

Flow Visualization
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Report 3: Team First Photo



For this project, teams were put together to collaborate and take photos on a certain fluids topic. Ferrofluids were chosen for this team photo-shoot. After collaborating with team members, the photos returned unsatisfying images so I changed my setup to be different from that of my team members. The team used a type of ferrofluid that was contained in jars, but the jar shape warped the images, which gave blurry unsatisfying images.

The setup for this image was relatively basic, the ferrofluid was put in an open petri dish with a large disc magnet underneath with a spacer to optimize the ferrofluid shape. A large light was used for backlighting and a large blue paper was put behind the ferrofluid to stop background reflection. Then using a tripod and a macro lens, the pictures were taken. The setup is shown in the figure below.



To understand the science behind Ferrofluids, it is first necessary to understand that that it is a colloidal liquid that is made from nano size ferromagnetic particles in a fluid. The larger ferromagnetic particles can be pulled from the mixture to form separate clumps of magnetic particles when exposed to a large magnetic field. The attraction of the particles is weak enough that the Van der Waals force can prevent any clumping. Ferrofluids are classified as superparamagnets because they do not retain magnetization when there is no external magnetic field. When a paramagnetic fluid is subjected to a large vertical magnetic field, the surface of the fluid forms peaks and valleys. This is called the normal-field instability, which is driven by the magnetic field. From a magnetic energy standpoint, the peaks and valleys are energetically favorable. In dense fields the stress and deformations take a rugged shape as they cluster together along field lines of equal strength, which give a spiked appearance.

The lens was a Nikon Micro 105mm macro lens. For the image the ISO was set to 320, the f-stop was f/45 and the exposure was 10s. Because of the long exposure a very sturdy tripod was needed. The camera was also set on timer mode so that any motion of pressing the shutter button did not affect the actual image.

If there was more time, I would have liked to play around some more with the ferrofluid and see what other images I could have gotten. Also because ferrofluid is completely black it was very hard to see the formations of the ferrofluid and I would have liked to investigate overcoming that difficulty with different lighting approaches. It would also be nice to play with different magnet configurations to see how they affected the shape. As

for the image that was chosen, I am quite happy with it, it shows a lot of the detail of the ferrofluid and also shows the pattern. The only post processing I did was to make it black and white to emphasize the fluid and deemphasize the background.