



MCEN 4151- Flow Visualization

Team Second Report

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In Conjunction With:

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Section 001

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I. OVERVIEW

This image was created in collaboration with Jess Holmes, Nicole Nageli, and Cameron Sprenger for the Team Second Assignment. The intent was to capture the interactions of ferrofluid in a magnetic field. Acrylic paint was also added to the ferrofluid to add more color and depth to our images.

II. EXPERIMENTAL SET UP

The image was shot on a Nikon D800. This image was produced by placing a cylindrical magnet underneath a plastic dish that was filled with ferrofluid and acrylic paint. A figure of the setup is shown below:

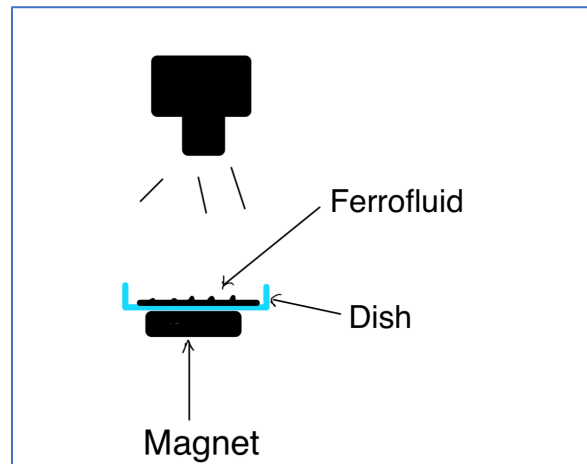


Figure 1.
Experimental Set- up

III. FLUID DYNAMICS

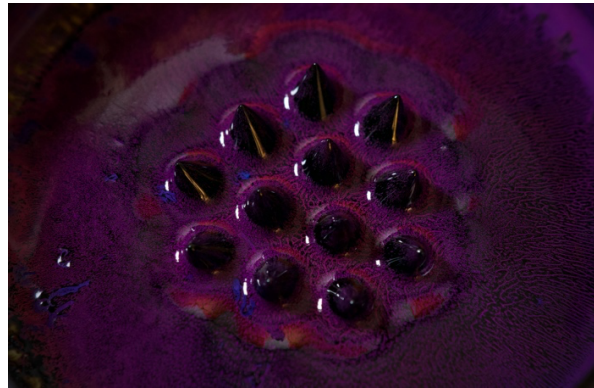
The structures or spikes that formed in the ferrofluid demonstrate a normal field or Rosenweig instability [1]. The Rosenweig instability arises due to the magnetic dipole or electronic spin of the atoms making up the fluid. At room temperature, the spins prefer to be aligned in the same orientation. When an external magnetic field is applied, a patterned matrix of peaks form [2].

IV. PHOTOGRAPHIC AND VISUALIZATION TECHNIQUES

Original Image:



Edited Image:



The field of view of the original image was larger than it needed to be so I ended up cropping the image during post-processing. The original image had 7369 x 4912 pixels, and the edited image had 4596 x 3000 pixels. During post-processing I also increased the vibrance, edges, fallout, and intensity to try and sharpen the edges of the spikes. Finally, I decreased the warmth, to bring out more of the purple in the image.

The image was captured in a room with all the lights turned off. We used a light board to hold level with the ferrofluid to minimize reflections in the fluid. The camera was mounted on a tripod.

Table 1.

Camera	Nikon D800
Focal Length	200 mm
F- Stop	4
Aperture	13
Shutter Speed	5 s
ISO	1250

V. CONCLUSION

I think that the team and I succeeded in capturing the peaks that form due to Rosenweig instability in detail. I also think that adding paint to the fluid added intriguing color to our images. I'm very happy with how the image turned out. If I were to do this again, I think it would be interesting to place the ferrofluids in a larger dish, under the influence of more magnets, to generate more intricate patterns of peaks.

VI. REFERENCES

- [1] Kadau, H., Schmitt, M., Wenzel, M., Wink, C., Maier, T., Ferrier-Barbut, I., & Pfau, T. (2016, February 1). *Observing the Rosensweig instability of a quantum ferrofluid*. Nature News. <https://www.nature.com/articles/nature16485>

- [2] Andelman, D., & Rosenweig, R. E. (n.d.). The phenomenology of modulated phases: From magnetic solids and fluids ... https://www.worldscientific.com/doi/abs/10.1142/9789814271691_0001