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Abstract

Often in physics classes we are faced with the need for demonstration attempts. Some physics classes can be well organized using certain educational content from the numerical assignments and experimental assignments given at the International Physics Olympiads (IPO). As mentors of students and participants in the Olympics, we want to share some experiences from using texts, draft schemes or whole experimental settings from the Olympics, in the teaching itself, making the teaching of physics more observant and motivating.

Example 1: “Determination of the geometrical shape of parallel plates from a plate capacitor”, IPO 2011, Bangkok, Thailand [1]

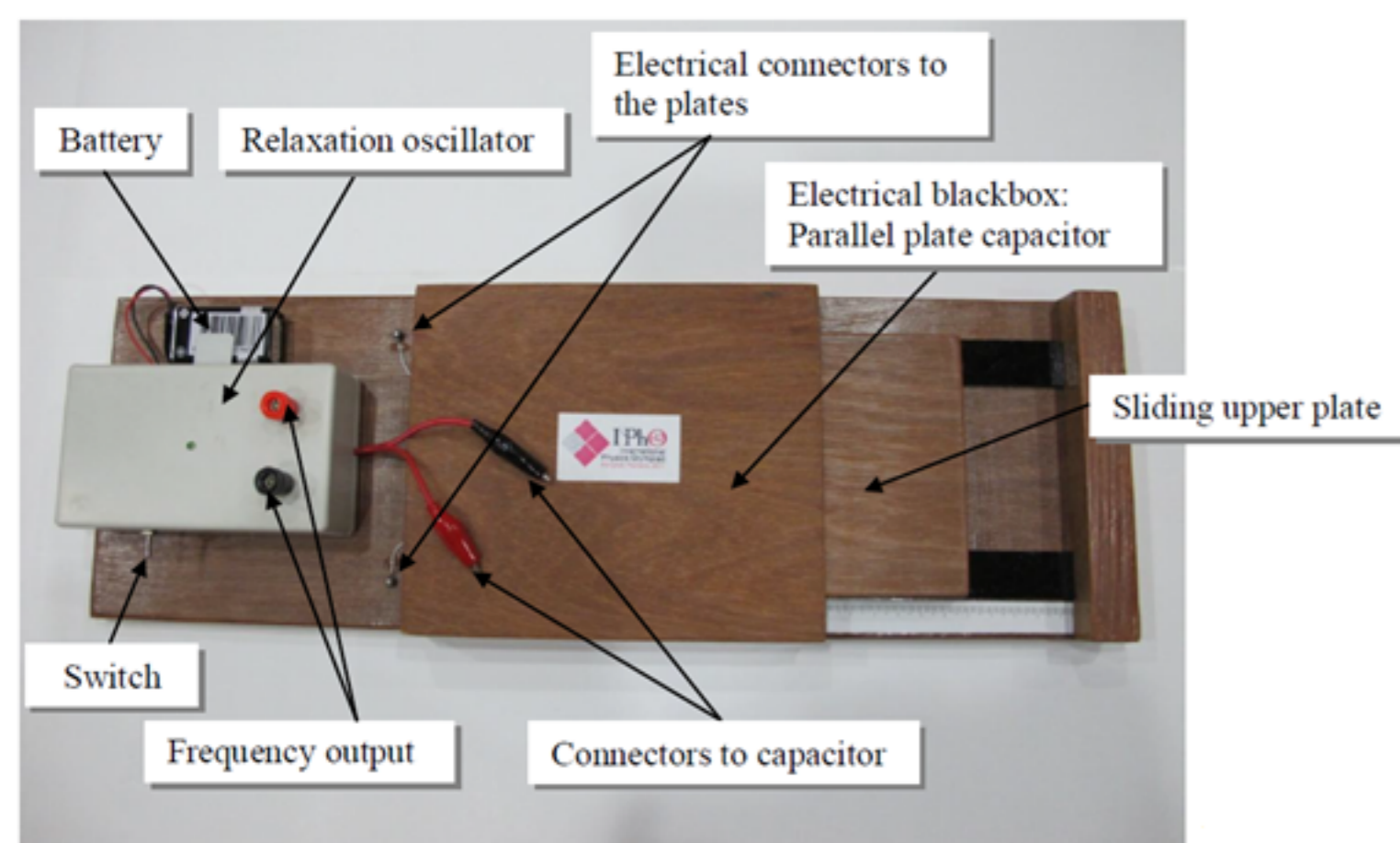


Figure 1: Appearance of the experimental setup with its components. The electric black box represents a parallel plate capacitor with a certain shape of the plates, which are unknown (the box is closed, “black” box).

