Chester Roe

Team Second

11-12-18

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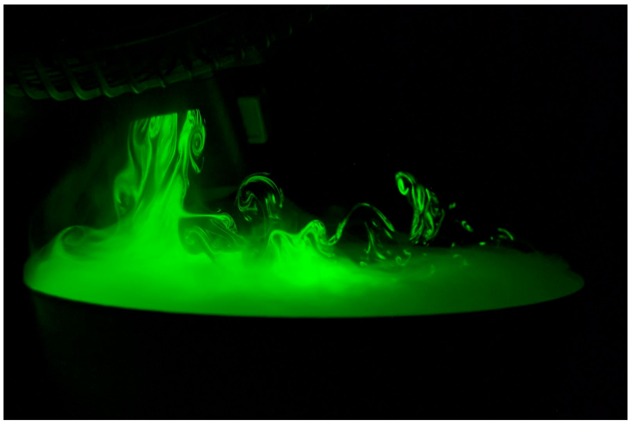
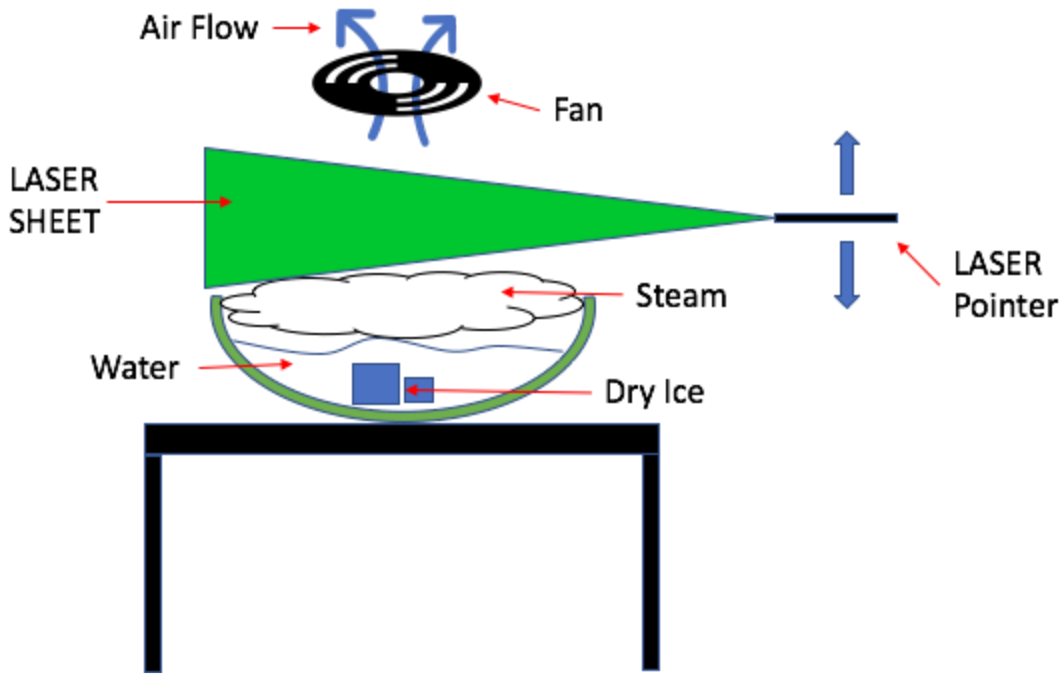


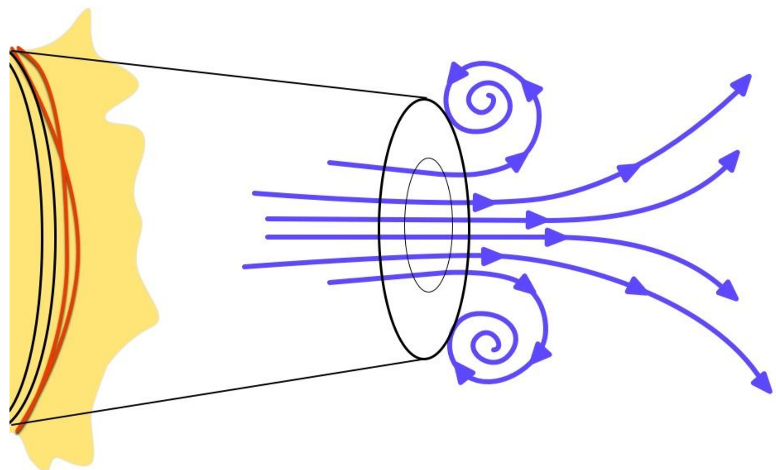
Before After

For this photo, we initially started by being interested in vortexes and tornado like flow. We were going to use an advanced flow setup and a fancy laser sheet, but due to timing and complexity, we decided to make the flow with a more basic setup. We eventually settled on dry ice and a small store bought laser pointer. We wanted to see the 2D image of gasses and vortexes and we mostly made this happen, although the vortex formation was somewhat inconsistent. Hana, as always was our pro camera operator. Eli held the laser, and Ibrahim and I operated the fan and the room lights.

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.



[Eli]



[1]

In the photo, 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.

[Chet]

To obtain the colored fog, we used dry ice, a green laser, and a fan. We put the dry ice in a bow and we poured room-temperature water on it to generate more vapor. Small blocks (approximately 1”x1”x1”) of dry ice were added whenever the vapor formation decreased and about every 10 minutes, some water was poured out and warm water was added. Then, we positioned the fan on top of the bowl to create a vortex (shown in the diagram above). The fan was held and moved around to vary the flow formations, while photos were being taken. This created variety, as well as was necessary due to the fact that the vortex formation being quite finicky. The green laser was shaken faster than the shutter speed to create the illusion of a laser sheet and to make the vapor more visible. The room was dark and 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.

[Ibrahim]

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. It was then cropped to 3493 x 1724. The final size of the image uploaded to flowviz.org is 1400 x 691. The exposure specs are as follows: exposure - 1/20 seconds, aperture - f/4.5, ISO 800. I liked the raw colors and definition, so the only alteration I made was completely blacking out the fan in the upper left, although it was quite dark to start with.

[Hana]

In my opinion, this image has two main focuses. On the left, we see and updraft/ vortex pulled up by the fan. Here we can see a really cool spiral that occurs. This can’t be only explained by the air vapor interface boundary and has more complex flow occurring. After a bit of research, I still struggled to adequately describe this. Just down to the right, we see a very perfect shaped mushroom that curls over. This is the side profile of a vortex ring as described above and is my favorite part of the photo. I would still like to learn more about the spiral formation and how this occurs. We could possibly get a better image with a laser sheet, but I think the photo turned out quite well. I am more than happy with our result and think it is a very catchy image.

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