

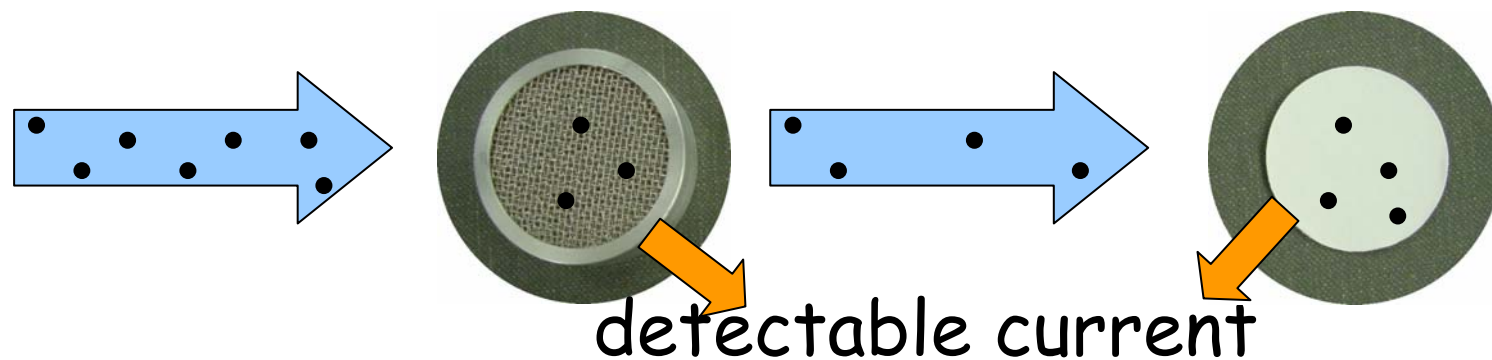
Miniature diffusion size classifiers for personal monitoring and sensor networks

M. Fierz, C. Houle, P. Steigmeier and H. Burtscher

Fachhochschule Nordwestschweiz, Windisch,
Switzerland

The diffusion size classifier (DiSC)

- Particles are labelled with positive charges in a unipolar charger, so that they can later be detected by the current they induce
- Particles are deposited by diffusion in a "diffusion stage" and detected as an electrical current
- Remaining particles end up in a filter stage

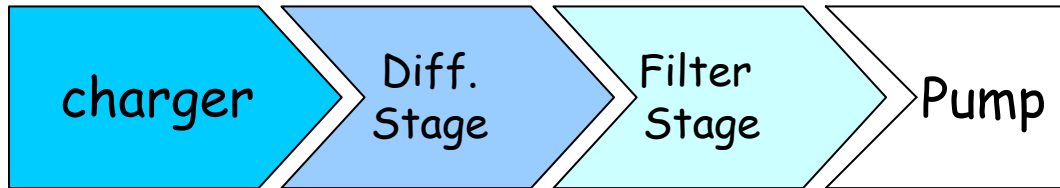


DiSC (2)

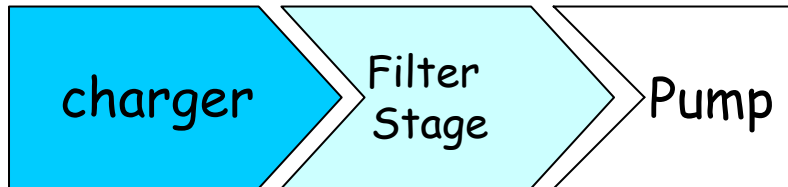
- Diffusional deposition is size-selective: smaller particles are captured more efficiently
- Filter stage current divided by diffusion stage current \Rightarrow particle size
- Total current + particle size \Rightarrow particle number



DiSC vs DC (Diffusion Charger)



Diffusion Size Classifier
(DiSC) average particle size,
particle number



Diffusion Charger
(DC)

no size/number information
measures „diameter concentration“
Can be interpreted as lung deposited
surface area - interesting!?

2008 Personal Monitor Prototype (DC) **n|w**

- 770 grams
- 9h battery life
- 45x82x180mm
- Data stored on SD-card



- 10x smaller and lighter than existing diffusion charging instruments

- 670 grams
- 8h battery life
- 40x90x180 mm
- Data stored on SD-card
- USB connection to PC

It's DiSC instead of DC
(but it could be a DC
too)



- DiSC measures particle number average diameter and DC signal with a time resolution of 1 second
- Detection limits:
~10...200nm (DC: no upper limit)
~1e3...1e6 pt/ccm
- Accuracy typ. +/-30%



