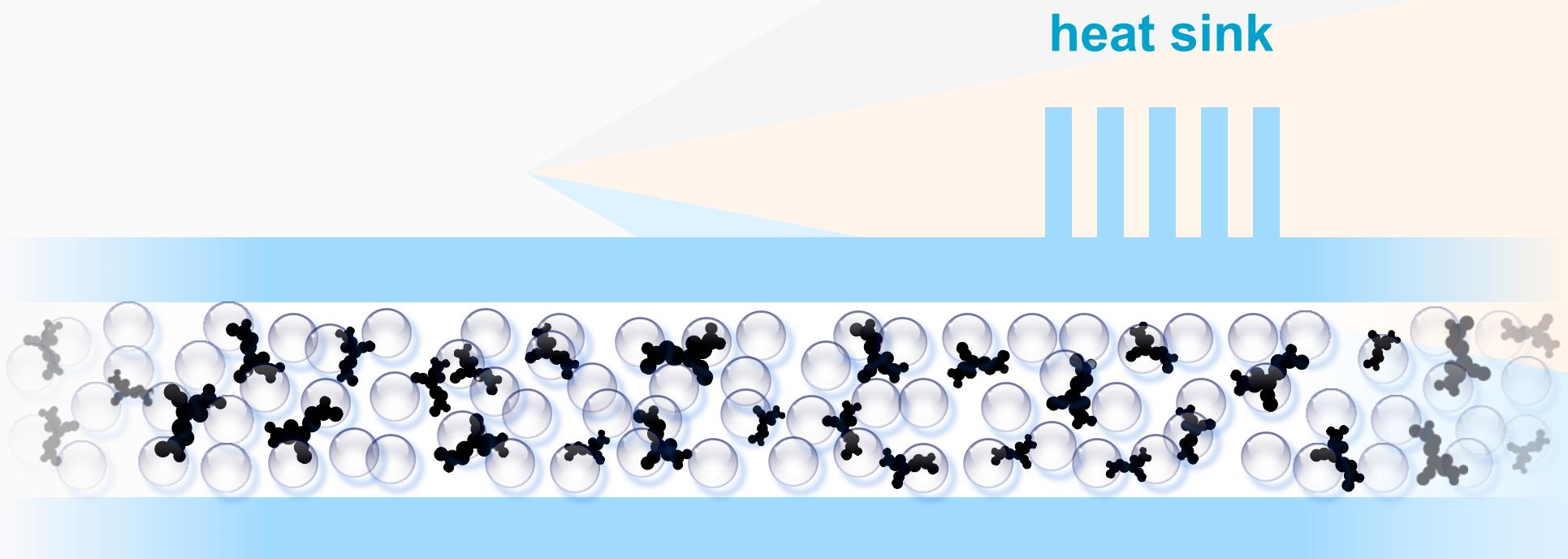
# Nucleation after DPF



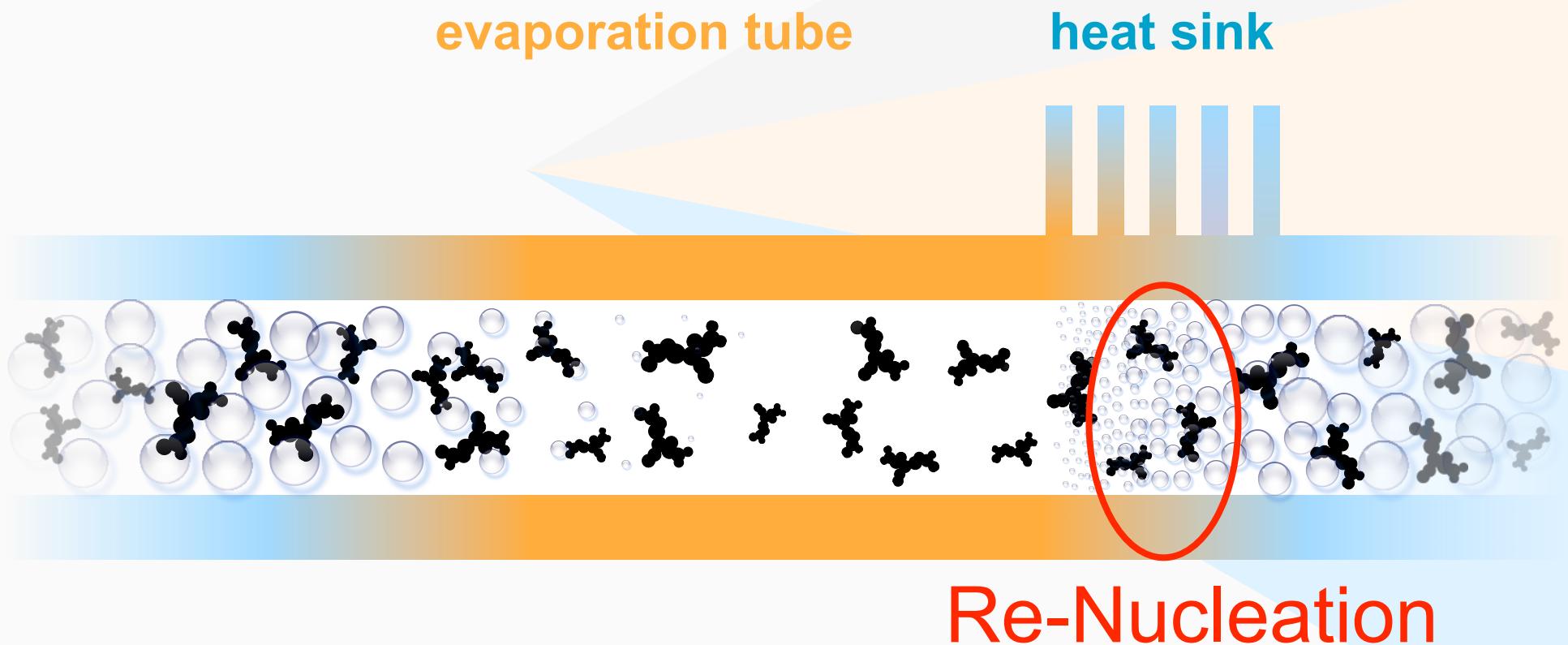
# Gravimetric Samples Before/After Trap



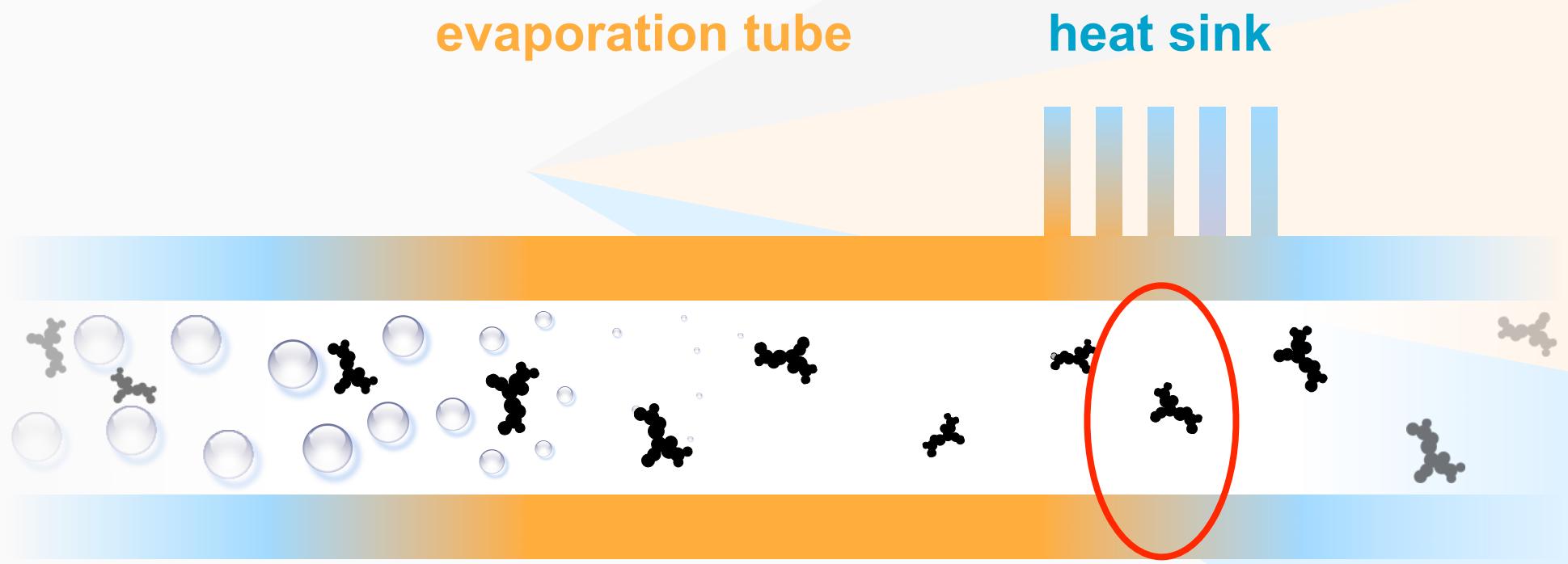
