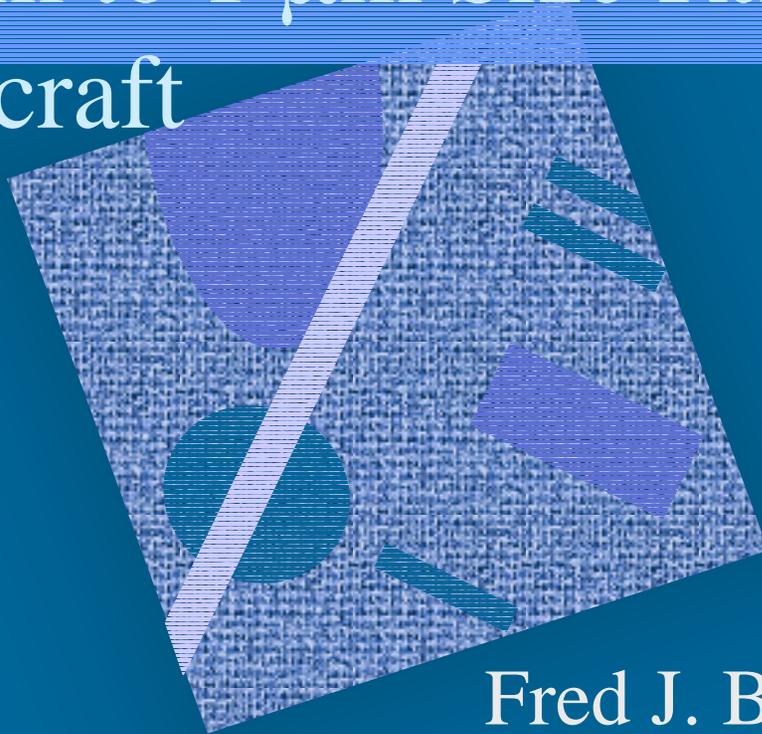


Instrumentation for Particle Size and Concentration Measurements in the 3 nm to 1 μm Size Range on the G-1 Aircraft



Fred J. Brechtel

Environmental Chemistry Division

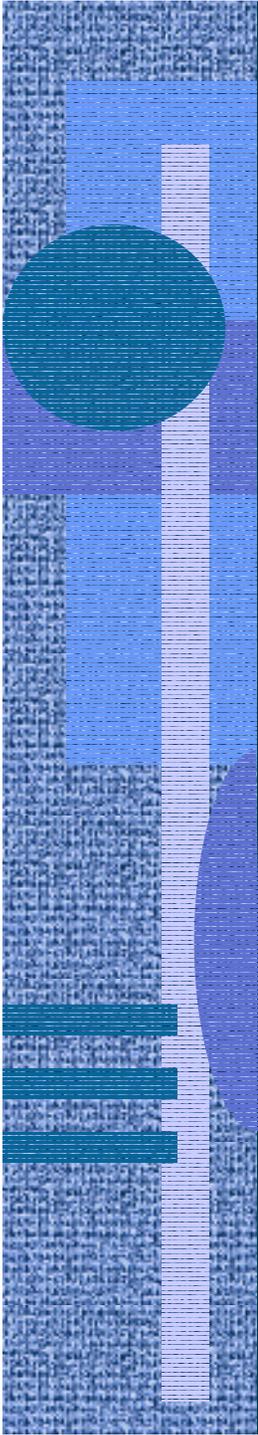
Brookhaven National Lab

Motivation

- Provide input for new national air quality standard for particulate matter
- Quantify ambient visibility reduction due to particulate matter
- Examine relationships between meteorological processes and particle size distribution
- Examine conditions for new particle formation in the troposphere

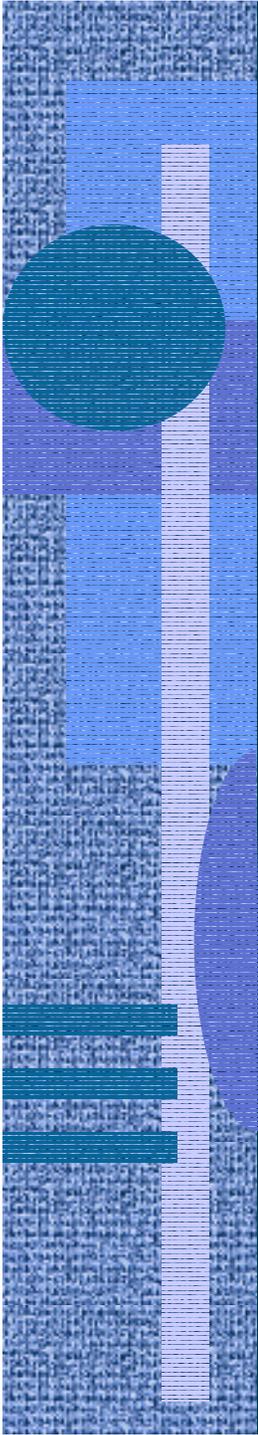
Previous Aircraft Particle Size Distribution Measurements

