



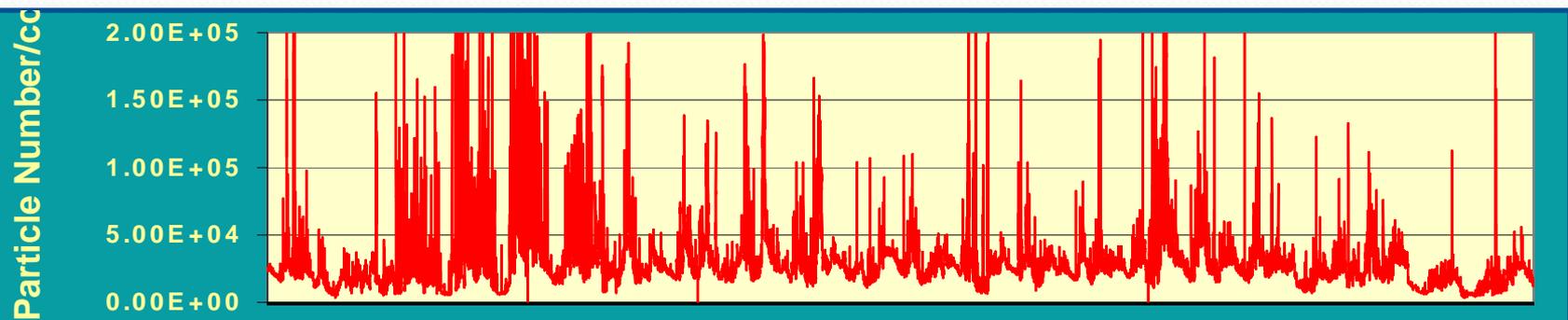
A Draining Experience: Working with the TSI 3781 Water-based CPC

