NMR Project workshop
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Hilton Copenhagen Airport

Various difficulties of comparing DMPS/SMPS systems during a calibration workshop and/or off-line

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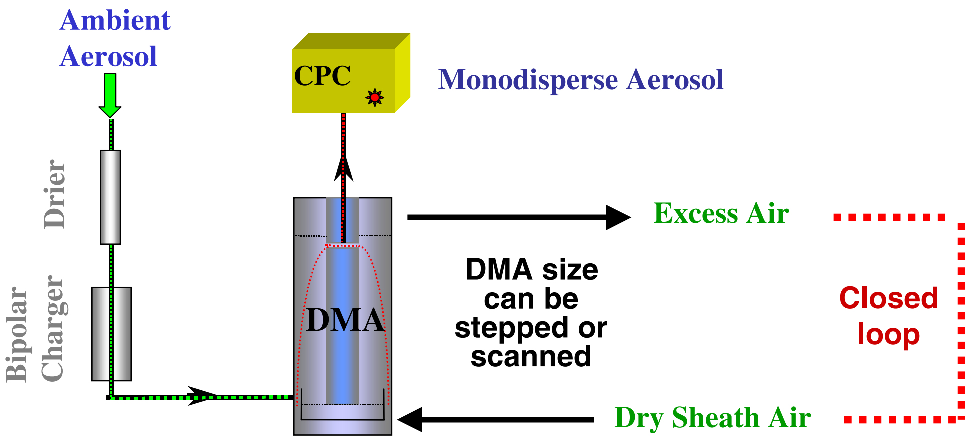
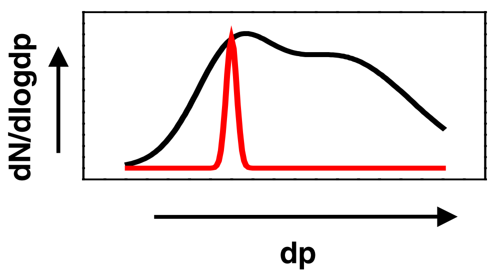
DMPS/SMPS comparison



We want to compare

- Size
- Measured number concentration



Impact on sizing: DMPS/SMPS

- Sheath flow stability (small impact)
- Ambient pressure in the DMA (small impact)
- Ambient temperature in the DMA (small impact)
- Relative humidity in the DMA (possibly high impact, because of particle growth in the system, efficient drying is recommended for closed loop systems)
- Correct DMA geometry (possibly high impact)
- Voltage calibration (large impact especially for small particle sizes, low voltages)

Impact on sizing: SMPS

- Residence time of particles in the system (DMA, tubing, CPC)

A system comparison in sizing can be provided for the raw data – if available!

Impact on measured number concentration: DMPS/SMPS

- Aerosol flow stability (small impact)
- Penetration losses in the inlet and the DMA (small impact for fine aerosol fraction)
- DMA transfer function (small impact)
- Probability of bipolar charging (possibly high impact if aerosol particles are not dried before)
- CPC efficiency (large impact especially for small particle sizes)

All these issues (except the first one) are size dependent properties and the specific data inversion algorithm should take into account the individual system properties. A system comparison in number concentration can only be provided after the data inversion!

Possible methods of comparison: DMPS/SMPS

- Systems are operated in a lab experiment - all systems will determine the same aerosol provided by e.g. a nebulizer (salt particles, spheres) or atmospheric aerosol perhaps in combination with a DMA (TDMA setup). Comparison in sizing and number concentration can be done.
- Systems are operated in different labs – a set up for particle generation has to be provided by e.g. a nebulizer (salt particles, spheres) or atmospheric aerosol. Comparison in sizing can be done, for comparison in number concentration a second, independent technique has to be added (e.g. CPC with well-known efficiency).

