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Exhaust gas dispersion effects under controlled environmental conditions

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***Exhaust gas dispersion effects* under controlled environmental conditions**

INTRODUCTION

I Dilution with a CVS tunnel

II Outdoor tunnel measurements

1) Small scale

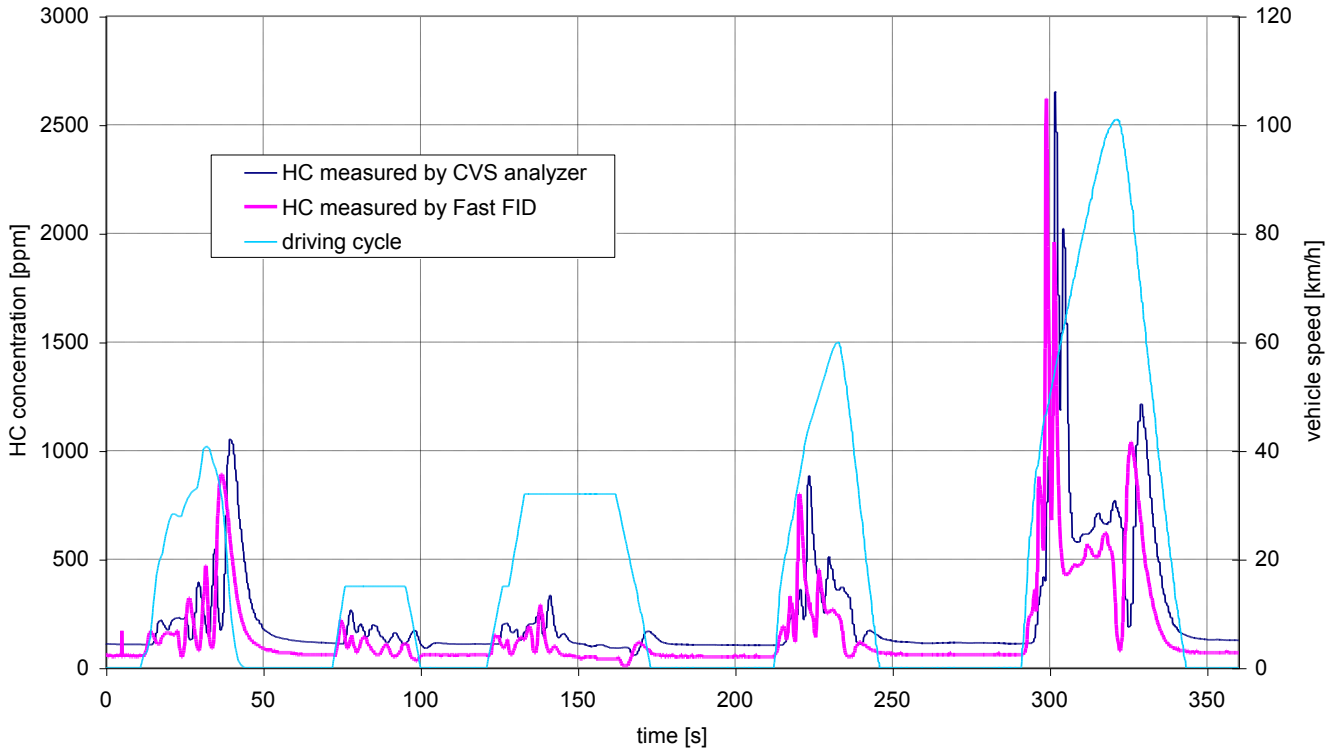
2) Large scale

III Coagulation Experiments

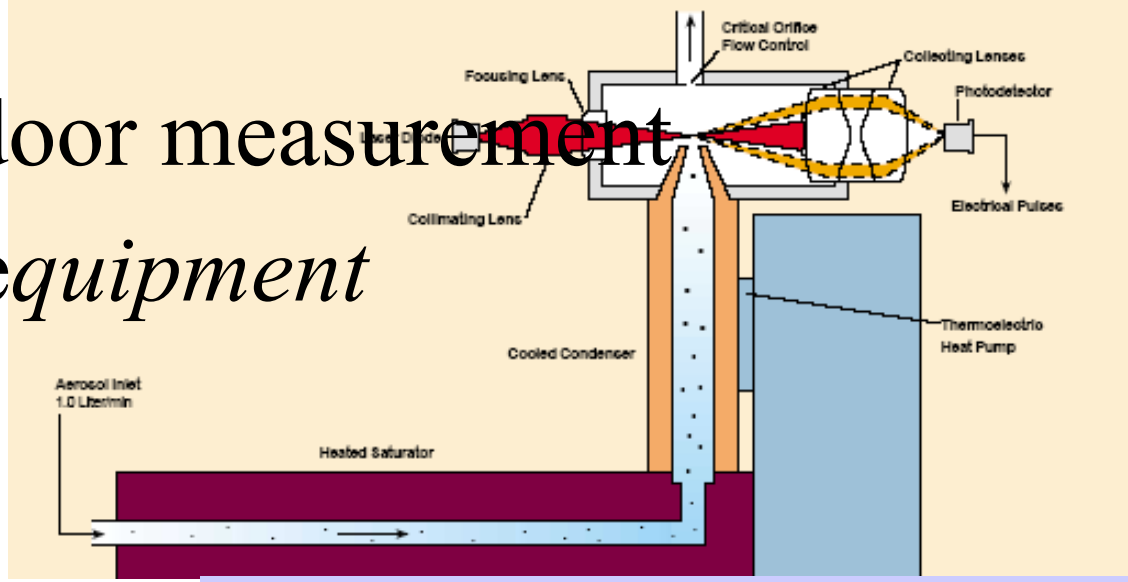
IV Density calculation approach for diluted particles

