Vortex and Kepler's Third Law

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Abstract

Experiments reveal that for each part of the same vortex, the square of its periodic time is in a constant ratio to the cubic of its distance from the center, namely $\frac{R^3}{T^2}$ =K. The value of this constant is related to the scale of the vortex and larger vortex leads to larger K. This result is the same as Kepler's Third Law, so Descartes' Vortex Theory may be correct. Hopefully, the Vortex Theory of this French foreseer will gain new recognition and development.

1. Objectives

In *Philosophiae Naturalis Principia Mathematica*, Newton concluded from mathematical reasoning that "the periodic times of the parts of a vortex are in duplicate ratio of the distance from the center of motion", which is inconsistent with Kepler's Third Law, and thus opposes Descartes' Vortex Theory.

In order to validate whether Newton's conclusion is right or not, we can conduct a vortex experiment, which will reveal the relationship between R, the distance from the center, and T, the periodic time, of a water vortex.

2. Materials

Materials include a basin of water, some rice grains, a walnut, a white fruit, a camera, a millimeter scale, a compass, and an angle meter.

3. Requirements and notes

When a vortex revolves, the rice grains are close to its center, the walnut is in the inside track, and the white fruit is encircling in the outside track. The position of the grains is considered as the center of the vortex. Repeated experiments revealed that the center of the vortex happened to be the center of the rounded vessel (the basin), and changed slightly.

The existing conditions could not produce a long-term stable vortex. In a stable vortex, its overall revolving speed won't be increased or lowered but maintains in a relatively stable state. The revolving speed was the highest at first, and then gradually decreased until it became quiescent, so the vortex in the vessel was varying. In comparison of the first few and the last few seconds, its motion was attenuated and varied, indicating two different vortexes. However, a stable vortex was needed in this experiment. In order to solve this problem, we should measure the states of the walnut and the white fruit in the vortex simultaneously. Thereby within very short time, we suppose the measurements were taken from the same vortex.

4. Measurements

The data to be measured are the periodic time, and distance from the center.

Distance from the center: distance between the center of the walnut or white-fruit to the center of the vortex.

The center of the vortex: not a point, but a central line. The walnut is at the bottom of the vessel, so its distance from the center is measured from its center to the bottom center of the vortex. The white fruit is on the water surface, so its distance from the center is measured from its center to the center of surface vortex.

