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Sandia National Laboratories


# A New Optical Chamber for the Measurement of Aerosol Cross Sections under Controlled Conditions.

Crystal C. Glen

Randy Schmitt, Shane Sickafoose, Josh Santarpia, Brandon Servantes, Mark Johnson, Michael Pack, John Brockman, Daniel Lucero, Andres Sanchez, Danielle Rivera

U.S. DEPARTMENT OF ENERGY | NNSA

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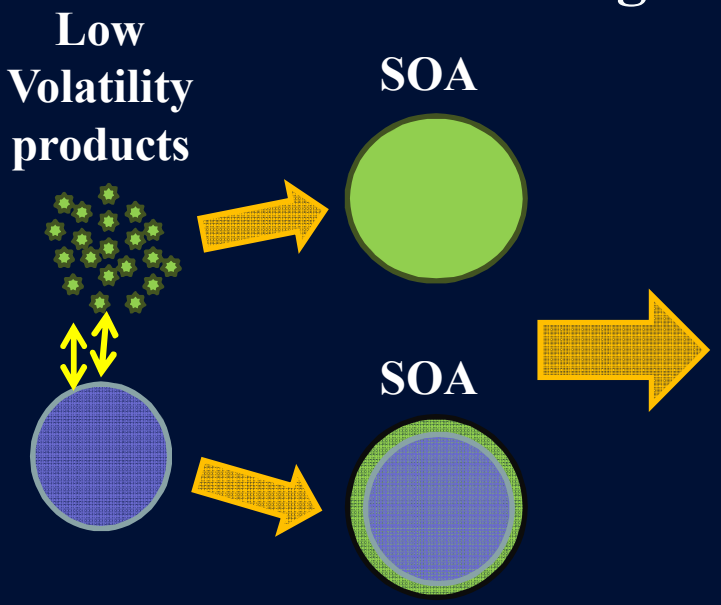
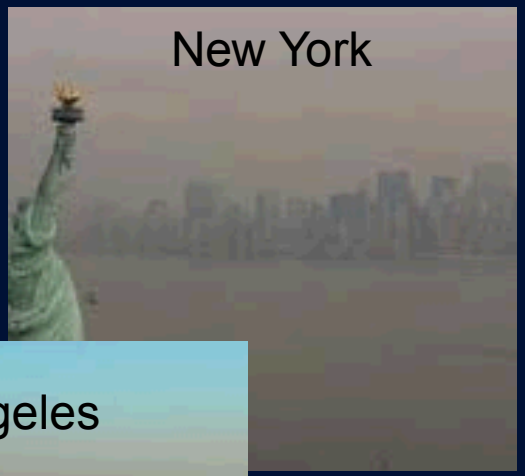
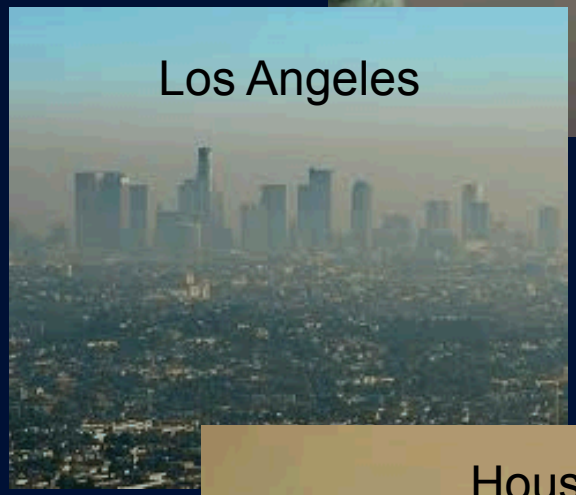
# Motivation – Standoff Detection in the Background Aerosol





- Atmospheric VOC (Volatile Organic Compound) oxidation may lead to nonvolatile and semi-volatile products that may condense onto existing particles or nucleate to form new particles – Very high background concentrations ( $> 10^5$ )

SOA = Secondary Organic Aerosol

# Motivation – Standoff Detection in the Background Aerosol

- High dust concentrations exist in many regions of the world and in major cities within the Southwestern U.S.

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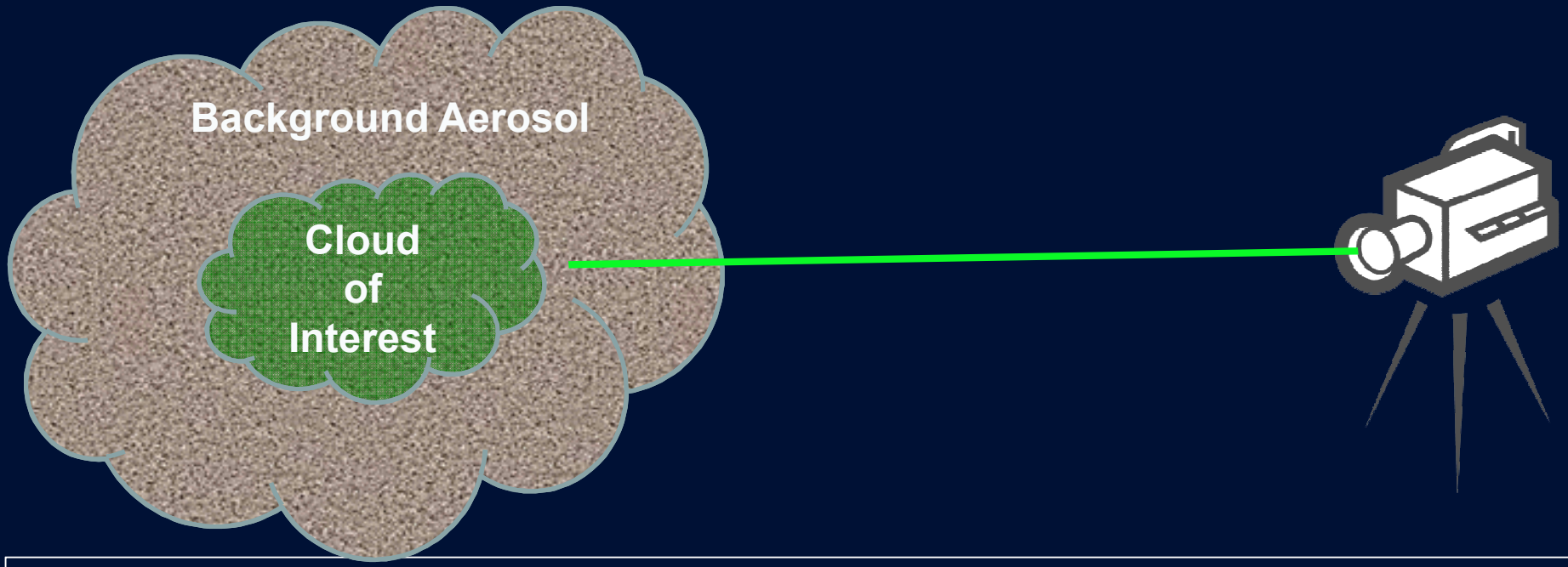
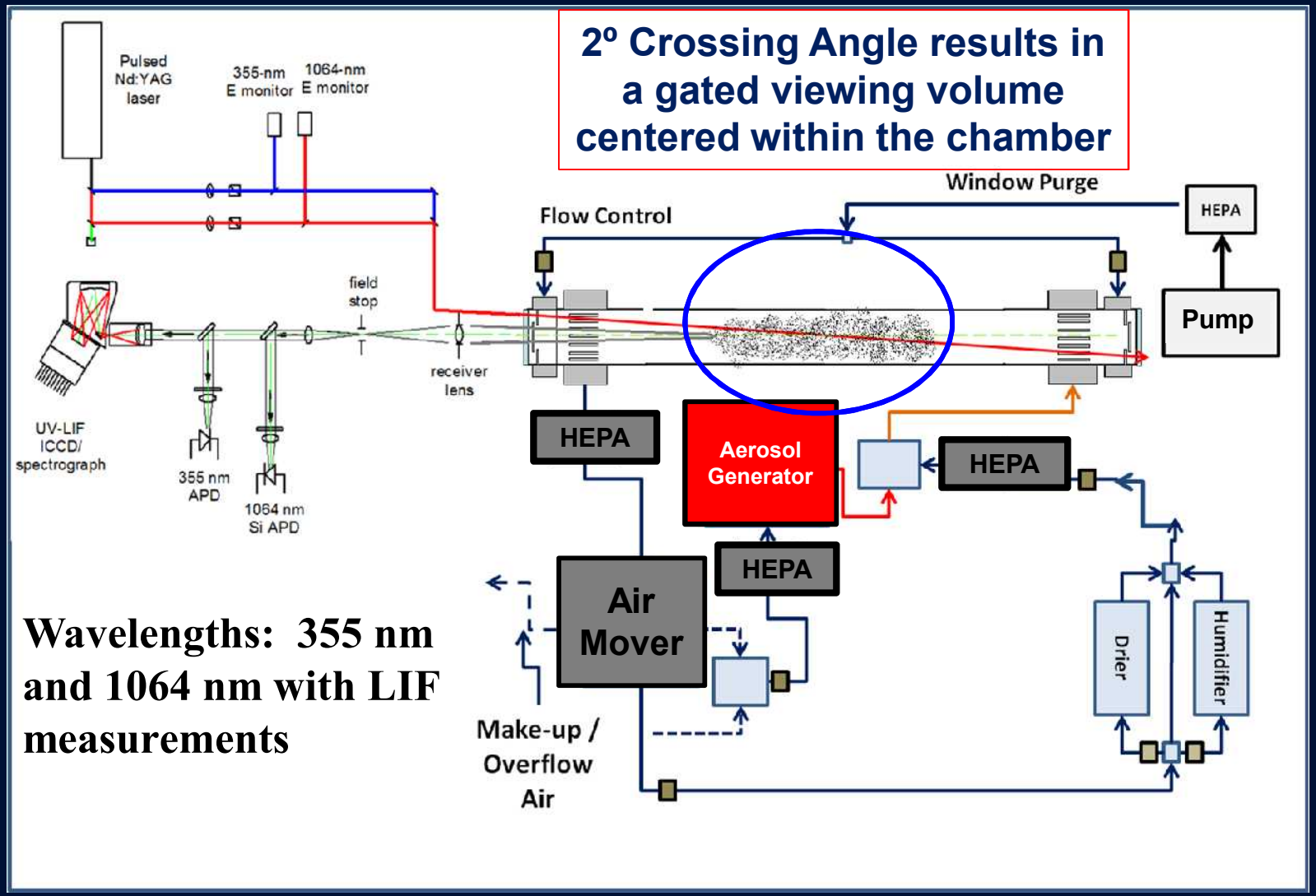