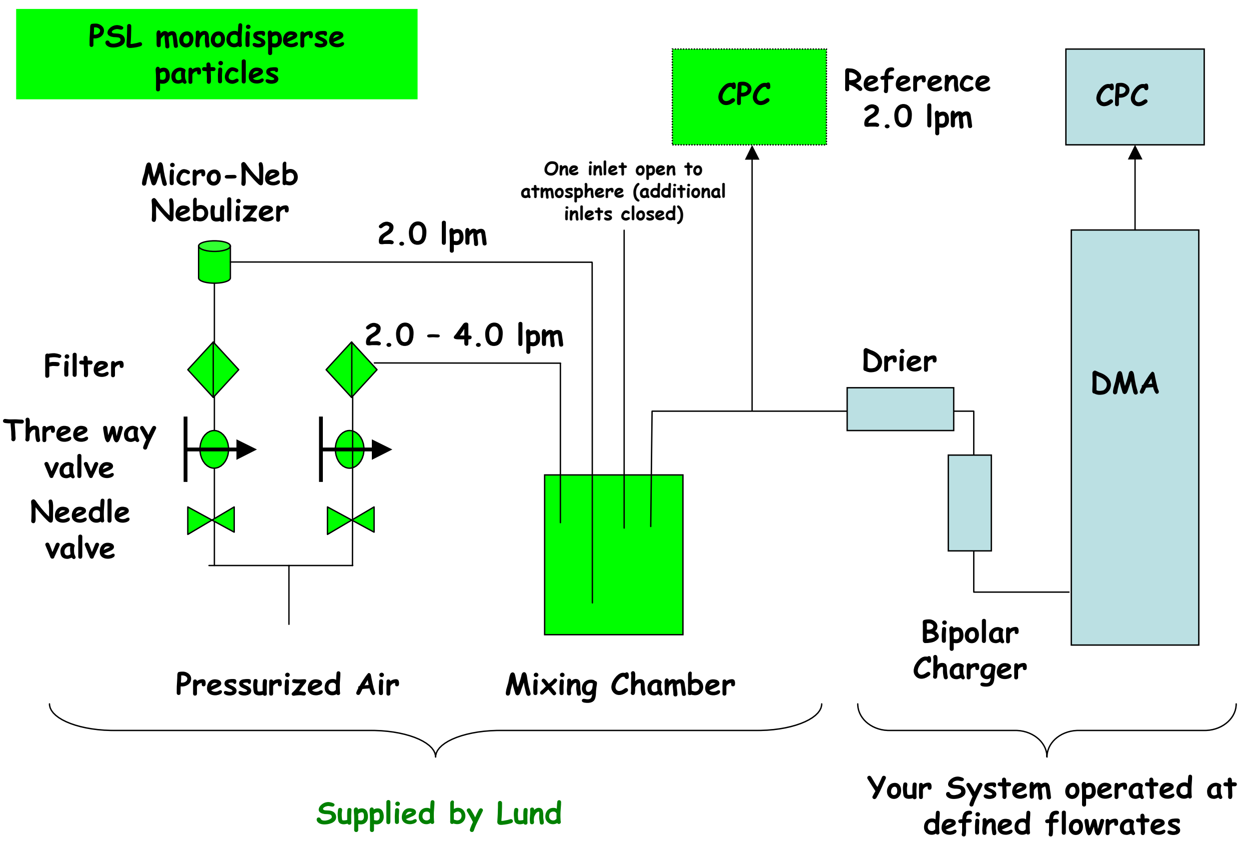
Problems and questions that may occur for DMPS/SMPS intercomparison

- Is it possible for the different systems to provide the raw data (non-inverted data)?
- Is it possible for the different systems to change the size range and or to define the size steps?
- Is it possible for the different systems to define the number of size bins of the inverted data?
- Is it possible for the different systems to select the number of charges to be accounted for in the inversion algorithm?