# Flow of Droplets Through Cold Tube



# Evaporation of Volatiles in Heated Section

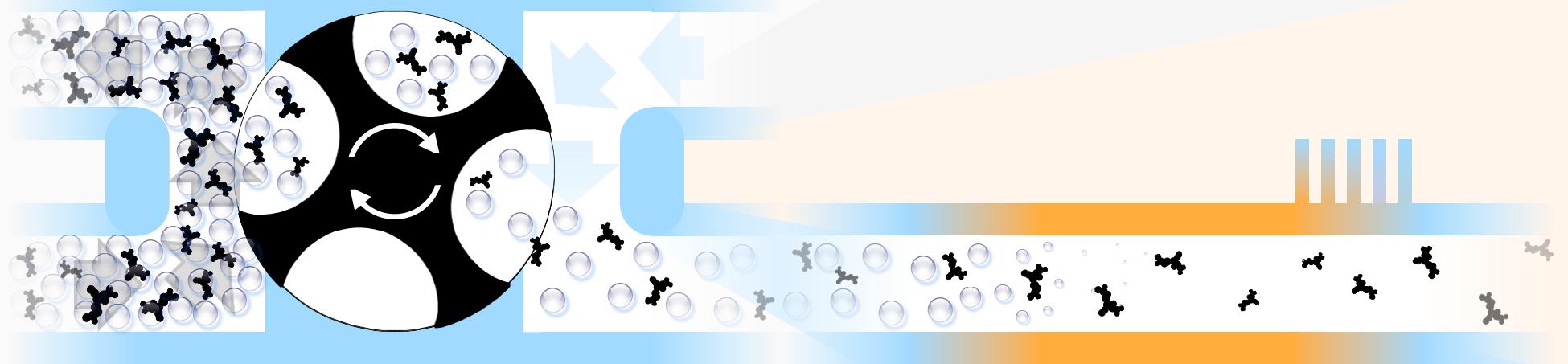


# No Re-Nucleation if Droplet Concentration is Low



volatile material  
