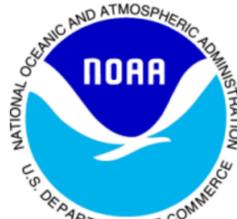


**PALMS:**

- 1) particles enter vacuum through inlet
- 2) scattered light indicates a particle
- 3) excimer laser beam hits particle to produce ions
- 4) positive or negative ions analyzed with TOF mass spectrometer

# Aerodynamic Particle Sizes During CRYSTAL-FACE

Daniel Murphy  
NOAA Aeronomy Lab



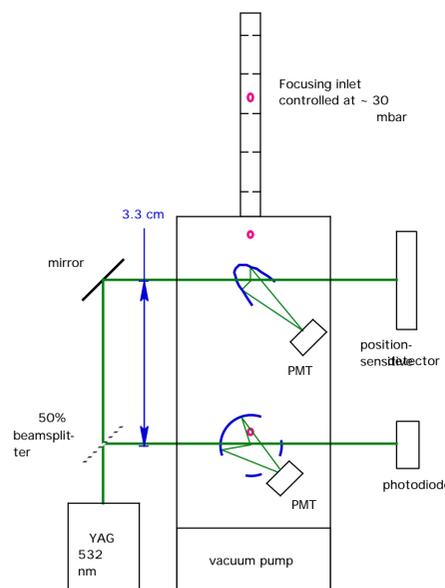
also: D. Cziczo, P. Hudson, M. Schein, D. Thomson

CRYSTAL-FACE Workshop 2003

## Salient Results

- 1) Aerodynamic and optical diameters were consistent with different particle densities.
- 2) Stratospheric particles with meteoric material had a very narrow size distribution at about 0.6 μm estimated geometric diameter.
- 3) Biomass burning particles mostly < 0.5 μm aerodynamic diameter
- 4) Cirrus cloud residuals:
  - small mode on July 9 southbound: mostly sulfate mixtures
  - large mode on July 9: more diverse particle types
  - large mode Florida outflow: mineral and sea salt

## Aerodynamic sizing



- Smaller particles have more drag per unit mass => accelerate more at end of inlet.
- Measure transit time, convert to diameter against lab calibrations.
- Low pressure inlet => particles smaller than mean free path =>

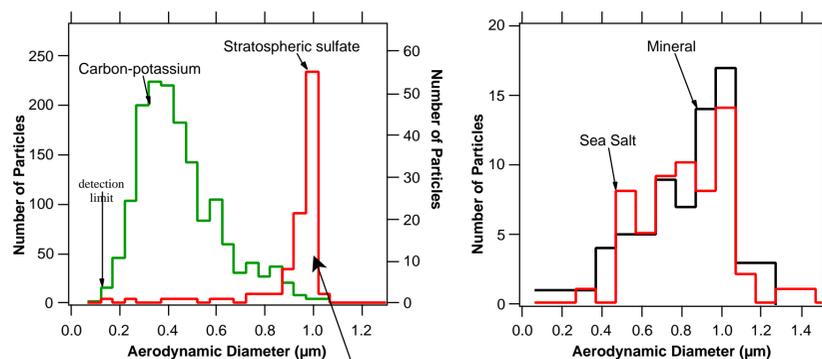
$$D_{aero} \sim D_{geom} \text{ part}$$

(not  $D_{aero} \sim D_{geom} \text{ part}^{0.5}$ )

Wilson, J. C., and B. Y. H. Liu, *J. Aerosol Sci.*, **11**, 139, 1980.  
Prather, K. A., T. Nordmeyer, and K. Salt, *Anal. Chem.*, **66**, 1403, 1994.

