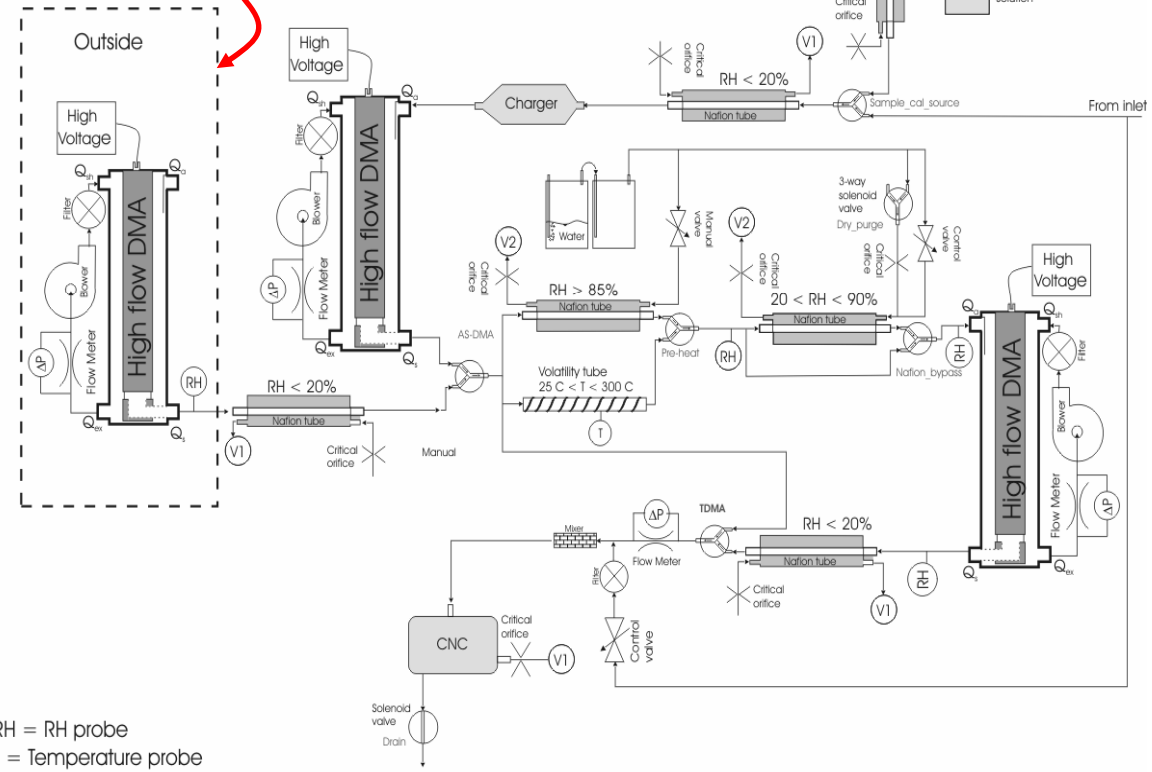
# ARM TDMA processing and results

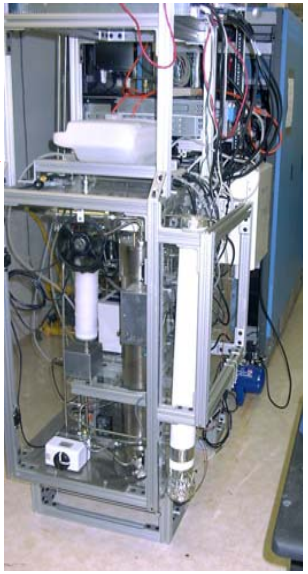
# SGP tandem differential mobility analyzer



- Installed in the AOS trailer ~ 10/1/05
- Uninterrupted operation since
- Mentor:  Don Collins – Texas A&M University
- Currently working on data ingest and archival

# SGP tandem differential mobility analyzer



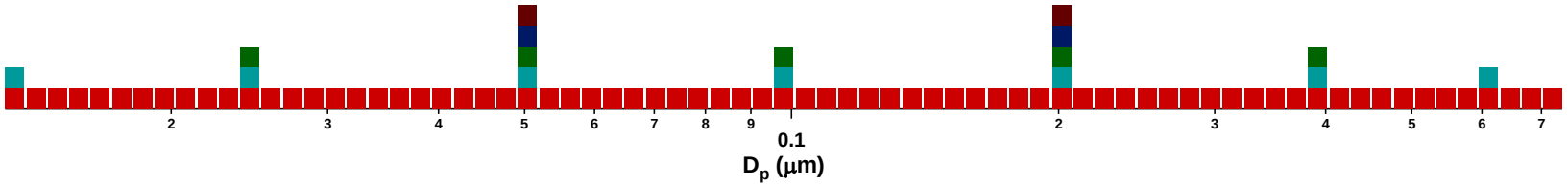



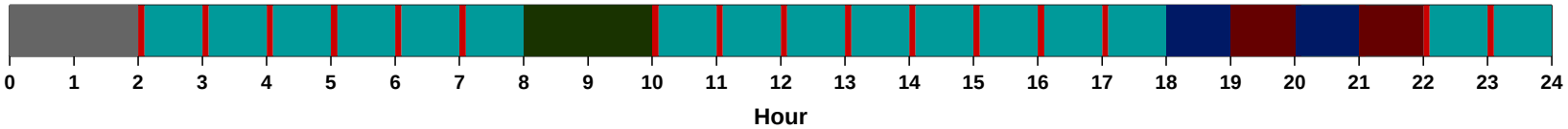
RH = RH probe
T = Temperature probe
V = Vacuum

# Daily sequence of measurements



| Measurement name | Quantity measured | Size resolution / range | Time | Frequency |
|---|---|---|---|---|
| DMA | Dry aerosol size distribution | 75 bins between 0.01 and 0.75 µm $D_p$ | 5 min | ~ 25 times daily |
| TDMA | Size-resolved hygroscopic growth at fixed RH (90%) | 7 bins between 0.013 and 0.6 µm dry $D_p$ | 40 min | ~ 25 times daily |
| RH scan | Size-resolved hygroscopic growth over wide RH range (30 – 90% RH) | Limited to 0.05 and 0.2 µm dry $D_p$ | 2 hr | once daily |
| T scan | Size-resolved aerosol volatility over wide temperature range (25 – 300 °C) | Limited to 0.05 and 0.2 µm dry $D_p$ | 2 hr | once daily |
| AS TDMA | Size-resolved ambient hydration state<br>o Generally suitable only when ambient RH is between 40 and 80% | 5 bins between 0.025 and 0.4 µm $D_p$ | 2 hr | ≤ once daily |
| Auto-calibration | o Growth of NaCl particles at low (~10%) and high (90%) RH<br>o False count rate | | 2 hr | once daily |



# Analysis of size distributions



Recorded size distributions

↓

Size-resolved probability of 1, 2, 3, or 4 + charges
Diffusionally-broadened transfer function
Size-resolved diffusional particle loss

Inversion

↓

Inverted distributions

↓

Integrated number concentration
Integrated volume concentration
($dV/d\log D_p$ @ 0.5 μm) / ($dV/d\log D_p$ @ 0.6 μm)
Correlation between up and down scans

Data checks

↓

Level 0, 1, and 2 inverted distributions

# Analysis of TDMA distributions



Recorded hygroscopic growth factor distributions

↓

"Zero growth" correction from low-RH NaCl measurements
RH correction from high-RH NaCl measurements

↓

Calibration-corrected distributions

↓

Contribution by particles with 2 and 3 charges
Diffusionally-broadened transfer function

↓

Inverted distributions

↓

RH vs. $RH_{set}$
# peaks
Relative concentration at edges
Correlation between up and down scans
Number of particles counted
Location of distribution mode