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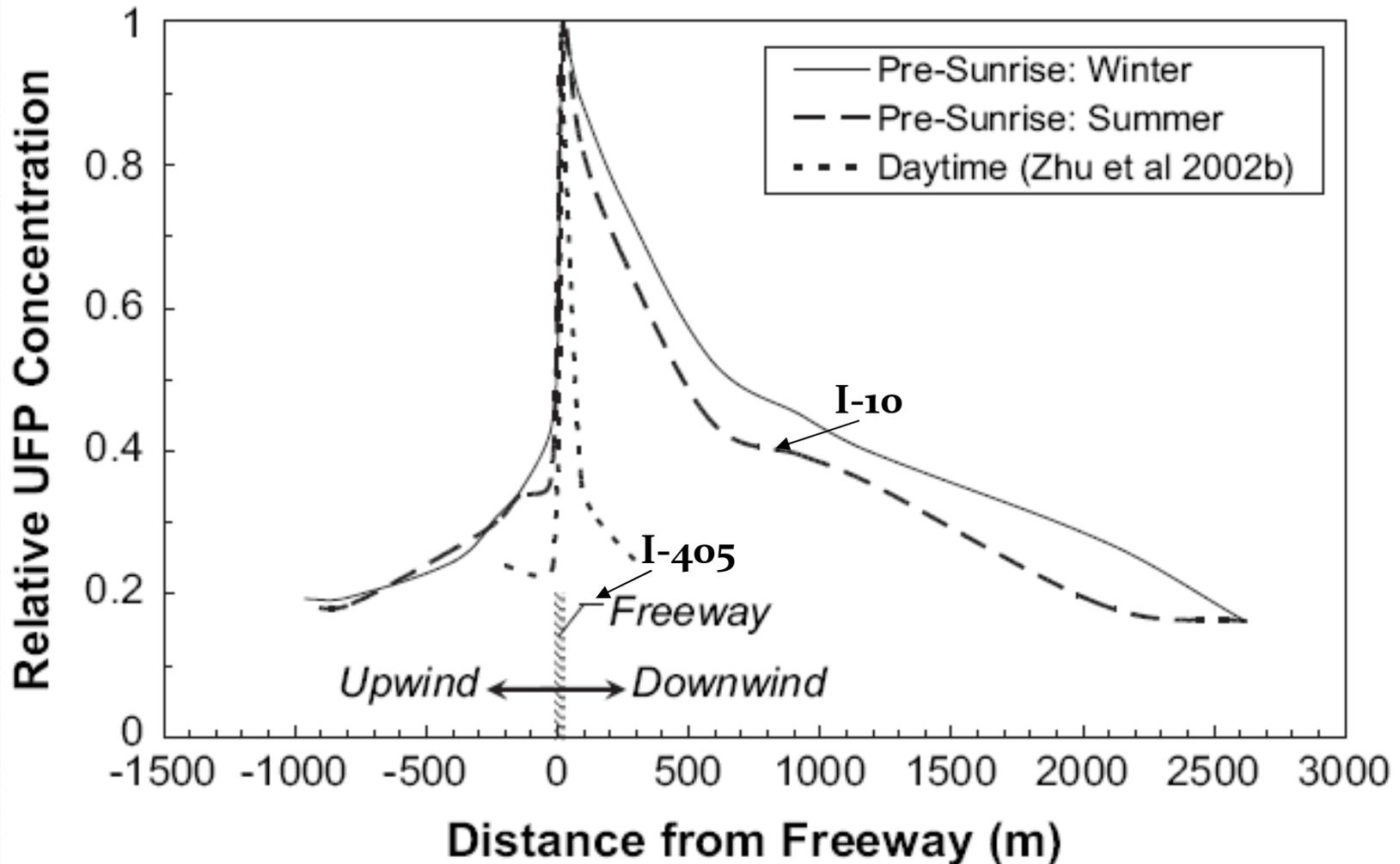
November 4, 2009 National Air Monitoring Conference
Nashville, TN

