Why Photonics?   —   Human Vision

↓

Science of
Light

Imaging

Optical Communications

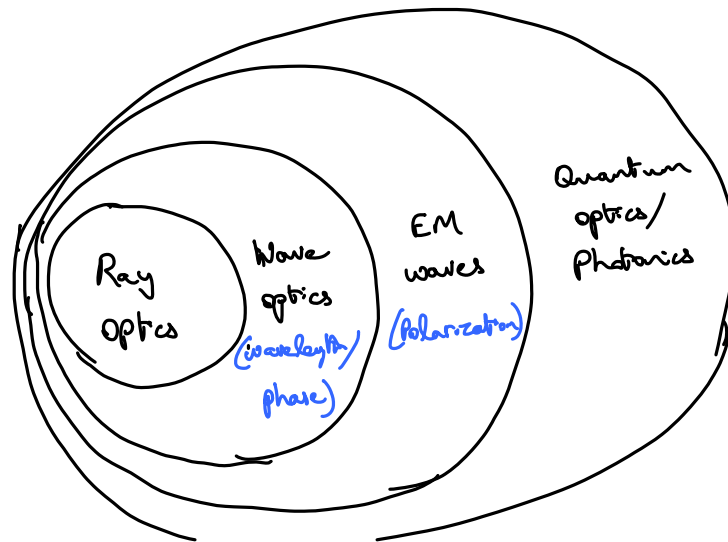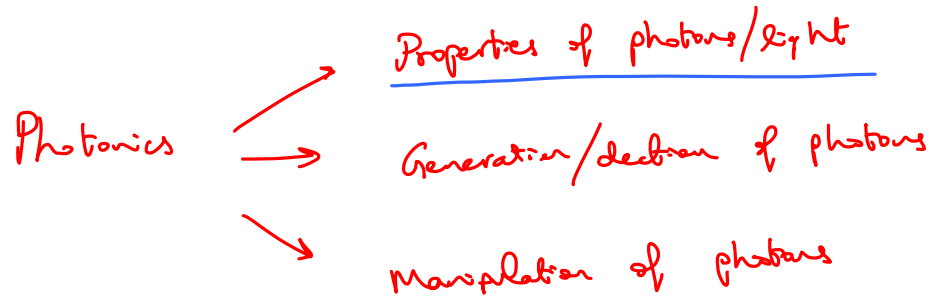Material processing

Augmented Reality

Gesture Recognition

Quantum Computing

}   →

Properties of light

Generation/Detection
of light

Manipulation of
light

— Wavelength

— Amplitude/Intensity

— Phase

— Polarization

Photonics →
- Properties of photons/light
- Generation/detection of photons
- Manipulation of photons

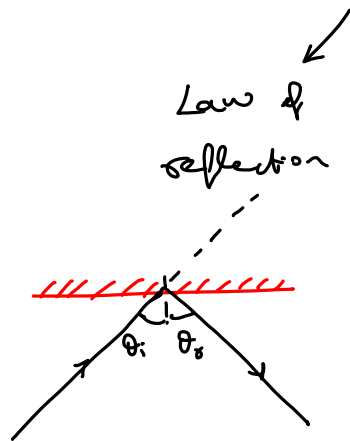Fermat, 1600s → light travels in straight lines

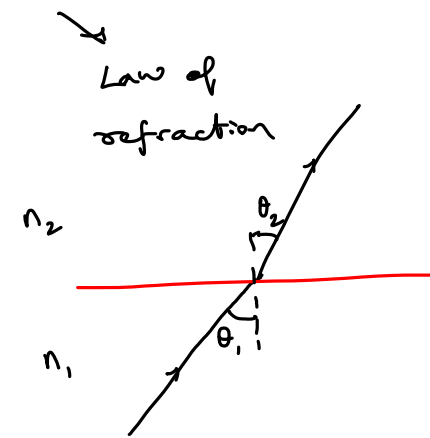Huygens, mid → light travels as waves
-1600s

Maxwell, mid → light travels as EM waves
-1800s

Planck, 1885 → light emission/absorption is quantized

Einstein, 1915 → light comprises of quanta of energy (photons)

Ray Optics
Wave optics (wavelength/phase)
EM waves (Polarization)
Quantum optics/Photonics

Endoscopy $\longrightarrow$ optical probe

Law of reflection

Law of refraction

n_2

θ_2

n_1

θ_1

θ_i θ_r

$$\boxed{\theta_r = \theta_i}$$

Snell's law

$$\boxed{n_1 \sin\theta_1 = n_2 \sin\theta_2}$$

$n_1 > n_2 \implies \theta_2 > \theta_1$

$\theta_1 = \theta_c \longrightarrow \theta_2 = \pi/2$

$n_1 \sin\theta_c = n_2 \sin\left(\frac{\pi}{2}\right)$

$\qquad\qquad = n_2$

$$\boxed{\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)}$$

If $\theta_1 > \theta_c \longrightarrow$ Total Internal Reflection

n_2

n_1

$\theta_1 > \theta_c$ θ_1

n_2