↓

Level 0, 1, and 2 inverted distributions

# Subset of figures to be available on website

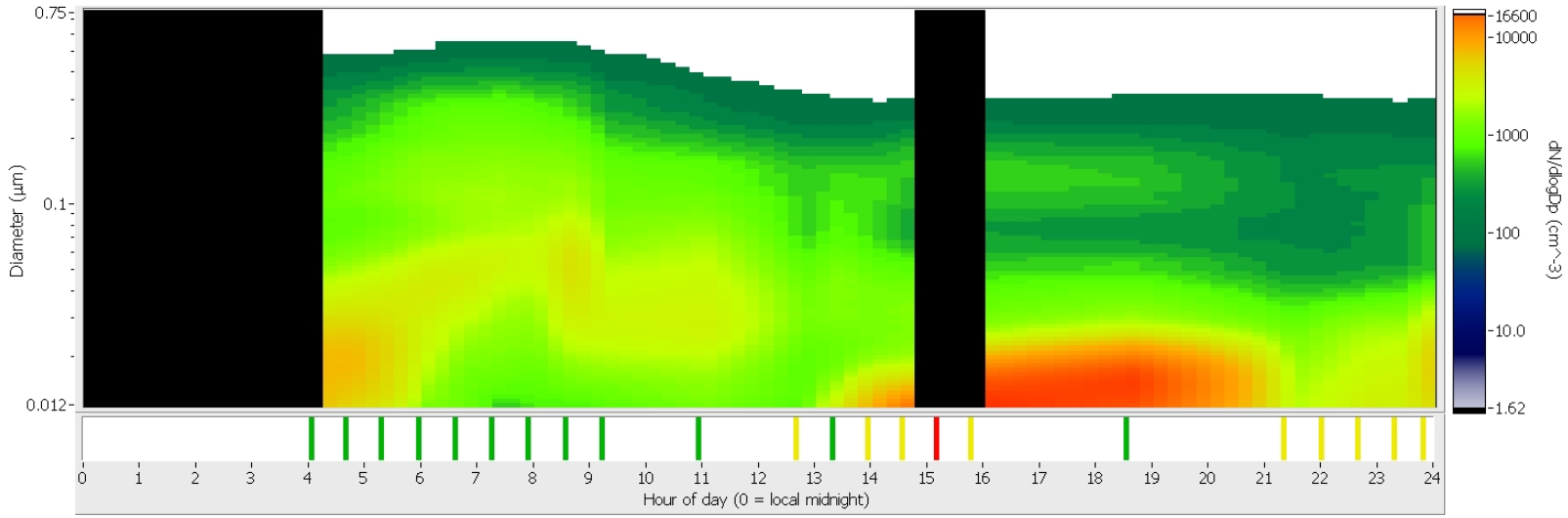
Instrument overview

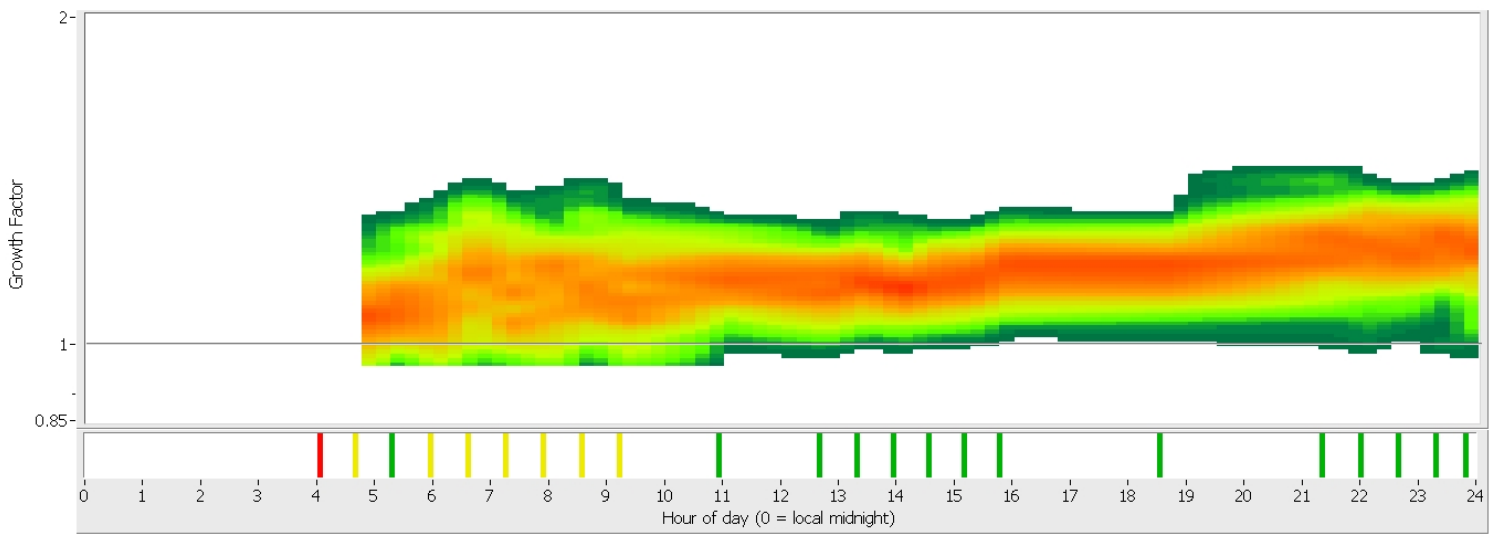
Measurement sequence

Analysis procedure

Files created

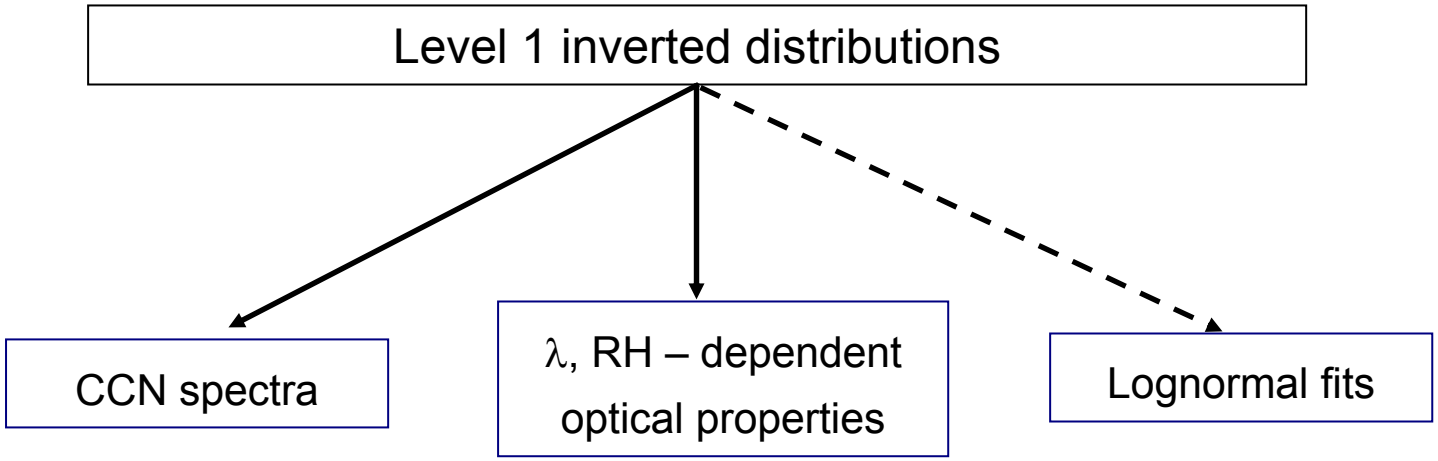
Links to -/+ presentations



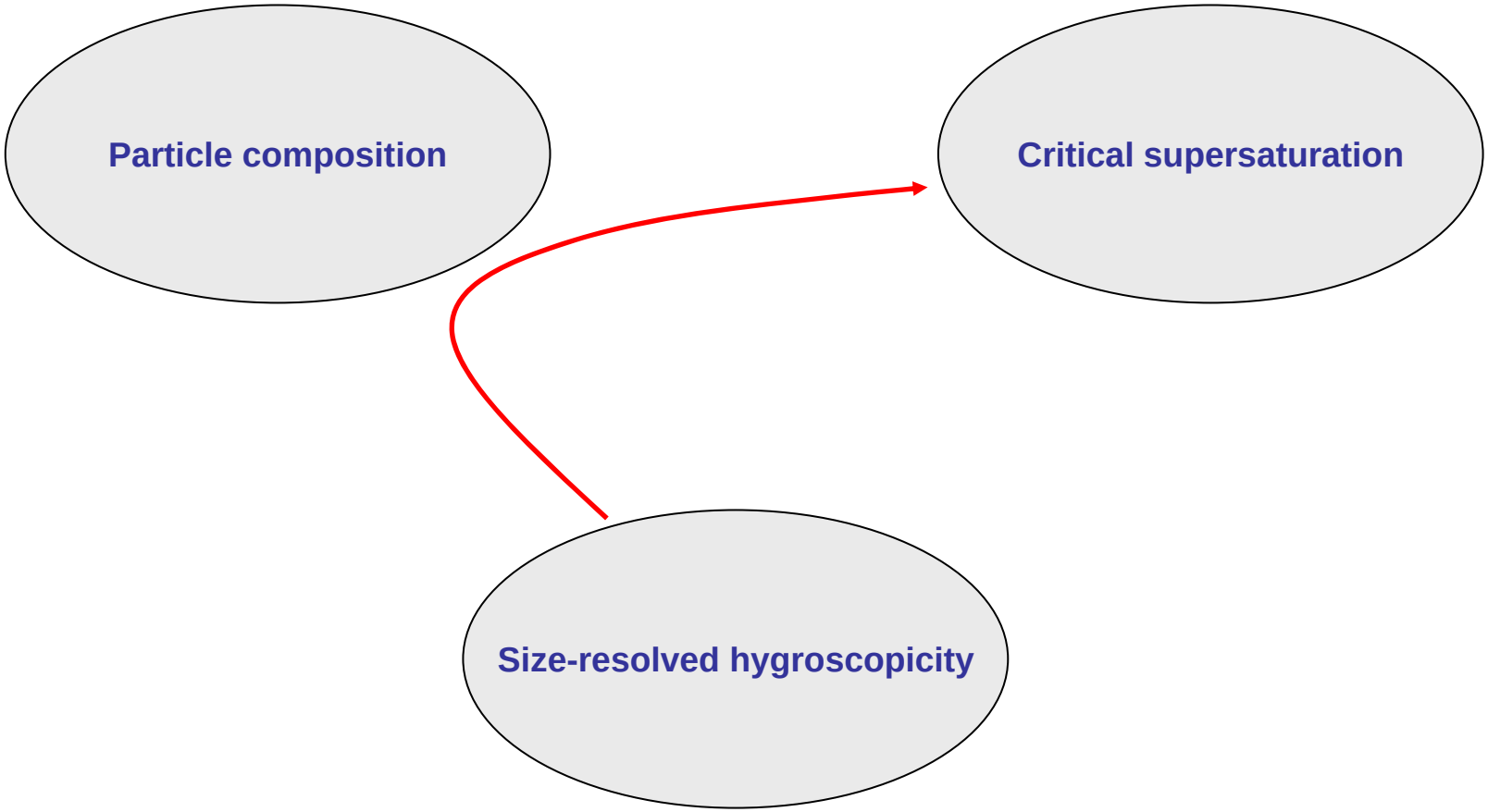
# Data products





# Calculated CCN spectra

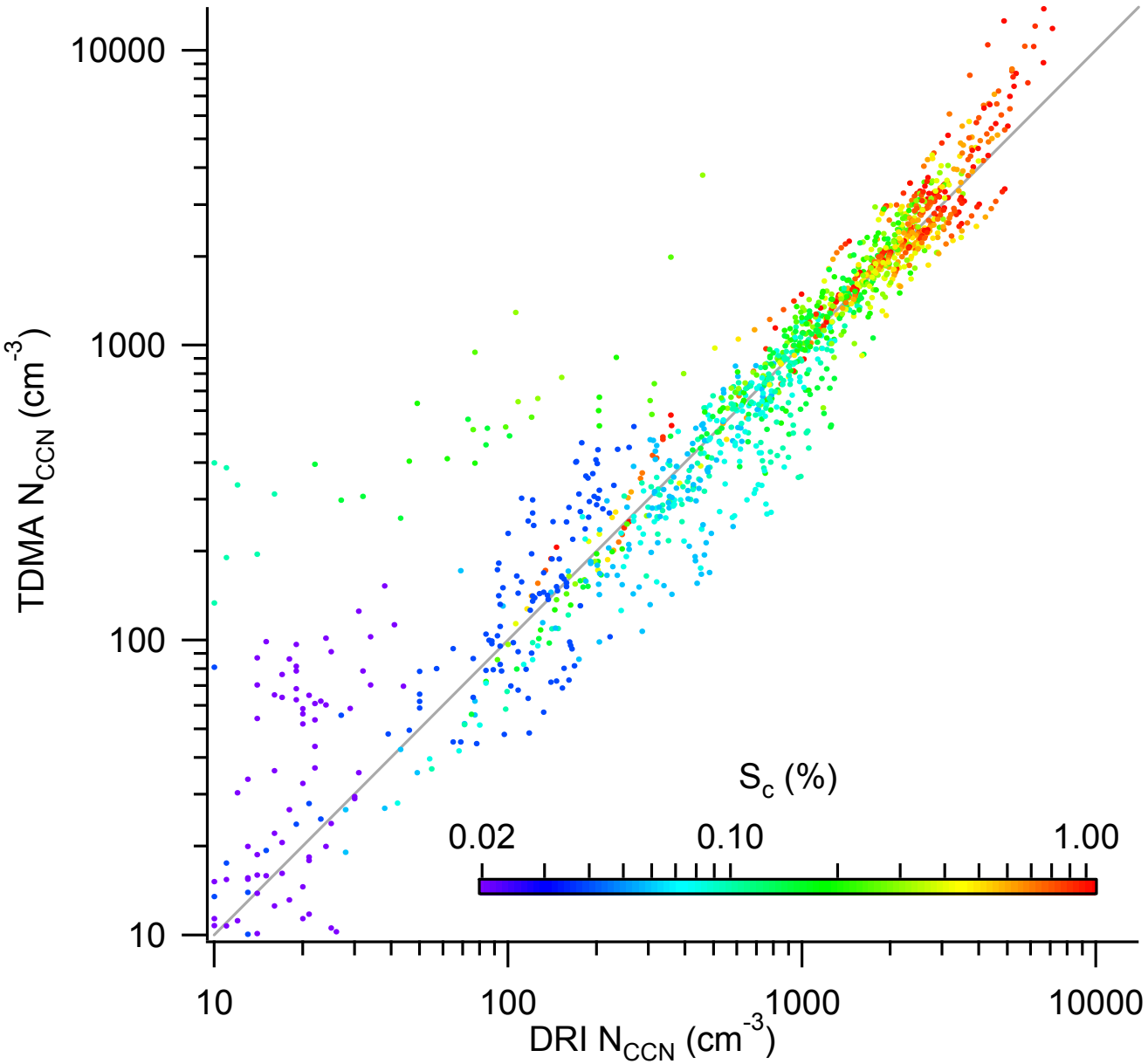





Files containing differential and cumulative spectra created

# Calculated CCN spectra





# Calculated optical properties

Instrument overview
Measurement sequence
Analysis procedure
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Links to -/+ presentations

- Extinction coefficient, $b_{ext}$
- Single scattering albedo, $\omega$
- Lidar ratio, S
- Asymmetry parameter, g
- Hemispheric backscatter ratio, $h_b$
- Mass extinction efficiency, $\alpha$
- *Upscatter fraction, $\beta$*

$$\left.\begin{aligned} x &= c_o + c_1\left(\frac{RH}{70\%}\right) + c_2\left(\frac{RH}{70\%}\right)^2 + c_3\left(\frac{RH}{70\%}\right)^3 \\ \overset{o}{a} &= c_o + c_1\left(\frac{RH}{70\%}\right) + c_2\left(\frac{RH}{70\%}\right)^2 + c_3\left(\frac{RH}{70\%}\right)^3 \end{aligned}\right\} \begin{aligned} &400\,nm \\ &550\,nm \\ &700\,nm \end{aligned}$$