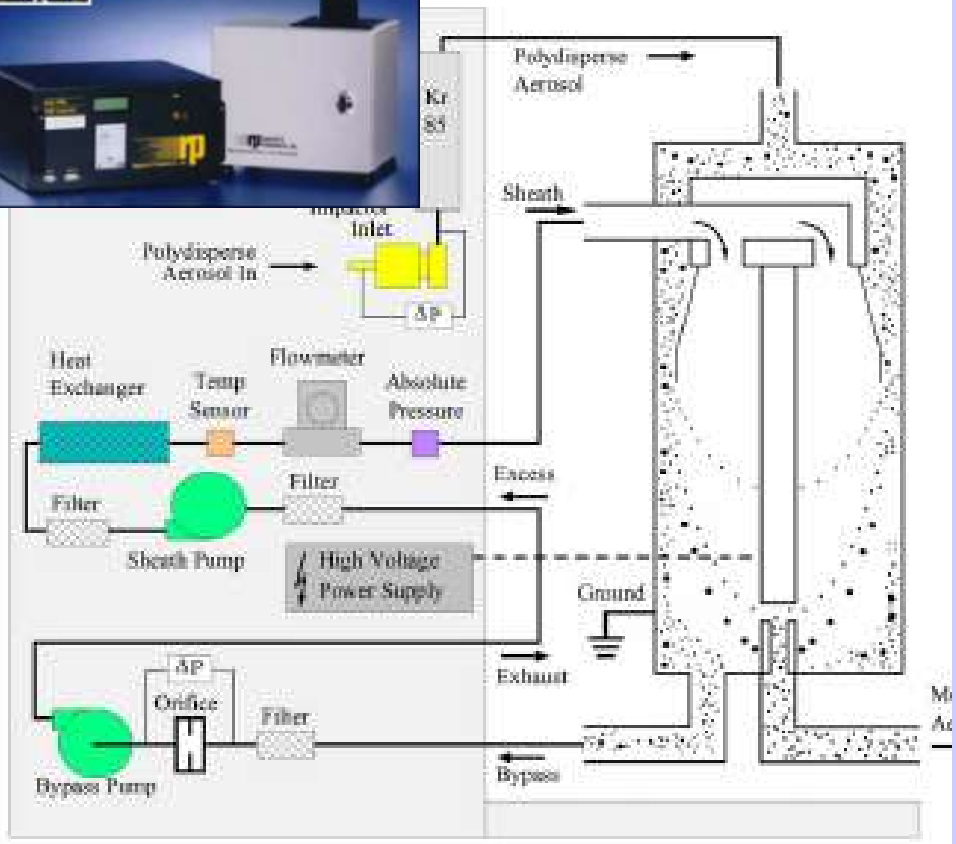
V Conclusion

(I) HC signal measured on roller test bed added by Fast FID



(II) Outdoor measurement *equipment*





- TEOM

for mass measurements

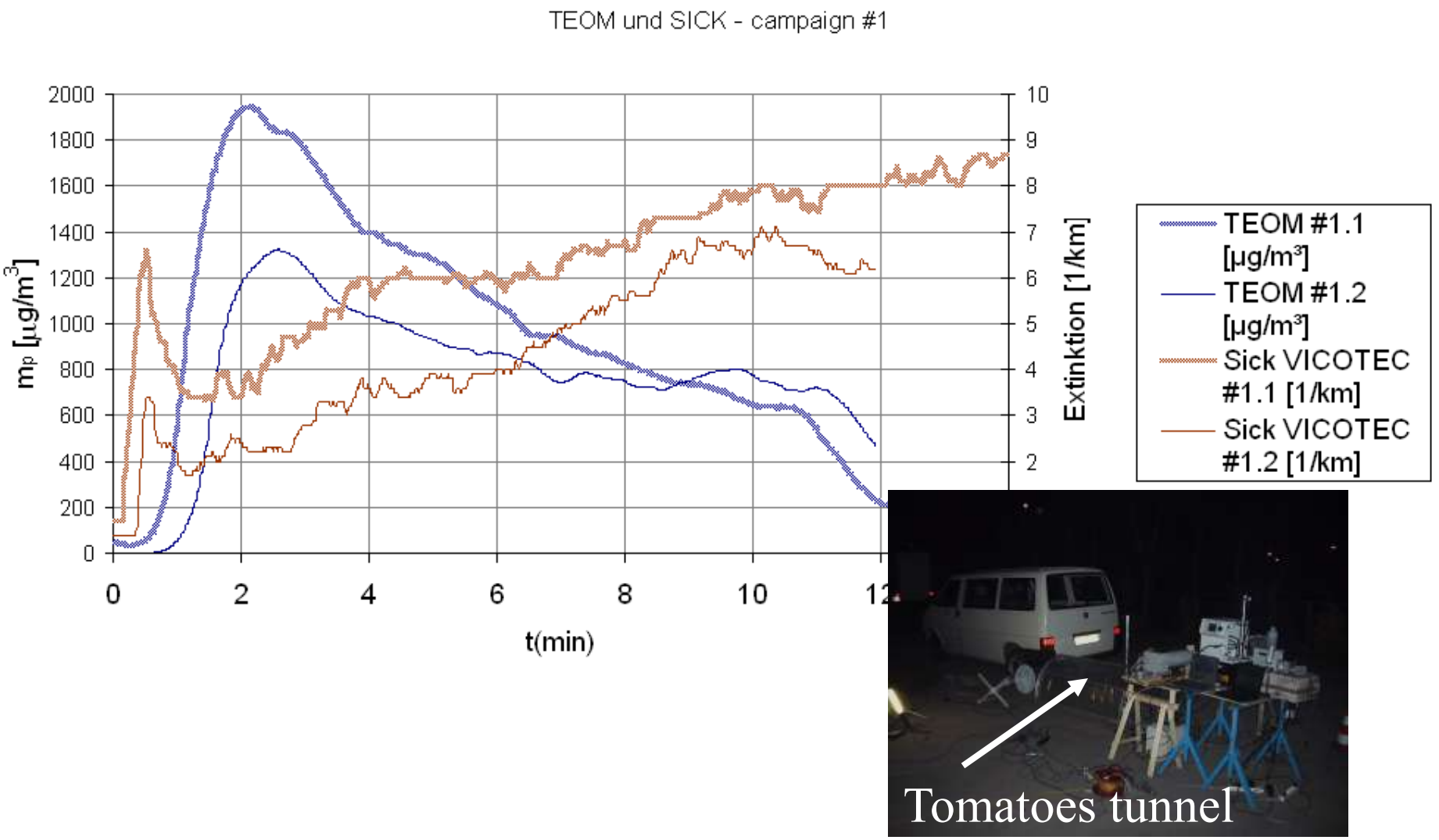
- SMPS and CPC

for particle number size distribution measurements

