EXPERIMENT 2

SPEED OF LIGHT MEASUREMENT

PURPOSE

The aim of this experiment to determine the speed of light using osciloscope.

EQUIPMENT

Osciloscope, Signal generator, Light pulses transceiver, Fiber Cable (15cm and 20m).

THEORY

Light always travels at the same speed in space. This speed is exactly 299,792.458 m/s (approximately $3x10^8$ m/s) and is denoted *c*. The speed of light has intrigued researchers for centuries, and many have conducted various experiments to calculate the speed of light.

The first successful experiment with the speed of light was carried out by Olaus Roemer in 1676. Roemer noticed that the eclipse duration of Jupiter's moon Io increased with distance from Earth. Roemer attributed this to the fact that light travels more as the distance between Earth and Jupiter increases. Thanks to this technique, Roemer calculated the speed of light as 214,000 km/h.

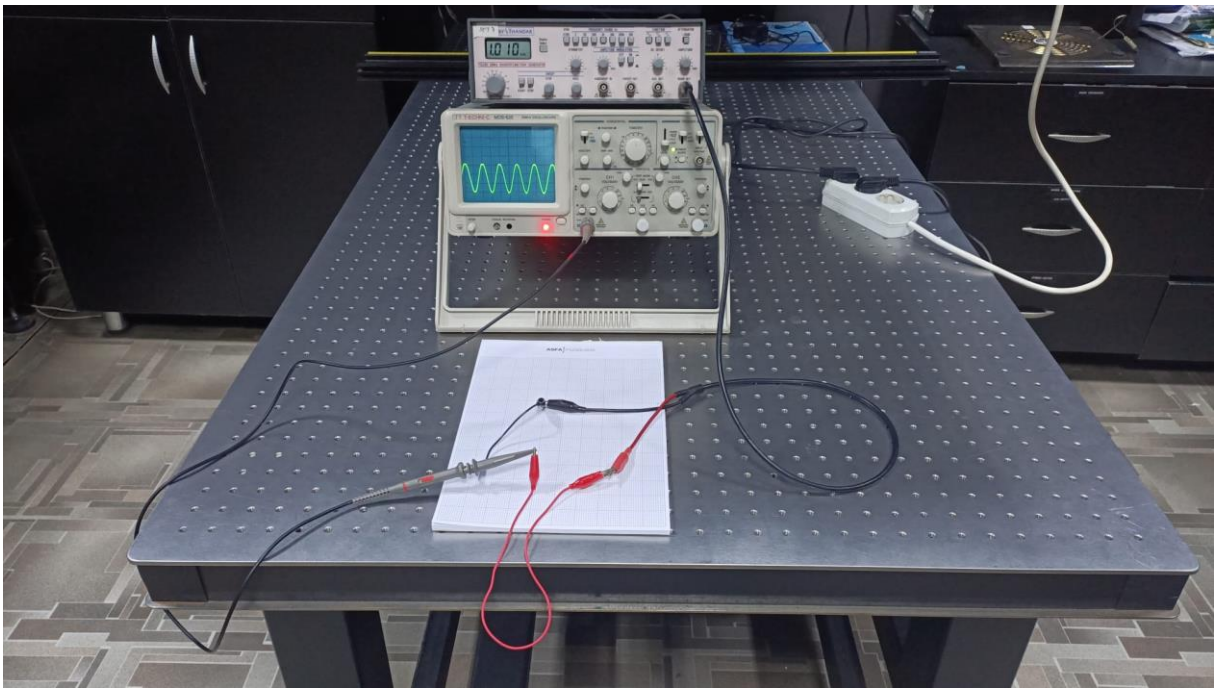
In 1718, James Bradley predicted that the light of the stars came at a certain angle as a result of the Earth's rotation around the Sun, and was able to measure this angle. Using this angle and calculating the rotation speed of the Earth around the Sun, he found the speed of light 301,000 km/h.

In 1849, Armand Fizeau passed light between two teeth of a rotating wheel, causing it to reflect back from a mirror 8 km away. He increased the speed of the wheel so that the light would appear through the next hole on the spin. With this technique, Fizeau found the speed of light to be 315,000 km/h. Leon Foucault then performed the same experiment more accurately using multiple mirrors and found the speed of light to be 298,000 km/h.

