Lecture 35: Wave optics
• In vacuum, electromagnetic waves travel with speed of light $c = 3 \times 10^8 \text{m/s}$

• In materials, light slows down because the electromagnetic waves interact with electrons in the material

- $n = \frac{\text{speed of light in vacuum}}{\text{speed of light in material}} = \frac{c}{v}$  
  Refractive index

- $v \leq c \rightarrow n \geq 1$

- $n_{\text{air}} \approx 1$
Wavelength and frequency

- \( n = \frac{c}{v} \) **Refractive index**, \( n \geq 1 \)
- The frequency \( f \) a wave does not change as it moves from one medium to another
- Because \( n \) changes, this means that the wave length must change
- \( \lambda f = v \)

- \( \lambda_{mat} = \frac{v}{f} = \frac{c}{nf} = \frac{\lambda_{vac}}{n} \)
- Wavelength in material is shorter than the wavelength in vacuum