- Clarke et al. (1998): measurements on NCAR C-130 & NASA DC-8 indicated that new particle production was correlated with lower pre-existing particle surface area
- Russel et al. (1998): observed inter-layer vertical transport in MBL during ACE 1 using particles as tracer
- Weber et al. (1998): observed new particle production and growth in MBL at rates much greater than could be explained theoretically



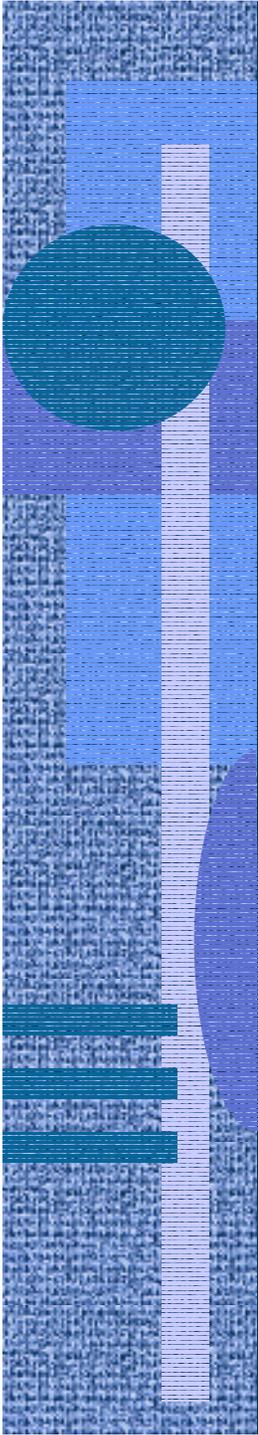
Experimental Methods: Three Systems

- Pulse Height Analysis: 3-10 nm
- Nano-Differential Mobility Spectrometer: 5-100 nm
- Long-Differential Mobility Spectrometer: 80-800 nm



Pulse Height Analysis System

- Measures number concentrations of particles between 3 and 10 nm diameter
- Particles are exposed to saturated alcohol vapor and then passed through a condenser - final droplet size is a function of initial particle size
- Modified commercial particle counter (TSI Inc. Model 3025 Ultrafine Counter)
- Diode laser is replaced by white light source to optimize scattered light pulse height and width

