Informal document No. GRPE-54-14
(54th GRPE, 4-8 June 2007,
agenda item 6(a))

Overview

- Situation as seen by OICA
- Result of a first comparison of instruments of ‚PMP conformity‘
- Conclusions for further steps

Situation as seen by OICA

- No clear description of measurement equipment available
- Validation was done with “Golden System” , not a final system
- final solution PN-systems are not available
- Manufacturers intend to certify Euro5 vehicles in advance of official Euro5 date
- Test program with suppliers best guess systems

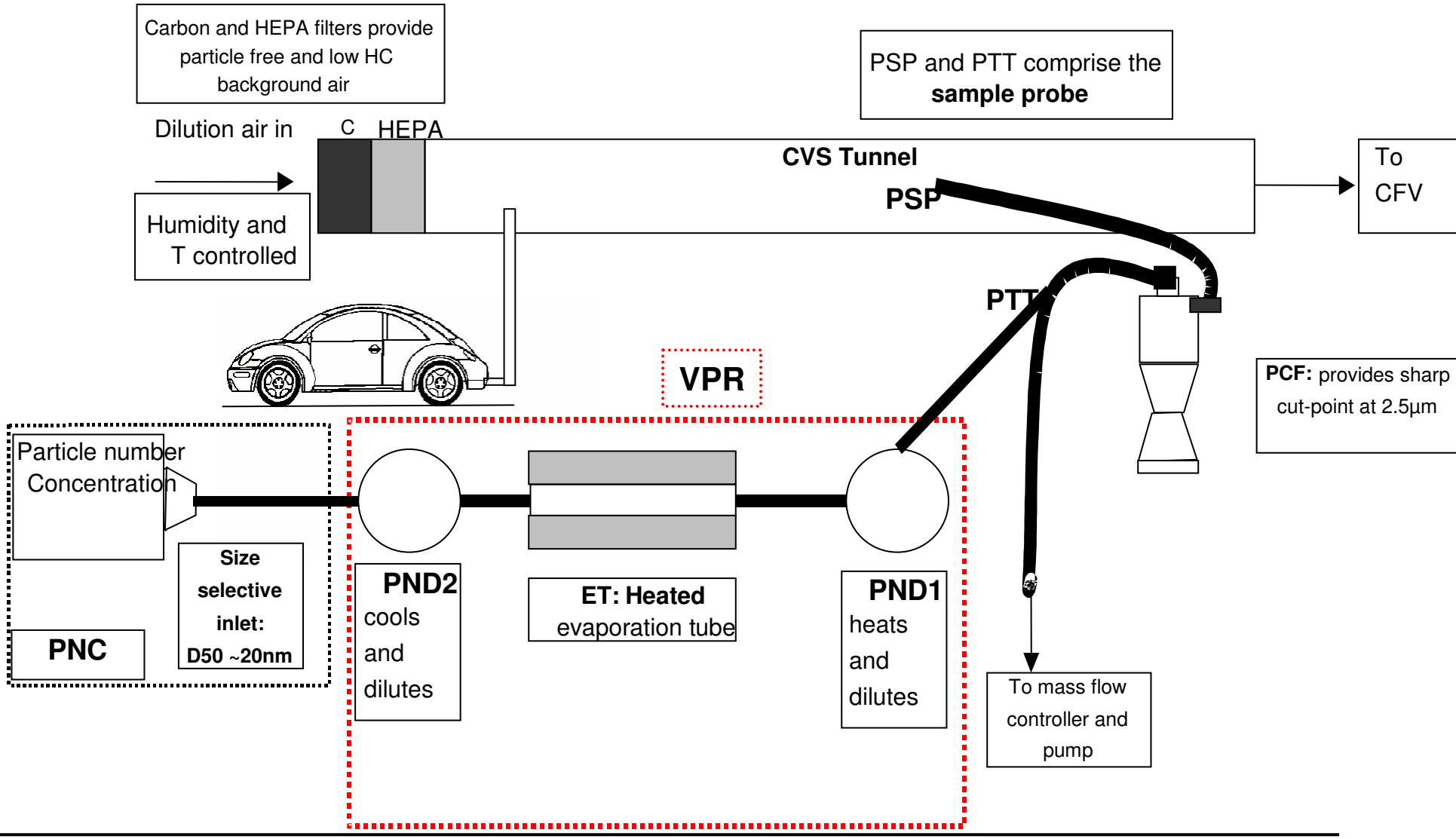
Equipment

Clone System PMP-setup

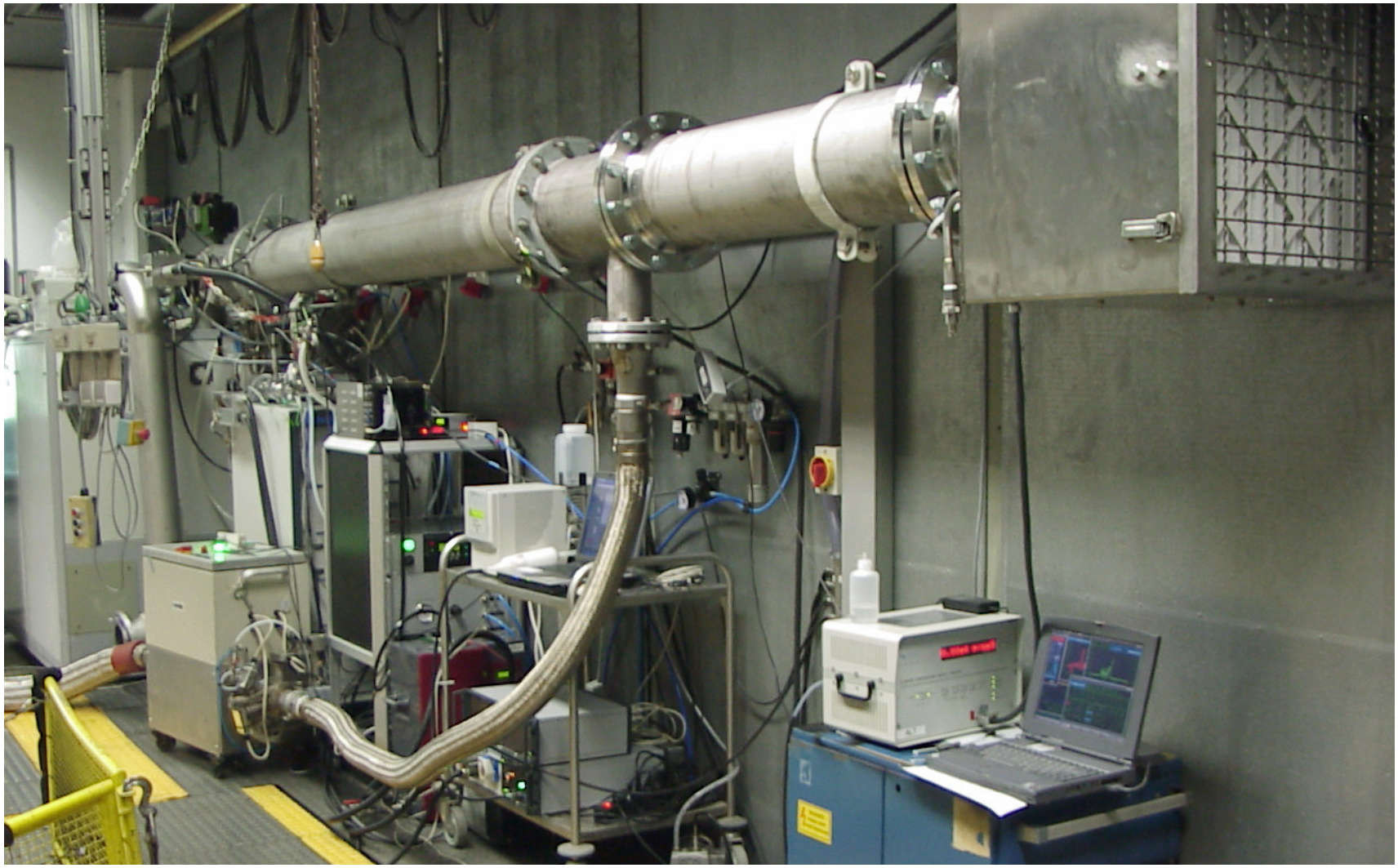
1. **DEKATI Fine Particle Sampler (FPS)**
   with Grimm CPC 5.404

