

THE BEGINNING OF THE MODERN ERA

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Supplementary Material for
PHY 3305 (Modern Physics)

INFORMATION

- Course Website
 - www.physics.smu.edu/sekula/phy3305
- Syllabus
 - Available on the above website
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LAWS OF MOTION

$$\vec{F} = m \vec{a} = m \frac{d^2 \vec{x}}{d^2 t} = \frac{d \vec{p}}{dt}$$

$$\vec{p} = m \vec{u}$$

$$\sum \vec{p}_{initial} = \sum \vec{p}_{final} \text{ when } \vec{F} = 0$$

LAWS OF MOTION

$$\sum E_{initial} = \sum E_{final}$$

$$W = \int \vec{F} \cdot d\vec{x} = \int m \vec{u} \cdot d\vec{u} = C + \frac{1}{2} m u^2$$

ELECTRICITY AND MAGNETISM

$$\oiint_{\partial V} \vec{E} \cdot d\vec{A} = Q(V) / \epsilon_0$$

Gauss's Law: charge and electric field

$$\oiint_{\partial V} \vec{B} \cdot d\vec{A} = 0$$

Gauss's Law: no magnetic charge

$$\oint_{\partial A} \vec{E} \cdot d\vec{l} = \frac{-\partial \Phi_{B,S}}{\partial t}$$

Faraday's Law: time-changing magnetic fields induce electric fields

$$\oint_{\partial A} \vec{B} \cdot d\vec{l} = \mu_0 I_S + \mu_0 \epsilon_0 \frac{\partial \Phi_{E,S}}{\partial t}$$

Ampere's Law: magnetic fields can be generated by electric current or time-changing electric fields

LIGHT

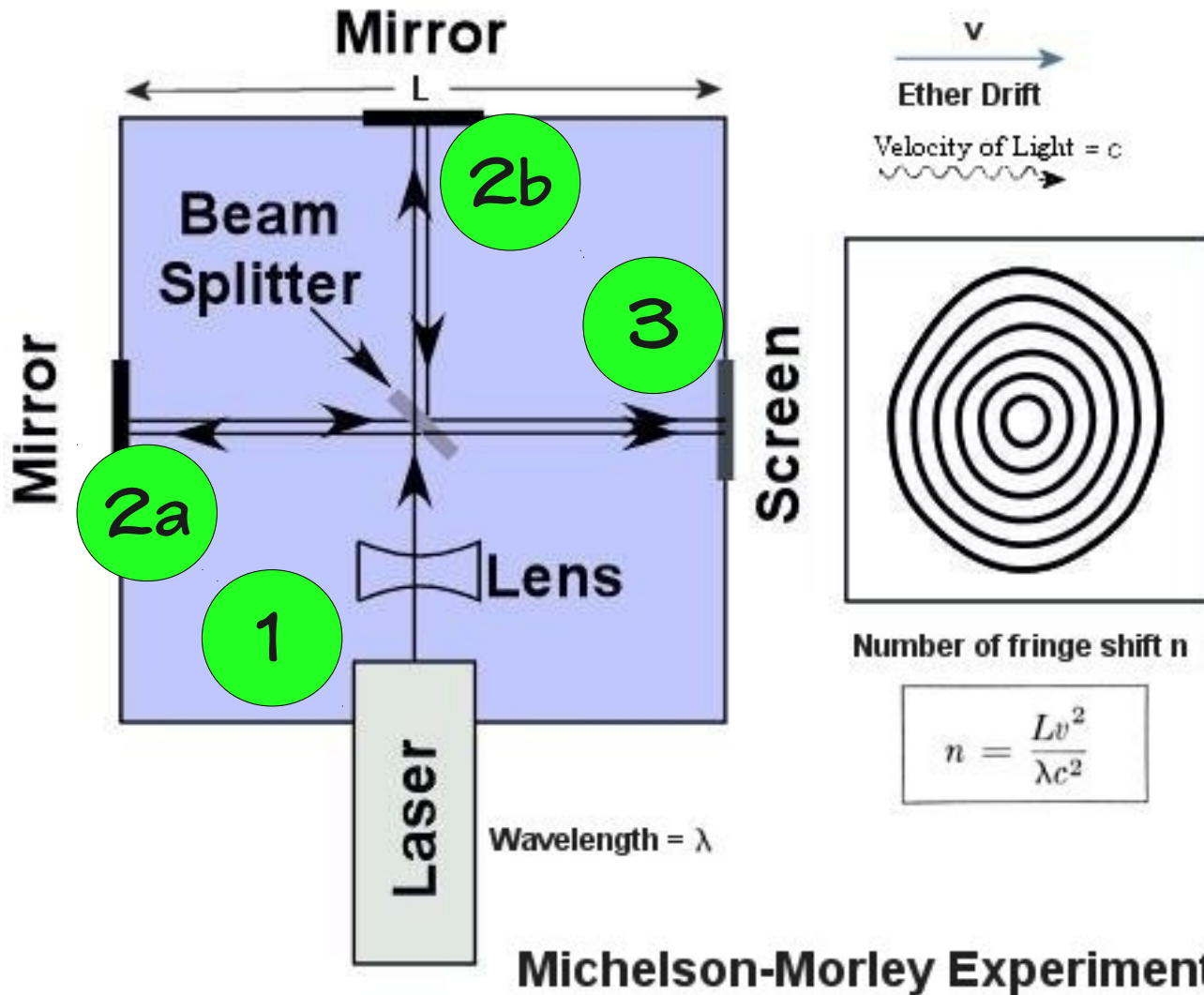
Electro-magnetic waves propagate in vacuum at a speed (c) given by:

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}} = 2.998 \times 10^8 \text{ m/s}$$

Maxwell noted the speed was the same as the measured speed of light in 1865.

Hertz experimentally confirmed light was electro-magnetism in 1887.

MICHELSON-MORLEY EXPERIMENT



Given the speed of the earth around the sun, a 4% shift in wavelength was expected.

$$n = \frac{Lv^2}{\lambda c^2}$$

Michelson-Morley Experiment

GRAVITATIONAL WAVES AND M&M



LIGO Site: Louisiana



LIGO Site: Washington

Modern versions of the Michelson-Morley experiment are designed to look for minuscule changes in space and time due to gravitational waves

THE COSMOS NEEDS CONDUCTORS



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THE BIG DIPPER

