Electromagnetic Radiation
The Doppler Effect

14. The H_β absorption band in the visible light spectrum of Megrez (δ-UMa) is found at 486.112 nm. In laboratory measurements of the hydrogen line spectrum, the H_β emission band for hydrogen is found at 486.133 nm. Calculate the velocity of Megrez with respect to the Sun and the its apparent direction of travel toward or away from us.

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \quad \text{so...} \quad v = c\frac{\Delta\lambda}{\lambda}$$

$$\Delta\lambda = 486.133\text{nm} - 486.112\text{nm} = 0.021\text{nm}$$

$$v = 3.00\times10^{8}\ {}^{\text{m}}\!/_{\text{s}} \times \frac{0.021\text{ nm}}{486.133\text{ nm}} = 12,960\ {}^{\text{m}}\!/_{\text{s}} \quad (=12.96\ {}^{\text{km}}\!/_{\text{s}}!)$$

Since the light is blue shifted, Megrez is moving toward us.

15. The giant elliptical galaxy NGC 4889 possesses a strong spectral line at 401.8 nm, which corresponds to singly-ionized calcium. The same line of singly-ionized calcium normally has a wavelength of 393.3 nm. What is the galaxy's velocity away from the Milky Way Galaxy?

This problem is identical to the previous problem.