

Development and Characterization of a Tabletop Fog Chamber at Sandia National Laboratories

The Problem

- Fog decreases visibility, presenting major problems for security, navigation, and remote sensing
 - **Both range and resolution are affected**

- Significant loss of life has occurred due to the reduction of situational awareness in fog (*pictured above*, commercial passenger plane almost entirely hidden in fog)

Current State of the Art

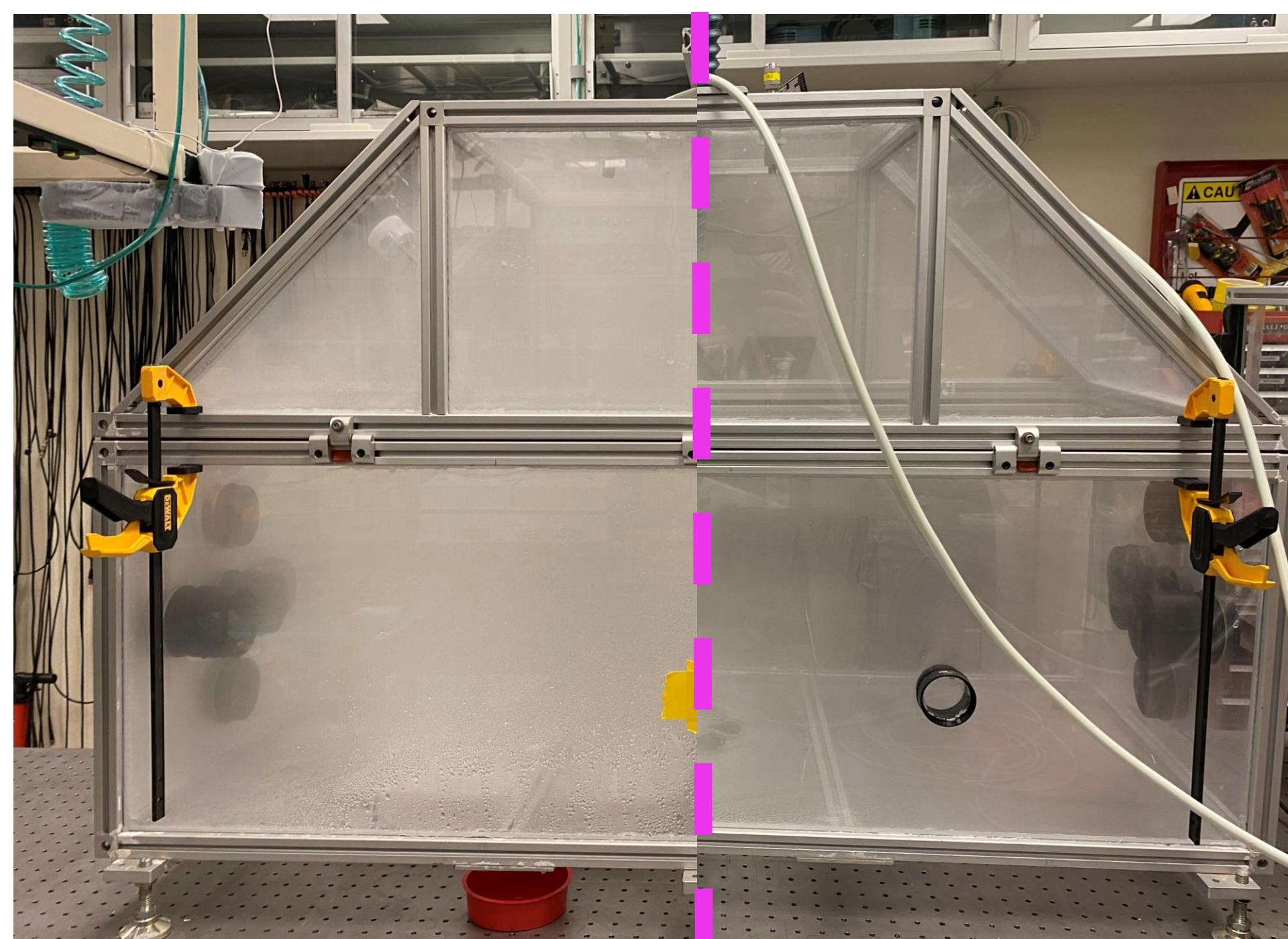
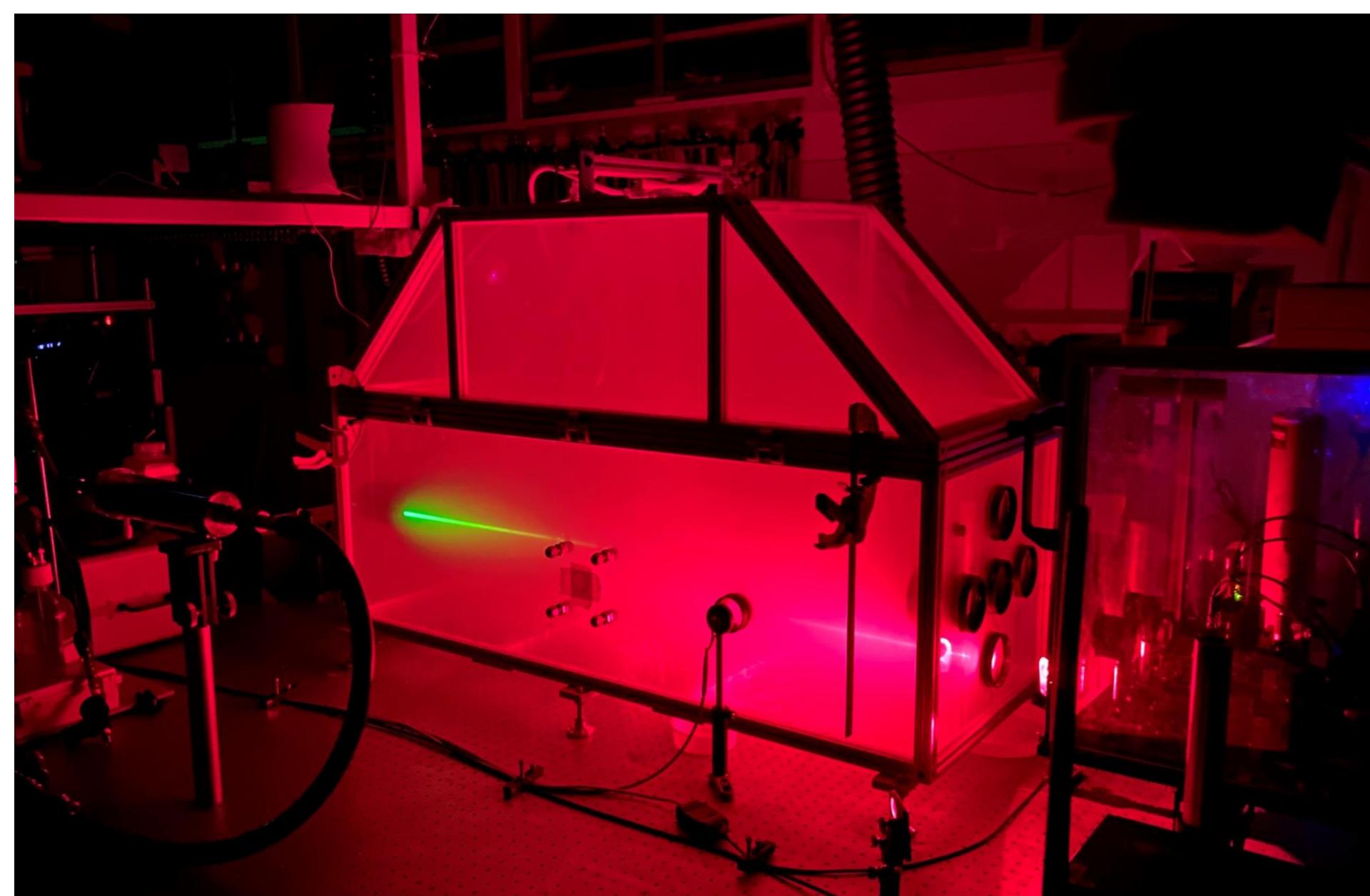
- The Sandia National Laboratories fog facility offers state-of-the-art fog environment testing
 - Repeatable, well characterized fog environment
 - 10' x 10' x 180' facility
 - Equipped to measure fog density and particle distributions
 - Multiband transmissometer
 - Malvern Spravtec particle sizer

