

**ASTR 311    STELLAR ASTROPHYSICS**  
**Problem Set #2**  
**(due 14 SEP 11)**

1. A star at a distance of 1 parsec has an annual parallax of 1 arcsec. A parsec is a dimensionless unit defined this way. To give it some physical meaning, let's see how many AU (another dimensionless unit equal to the average distance between the Earth and the Sun) it corresponds to. At a distance of 1 parsec, 1 arc second is the angle that an object 1 AU across would appear. Suppose the object had a parallax of 1 radian. How many arcseconds are there in a radian? What is the distance to the object in AU? [Hint: what should you know about arclength on a circle and the definition of a radian?] How many AU are there in 1 parsec?

**Here are some measured properties of a "nearby star":**

- **parallax:            379 milliarcsecond**
  - **proper motion:  $\mu_\alpha = -546$      $\mu_\delta = -1223$     (both in milliarcsec/year)**
  - **apparent magnitude: -1.47**
2. If this star were located at  $6^{\text{h}} 45^{\text{m}}$  and  $-16^\circ 43'$  on the day when you were born, what would its coordinates be on your 50th birthday?
  3. Calculate the distance to this star in parsec, AU, and cm.
  4. Calculate the tangential component of its space velocity [note: this is a vector quantity].
  5. Suppose a spectral line from this star that is expected from lab measurements to appear at 5000 Angstroms is observed at a wavelength of 4999.9 Angstroms. What is the radial velocity of this star?
  6. Given the results from 3 and 4, what is the true space velocity of this star?
  7. Given that a factor of 100 in brightness corresponds to a 5 magnitude difference, derive the distance modulus  $m-M=5\log(d/10)$ , where  $m$ =apparent magnitude,  $M$ =absolute magnitude, and  $d$  is the distance in parsecs.
  8. What is the absolute magnitude of this star? How Luminous is this star compared to the Sun (absolute magnitude of the Sun = 4.76) is this star?