- In high aerosol loading backgrounds, the smaller particles may contribute significantly to the volume and thereby the optical properties of the atmosphere.
- Need to isolate and measure atmospheric particles and mixtures of atmospheric and biological particles using standoff detection methods in the laboratory.

# Aerosol Optical Measurement Flow Chamber



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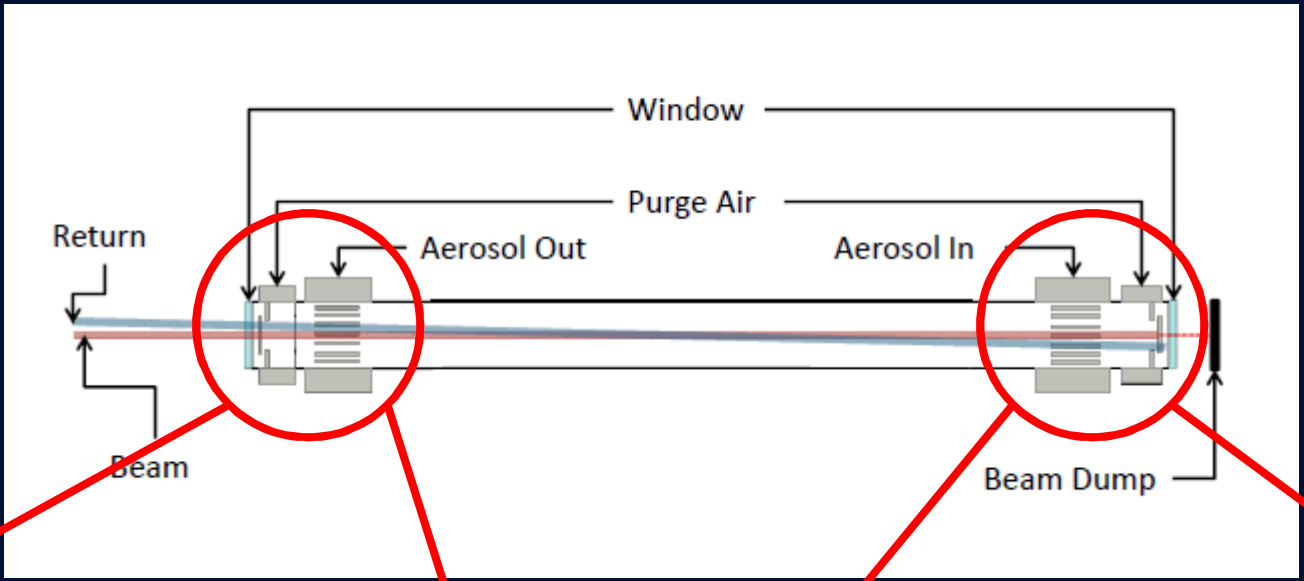


