TECHNISCHE UNIVERSITÄT DRESDEN

TU Dresden
Institute of process engineering and environmental engineering

Aerosol mobility spectrometry based on diffusion charging

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Agenda

- Motivation
- Charging mechanisms
- Diffusion charging
  Modeling - Measurement
- Application: New aerosol spectrometer UFP
- Comparison to reference
- Summary

Motivation

Charger

charging the particles

classifying into size classes

Classifier

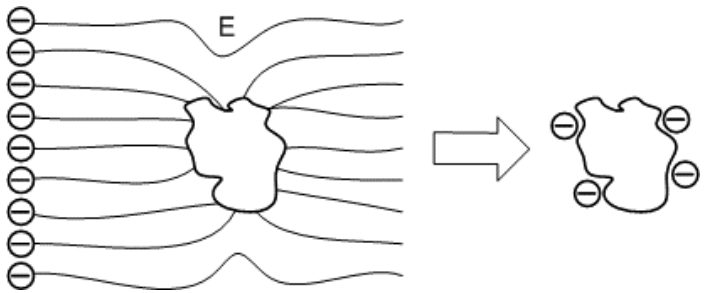
quantifying the concentration

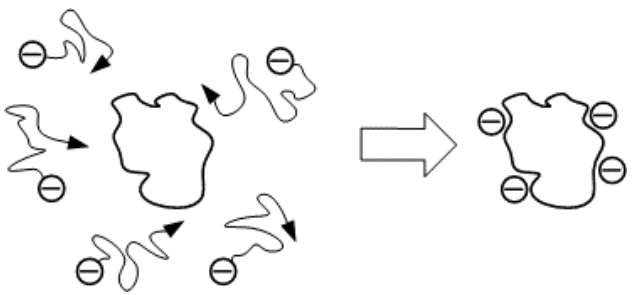
Detector

Charging mechanisms

Particle charging

- Field charging
- UV-radiation
- Diffusion charging



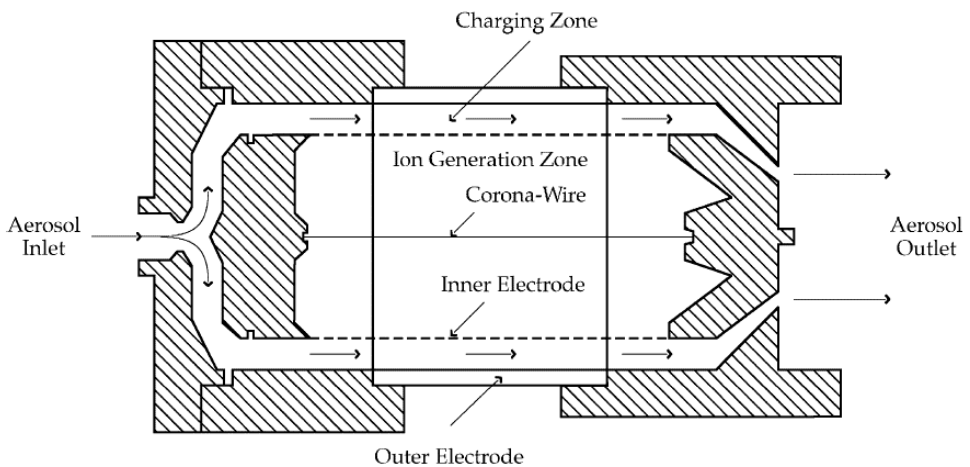


Ion generation

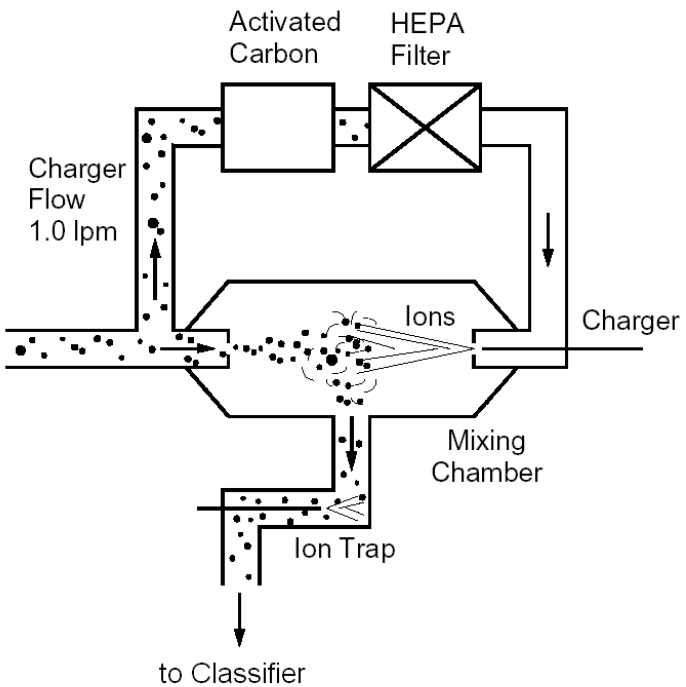
- Radioactive material
- Corona-discharge

