# Stray Cats News

***Aich Physics Circle, Japan***

**08/2018**

## HSCI2018 – Advancing Science. Improving Education

HSCI2018 (Hand-on Science 2018) was held at Barcelona in Spain from 16 to 20 July. First, I must tell you that we lost Dr. Alexander Kazachikov. It was ICPE conference at South Korea in 2002 Stray Cats members met him for the first time. His experiments fascinated us and we hit it off each other. Since then we had been exchanging ideas of simple and essential experiments. So, we are very sorry to lose our best colleague. However, the conference was very exciting and attractive as usual because of ardent participants including Kseniia and Nataliia, Alex' colleague. I want to appreciate all the stuff and participants for wonderful conference. If you interested in the conference, please see the Web page of "The Hand-on Science Network".

**SUGI**

← Opening ceremony was held at the solemn chapel in ex-Univ. of Barcelona .

→ I presented some simple and essential experiments in Electromagnetics.

↓ Exciting lectures, sessions and workshops.

↓ Gaudi's architects.

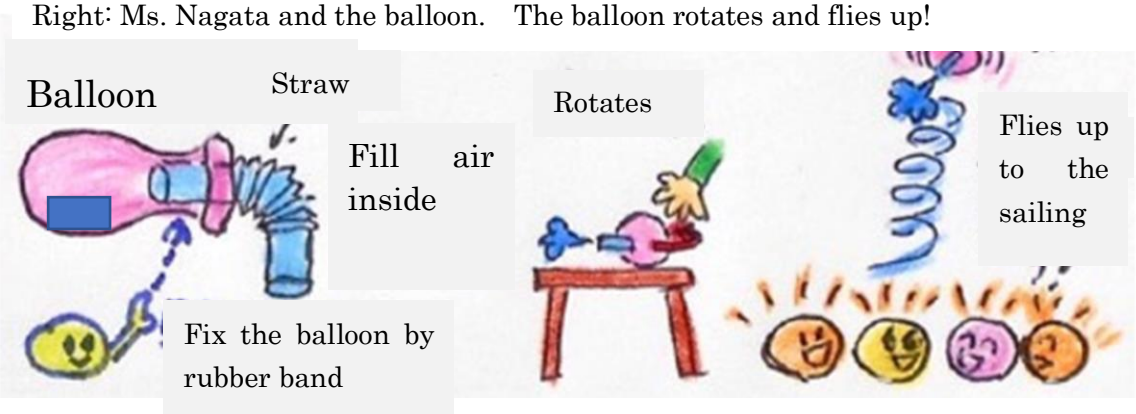
# Recent topics

### 1. UFO balloon – Why it flies up? (Y. Nagata)

What do you think to happen if the balloon with the bent straw at the mouth of it released on the table? You can anticipate that it rotates on the table because the air spouts out from the straw. Ms. Nagata found the balloon flies up by attaching a bit of tape at the specific place on the surface of the balloon. Then, she named the balloon "UFO balloon".

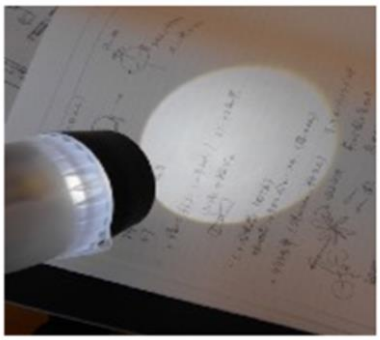
In the meeting we did exciting discussion on why it flies up in the air. But, we did not reach the conclusion. It is certain that the tape break symmetry of the balloon and that makes the nozzle of the straw down. Now, it is the most dominant explanation that nozzle leans because of the precession of the balloon by the centrifugal force. What do you think?


Left: Place of the tape. 45° north from the equator if we compare the balloon with the earth.
Right: Ms. Nagata and the balloon. The balloon rotates and flies up!




### 2.Experiment of mixing of primary colours of light using LED torches (H. Okumura)

He demonstrated a simple and beautiful experiment. His idea was that because white LED light from the torch was made by mixing lights of three types of LED bulbs that emitted three primary colours, respectively, respective lights must make white again if they were mixed and could be used to make other mixed colours. He attached red, green and blue filter to the torches, respectively, and projected on the screen. You can see red, blue, green, white and yellow in the picture below.



Select the torch that projects uniform spot.

Left:
Mr. Okumura and the assistant (his daughter)
Right:
They are mixing the colors. Boundaries of colors are clear

**3. Use a toy Drone to the experiment of "hovering bird problem" (H. Okumura)**

Recently, high-performance toy drones are sold.(Fig 1) Mr Okumura showed how we can use for experiments of mechanics. He challenged the experiment of "hovering bird problem". This problem is like this.
"There is a bird in a closed box on a scale. If the bird hovers in the air in the box, the scale indicates weight of

a) the box b) the box and the bird c) none of them

There are some optional questions shown below.

