Information in Light

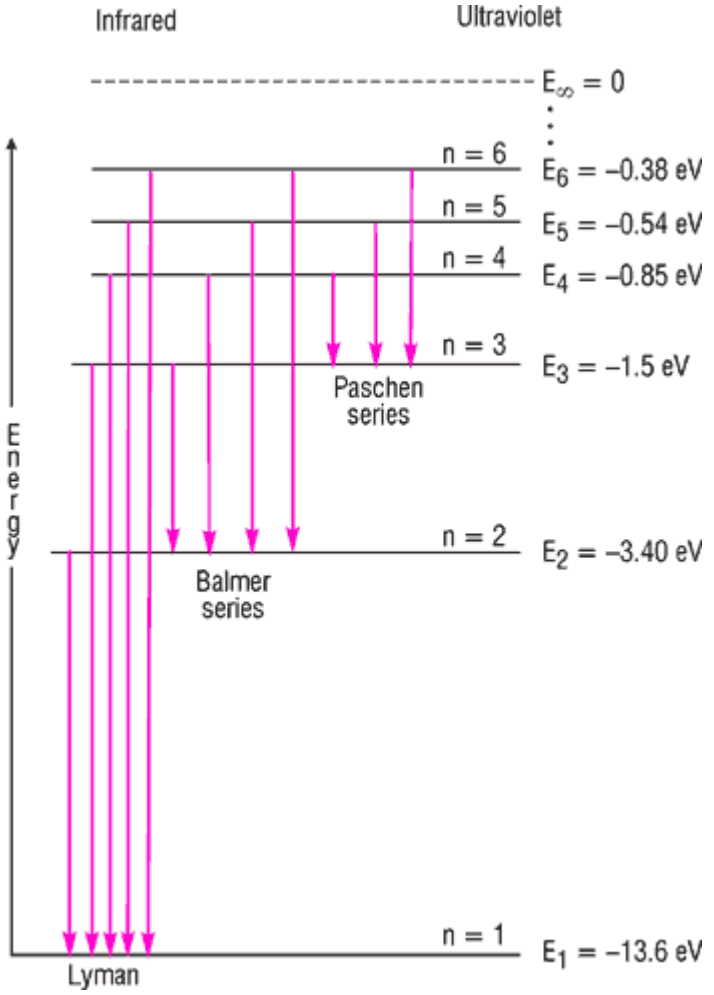
10/12/2009

Opening Discussion

- Have you seen anything interesting in the news?
- What did we talk about last class?
- Report from DPS.

Atoms and Energy

- Electrons can only exist at specific energies in atoms. This is called quantization.
- Electrons jump from one energy level to another. Can't exist in between. Absorb or emit exactly the energy needed to move between levels.