Charging mechanisms

Hewitt-type charger



Corona-jet-charger

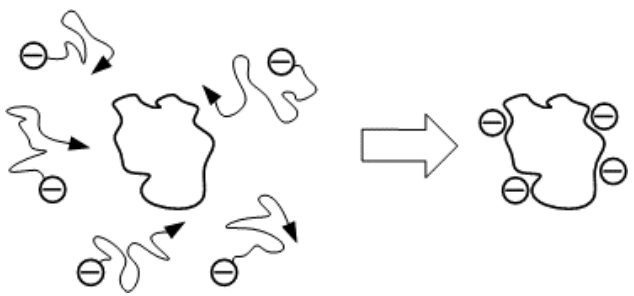


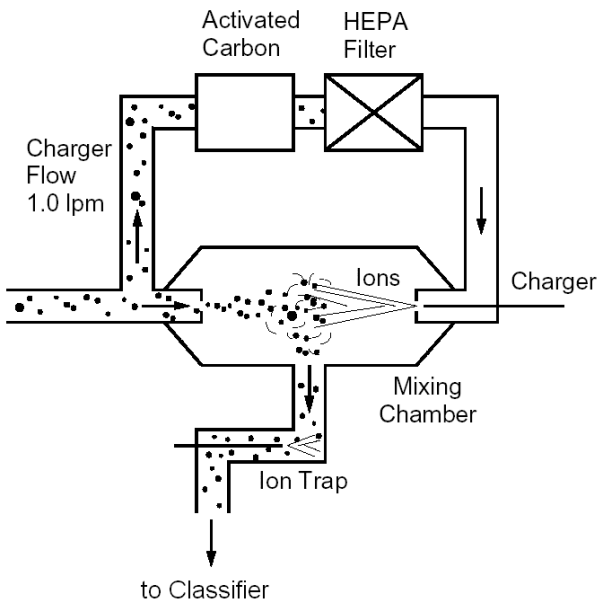
Diffusion charging

Modeling

Transition regime:

- limiting-sphere-theory
- Model from Marlow&Brock





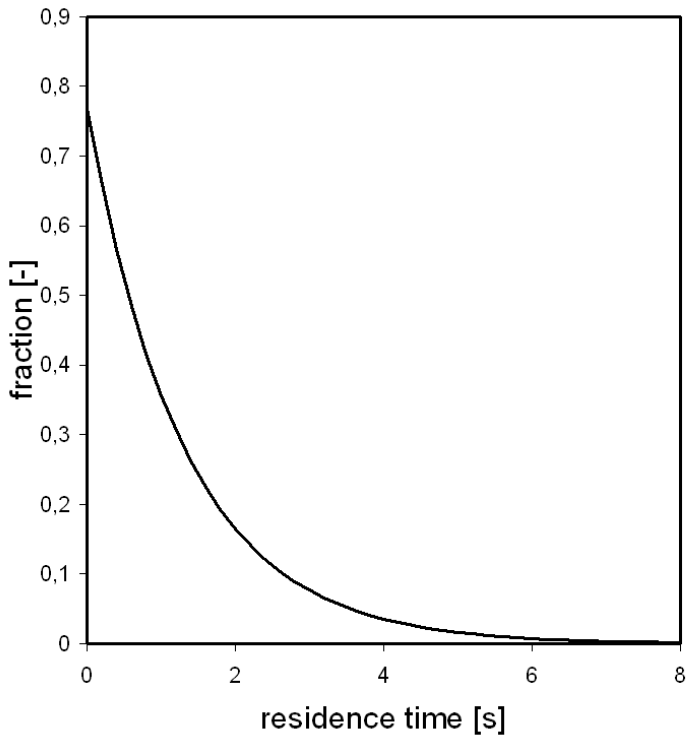
Diffusion charging

Modeling

limiting-sphere-theory

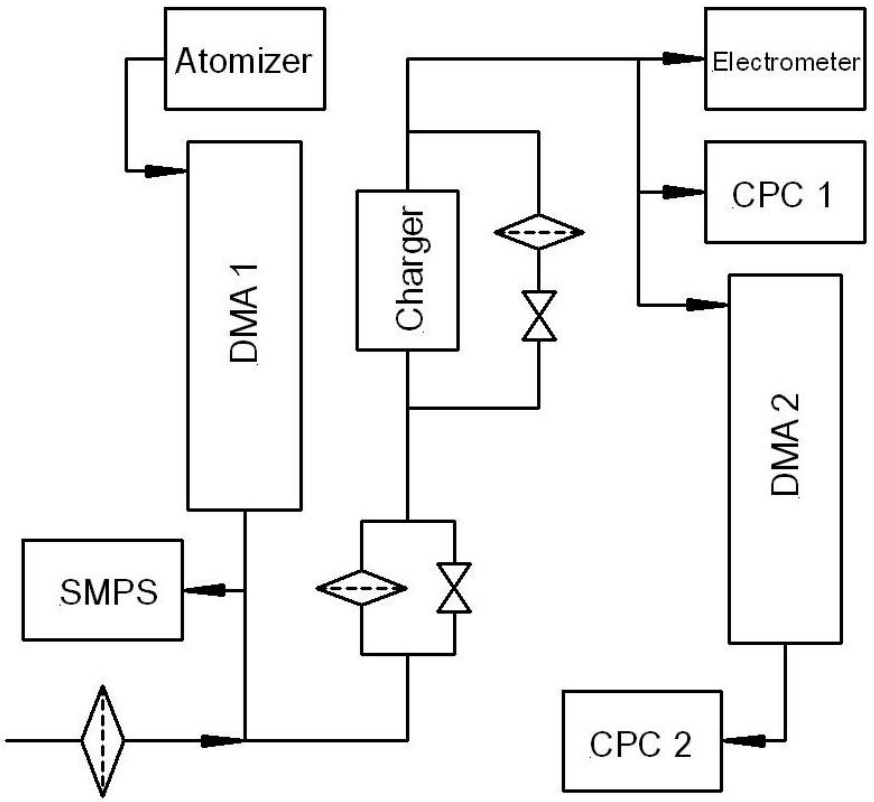
+

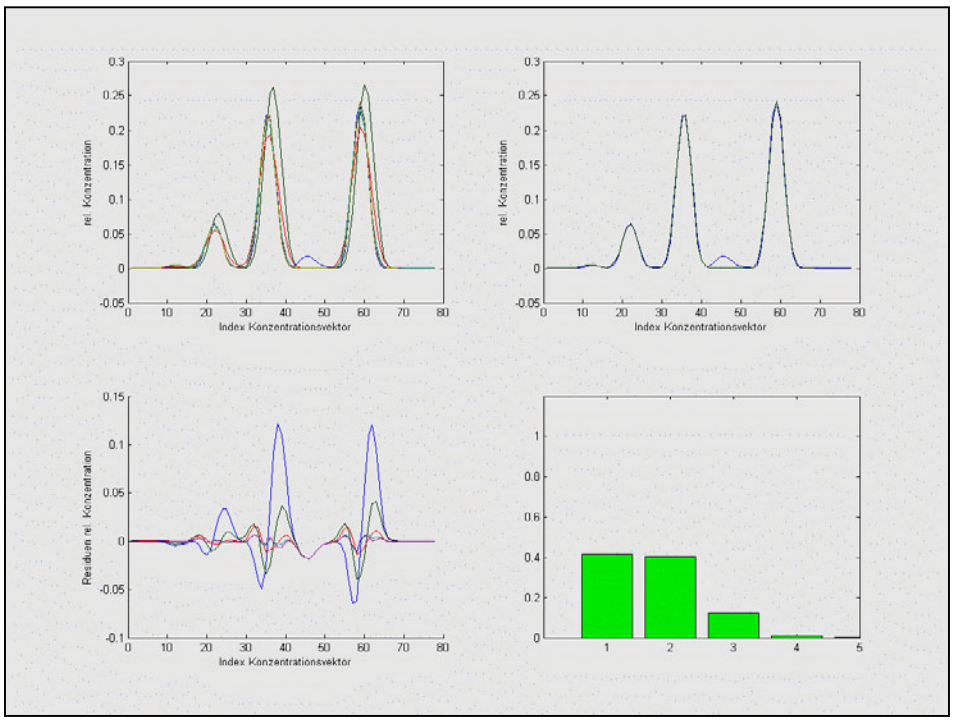
flow model in mixing chamber



Diffusion charging

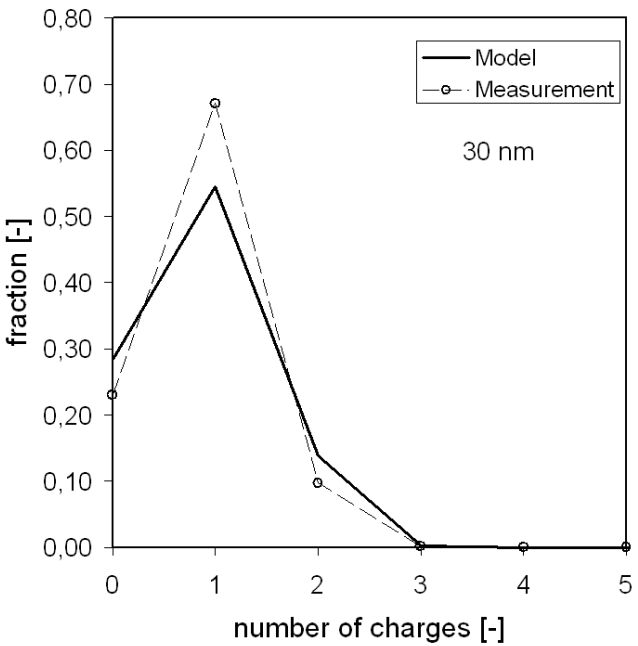
Measurement

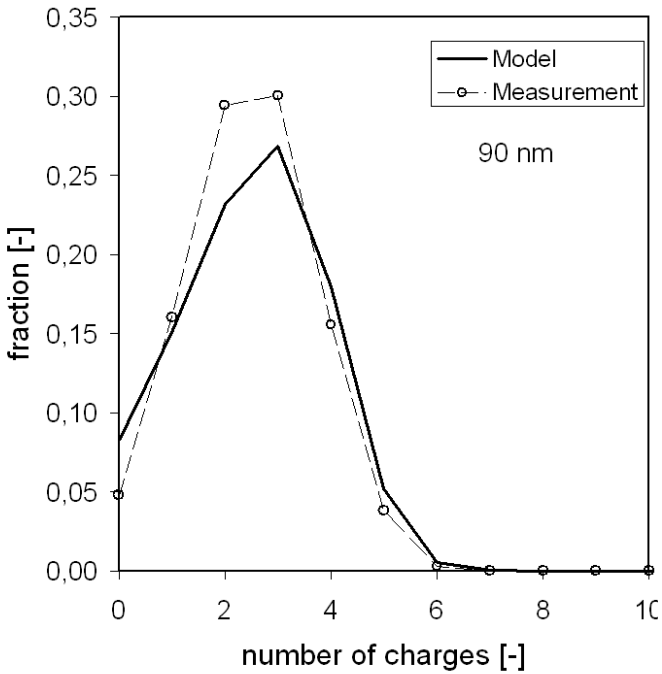