# Calculated optical properties

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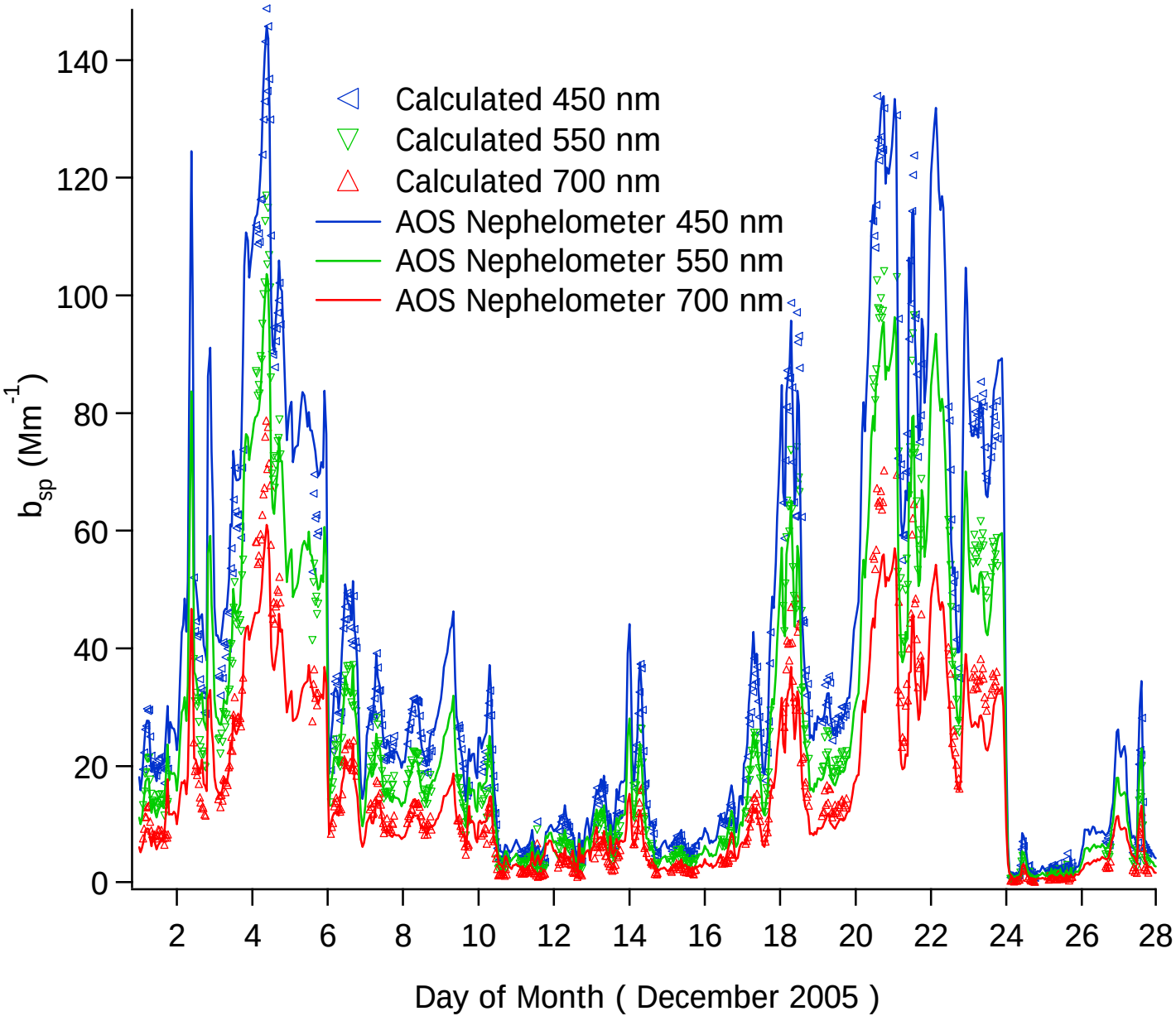

# DMA / TDMA to DMT CCN counter (?)

Instrument overview

Measurement sequence

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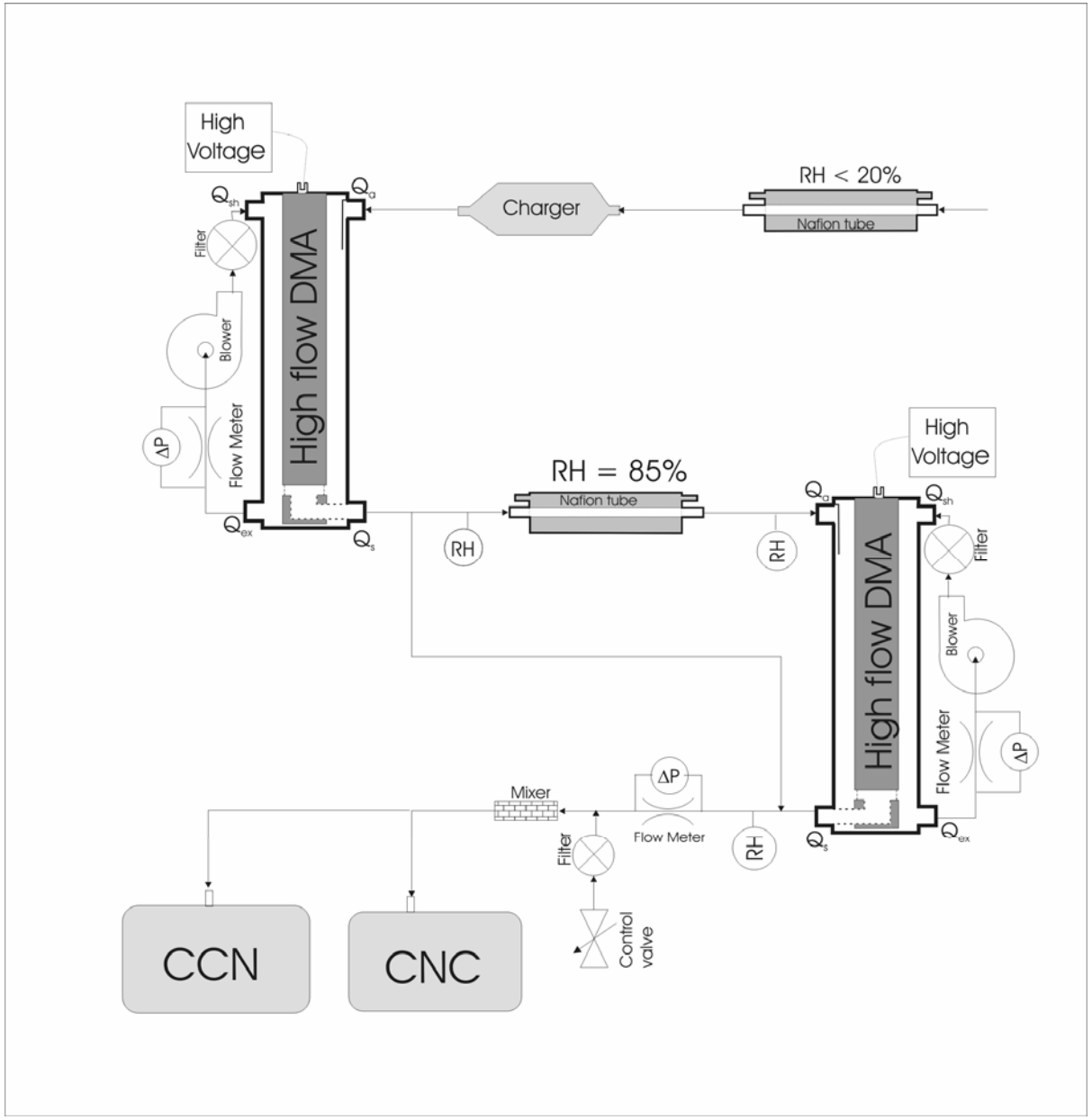