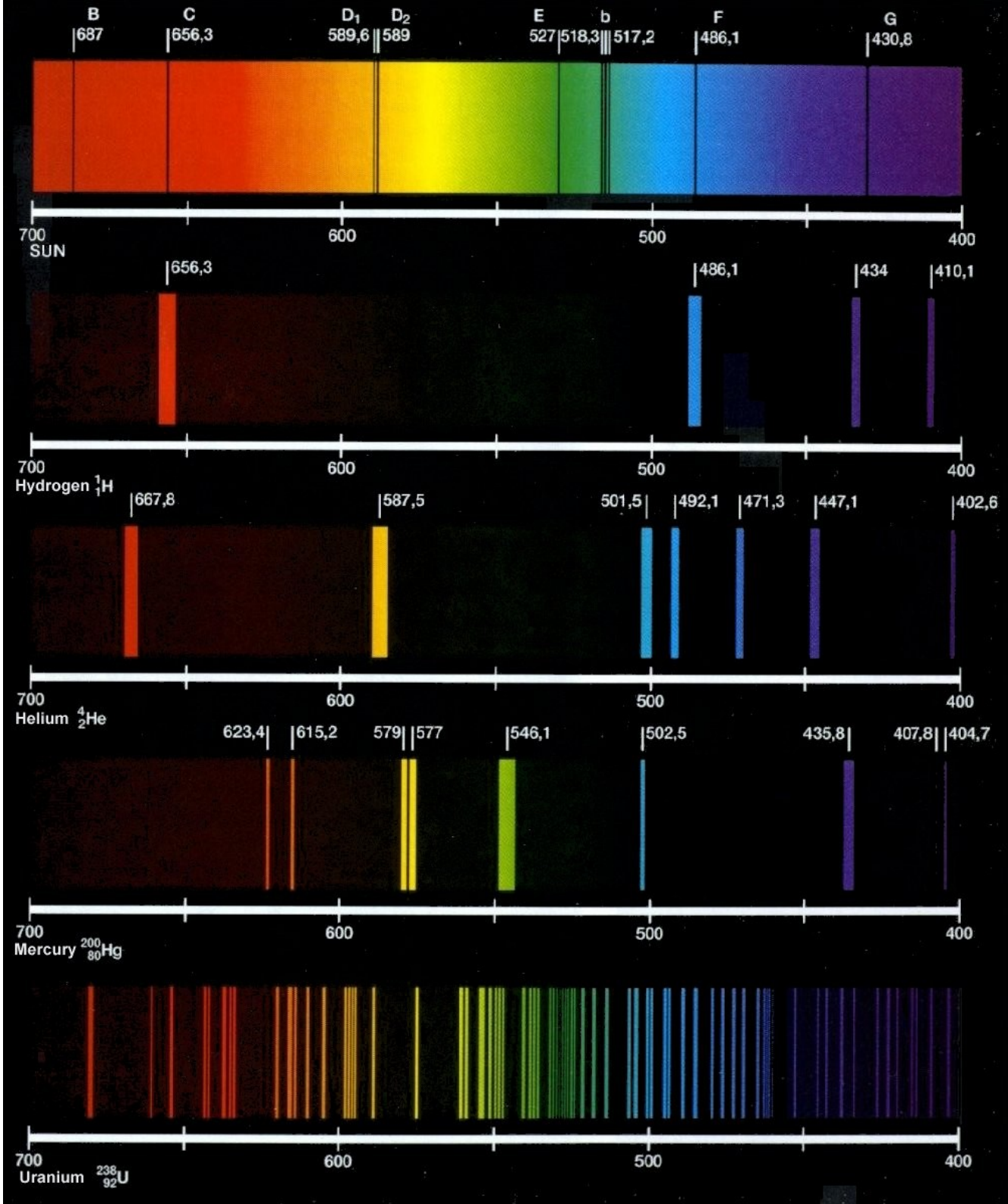


Spectroscopy and Types of Spectra

- The practice of breaking apart the light from an object into the spectra and analyzing that is called spectroscopy.
- There are different types of spectra.
  - Continuous spectra have broad emissions over a range of wavelengths.
  - Emission line spectra have light only at certain discrete wavelengths.
  - Absorption line spectra have a continuous spectra with discrete lines taken out at certain wavelengths.

Line Spectra

- This figure shows the continuous spectra of the Sun with line absorption features.
- It also has line emissions from a few different elements.