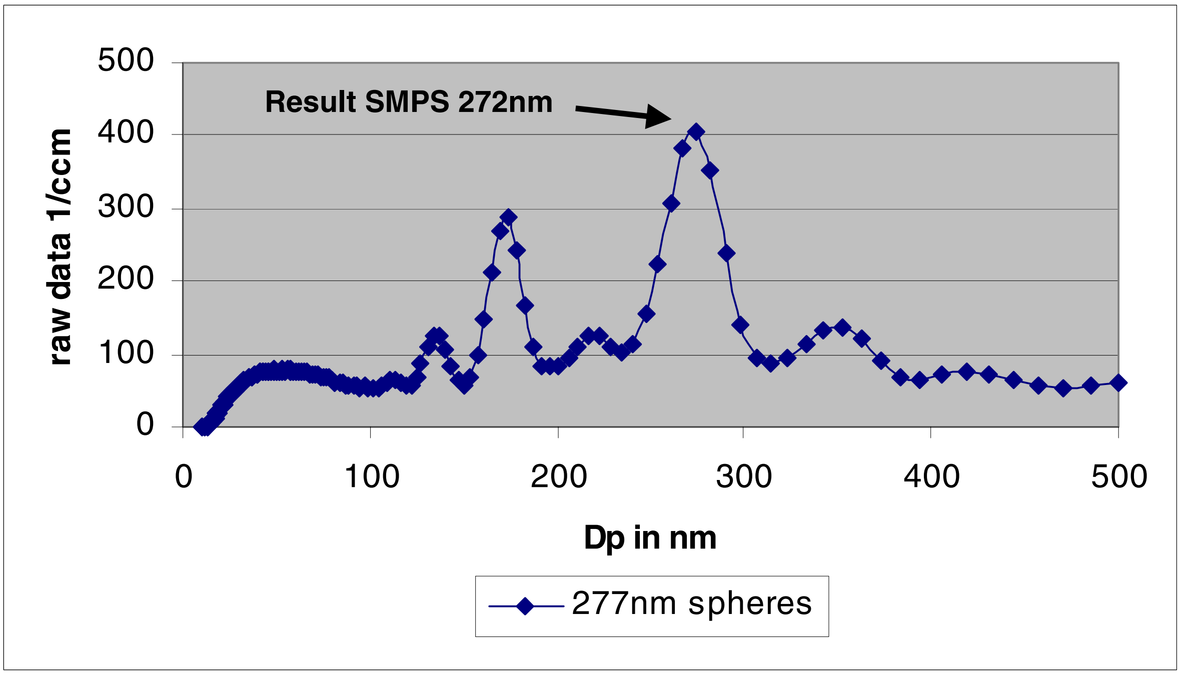
DMPS/SMPS intercomparison

- Systems will be operated in different labs – a set up for particle generation will be provided by a nebulizer spraying latex spheres (PSL). Comparison in sizing can be done for diameters Dp = 101, 277, 420nm.
- Atmospheric aerosol number size distributions will be taken over several days with the DMPS/SMPS in conjunction with a CPC 3022 with well-known efficiency. The calculated total particle number after inversion should match the measured value of the CPC 3022 for periods when the particle number beyond the size range of the DMPS/SMPS system and the CPC 3022 (7nm – 10µm) is negligible small.
- A charger will be provided by Lund for comparison of charging probability.

