Airplane Integration Issues for the Aerodyne Aerosol Mass Spectrometer

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AMS Airplane Integration Issues

- Main issues
  - Keeping the background low
  - Pressure effects on the inlet
  - Inlet heating
    • can be 20-50 C => drive off NO₃, Organics
- Other issues
  - Rack system
  - Power supply
    • Supply electronics with DC from Balzers controller
    • Pumps can run directly on DC from airplane
  - Time resolution
    • Twin Otter: 1 min (clean areas)
    • G-1: 0.5 min (polluted areas)
CIRPAS Twin Otter
Sampling speed: 50 m/s
Maximum altitude ~ 3,000 m
Power: 28 V DC & 110 VAC
Inlet Pressure Effects

- With fixed critical orifice, as P changes:
  - Flow changes
  - Size calibration changes
  - Air Beam changes
    - Because of lower flow
    - Because of different shape of molecular beam
  - Transmission vs. size changes
  - (Transmission vs. size + shape changes)
- Lots of things to calibrate and keep track of
  - Some of them are nearly impossible to calibrate
- It would be to our advantage to keep the pressure inside the lens always the same

Size Calibration Results

\[ t = \frac{L}{v} \]

\[ v = v_f + \frac{v_a - v_f}{1 + \left( \frac{D_a}{D_r} \right)^b} \]

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![Graph of Particle Time of Flight (s) vs. Sample pressure (mbar)](image1)

![Graph of Particle velocity (m/s) vs. Sample pressure (mbar)](image2)
Sensitivity Corrections

• Gain of the multiplier changes with time
• Need to take into account sensitivity changes

\[
Q = 0.58k_d A \sqrt{\frac{\gamma p}{\rho}}
\]

\[
\dot{m} = 0.58k_d A \sqrt{\gamma P \rho}
\]

\[
AB_{\text{Alt}}^\text{Corr} = AB_{\text{Alt}} + f(P_{\text{Grd}}, P_{\text{Alt}})
\]

Air Beam-Pressure Variation

![Graph showing the relationship between sampling pressure and O₂ gas beam frequency, with markers for Air Beam (O₂⁺) and Lens Pressure. The graph indicates a positive correlation between the two variables.]
First Airborne Deployment of an AMS

- Power Consumption: 650 W
- Weight: 220 lb = 98 kg
- Depth: 24" = 0.60 m

Twin Otter Cockpit

Rack Systems: Twin Otter & G-1

Caltech – CIRPAS Twin Otter
Aerodyne – DOE G-1
Rack Systems: 80/20 (Colorado-Jimenez)