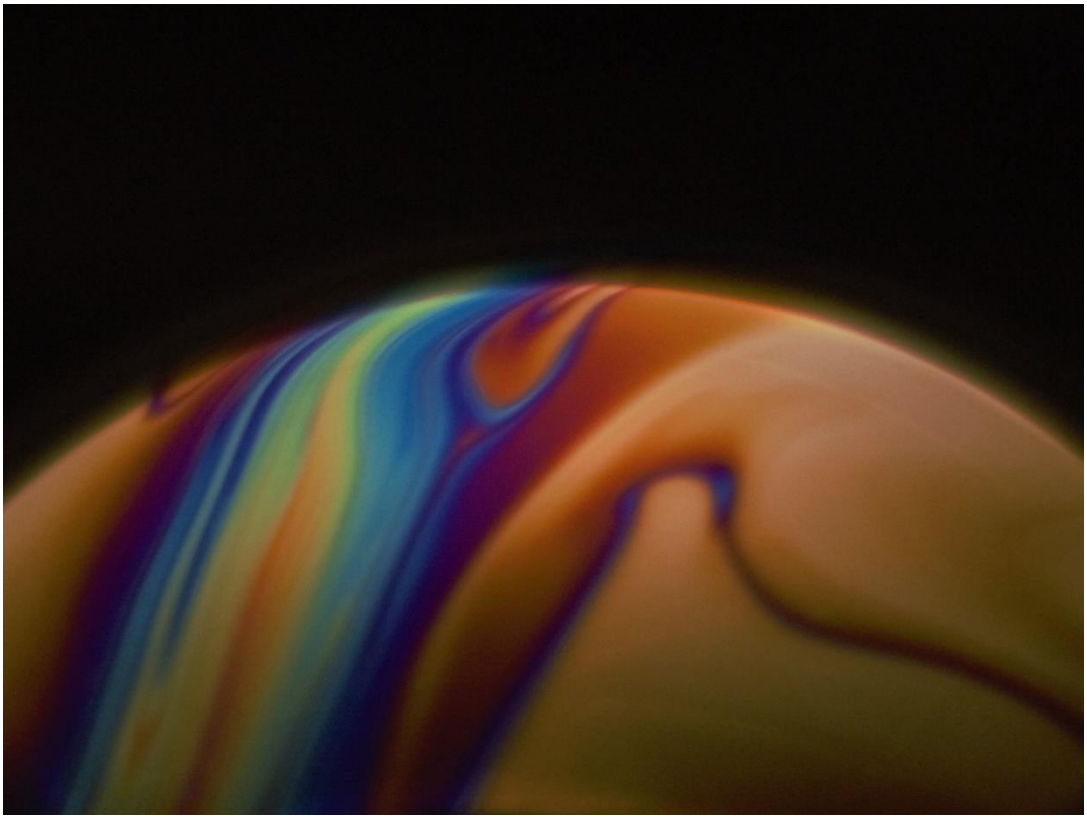
Light Diffraction of Bubble



Flow Visualization

MCEN 4151

Team Second

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I captured a picture which is named as 'Light Diffraction of Bubble'. The reason I chose 'Light Diffraction of Bubble' as the title of my picture is that the bubble diffracts the light from top side and makes a beautiful combination of colors. The phenomenon I was trying to see in my picture is that the light is diffracted beautifully by a bubble under the light source. The container is connected to a long straw. The soap bubble is made on the top of the container. Then, a breath goes in to container through a long straw and the bubble on the top inflates.

Figure 1: The Picture of Set-up

The figure 1 is showing the flow apparatus with whole set-up. The light source is placed at the top of object and the other light sources are blocked with black curtain. The main flow in this set-up is the motion of gas. The breath is blown from a mouth and goes into the container through the straw. The soap bubble inflates due to incensement of

volume of breath until the surface tension of soap bubble exceeds the maximum value of surface tension. If the surface tension of soap bubble collapse, the soap bubble pops up. While the soap bubble doesn't pop up, it diffracts the light from light source at the top and shows a beautiful pattern of colors. The soap bubble takes role as a prism while it diffracts the light. Prism is a tool that is used to break light up into its constituent spectral colors.

$$\mathrm{Re} = \frac{\rho \mathrm{VD}}{\mu} = \frac{VD}{\nu} = \frac{\left(.5\frac{\mathrm{m}}{s}\right)(.007112\ m)}{(1.47*10^{-5}\frac{m^2}{s})} = 241.90 \qquad \text{----------} \qquad \text{Eqn. 1}$$

Equation 1 shows that the Reynolds number is the behavior of breath in the straw. I have assumed that the velocity of breath and a diameter of straw is measured with a ruler. I assume that the temperature in container is 20 Celsius and the breath is composed 100% carbon dioxide, so the kinematic viscosity of carbon dioxide is found as 1.47 *10^-5 m^2/s. With all assumptions and values, I could find that the flow of breath is laminar because the Reynolds number is 241.90 which is lower than 2100.

