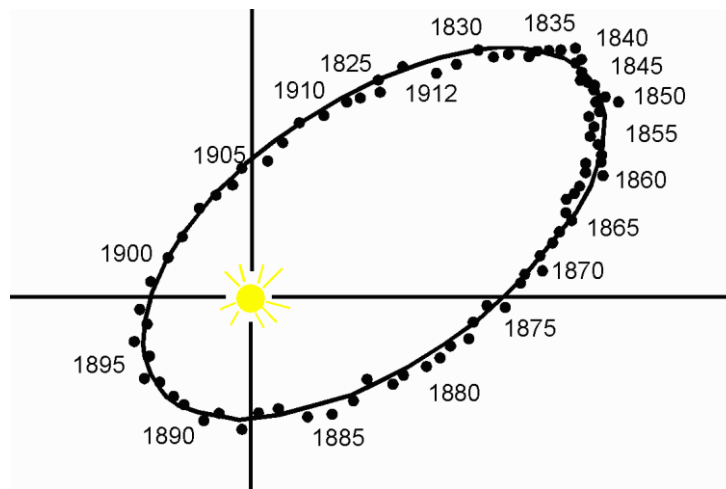


# Introduction to Astronomy

## HW150312

due in one week

1. (a) Estimate how many kilograms of hydrogen the Sun has consumed over the past 4.56 billion years, and estimate the amount of mass that the Sun has lost as a result. Assume that the Sun's luminosity has remained the same during the time. (b) In fact, however, the Sun's luminosity when it first formed was only about 70% of its present value (the "*faint young sun paradox*"). With this in mind, explain whether your answers are an overestimate or an underestimate.
2. How far away is a star that has a proper motion of 0.08 arcseconds per year and a tangential velocity (proper motion) of 40 km/s? For a star at this distance, what would its tangential velocity have to be in order for it to exhibit the same proper motion as Barnard's star?
3. The visual binary 70 Ophiuchi has a period of 87.7 years. The parallax of 70 Ophiuchi is 0.2 arcseconds, and the apparent length of the semimajor axis as seen through a telescope is 4.5 arcsec. (a) What is the distance to 70 Ophiuchi in parsecs? (b) What is the actual length of the semimajor axis in AU? (c) What is the sum of the masses of the two stars in solar masses?



4. Search the World Wide Web for information about *Gaia*, a European Space Agency (ESA) spacecraft meant to extend the work carried out by *Hipparcos*. What is the status of *Gaia*? What is the main mission of *Gaia*? How does it compare to *Hipparcos* in terms of performance? What other types of research is it supposed to carry out?
5. A star is measured to have  $m_V=10.00$ . It is later resolved to be a binary with a brightness ratio of 2. What is the apparent magnitude of each binary component? If the system is at a distance of 100 pc. What is the absolute magnitude of each star?