PROCEDURE

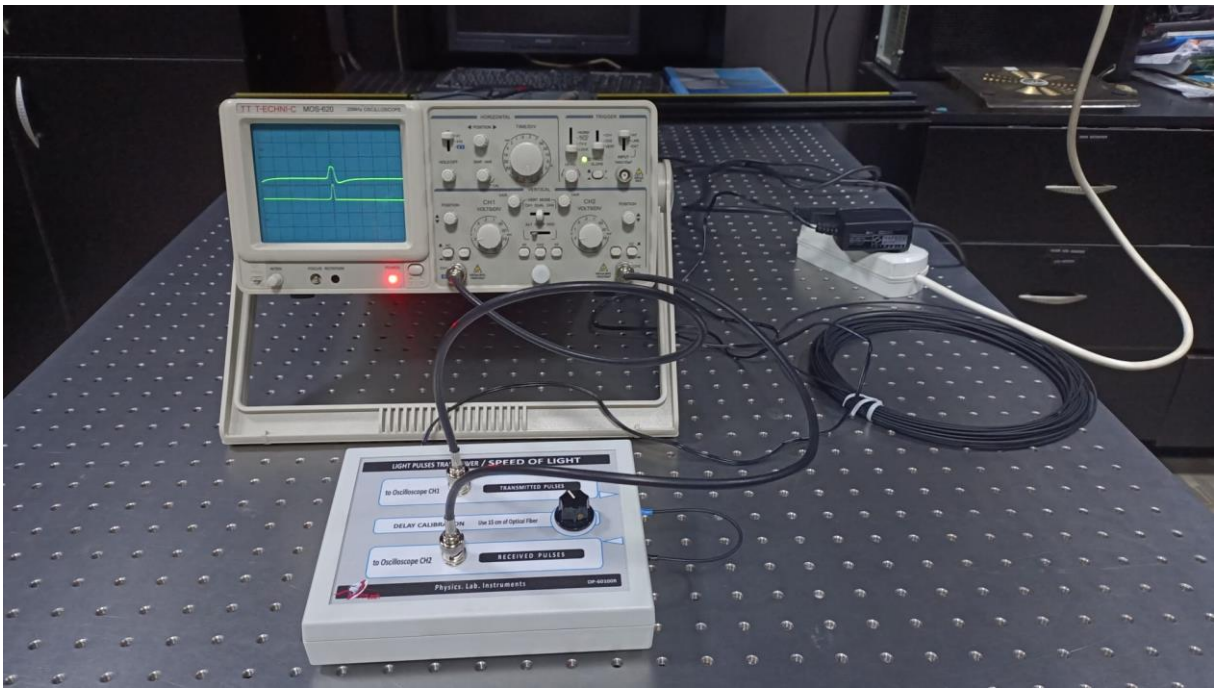
Calibration of the Osciloscope

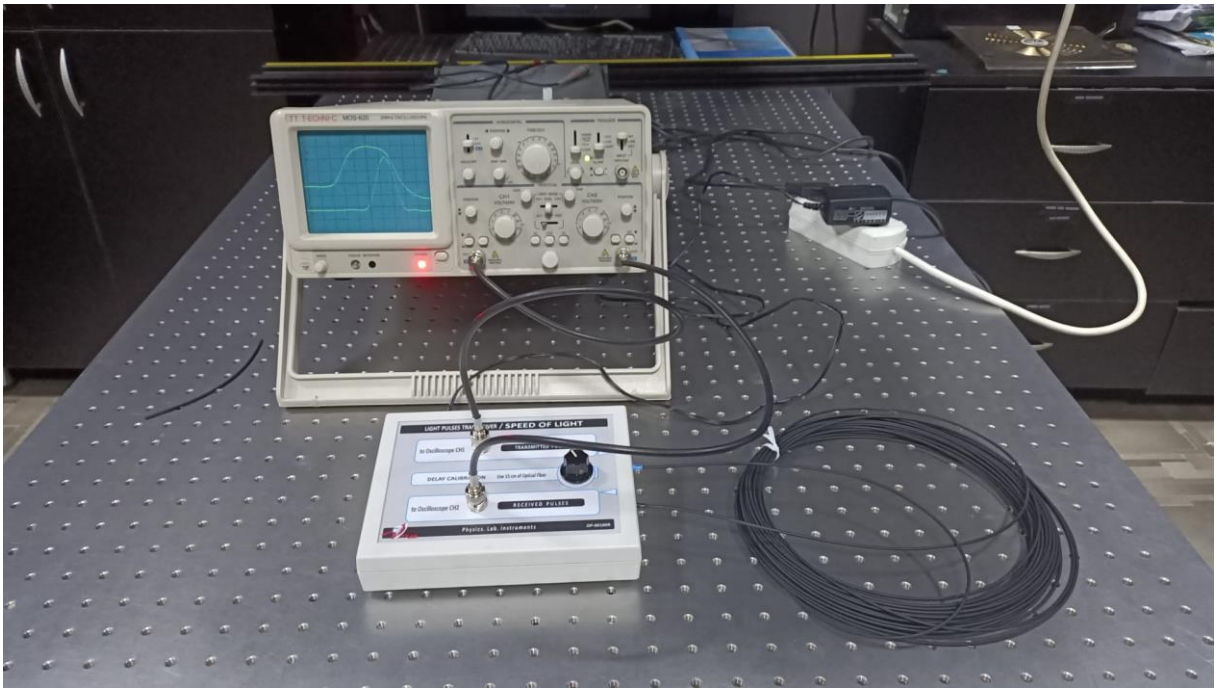
1. Connect the osciloscope and the signal generator using “CH1”.
2. Turn on the osciloscope and the signal generator.
3. Generate the signal with 1kHz frequency.
4. Measure *peak to peak distance* and calculate the frequency of signal.
5. If the frequency is smaller than 1kHz (or bigger than 1kHz), adjust the distance using calibration button on the osciloscope.



Measurement of Speed of Light

1. Connect the osciloscope and light pulses transceiver using “CH1” and “CH2”.
2. Turn on the osciloscope and light pulses transceiver.
3. Firstly connect the fiber cable with 15cm between *transmitted pulses* and *recived pulses*.
4. You will see two signal on the screen.
5. Adjust the peak point of the signals as on the same point, using *delay calibration* button on the light pulses transceiver.
6. After than change the fiber optic cable with 20m.
7. Now the peak positions of the signals changed.
8. Using the distance between the peak positions of two signals, calculate the time difference between transmitted and recived signals.
9. Calculate the speed of light in fiber cable.
10. Calculate the speed of light in air with the help of the refraction law. ($n_{fc}=1.49$)


TTI TECHNI-C MOS-620
SPEED OF LIGHT
to Oscilloscope CH1
TRANSMITTED PULSES
DELAY CALIBRATION
Use 15 cm of Optical Fiber
to Oscilloscope CH2
RECEIVED PULSES
Physics Lab. Instruments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