

PHY115

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Digipen

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Light

Introduction

Electric Field

Magnetic Field

Electromagnetic Radiation

Introduction

What is light?

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What is light?

Light is Electromagnetic radiation

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- ▶ Changing Magnetic Field \rightarrow Changing Electric Field

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Electromagnetic Wave: Wave of Electric and Magnetic Field

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Electromagnetic Wave: Wave of Electric and Magnetic Field

Changing Electric Field \rightarrow Changing Magnetic Field \rightarrow Changing Electric Field

The light is an electromagnetic wave that can propagate through space.

Introduction

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- ▶ what is an Electric Field?

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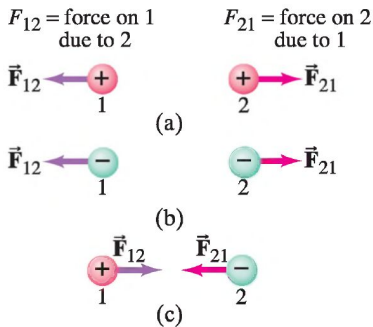
- ▶ what is an Electric Field?
- ▶ what is a Magnetic Field?

Electric Field

Force between two point charged particles:

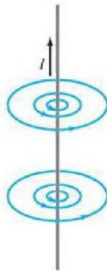
Electric Field

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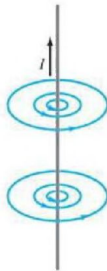
Magnetic Field

Sources of Magnetic Fields: Ampere's Law



Magnetic Field

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The magnetic field generated by a straight wire is circular

Example: Magnet



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Iron - Cobalt - Nickel

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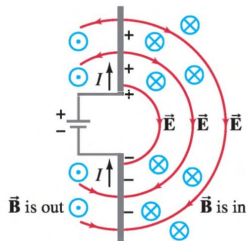
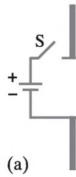
A changing magnetic field generates a changing electric field that generates a changing magnetic field.

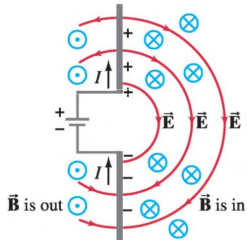
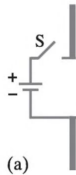
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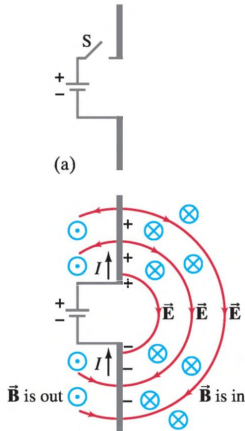
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→ **Wave traveling in the space**

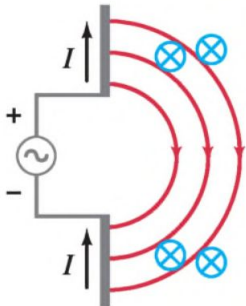


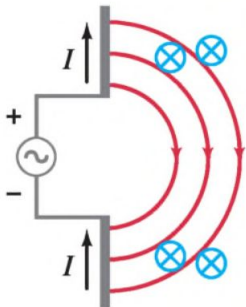


- We connect two rod to a battery → Electric Field

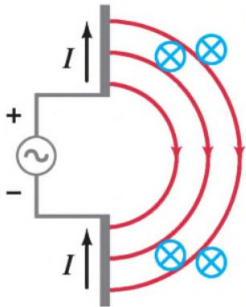


- ▶ We connect two rod to a battery \rightarrow Electric Field
- ▶ The charge is re-distributed \rightarrow Magnetic field

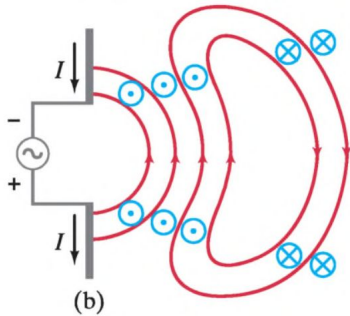


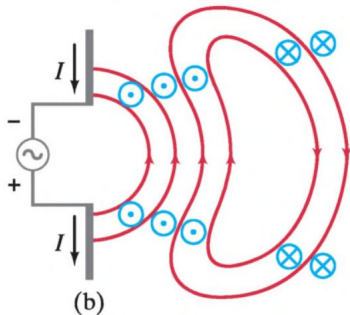


► sinusoidal voltage \rightarrow Alternating Current

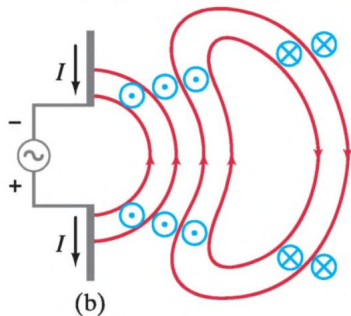


- ▶ sinusoidal voltage \rightarrow Alternating Current
- ▶ \rightarrow variable Electric and Magnetic Fields.