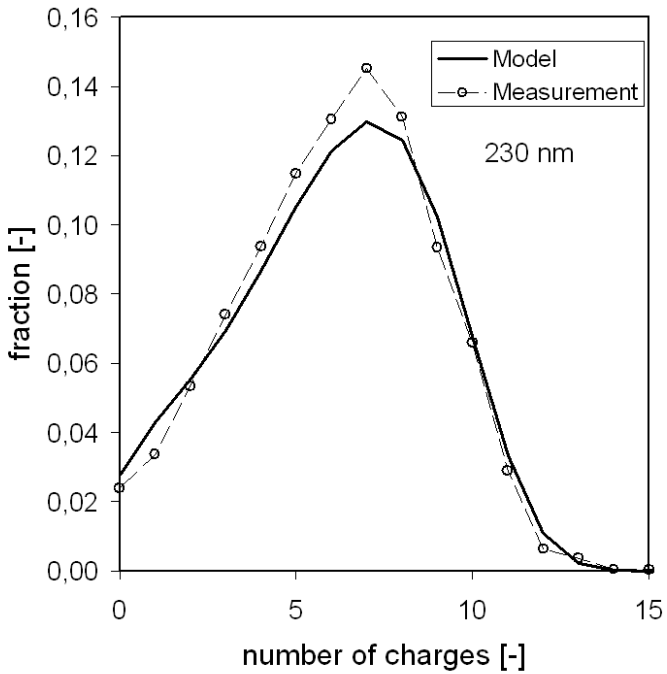


Diffusion charging

Comparing Measurement - Model

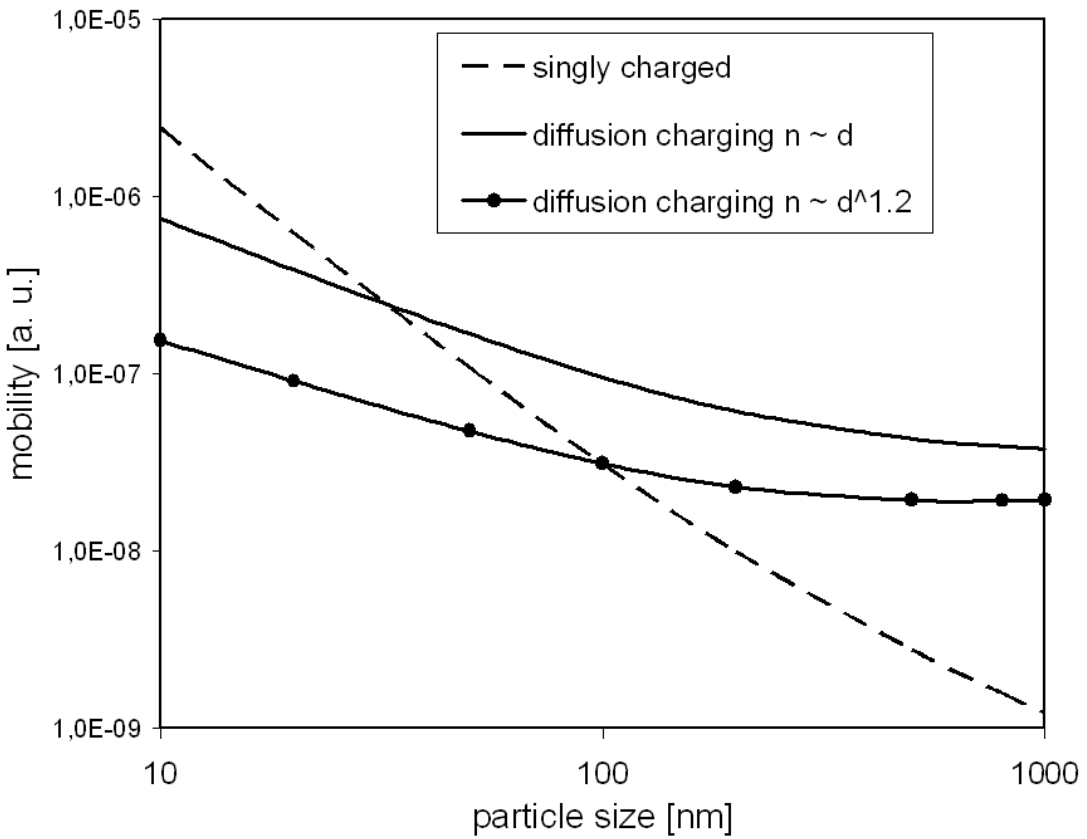






New aerosol spectrometer

Inversion

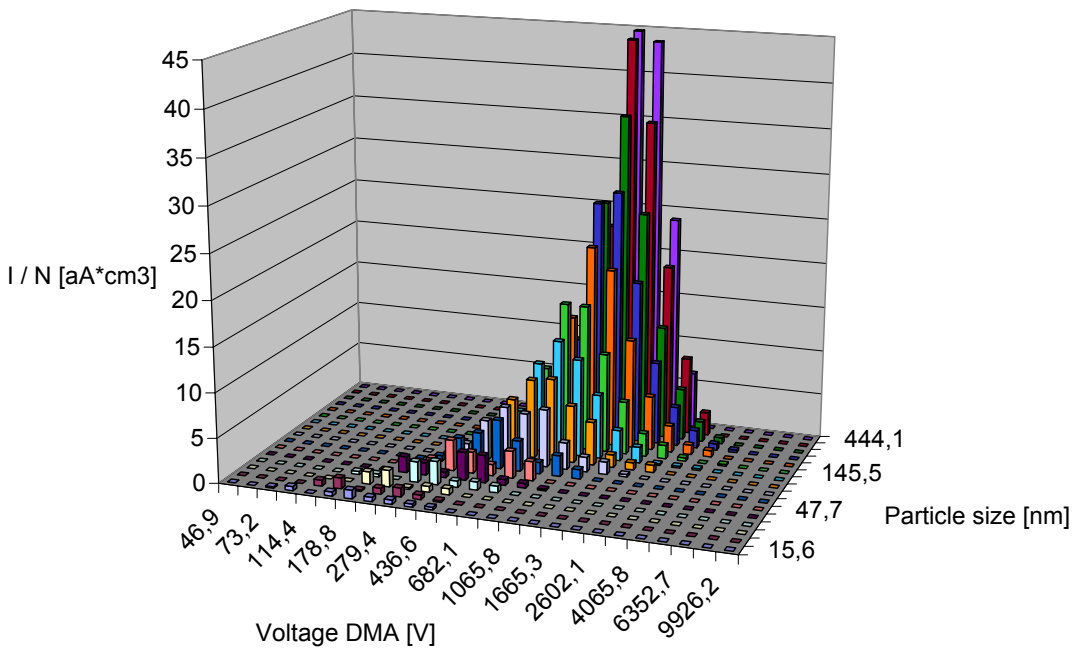


New aerosol spectrometer

Inversion

$$g(y) = \int_a^b K(x,y)\, f(x)\, \mathrm{d}x$$

$$\vec{g} = K \cdot \vec{f}$$