What does the scale indicate if we open the top of the box?

What does the scale indicate if the bird hover just above the scale (no box)?

First, we were surprised Mr. Okumura operated the drone as if he was a professional drone operator! Second, we were surprised the result of the experiments were perfect! However, he added we need to enough practice for operating in the box because drone becomes unstable in the closed box.


Fig 1

Fig 2

= Box+Bird

> Box+Bird

< Box+Bird

**4. Experiments of Static electricity using hand-made simple electrometer (E. Tanaka and N. Sugimoto; from Sugi's presentation in HSCI2018)**

We usually use leaf electroscope for the experiments of the static electricity. We propose to use simple hand-made electrometer (Picture) in addition to the experiment of classical electroscope. It detects the polarity of the charged body by the polarity of the charge induced at one of the plate of the capacitor in the electrometer (Fig 1).

This equipment enables us to do almost all experiments we do using leaf electroscope with information of the polarity of the charge. Furthermore, we can show movement of the charge dynamically using electrometer and galvanometer with DC amplifier. I show a diagram of the experiment in Figure 2. The aluminum sheet A is connected to the electrometer via the galvanometer to measure the polarity of the charge induced on A. The ground of the electrometer is connected to the aluminum sheet B. If we bring the negatively charged body near the aluminum sheet A, the indicator of the galvanometer indicates the current flows from B to A. And at the same time, the indicator of the electrometer indicates A is positively charged. On contrarily, if we bring the negatively charged body near the aluminum sheet B, the galvanometer and the electrometer indicate the current flow from A to B and A is negatively charged, respectively. Students realize what takes place in the process of the electrostatic induction.

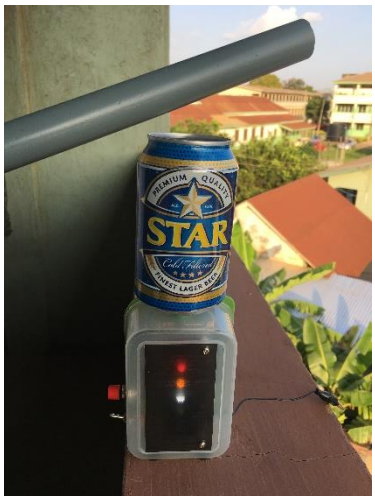



Fig 1

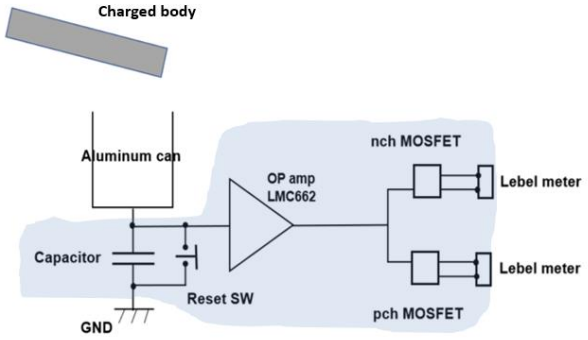



Fig 2

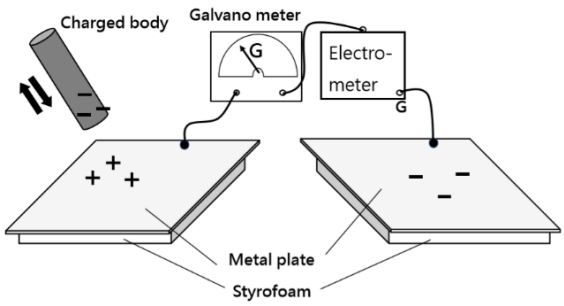



Fig 3

**5. Hand-made equipment to measure the light speed - Modern version of Fizeau's experiment (H. Hayashi; from Sugi's presentation in HSCI2018)**

Mr. Hirotaka Hayashi recently developed simple equipment to measure the light speed that is easy to understand the principle of measurement for students. Fundamental principle of the measurement is almost the same as that of Fizeau's experiment. Fizeau modulated light using teethed wheel and observed the delay of the phase of light because of the transmitting time. In this experiment, light is modulated by applying sine voltage of 10MHz to LED light and monitor a delay of the phase on the display of the oscilloscope. Fig 1 is the diagram of the equipment.

Modulated light emitted from LED transmits the passes below and detected by the photo diode.

LED → Beam splitter → reflector → Beam splitter → Photo diode

And, the signal is displayed on the display of the oscilloscope.

Fig 4 is the result of the case we moved back the reflector 2.00m. Time of the delay was 13.2ns. By changing the optical path difference, we could draw the graph of the delay time vs distance of the path as Fig 5. As we expected, the delay time was proportional to the optical path difference. Light speed was calculated by the slope of the graph as below.

$$c = \frac{12.00}{40.0 \times 10^{-9}} = 3.00 \times 10^{8} m/s$$

Recently, this experiment was adapted to the introductory Hands-on experiment for freshman of faculty of science in Nagoya University.

