Hana Kieger
Team Two

Team partners: Chet Roe, Eli Kopp-DeVol, and Ibrahim Alhajji

This image was for our second team assignment. Our intent was to capture a photo of fog that gets cut with a laser and to get an idea of how fog moves on its own and when we used a fan to manipulate the flow. We wanted it to be dramatic and beautiful, which is why the laser is our only source of light.

Setup: Written by Eli
"The set up for this image was relatively simplistic, using only everyday household items. As can be seen in Figure 1 below, a plastic bowl, with a matte white interior surface, was placed on a flat surface with a black backdrop (not pictured). This bowl was then filled with lukewarm water and two medium sized chunks of dry ice were dropped in. As steam started to collect in the space above the water, a small window fan was held roughly a foot above the bowl (pointed upwards) and turned on. This caused air currents to begin to flow from around the bowl, up through the fan, disturbing the collecting steam and pulling it upwards from the surface of the bowl. A laser pointer was then rapidly shook up and down creating a laser sheet which "sliced" through the rising steam, resulting in the above image. The diagram is shown from the perspective of the camera, indicating camera position."

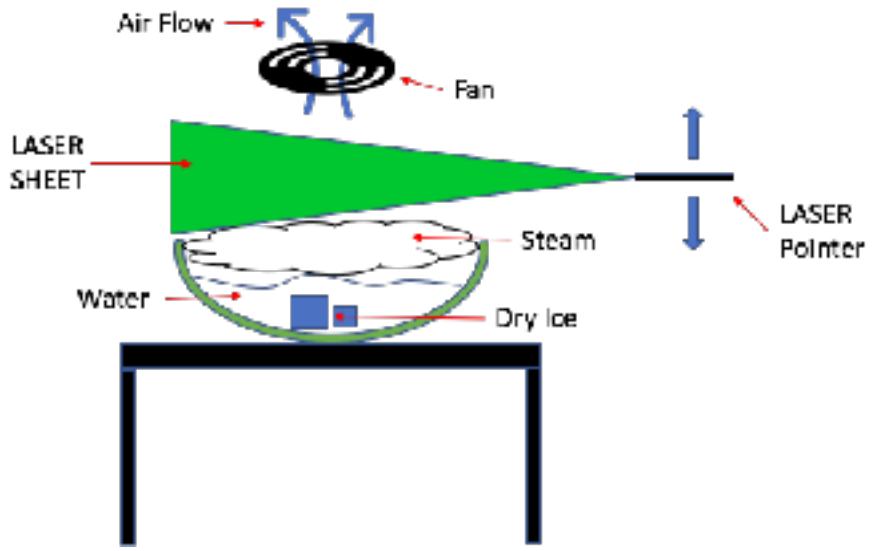
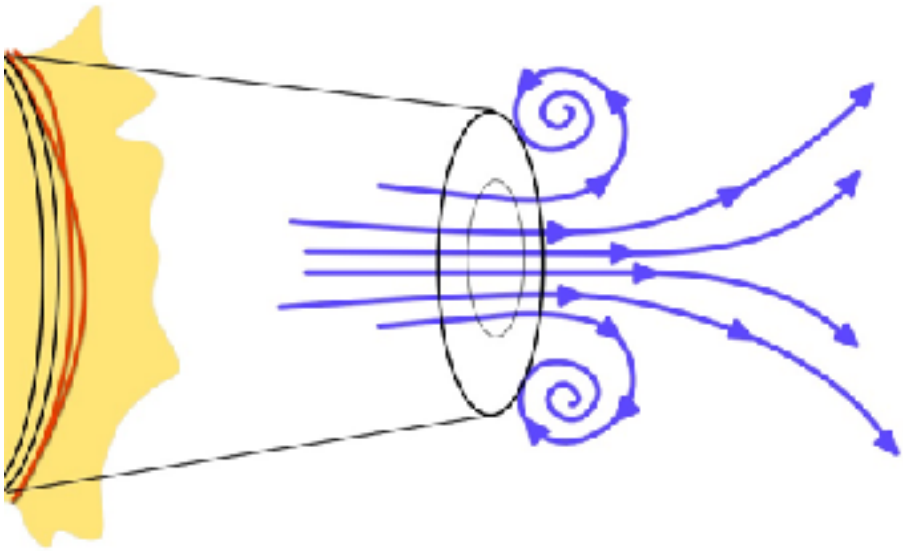