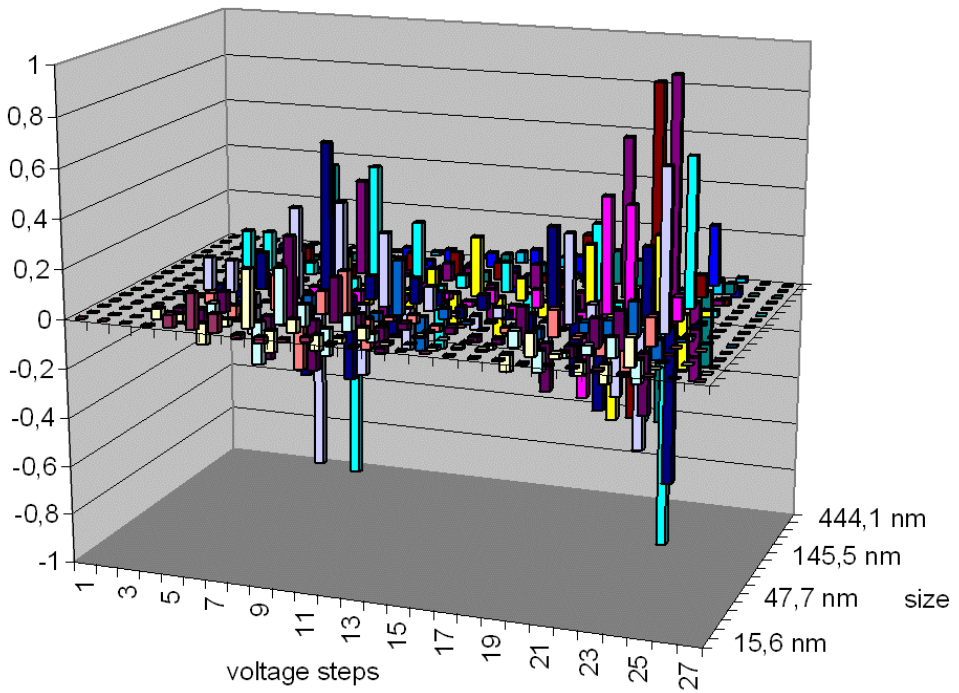
New aerosol spectrometer

Inversion

- Least square solution

$$S = (A * A)^{-1} A$$

- Nonlinear minimization



New aerosol spectrometer

Inversion

- Least square solution

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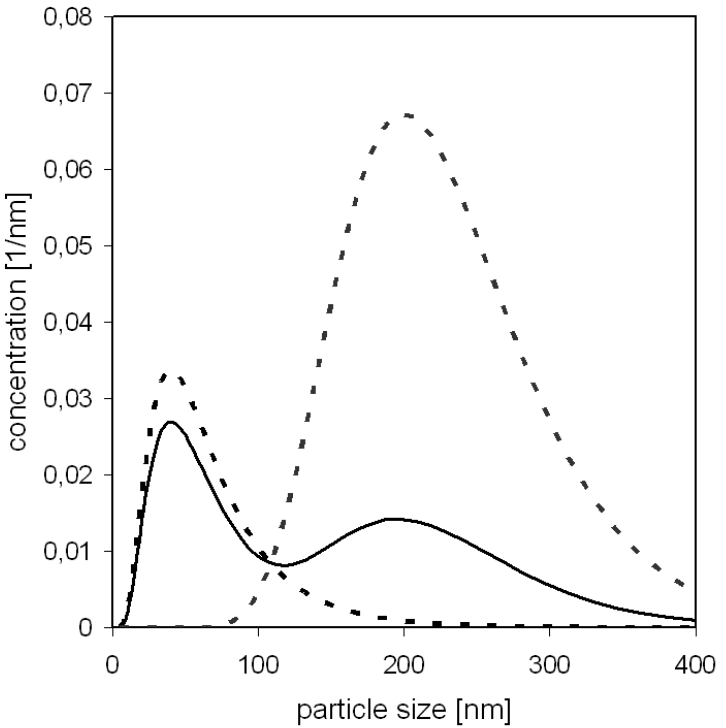
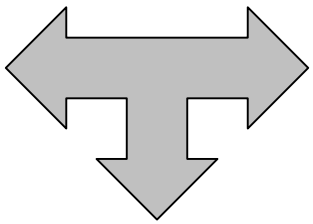
- Nonlinear minimization



