

Bending Water
Fall 2020 IV 1 Report
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Background

For the second image-video assignment in Flow Visualization I decided to bend a free falling laminar flow using static electricity. This classic science experiment popular in elementary and highschool physics classes poses an interesting canvas for photography and further exploration of the science going on in the image captured. I decided to explore something easy to explain and spend time perfecting the image and editing, rather than spending hours recreating a more complicated experiment. Bending water with static is easy to photograph due to the ease of set up and repetition. This helped me compare different camera settings to further develop my understanding of photography.

Setup

Setting up for this image I decided to use a standard plastic comb, as that seemed to be the most popular example in online tutorials. That was the only item required for this experiment other than a sink. I did set up a black sheet as a backdrop, as well as a black rubber mat to put inside of my sink, in order to keep the background dark. Then I set the sink to a low flow rate, keeping the flow laminar and the flow as small in diameter as possible. Lastly I used a 4000 Kelvin flood lamp to light the flow of the water and I placed the light to the right of the camera, about a 60 degree angle from the camera to light. To capture this image the camera was placed directly behind the faucet and on the very edge of the sink to get a close up view.

Science

Although the plastic comb is considered an insulator, it still can become polarized with a negative charge. When an object is polarized, the electrons redistribute within the object. A classic way to represent this redistribution can be seen in Figure 1, where the blue negative charges are around the comb while positive charges in the water are free to rotate and move. Since the water is free to move and is influenced by forces, as it passes the polarized object the positive charges are attracted to the negative charges in the object.¹ The attraction causes the small water stream to deflect from gravity's natural downward direction. This stems from Newton's Third Law and eclectic forces.

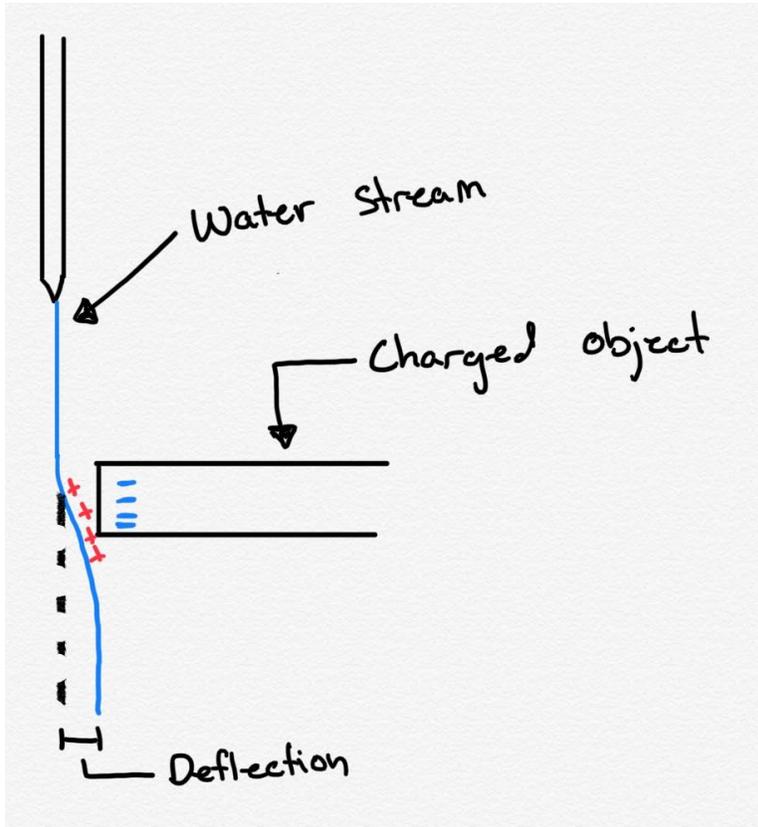


Figure 1. Sketch of the experiment performed, with positive (red) and negative (blue) charged drawn in.

The water is not charged in a special way. But the comb is rubbed with wool or even through hair. This polarizes the comb, and when a neutral object interacts with a polarized object the law of attraction can be observed.

Photography

I chose to get close to the phenomenon being observed and use the sink as a rest opposed to a tripod being further away from the sink This put the lens around 16 inches away from the water and comb. The image was taken with a focal length of 62mm on a 24-105mm lens with a Canon 6D mark II body. The unedited image seen in Figure 2 came out to be 6252x4168 pixels while the edited image in Figure 3 is 4152x3846 pixels.



Figure 2. Unedited image.



Figure 3. The final image edited using Lightroom.

I ended up playing with the aperture a lot to get a crisp image and the depth of field I was looking for, the final image I selected was with an f stop of 4.0. I also played with the ISO to keep the image from getting grainy. An ISO of 400 ended up being what I used after this image was shot many times with a high ISO resulting in grainy images. Exposure speed was not a major concern, and I used 1/100 for all the images I shot.

Using Lightroom I slightly cropped the image to cut out the faucet where water was coming out. I also darkened all of the blacks and did my best to reduce the glare in the background. With these changes, the water stream ended up getting dark, so I added a filter over the middle of the steam and increased the exposure to help bring out the curvature of the flow more.

Conclusion

This image helped me gain a better understanding of camera settings as well as using manual focus. I think overall the image turned out pretty good, it shows the science I set out to show, and the image incorporated some good aspects of photography. I would like to repeat this image again with a less reflective background, I think that could really add some value to the flow being observed. Same goes for the comb, by painting it mat black I think that would have increased the image quality.

References

¹Physics Tutorial: Charge Interactions. (n.d.). Retrieved October 08, 2020, from <https://www.physicsclassroom.com/class/estatics/Lesson-1/Charge-Interactions>