

Get Wet Report

Vapor Jellyfish



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Flow Visualization

INTRODUCTION

The flow of a smoke ring or a vortex ring will be analyzed and discussed in this report. As an avid e-cigarette user myself, I enjoy doing smoke tricks. Doing these tricks on a daily basis I am able to consistently perform some while others require a few attempts. The “jellyfish” is a trick I would consider a more difficult trick to perform based on the ability to create a vortex ring, then exhale smoke and have it curl the outside of the vortex ring without breaking it. The image was created with the assistance of my peers Jeremiah Chen and Jason Savath.

The apparatus used to create the vapor for the jellyfish was produced by vaporizing vegetable glycerine on a kanthal coil. The “jellyfish” is produced by inhaling the vapor, coughing out the letter “O” to create a vortex ring, then slowly exhaling vapor in the center allowing it to curl around the vortex ring. The ring is produced by the friction between stationary air against the rotating air in the vapor ring. More vapor is then exhaled into the center of the vortex ring, and picked up due to the Coanda effect follows the flow of the toroid. The Reynolds number can be calculated as $Re = UD/\nu$ where U =Flow Velocity, D = Characteristic Length, ν = kinematic viscosity. Using values of $U=.25$ m/s, $D= 0.05$ m (2in dia), and $\nu=1.568*10^{-5}$ we get $Re= 797.19$ which means the flow is laminar. In the image Azimuthal instability can be seen due to perturbations in the system caused by the exhaling of vapor into the core of the toroid.

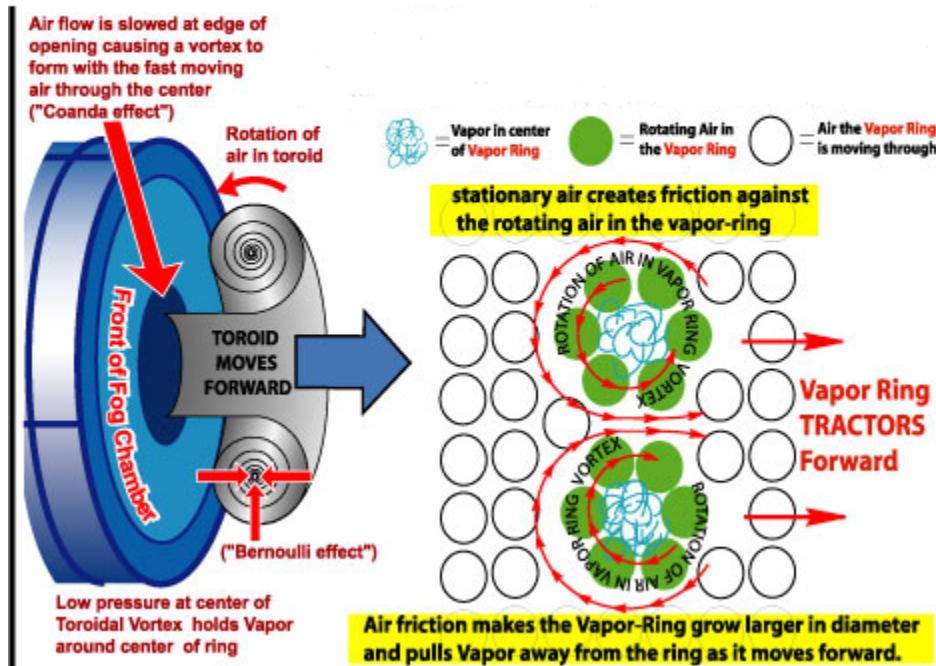


Figure 1. Image describing smoke rings (Your, 2011)

The visualization technique used is vapor with a black cloth backdrop. The vapor was produced by inputting 50W through two kanthal coils with an inner diameter of 2.5mm. The inner diameter of the coils are filled with cotton that is saturated with vegetable glycerin. The room is approximately room temperature and there is no apparent draft. The lighting was set up to be behind the lens and a bit of light above the flow. This light would be used to highlight the flow and ideally create a more vivid image.

The image was created using a mirrorless camera, the Olympus OM-D E-M5 specifically. Using an aperture of F4.0 with a 12mm focal length at ISO 6400 this image was captured at about 1m away from the lens. This gave me a pixel resolution of 4608x3456 to capture roughly a 1m field of view. Using photoshop I increased the contrast a bit as well as making the photo black and white. I did this to really bring out the white smoke against a black backdrop.

CONCLUSION

The image allows one to clearly visualize the flow of the “jellyfish” smoke trick. The view can see the thick portion of the original smoke ring as well as the light curls of smoke around it. The image could use more contrast to bring out the white of the smoke against the black backdrop. The backdrop could have looked more professional in the sense that wrinkles can be seen on the backdrop drawing attention away from the fluid flow. The intent of the get wet project was fulfilled, but my curiosity is still piqued. I am curious as to how exactly the human mouth can create that sort of toroidal ring. Improvements would be to get thicker smoke, better backdrop, and better editing for contrast to really highlight the fluid phenomena that is occurring.

REFERENCES

Your, Thomas (2011). *The Science of Smoke Rings!*. Retrieved 09 20, 2016, from Boston University, bu.edu/biolocomotion/2011/12/13/the-science-of-smoke-rings/