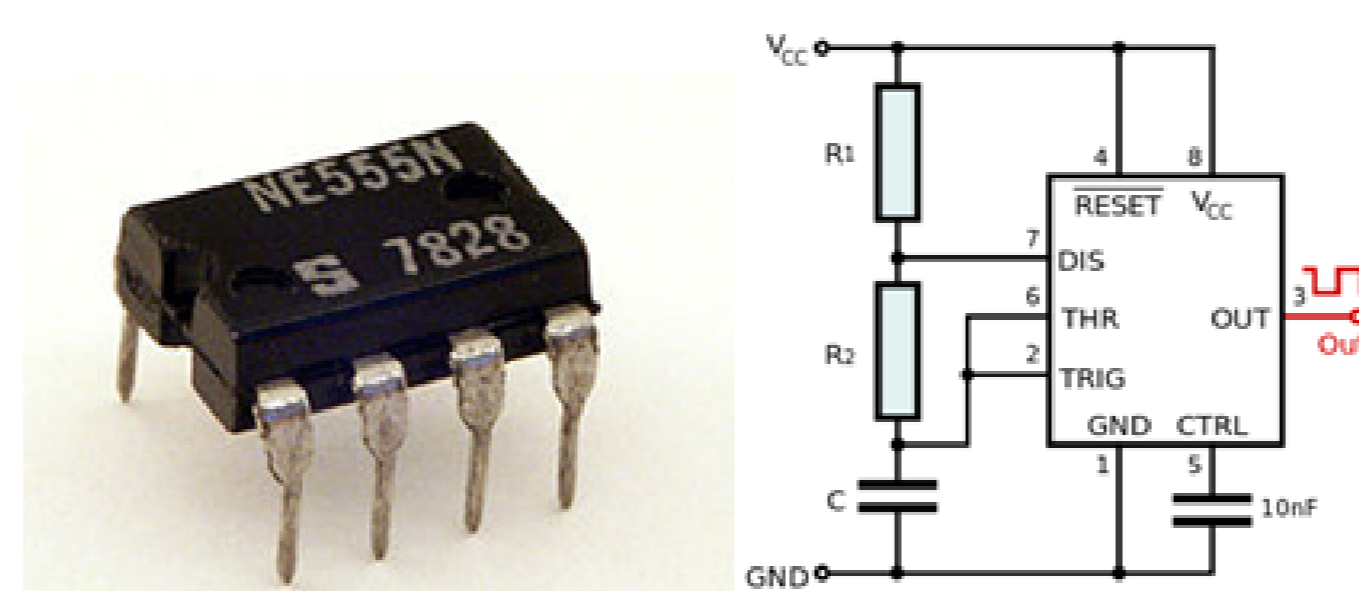


Figure 2: If you open the box of the relaxation oscillator you can see the following. Inside is the NE555E integrated circuit.