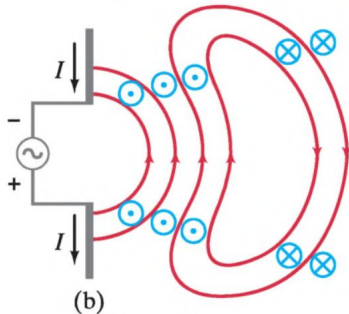




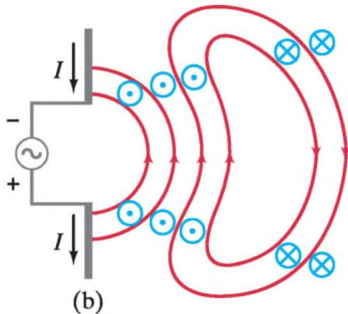
- Old Field lines fold back to connect to some of the new lines \rightarrow closed loops



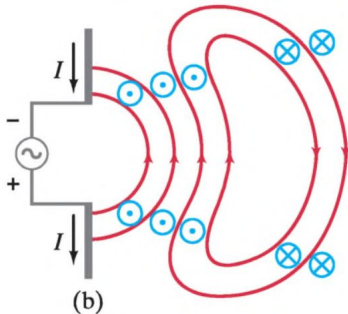
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- ▶ They are on their way to distant points.

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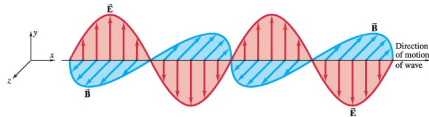
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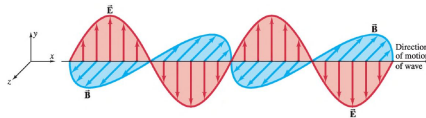
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Electromagnetic Waves



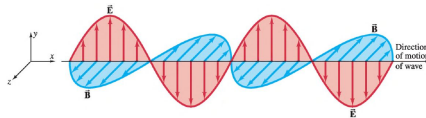
► Transverse wave

Electromagnetic Waves



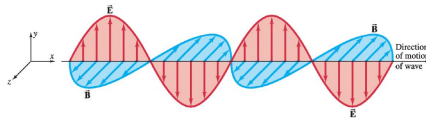
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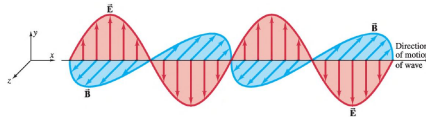
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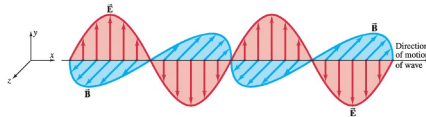
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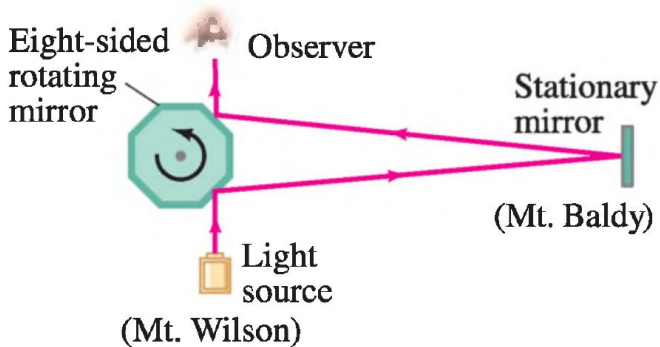
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Accelerated electric charges give rise to electromagnetic waves