remains in gas phase

# Combine Diluter+Heater to Remove Droplets from Aerosol Sample



exhaust with  
nano-droplets



sample with nano-  
droplets

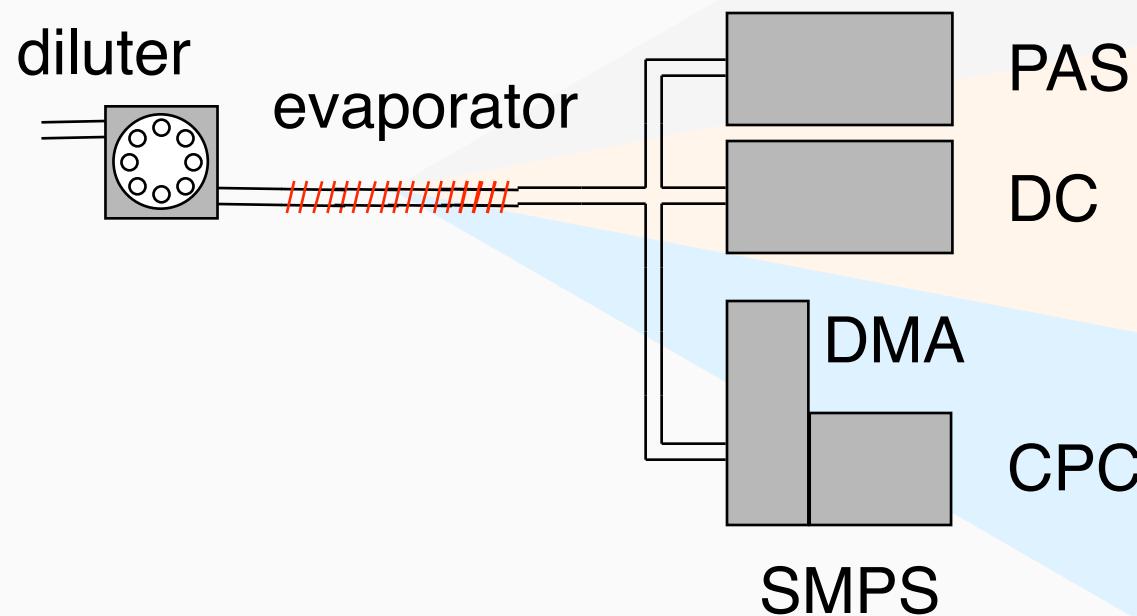


only solid  
