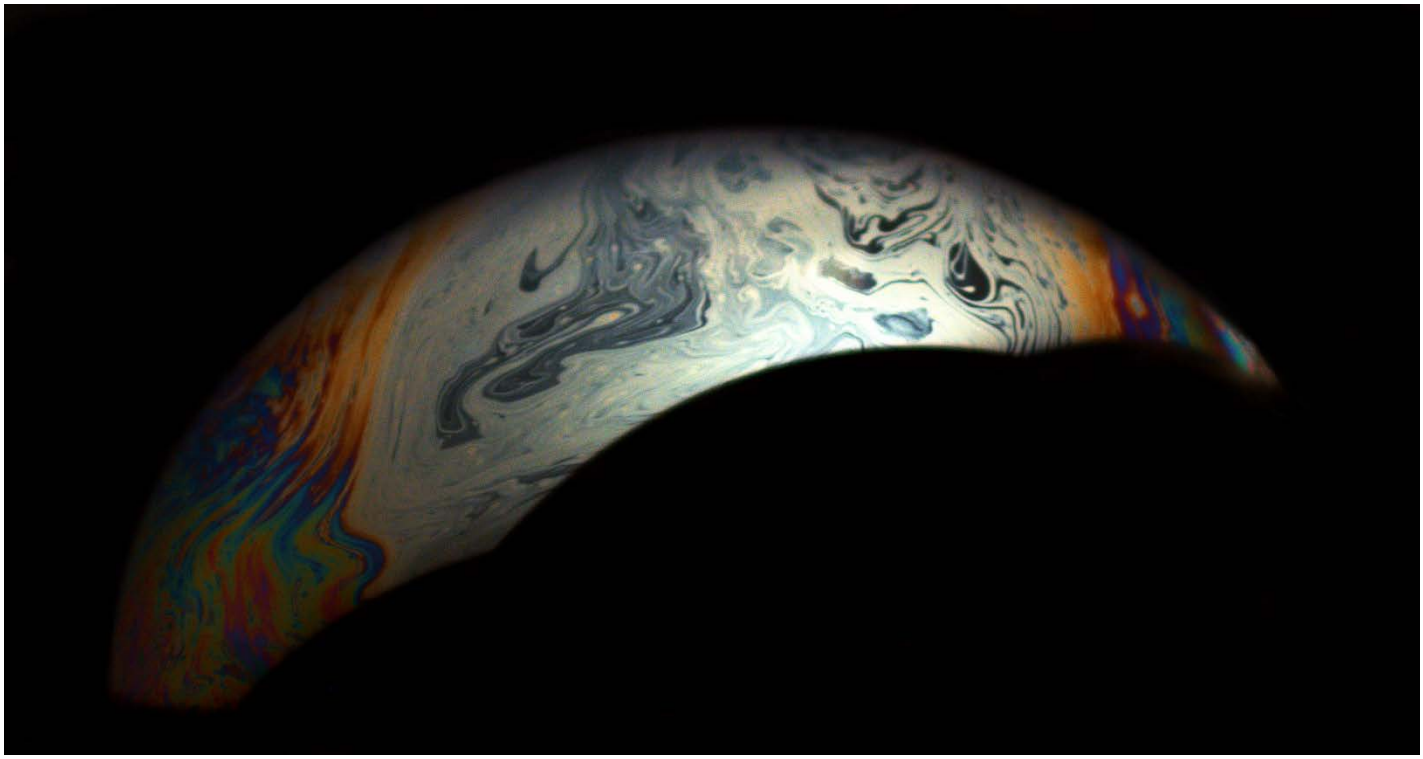

TEAM IMAGE I

MCEN 5151

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I. Introduction

The purpose of the Team Image assignment was to capture any fluid phenomena with a group of students. Each student would attempt to capture their own image in a common set-up and then complete their own post-processing on the image. The specific flow visualization that was desired to be captured in this report was the interaction of refracted light on the surface of bubbles. Since light interacts with water in interesting ways, vibrant colors appear on the surface of the bubble in unique patterns. Sometimes, the interaction of light with the inner and outer surfaces of the bubble produce planetary looking bubbles. Therefore, after being inspired by artists such as Jason Tozer[1], it was the intention to capture an image that closely resembled the surface of a planet, similar to the vibrant colors and patterns on Jupiter. Understanding light refraction and surface tension is an important topic in fluid mechanics because of the prevalence of the two occurrences in the presence of any fluid.

II. Experimental Setup

In order to capture an image of a bubbles surface, a cup containing dish soap, water, and glycerin was blown into using a straw to create large bubbles. This cup was set on top of a black surface, with a black background. This removed any distracting objects in the background and also allowed the light to focus on the bubble from a single source. The lighting set-up was simply a standard incandescent bulb pointed directly at a white poster board, which was placed above the bubble. The camera then captured the images by zooming in as much as possible, without losing focus. A schematic of the experimental set up can be seen in Figure 1.

