Solar Physics, Exercise 1

25 January 2017 at 14-16 in D116
Submit by 24 January 2017, 12:00

1. Assume that the limb-darkening function is given by the Eddington approximation
$$\frac{I(\mu,\lambda)}{I(1,\lambda)} = \frac{2+3\mu}{5}; \quad \mu = \cos\theta .$$
Calculate the the mean intensity $\bar{I}(\lambda)$, Eq. (1.15), for $I(1,\lambda) = I_1$ and compare your result with Fig. 1.2 of the lecture notes.

2. Derive the effective temperature starting from Planck's law
$$B_\lambda = \frac{2hc^2}{\lambda^5(\mathrm{e}^{hc/\lambda k_\mathrm{B}T} - 1)} .$$

3. Approximate the spectral irradiance of the quiet Sun at radio wavelengths by
$$S(\lambda) = \frac{2\pi c\, k_\mathrm{B} T_0}{215^2\, \lambda^4[1 - 0.99\, \lambda^2/(\lambda_0^2 + \lambda^2)]}; \quad T_0 = 10^4\,\mathrm{K},\ \lambda_0 = 10\,\mathrm{cm}.$$
Determine the brightness temperature of the Sun at $\lambda = 3$ cm, $\lambda = 30$ cm and $\lambda = 3$ m, and draw a sketch of the spectrum (log-log plot).

4. Derive the equations (2.29-2.31) for the adiabatic temperature gradient and specic heat, respectively.