2. **Matter volatile particle remover**
   with TSI CPC 3790

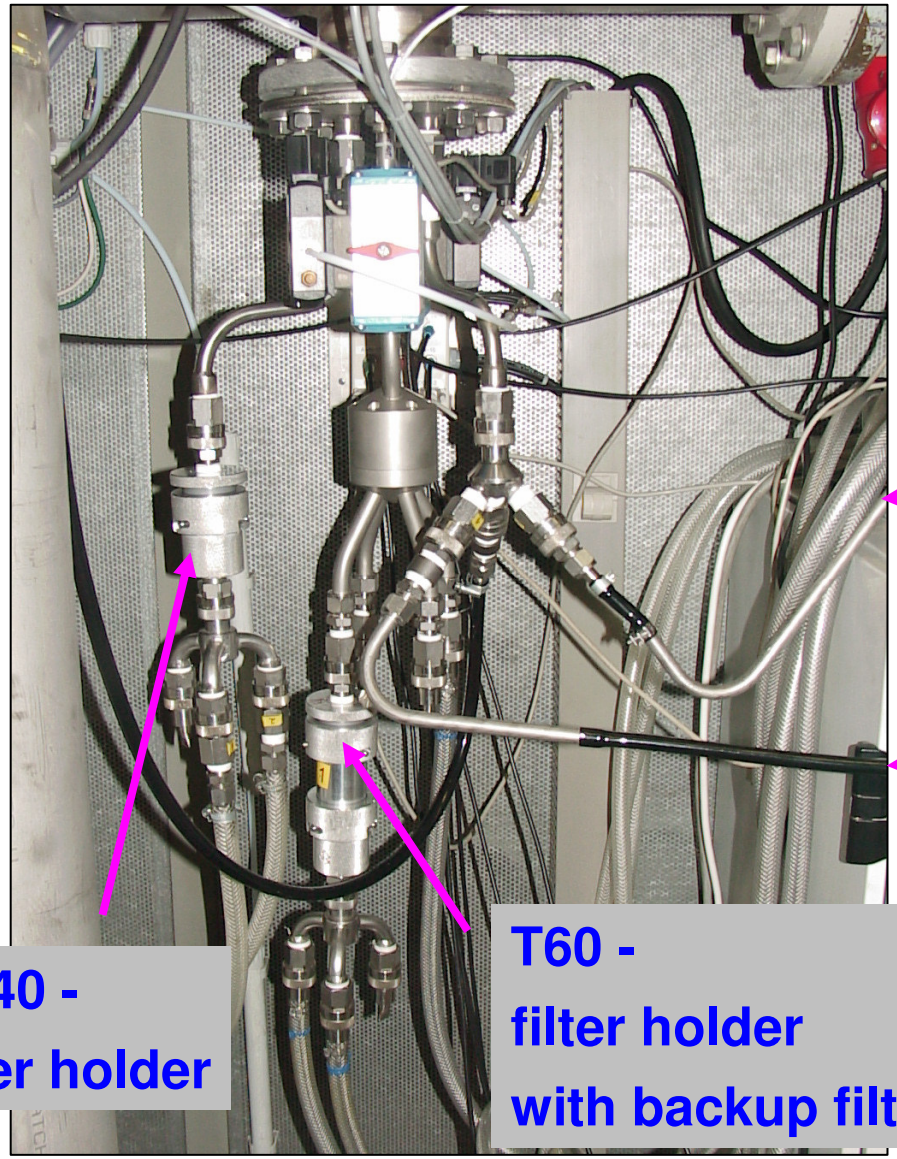
Recommended Particulate Sampling System



Test Set-up for Particulate Mass and Number Measurement



Particulate Sampling at the CVS-Tunnel for PM and PN



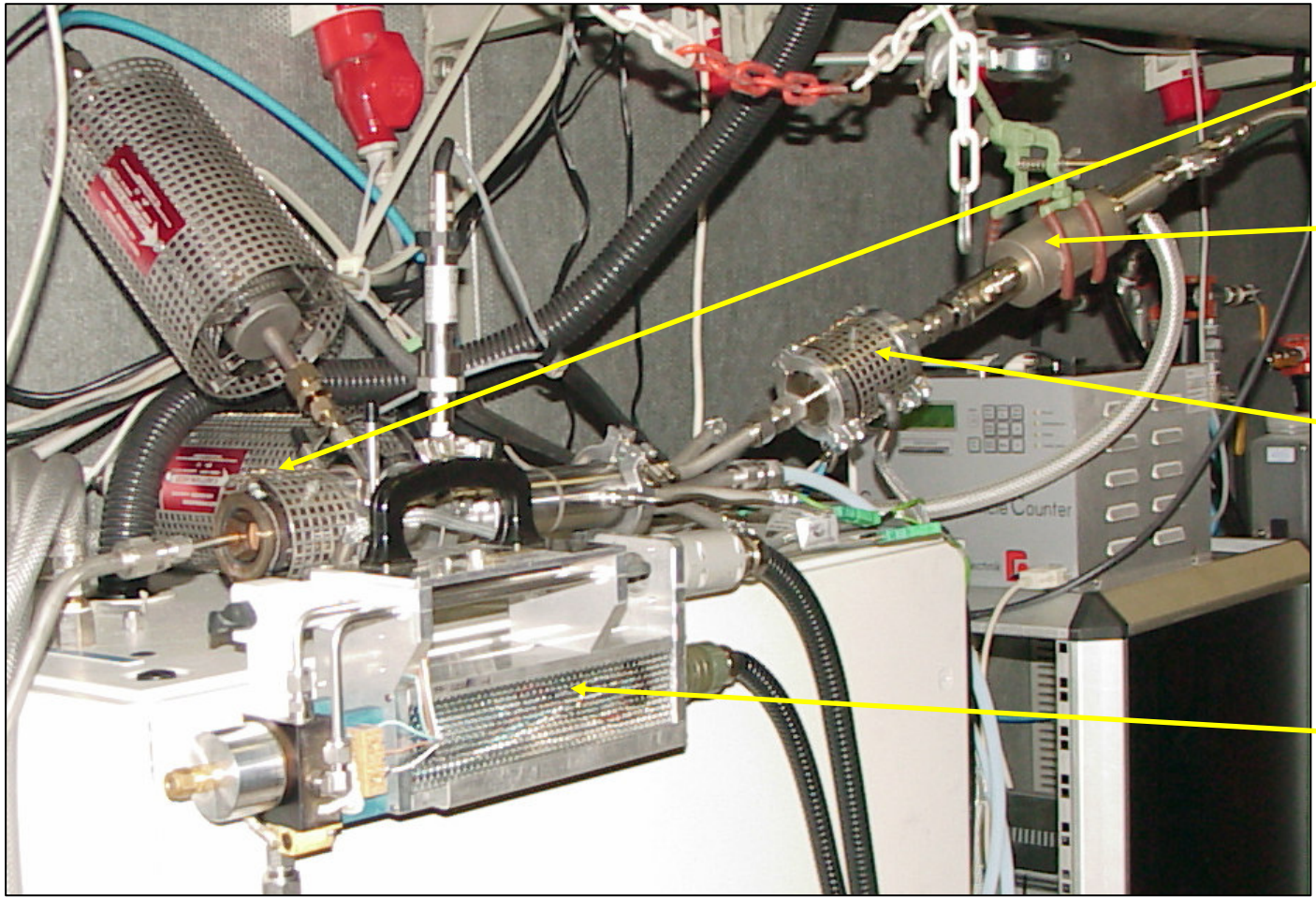
to FPS Dekati/Grimm

to Matter-diluter/TSI

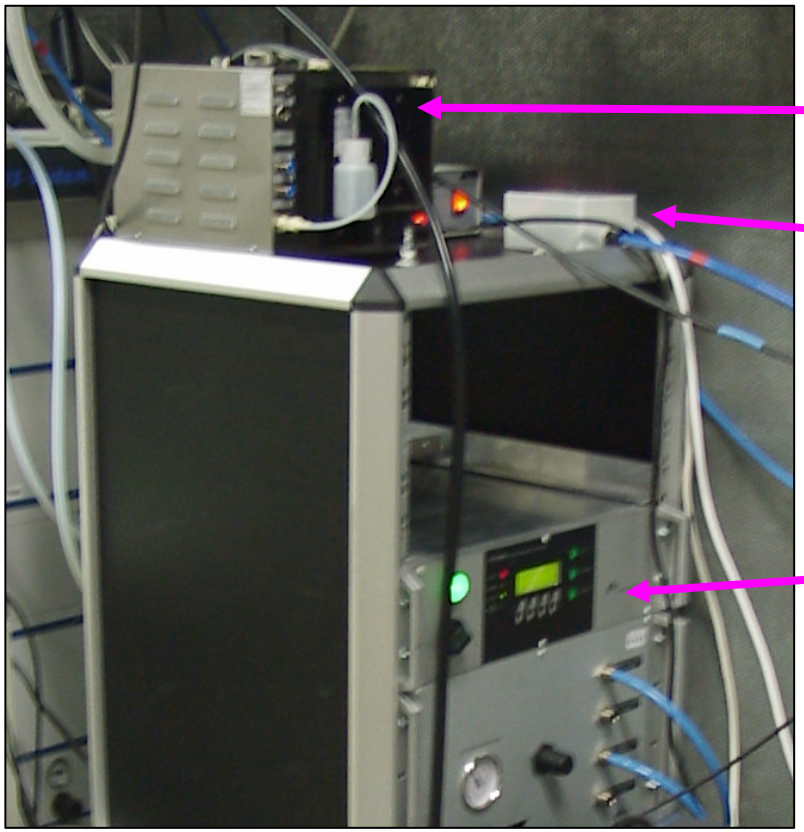
TX40 - filter holder

T60 - filter holder with backup filter