Why Measure Number Concentration?

- Indicator of ultrafine particles
- Evidence linking ultrafine particles and number counts to adverse health effects
- Indicator of fresh combustion exhaust
- Indicator of secondary nucleation bursts in some areas
- Another continuous measurement – may be useful for source apportionment methods

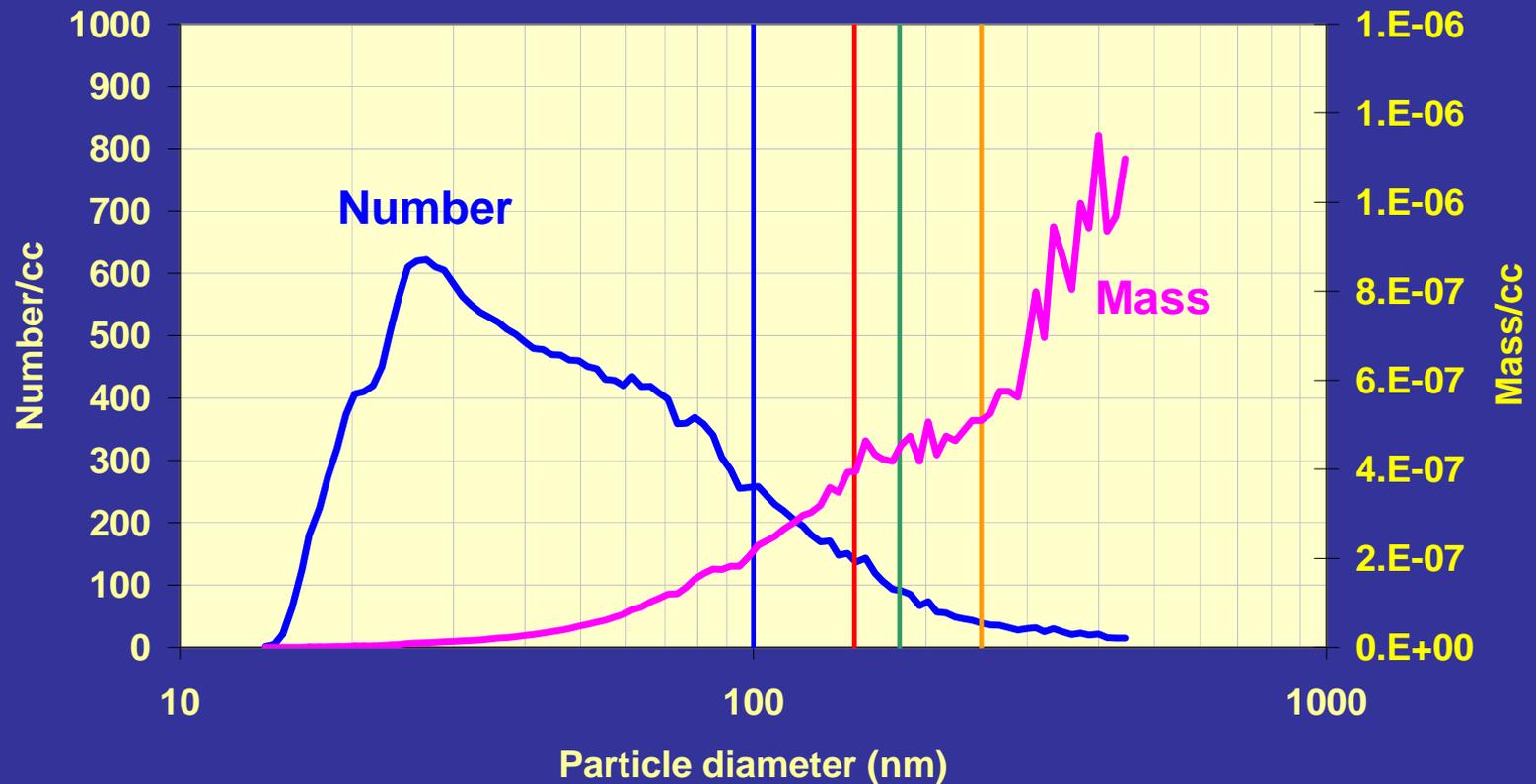


Near Roadway Measurements



Source Aerosol

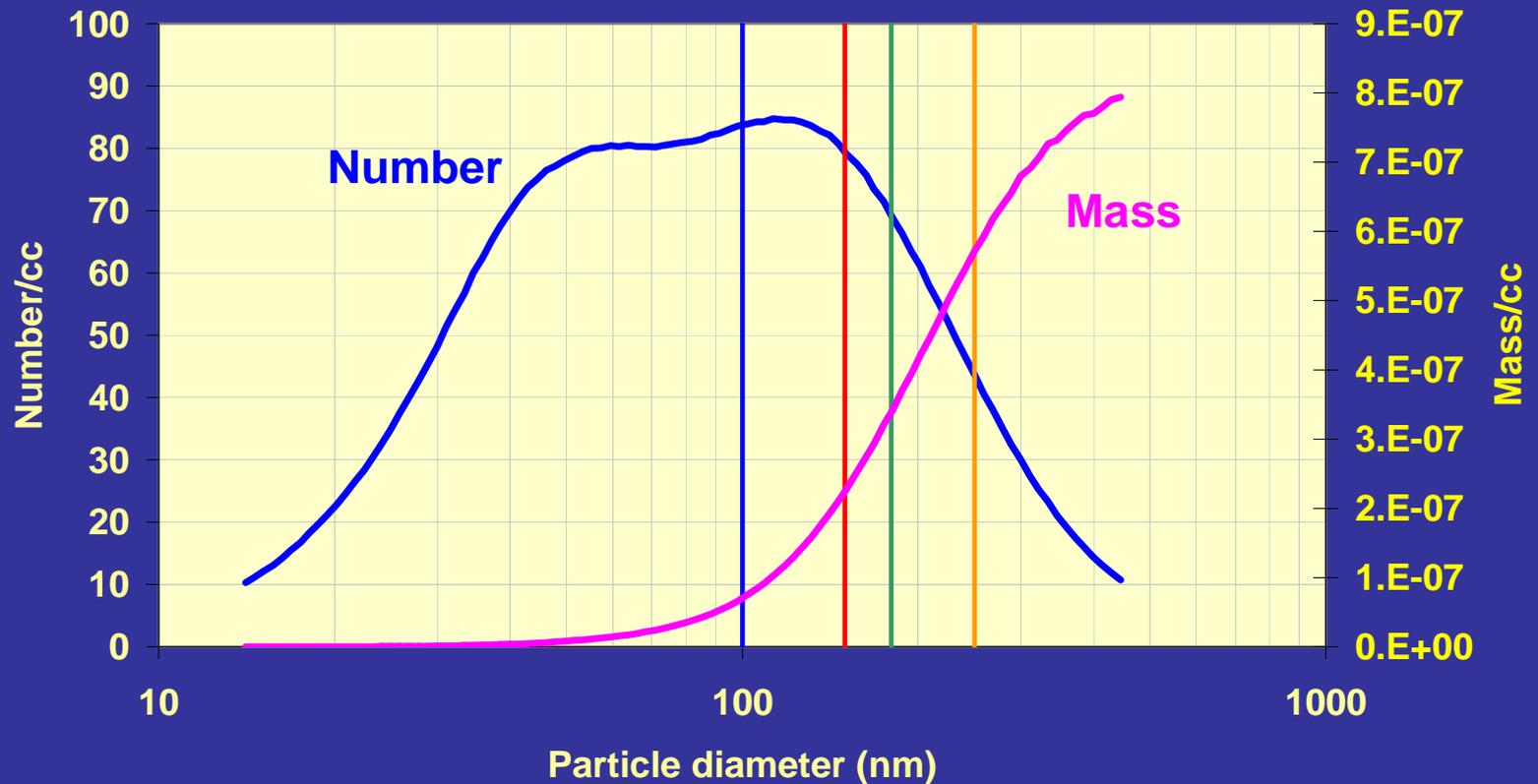
Size Distribution - Long Beach Morning - October, 2002



