

# Lecture 35: Wave optics

# Refractive index

- In vacuum, electromagnetic waves travel with speed of light  $c = 3 \times 10^8 m/s$
- 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**
- $v \leq c \rightarrow n \geq 1$
- $n_{air} \approx 1$

# 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