Measuring the speed of light

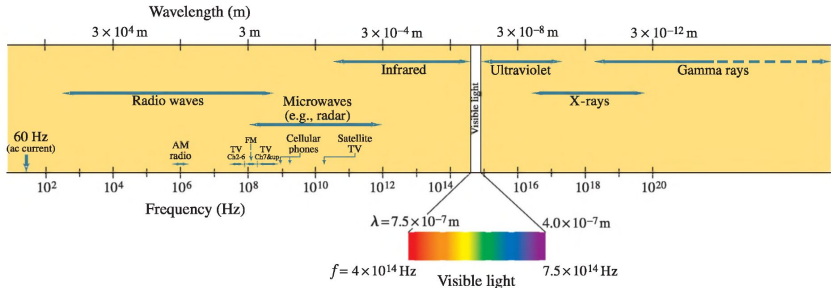
Michelson's Experiment



Electromagnetic spectrum

The frequency of light is related with its speed through the expression,

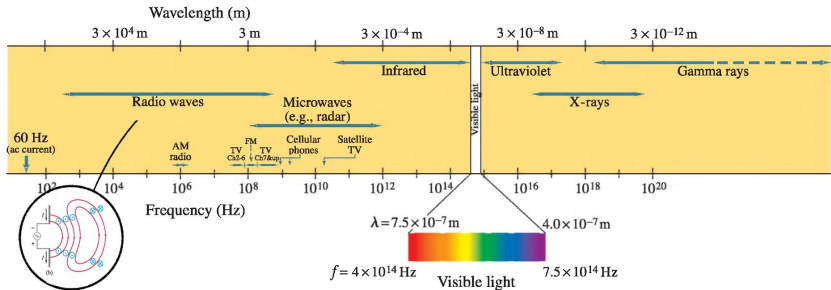
$$c = f\lambda$$



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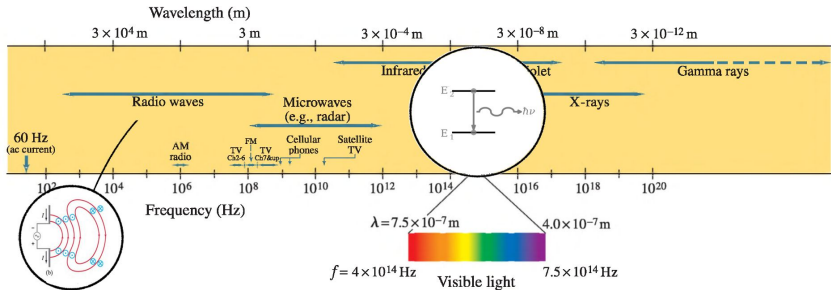
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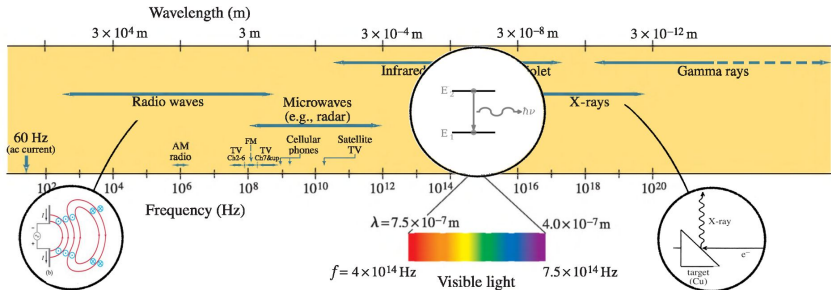
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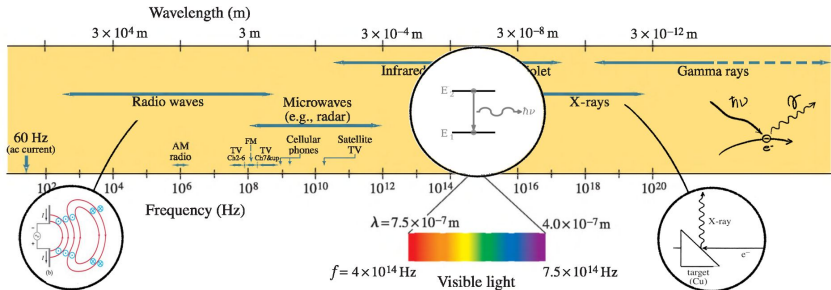
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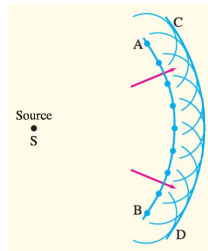
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Huygens' principle

Every point on a wave front can be considered as a source of tiny wavelets that spread out in the forward direction at the speed of the wave itself. The new wave front is the envelope of all the wavelets—that is, the tangent to all of them.