Diagram 1: Setup of flow

Physics: Written by Chet



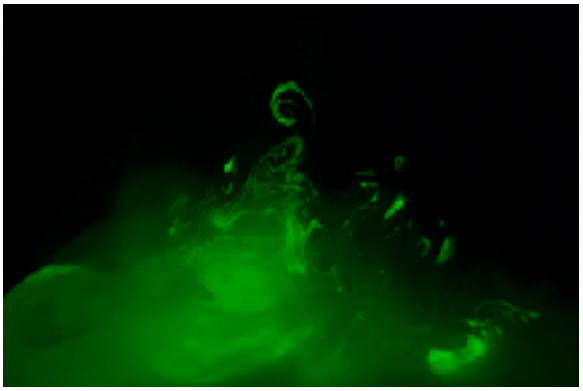
“In the photo [above], we can see the side profile of some vortex rings. For a vortex ring to occur, a uniform jet of fluid moving upwards (in our case) is the instigator of the curling flow. When this jet reaches a surface, the outside edge catches with the no slip condition at the interface. This means that the fluid nearer to the edge will move slowly, while the center is moving quickly, causing a spinning motion to form. As this spinning fluid with the jet at the center moves through the air, the air at the outside is still relative to the moving fluid, causing the fluid at the edges to slow, similar to how it did at the surface interface. This interaction continues the spinning of vortex.

For our fluid, we have a miniscule amount, about one drop, of dish soap in the mix bowl of water and dry ice. As a dry ice bubble forms and is rises quickly to the top of the water it has a very uniform speed. When it reaches the water surface, the bubble bursts and some of the vapor catches on the water surface, as if it were a hole in a can as shown above [1]. This creates a vortex as described earlier.

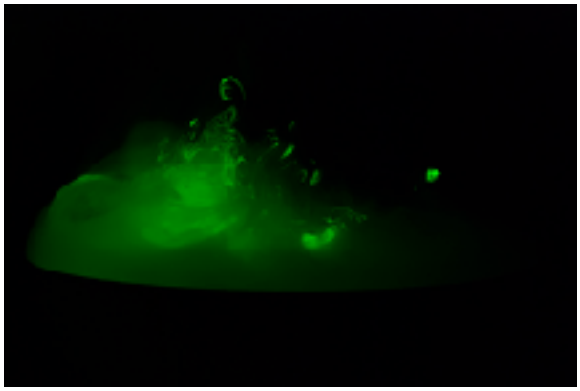
Another phenomenon we see is that the CO2 gas is staying very low and just above the bowl. This a simple hot air rises situation, where the gas is still much colder than the surrounding air. The only upwards plumes are caused by exploding bubbles or by the fan sucking the air upwards.”

Visualization Technique: written by Ibrahim
“To obtain the colored fog, we used dry ice, green laser, and a fan. We put the dry ice in a bow and we poured room-temperature water on it to generate more steam. Then, we positioned the fan on top of the bowl to create a vortex (shown in the diagram above). We used the green laser to make the steam more visual. We kept shaking the laser left and right to cover more area of the steam. We had the entire set up in a dark room. Also, we did not use any light other than the light produced by the laser. A Nikon D80 camera was used to capture the photos. The flashlight on the camera was turned off.”

The size of the field of view was around a foot wide and the distance from the object to the lens was around 6-7 inches. The focal length was 40.00 mm. The image was taken with a digital Nikon D80 camera which resulted in an original image of size 3872 x 2592. The final size of the image uploaded to flowviz.org is 1300 x 866. The exposure specs are as follows: exposure - 1/15 seconds, aperture - f/10, ISO 800. I used Photoshop to crop the image to eliminate the bowl at the bottom and some unnecessary black space on the edges of the image. I did very minimal color editing of the image because the color was so bright anyway.



Edited Image



Original Image

Sources:
[1] https://www.sciencefriday.com/educational-resources/design-a-better-vortex-cannon/