Diffraction and Interference for bouncing drop

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I. Introduction

Bouncing droplets have been found to be similar to quantum phenomena, for examples: diffraction, interference and quantum tunneling effect and so on. The behavior of droplets gives us a way to "see" the action of quantum. We conduct the experiment of single-slit and double-slit to focus on diffraction and interference of the droplet to observe the behavior of them.

II. Air layer and Walker

Air layer

When the droplet falling to the oil surface, some of the air would be squeezed between the droplet and surface, which becomes the air layer. This layer avoids the droplet touching the surface so that they won't combine together.

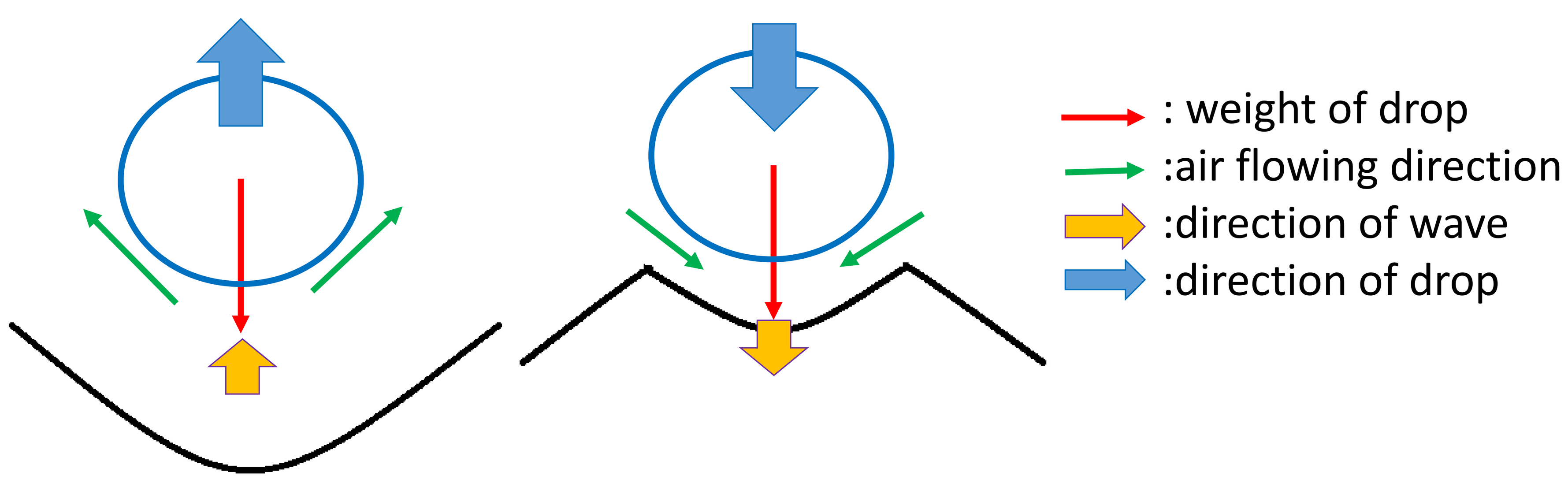
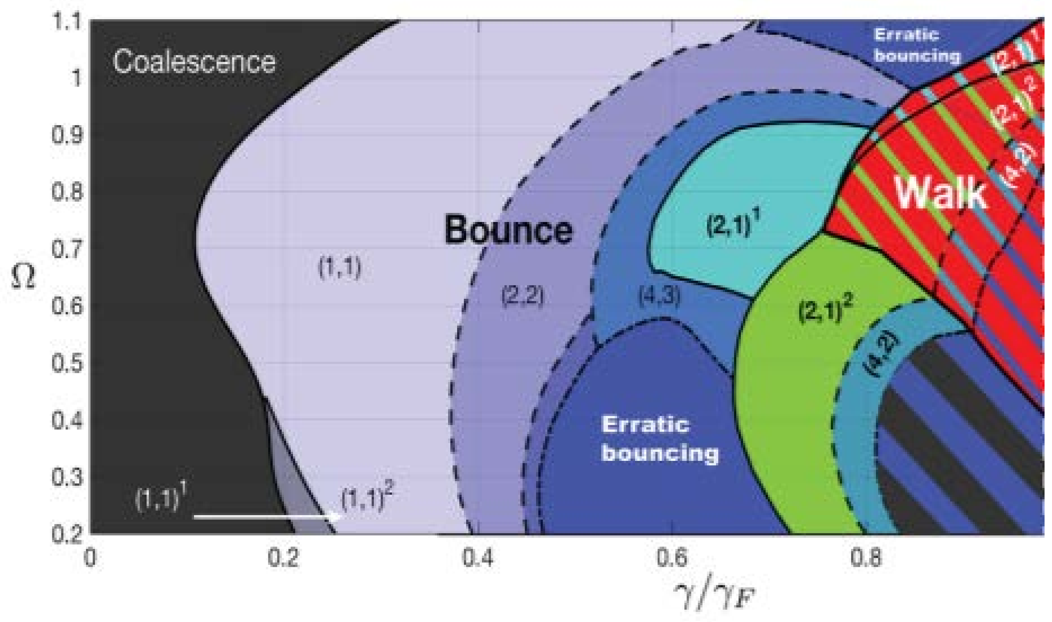


