PHY385-H1F Introductory Optics
Class 14 – Outline: Section 7.1 + a look ahead at Section 13.1

- Depth of Field
- Resolution
- Principle of Superposition
- Standing waves in 1D and 2D
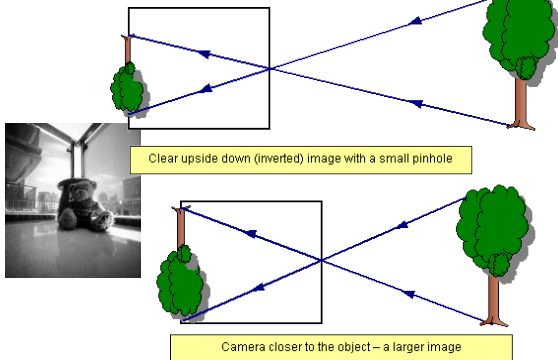- Blackbody Radiation
- Stefan-Boltzmann Law

Depth of Field

- **"depth of field (DOF)"** is the distance between the nearest and farthest objects in a scene that appear acceptably sharp in an image. Although a lens can precisely focus at only one distance at a time" … "within the DOF, the unsharpness is imperceptible under normal viewing conditions."
  - -http://en.wikipedia.org/wiki/Depth_of_field

Pinhole Camera

A pinhole camera has an infinite depth of field.

Clear upside down (inverted) image with a small pinhole
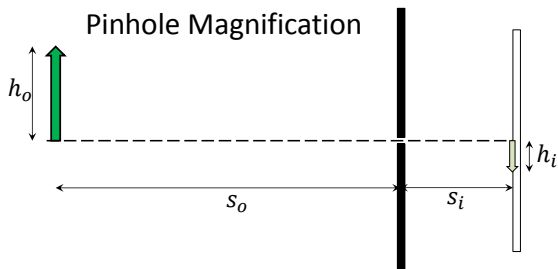
Camera closer to the object – a larger image

Lens Magnification
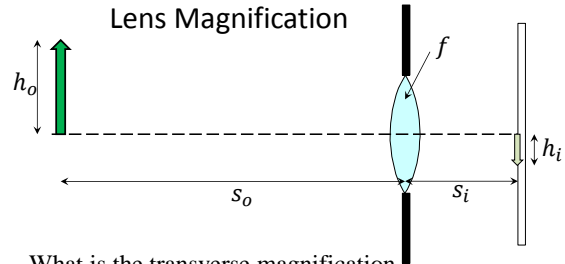
What is the transverse magnification of the image $M_T = h_i/h_o$?

1. $-f/s_i$
2. $-1/f$
3. $-(s_i + s_o)/f$
4. $-s_o/s_i$
5. $-s_i/s_o$
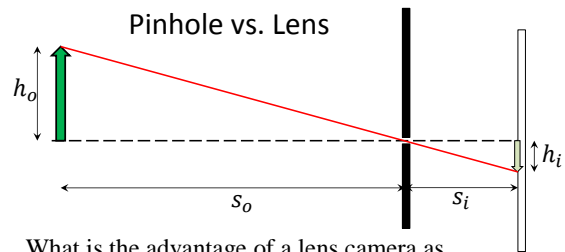
Pinhole Magnification

What is the transverse magnification of the image $M_T = h_i/h_o$?

1. $-s_o/s_i$
2. $-s_i/s_o$

Pinhole vs. Lens

What is the advantage of a lens camera as opposed to a pinhole camera?