Thermal Radiation

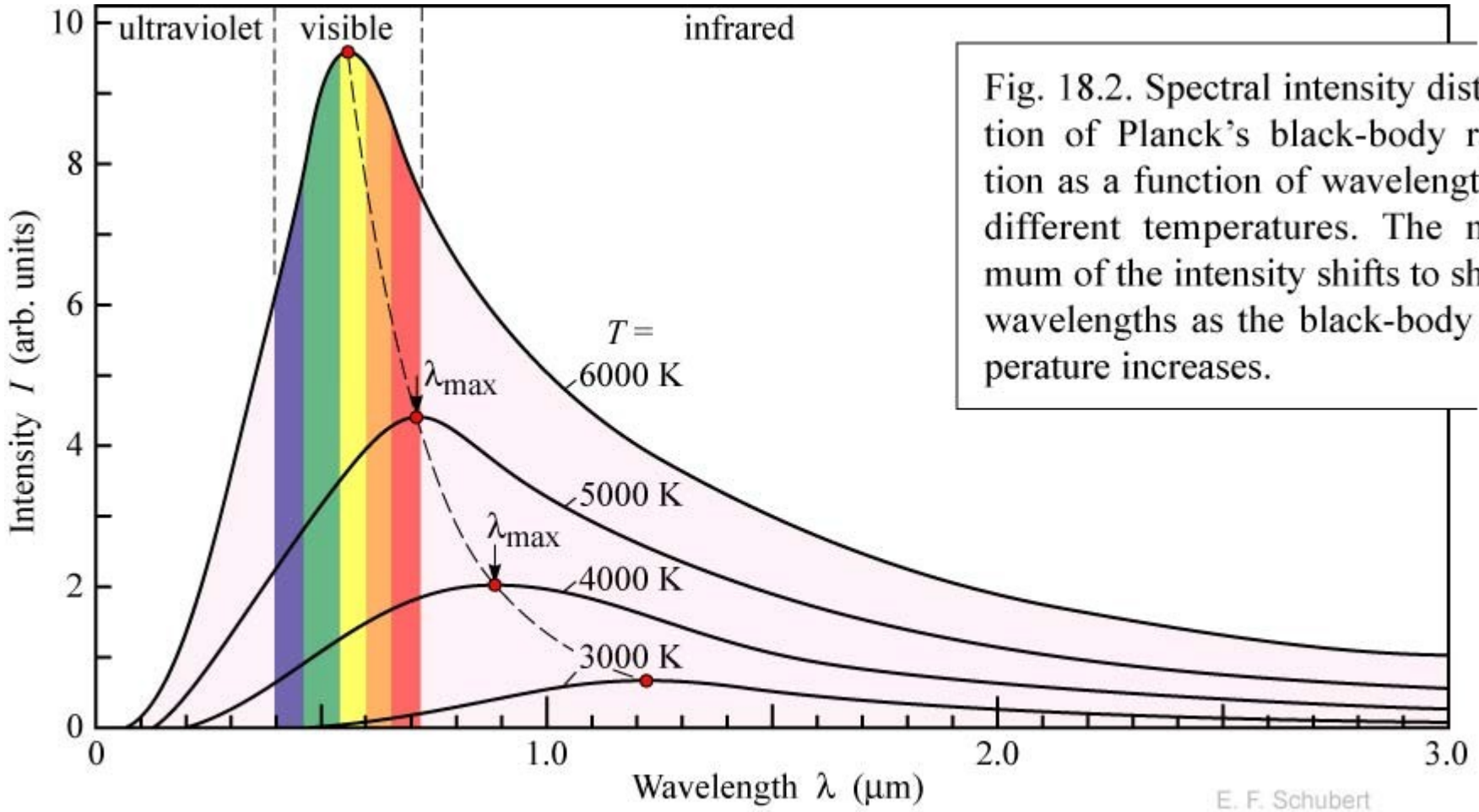


Fig. 18.2. Spectral intensity distribution of Planck's black-body radiation as a function of wavelength for different temperatures. The maximum of the intensity shifts to shorter wavelengths as the black-body temperature increases.

Information in Thermal Spectrum

- The thermal spectrum, often called blackbody emission, contains information about the temperature of a body.
- Stefan-Boltzmann law on total emitted power:

$$emittedPower = \sigma T^4$$

$$\sigma = 5.7 \times 10^{-8} watts/(m^2 \times Kelvin^4)$$

- Wein's law on wavelength of maximum emission

$$\lambda_{max} \approx \frac{2{,}900{,}000}{T[Kelvin]}[nm]$$

Doppler Shift

- Motion of objects leads to Doppler shifting of the spectra.
- When objects move toward you the wavelength is shortened (blue shifted).
- When objects move away from you the wavelength is lengthened (red shifted).

$$\frac{v_{rad}}{c} = \frac{\lambda_{shift} - \lambda_{rest}}{\lambda_{rest}}$$

Minute Essay

- What questions do you have about light?
- Quiz #4 is at the beginning of next class.