- SICK

for light extinction measurements

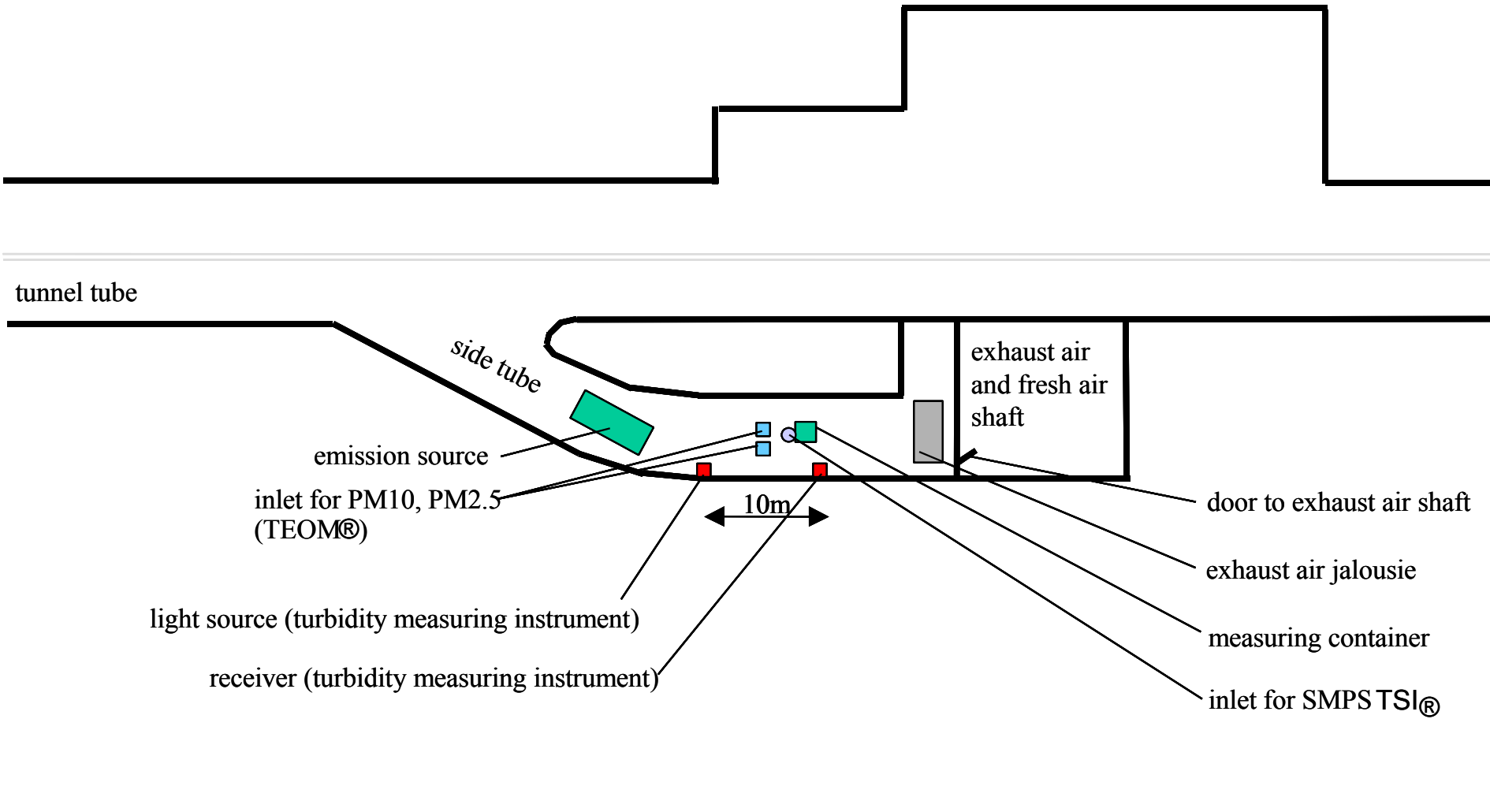
(II,1) Small scale tomatoes tunnel



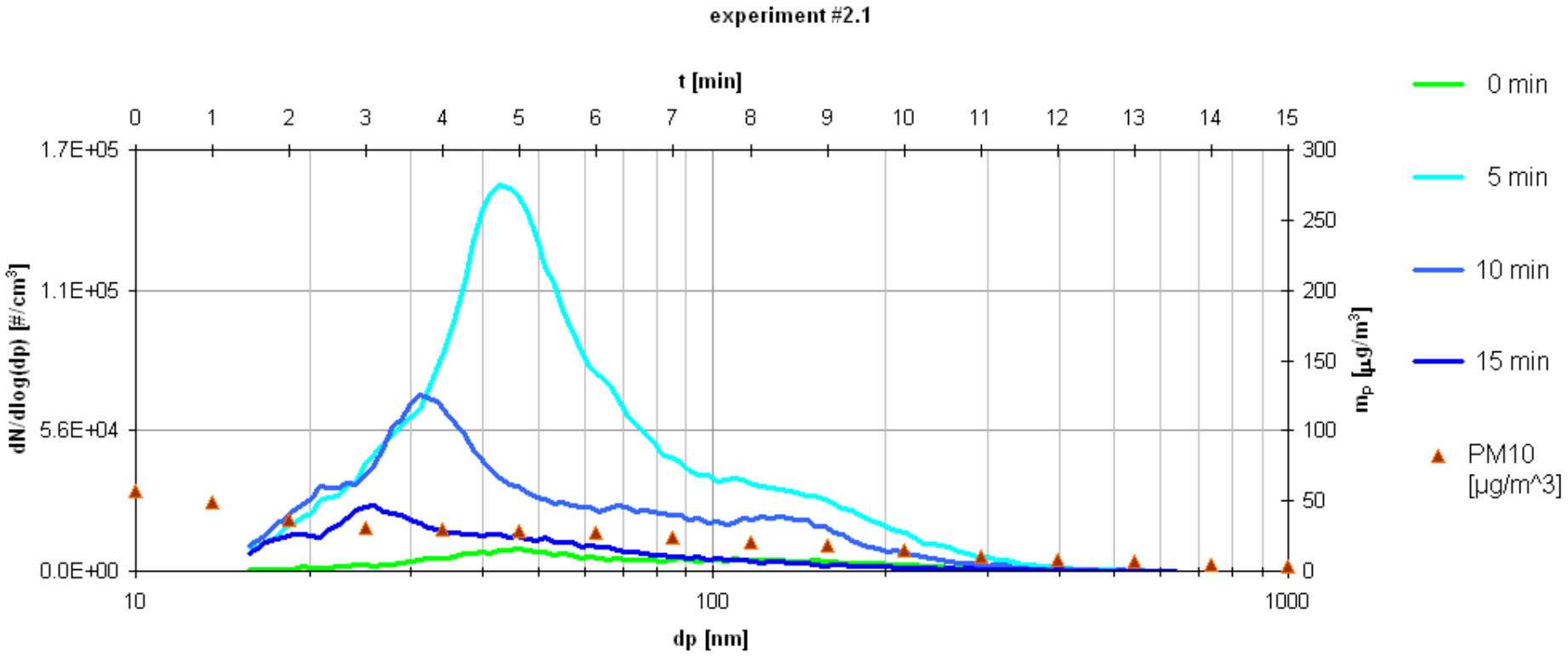
(II,1) Small scale tomatoes tunnel results for the lognormal distribution

	#1.1				#1.2			
t	4.1	6.1	8.2	10.2	4.1	6.1	8.2	10.2
N_{tot}	4.83E+06	4.89E+06	4.96E+06	4.47E+06	4.56E+06	4.30E+06	4.88E+06	5.53E+06
$\ln(\sigma_g)$	0.425	0.423	0.431	0.474	0.473	0.510	0.491	0.489
σ_g	1.530	1.526	1.539	1.606	1.605	1.665	1.634	1.631
dp_g	58	53	48	44	47	44	44	43
N in %	100%	101%	103%	92%	100%	94%	107%	121%
m_p	1837	1320	949	753	1224	1019	858	723