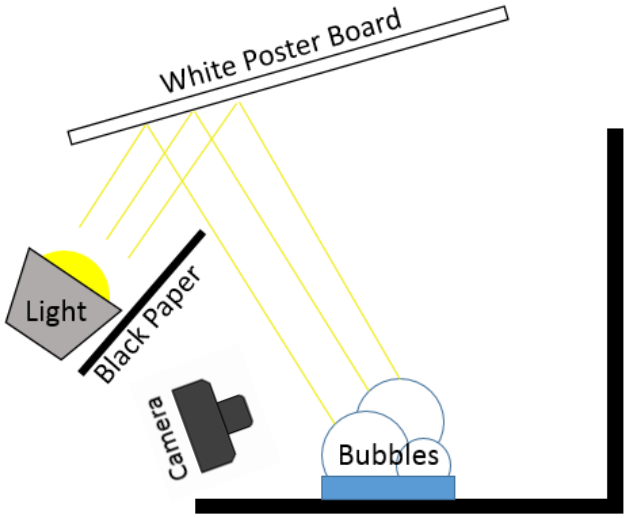

Figure 1: Experimental Set-Up

The vibrant colors that can be seen on the bubble can be attributed to the iridescence on the surface of the bubble. As white light hits the bubbles surface, some of that light is reflected back. This reflected light is the light that can be seen with the human eye. Therefore, based on varying angles and bubble thicknesses, many different wavelengths of light are reflected from the surface because the light is traveling different distances through the bubble[2]. This can be seen in Figure 2[2].

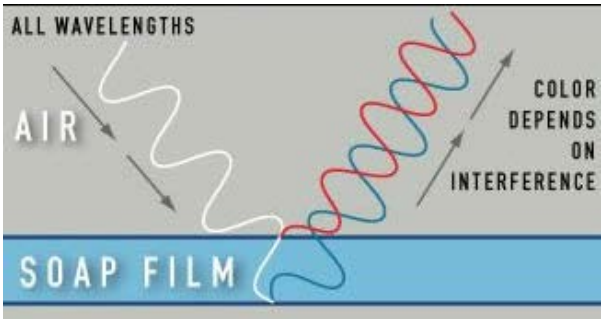

Figure 2: Light reflection on surface of bubble[2]

In addition, the outer surface of the bubble might reflect a different color than the inner surface. Because of this, the two different wavelengths of light might cause constructive or destructive interference with each other, further varying the colors of the bubble[2]. This interaction between the inner and outer surfaces can be seen in Figure 3.

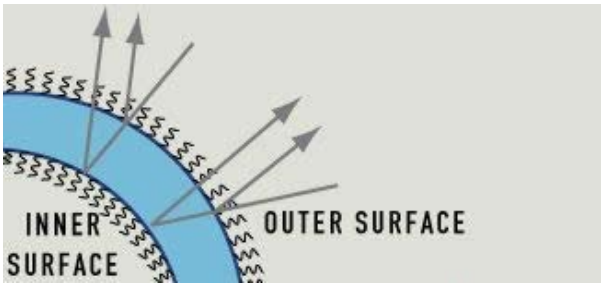

Figure 3: Light interaction between inner and outer bubble surfaces[2]

Between the different interactions of the reflected wavelengths of light, vibrant colors may appear on the surface, such as is seen in the image of this report. On the far left and right of the bubble, one can see many different colors in swirling shapes, which is due to the swirling water molecules between the inner and outer soap molecules. In these areas, the bubble is thicker because not many wavelengths are cancelled in these areas. But as the bubble begins to thin due to evaporation, different color wavelengths begin to cancel out, until eventually all visible light wavelengths cancel and the bubble appears black and clear. This black and clear region can be seen in the center of the bubble. This area is very thin and is therefore close to popping. Shortly after this image was taken, the entire bubble turned black and white and then popped.

III. Photographic Technique

A. Image Capture

In order to capture this image a Nikon D5200 camera was placed 2-3 inches away from the cup containing the bubbles with a focal length on the lens of 55 mm (lens is 18-55 mm). The size of the field of view was roughly 2 x 2 inches (the image was cropped). The camera settings were set to an ISO of 250, exposure time of 1/20 seconds, and aperture of F 5.6. The low aperture value allowed for more light in the photo and the slow exposure time added focus to the image. No flash was used in the picture due to the good lighting conditions of the white poster board and light combination..

B. Post Processing

Post processing of the image included increasing the saturation to bring out the colors of the bubble and adding an S curve to the color tones to lighten whites and darken blacks. The image was cropped and the surrounding bubbles were removed to provide focus on the single bubble present in the picture. Additionally, the surrounding blackness was darkened to a pure black to give the effect of space. The final image size was 2979 x 1579 pixels.

IV. Conclusion

Overall, this image turned out fantastic. The bubble truly appears to be a planet in space. The swirling vibrant colors are reminiscent of the storms seen on Jupiter. The black and white regions appear to be a lunar-like surface, which creates a beautiful contrast to the colorful regions. Because of the lonely state of the bubble, surrounded by blackness, this image is also reminiscent of the infamous Earthrise photo seen in Figure 4. The purpose and intent of this project was successfully achieved.

Figure 4. Earthrise photo captured during Apollo 11[3]

V. References

[1] Tozer, Jason. "Bubbles." *Jason Tozer Photographer Jtjasontozercom RSS*. Wordpress, n.d. Web. 13 Mar. 2014. <http://jasontozer.com/archives/media-tags/bubbles>.

[2] "Bubbles | Causes of Color." *Bubbles | Causes of Color*. Web Exhibits, n.d. Web. 13 Mar. 2014. <http://www.webexhibits.org/causesofcolor/15E.html>.

[3] Dunbar, Brian. "Earthrise." *NASA*. NASA, n.d. Web. 13 Mar. 2014. <http://www.nasa.gov/multimedia/imagegallery/image_feature_1249.html#.UyFOVfldWSo>.

VI. Acknowledgments

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Thank you

VII. Appendix

Figure 5: Original photograph