Homework 3

1. Assume that LTE is valid in the atmosphere of a star so that the local source function can be represented by the Planck function, i.e. $S_\lambda = B_\lambda(T)$, and that the depth dependence is given by the Taylor expansion

$$S_\lambda(t) = \sum_{n=0}^{\infty} \frac{d^n B_\lambda}{d\tau_\lambda^n}(t - \tau_\lambda)^n / n!$$

Calculate the outward directed (μ>0) intensity $I_\lambda^{out}(\tau_\lambda,\mu)$. (2 points)

2. The observed center to limb variation of the solar intensity at different wavelengths can be described by the fit

$$I_\lambda(0,\mu)/I_\lambda(0,1) = a(\lambda) + b(\lambda)\mu + c(\lambda)\mu^2$$

with the wavelength dependent coefficients a(λ), b(λ), c(λ) and the solar center emergent intensity $I_\lambda(0,\mu)$ given in the table below. Assume again LTE and a Taylor expansion for the depth dependence of the source function as in 1.

Calculate and plot the temperature as a function of optical depth at the different wavelengths.

Homework 3

Determine the wavelength dependence of the absorption coefficient at $\kappa_\lambda/\kappa_{\lambda=5010A}$ by comparing optical depths corresponding to a temperature of 6000 K. Note that for the same temperature different optical depths must correspond to the same geometrical depth in the atmosphere. Assume that the wavelength dependence does not change with depth. (Intensity in units of 10^{13} erg cm^{-2} s^{-1} cm^{-1}).

λ[A]	a(λ)	b(λ)	c(λ)	$I_\lambda(0,1)$
5010	0.2593	0.8724	-0.1336	40.3
6990	0.4128	0.7525	-0.1761	25.0
8660	0.5141	0.6497	-0.1657	15.5
12250	0.5969	0.5667	-0.1646	7.7
16550	0.6894	0.4563	-0.1472	3.6
20970	0.7249	0.4100	-0.1360	1.6

(6 points)

Please return homework on Monday, September 26