I have used straw, container, and soap bubble as the visualization techniques. The number of lightening source that I have used is just one. The lightening source is come from ceiling which is placed above the object.

I have tried variety sizes of containers, and I figured out that the size of container used in picture is just appropriate for the size of the soap bubble that is able to diffract light. I wanted to show how the soap bubble diffracts the light and focus on the surface of bubble, so my team have decided the distance from object to lens as about 30 cm. The camera that is used for taking picture was Grace's DSLR camera.

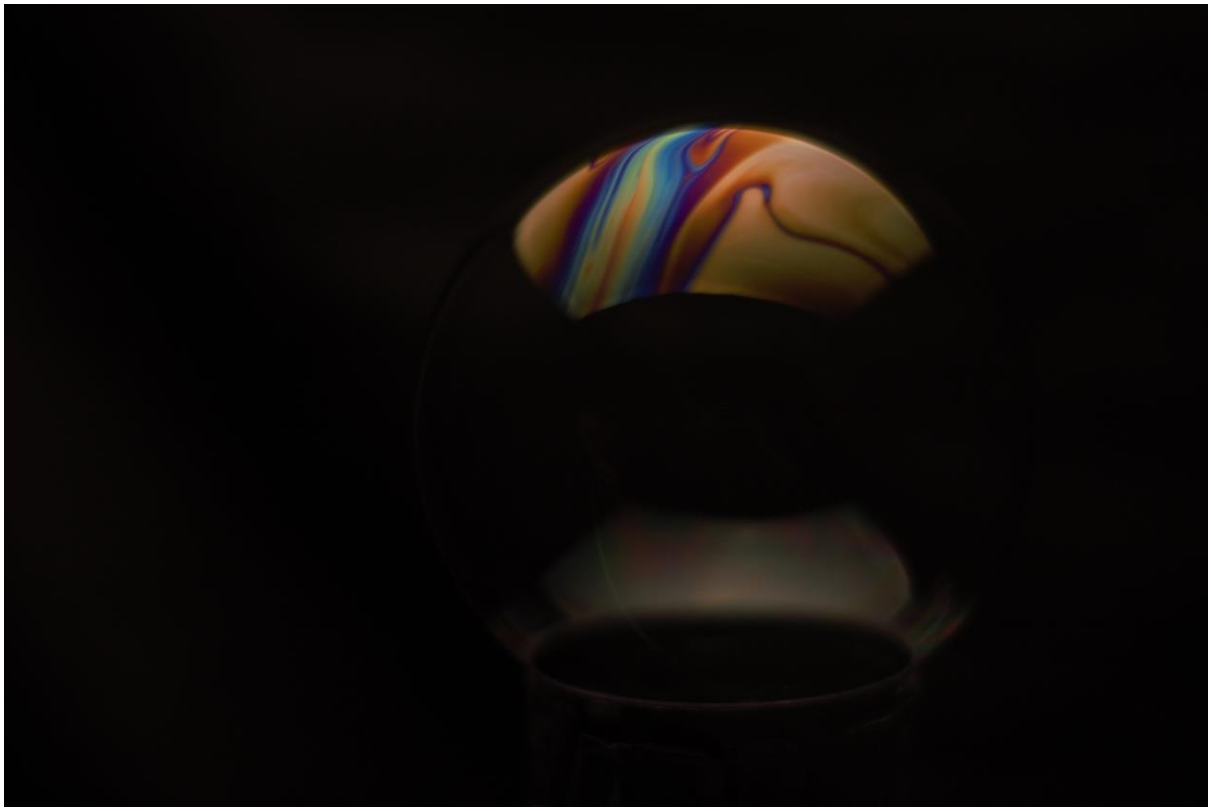

Figure 2: The Picture of Original Image

This figure 2 is the picture of original image. The original image shows how light source illuminates. I cropped the original image and increased color contrast to make my phenomenon clear.

In my opinion, the image came out really well. It captured the phenomenon of light diffraction due to thin surface. I could find that the behavior of bubble obeyed the laws of physics which is surface tension. My question is how the thickness of soap bubble affects on color of light diffraction. I think that I fulfilled my intent by showing beautiful combination of colors. I think that it would be a significant improvement if we put light source that covers surroundings of soap bubble.

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