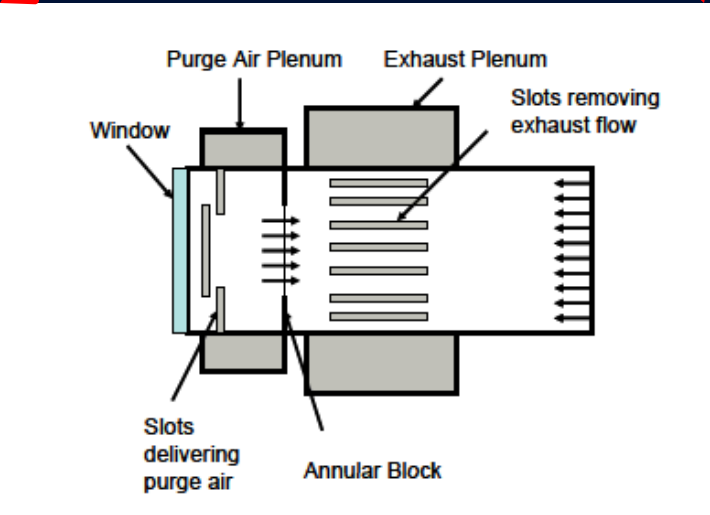


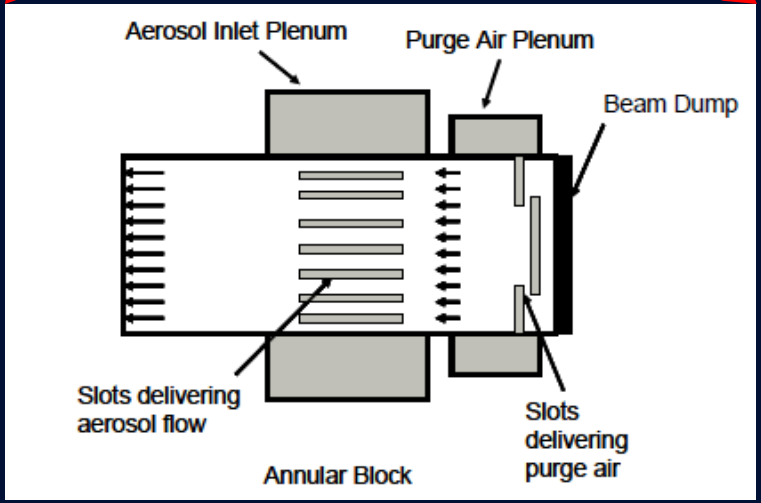

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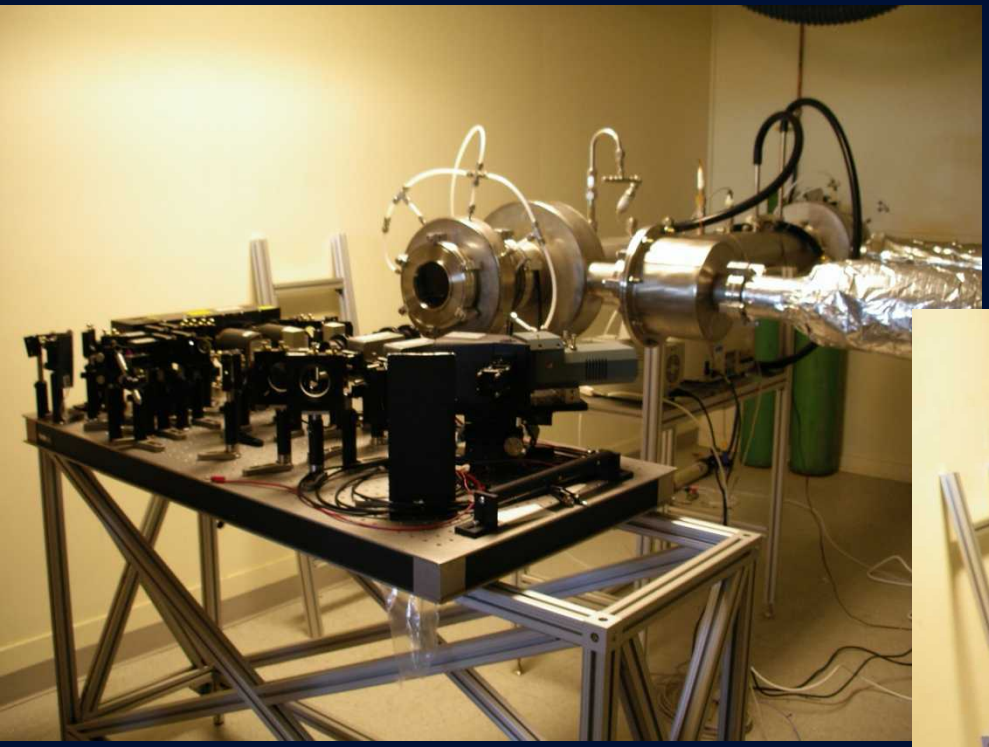
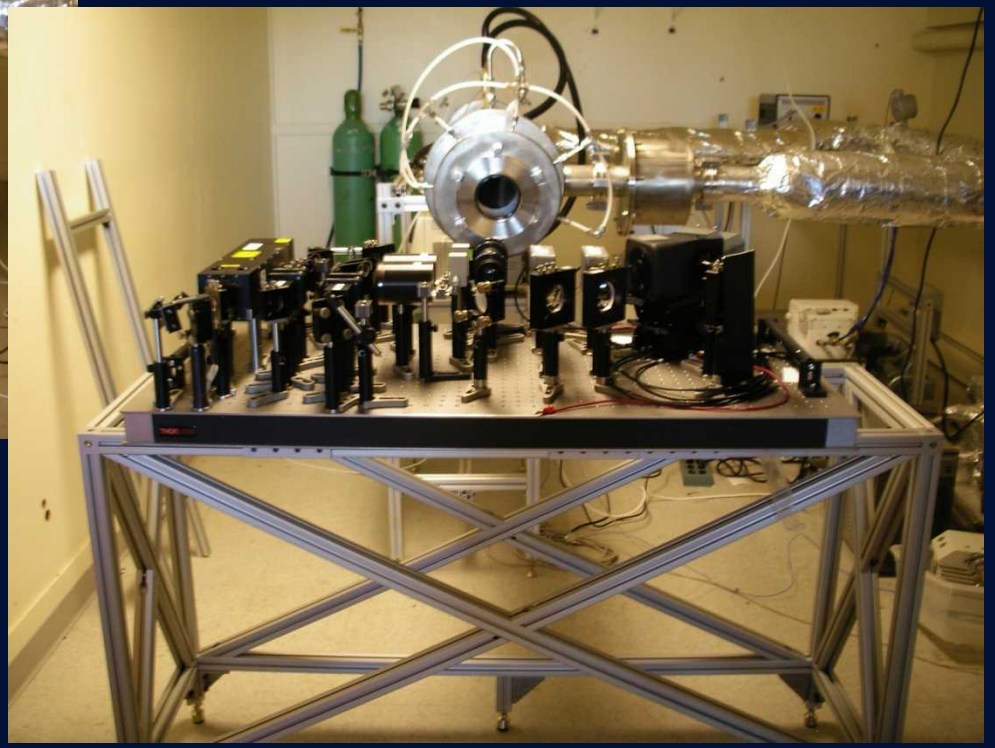
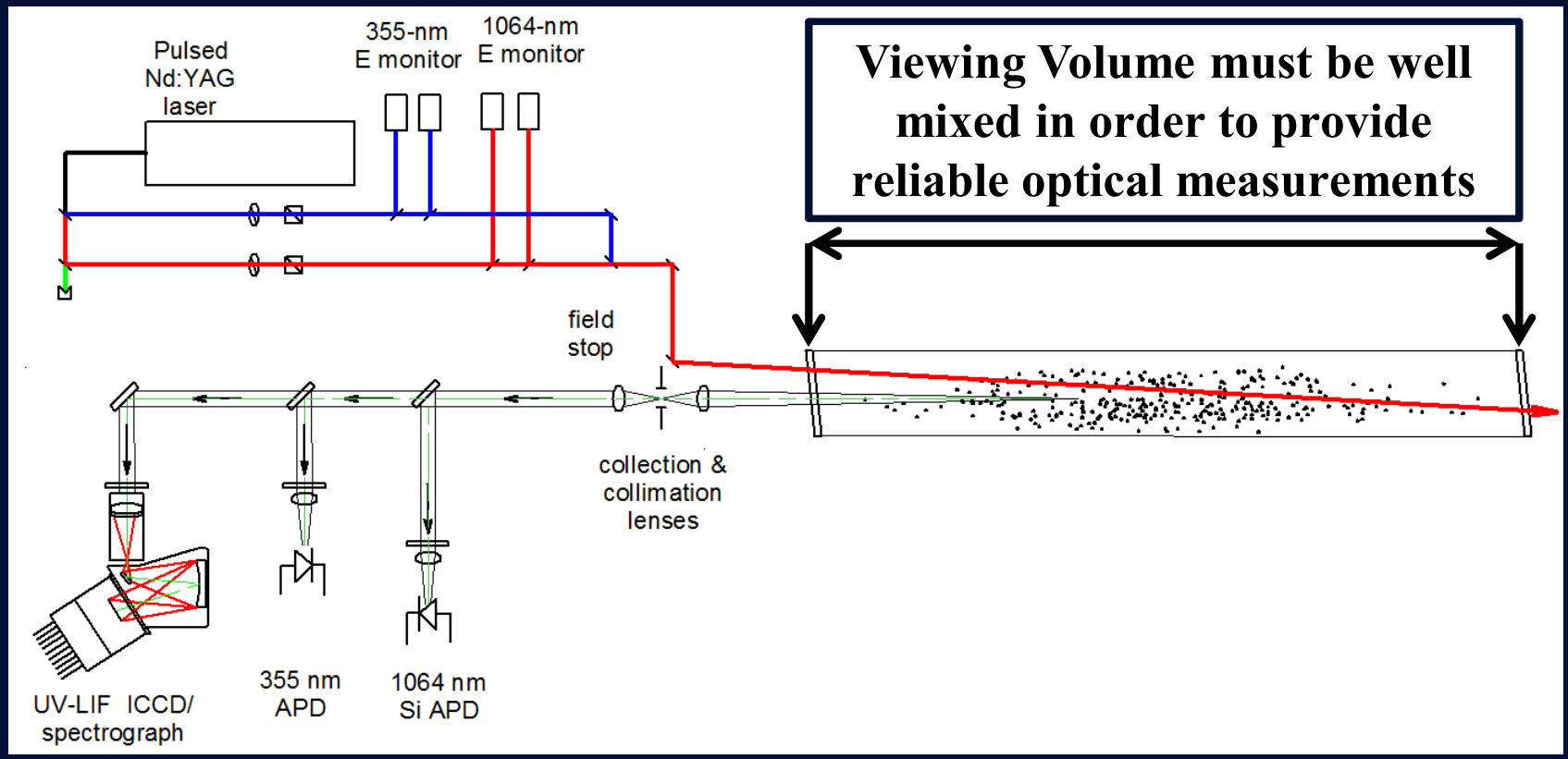