5. Sampling

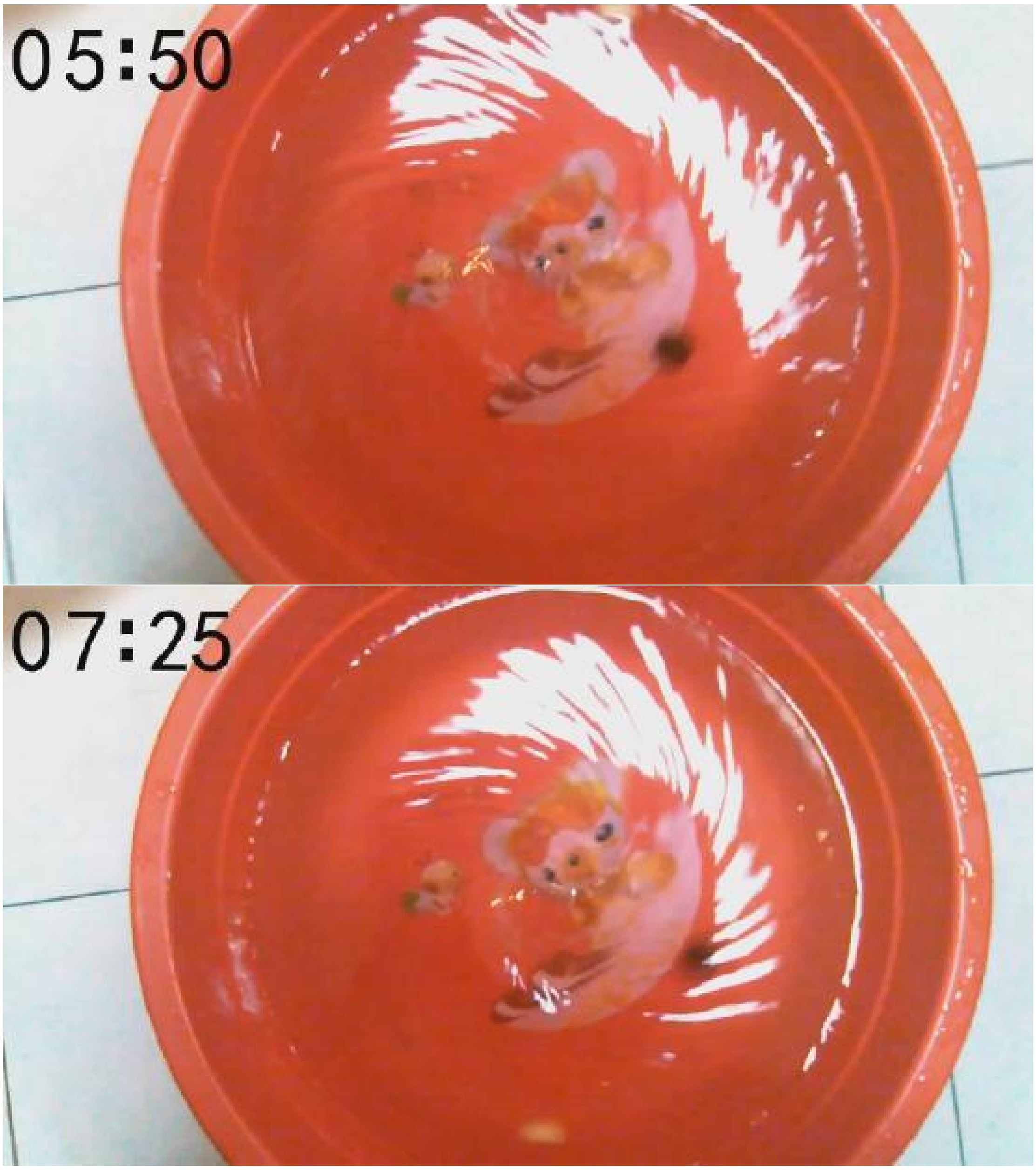
Two periods of an experiment video were selected as the targets. The first period runs from 5:50 to 7:25, and the second from 14:04 to 16:56. The two periods corresponded to two parts of a vortex and were studied separately.

6. Experiment

Vortex video: http://www.youtube.com/watch?v=xT7Zg9gBOdg

6.1 Analysis of the first period

(1) The periodic time of the walnut



The periodic time of the walnut is 1.75 s, from 5:50 to 7:25.

(2) The periodic time of the white fruit

The walnut revolves a periodic time of 360°, from 5:50 to 7:25. At 7:25, the white fruit only revolves 175° and leaves 185°, so how to measure its periodic time? We cannot let the white fruit complete one periodic time, otherwise it will produce error because vortex motion is in the decline and variation until it restores quiescence. The vortexes corresponding to the period after 7:25 and the period between 5:50 and 7:25 are completely different. We need the vortex corresponding to the second period and should calculate the periodic times of the walnut and the white fruit.

Therefore, the ratio method was used to obtain the periodic time of the white fruit:

