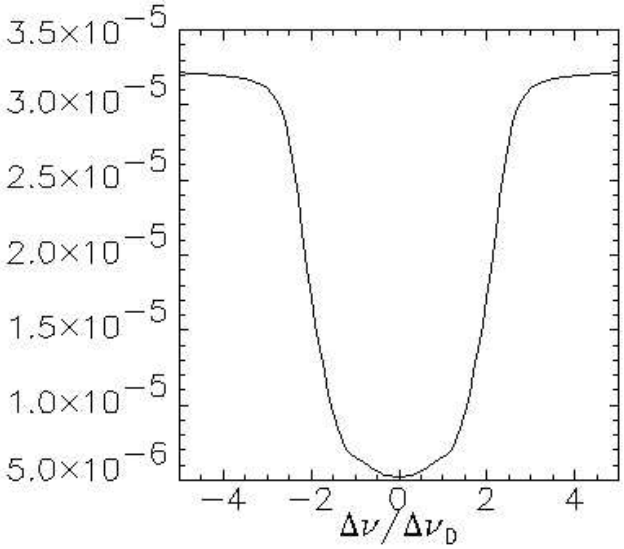
Astronomy 304, STARS

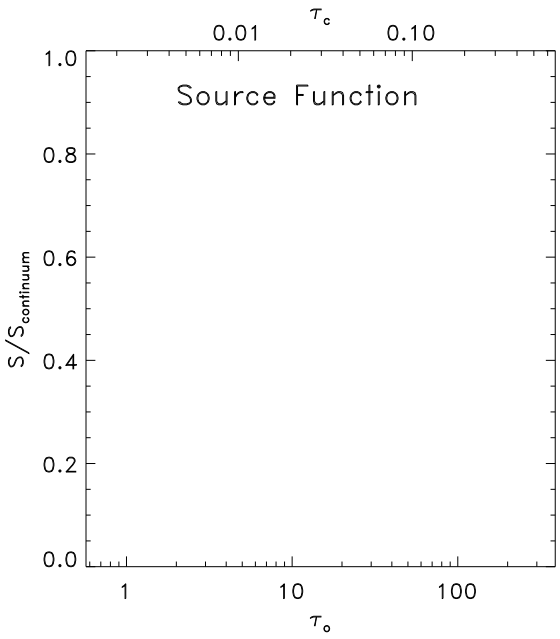
Homework # 7, Due Wednesday, Feb. 26, 2003

Show All Your Work

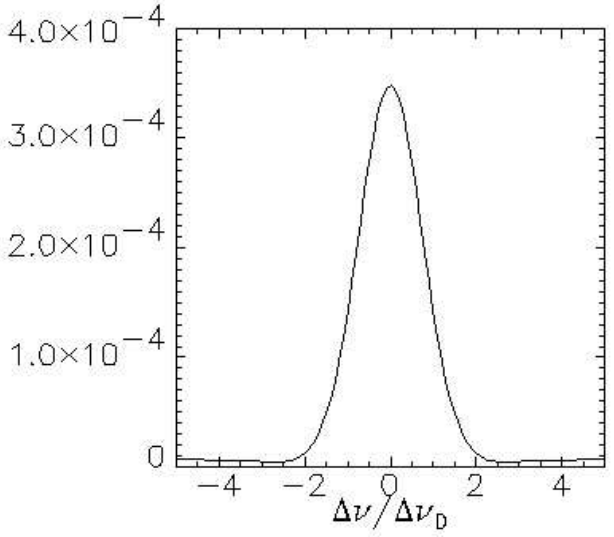
1. Use the Eddington-Barbier relations to sketch the optical depth dependence of the source function (in the blank graph on the right) that produces the line profile shown in the graph on the left, for the three cases (a), (b), (c). Here $\Delta\nu$ is the frequency offset from the center of the line, $\Delta\nu_D$ is the Doppler width of the line, τ_o is the line center optical depth and τ_c is the continuum optical depth. Note: the absorption coefficient in a line decreases approximately as a Gaussian with increasing offset from the line center frequency.

