Team Third

Gregory Kornguth
Credit: Leo Steinbarth
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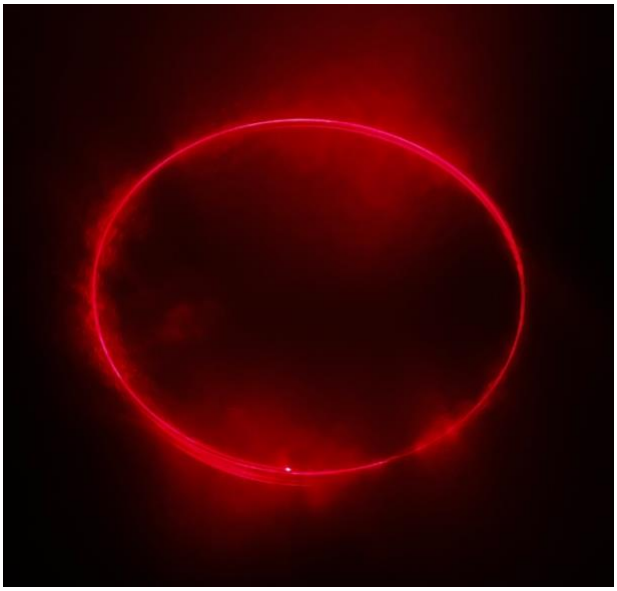
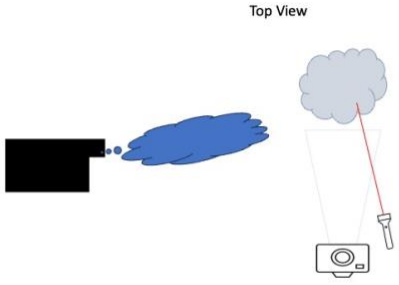
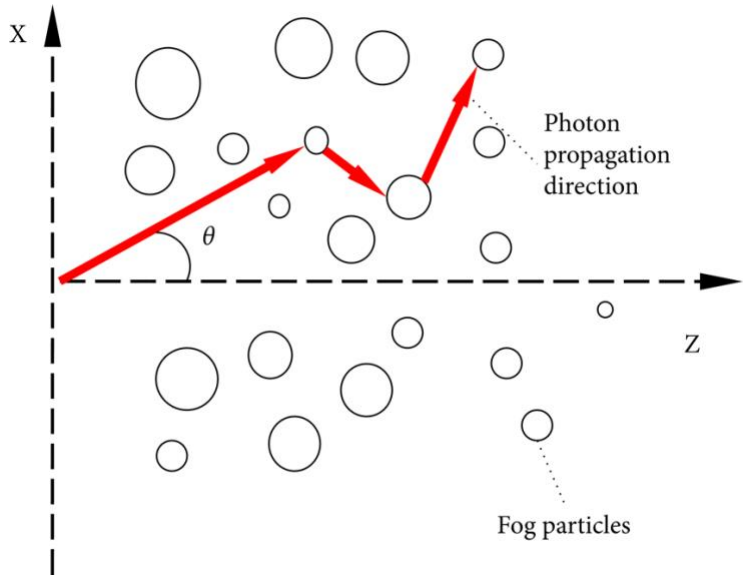


For our team third photo, our group used lasers and a fog machine to get some cool images. We initially planned on using the lasers to make it easier to see the movement of the fog from the fog machine, but we thought that drawing designs in the fog with the laser produced more interesting photos. In the final image, we can tell the relative density of the fog in different areas by how much of the light is refracted.

The setup for our image included a fog machine to produce the fog and a red laser which we shone through the cloud of fog. Because the red laser gets dispersed when it hits more dense areas of fog, we can see where the fog is concentrated. The area that we shot was a couple of feet away from the fog machine, so it had started to disperse about the photographed area. To get the pattern traced out by the laser to look like a circle in the photo, the exposure was a bit longer which caused the moving light to look like one shape. Besides the exposure and moving laser, there wasn't much else to the setup.