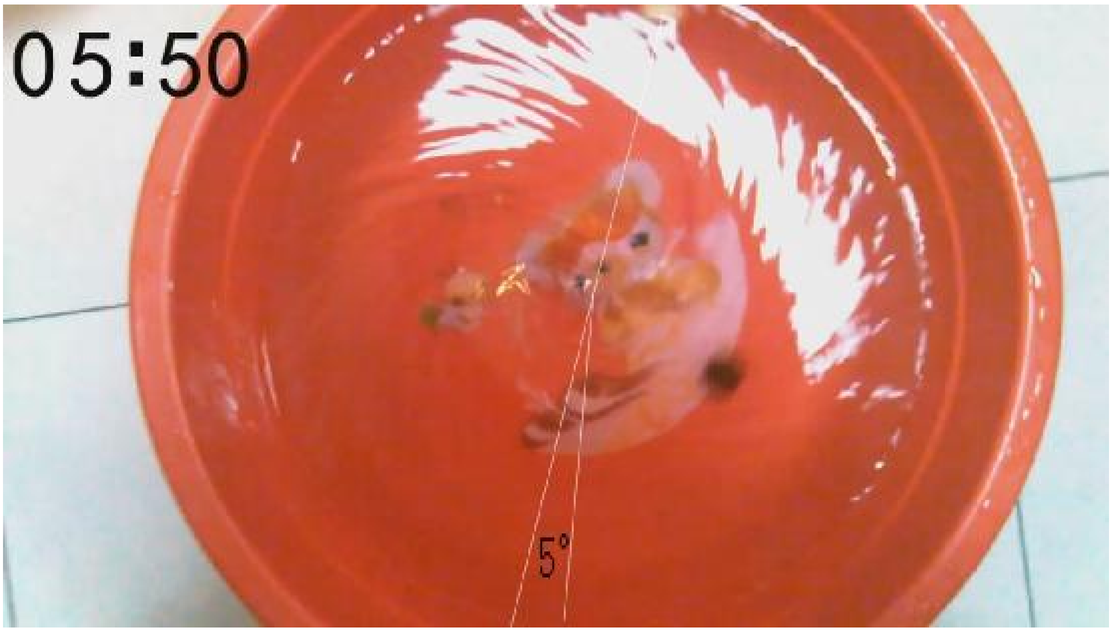
The white fruit revolves 175° within 1.75 s, from 5:50 to 7:25.

Let X be the time for the white fruit to revolve 360°.

$$\frac{1.75}{175}=\frac{X}{360}$$

X=3.6 s

The periodic time of the white fruit is 3.6 s.



The above figure shows that at 7:25, the white fruit has revolved 175°. This angle was measured by the angle meter after localization.

(3) The walnut's distance to the center

Distance to the center was calculated as the average of a group of data.