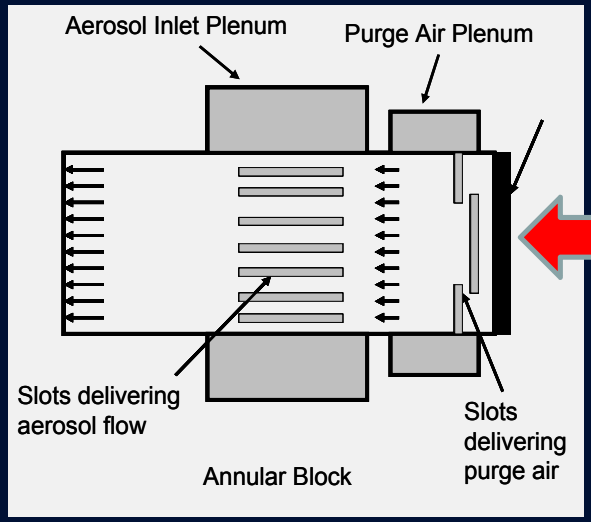


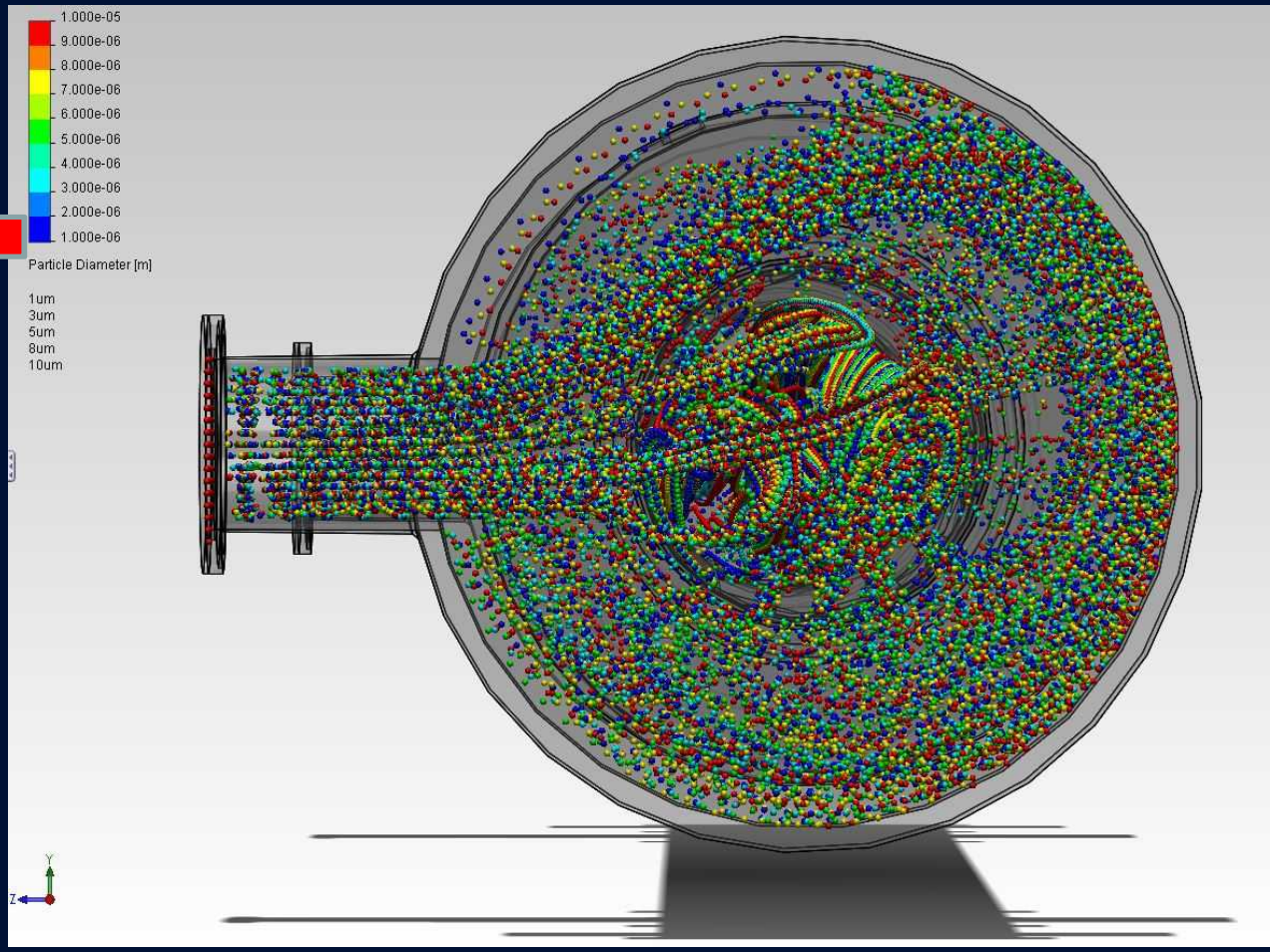
# Aerosol Measurement Flow Tube – Presenting a Well-mixed Aerosol Inside the Chamber Viewing Volume