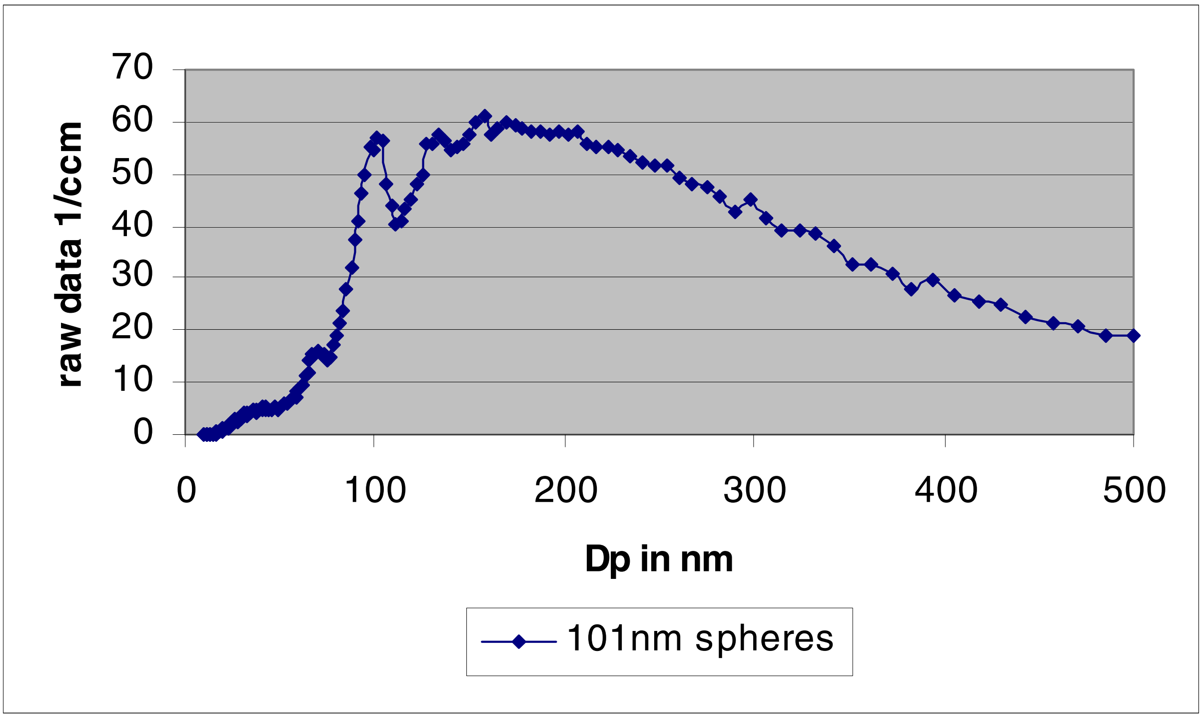
DMPS/SMPS intercomparison set up



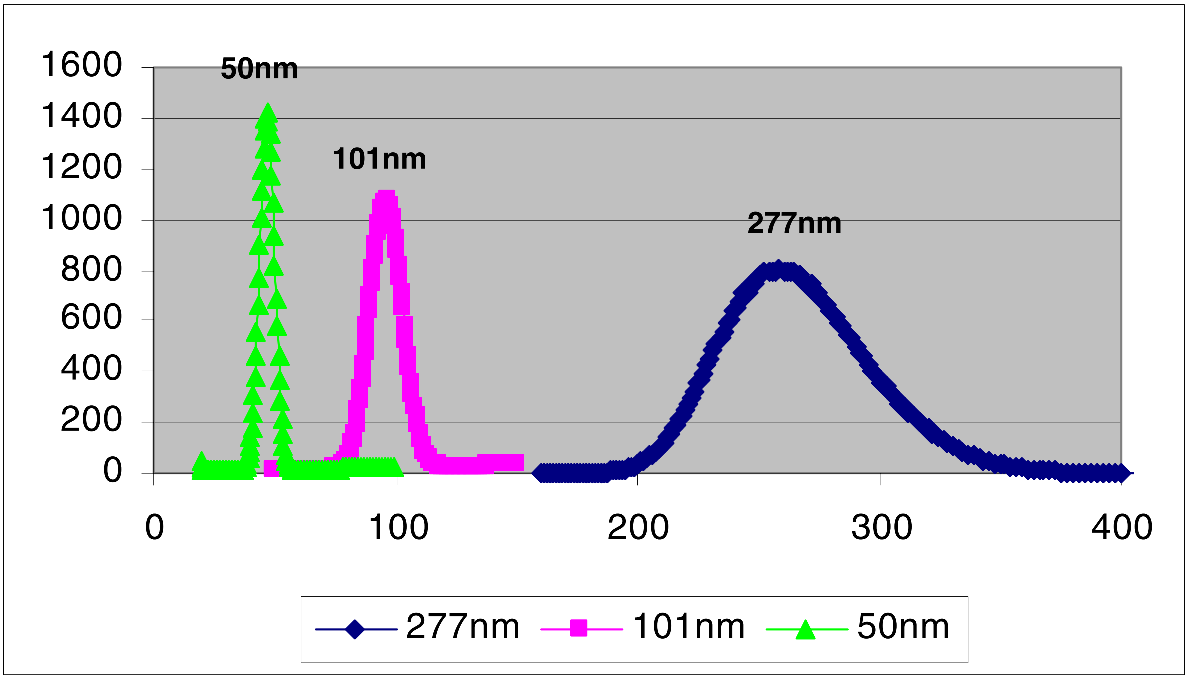
Size calibration with latex spheres (Dp = 277nm)



