

ASTRO 220 - Homework 1, Sep 15 2010

due Sep 22

1. Bats

Bats are mammals, and when hunting for insects in summer they maintain their body temperature at about 40°C . However, unlike most other mammals, they are able to lower their body temperature when they are inactive. Consider a hibernating bat with a body temperature of 5°C .

- Determine the wavelength of maximum radiation for an active bat and for a hibernating bat, and sketch their blackbody curves. Assume that a bat is a perfect blackbody.
- How much energy does a bat conserve by hibernating? Express the answer as a percentage. (This makes the calculation easier!)

2. The spectrum of a distant galaxy

An astronomer has obtained the spectrum of a distant galaxy. At an average wavelength of 662.8 nm there is a prominent emission line, which the astronomer recognizes as $\text{H}\alpha$.

- Find the emitted (laboratory) wavelength of this line, using the web or the book.
- Use your answer to a) to determine the velocity of this galaxy with respect to us.
- The astronomer notices that the observed wavelength of the line is slightly different on one side of the galaxy compared to the other side. She measures the wavelength of the line at three locations: 1 kpc left of center, in the center, and 1 kpc right of center. On the left side, the line is at 663.2 nm, in the center at 662.8 nm, and on the right side the line is at 662.4 nm. Calculate the observed velocity difference between the left side of the galaxy and the center of the galaxy, and between the right side and the center.
- The galaxy appears as an oval on the sky, with the long axis twice as long as the short axis. Calculate the rotation velocity of the galaxy.
- Estimate the mass of the galaxy, enclosed in 1 kpc. Express your answer in M_{\odot} , i.e., Solar masses.

3. Feeble gravity

Gravity is the weakest of the four fundamental forces. In fact, electromagnetism is stronger by a factor of $\approx 10^{36}$! Given its weakness, why do astronomers only take gravity into account (and no other forces) when they develop models for the formation of structure in the Universe? Also give an exception to this statement.

And from book:

Chap 4: 43

Chap 5: 30, 33, 36, 41, 45