5:50 R_1=8.5 cm

6:31 R_2=7.1cm

6:56 R_3=8.6cm

7:05 R_4=9.5cm

7:13 R_5=9.3cm

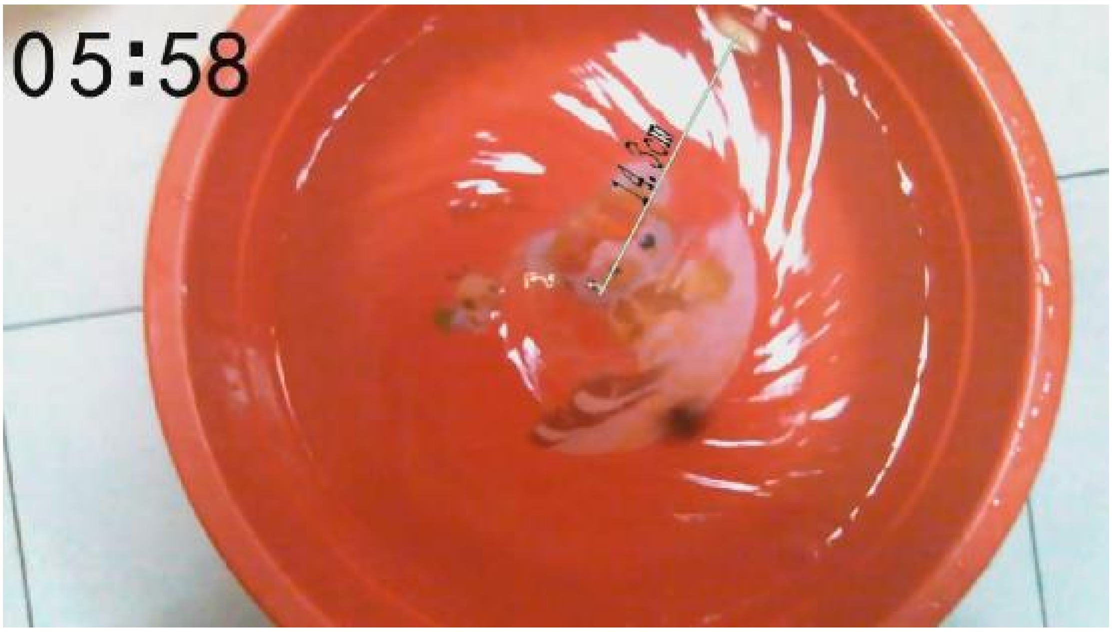
7:25 R_6=9cm

$$R=\frac{R_1+R_2+R_3+R_4+R_5+R_6}{6}=8.67cm$$

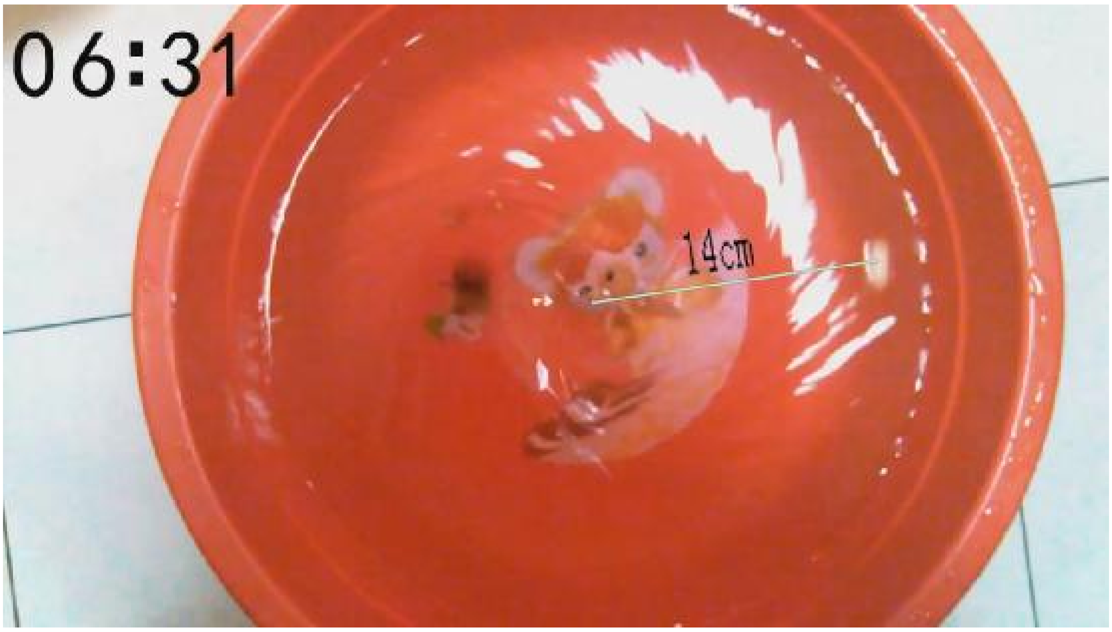
(4) The white fruit's distance to the center

The distance from the center of the vortex to the boundary of the water surface is 16.3 cm.

