

Of Shadow and Smoke



The image I created was a shadow of smoke from a smoke gun on a wall, with the light coming from a projector. The first thing I needed to do was get the smoke gun and make sure it had power and a full tank of smoke liquid. After playing with the gun for a while I noticed that if I held the trigger smoke would flow out in a very appealing manor. So I turned on the projector to get some light and then had my teammate take the image of the ring (top left) as well as the after flow leaving the gun. The flow within the image depicts the smoke rising from the smoke gun. The phenomena observed would be a combination of smoke density mixed with the force of the gun on the smoke itself. The intent of the image was to capture the full body of the smoke and not just the thick parts normally observed with not looking at a showdown.



Above is an image of the smoke gun used to create all of our smoke rings in this shoot

The flow within this image would be best described as smoke and a smoke ring. A smoke ring is commonly formed when a puff of smoke is suddenly injected into clear air, especially through a narrow opening. The outer parts of the puff are slowed down by the still air (or by edges of the opening) relative to the central part, imparting it the characteristic poloidal flow pattern. The smoke makes the ring visible, but does not significantly affect the flow. The same phenomenon occurs with any fluid, creating vortex rings which are invisible but otherwise entirely similar to smoke rings. ^[1]

The image depicted above has a total size of about 24" x 24" and was taken from 12" away. Sam Oliver was the photographer in this photo while I controlled the smoke gun.

For this image, the photographing technique was quite simple. The area was completely dark with the only light coming from the projector onto the wall. The flash was turned off so that it wouldn't take away any shadows or create new ones. After taking several images of the smoke and several different rings, I decided on this one because it not only showed the most interesting shapes, but it also had the most balance surrounding the sphere.

This image was taken using a Cannon model DS 126311 with a standard 18-55mm lens and a shutter speed of approximately 1/15 a f/ of 1.7 and an ISO of 1746. In terms of post processing I used Gimp to crop out the all but the smoke ring and rising smoke, enhance the contrast, and complete the color editing which helped put focus on the depth and contrast of the shadow. I also increased the brightness just slightly to further help the shadows stand out.

Overall I am really pleased with how the image turned out. I am quite the novice when it comes to photography and image processing, so being able to produce something that I consider to be "quality art" is a real moment of pride for me. Looking back, I wish I would have cleaned the wall so that the image didn't look as dirty. Since the smoke flow happened due to having too much smoke in the ring there isn't much math behind why the flow came out the way it did, with

the exception of the smoke ring itself. The forces associated with that involve several higher order differential equations which are too large to include in this paper, but can be seen in source link 2. This derivation come from the vortex equation as well as the non-linear Schrodinger equation. ^[2] I would say, that my intent for the photo was fulfilled and if I had to do it again I would try repeating it with different ISO's and possibly multiple different smoke guns at once to see how several bodies of smoke interact.

Source links:

1. https://en.wikipedia.org/wiki/Smoke_ring
2. <http://page.math.tu-berlin.de/~knoepfel/talks/what-is...-a-smoke-ring-2012.pdf>