Particle Number Dilution Devices



Dekati/Grimm PN-System



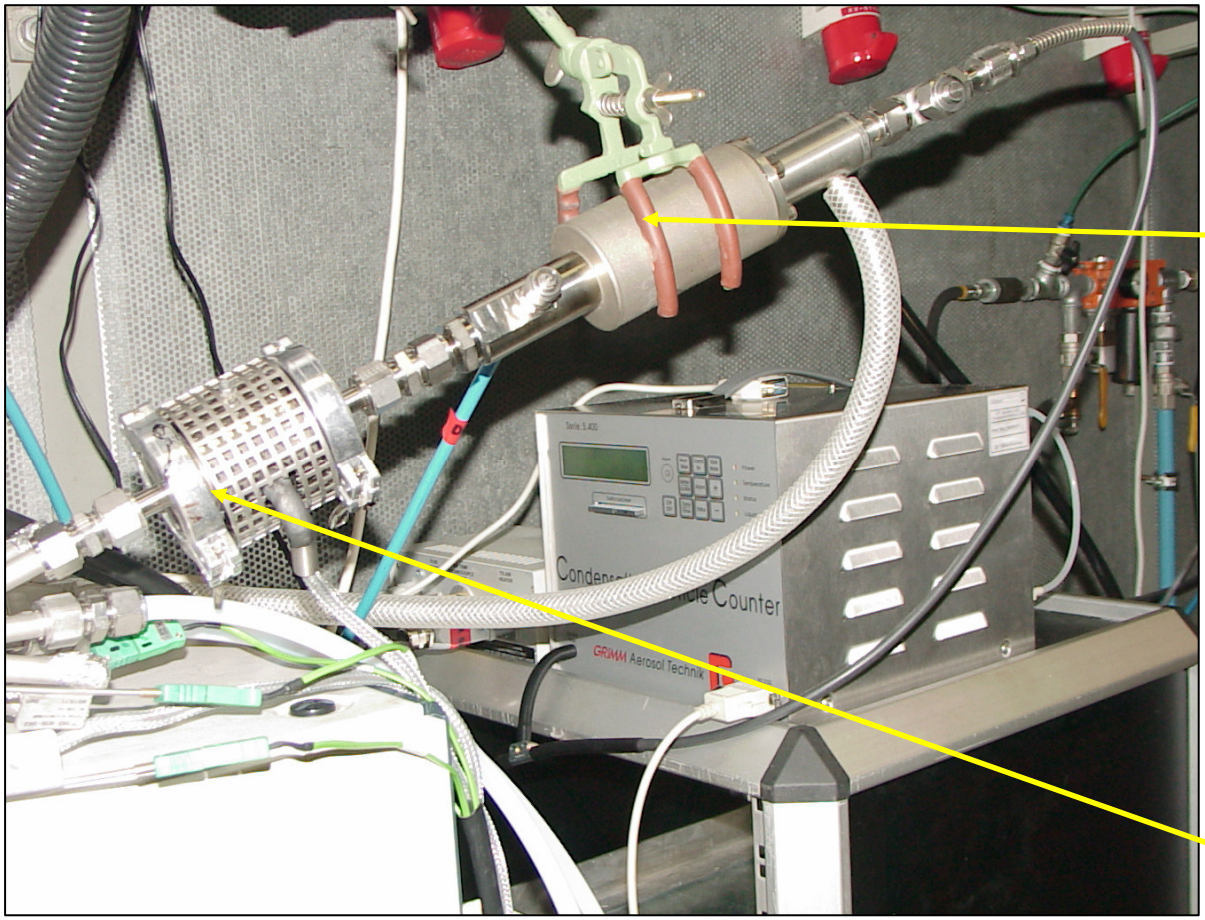
Grimm CPC 5.404

Pressure regulator

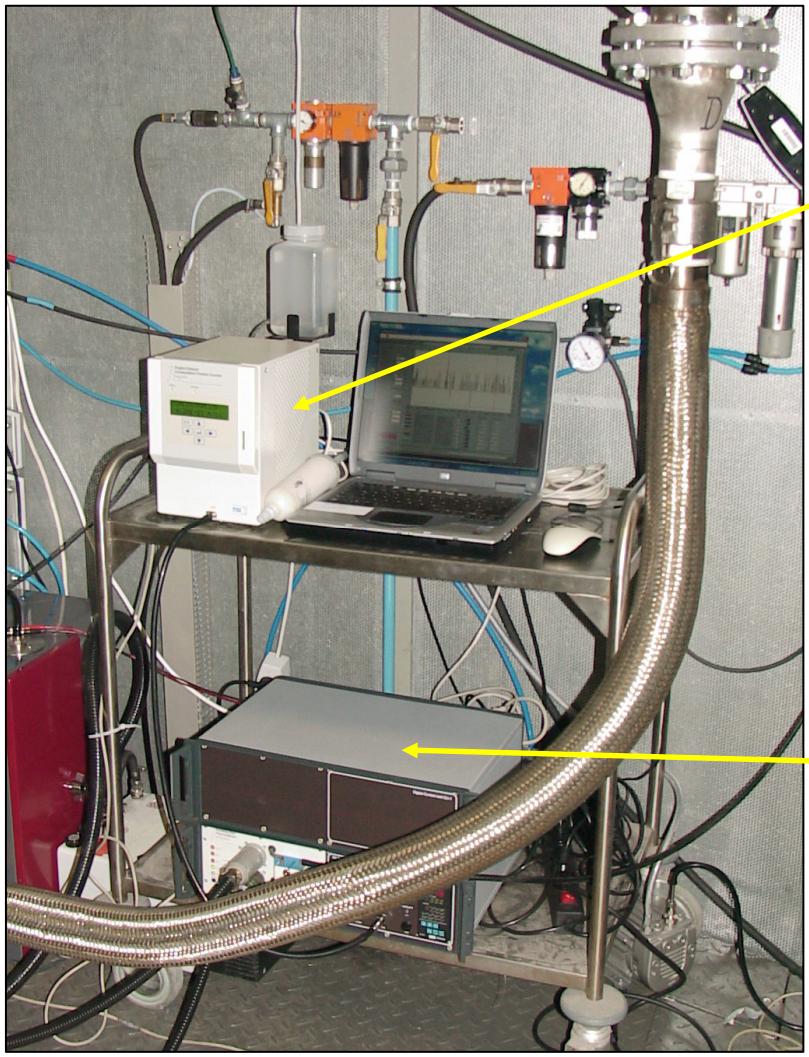
Dekati FPS control unit

(Fine Particle Sampler)

Ejector Diluter PND2 and Evaporation Tube (Dekati)



Diluter PND2 and Evaporation Tube (Matter)



TSI CPC 3790
with control unit

ET and PND2

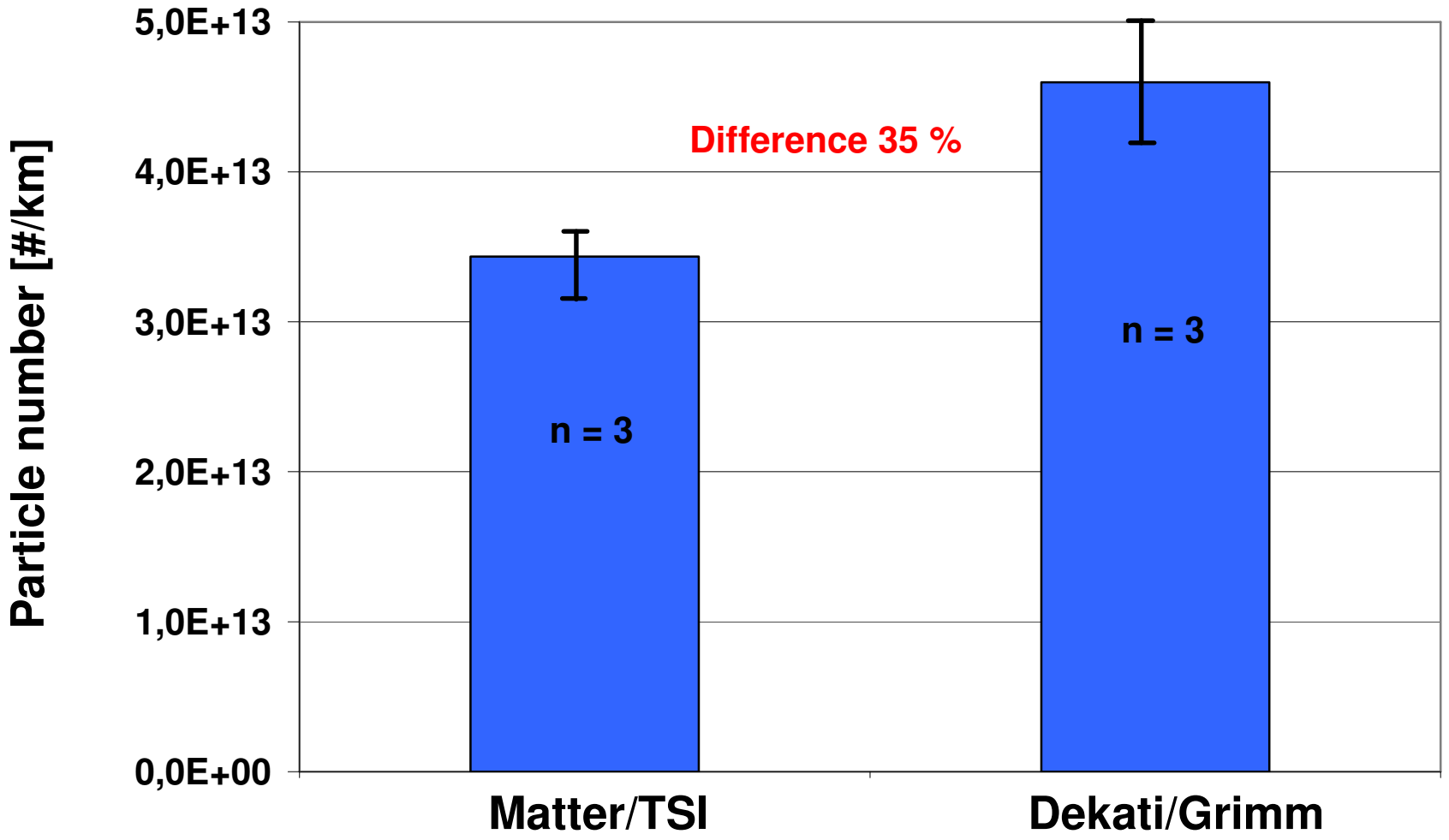
Necessary further Actions for system development