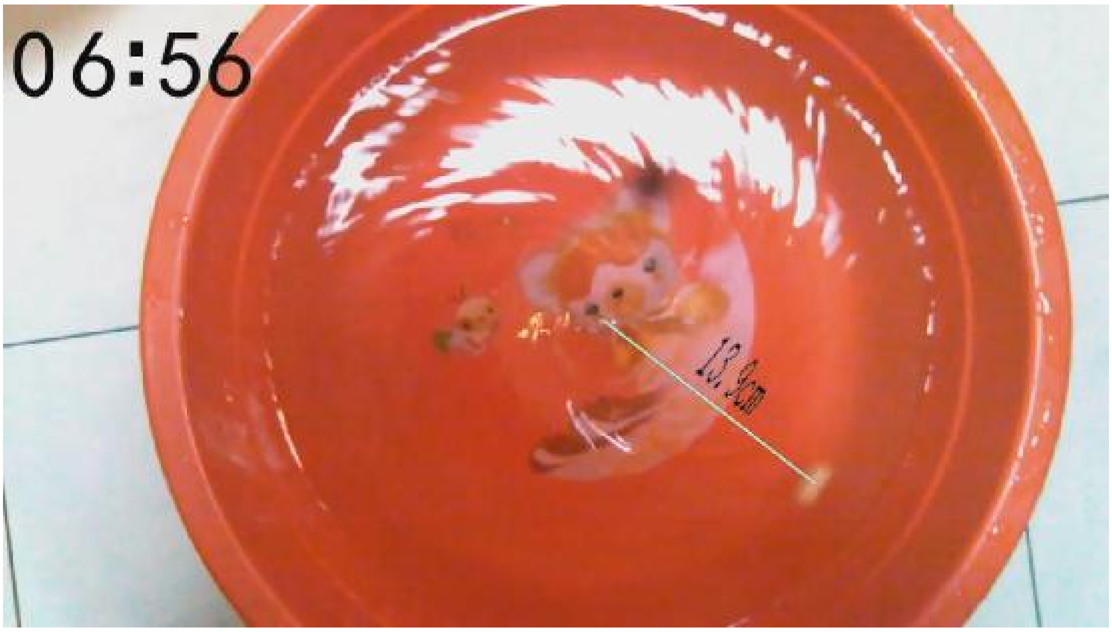
The following are four sampled data:



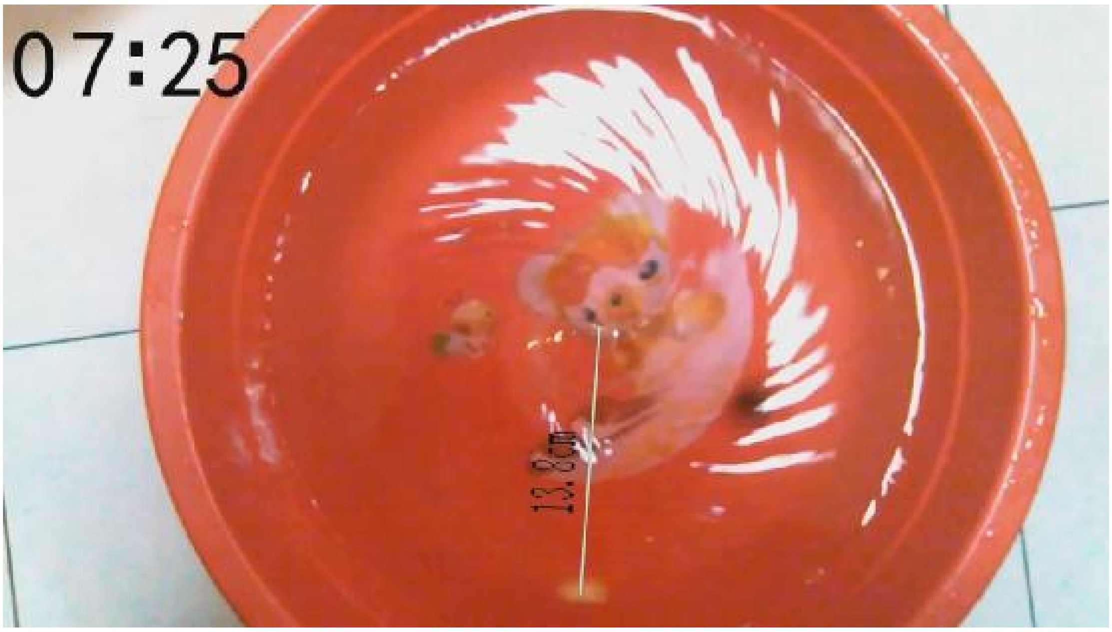
5:58 R_1=14.3cm



6:31　R_2=14cm



6:56　R_3=13.9cm



7:25 R_4=13.8cm

$$R=\frac{R_1+R_2+R_3+R_4}{4}=14cm$$

The white fruit's distance to the center is 14 cm.