**Both Flow modeling and aerosol measurements were utilized to verify the mixing state within the viewing volume.**

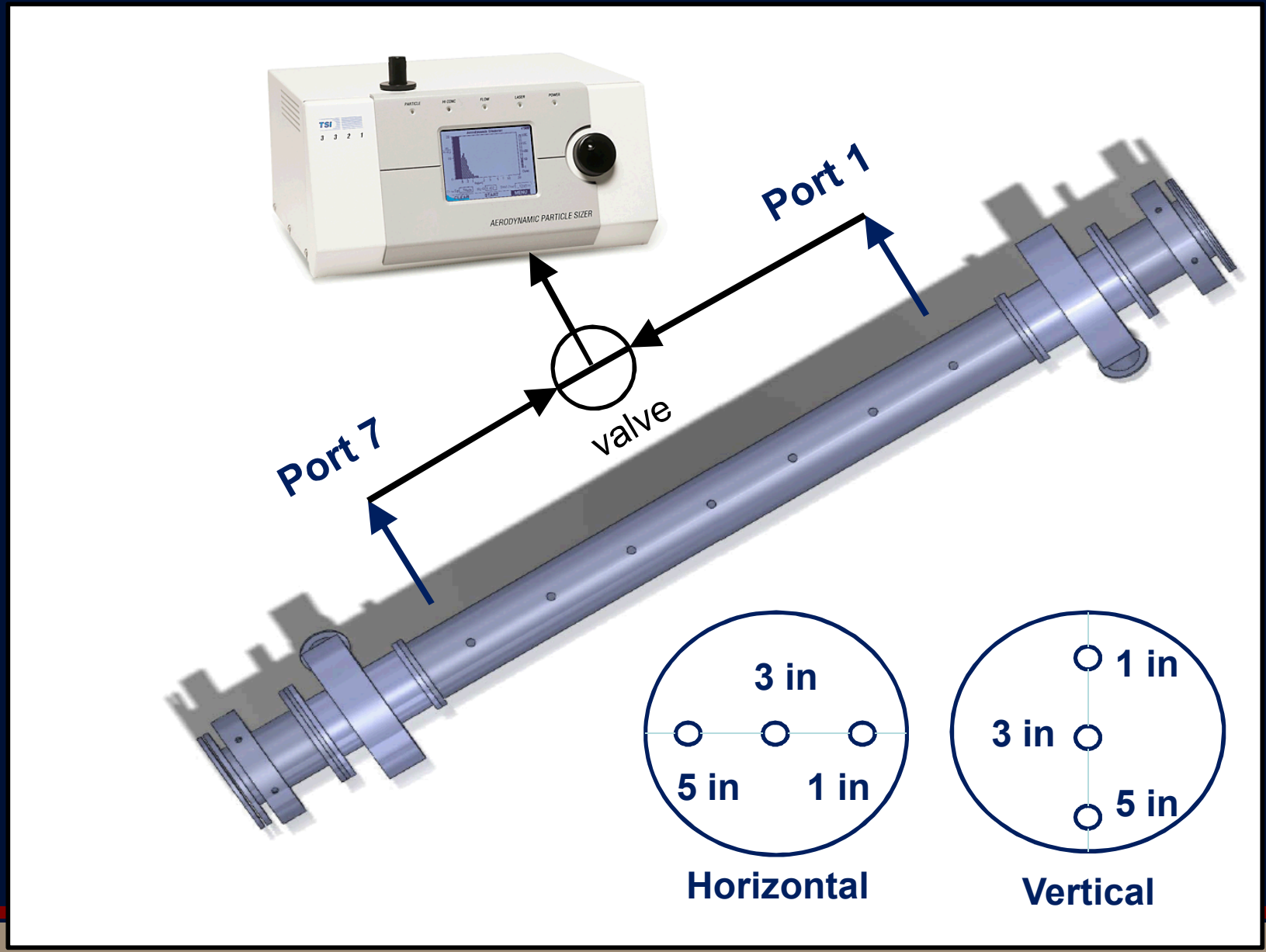
# Aerosol Measurement Flow Tube – Presenting a Well-mixed Aerosol Inside the Chamber Viewing Volume




Inlet view presents a well-mixed aerosol upon entrance into the measurement tube.

# Chamber Sampling Port Locations And Setup



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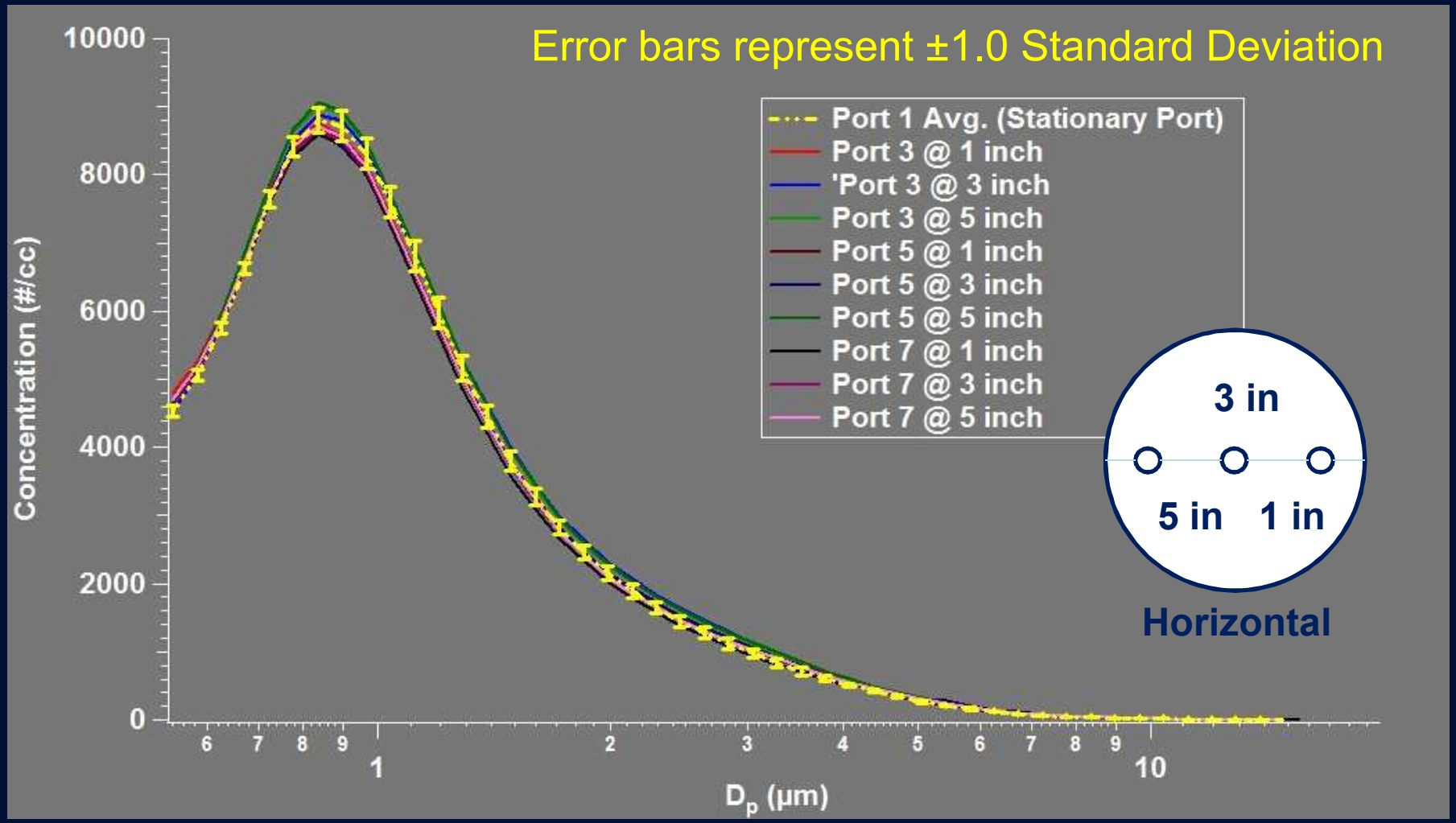