- Hardware integration
- Software integration
- Check-procedures implementation

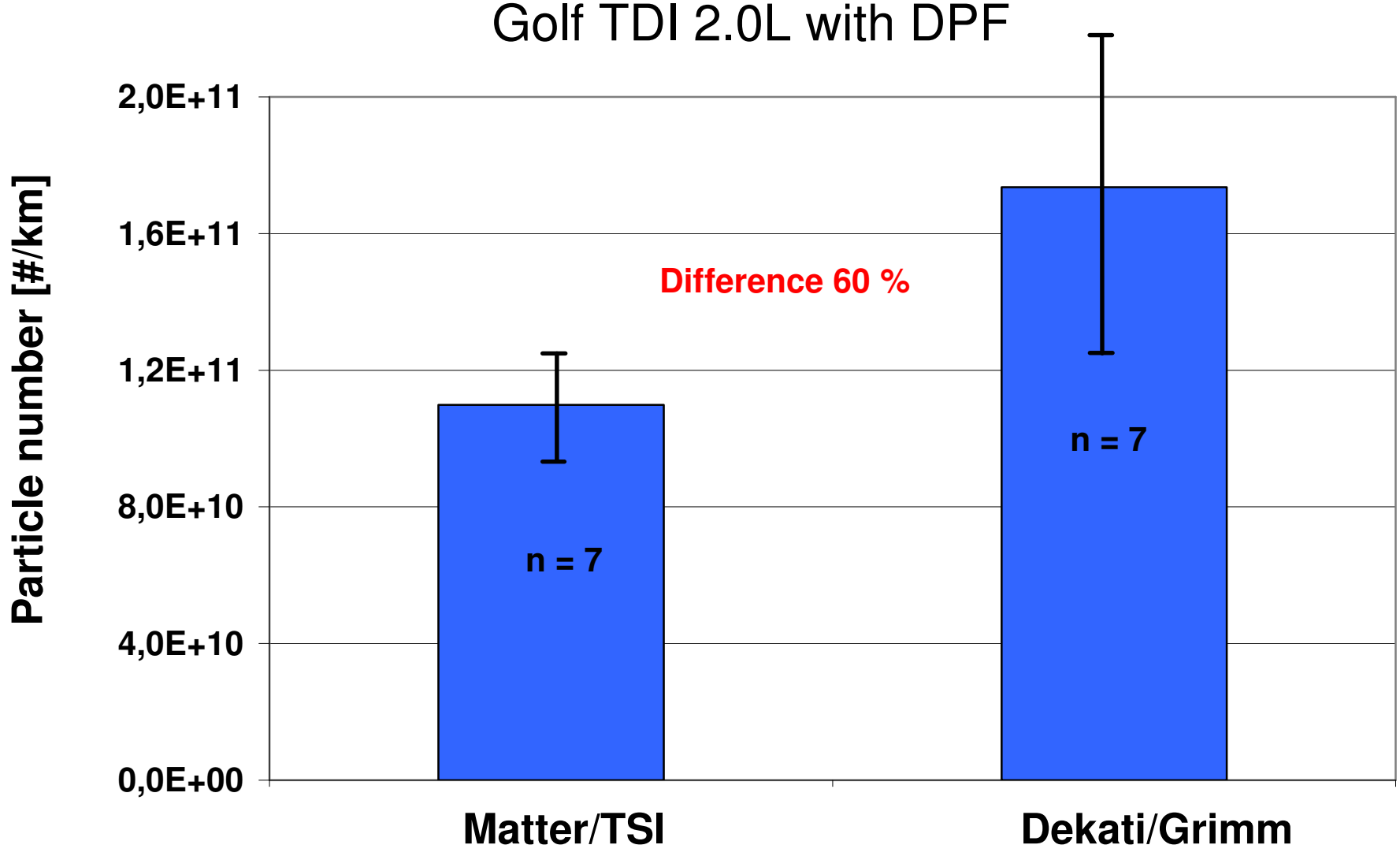
… for a robust and practical use PN-system