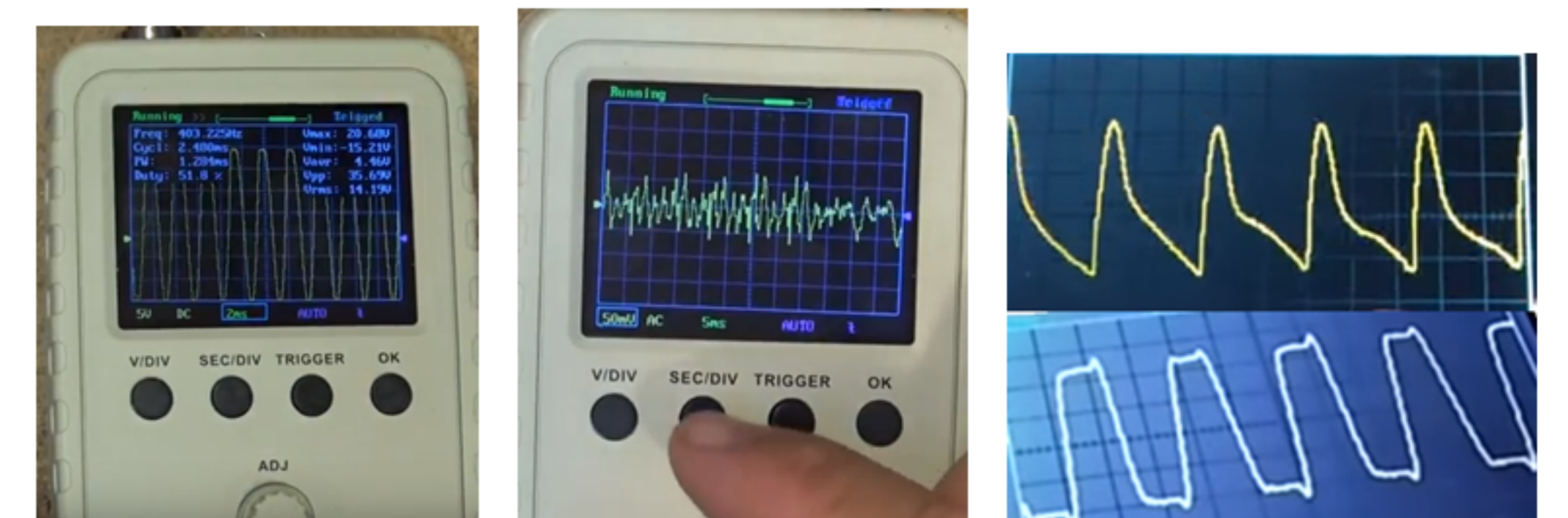


Figure 3: If a small oscilloscope (picture 3) is connected to the output of this generator, different deformations of the shape and frequency of rectangular pulses can be obtained. Thus, the experimental task can become an interesting “toy” in the hands of both students and teachers.

- A piezo earphone is connected to the output of the oscillator frequency. By moving the upper plate of the capacitor, the frequency that is in the audible range can also be changed, so it can be heard with the sense of hearing.
- Instead of the plate capacitor, it can be removed and a plate capacitor from an old radio receiver, or a Leyden cup capacitor can be connected.
- By changing the capacitance of different types of capacitors, different sounds are generated.

Example 2: “Planck’s constant in the light of an incandescent lamp”, 36 IPO 2005, Salamanca, Spain [2]

Explaining other physical properties:

- Properties of photo resistors;
- Absorption of light, absorption spectra and
- Production of the measuring instruments – photometers as well as their working principle.

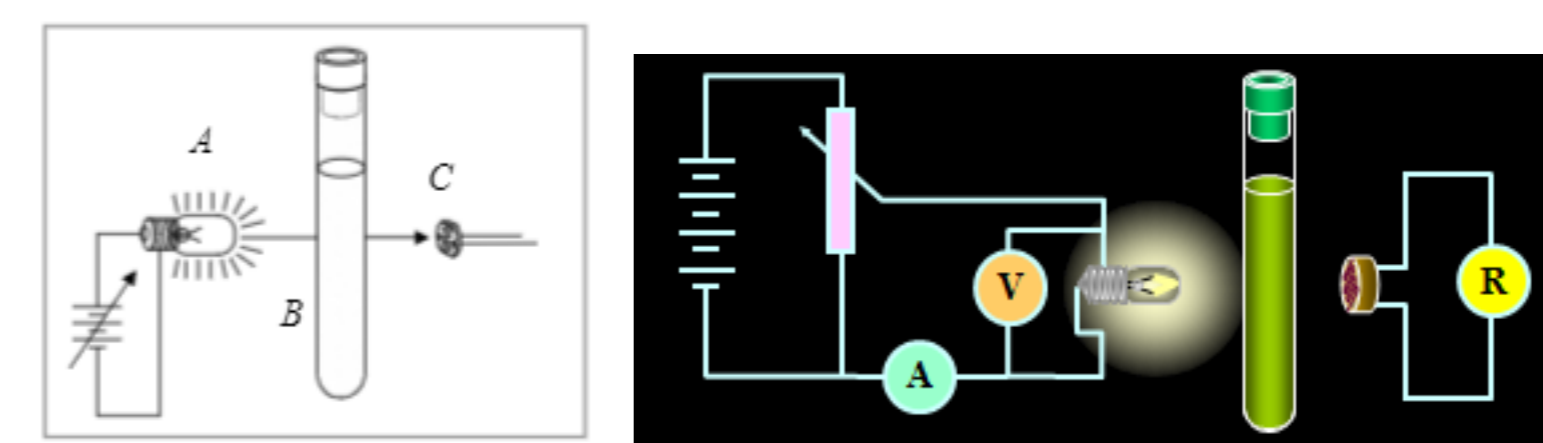


Figure 4: Authentic electrical scheme of the apparatus.

Example 3: “Measuring Plank constant with colour LEDs and compact disk”, EPO2 25 Apr 2015, Sofia, Bulgaria [3]

- The Experimental Physics Olympiads (EPO) organized by the Sofia branch of the Union of physicists in Bulgaria and, the Regional Association of Physicists from Strumica and the Society of Physicists of the Republic of Macedonia held 9 Olympiads 2014–2022.
- Particularly interesting educational resource to make physics classes both effective and efficient.
- Each student who participates in the competition receives the entire experimental set-up free of charge as a teaching aid as a visual aid in the physics classroom.
- Age categories S, M, L, and XL and a separate ranking will be made for each age group.
- The task of the Olympiad is actually a sequence of many related tasks, given as different sub-tasks with increasing difficulty – every participant has to do the best to solve these sub-tasks.
- Solving tasks by mentors provides an excellent opportunity to upgrade and refine experimental tasks.