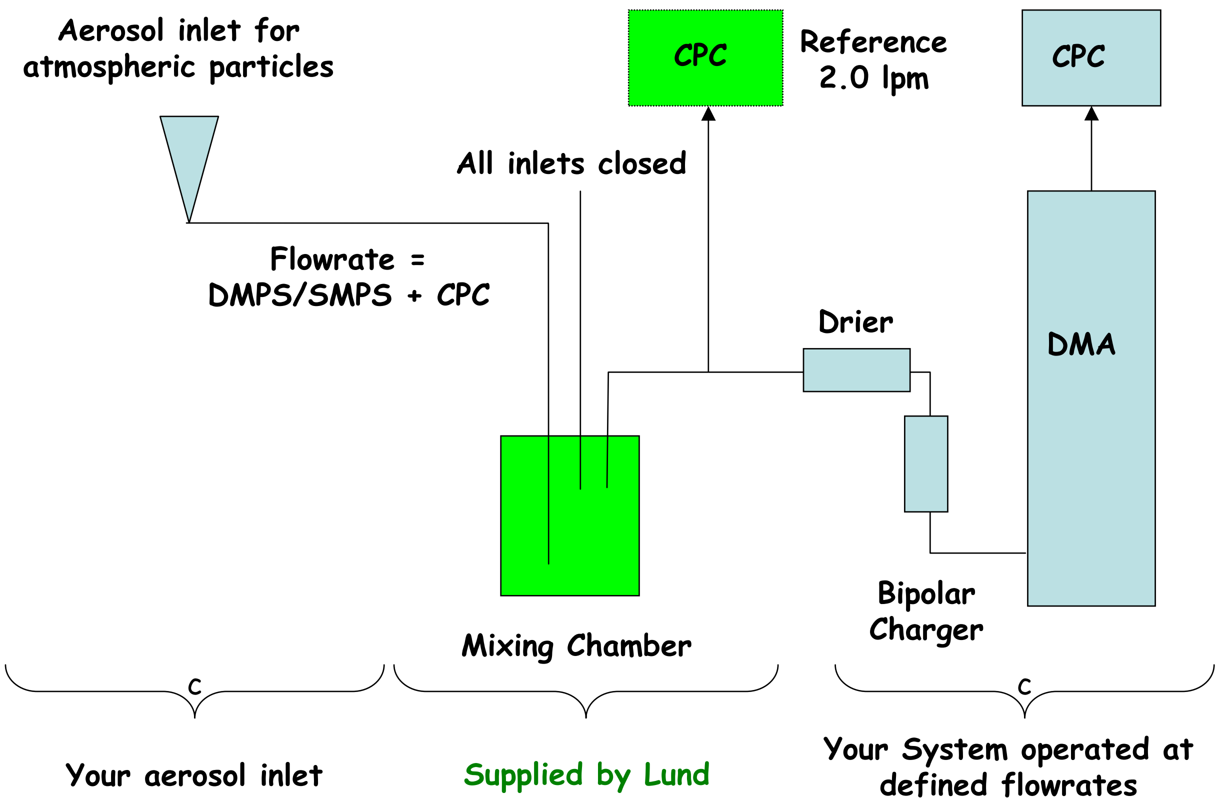
Size calibration with latex spheres (Dp = 101nm)



Comparison: size calibration with a Tandem-DMA set up (salt particles: Dp = 50, 101, 277nm)



DMPS/SMPS intercomparison set up



Atmospheric aerosol: comparison total particle number measured by SMPS (10 – 660nm) and CPC 3022 (7nm – 10µm)