Comparison of two PMP PN-Systems

Golf TDI 1.9L

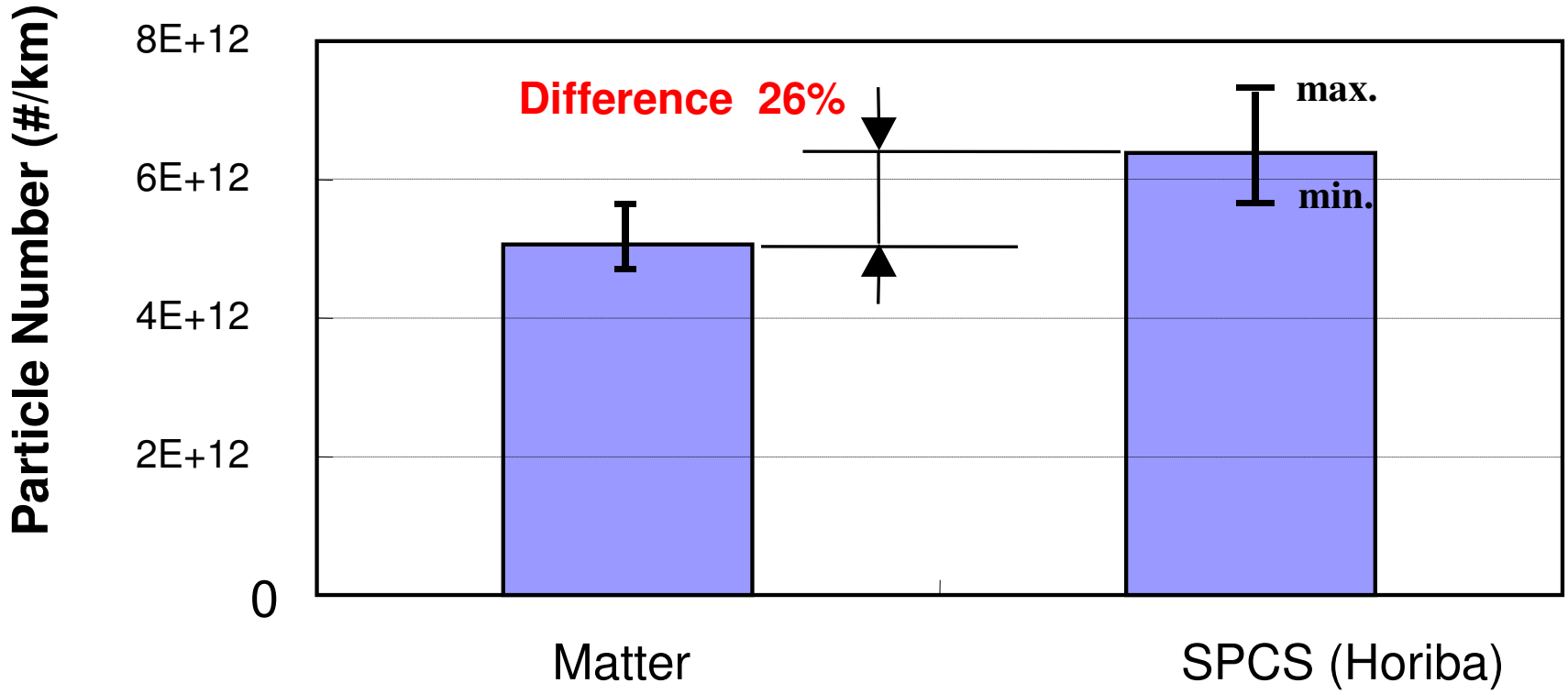


Comparison of two PMP PN-Systems

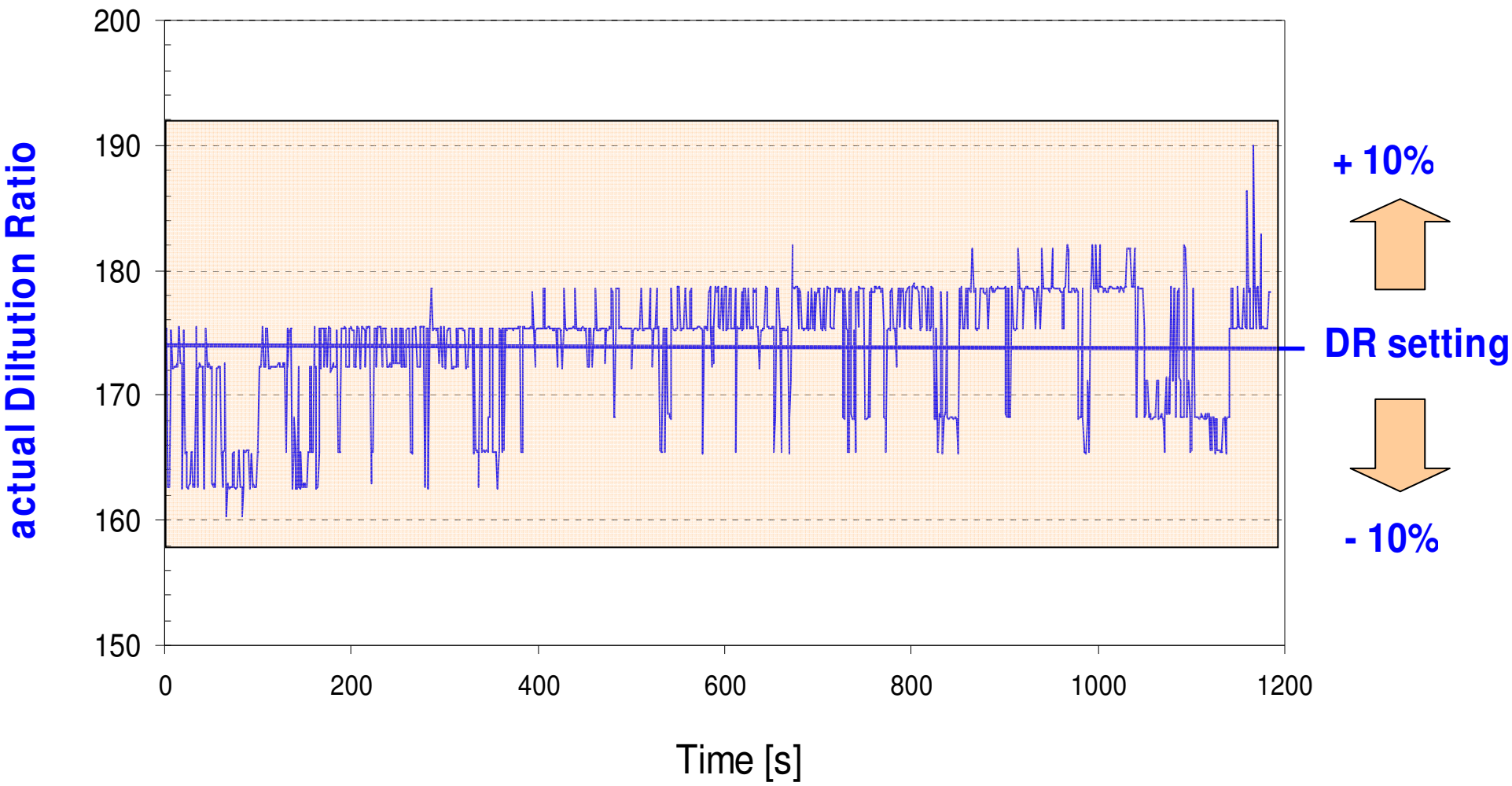


Particle Number(PN) Results Measured by Different Types of Instruments

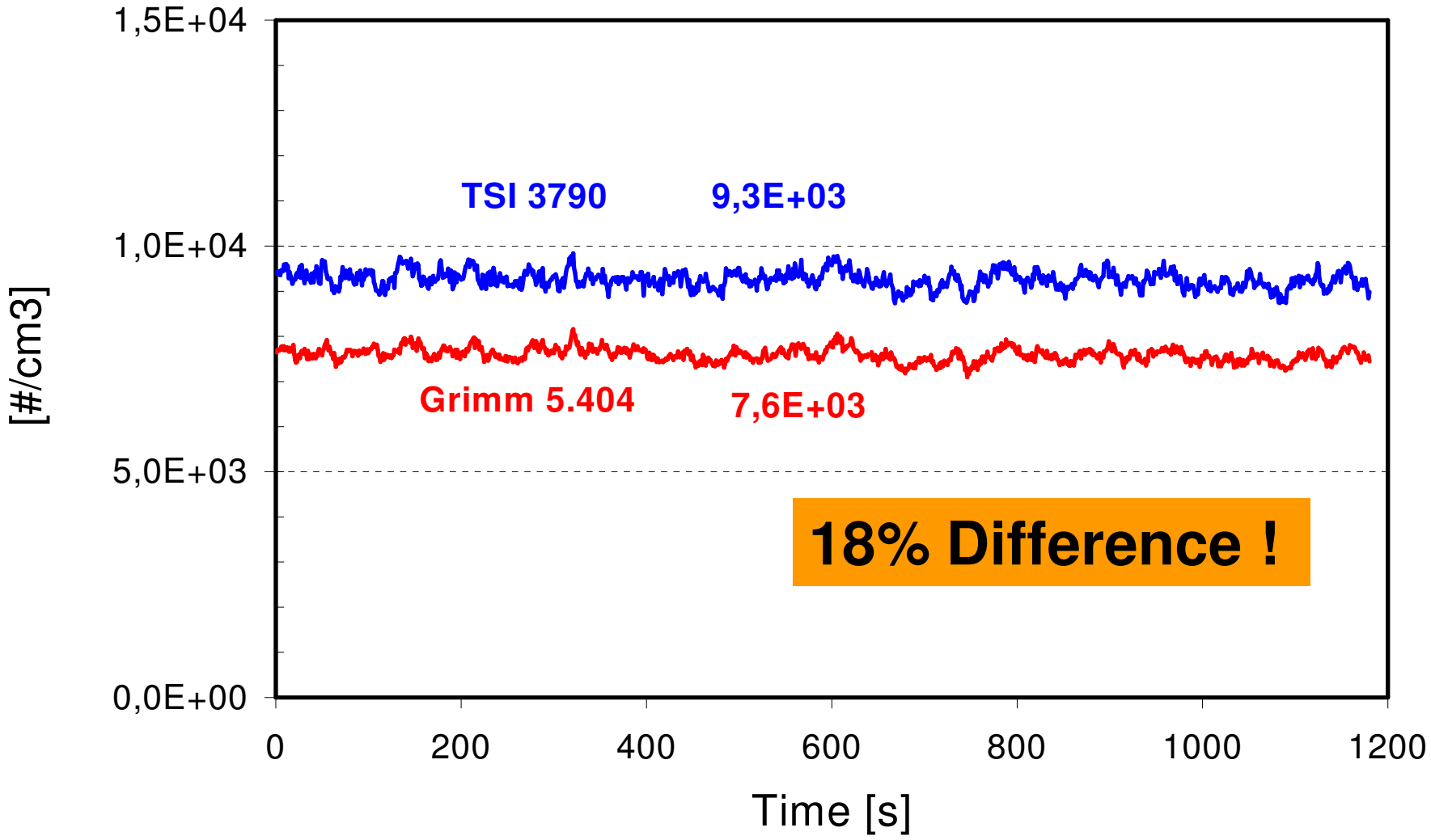
Test mode : NEDC n=7
Vehicle : Gasoline direct injection lean burn
Calibration : CO standard gas