(II,2) Large size scale measurements Gleinalmtunnel- Styria -Austria

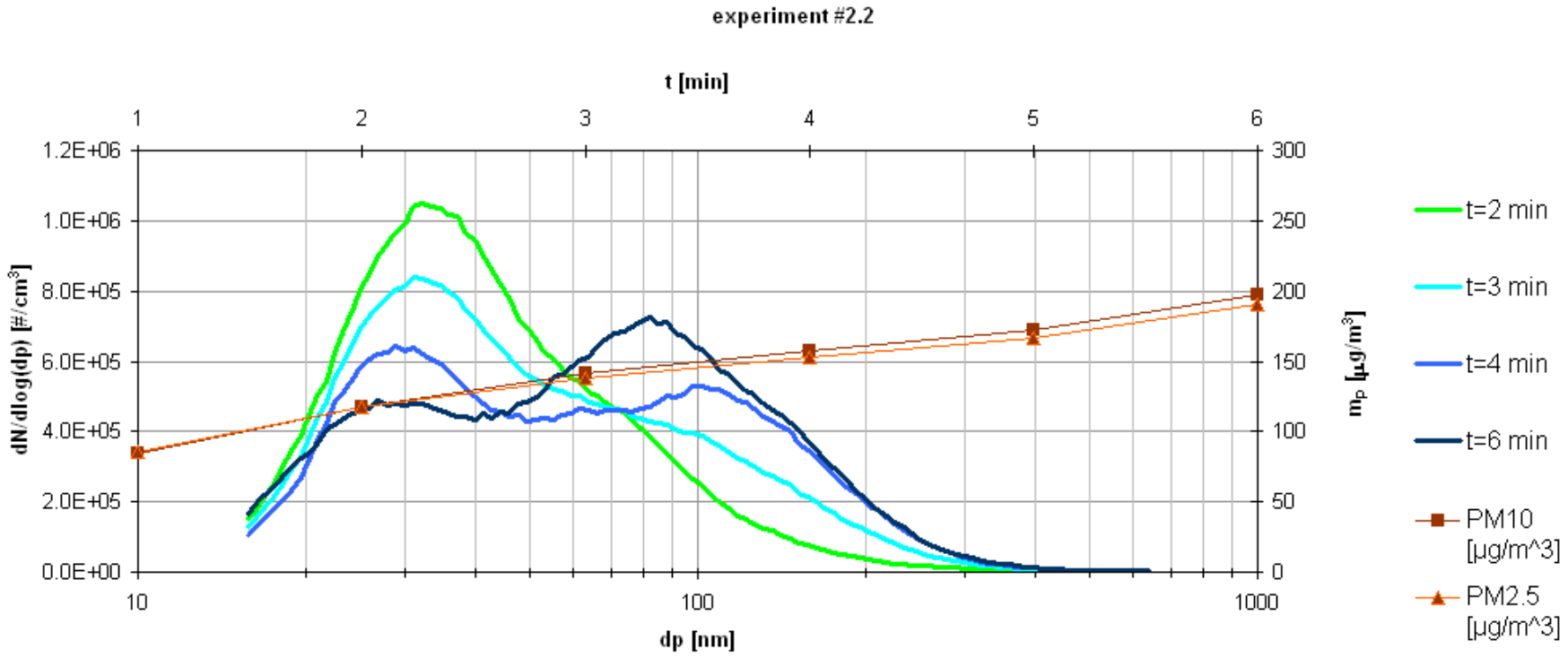


(II,2) Large size scale measurements Gleinalmtunnel- Styria -Austria