particles left

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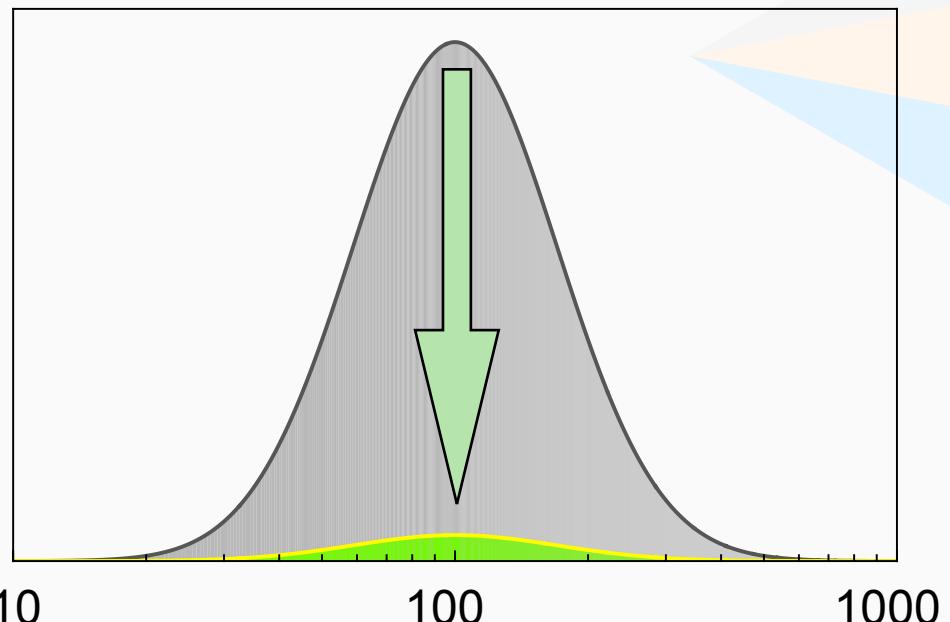
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# DPF Testing Equipment - Set-Up