Figure 5: Details from the experimental set for measuring the Plank constant h: Wires ending with plug and crocodile clip, multimeter, battery holder and 3 batteries of 1.5 V, 4 LEDs, potentiometer with wires ending with crocodile clips, 3 binder clips, touch and its lens, Compact Disc (CD) double stick tape, photo-resistor, non transparent tube, plasticine, paper clip.

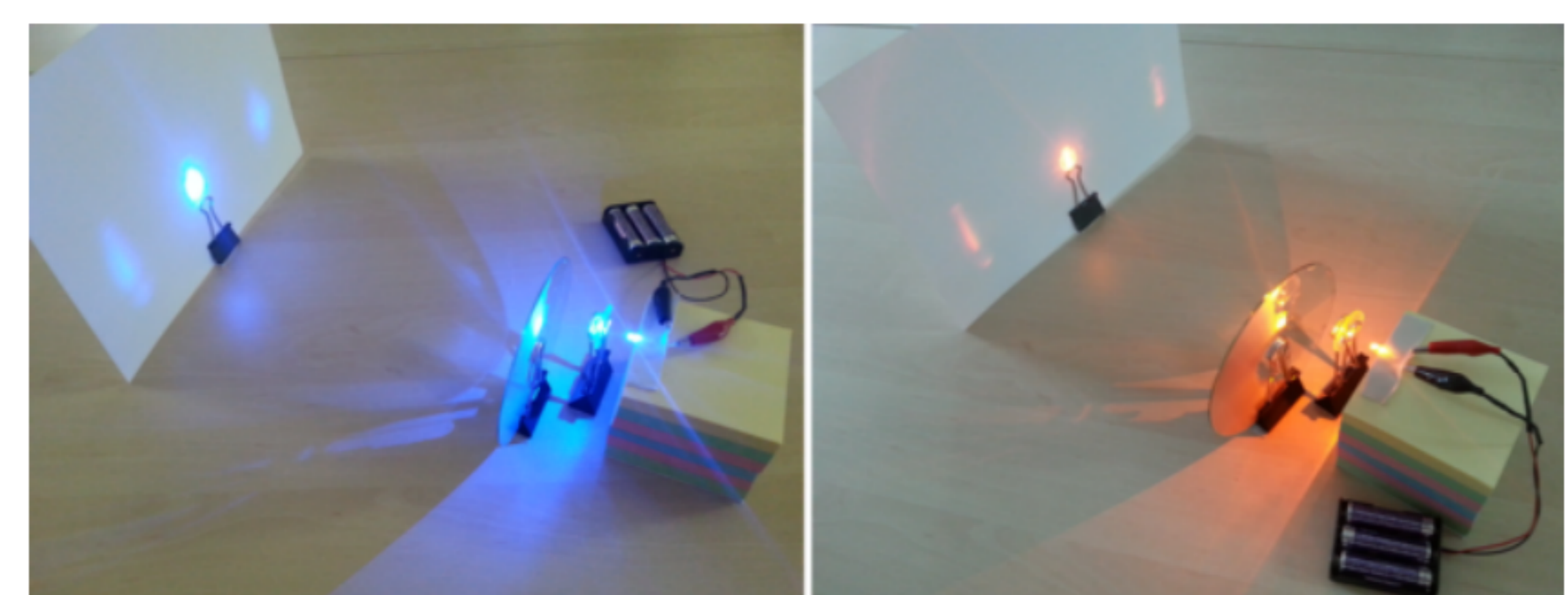


Figure 6: Experimental setup for measuring the wavelength of LED light: The LED is connected with wires to the power supply. The light is collimated with lens then it pass the tracks of the transparent compact disk and one can see a bright image of the LED on the screen. Together with the central maximum two pale diffraction maximums can be observed on the screen. Diffraction angles are different for the different colour of the used LEDs, yellow and blue on the pictures. The wavelength of the light can be determined by measuring the diffraction angles.

References

[1] http://mpec.sc.mahidol.ac.th/ipho2011/sites/default/files/Q1_Experiment_Question_Eng.pdf
 [2] <https://physprob.com/>
 [3] V. N. Gourev, S. G. Manolev, V. G. Yordanov, T. M. Mishonov, “Measuring Plank constant with colour LEDs and compact disk”, arXiv:1602.06114 [physics.ed-ph] (2016), <https://arxiv.org/abs/1602.06114>.