New aerosol spectrometer

minimum size ~ 20 nm



maximum size ~ 800 nm

minimum concentration ~ 1000 p/cm^3

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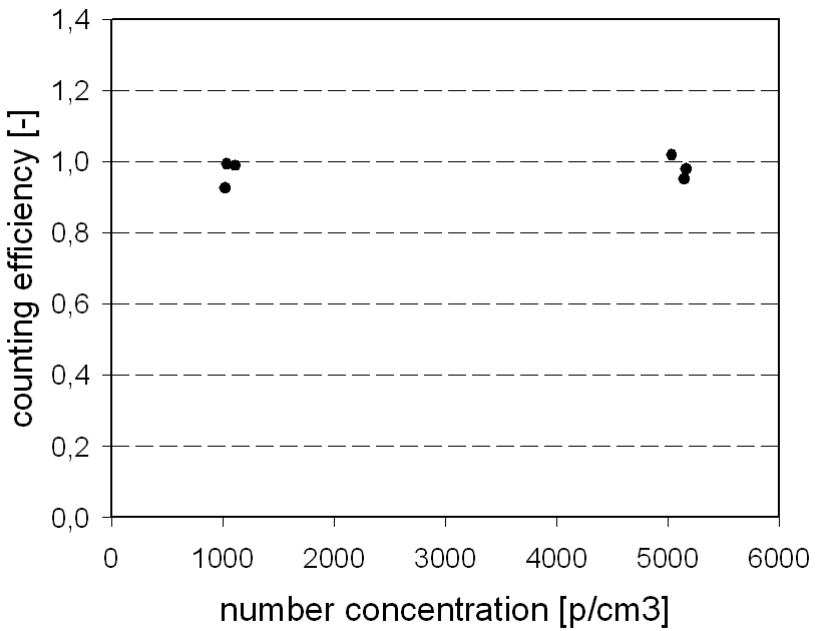
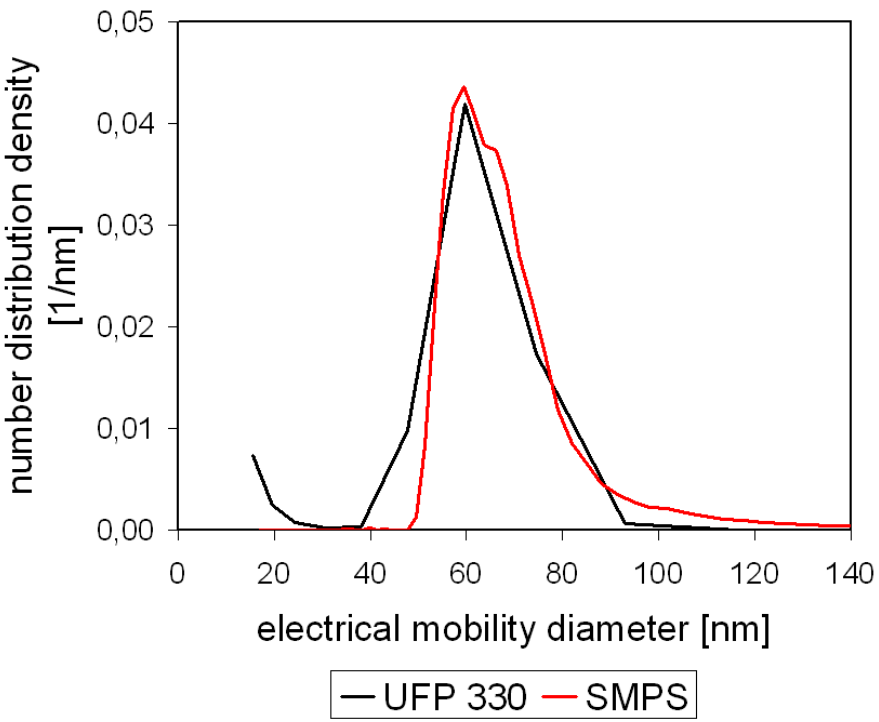
New aerosol spectrometer