Fig. 1 How the air layer form.

Walker

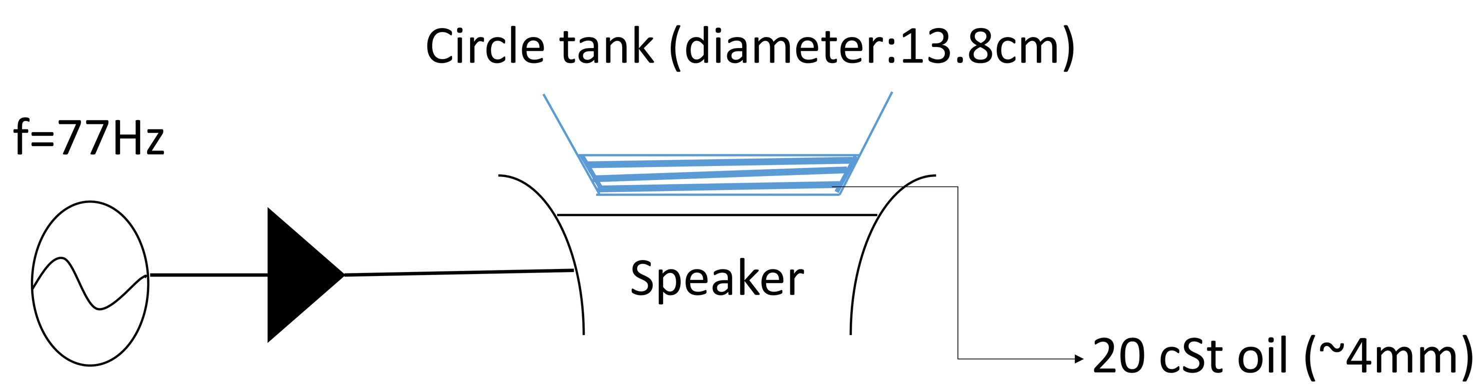
The bouncing drop will "walking" on the surface of the liquid bath if the oscillating frequency and amplitude is control in a certain range.



γ/γ_F : forcing acceleration
Ω: vibration number

Fig. 2 An extension of the regime diagram for 20 cSt silicone oil-driven at 80 Hz.[2]

III. Experimental Set Up



IV. Experimental Results

1. In order to let the drop start walking at the same place and same direction, we test the different Y-shape boundary with a different open angle. We found that when the open angle is 70°, the probability for drop walking straight is highest.
2. Double slits data (Number of success pass slits vs. scattered angle) with longer boundary. Most walkers were tending to walk right-hand-side.
3. Both boundaries of double slits can't form an interference pattern.
4. Single slit seems to form a diffraction pattern.