100 nm 150 nm 180 nm 250 nm

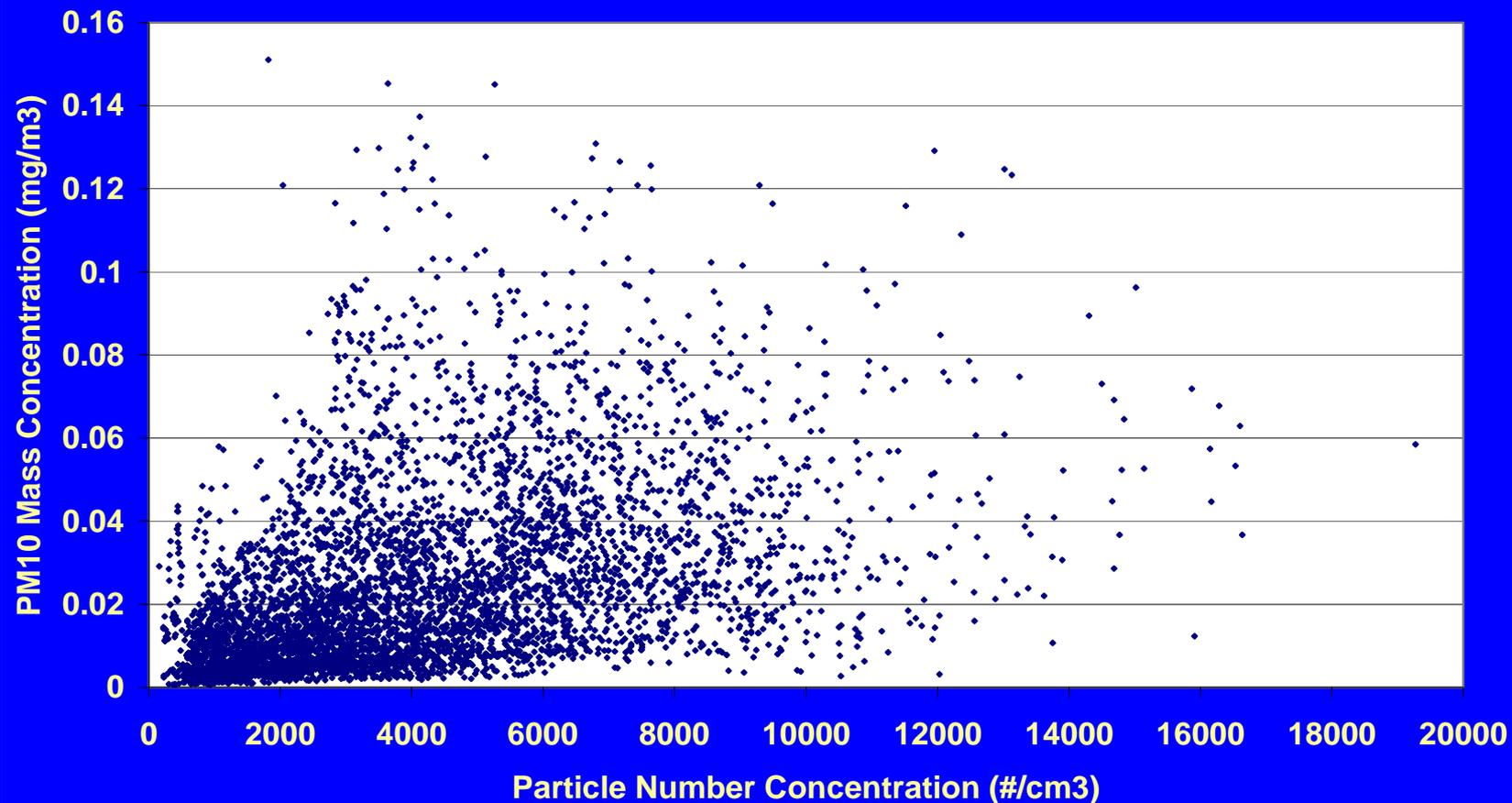
Aged Aerosol

Average Size Distribution - Riverside May 2001
(6AM-10AM)



100 nm 150 nm 180 nm 250 nm

Number vs. Mass



Riverside, Rubidoux, and Claremont, California. (February 2001 - March 2002)
(Fine et al, AS&T, 38 (S1), 2004)

Particle Number Measurement Issues

- Total particles or upper size cut
 - Definition of Ultrafines (< 100, 150, 180, 250 nm)
 - Aged aerosol can have a mode at 100 nm or larger
- Lower size cut of the type and model of CPC
 - Ranges from 5 nm to 20 nm
 - Can have significant effect on total number counts
 - Potential composition effects
- Single counting vs. photometric modes
- Volatile vs. Non-Volatile Particles
 - European PMP Protocol
- Particle number not conserved in the Atmosphere
 - Evaporation, Condensation, Coagulation, Nucleation