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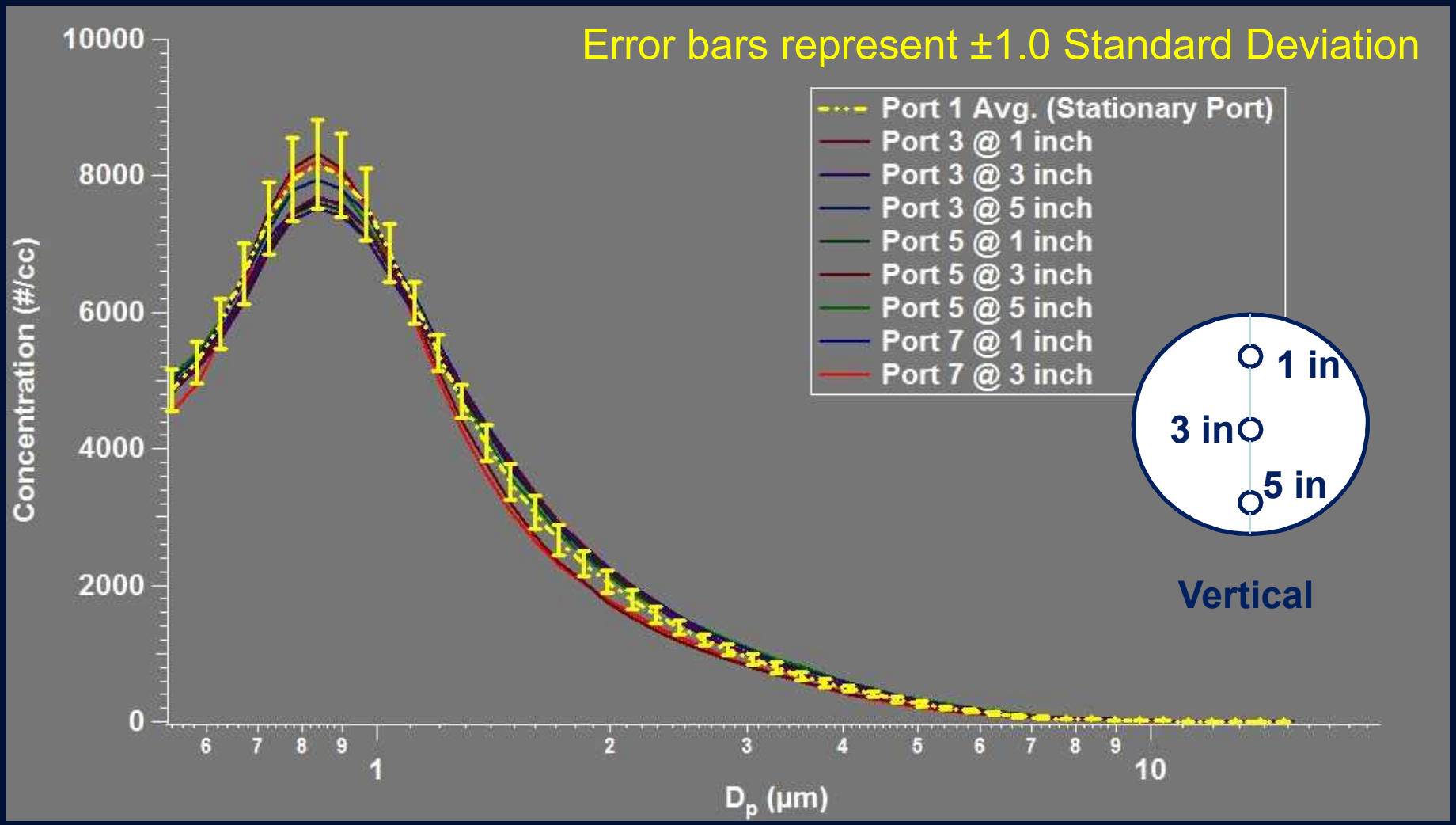
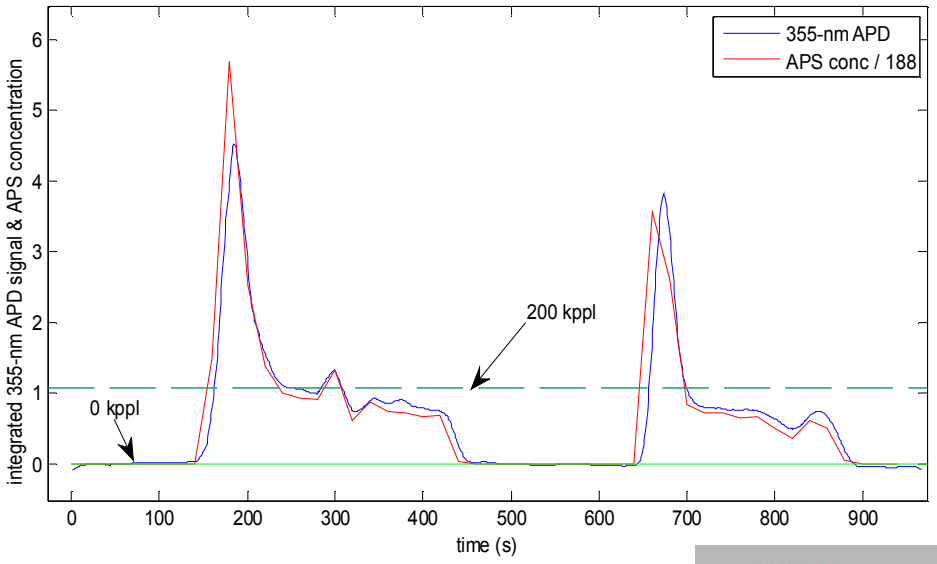
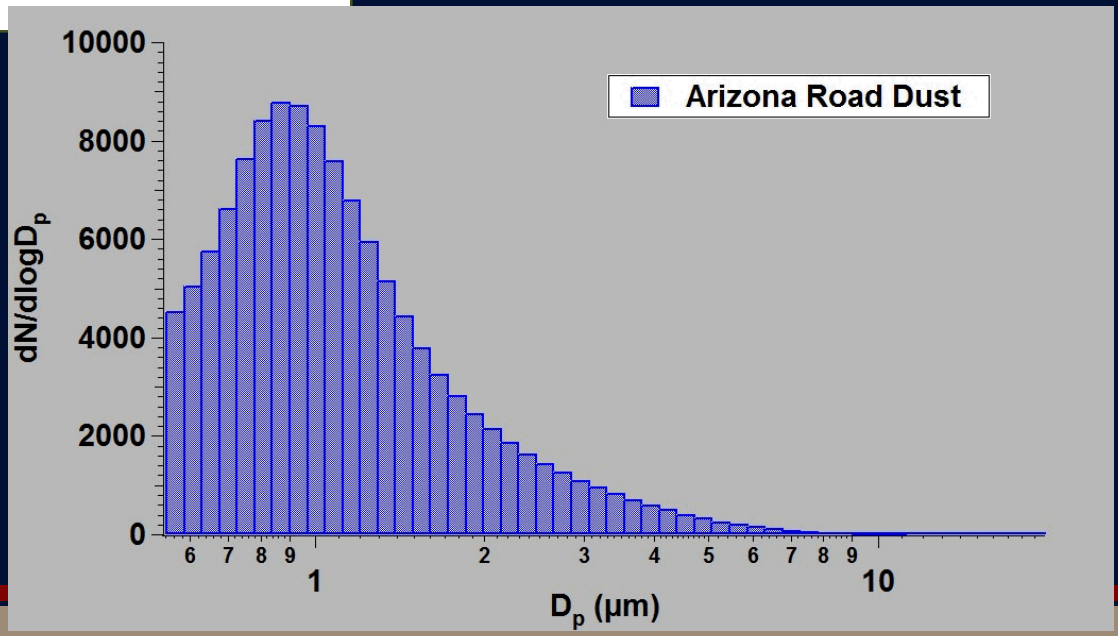


# Aerosol Optical Measurement Flow Chamber
# Preliminary Results (Arizona Road Dust 355 nm elastic signal)




Data shows raw signals averaged over 20 s intervals (same sampling interval as the APS)