Development of the Tabletop Fog Chamber

- Small scale experiments are better suited for a smaller environmental chamber
 - 1.5' x 1.5' x 4' tabletop chamber
 - Capable of being equipped with all instruments present in the main chamber
 - Compact design allows for:
 - Reduced experimental overhead
 - Setup time, material cost
 - Provides a platform for testing novel proof-of-concept ideas

Work With Us

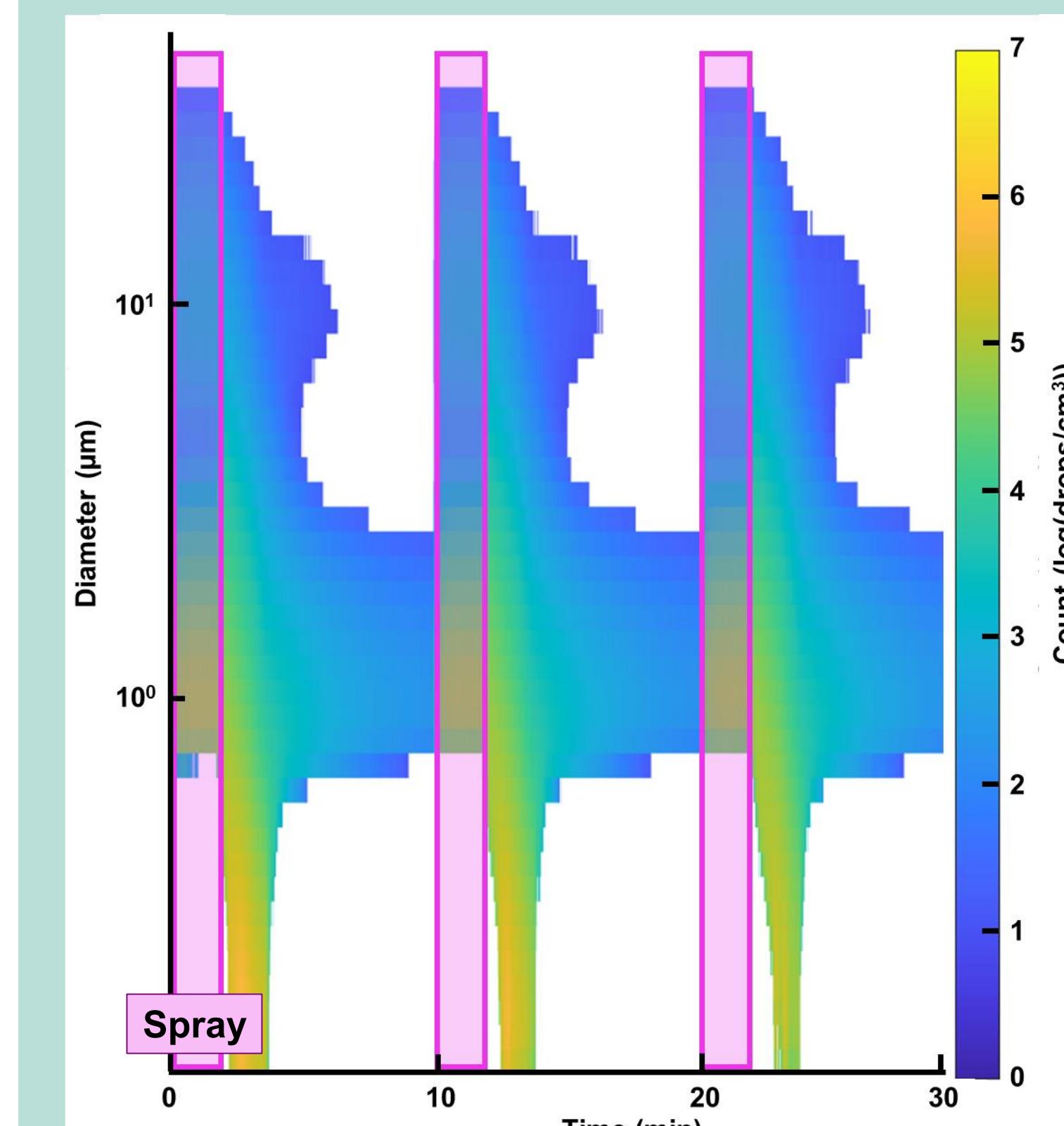
- Cost-effective and rapid turnaround allows collaborators to leverage our expertise and facilities to solve difficult technical challenges
 - Sandia SPP Agreements facilitate collaboration