TSI 3781 Water-based CPC

- Advantages

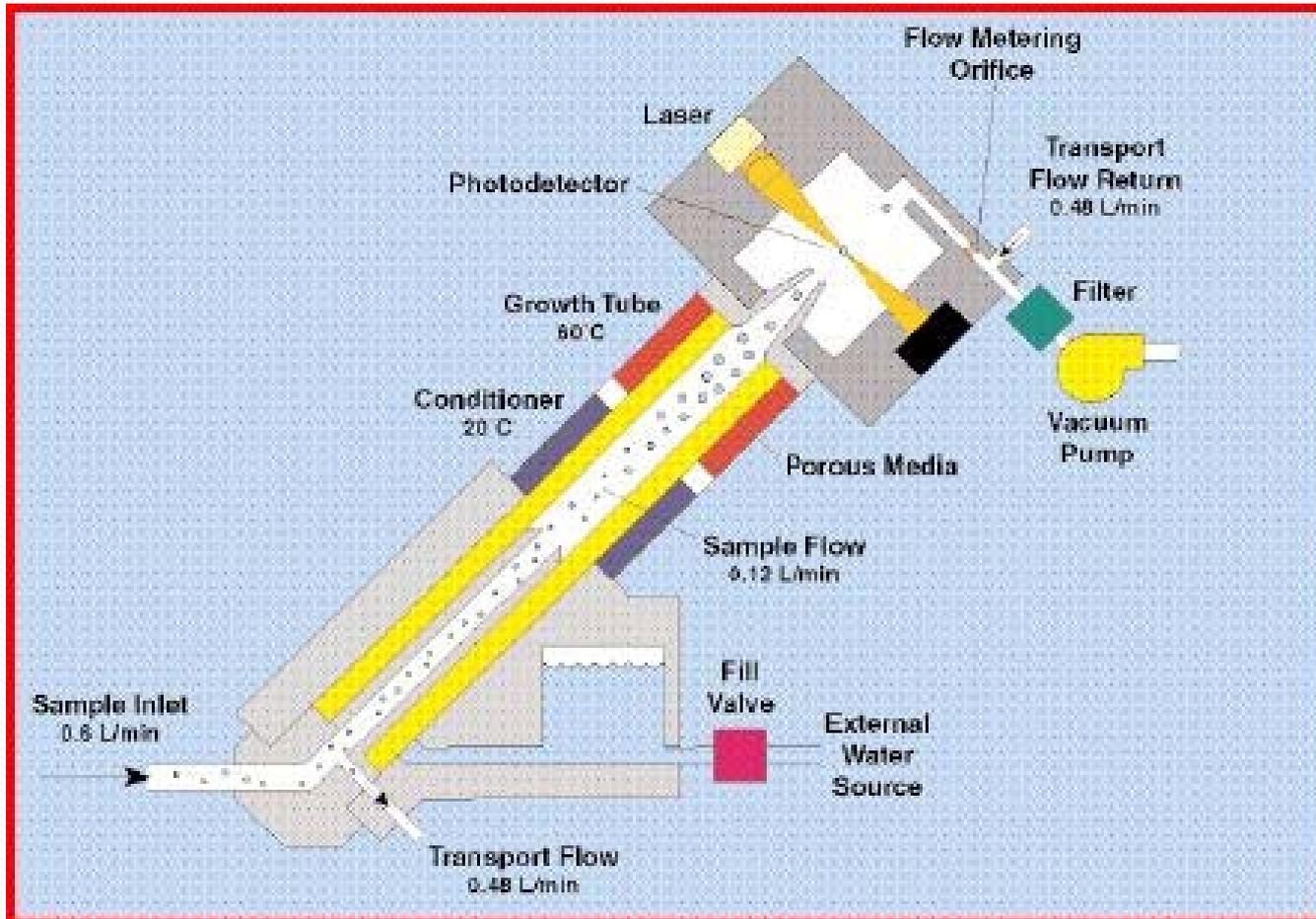
- Price (wider spatial coverage)
- Simplicity
- Size
- No butanol fumes
- Fast time response
- Internal data logging