**Typical Integration Volume for Standoff Detection Applications is between 1 and 10 µm**



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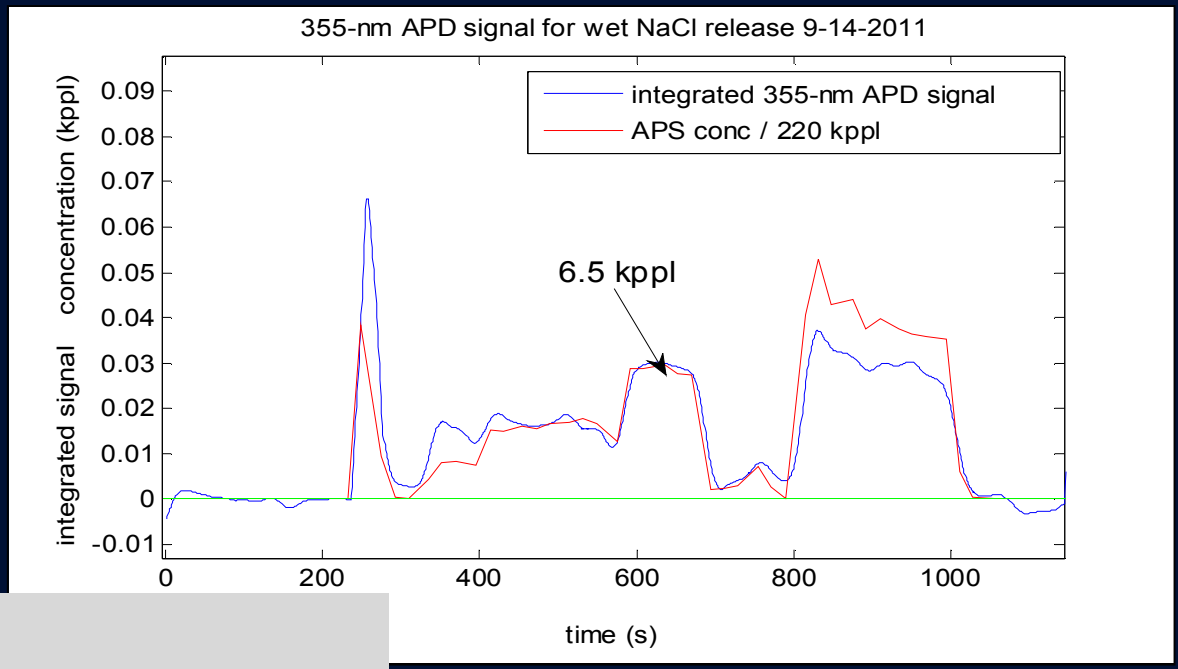
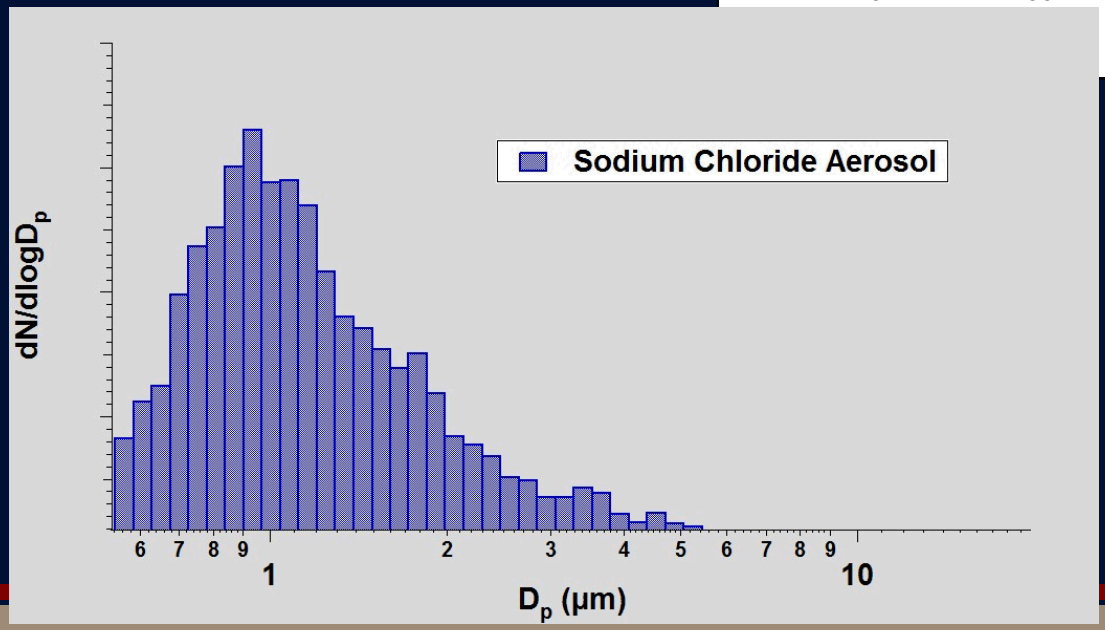
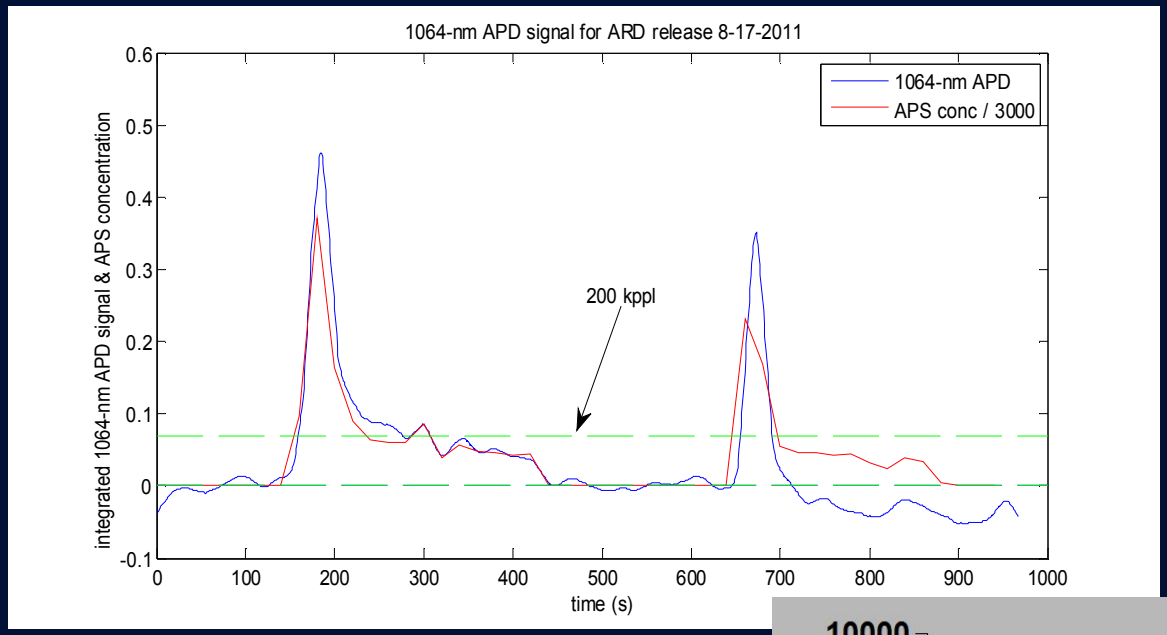