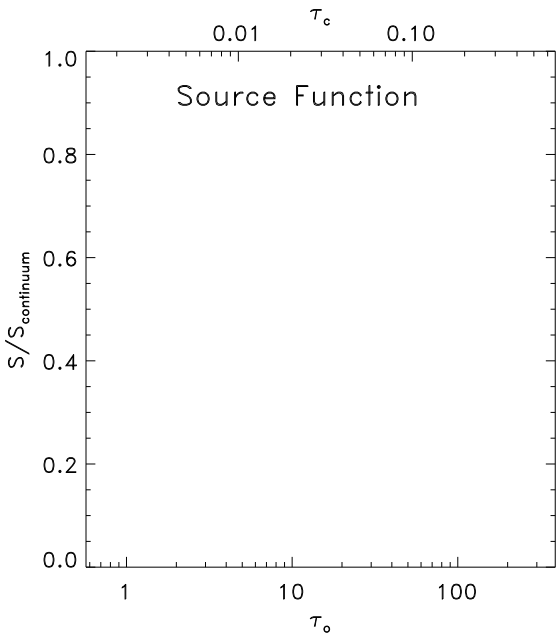
   (a)



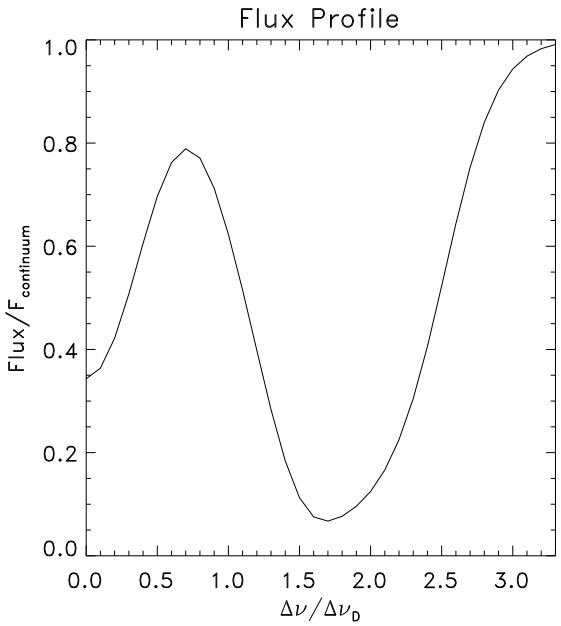


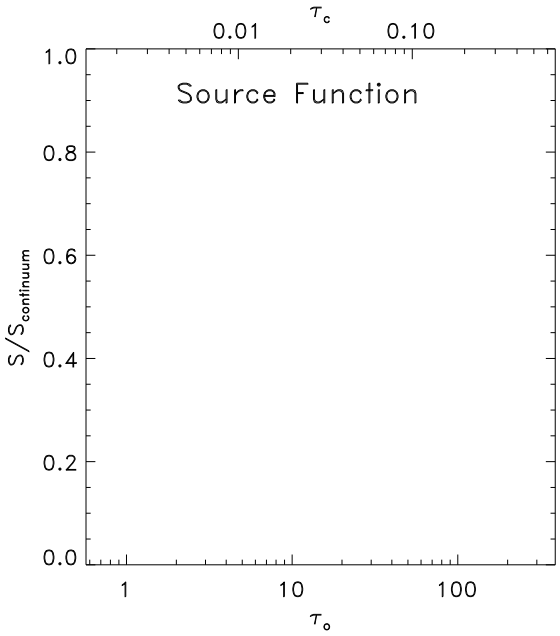
(b)


