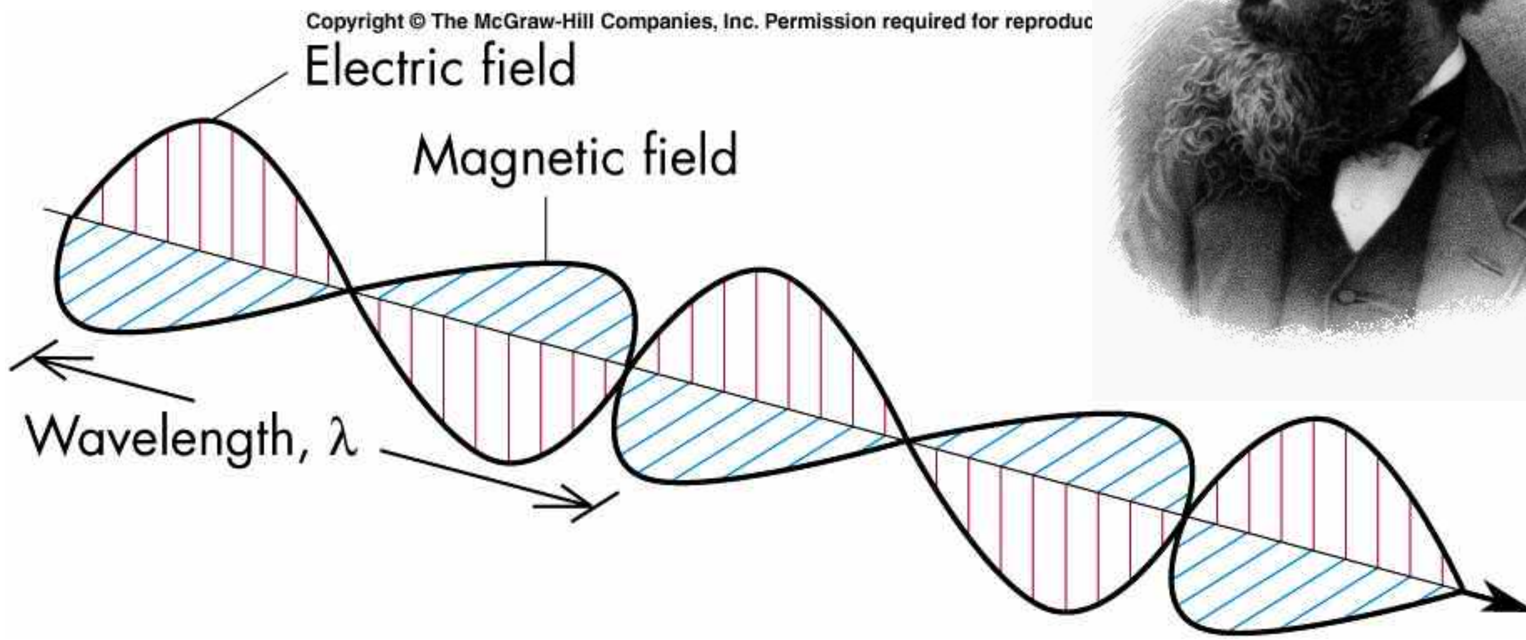
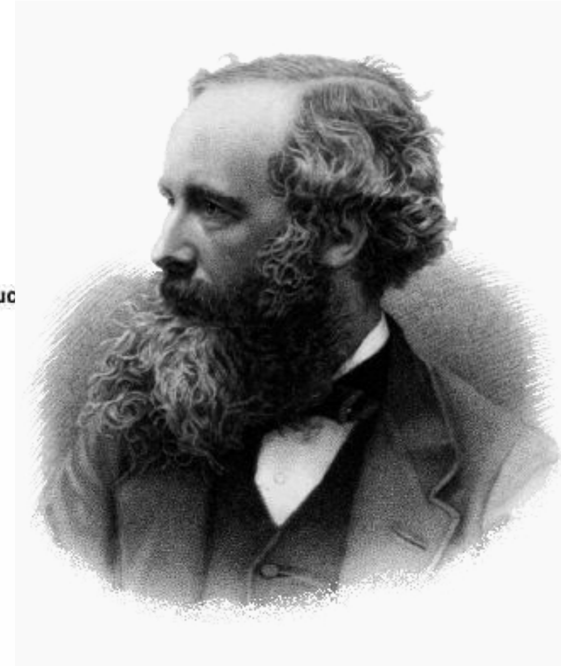
Light is the only information we get from most astronomical objects. To understand these objects, we need to understand the physics of light and how it is produced.