# Ambient hydration state measurements

Instrument overview
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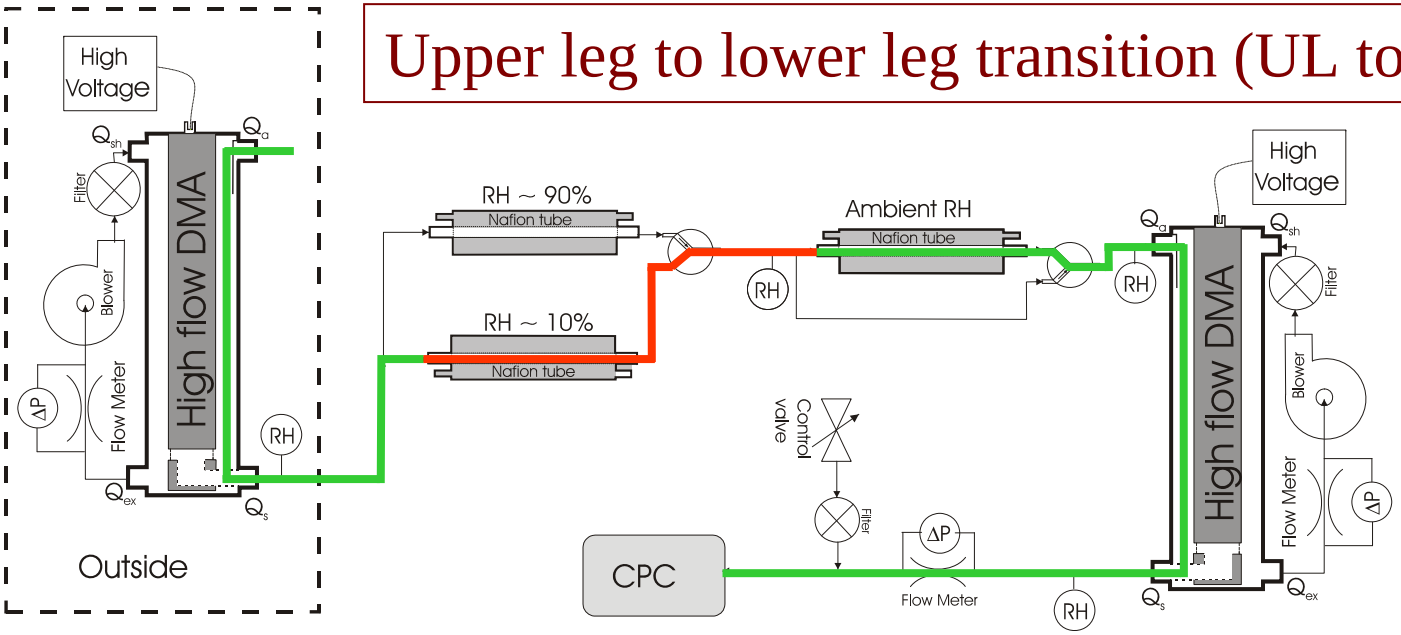
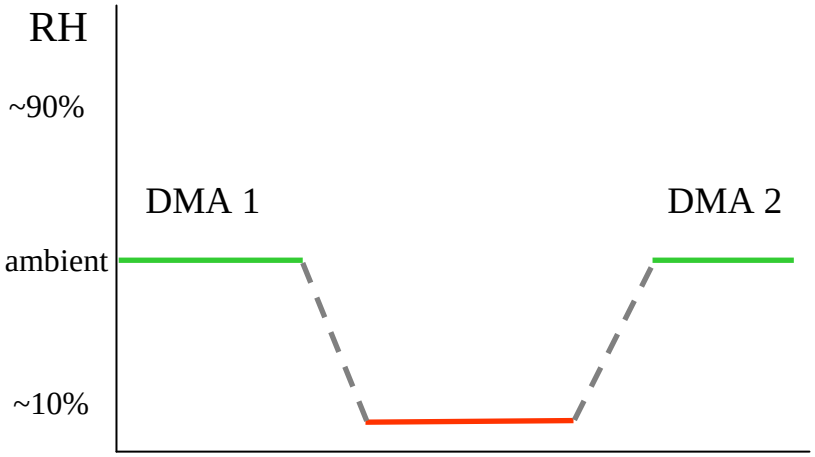
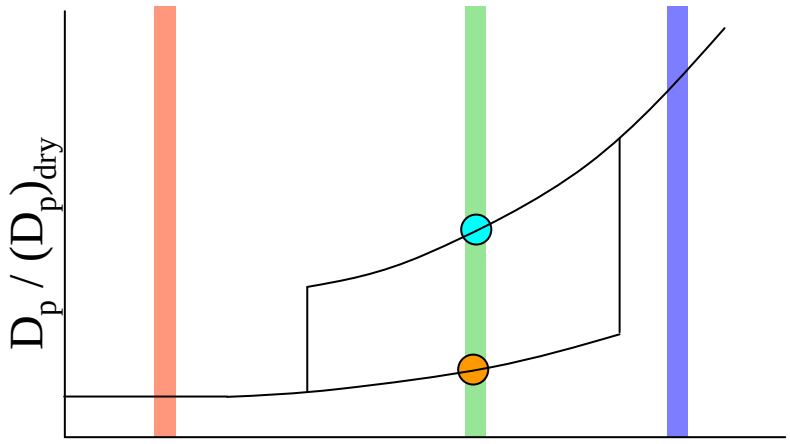
## Upper leg to lower leg transition (UL to LL)