4.0×10^−4
3.0×10^−4
2.0×10^−4
1.0×10^−4
0
−4
−2
0
2
4
Δν/Δν_D

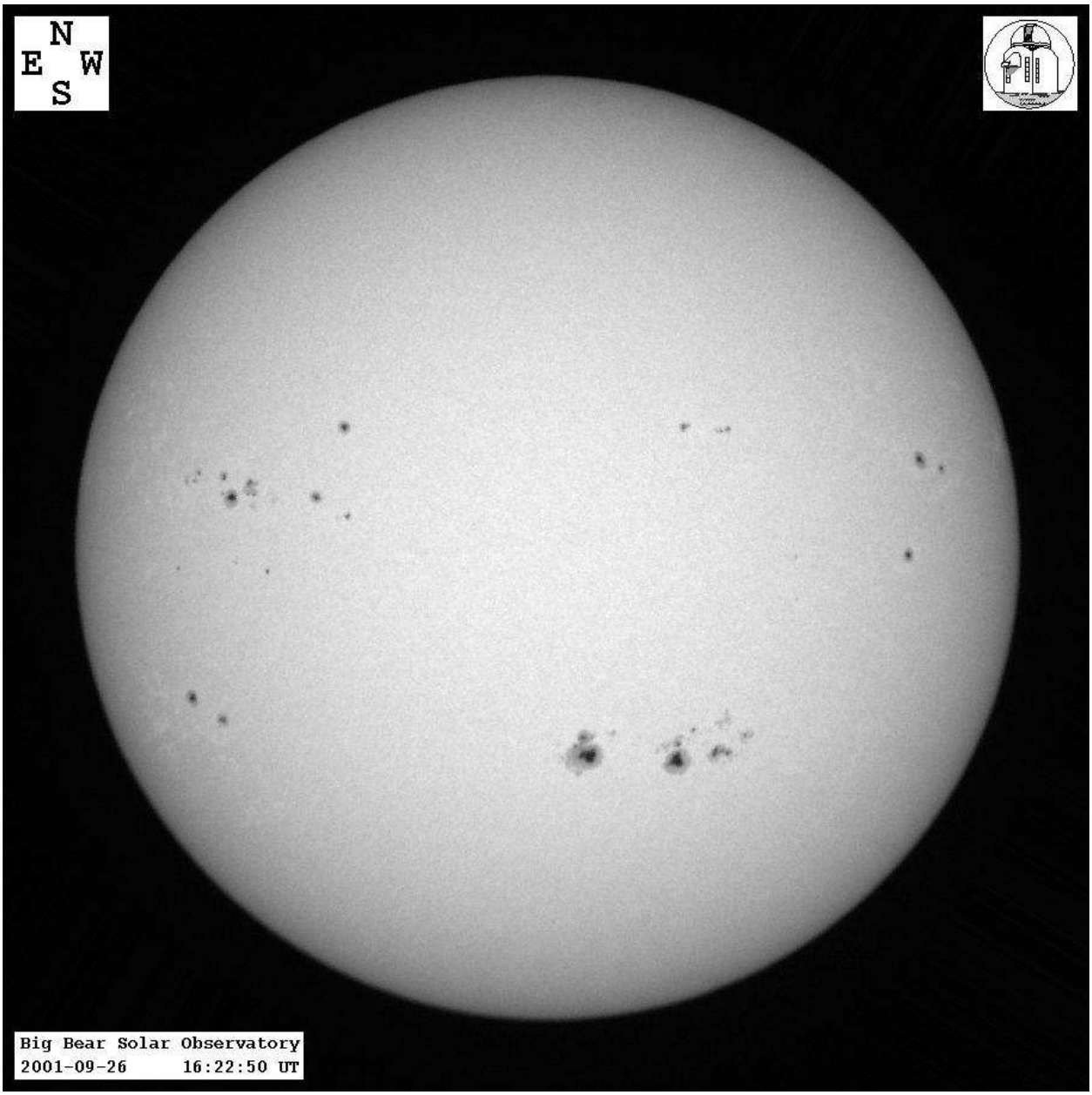

τ_c
0.01
0.10
Source Function
S/S_continuum
1.0
0.8
0.6
0.4
0.2
0.0
1
10
100
τ_o

(c)


Flux Profile
Flux/F_continuum
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Δν/Δν_D


τ_c
0.01
0.10
Source Function
S/S_continuum
1.0
0.8
0.6
0.4
0.2
0.0
1
10
100
τ_o

2. Below is an image of the Sun taken in the continuumn (a broad wavelength range corresponding roughly to visible light). Based on this image, what can you tell about the variation of the source function (in this case equal to the Planck function) with height above the level of optical depth = 1 looking vertically down on the center of the Sun?



3. Carroll & Ostlie: problem 11.2

4. Carroll & Ostlie: problem 11.3