First result: light is a wave (electromagnetic wave)

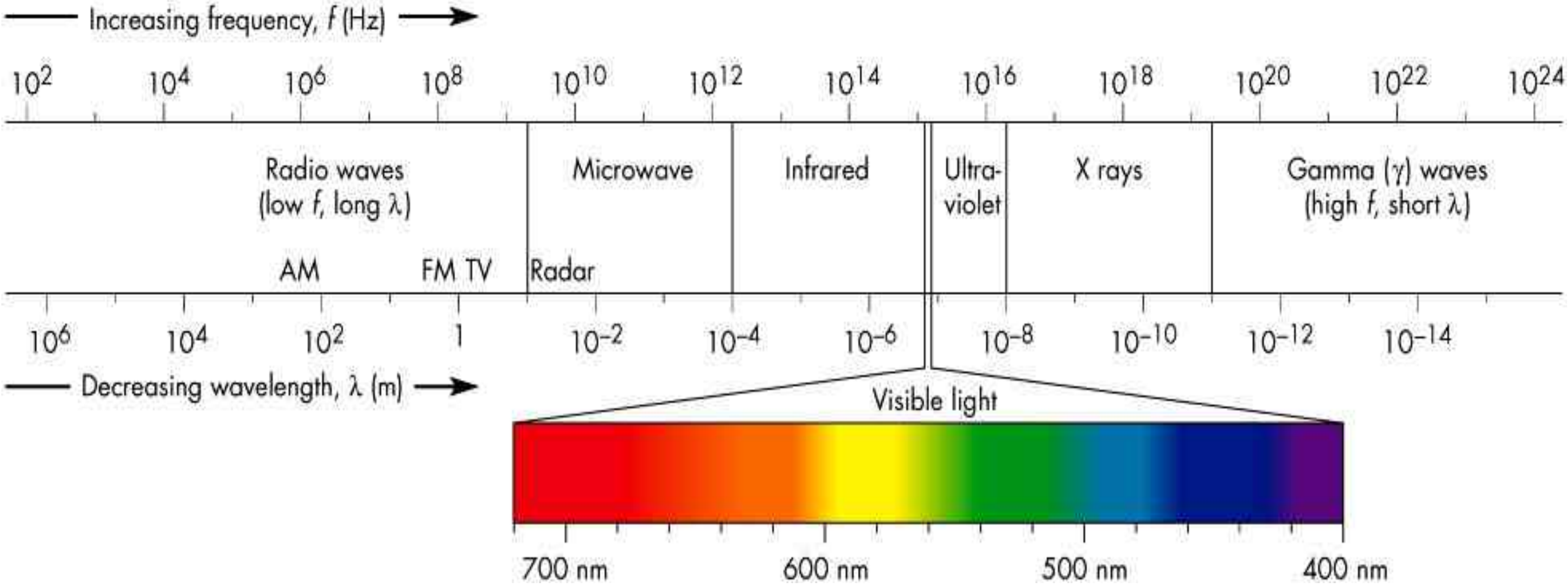




Wave characterized by wavelength, amplitude

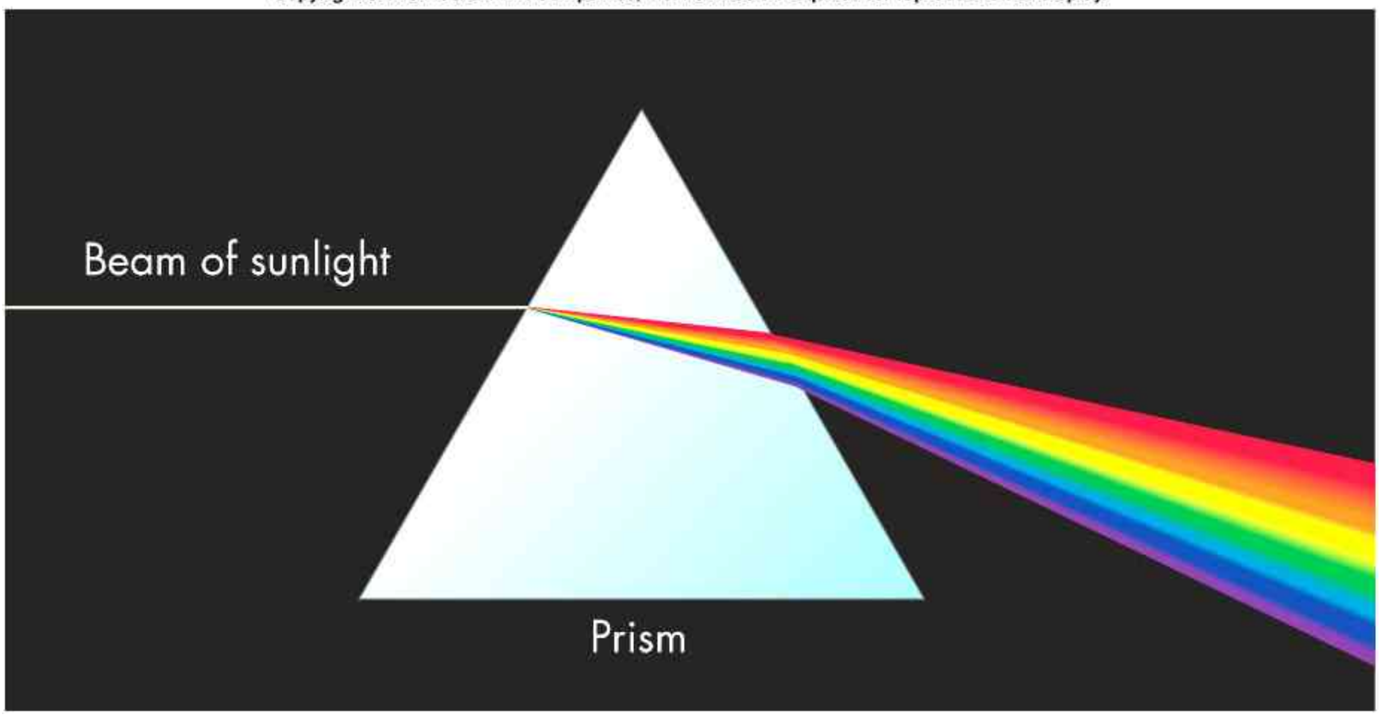
DEMO

Amazing fact of nature: wide range of wavelengths of electromagnetic waves



EM radiation includes gamma rays, x-rays, ultraviolet, Light, infrared, microwave, radio

Concept from physics crucial for astronomy: the spectrum of light



Will do in lab this week (or soon); DEMO

Spectra (plural of spectrum)

The solar spectrum

- A fundamental measurement to extract more information from starlight
- Spread out light according to wavelength

