Fiber Optic Speed of Light Kit

Lab Project

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December 12, 2023

Outline

Purpose and Hypothesis

- Purpose: Examine the relationship between wavelength (λ) and speed of light in a vacuum (c)
- Hypothesis: The speed of light is independent of wavelength

Main Materials

- Speed of Light Apparatus
- Short and long fiber optic cables
- Dual-channel oscilloscope
- Red, green, blue, and infrared LEDs
- Soldering iron and solder sucker

Procedures

1. Polish ends of fiber optic cables
2. Desolder pins connecting LED to the kit
3. Measure short cable length
4. Measure mass of both cables
5. Connect speed of light kit and oscilloscope together
6. Calibrate kit using the short cable
7. Measure time for light to travel through long cable
8. Repeat for different colored LEDs

Equations

Light slows down in the cable

$$c = nv \tag{1}$$

Long cable length can be determined with linear density

$$L = \frac{M}{\mu} = \frac{Ml}{m} \tag{2}$$

Speed is distance traveled divided by time

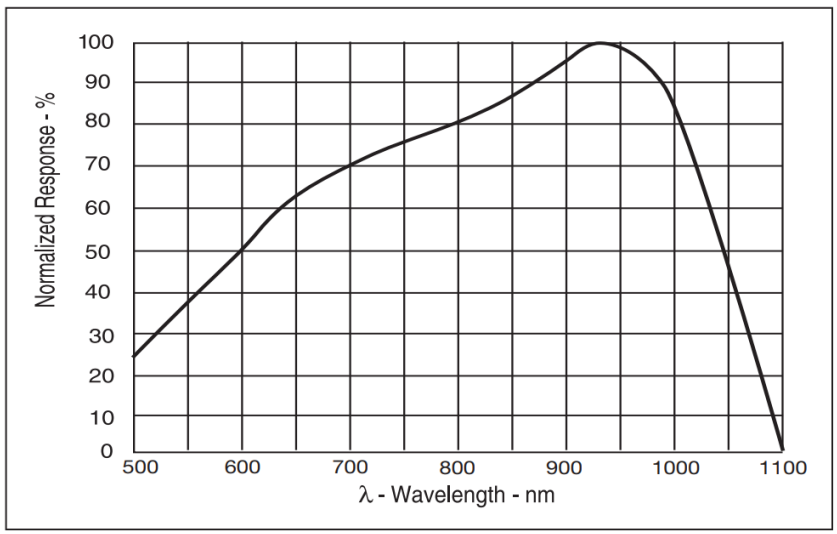
$$v = \frac{L}{t} \tag{3}$$

Combining these equations together

$$c = \frac{nMl}{tm} \tag{4}$$

Results

- Red light worked fine ($c = (2.93 \pm 0.07) \times 10^8$ m/s)
- Blue and green light not detected through short cable (photodetector less sensitive to lower visible wavelengths)
- Infrared light not detected through long cable (dissipating earlier)
- Infrared light not detected clearly through shortened cables (switching time not fast enough)



Conclusions

- Not enough data to support or reject hypothesis
- Speed of Light Kit is a one-trick pony