Particle Mass Loadings Reported by the AMS require an Ionization Efficiency

From Mass Spectrometer
Ionization Efficiency calibration

\[
\frac{\text{mass}}{\text{volume}} \quad \longrightarrow \quad \frac{\mu g}{m^3}
\]

From volumetric flow rate

Ionization Efficiency Calibration

Currently there are two methods being used

1. DMA/CPC mass based method.
2. Single particle based method (BFSP).
Single Particle Based Mass Calibration

**Signal**

- Single particle pulses
- Particle threshold set above single ion level
- Single ions above electronic noise level

**Amps (Coulombs/time)**

- Average single particle pulse
- Average single ion pulse

Ionization Efficiency = IPP/Molecules per Particle
BFSP Analysis Panel for IE Determination
Setup for Mass Based IE Determination

Input Mass = \( \rho \times \text{Volume(size)} \times \text{Number} \)

Reported Mass

Plot Measured Mass vs Input Mass
Mass Based IE Determination

- Mass reported by V1.5 ToF DAQ (ug/m3)
- Calculated/Input AN mass (based on CPC, ug/m3)

- Dmob
  - 300 nm
  - 250 nm

- Intercept = 0.068 ± 0.041
- Slope = 0.493 ± 0.003
Mass Based IE Determination

Multiple charged diameters

Lens transmission limitation

Need to consider fragmentation pattern for NH₄NO₃
Comparison of Mass and CPC Based Ionization Efficiency Determination

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<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>CPC/Mass</td>
<td>Multiple point calibration</td>
<td>Requires a CPC and a DMA</td>
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<td>Better precision</td>
<td>Lens transmission consideration</td>
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<td>Multiple charged DMA diameters</td>
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<tr>
<td>Single Particle</td>
<td>Does not require a CPC</td>
<td>Single point calibration</td>
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<td>Not dependent on lens transmission properties</td>
<td>Breaks down in the limit of low IPP</td>
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<td>Not dependent of multiple charged diameters exiting DMA</td>
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<td>Could be performed without a DMA</td>
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<td><em>Velocity selector?</em></td>
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