12 times smaller than
the original DiSC

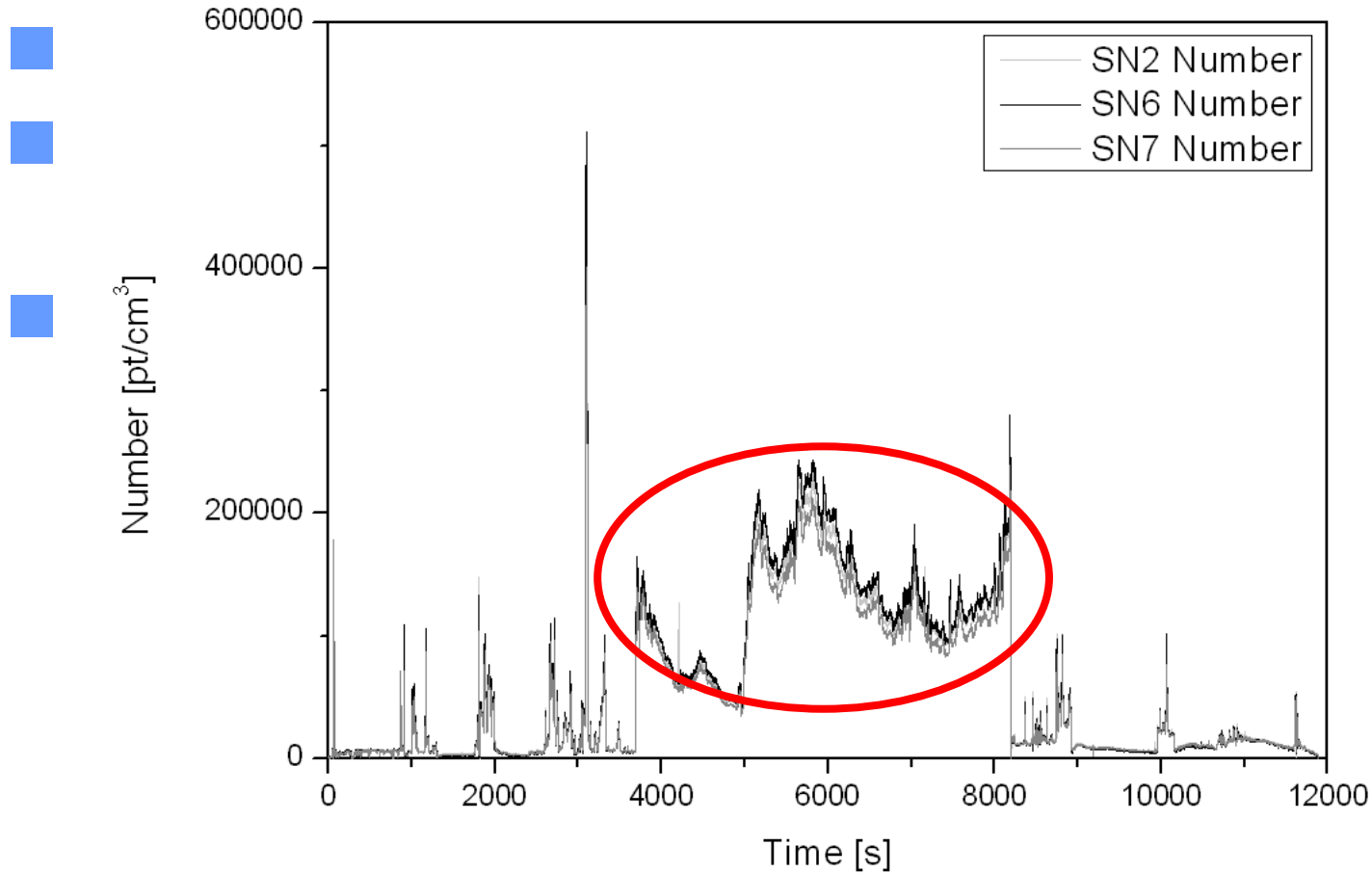
Compared to the desktop DiSC, the miniDiSC has

- a lower flow rate (1lpm) = lower signals = higher detection limits
- a weaker pump (less underpressure possible)
- finer meshes in the diffusion stage which require more frequent cleaning & recalibration
- Less power available for heating to stabilize temperature