- Disadvantages

- New
- Upper concentration limit of 500,000 particles/cc
- Maintenance schedule



Principle of Operation



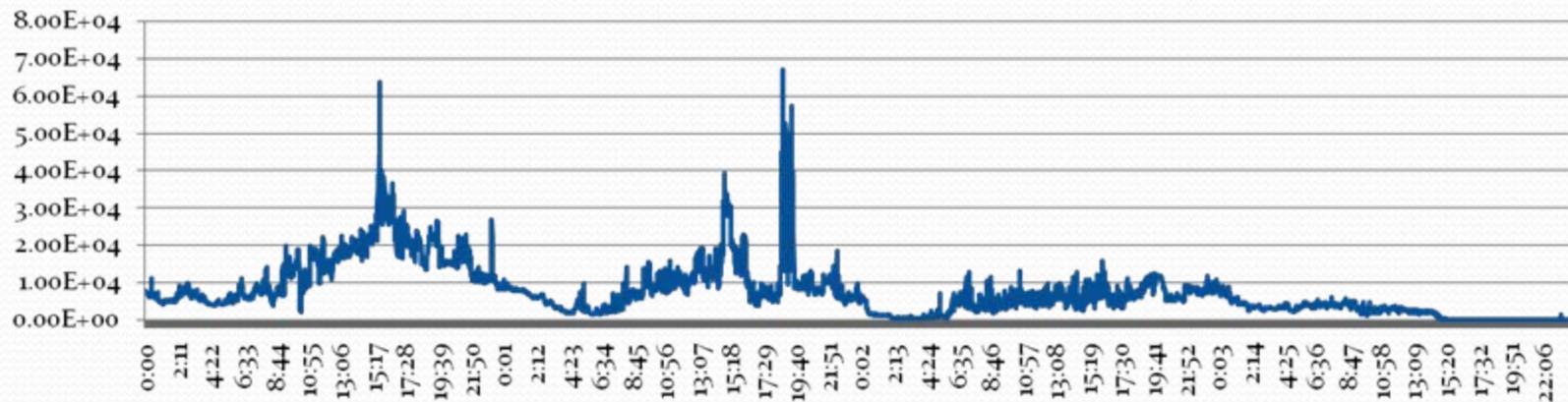
Initial Problems and Solutions

- Flow system problems
- Communication problems
- Data storage problems
- Nozzle problems
- Creating a maintenance schedule



Data indicating flow problems

- WBCPC data from 9/15/07 to 9/18/07 indicating problems with both the flow and nozzle , unit gave no indication (flags) that there was a problem.



Flow System

- Orifice clogging and replacement of original orifices with modified screened units
- Added filtration within the transport flow path



Data Storage/Communication

- Units responded poorly to data request had com storage errors
 - “an invalid argument has occurred” error message
- TSI was informed of problems and updated firmware to overcome errors with the units
 - Updated firmware to ver. 1.04, eliminated download problems, also addressed problems with occasional flooding of unit

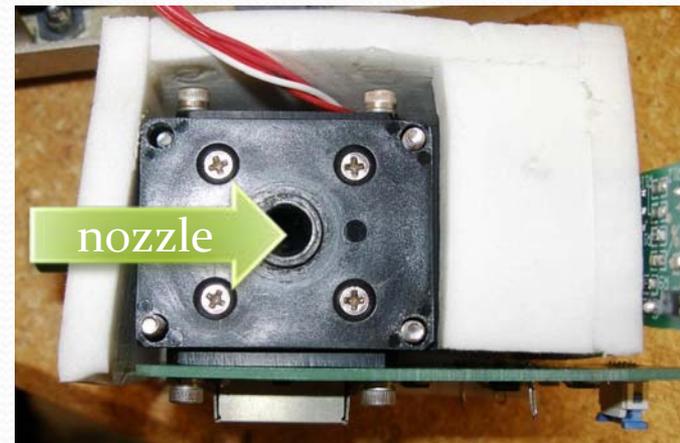
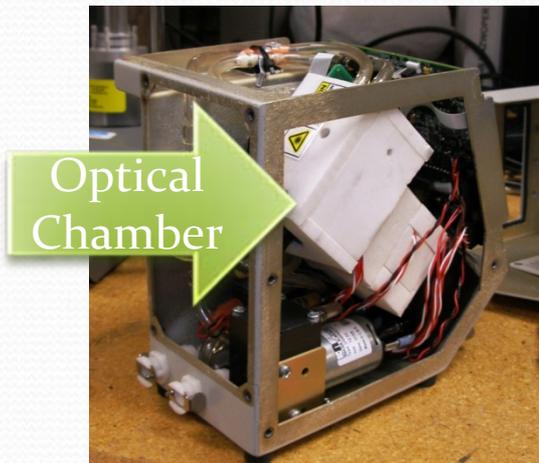
Nozzle Clogging

- Like other parts of flow system, nozzle would quickly get clogged with particulate material
- TSI could not fix the problem
- Developed maintenance schedule in order to keep units counting correctly
- Flow checks, cleaning of the nozzle and recalibration routinely performed

Nozzle Cleaning

Removal of measurement chamber (optical /laser chamber)

- Cleaning the CPC nozzle



Routine Maintenance

- Weekly/Biweekly

- Drain/Fill reservoir



- Clean inlet screen/cyclone,
Check flow (adjust flow if
necessary)



Routine Maintenance

- 6-12 Weeks
 - Clean flow system, replace wick, recalibrate flow, zero particle count with HEPA filter
- Annual
 - Replace parker filters (transport & pump)