Comparison to reference

Validation – test aerosols





Comparison to reference

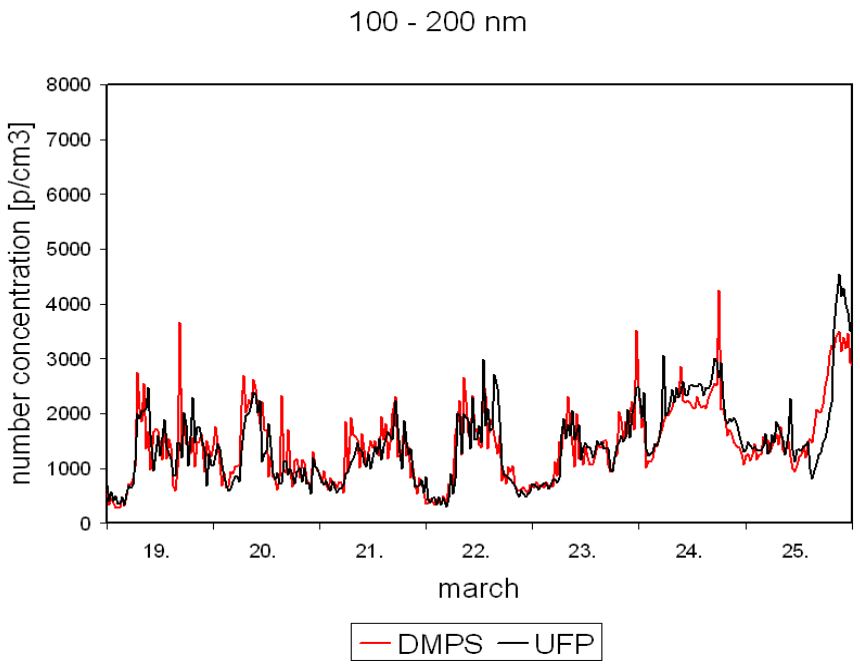
Validation – in the field

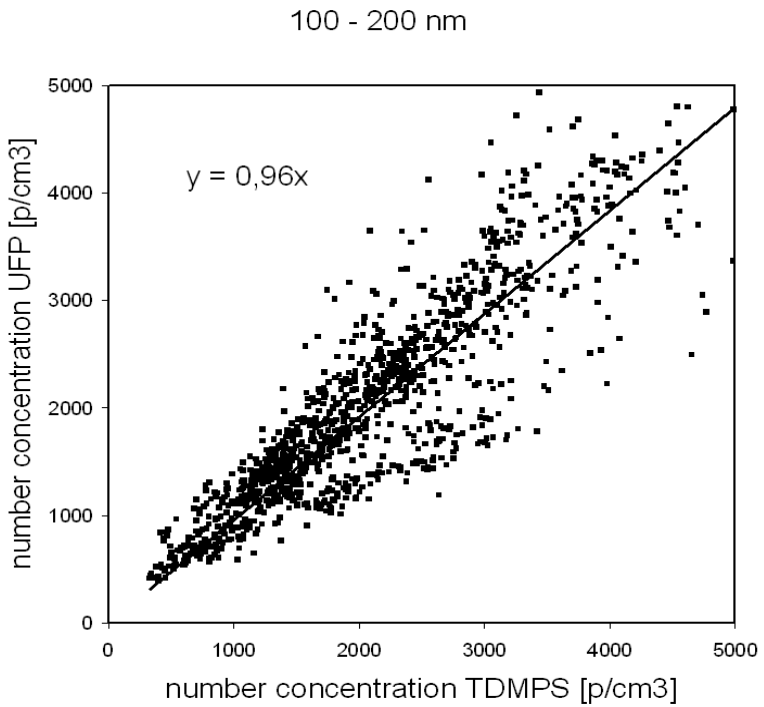
- IFT Leipzig

- Monitoring station Dresden Nord

Comparison to reference

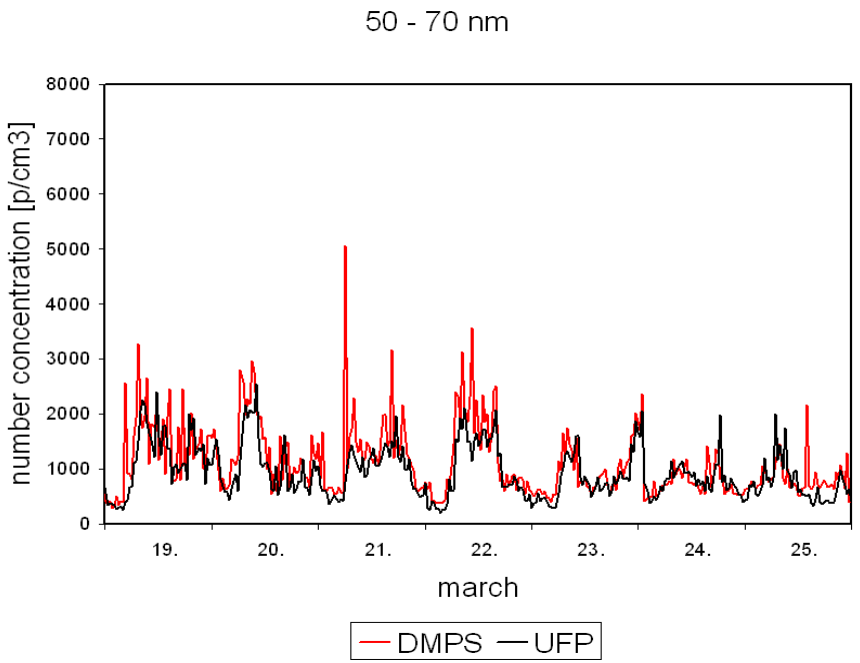
- TDMPS versus UFP
- size channel 100 – 200 nm