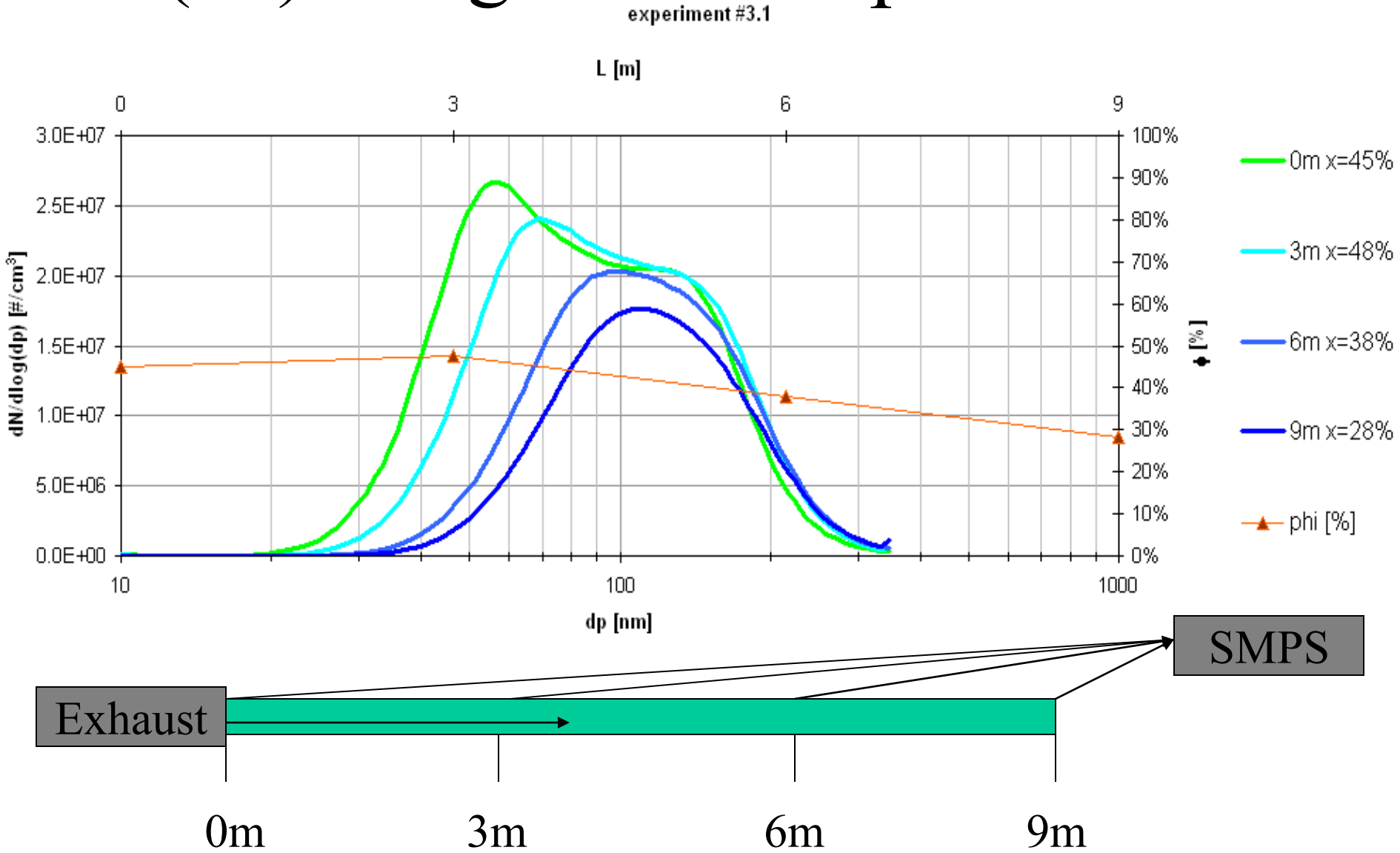
Particle number size distribution with the PC with a pre-Euro engine and PM_{10} for experiment #2.1