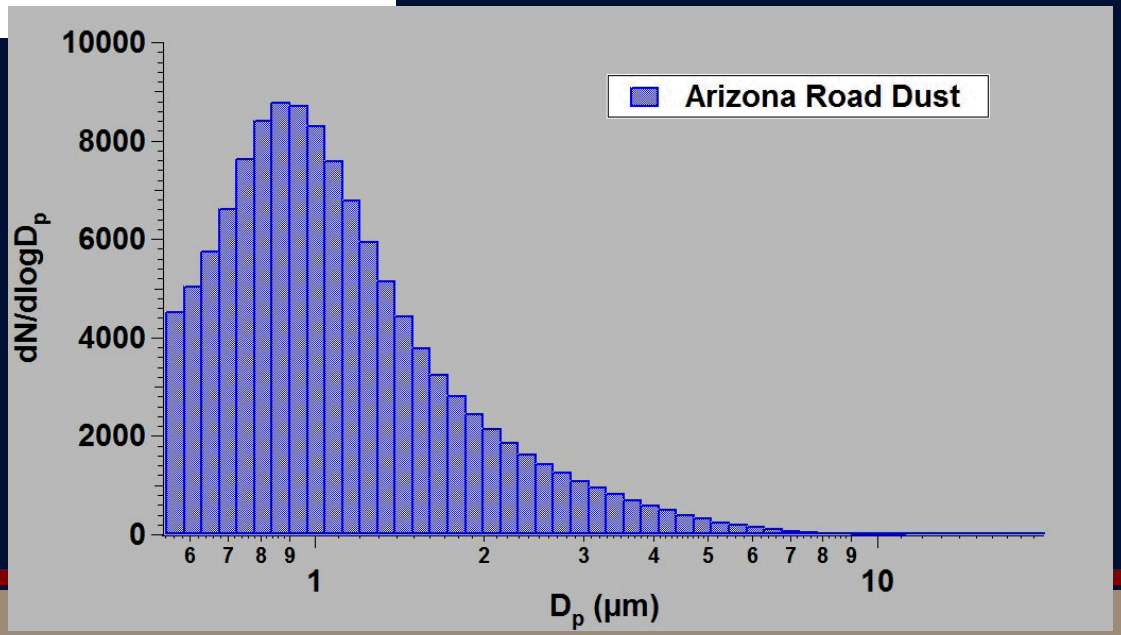




**Observed large fraction of small particles (<1 μm)**

# Aerosol Optical Measurement Flow Chamber
# Preliminary Results (Arizona Road Dust 1064 nm elastic signal)




**Data shows raw signals averaged over 20 s intervals (same sampling interval as the APS)**



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# Preliminary Results (Arizona Road Dust 1064 nm elastic signal)

Sandia National Laboratories

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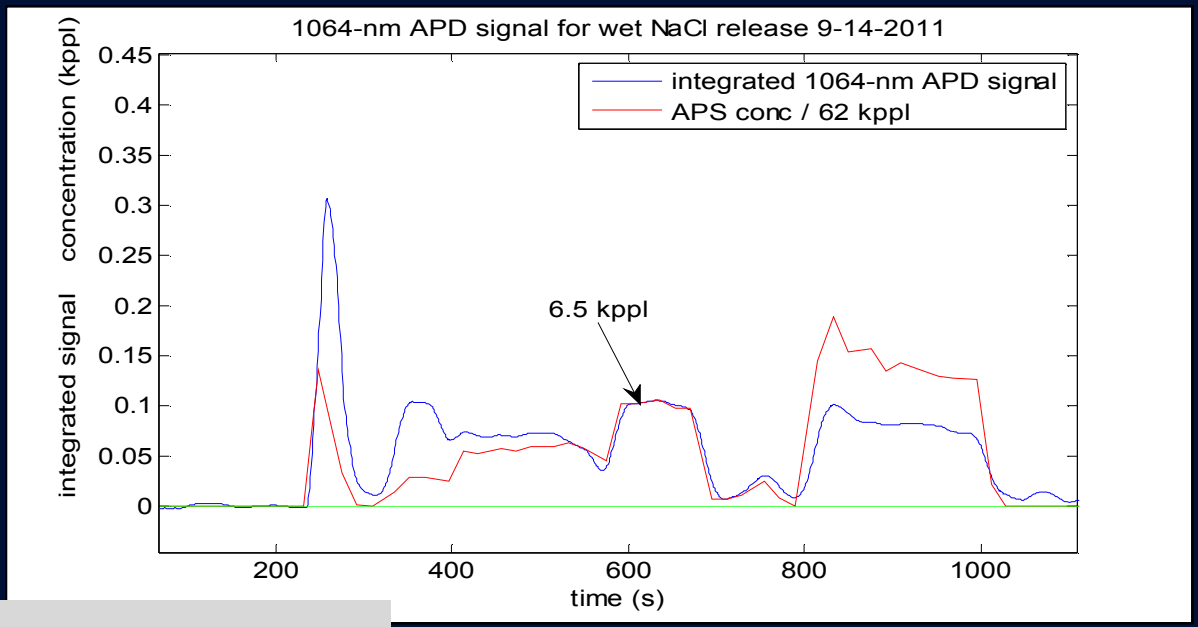


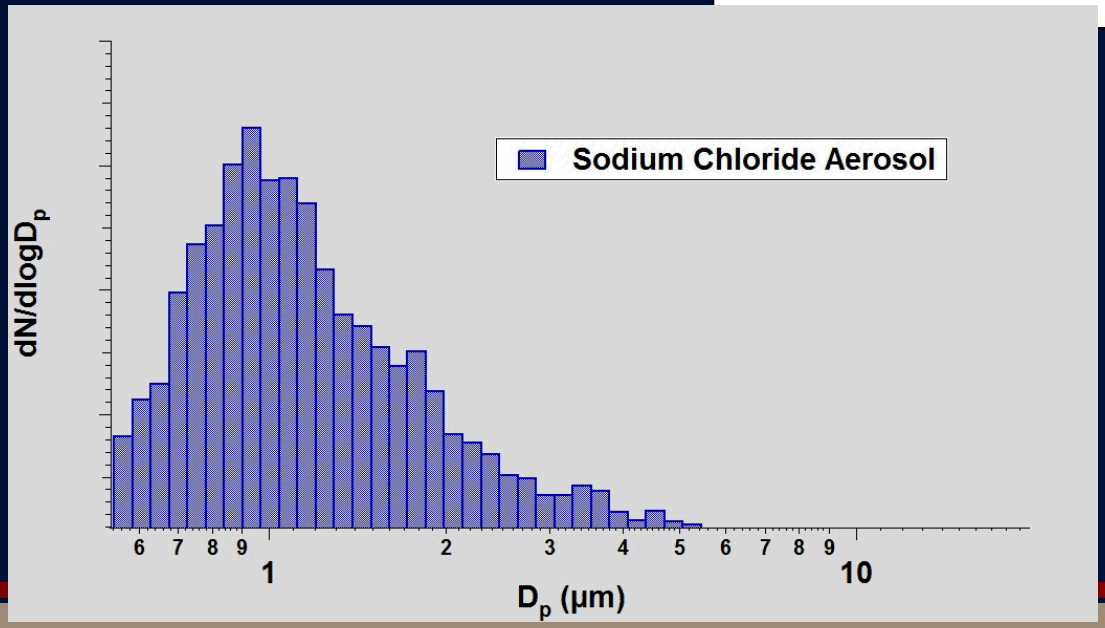

# Summary and Conclusions

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- **Standoff detection of biological particles is essential for our Nation's defense system.**

- **Because of high aerosol loading in cities as well as remote regions, it is important to measure the cross-sections of the urban aerosol and dust in a laboratory setting.**

- **A new aerosol flow measurement chamber coupled with a miniaturized standoff optical system has been established at Sandia National Laboratories which can be used to measure the optical cross-sections of atmospheric background particles.**

- **Modeling results combined with radial and axial measurements throughout the length of the chamber show that the viewing volume presents a well mixed aerosol distribution. This provides confidence in the optical measurements.**

# Summary and Conclusions (cont. )

Sandia National Laboratories

- **Preliminary results of both Arizona Road Dust and NaCl particles show good system response with the optical signals tracking the particle concentration over time.**

- **This system is a useful tool in advancing current efforts in Standoff Detection – Establishes a more cost effective method of evaluating standoff detection capabilities.**

- **Future work involves measuring the size and particle dependence of atmospheric aerosol cross-sections.**

# Acknowledgements

**Special thanks to the Lab Directed Research and Development Program at Sandia National Laboratories and the Department of Defense Joint Biological Standoff Detection Systems Program for funding and support**