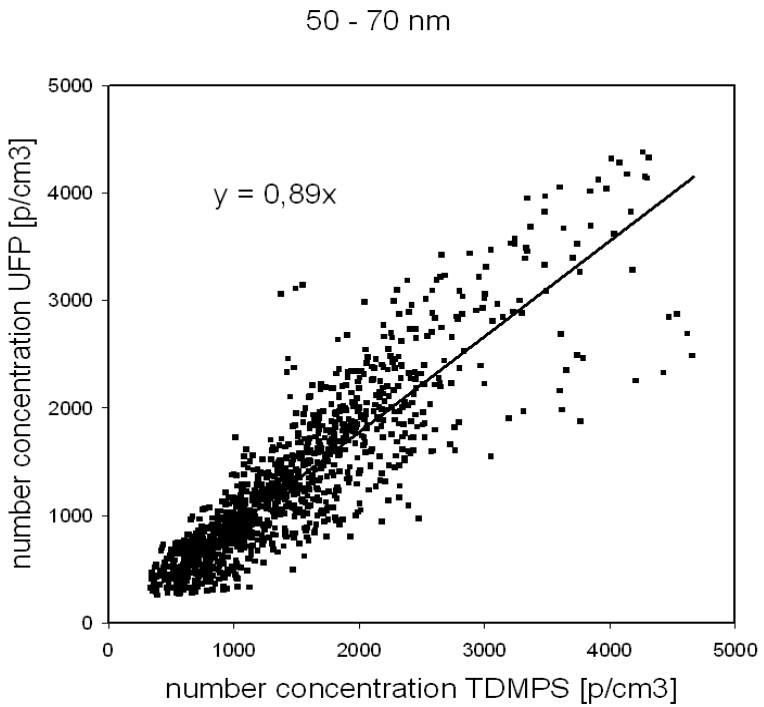




Comparison to reference

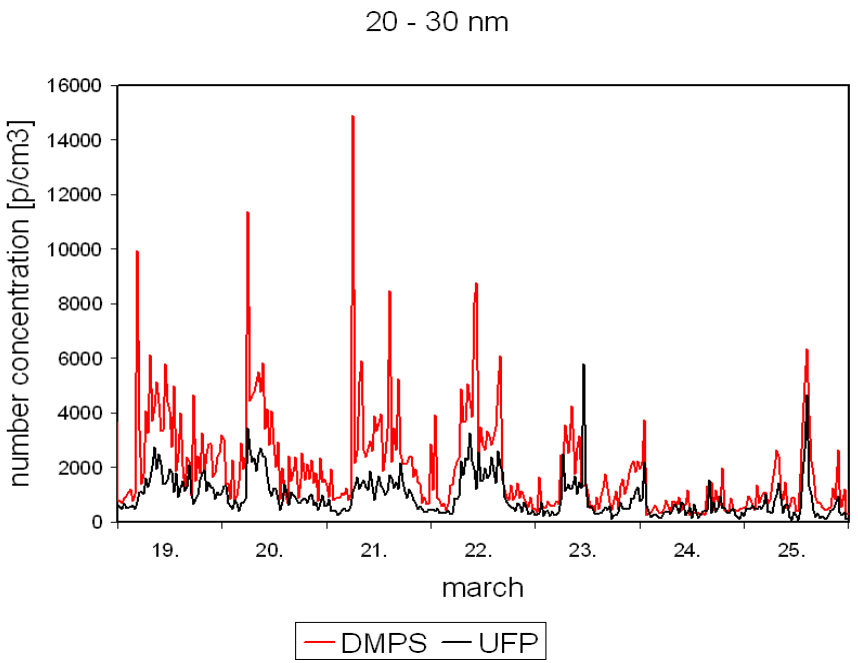
- TDMPS versus UFP
- size channel 50 – 70 nm

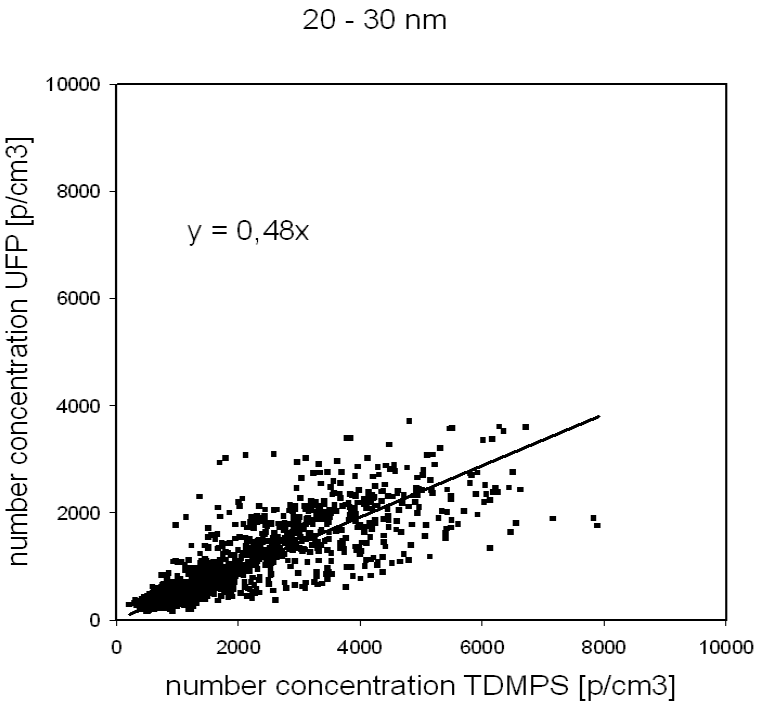




Comparison to reference

- TDMPS versus UFP
- size channel 20 – 30 nm





Summary

Charger

diffusion charger

band-pass DMA

Classifier

electrometer

Detector

Summary

Final Conference « Ultrafine Particles in Urban Air »

- 23.-24. October 2007 in Dresden
- german / english
- measurement of ultrafine particles
  legislatory framework
  health effects
- more details at:
  www.ufipolnet.eu

UFIPOLNET
Ultrafine Particle Size Distributions in Air Pollution Monitoring Networks

ULTRAFEINSTAUB IN DER STADT
23. bis 24.10.2007

Summary

Links

- T02A048 A. Zschoppe
- T13A202 B. Wehner
- T13A162 H. Gerwig

Summary

UFIPOLNET (www.ufipolnet.eu) is financed by the LIFE financial instrument of the European Community under No. LIFE04 ENV/D/000054.

UFIPOLNET

ultrafine particle size distributions in air pollution monitoring networks

GSF – Forschungszentrum für Umwelt und Gesundheit in der Helmholtz-Gemeinschaft

Thank you

Questions ?