What a single particle experiences




RH

# Ambient hydration state measurements

Instrument overview
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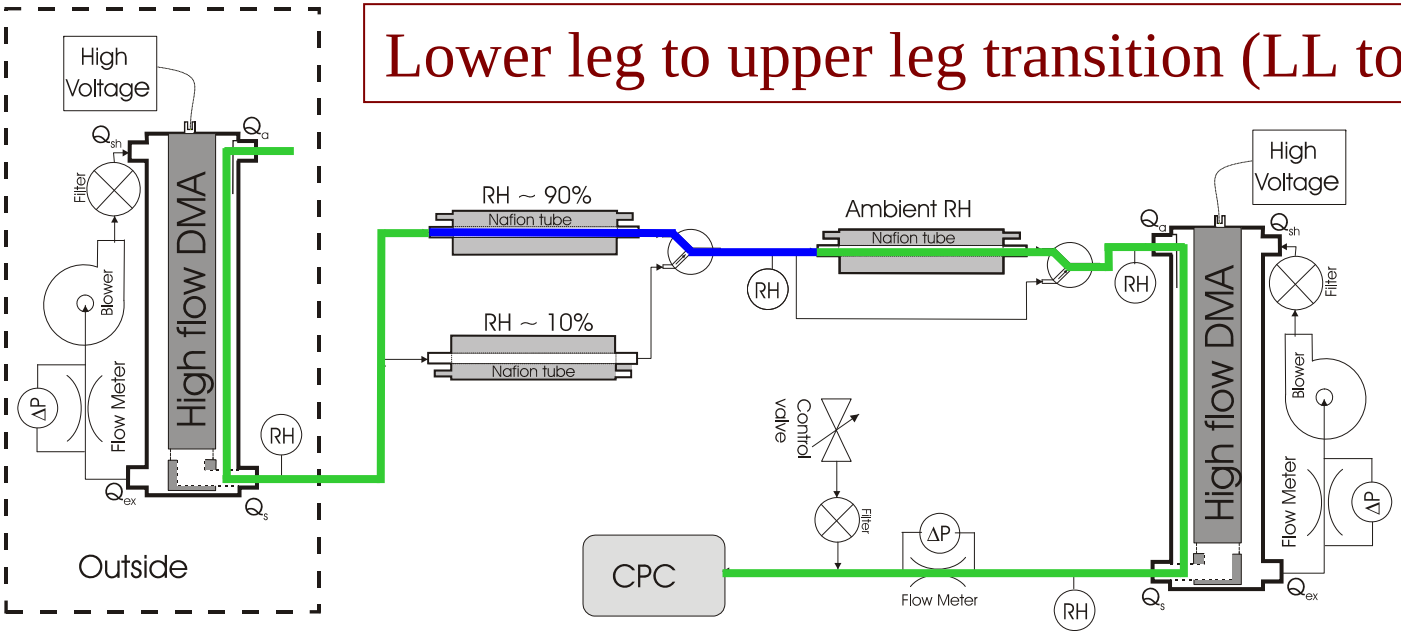
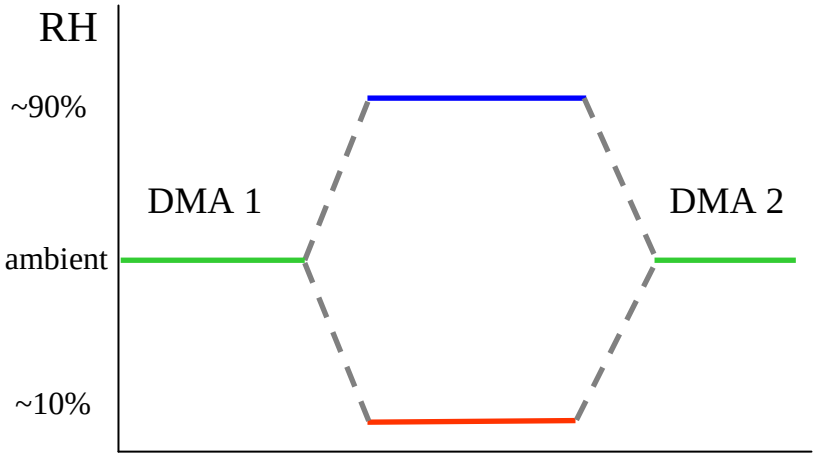
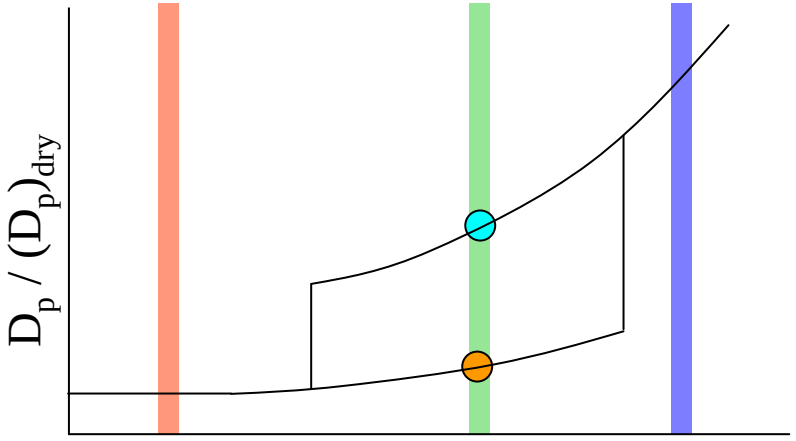
## Lower leg to upper leg transition (LL to UL)




What a single particle experiences




RH

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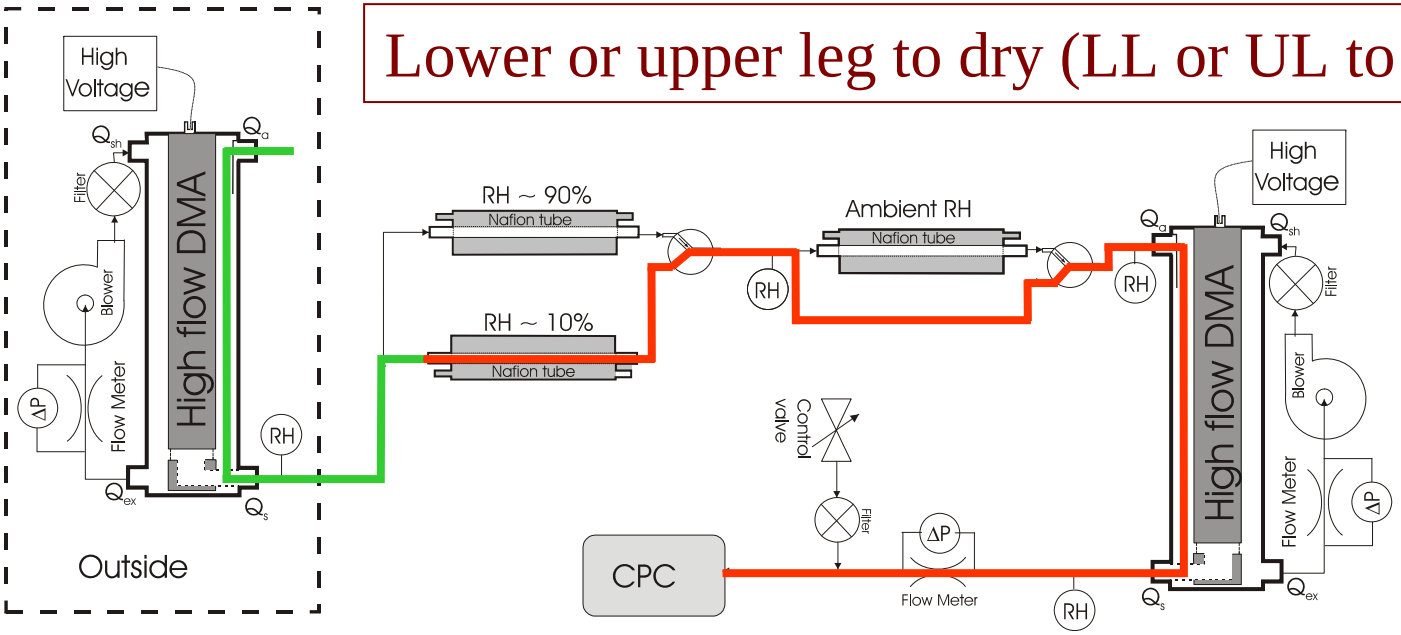
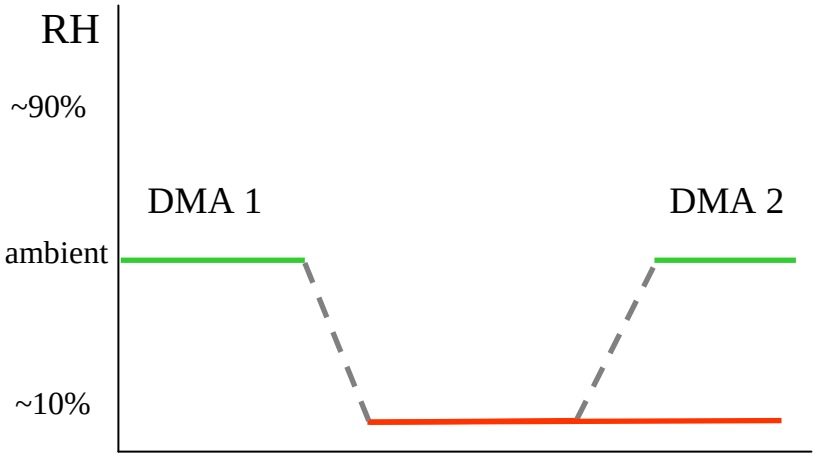
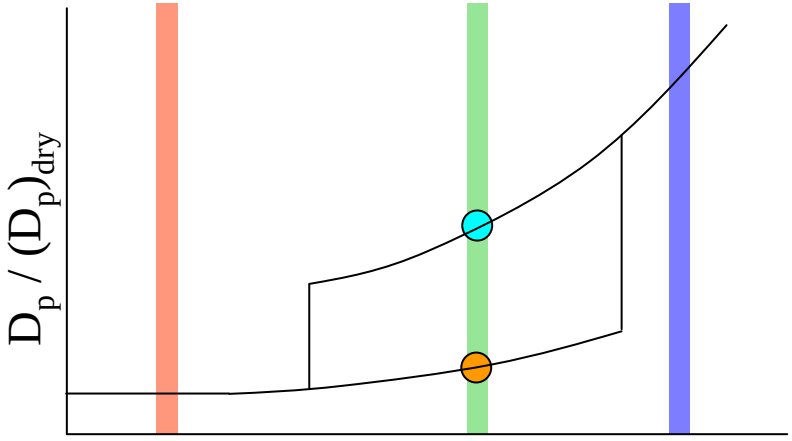
Lower or upper leg to dry (LL or UL to dry)