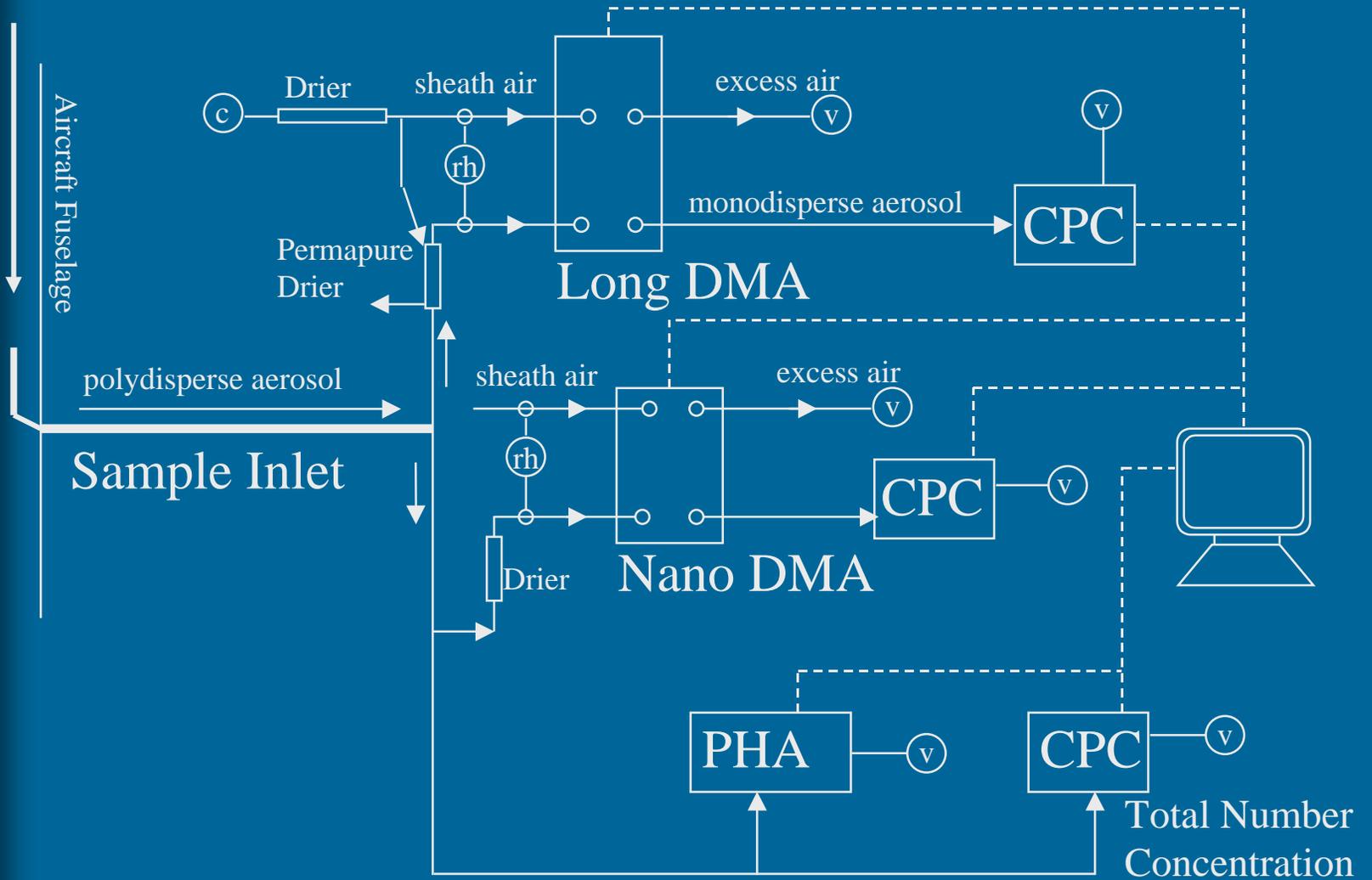


Differential Mobility Spectrometers

- Classify particles according to electrical mobility
- Monodisperse, charged particles exiting the spectrometer are counted by a condensation particle counter
- A broad size range of particles is observed by scanning the spectrometer voltage over a period of 45 to 60 seconds

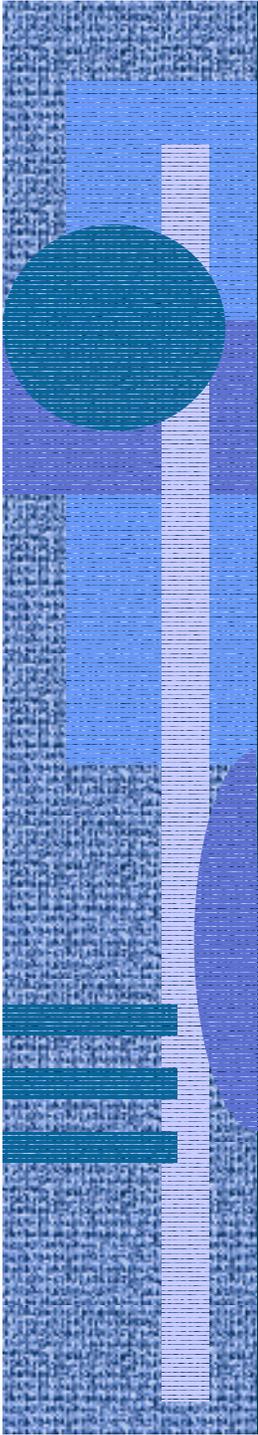
System Schematic

Air Flow



'v' = vacuum

'c' = compressed air



Sample Results from Previous Pulse Height Analysis and Mobility Spectrometer Measurements



Timeline of Activities

- Assemble systems in laboratory: 3/99
- Software development: 4/99
- Laboratory calibration studies: 5-6/99
- Philadelphia study: 7-8/99
- Big Bend BRAVO study: 10/99
- Present preliminary results at AGU: 12/99

Future Work

- Examine conditions for new particle formation in the troposphere
- Study how meteorological processes affect the ambient size distribution
- Improve measurement time resolution
- Develop instrumentation to measure particle water uptake as a function of relative humidity

Aerosol Sources, Cycles & Sinks