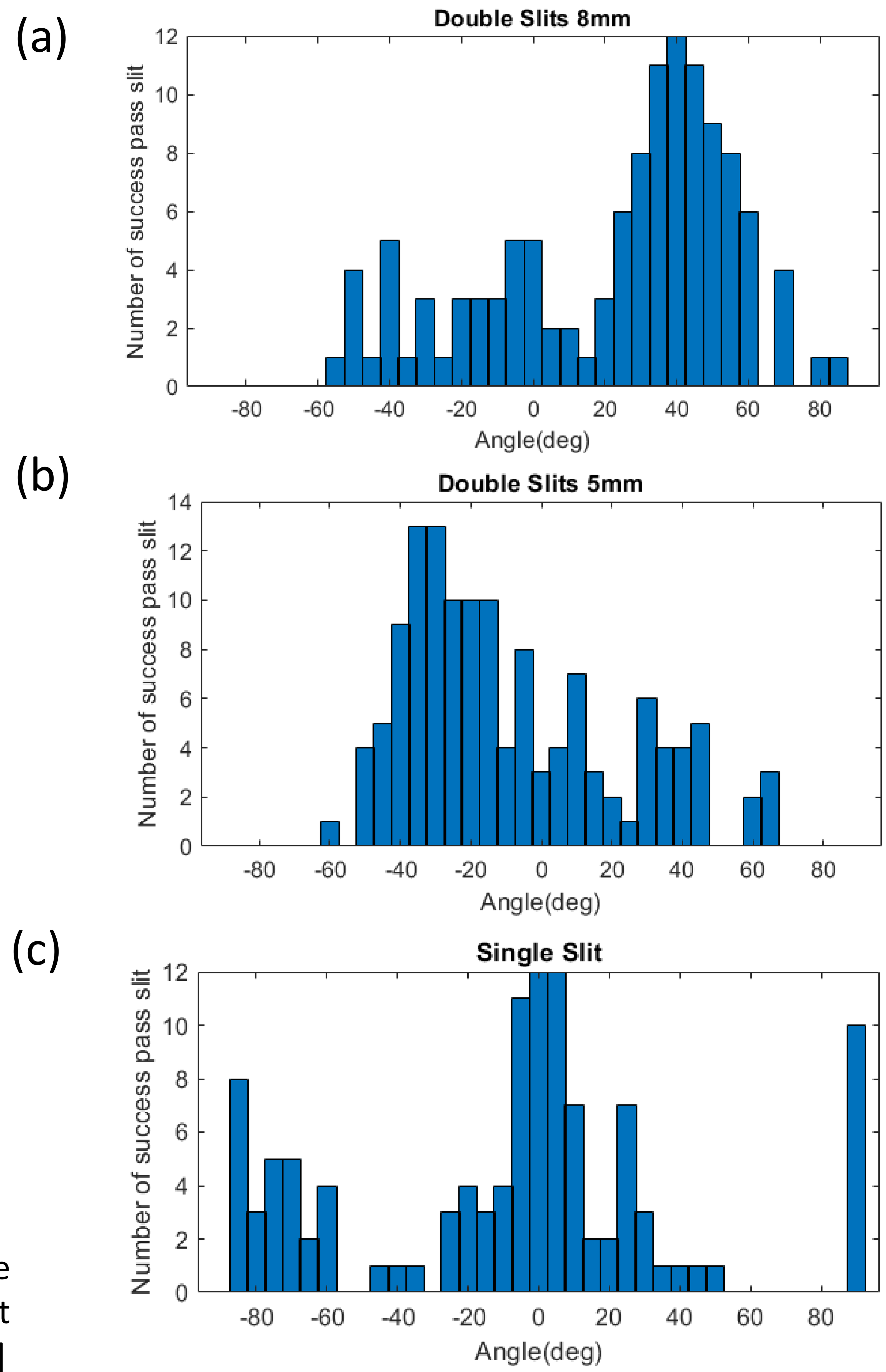


Fig. 3 (a) Double slits data(Number of success pass slits vs. scattered angle) with longer boundary. (b) Double slits data(Number of success pass slits vs. scattered angle) with shorter boundary. (c) Single slit data.

V. Discussions

In figure (a) and (b), we can observe that the drop prefer to walk right and left respectively. We think the reason is the potential in the middle of the slit is higher than in other places. Thus, when the drop passes through different slits, it prefers to turn left or right. In figure (c), we see the number of drops with smaller angles is more than larger angles. However, we still couldn't see the diffraction pattern. We think that not only the width of slit but also the distribution of potential would affect the path that the drop takes.

Reference:

[1] Single-Particle Diffraction and Interference at a Macroscopic Scale, Yves Couder,* and Emmanuel Fort, PRL 97, 154101 (2006)
[2] Bouncing droplet dynamics above the Faraday threshold, L. D. Tambasco, J. J. Pilgram, and J. W. M. Bush (2018)