(II,2) Large size scale measurements Gleinalmtunnel- Styria -Austria



particle number size distribution for experiment #2.2 with the PC with a pre-Euro engine; the total mass concentration (PM_{10}) is increasing

(III) Coagulation Experiments



(IV) Density Calculation approach for diluted particles

$$c = N \cdot Vp \cdot \rho$$

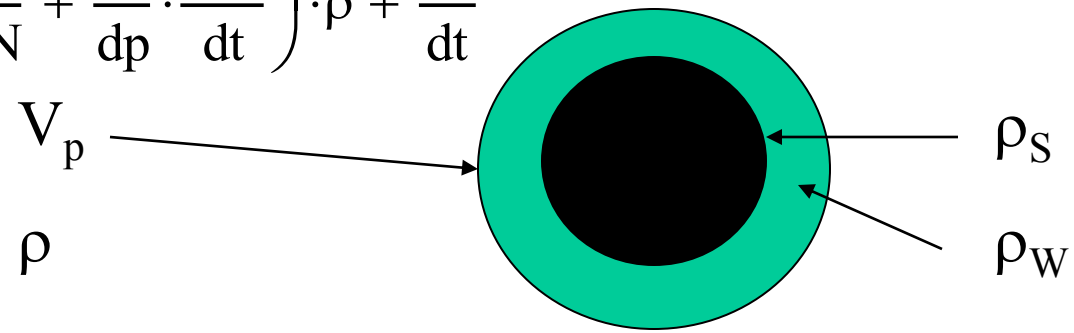
...N=number of particles per volume

...c=mass per volume

...V_p=volume of particle

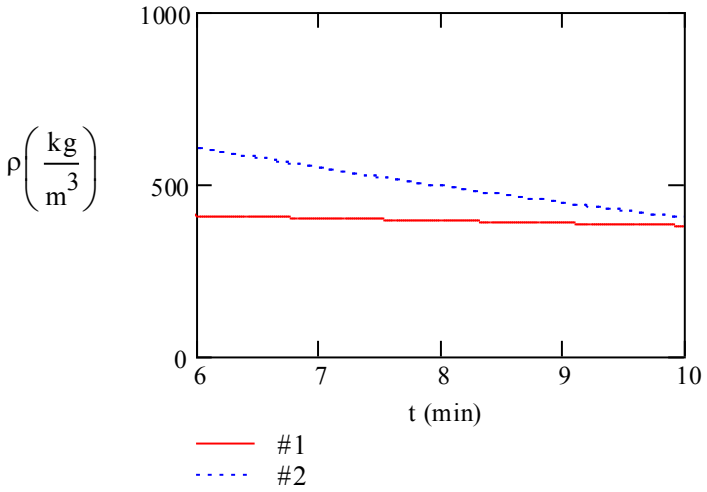
...ρ=total density of particle

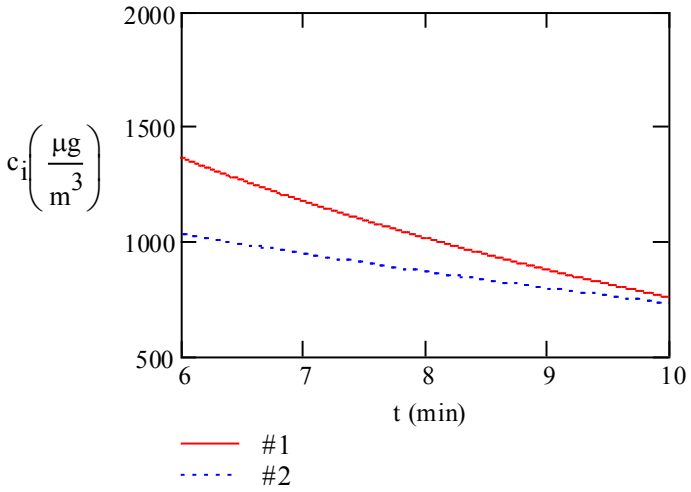
$$\frac{\frac{dc}{dt}}{N \cdot Vp} = \left(\frac{dN}{dt} \cdot \frac{1}{N} + \frac{3}{dp} \cdot \frac{ddp}{dt} \right) \cdot \rho + \frac{d\rho}{dt}$$

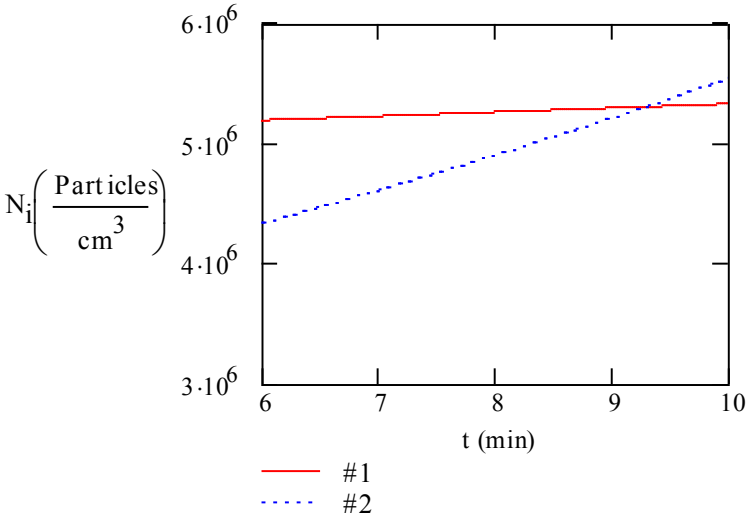


