Blackbody radiation

In Chapter 7, Schroeder derives the Planck Function and Stefan's law. However, in practice it is not generally possible to measure the total power emanating from an object, so how can we determine the object's temperature? Generally, we can only measure the brightness of an object at a particular wavelength (or multiple wavelengths). So, how does the brightness of an object vary with wavelength? In equation 7.95, we find that

$$\text{total energy escaping} = \int_0^{2\pi} d\phi \int_0^{\pi/2} d\theta \frac{A\cos\theta}{4\pi}\frac{U}{V} c\,dt \sin\theta$$

From this, we can pull the integrand to get

$$\text{power per area per solid angle} = \frac{c}{4\pi}\frac{U}{V}$$

Since, in practice, we can only measure the radiation that was emitted in a certain direction (our detector must be somewhere and not always surrounding the emitter in all directions), this is the relevant equation. Furthermore, we calculated U/V as a function of wavelength in problem 7.39.

Problem 1: Use your solution to that problem to show that the brightness is

$$\text{power per area per solid angle per wavelength} = I_\lambda(T) = \frac{2hc^2}{\lambda^5}\frac{1}{e^{hc/\lambda kT} - 1}$$

Also, plot curves of brightness as a function of wavelength for various temperatures (room temperature up to temperature on the surface of the sun).