(5)The relationship between the periodic time and the distance to the center of a vortex

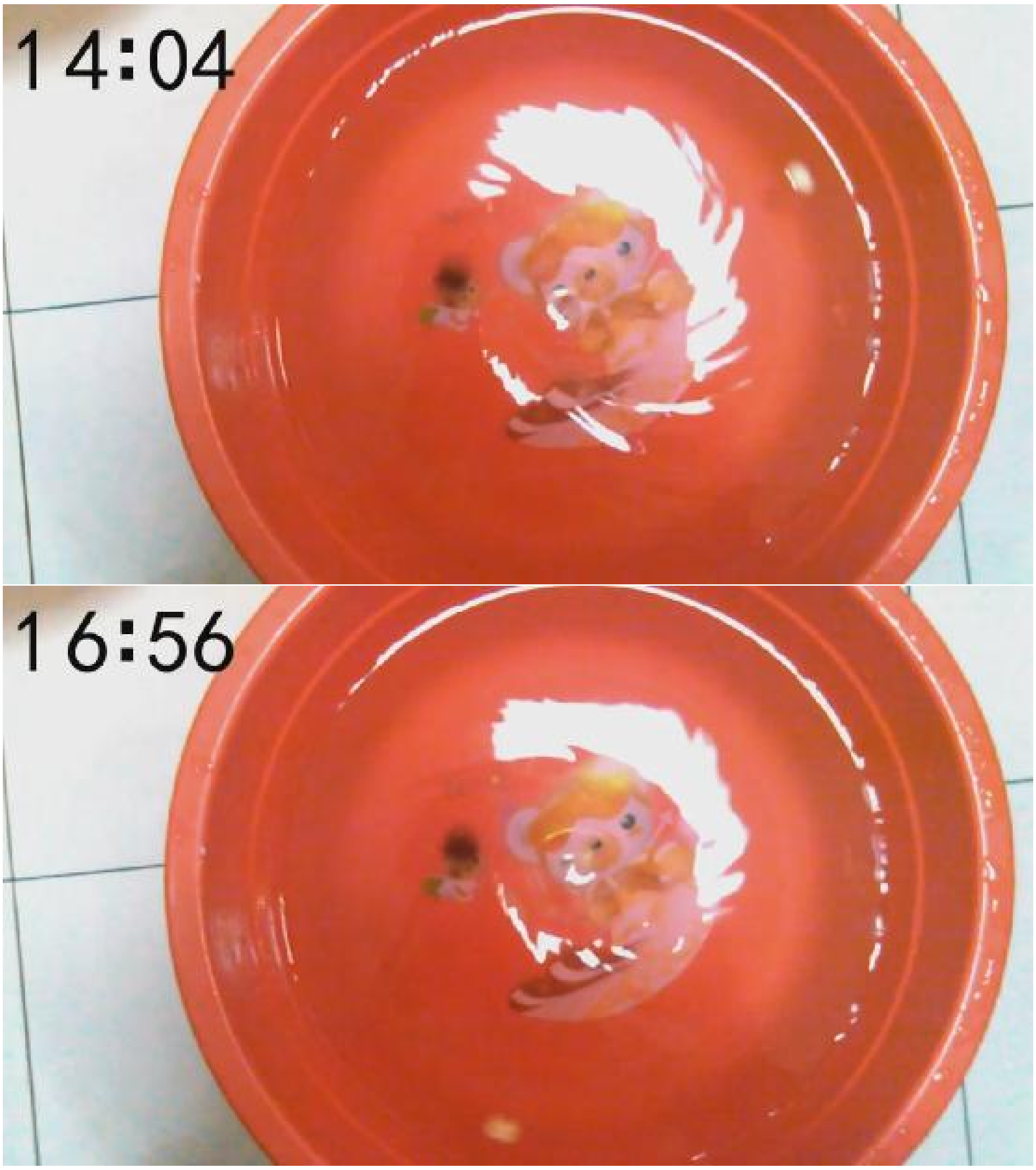
	Periodic time T	Distance to the center R	$\frac{R^3}{T^2}$
Walnut	1.75 s	8.67 cm	212.8
White fruit	3.6 s	14 cm	211.7