1. Sharper focus
2. Greater depth of field
3. Greater magnification
4. Brighter image

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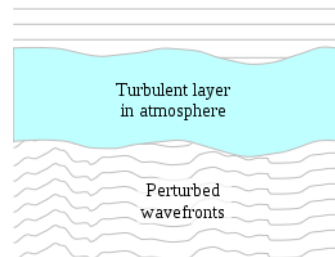Camera closer to the object – a larger image
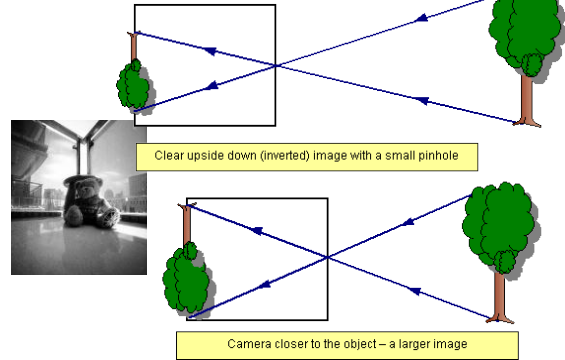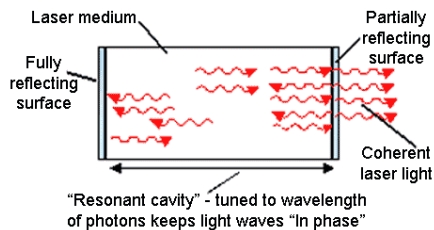
Test on Tuesday Nov. 6

- The 50 minute test on Tuesday, Nov. 6 will contain 6 multiple choice questions, and 3 long-answer questions
- This test will cover all of Hecht Chapter 5, plus the sub-sections we covered in Chapter 7 and Chapter 13.
- As with test 1, the allowed aids include your calculator and a single 8.5x11" aid sheet, double-sided.
- Also don't forget – problem set 4 is due on Thursday (2 days from now!)

Astronomical Seeing

Plane waves from distant point source

Turbulent layer in atmosphere

Perturbed wavefronts

Laser Resonant Cavity

Laser medium

Partially reflecting surface

Fully reflecting surface

Coherent laser light

"Resonant cavity" - tuned to wavelength of photons keeps light waves "in phase"

Kirchhoff's Thermal Radiation Analysis 1859

- ε_λ = emission coefficient
- ε_λ = the energy per unit area per unit time emitted in a tiny wavelength range around λ
- Units of ε_λ are [W / m^2 nm]
- α_λ = absorption coefficient
- α_λ = the fraction of the incident irradiance absorbed per unit area per unit time in that wavelength range
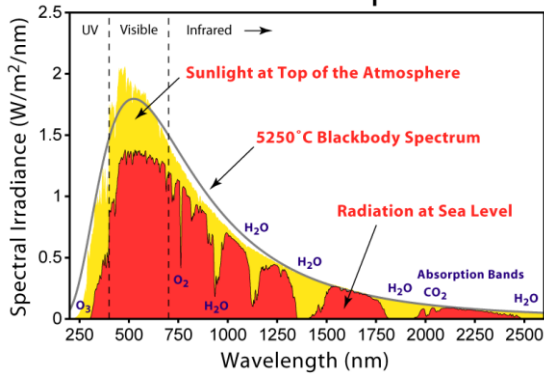- α_λ is dimensionless

Absorption Coefficient

- What are the absorption coefficients α_λ for a perfect mirror and a perfectly white piece of paper?
1. 1 for the mirror, 1 for the paper
2. 0 for the mirror, 1 for the paper
3. 1 for the mirror, 0 for the paper
4. 0 for the mirror, 0 for the paper

Blackbody Radiation

$$I_\lambda = \frac{2\pi hc^2}{\lambda^5}\left[\frac{1}{e^{hc/\lambda kT}-1}\right]$$
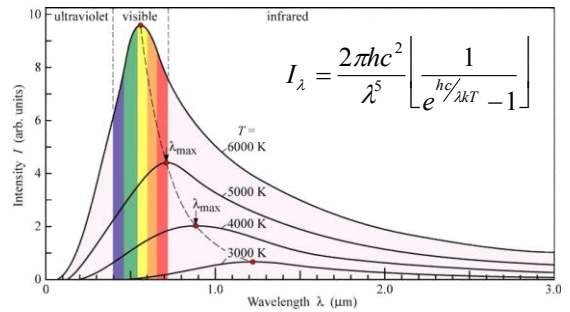
Solar Radiation Spectrum

Blackbody Radiation

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