What a single particle experiences




RH

# Ambient hydration state measurements

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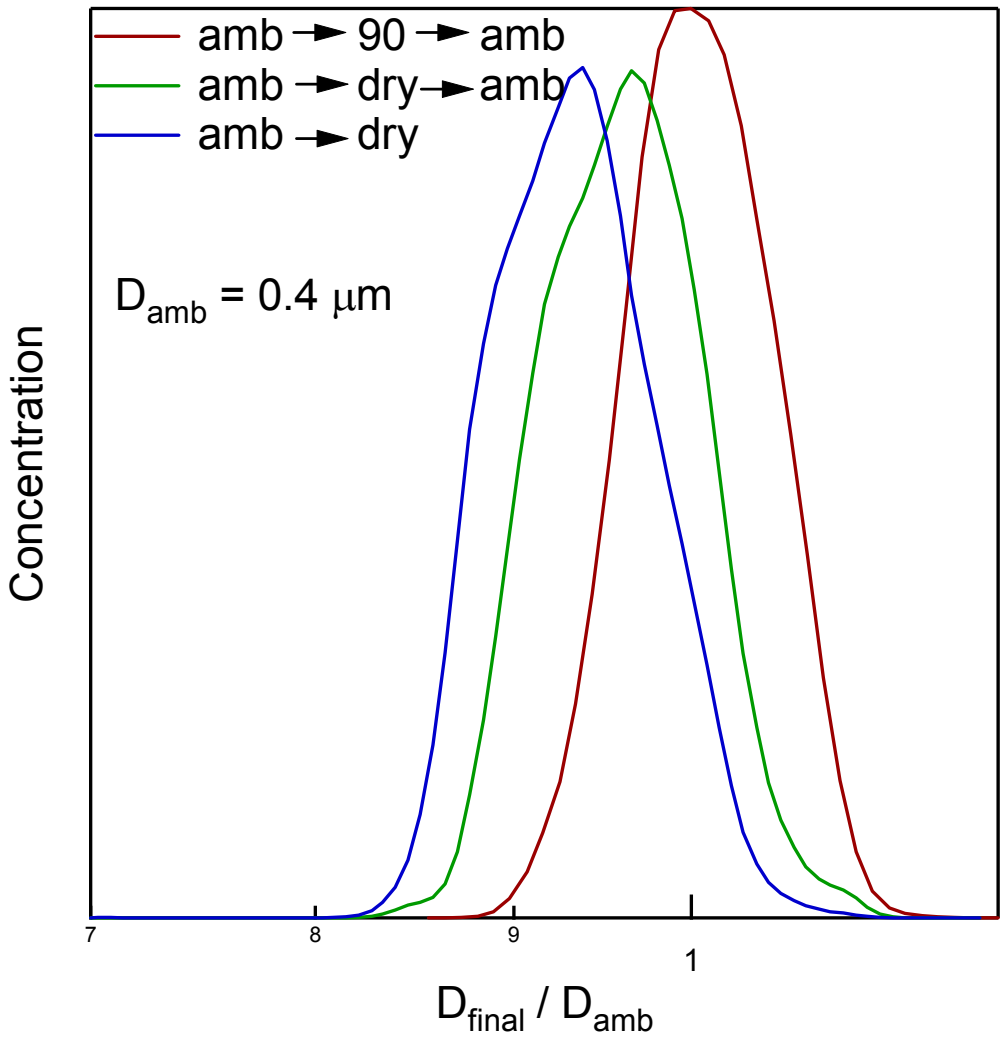
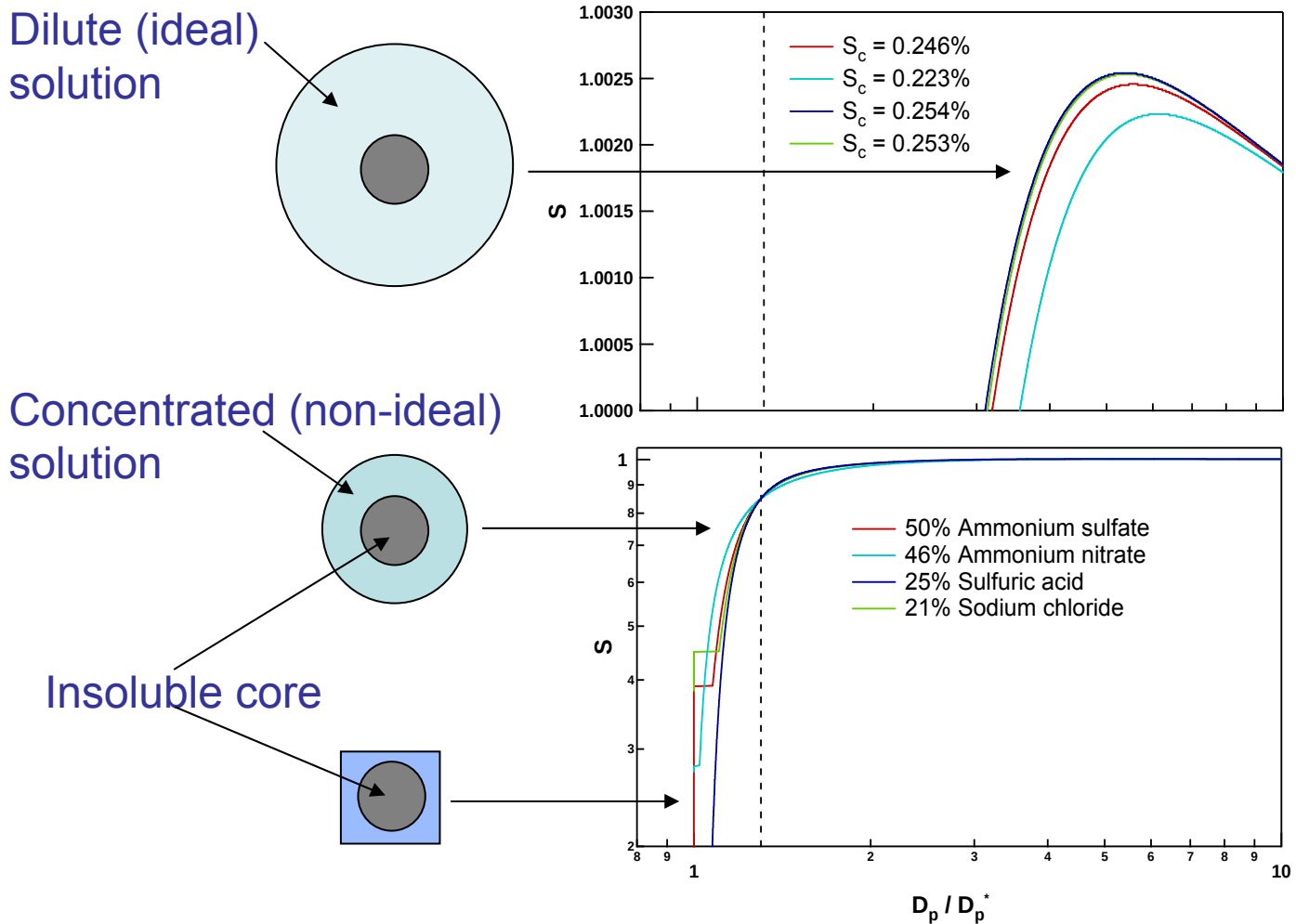
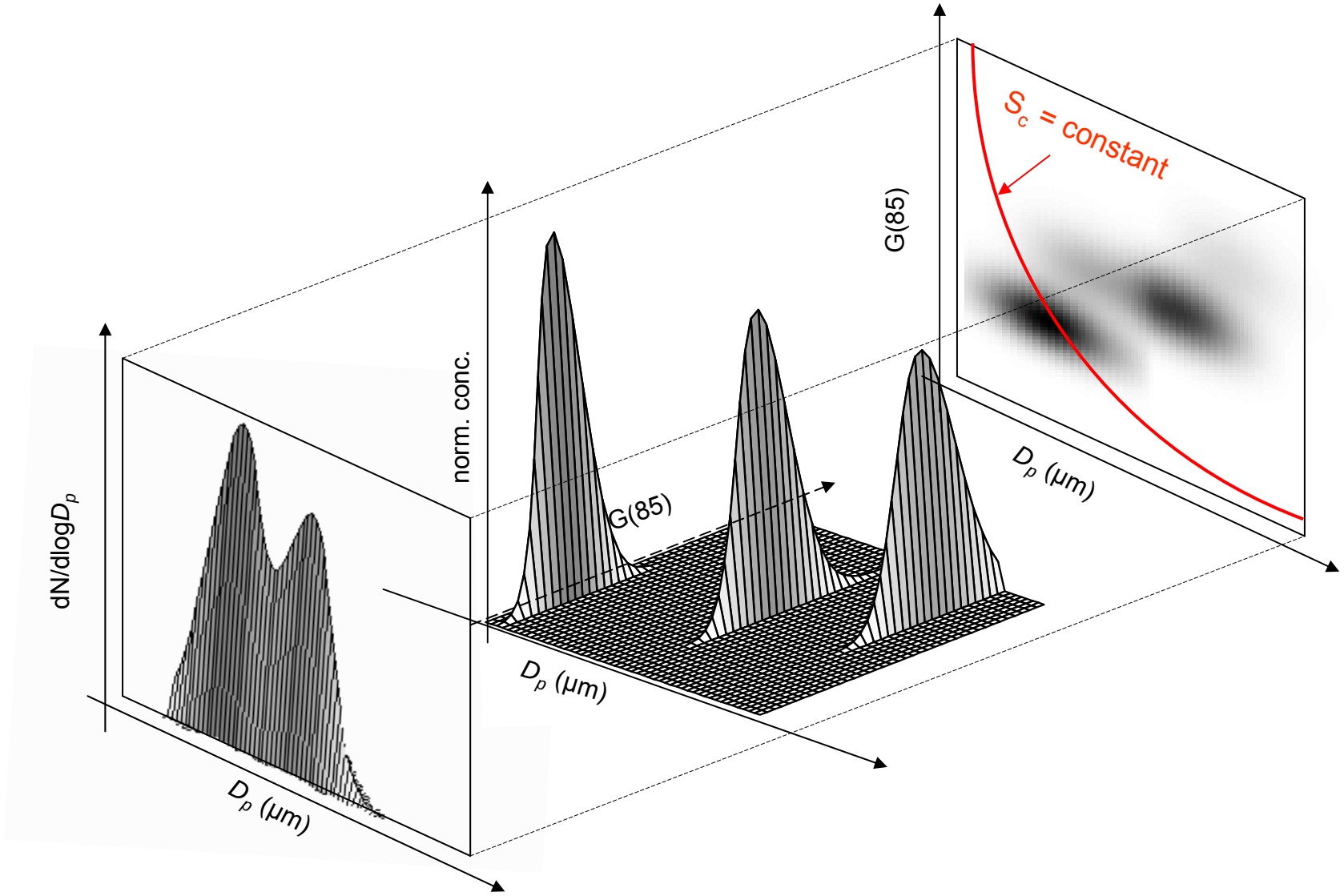