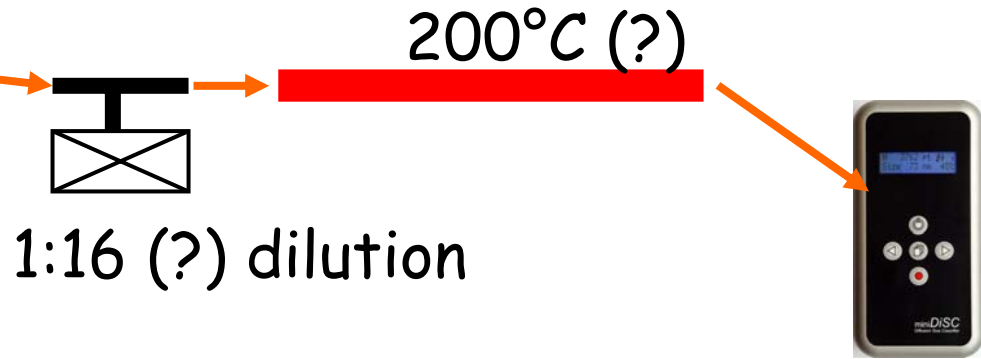
- We can build both a DiSC and a DC in a miniature package
- Both instruments seem interesting to me
- The DiSC is a „superset“ of the DC - you get DC signal plus particle number plus average particle diameter

Application 1: Personal exposure

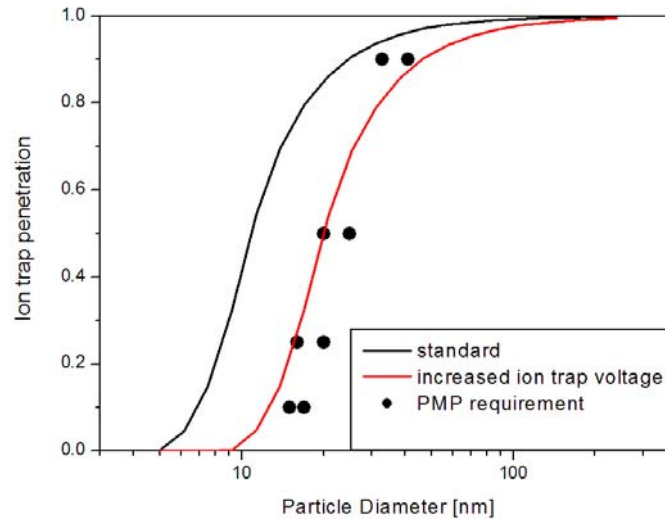
Brugg - Baden - Zürich - Küssnacht 30.4.2009



Application 2: portable „PMP“



Particle losses
in ion trap:

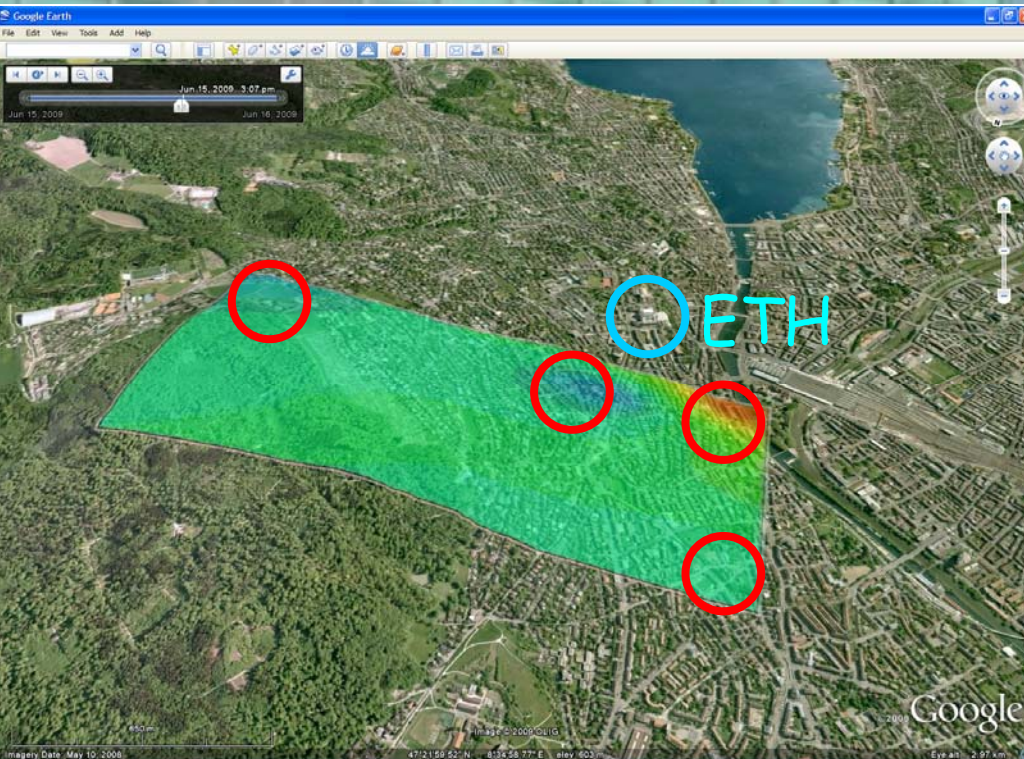


Application 3: Monitoring network **n|w**

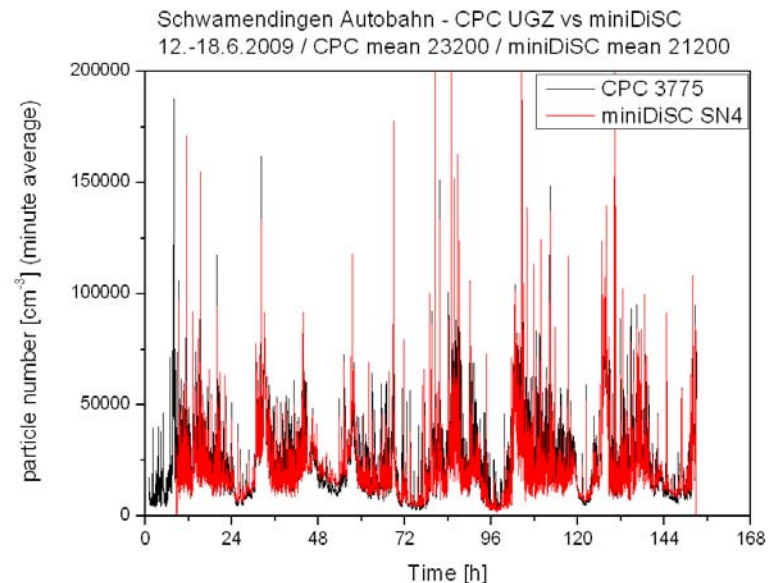
- 6 miniDiSCs were deployed for one week in Zürich
- Environmental enclosures used in exposed locations
- 220V mains power used
- External battery pack in enclosure would last approximately one week
- Data recorded to SD-card



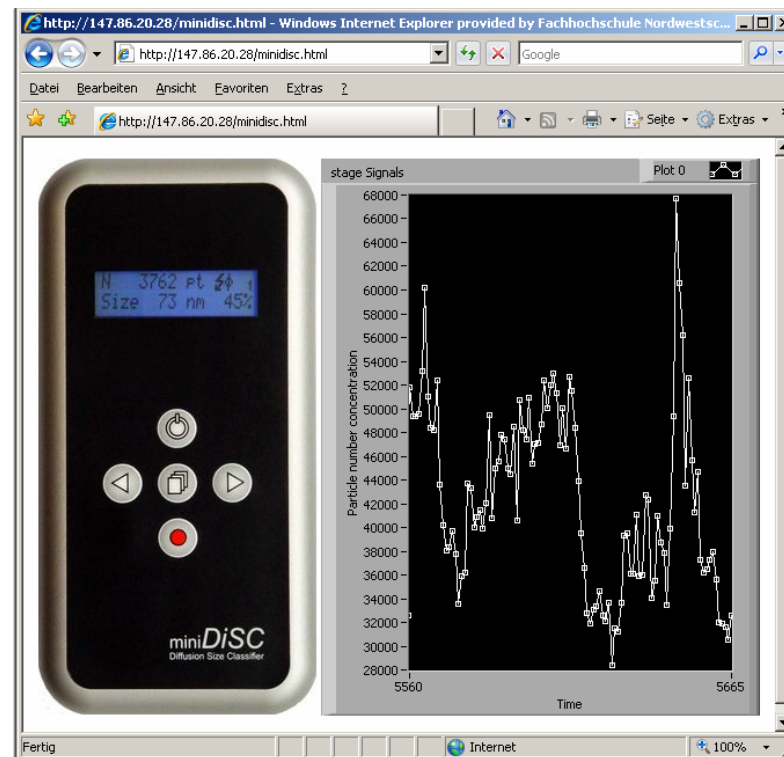
Results



Totally different type of data than that available today - high temporal and potentially high spatial resolution



Wireless monitoring network



<http://147.86.20.28/minidisc.html>
(limited time only!)

Summary

- The miniDiSC is a new handheld aerosol detector
- DiSC or DC?
- It should be useful both for exposure studies as well as for flexible measurement networks, such as transport of PM from a localized source (not for long-term-monitoring!)
- It might be useful for „PMP-like“ field measurements in combination with a simple thermodiluter

Acknowledgements

Work

Corey Houle (mechanical design)

Peter Steigmeier (electronics)

Monitoring Network Example

Susanne Schlatter (UGZ)

Peter Mertes (PSI)

Funding

Forschungsfonds Aargau



Thank you for your attention!