The Solar Spectrum as an astronomer would study it

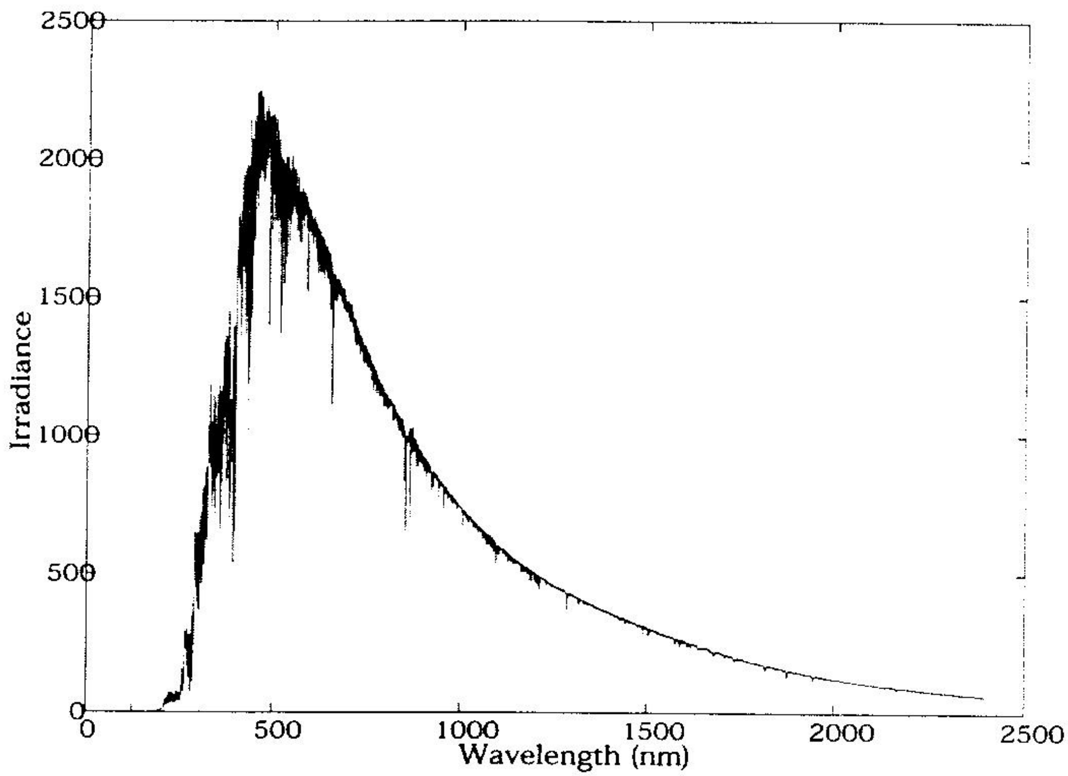
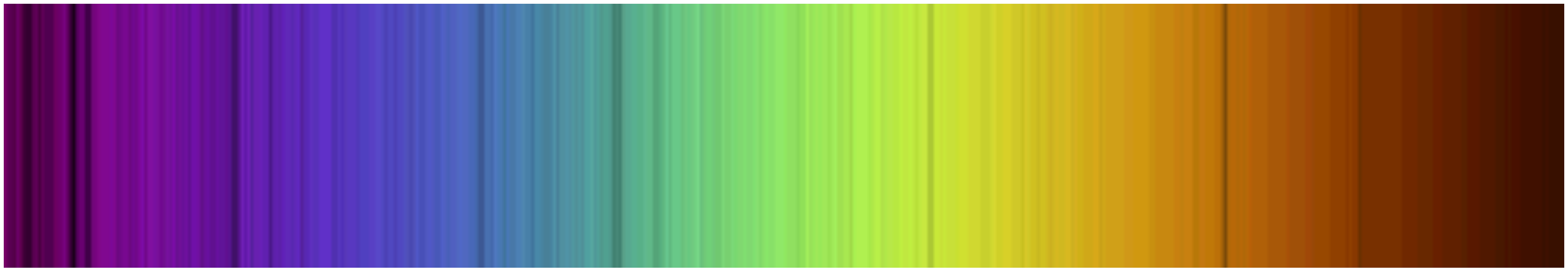


Fig. 3-1 The spectral distribution of solar irradiance measured above the Earth's atmosphere, in units of mW/sq.meter/nanometer. Kindly provided by G. Thuillier (see G. Thuillier et al., "Sun Irradiance Spectra" in *"Solar Variability and Its Effect on Climate"*, J. Pap et al., Eds., AGU Monograph Series (2003).

What do the spectra of the Sun and stars tell us about those objects?