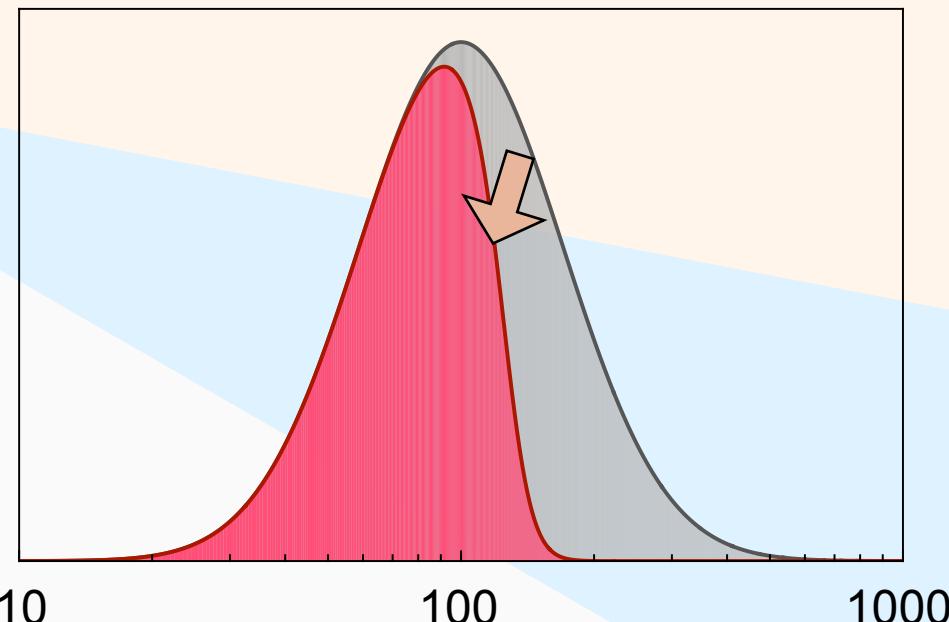


# Good Particle Trap $\Leftrightarrow$ Appropriate Methods

Mass: -95%  