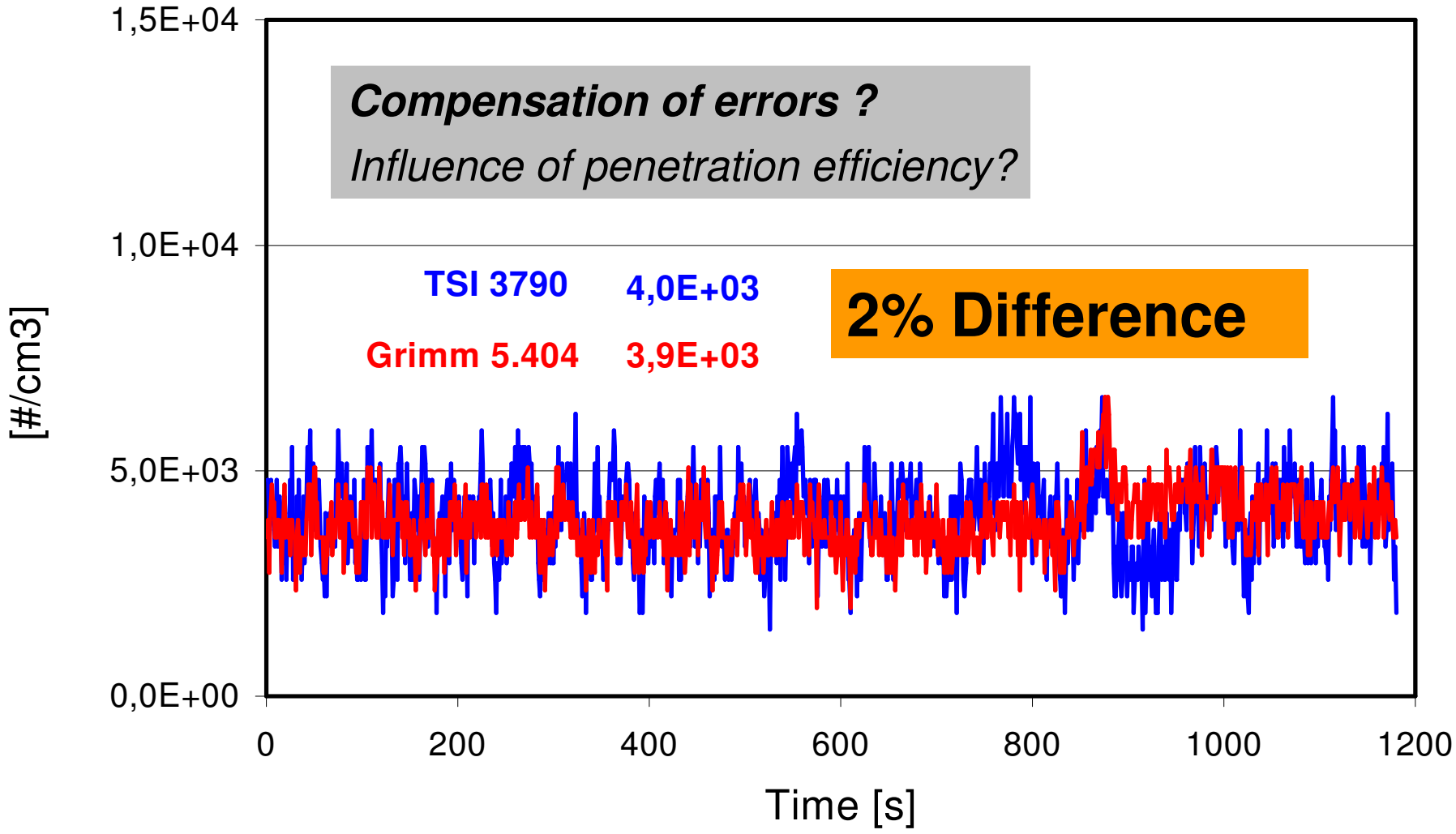
Dilution Ratio of PND1 during NEDC



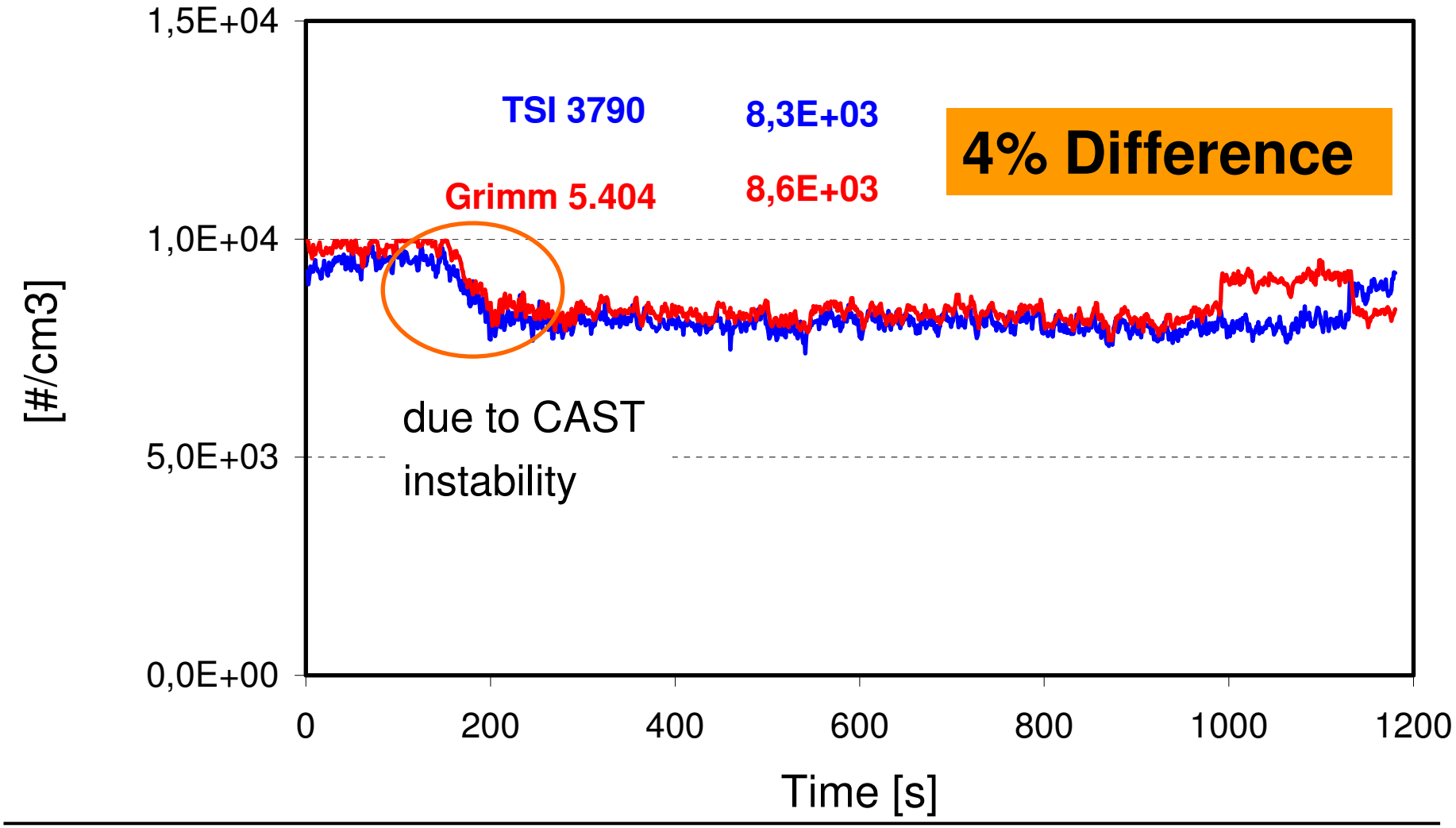
97 nm Particulates (CAST) to CPCs without Dilution



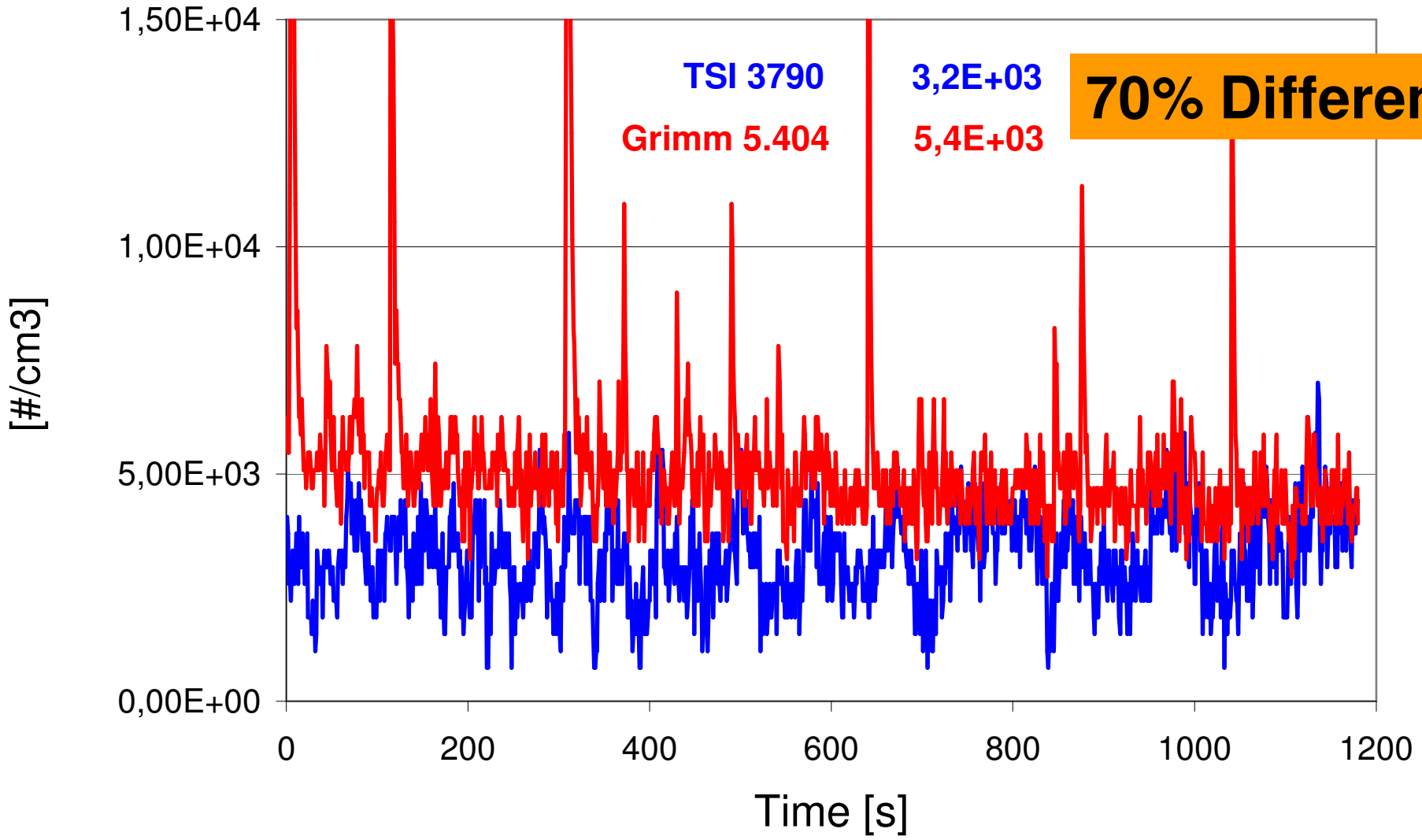
97 nm Particulates (CAST) to CPCs <u>with</u> Dilution System