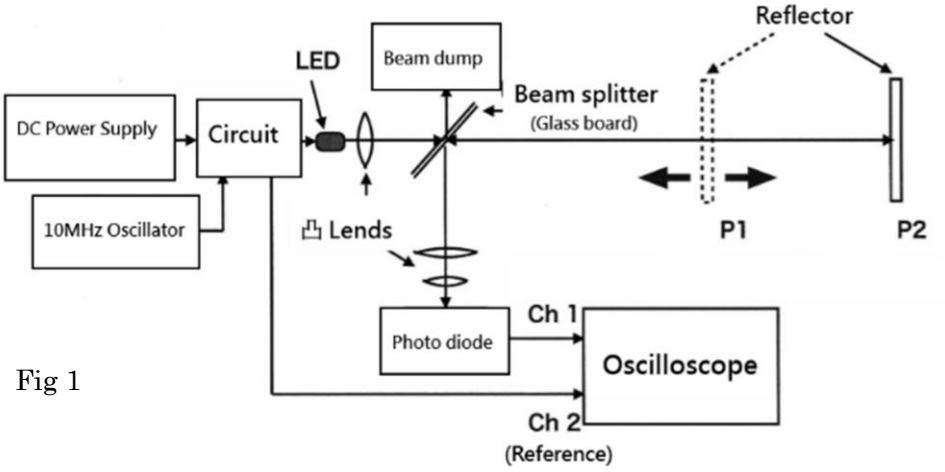



Fig 1

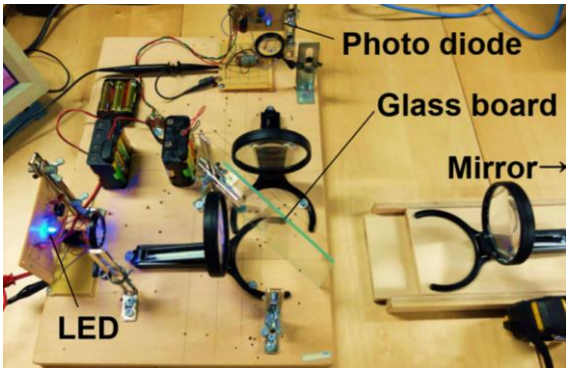



Fig 2

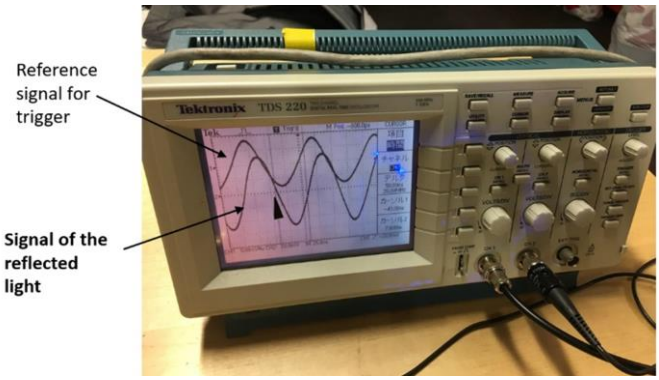



Fig 3

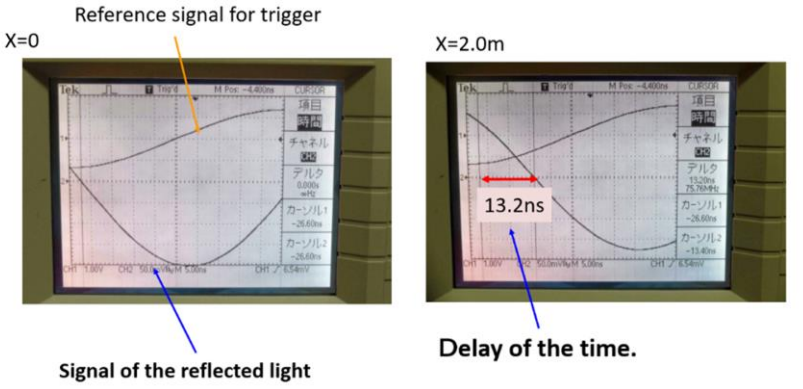



Fig 4

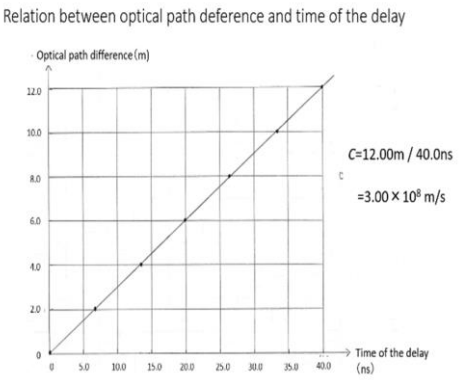



Fig 5