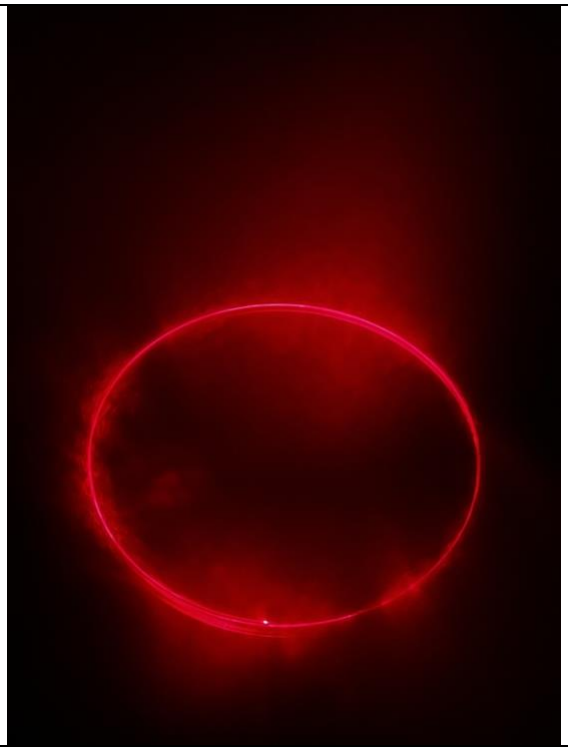
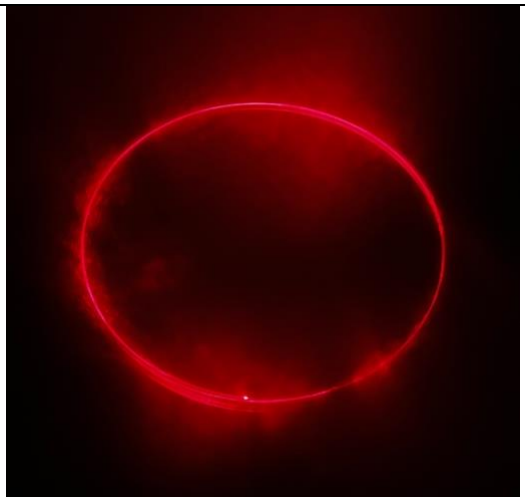


Because the fog was far from the machine at the time of the photo, there was plenty of time for the fog to mix with the turbulent surrounding air and create areas of higher and lower concentrations of fog. In the photo, the brighter areas are where there is more fog, and the darker areas are where there is less fog. The difference in brightness in the areas is due to the scattering of the laser as it contacts the fog particles by various methods. Since atmospheric air is typically clear and reflects a very small amount of visible light, the areas with only atmospheric air appear darker since there is nothing to reflect the light to the camera. In the areas of higher fog density, the laser beam encounters the many fog particles floating around and scatters. When light hits a particle of fog, it can either be absorbed and reemitted, pass through the fog particle and get scattered, or bounce off the particle. When the light scatters, it illuminates the area of fog around it and makes it brighter depending on how much fog there is for it to reflect off. The image below from a research paper written by Qiang Xu, Yunhua Cao, Yuanyuan Zhang, Shaohui Yan, Yiping Han, and Zhensen Wu about the scattering of lasers in fog depicts how the scattering works.[i]



The visualization technique used for this photo was just using a long exposure on an iPhone to get the circular shape of the laser which illuminates many different parts of the frame. To capture the movement of the light in one frame, we used a five-second exposure while moving the laser in a circular motion. Because we didn't want to get any light besides the laser in the shot, we waited until it was dark and turned all the lights off. This allowed us to only see the parts of the fog that were illuminated by the laser.

The field of view of the photo was about two feet wide. Since the room was very dark and the only lighting was the laser itself, the ISO was very high at 10000. The focal length was 26 mm, and the aperture was 1.6. We used a five-second exposure with the low light mode on an iPhone 13 mini. The only edits I made on the photo were cropping the image and lowing the brightness a very small amount. The size of the original photo was 3024x4032 pixels, and the size of my edited photo was 3024x2888 pixels.

Pre	Post
	

I believe that this photo displayed an interesting and creative way to visualize densities in fluids as they disperse in the air. I felt that our team third photos were very visually striking and created a kind of physical heatmap of the densities of the fog in the frame. Next time we attempt something similar to this, we may try using different colors to see if that has any effect on the clarity of the density regions, or even try moving the frame closer to the output from the fog machine to get a more uniform spread of fog.

[i]Xu, Qiang, et al. “The Multiple Scattering of Laser Beam Propagation in Advection Fog and Radiation Fog.” *International Journal of Optics*, Hindawi, 10 Jan. 2023, www.hindawi.com/journals/ijo/2023/9715482/.