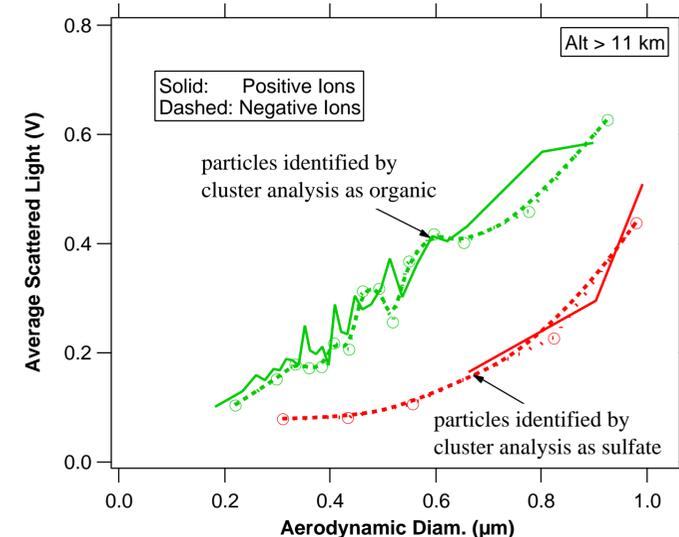
## Results from CRYSTAL-FACE

*Spectra -> cluster analysis to find similar spectra  
-> look at size distribution of clusters*



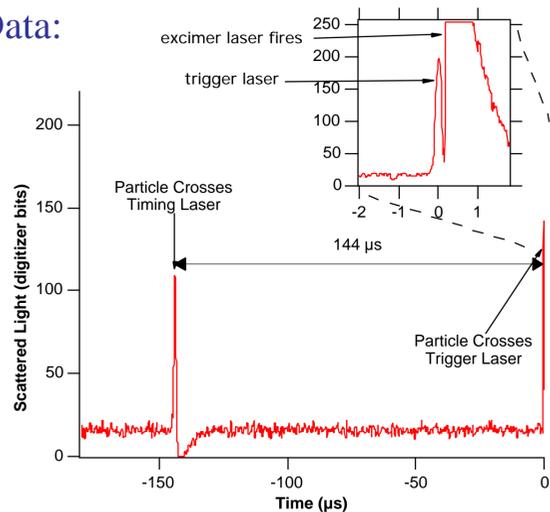
0.6 μm estimated geometric diameter  
Wilson et al. ER2 size distributions often show a mode at 0.7 μm

## Combine timing and pulse height data:



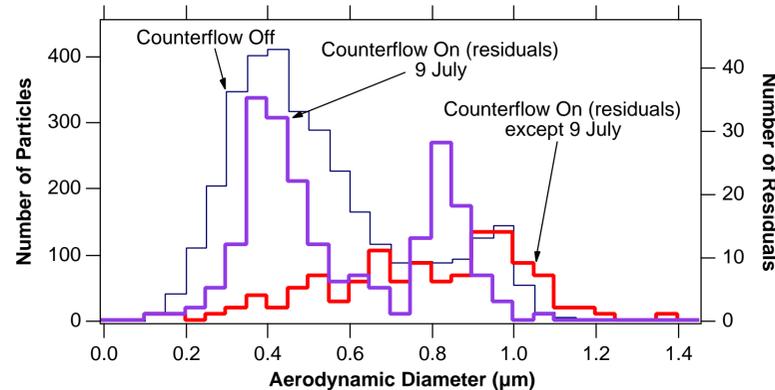
## Sample Data:

Sample data from laboratory PSL particles. Trace is the sum of the PMT signals from both laser beams



During CRYSTAL-FACE, the timing laser position was not controlled in flight, so aerodynamic diameters were obtained for just under half the particles.

## Size of ice residuals



- Southern flight July 9: Bimodal : Smaller mode sulfate mixtures, larger mode varied particles with more tropospheric character.
- All other flights: A broad mode weighted to the larger aerosols, mostly mineral and sea salt particles.

## Optical and aerodynamic data obtain density:

Most organics have density near 1 g cm<sup>-3</sup>. Sulfuric acid is near 1.7 g cm<sup>-3</sup>.  
Use these densities to estimate geometric diameters from aerodynamic diameters.  
Assume refractive indices are similar.  
The curves match!

