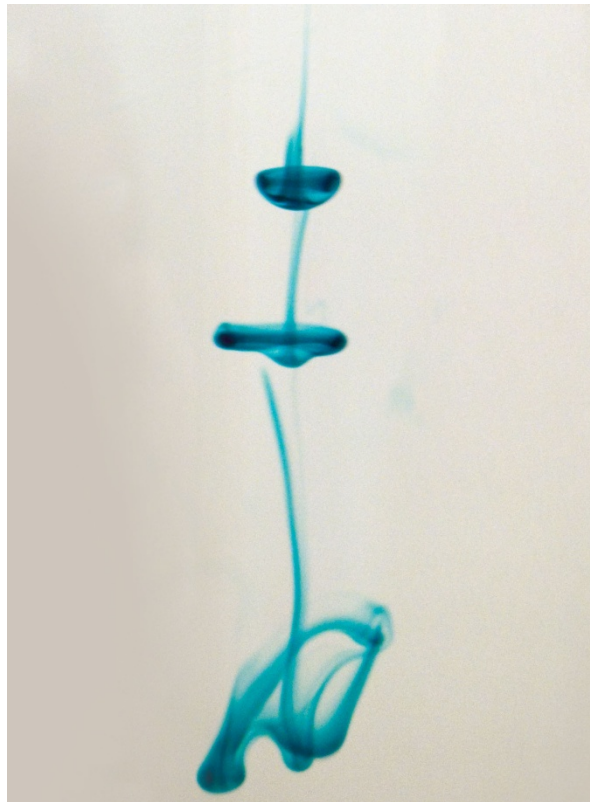


Tony Vo  
Flow Visualization  
Team Project 1  
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## Introduction

In this project our group decided to work in the flume and demonstrate some channel flow physics including but not limited to flow over a weir, and water dye interaction. Although we got a lot of really great shots demonstrating various flow phenomena I decided to do some experiments with dye and static water. My goal was to photograph a high quality photo of a vortex ring made of dye traveling through water. During the experiment I realized that I could capture several stages of the life of a vortex ring in one frame and this resulting in the photo below after processing:



## Experimental Setup

This experiment was conducted within a circular vase with a diameter of eight inches and a height of two feet. The vase was filled with water directly from the faucet. To form the vortex rings blue food coloring was injected via an eye dropper. Depending on the force applied to the eye dropper the dye would behave differently. For example high force would yield a very violent and turbulent mixing of the water and dye. A very subtle and gentle force would result in a tiny vortex ring about one tenth of an

inch. Increasing the force increased the size of the vortex ring up until there was a turbulent mixing of the dye. The vortex rings in the photo are about one to two inches in diameter. The camera, a Nikon D60 was about 8 inches from the vortex rings within the vase. For the photo the eye dropper was squeezed in succession 3 times, and the photograph was taken as the 3 vortex rings traveled and developed downwards.

## Photography and Post Processing

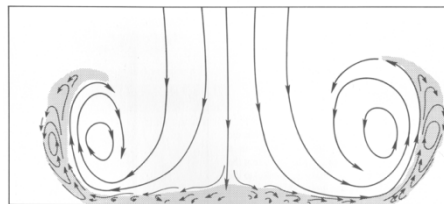
Behind the vase there was a white piece of poster board to act as a background. There was no flash, but fluorescent lights were present. The camera and photo data can be seen below:

Camera	Nikon D60
Date	3/7/2010
Time	8:19 PM
Shutter	25-Jan
F-stop	f/4.5
Aperature	f/4.4
Iso	400
Focal Length	28mm
Flash	No
Dimensions	1279x1734

For processing all that was done was cropping to enhance visual balance and make the vortex rings the undisputed focus of the photo. There was also some light dye streaks in the background that were removed. The contrast was also slightly altered to enhance color. I found it extremely difficult to put the vortex rings into focus but reducing the size of the image seemed to help sharpen it up a little bit.

## Flow Phenomena

The phenomena captured in the photo are vortex rings. They are formed when a mass of moving fluid is injected into a static fluid. In this case a cylindrical mass of dye was injected into static water. Once injected the interaction between the edges of the dye cylinder and the static water peel back the edges and roll around themselves, thus forming a vortex ring. As the vortex ring progresses downwards they increase in diameter, losing energy along the way. As the ring expands and becomes unstable they begin to form a shape resembling an inverted crown, then the tips of the crown form vortex rings as well. Below is a representation of a vortex ring and the fluid flow within it:



## References

<http://www-frd.fsl.noaa.gov/~caracena/micro/MBVoring.htm>

[http://en.wikipedia.org/wiki/Vortex\\_ring](http://en.wikipedia.org/wiki/Vortex_ring)