Number: -95%

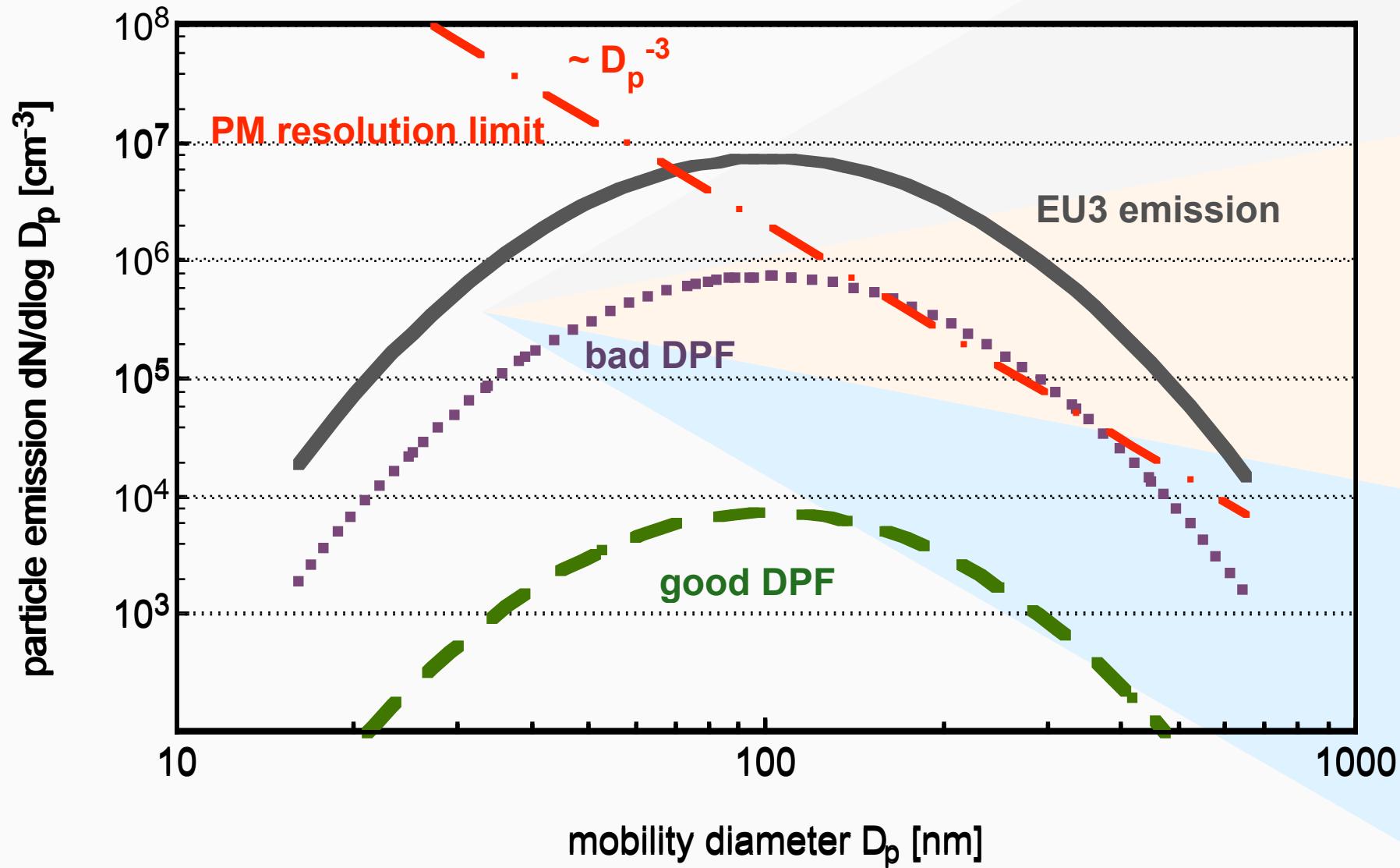


Mass: -95%  
Number: -55%



mobility diameter [nm]

