

**Astrophysics & Intro. Astrophysics I**  
**HW #1**

**NAME:**

*Due: Friday October 2 in class.*

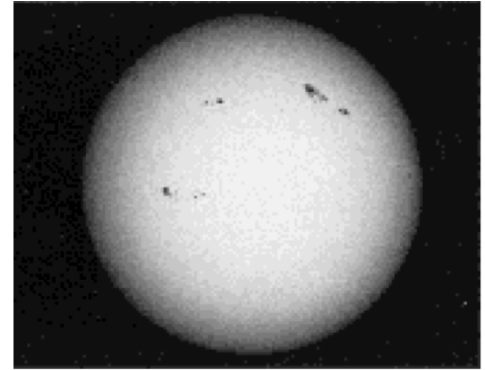
1. a. One of the most important resources for research in astrophysics is SIMBAD:  
<http://simbad.u-strasbg.fr/simbad/> Go to this web site and (in the left hand column) click on the link labeled **by identifier**. In the field called **Identifier**, type in the star designation **HD 44179**<sup>1</sup> (it is not case-sensitive) and hit *return* or click on the *submit id* button. Among the wealth of information listed is the parallax of the star in milli-arcsec (milli seconds of arc) or *mas* for short. Using this information, calculate the distance to HD 44179 in parsecs. The number following the parallax [2.37] is the uncertainty in the parallax measurement. What is the best estimate of the distance to this object in pc? What is the uncertainty in this value? (Hint: you cannot use simple derivative here as  $d(\text{parallax})$  is NOT  $\ll \text{parallax}!!$ ). (3 points)

b. Hit the Aladin applet button near the bottom. Using the Zoom button, scale the image up to 8x. Then click on the **dist** button, and using your mouse, draw a line from the center to the upper right corner of the “Rectangle”. What is the angular distance in seconds of arc, and what physical size is this in AU if you use the given parallax to get the distance? (2 points)

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<sup>1</sup> The “HD” refers to the Henry Draper catalog of stars, originally published between 1918 and 1924. It contains the positions of about a quarter of a million stars.

2. Suppose the mean surface temperature of the Sun is given by its effective temperature  $T_{eff} = 5780K$ , and that the “typical” temperature of the central regions of a sunspot is 4500 K. (2 points)



(a) How do the specific intensities in the center of the V-band ( $0.55 \mu\text{m}$ ) compare? (2 points)

(b) How do their total wavelength-integrated fluxes compare? (1 point)

3. The skin of the average person has a surface area of about  $1.4 \text{ m}^2$ , and a surface temperature of roughly 306 K. (4 points):

(a) Calculate the power radiated by the average person in the form of blackbody radiation.

(b) Determine  $\lambda_{\text{max}}$  (for brightness in units of  $\lambda F_{\lambda}$ ) in  $\mu\text{m}$

(c) Because a blackbody is also absorbing radiant energy from its environment, the human body is bathes in radiation from the walls ceiling, floor (and even the air) in the room. For a room temperature of 293 K, how much power is absorbed by the human body?

(d) What is the difference between the power radiated & absorbed in this case, and how much would be gained/lost in one day? Give your answer in Joules and kilocalories. (FYI – what people normally call “calories” in everyday usage relating to food consumption are actually *kilocalories*)

4. The angular diameter of the Sun, as seen from Earth, is about  $1/2^\circ=30$  arcmin.

(a) What would its angular size be, as seen from Neptune (30 AU from the Sun)? As seen from Proxima Centauri (the nearest star to our Sun)? (2 points)

(b) Suppose you wanted to build a telescope that could resolve Proxima Cen at visible wavelengths, say  $0.5 \mu\text{m}$ . If there were no air turbulence at the observing site, how big (diameter) of a telescope would you need to resolve Proxima Cen? (2 points) *[Hint: To do this, one needs the radius of this star. One can estimate it by using Simbad to get its spectral type and then use the table on slide 11 of the Ch. 3 class notes, but I know that a number of you will just Google “Proxima Centauri radius”, and get the value from a recent ESO press release...]*

## Graduate Students

(A) Using the equation for the Planck function, derive the expression for Wien's Law for the quantity  $\lambda B_\lambda = \nu B_\nu$ , in units of  $\lambda(\mu\text{m})$ : i.e.  $\lambda_{\text{max}} = \frac{3670}{T} \mu\text{m}$  (*Hint: use the examples in the class notes as a guide – 4 points*).