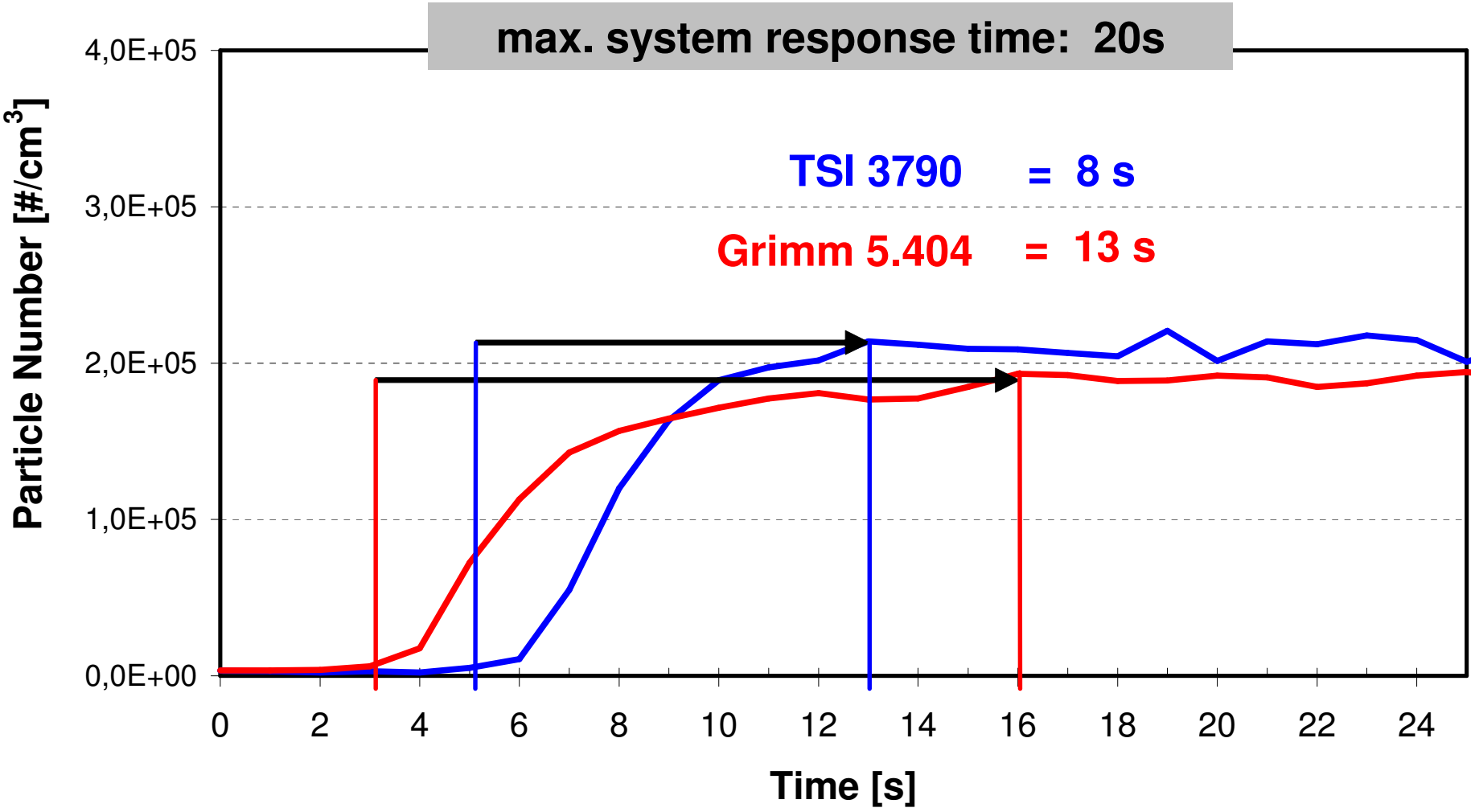
33 nm Particulates (CAST) to CPCs without Dilution



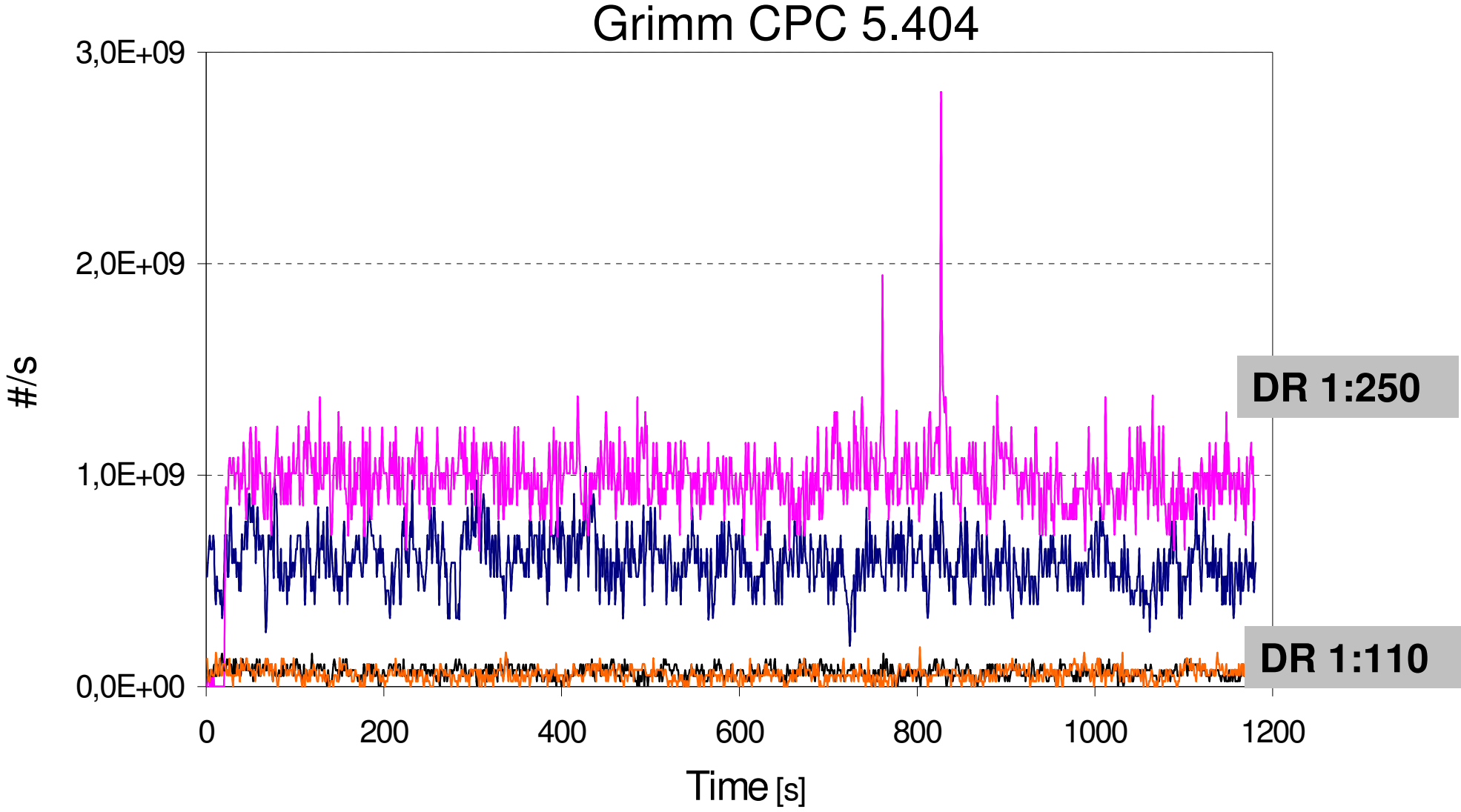
33 nm Particulates (CAST) to CPCs <u>with</u> Dilution System