# Resolution Limit Applied to DPF

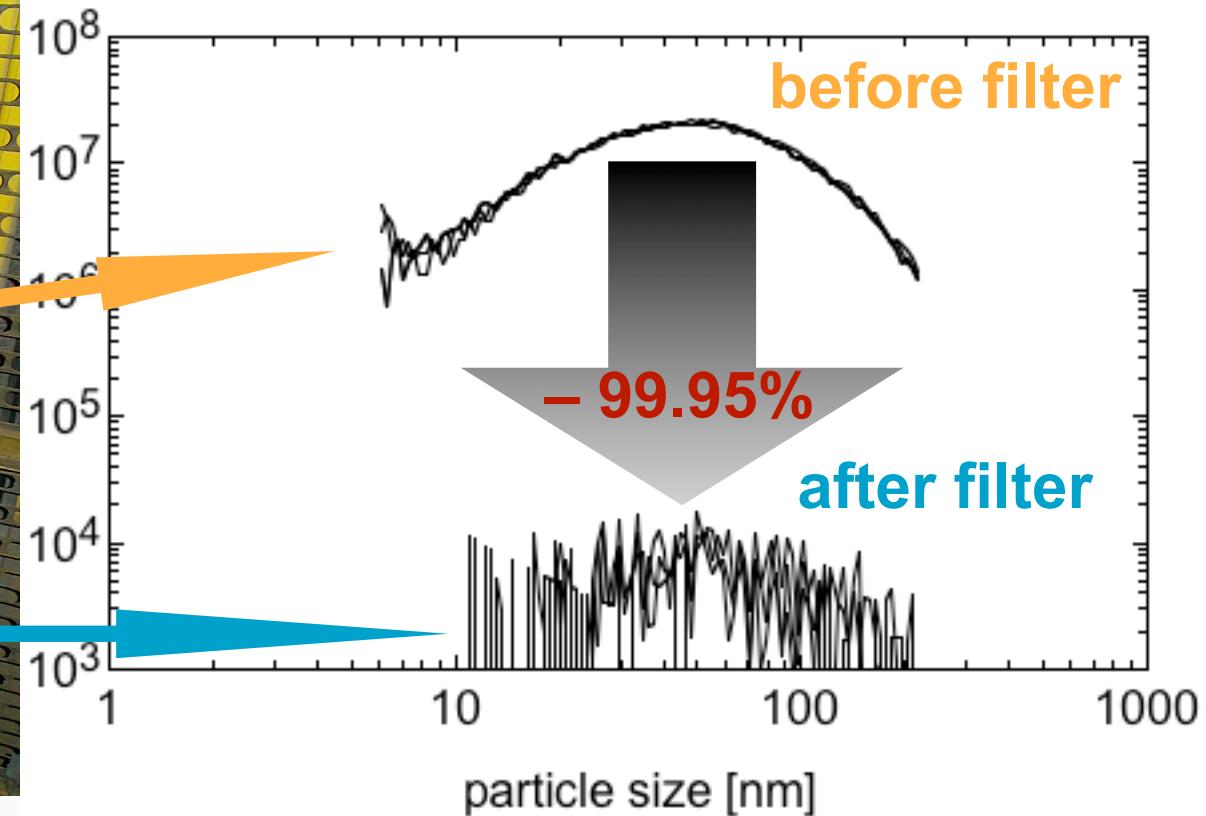
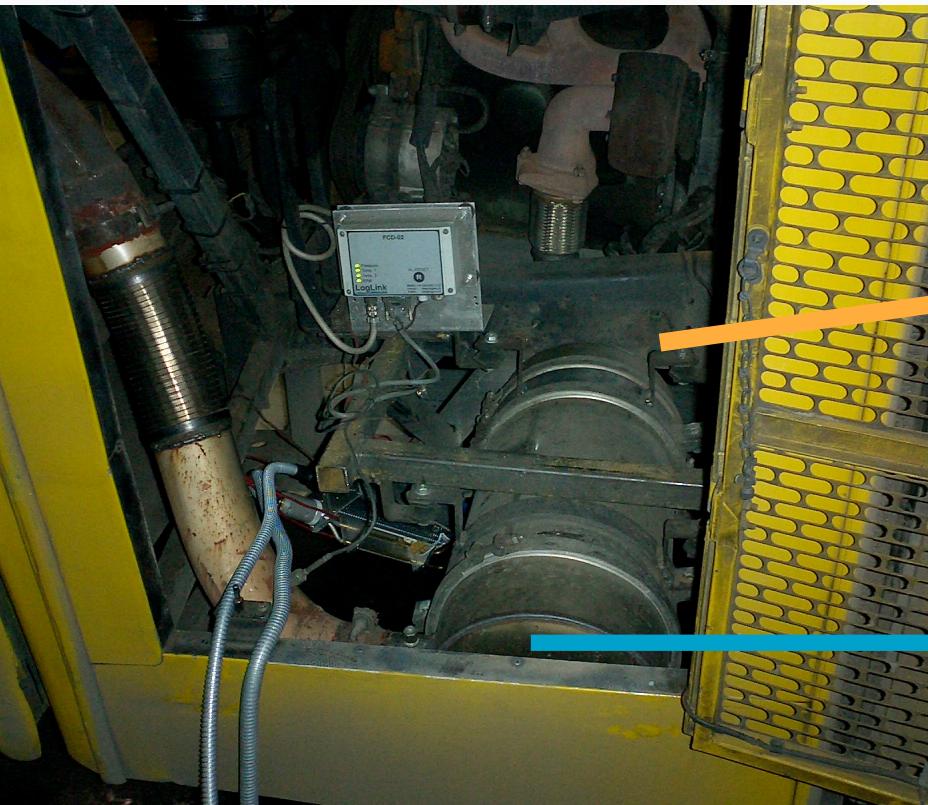


