Team Third Report

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Flow Visualization Fall 2023 Section 001
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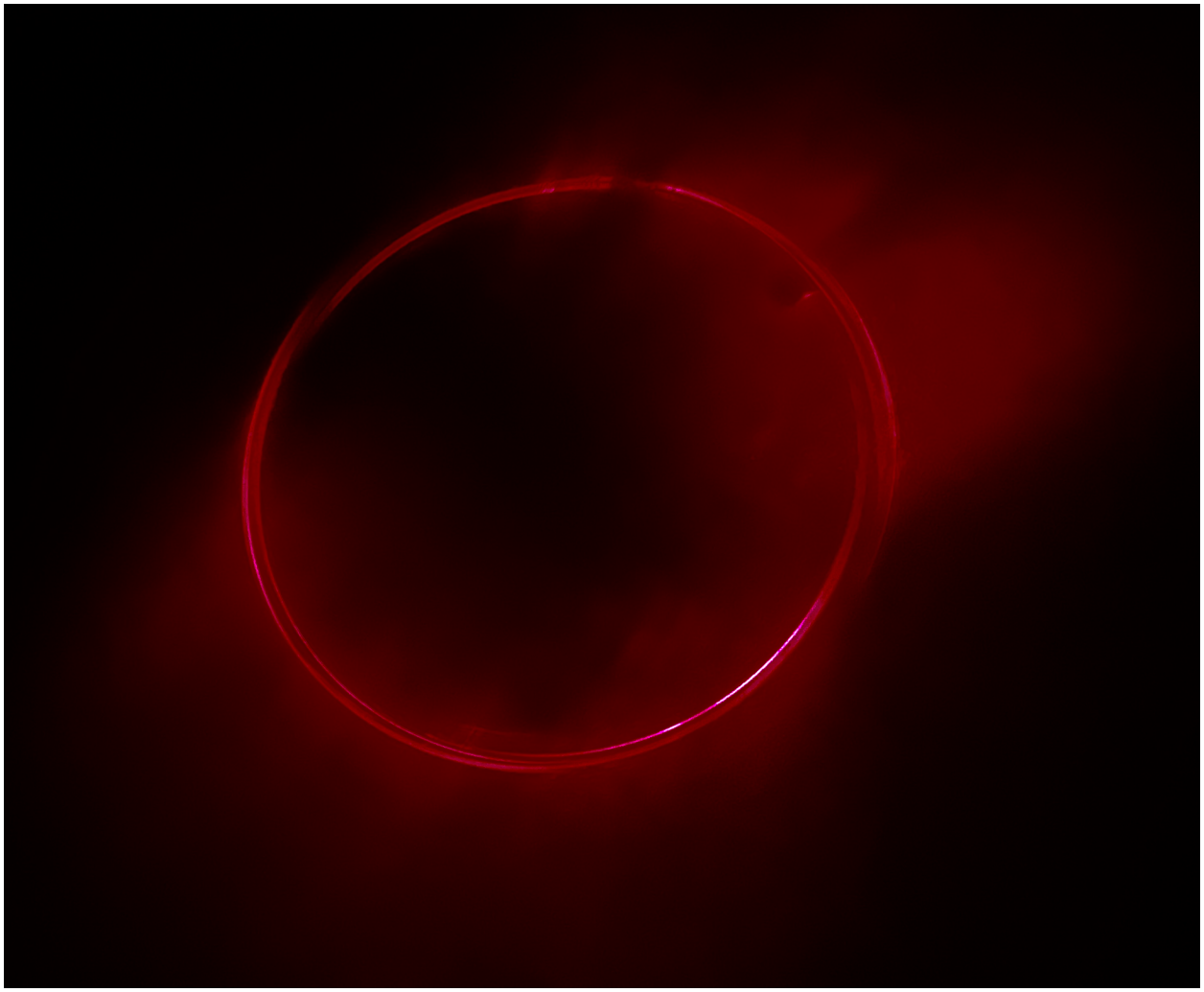

Context and Purpose

For the third team exercise, our group opted to capture “laser sheets” similar to green curly picture featured on the flowvis.org site. We initially sought out to visualize vortices using a fog machine and an oar or flat peive of cardboard, but the results were not very great. We then pivoted to using a solid transparent material that gave us the results we were after in a beautiful and simplistic form. This technique is used often in the aerospace industry, as it allows the human eye to visualize flow in different regions of the wing, body, or other aerodynamic surface. For example in Figure 1, you can see the 3 separate laser sheets identify the behavior of airflow of a military fighter jet model in a wind tunnel.[1]