Diffraction

What happens when waves impinge on an obstacle?

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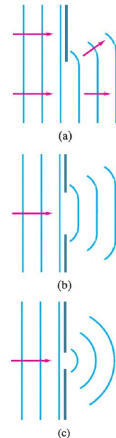
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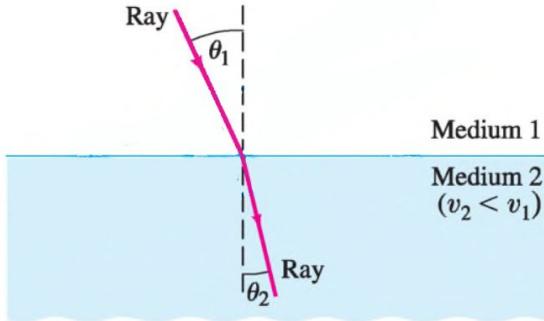


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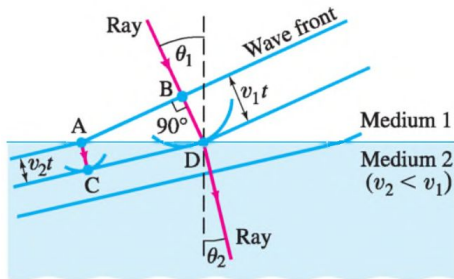


Refraction

We are going to use the Huygens' principle to explain this...

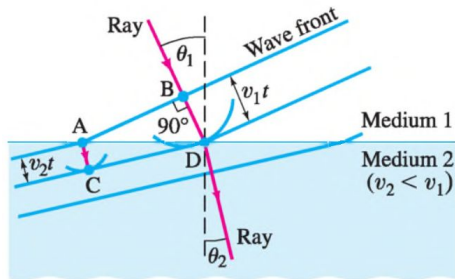
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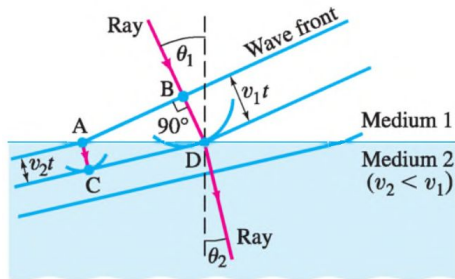
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where,

$$n = \frac{c}{v} \quad (1)$$

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is the **refraction index**.

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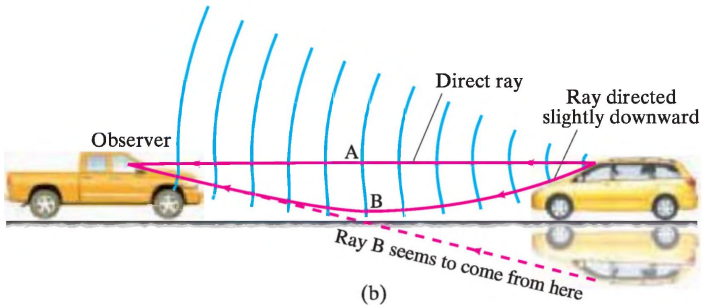
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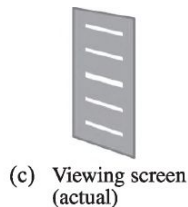
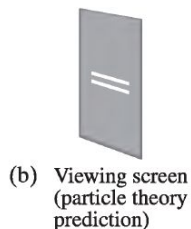
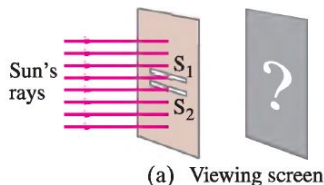
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Refraction

Example: Mirages



Interference: Young's double-slit Experiment



If light consists of tiny particles, we might expect to see two bright lines on a screen placed behind the slits as in (b). But instead a series of bright lines are seen, as in (c). Young was able to explain this result as a wave-interference phenomenon.

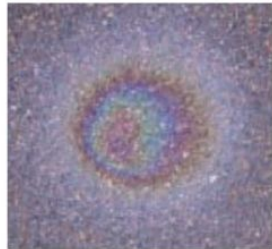
Interference in Thin Films



(a)



(b)



(c)

Colors in a Thin Soap Film

