PHYS 6980/8980 — Spring 2006

Homework Assignment 2

Due March 3, 2006

1. In the HW2 folder, in the Files section, for this course in MyUT you will find a file
\texttt{sirius-sed.fits}. It contains the spectral energy distribution of the star Sirius from 1000 to 7000 \AA, digitized from Fig. 1 of Code et al. 1976 (ApJ, 203, 417).

(a) The SED is given as flux measured outside the Earth’s atmosphere. Using the uniform disk angular diameter given for Sirius in Kervella et al. 2003 (A&A 408, 681, see the HW1 folder), convert the SED to flux at the stellar photosphere by means of \texttt{arith}.

(b) With the \texttt{iraf} task \texttt{mk1dspec} (use \texttt{help mk1dspec} to identify the package to which it belongs), construct a blackbody function with a temperature of 9900 K, for the wavelength range 1000 to 7000 \AA.

(c) Your function will be scaled to a value of 1000 (or whatever value you specified) at the first pixel. Scale it to absolute energy units: using the Rayleigh-Jeans approximation, calculate the black body function for the wavelength of the last pixel in your curve, then scale the curve to that value by multiplying it by the appropriate factor.

(d) The Planck function is usually given in units of specific intensity. For comparison to the stellar SED, convert to the flux emerging from the black body by multiplying it by \pi.

(e) Now that they are in the same units, overplot the stellar SED and the black body and discuss the proposition that stars are black bodies.

(f) Using the \texttt{’e’} graphics command in \texttt{splot}, integrate under both curves and discuss the proposition that the effective temperature of this star is 9900 K. Discuss possible sources of error, such as error in the absolute calibration of the SED.

2. In the same directory on MyUT, you will also find a text file, \texttt{lester.txt}, containing the theoretical \textit{uvby} -\textit{β} colors from Lester, Gray, and Kurucz 1986 (ApJS, 61, 509), as well as the PDF of the original Table 2 from that paper. Use the original to double check for typographical errors in the text file, and use the data to find $T_{\text{eff}}$ and $\log g$ for three stars.

(a) In SIMBAD, look up the \textit{uvby} -\textit{β} photometric data, with errors, for the stars Procyon, Sirius, and η UMa. (After the SIMBAD screen for the star comes up, select \textbf{Display all measurements}.) Use mean values (in boldface) if given.

(b) By double linear interpolation in the Lester et al. table, either graphical or numerical, estimate the temperatures and gravities.

(c) Given the temperatures and gravities, discuss whether the stars’ observed $m_1$ indices are compatible with the assumption of solar composition.

(d) Based on the photometric errors given in SIMBAD, what are the resulting errors in the temperature and the gravity?