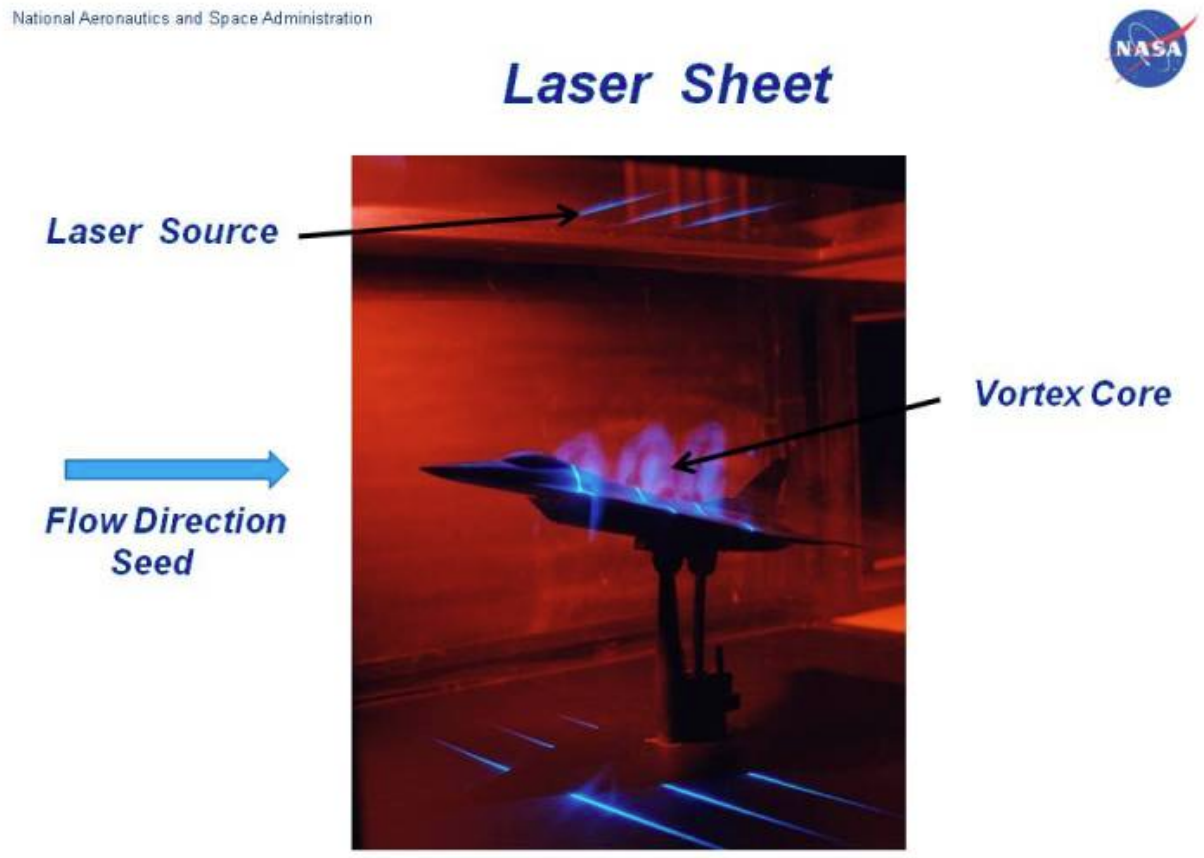

Figure 1: NASA Langley Basic Aerodynamic Research Tunnel Laser Sheet Example

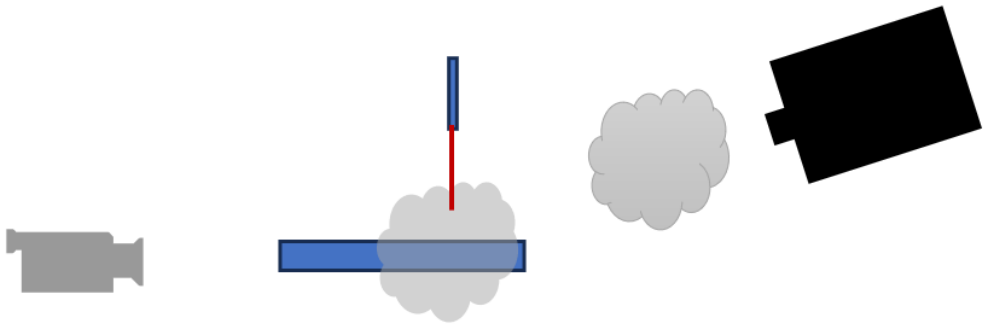

Figure 2: Sketch of setup used for image capture.

As the fog covers the surface area of the glass rod, the laser beam that is illuminated towards the rod refracts and creates the circle shape displayed in the final image. Some takeaways from the image taken were that the denser regions of fog lead to a brighter reflection of the light. This would indicate the density of the fog is proportional the the amount of light that is refracted from the laser. Additionally, the circular outline reflection indicates that the glass rod did not refract as much compared to the fog and with the fog surrounding only the surface of the rod, we were left with just the outline. I would imagine and could test the intuition that a hollow glass tube or straw-like object would have a very different result. This would allow the fog to enter the center and outside portion of the tube and amount of light refracted or scatted would be much greater and therefore brighter.

Photographic Technique

The photo settings are described here as follows. The camera used was an iPhone 13 mini. The ISO was 10000, the focal length was 26mm, and the aperture was 1.6. The shutter speed was set to 5 seconds to utilize the low-light mode feature. The photo resolution was 3024x4032 initially before being cropped to 2937x3080. The brightness level was reduced and saturation was increased but for the most part this image had little editing.

Figure 3: Original unedited image

Reflection

I was super happy with the results of this image, I would like in the future to try and get different laser sheet effects by using more unique materials. This was my first time being exposed to this type of flow visualization technique and I thought it was really cool. The results of our teams images were that of a light painting images with a long exposure and moving bright objects in the frame. I think the introduction of RGB lighting with several colors would ne amazing, but it is difficult to find while using lasers for this effect. Overall I think our team did a great job experimenting with laser sheets!

References

[1] NASA. (n.d.). Laser sheet - flow visualization. NASA.gov. https://www.grc.nasa.gov/www/k-12/airplane/tunvlaser.html