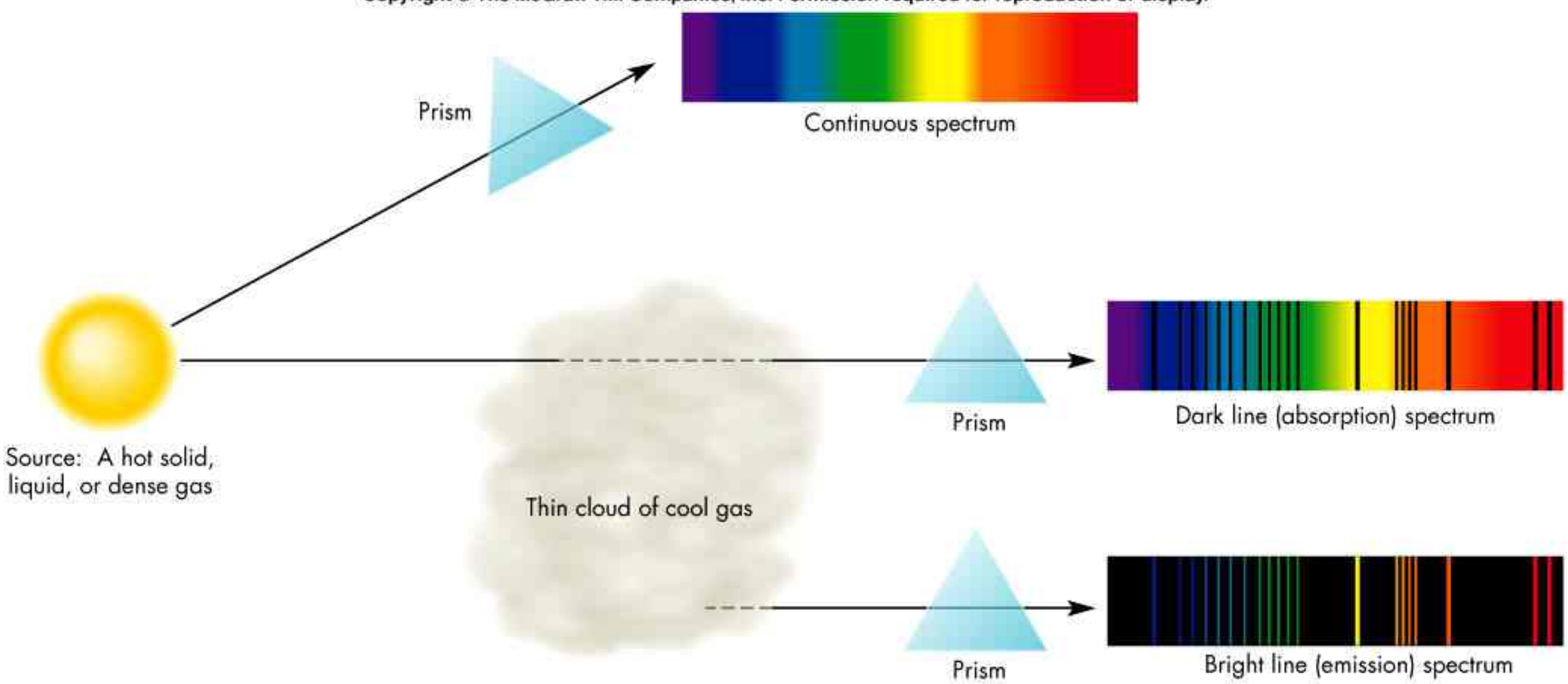
See Figure 16.11 from book

http://www.astro.umd.edu/~ssm/ASRT220/OBAFGKM.html

The Physics of Spectrum Formation, Kirchoff’ s Laws and Wien’ s Law

- Hot opaque solid or liquid produces a continuous spectrum
- Hot, tenuous gas observed against dark background produces emission line spectrum
- Cold, tenuous gas observed against bright background produces absorption spectrum

Kirchoff's Laws of Radiation



Kirchoff's First Law + Wien's Law

- Hot, opaque objects produce *continuous spectrum*
- The hotter the object, the bluer it is
- Wien's Law w_{max} = 2.9E-03/T
- The hotter an object, the brighter it is
- demo

Why does Wien's Law look like that?

A physicist is bothered when he or she sees an equation like:

$$w_{max} = \frac{2.90 \times 10^{-3}}{T} \text{ meters}$$

The form which emerges from fundamental equations of physics is:

$$w_{max} = \frac{0.201hc}{k_B T}$$

Kirchoff's Third Law: Absorption Spectra