# Transantiago Filter Efficiency Measurement

- Dilution and Conditioning
- Particle Characterisation
- Application: DPF Characterisation



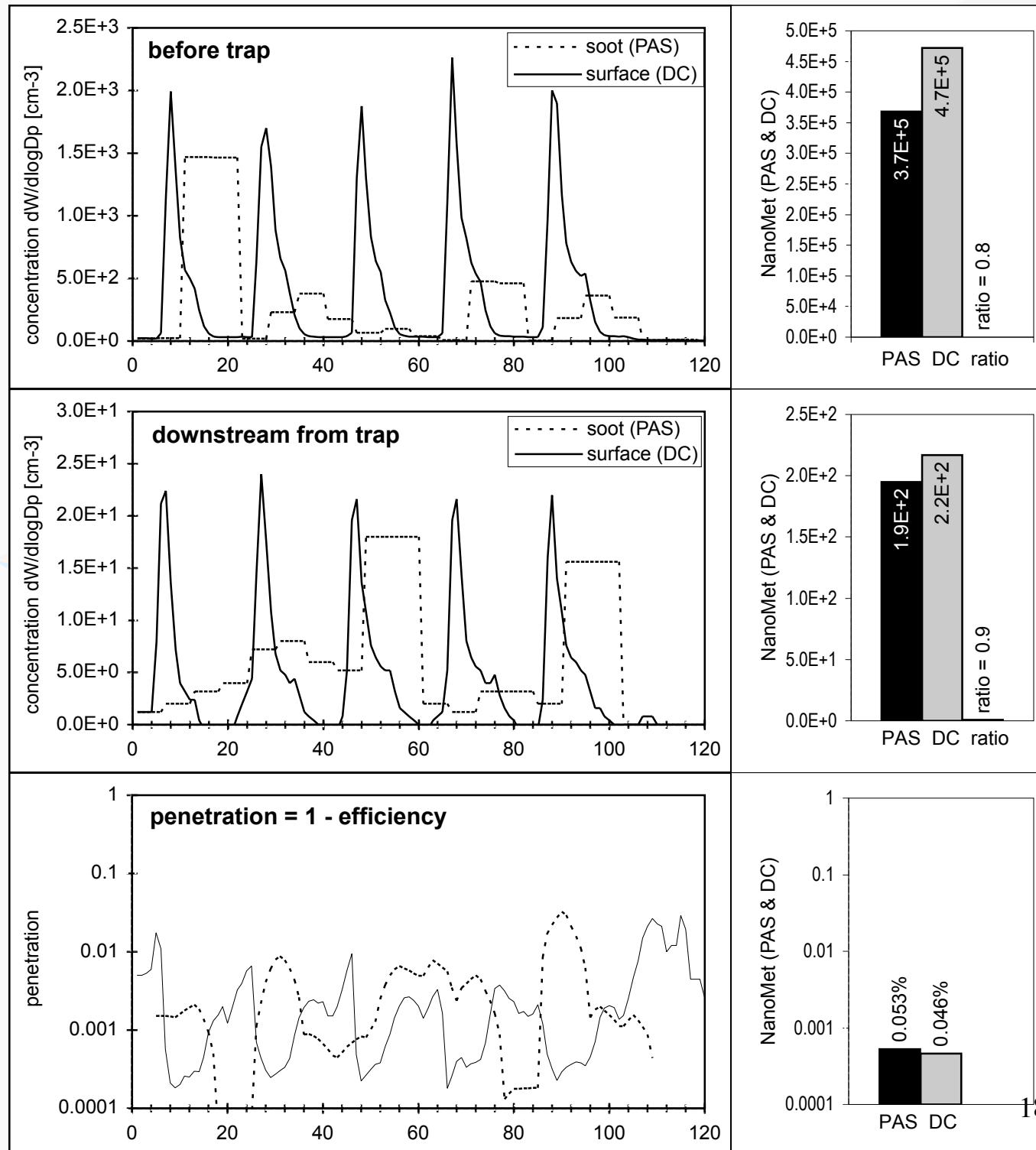
# Filter Efficiency Measurement



## DPF Efficiency -

Snap  
Acceleration

=> 99.95%



# Filtration Efficiency Transantiago

<b>Aftertreatment</b>		<b>Licence plate</b>	<b>Filtration</b>
Adastra	DPF VERT	TF 52 04	99.909 %
Airmeex	DPF VERT	RR 15 47	99.377%
Engelhard	DPF VERT	NR 43 62	98.249%
Engelhard	DPF VERT	TT 21 91	99.777%
HJS	DPF VERT	TE 37 76	99.954%
HJS	DPF VERT	TJ 92 89	98.588%
HJS	DPF VERT	VF 37 42	99.975%
Huss	DPF VERT	LD 85 23	99.998%
Huss	DPF VERT	SZ 58 75	99.994%
Sudchemie	DOC	ZU 25 82	4.402%
Bekaert *	DPF	UK 83 19	39.942%
ETG *	DPF	UY 52 02	34.143%

# Summary

- Controlled sampling is essential for particle measurement
  - separate solid particles from volatile nano-droplets
  - freeze coagulation by early high dilution
- High-quality DPF require appropriate method
  - simple mass measurement leads to incomplete/wrong conclusions
  - size resolved number measurement provides valuable information
  - fast measurement is possible at limited loss of information
- Good DPF reduce particles of any size by >99%
  - lower reduction rates should not be accepted by the user