Dilute (ideal) solution
Concentrated (non-ideal) solution
Insoluble core
S
1.0030
1.0025
1.0020
1.0015
1.0010
1.0005
1.0000
$S_c$ = 0.246%
$S_c$ = 0.223%
$S_c$ = 0.254%
$S_c$ = 0.253%
50% Ammonium sulfate
46% Ammonium nitrate
25% Sulfuric acid
21% Sodium chloride
1
10
$D_p$ / $D_p^*$

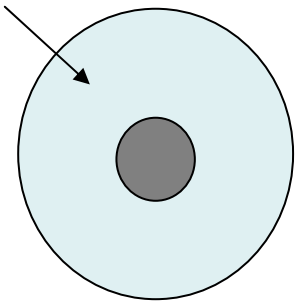
# Parallel measurement approach

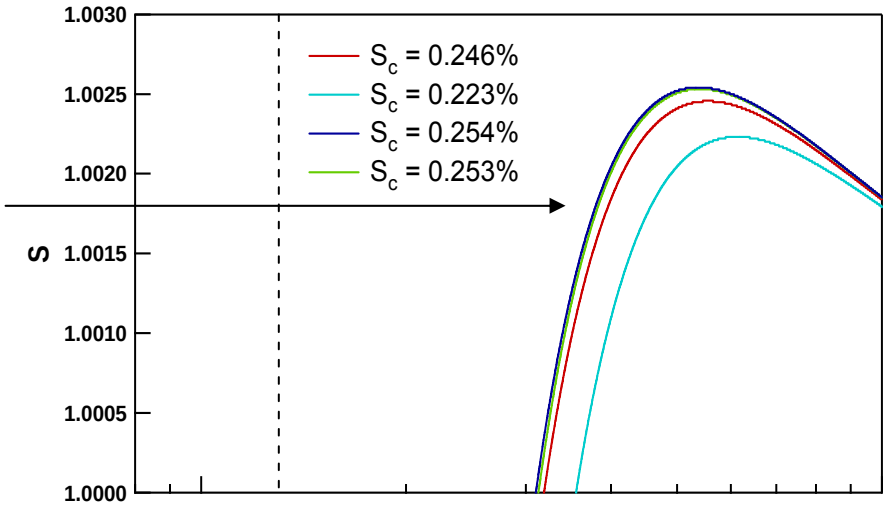


# Calculated CCN spectra

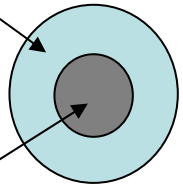
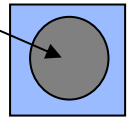
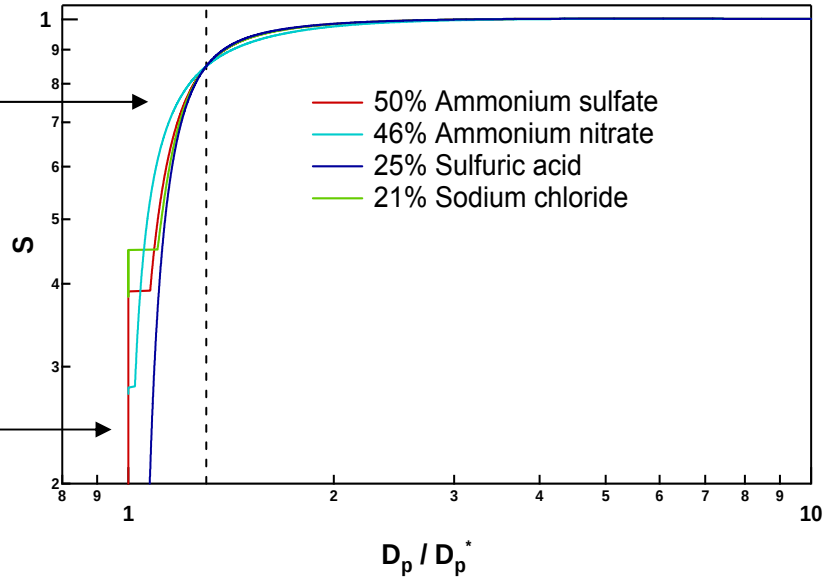


Dilute (ideal) solution






Concentrated (non-ideal) solution



Insoluble core