Ay101

Fall 2002

PHYSICS OF STARS

Midterm

Due Mon, November 4, 2002

Give yourself three contiguous hours to solve the problems below. Please write your solutions as clearly as possible. You may use any books and notes that you want, but please do not consult with anybody else about the test.

1. Derive how the line depth of an optically thin line of neutral iron, i.e., the Fe I line depth, will change with decreasing metal abundances in solar-type stars. Derive how the line depth for an optically thin Fe^+ line will change with decreasing abundances of the heavy elements. Assume that the abundances of all heavy elements are reduced by the same factor.

2. An early F star has a temperature of 7800 K. In the atmosphere we find a microturbulence with a reference velocity of $\xi_t = 4$ km/sec. What is the half width of an optically thin Fe line in the star? How large is the thermal half width?

3. A star is rotating with an equatorial velocity of 50 km/sec. This rotation broadens its lines. Estimate the half widths of the lines due to this rotation. Compare this half width with the thermal Doppler half widths of an Fe^+ line in an A0 V star.

4. If in a star the half width of the line absorption coefficient of an Fe II line is increased by a factor of 2 due to microturbulence, by how much is its equivalent width increased when it is on the flat part of the curve of growth?

5. How does the depth in the hydrogen line wings change with decreasing metal abundances (a) for solar-type stars? (b) for A stars?

6. How does the depth in the hydrogen line wings change for increasing He abundance, or in other words, for decreasing hydrogen abundance (a) in solar-type stars? (b) in A stars?

7. How does the Balmer discontinuity change with decreasing abundances of heavy elements (a) for F stars? (b) for B stars?

8. How does the Balmer discontinuity change with increasing He abundance (a) for F stars? (b) for B stars?