For each part of the same vortex, the square of its periodic time is in constant ratio to the cubic of its distance to the center, and this constant is related to the scale of the vortex.

6.2 Analysis of the second period

The vortex of the second period was selected as the target.

(1) The periodic time of the walnut



The periodic time of the walnut is T=2.52 s, from 14:04 to 16:56.

(2) The periodic time of the white fruit

From 14:04 to 16:56, the white fruit has revolved 131°.

Let Y be the time for the white fruit to revolve 360°.

$$\frac{2.52}{131} = \frac{Y}{360}$$

Y=6.925 s

The periodic time of the white fruit is T=6.925 s.

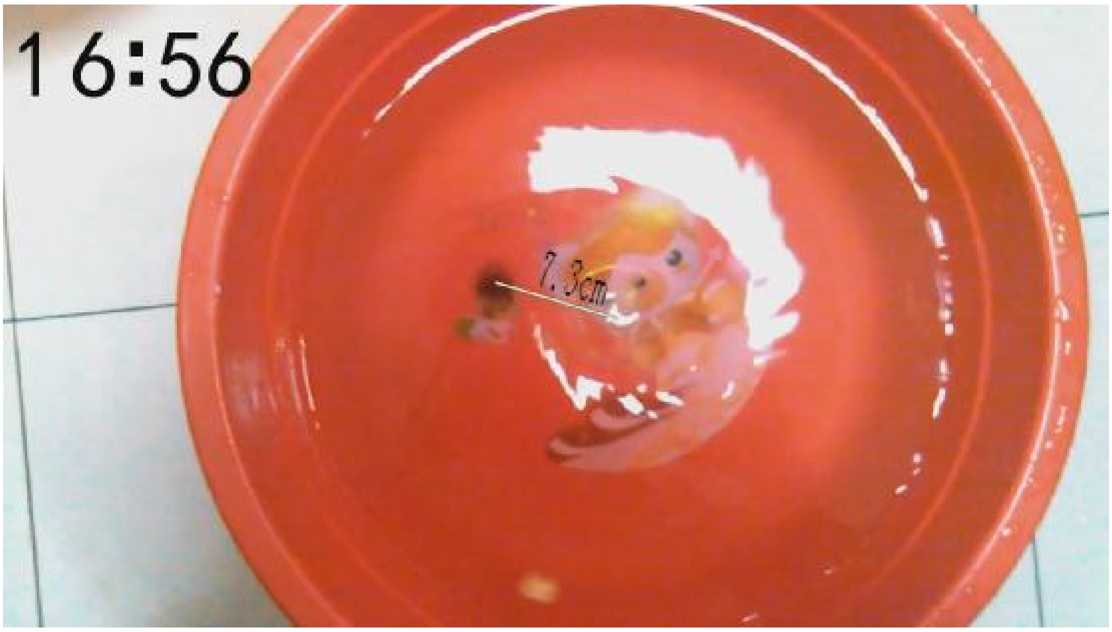
(3) The walnut's distance to the center

14:04 R_1=7.5cm

14:33 R_2=7.3cm

14:49 R_3=7cm

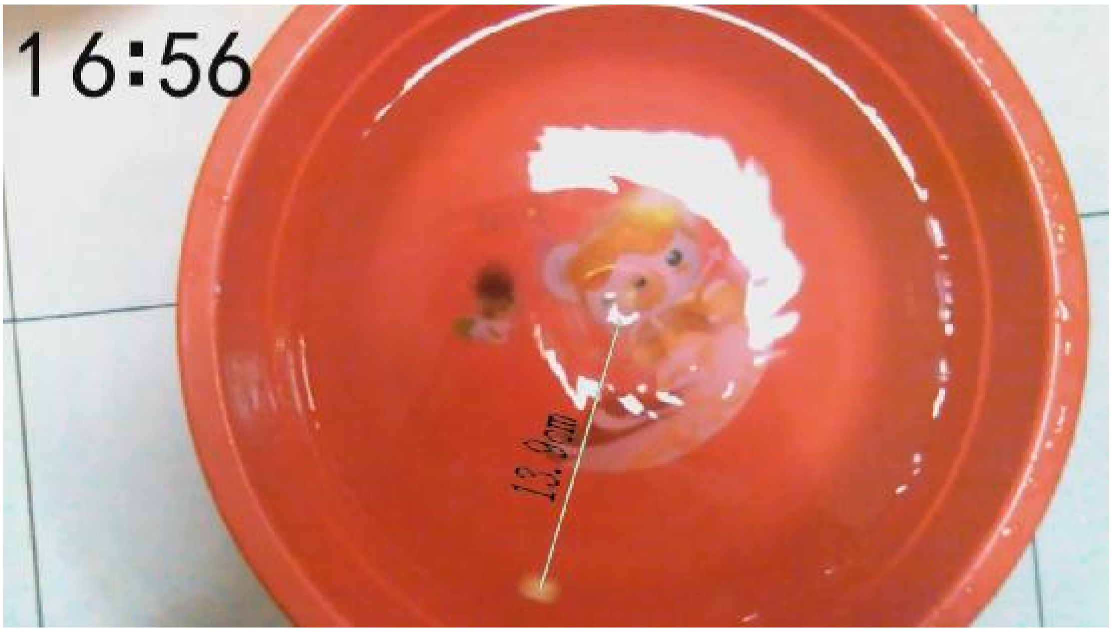
15:14　R_4=6.3cm



16:56　R_5=7.3cm

$$R=\frac{R_1+R_2+R_3+R_4+R_5}{5}=7.08cm$$

(4) The white fruit's distance to the center



The white fruit's distance to the center is 13.9 cm at 14:04, 14:45, 15:14 or 16:56.

Therefore, the white fruit's distance to the center is R=13.9 cm.

(5)The relationship between the periodic time and the distance to the center in a vortex

	Periodic time T	Distance to the center R	$\frac{R^3}{T^2}$
Walnut	2.52 s	7.08cm	55.88
White fruit	6.925 s	13.9cm	56.00

As the first experiment, for each part of the same vortex, the square of its periodic time is in constant ratio to the cubic of its distance to the center, namely $\frac{R^3}{T^2}$ =K. This constant is related to the scale of the vortex. Larger vortex produces larger K.

7. Error

Only two periods of a vortex video were selected as targets in this experimental report. In order to affirm accuracy, the experiments were repeated by selecting different periods for measurement and comparison. The results show that for each part of the same vortex, the square of its periodic time is in constant ratio to the cubic of its distance to the center.

Researchers are expected to repeat this experiment so as to effectively validate its accuracy. Also different methods and more precise instrument are welcome to study the relationship between the periodic time and the distance to the center of each vortex part, which will certainly improve this experiment.

8. Conclusions

For the same vortex or the same part, the square of its periodic time is in constant ratio to the cubic of its distance to the center, namely $\frac{R^3}{T^2}$ =K. This constant is related to the scale of the vortex. Larger vortex produces larger K.

Kepler's Third Law actually proves Descartes' Vortex Theory.

The universe may be a turbulence field, filled with uncountable large and small vortexes, including the Milky Way Galaxy, the sun, the earth, and the moon. Vortexes grant them with gravitation.

Newton's understanding of vortexes is wrong, so we should recognize and develop Descartes' Vortex Theory, and grant this French foreseer the honor that he deserves.