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The purpose of this assignment was to explore the flow dynamics of vapor clouds. A fog machine and conical laser were used to image “slices” of the vapor. Many images were taken and due to the randomness of the setup the images varied greatly. I chose my image on its aesthetics value over all.

A pitch black room was needed to optimize the laser sheet. The only dark room available was small and had an AC blasting constantly. The laser sheet was place on the ground and its cone of light shined upward. The fog machine was placed a foot away from the light and directed such that the fog flowed directly into the cone. The exit velocity of the fog is estimated to be 1 m/s however diffusion into the ambient air quickly slowed the fog down into turbulent clouds that expanded outward. The Reynolds number of this flow can be estimated using the following equation:

$$Re = \frac{\rho V L}{\mu}$$

Density ρ of the vapor is estimated to be .554 kg/m^3. (1) Length L = .6 m. Dynamic viscosity μ = .000043 Ns/m^2 (2)

This gives a Reynolds number of 8,310. This indicates a lower end turbulent flow which aligns with our observation. A 3 second stream of fog would fully diffuse in the ambient air in about 15 seconds by which point there was no observable flow in the laser sheet. Below in figure 2 is a diagram of the setup.

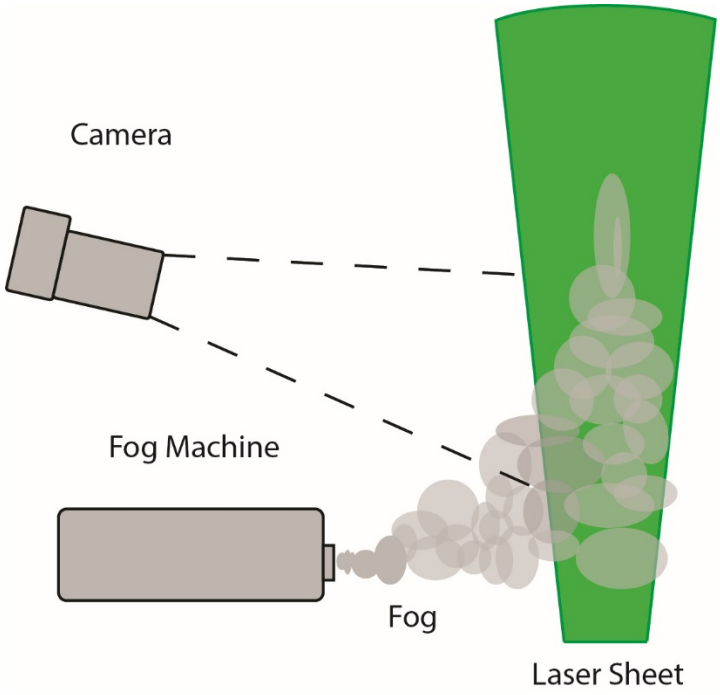

Figure 2: Diagram of setup

I used a sony alpha 5100 with a 50mm prime lens shooting at f/1.8 ISO 500 and 1/80 sec. The camera was approximately 2 feet away from the laser sheet and the field of view was about 1.2 feet. The time resolution seemed sufficient as the edges on the clouds were sharp. The image was shot in RAW and edited in Lightroom. The contrast, clarity and exposure were all enhanced to deepen the dynamic range, and saturation was zeroed out and replaced with split toning. This replaced the harsh green color of the laser with a more pleasant tan and purple.

The image captured turned out nicely. A flat laser sheet would have been ideal as the aperture was so large however the curve added a depth of field that may be a aesthetically pleasing to some. A tripod setup would have also made the focusing easier and more consistent. Overall the depth of the flow came out well and the dynamics of turbulence were imaged well.

References

1. **Khalil, Rudolf.** Density of water vapor. *ResearchGate.* [Online] https://www.researchgate.net/post/Can_someone_advise_on_the_density_of_water_vapor.

2. **Dynamic Viscosity water vapor. *The Engineering Toolbox.* [Online] https://www.engineeringtoolbox.com/steam-viscosity-d_770.html.**