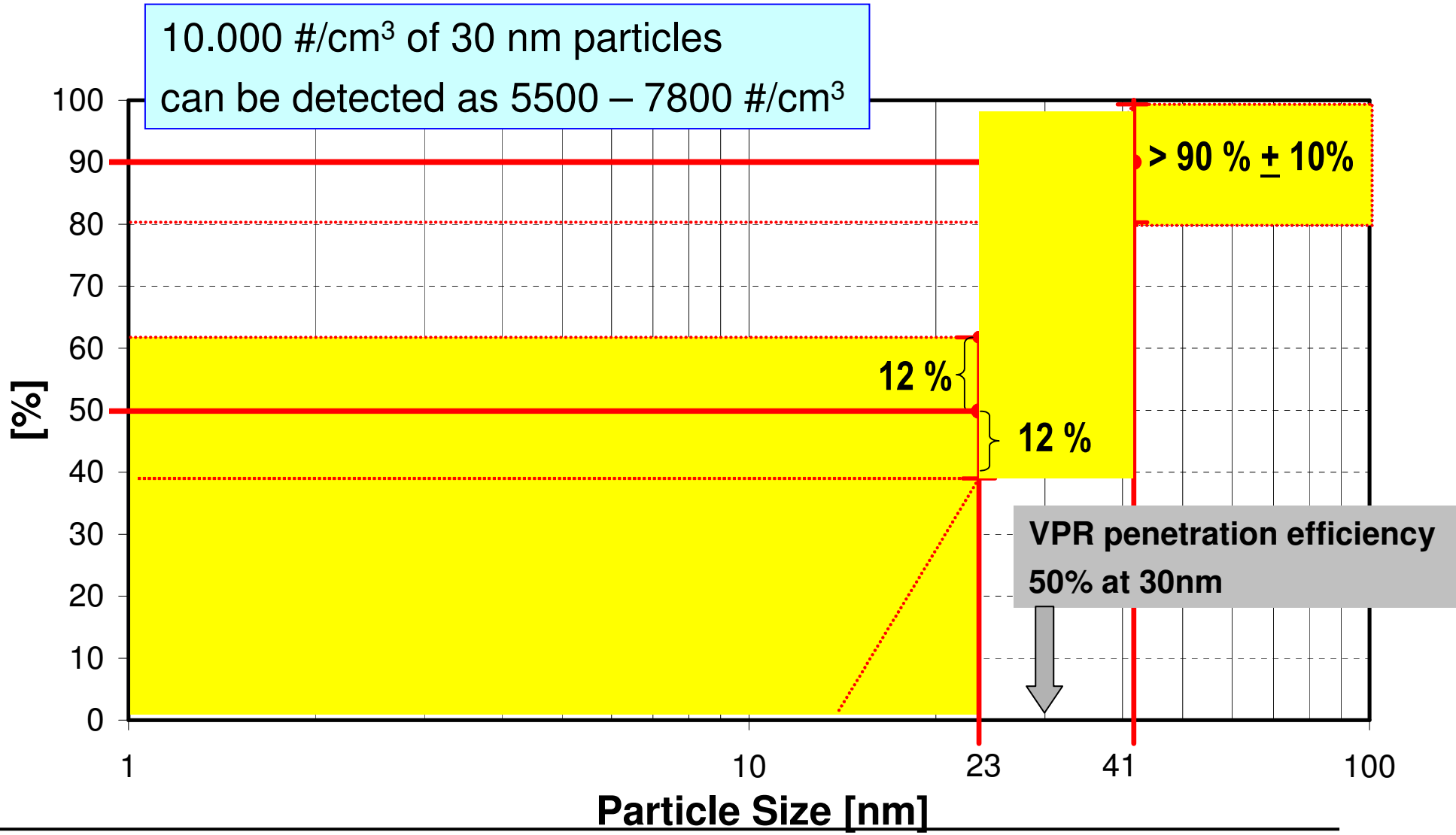
PN- System Response Time



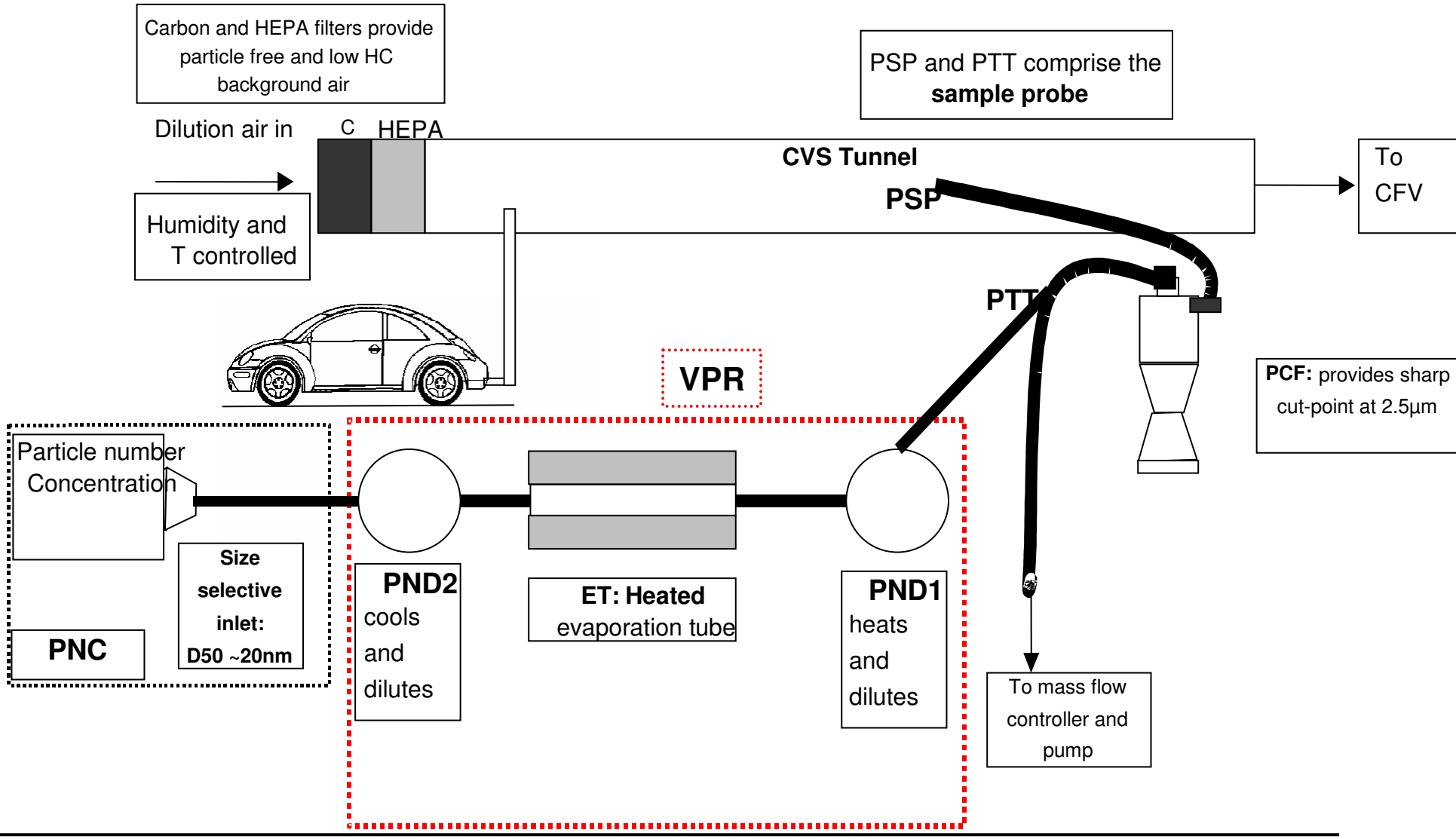
Background PN- Concentration



Size dependent CPC Counting Efficiency



Recommended Particulate Sampling System



Margin of Errors on PN-Measurement

System Component	Accuracy requirements		Error
PTS (PSP+PTT) (Particle transfer system)	**?** Penetration for 30 nm particles		
PND1 (hot dilution)	**± 10%** Accuracy		**20%**
ET (evaporation tube)	**99%** Reduction of 30 nm n-C_{40} while PND2 = 1:10	**VPR** Penetration **50/55/60 %** at 30/50/100 nm	**?%** **10..** **40%**
PND2 (cold dilution)	**± 10%** Accuracy		**20%**
PNC (particle number counter)	R^2>0,97 Linearity (incl. unheated VPR) **± 10%** Counting accuracy **50% ± 12%** Inlet efficiency for 23 nm particles **> 90%** Inlet efficiency for 41 nm particles		**10%** **20%** **?%**

OICA

Necessary further Actions before Inclusion in Legislation

- Discussion of error margins
- Comparisons of instruments
- Need for round robin-test

Conclusions

- Measurement equipment requires clear description
- Validation needed on final system
- Time needed until PN-systems are available
- Status of instrumentation presented is not in a final stage
- Hardware and software integration is needed
- Further work is necessary:
  - Completion of equipment development to a fixed spec
  - Analysis and Comparison of instruments
  - Round-Robin

OICA Position on PN Measurement