ASTR 1040 Recitation: Light and Spectra

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Announcements

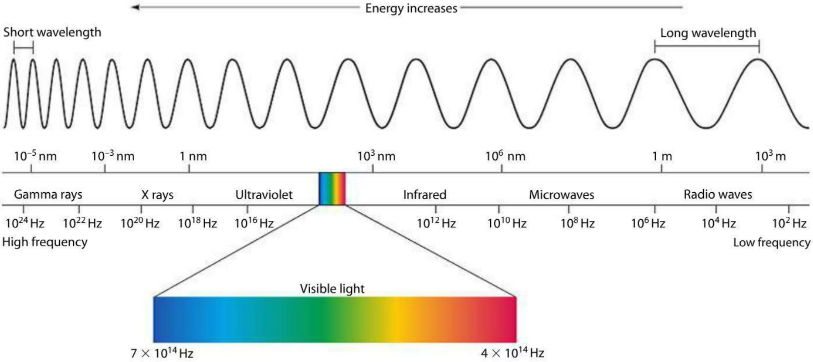
- Last Day to Drop without tuition/fee charges and a W grade: Jan 30
- Next Observing: Thurs, Feb 7 (8pm or 9pm at SBO)
- My Office hours changed: Tu 2-4pm

Parallax

Traditional Angular Velocity

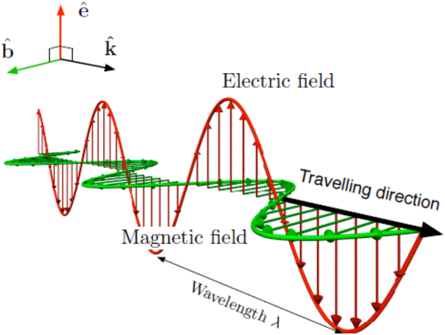
Still Angular Velocity

Electro-magnetic Spectrum



$$c = \lambda\nu$$

Electro-magnetic Radiation



- Charged particles generate E fields
- Charged particles in motion generate B fields
- Time-varying E fields generate B fields
- Time-varying B fields generate E fields

Blackbody Radiation

- Objects that contain heat, radiate energy

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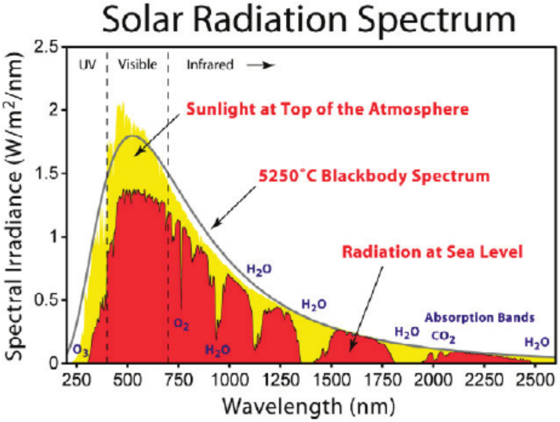
- Perfect blackbody: energy absorbed = energy emitted
- Emits energy at all wavelengths
- How much energy is described by a single temperature

Blackbody Radiation

Solar Spectrum



$$\lambda_{\max} T = 2.90 \times 10^6 \text{ nm K}$$

Wave/Particle Nature of Light

- Requires quantization of energy, massless photons
- $E_{\text{photon}} = h\nu = hc/\lambda \qquad h = 6.626 \times 10^{-34}$ J s

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    - $E^2 = m^2c^4 + p^2c^2$
    - $E = cp \qquad \Rightarrow \qquad$ de Broglie wavelength $p = h/\lambda$

Practice Problem: proton-electron binary system

An electron orbits a proton in a circular orbit.

1. What is the radius of an electron in the n^{th} orbit? r_n
2. What is the Energy of the n^{th} level? E_n
3. What is the wavelength of the $n_0 \to n$ transition?

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- Electro-statics: $F = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}$

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- Quantized Angular Momentum: $L = \mu r v = n\hbar$
- Energy: $E = U + K,\qquad U = -\frac{1}{4\pi\epsilon_0}\frac{e^2}{r},\qquad K?$

Practice Problem: proton-electron binary system

1. $r_n = \frac{4\pi\epsilon_0\hbar^2}{\mu e^2} n^2$
2. $E_n = -\frac{1}{8\pi\epsilon_0}\frac{e^2}{r_n} = -\frac{\mu e^4}{32\pi^2\epsilon_0^2\hbar^2}\frac{1}{n^2}$
3. $\lambda_{n_0 \to n} = \left[\frac{\mu e^4}{64\pi^3\epsilon_0^2\hbar^3 c}\left(\frac{1}{n^2} - \frac{1}{n_0^2}\right)\right]^{-1}$