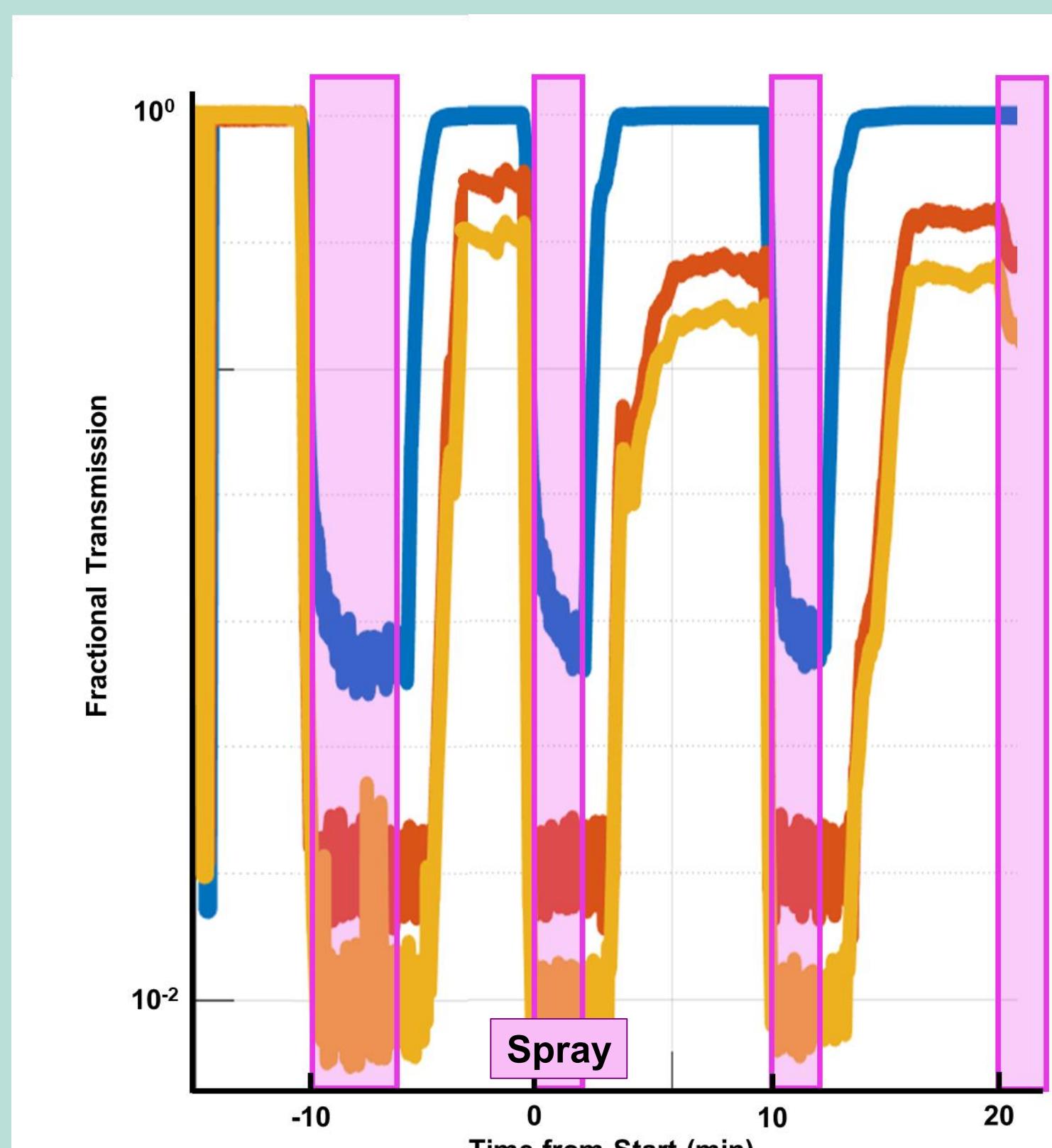
From top to bottom: super-resolution imaging test, transmissometer visible (green) and experimental (red) beams can be seen scattering; side-by-side images of different fogs generated by the chamber; Malvern Spraytec attached to the chamber

Characterization of the Tabletop Fog Chamber

- Repeated experiments were run to investigate the impact of changing several key control variables on the resultant fog
 - Control variables: system pressure, system temperature, and salinity of feed water



Particle size distribution of tabletop fog chamber over time. Bimodal distribution seen, similar to the main fog chamber



Multiband transmission data through the tabletop chamber, pictured from initial humidification through several sprays

- Generated fogs were measured with a Malvern Spraytec particle sizer and the Sandia Fog multiband transmissometer to obtain particle size distribution and aerosol density

Future Work

- Using the tabletop and main fog chambers in tandem we are actively pursuing the following research areas:
 - **Scale up:** the next step in this series of experiments, we intend to investigate how to scale results from the tabletop chamber to the main chamber to support multi-stage investigations
 - **Fog composition:** we are investigating the effect of pollutants common in diesel exhaust on fogs and clouds for environmental monitoring
 - **Optical super-resolution:** we are investigating the ability to leverage laser speckle to detect relative motion of objects hidden within fogs
 - **Machine learning:** we intend to leverage a physics-informed neural network to enhance our ability to detect, identify, and classify objects obscured within fogs