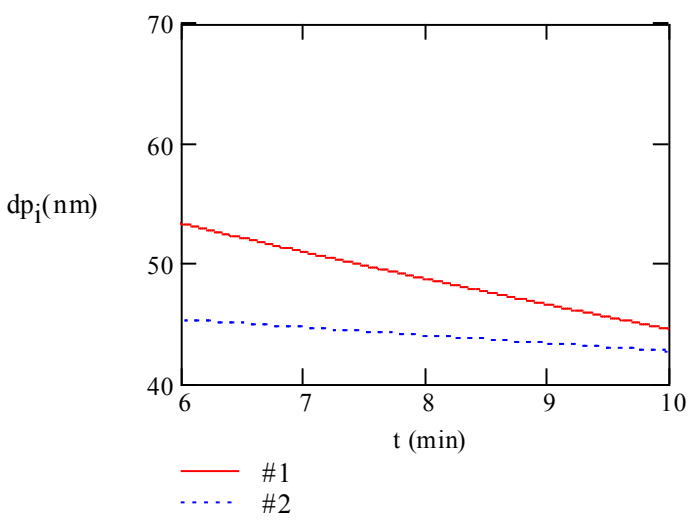
$$\rho = \alpha \cdot \rho_W + (1 - \alpha) \cdot \rho_S$$

(IV) Density Calculation approach for diluted particles









Conclusions

- Cold start emissions lead to two types of particles: liquid and solid – the liquid phase disappears – monomodal soot distribution
- Previous state of engine ist of importance for liquid but not soot
- Cold start emissions in the atmosphere are purely mixed with the ambient air – no (fast) coagulation
- Coagulation experiments that it is necessary for coagulation to have high concentrations and long residence times
- Nucleation and coagulation can be observed together
- A new method for gaining liquid uptake of particles has been shown

Thank you for your attention!