WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 11, Nov., 2022

OBSERVATION OF THE GENERATION OF AN ELECTRIC PULSE DUE TO A CHANGE IN THE MAGNETIC FLUX IN A CLOSED CIRCUIT AT THE CASSY Lab2 DEVICE

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Abstract
This experiment measures the induced voltage U(t) for various magnetic flux densities B and numbers of turns N for various coils, determines the time integral and thus the voltage impulse in the evaluation of a recorded curve and ultimately verifies Faraday's law of induction.

Keywords: Closed circuit, magnetic flux, electric power, induction, Faraday's law, magnetic field, electric field.

The magnitude of the magnetic induction at any point in the field is proportional to the current i in the coil. Therefore, the magnetic flux through the coil is also proportional to the current:

$\Phi = Li$ (1)

Applying the basic law of electromagnetic induction to the phenomenon of self-induction, we get the following for the self-induction electromotive force:

$\mathcal{E} = -L\frac{di}{dt}$ (2)

The main part: In experiment part a), the integral quickly reveals that the voltage impulses have the same absolute value but different signs when the magnet is inserted in and withdrawn from the coil. The use of two magnets additionally verifies the proportionality between the voltage impulses and the number of magnets used resp.

$$\int_1^2 U(t)\cdot dt \propto \Phi_2 - \Phi_1 = \Delta\Phi \qquad (3)$$

the difference in the magnetic flux produced in this manner:

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$U = -\frac{d\Phi}{d\Phi}$ (4)

By means of differentiation we verify Faraday's law of induction

The magnetic flux through a coil depends on the number of turns, as each individual turn causes a flux difference $\Delta\Phi_0$ and the total flux is calculated as

$\Delta\Phi = N \cdot \Delta\Phi_0$. (5)

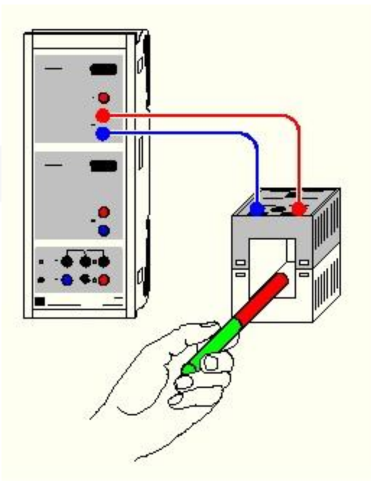
When we look at experiment part b), the relationship between a voltage impulse and the number of turns N of the respective coil, we can also confirm this relationship. To do this we determine e.g. all positive areas and enter these in the Number of Turns display together with the number of turns N. Once again, the proportionality gives us

$\int_1^2 U(t) \cdot dt \propto N \cdot \Delta\Phi_0 = \Delta\Phi.$ (6)

The slope of the straight line in the display of voltage impulses as a function of the number of turns corresponds to the magnetic flux Φ_0 generated by the magnet in each individual coil winding.

The following instruments were used to observe the formation of an electric pulse as a result of a change in the magnetic flux: Sensor-CASSY, CASSY Lab 2, Round bar magnets, Coil with 250 turns, Coil with 500 turns, Coil with 1000 turns, Pair of cables, 100 cm, red and blue, PC with Windows XP/Vista/7/8.

The device assembly device is the device shown in Figure 1



(Pic.1)

When conducting an experiment, we assemble the device in the following order.

* Connect a coil to input A of Sensor-CASSY.

a) Measuring as a function of the magnetic flux Φ

* Load settings.

* Connect the coil with 250 turns to input A.

* Start the measurement with  .

* Insert one magnet half-way and remove it  .

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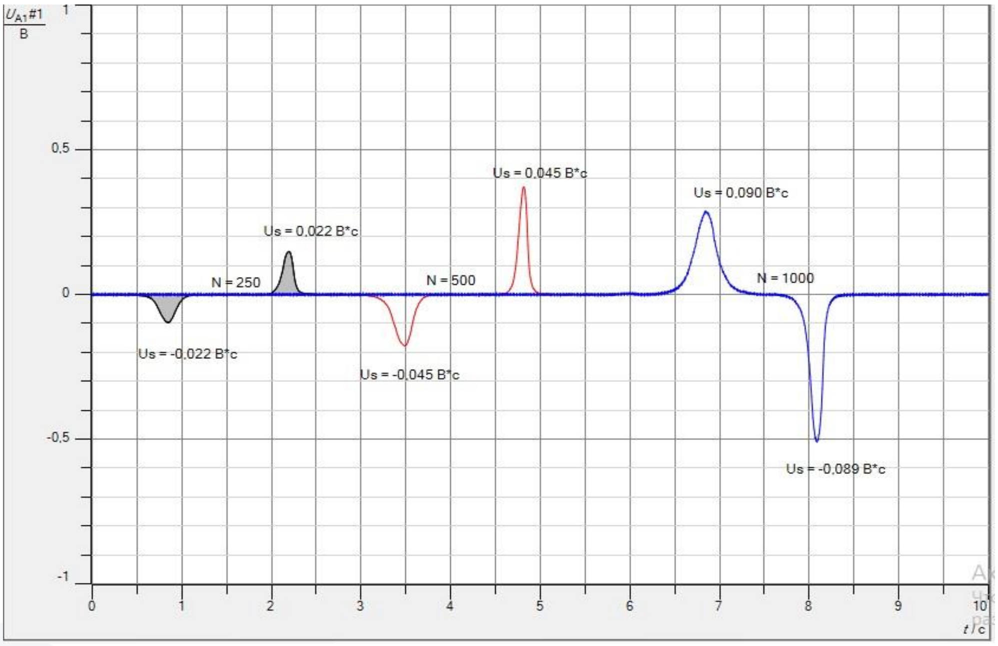
* Stop the measurement with (or the measurement stops automatically after 10 seconds)..
* Start the measurement with and wait until the new measurement has proceeded far enough so that it no longer covers the old measurement.
* Insert two magnets half-way and remove them.
* Stop the measurement with (or the measurement stops automatically after 10 seconds).

b) Measuring as a function of the number of turns N

* Connect the coil with 250 turns to input A.
*Start the measurement with
*Insert the magnet half-way and remove it.
*Stop the measurement with (or the measurement stops automatically after 10 seconds).
*Connect the coil with 500 turns to input A.
*Start the measurement with and wait until the new measurement has proceeded far enough so that it no longer covers the old measurement.
*Insert the magnet half-way and remove it.
*Stop the measurement with (or the measurement stops automatically after 10 seconds).
*Connect the coil with 1000 turns to input A.
*Start the measurement with and wait until the new measurement has proceeded far enough so that it no longer covers the old measurement.
*Insert the magnet half-way and remove it.
*Stop the measurement with (or the measurement stops automatically after 10 seconds).

To integrate, you need to find the start of the range, which is not always easy when multiple curves are superimposed. It is easier when the measurement is stopped with immediately following the voltage impulse (do not wait for the 10 seconds to elapse) and the integral is calculated immediately after measuring. If you wait until after the end of the previous measuring curve before starting the next voltage impulse measurement, no curve covers the others while integrating.

The analysis of the experiment is presented in Figure 2.



(Pic.2)

Summary

The purpose of this work was explained by measuring the electromagnetic induction on the CASSY Lab2 device, analyzing the variation of the voltage depending on the number of windings of the coil, and obtaining the time dependence graph of the variation of the voltage depending on the number of windings N.

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