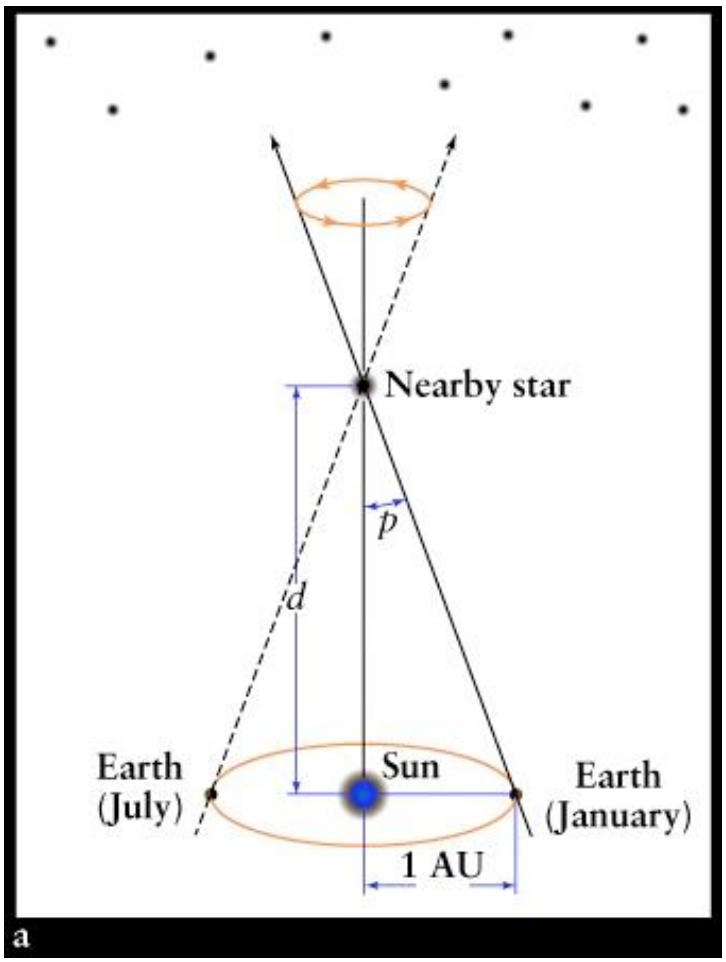
Workshop 2

1. The unit of distance used in astrophysics the parsec (pc) stands for parallax arcsecond. It corresponds to the distance (d) of a star that has a trigonometric parallax angle (p) of one arcsecond. The parallax of a star is half the angle through which a star appears to move relative to background stars due to the Earth's motion around the Sun in 6 months – see diagram below:

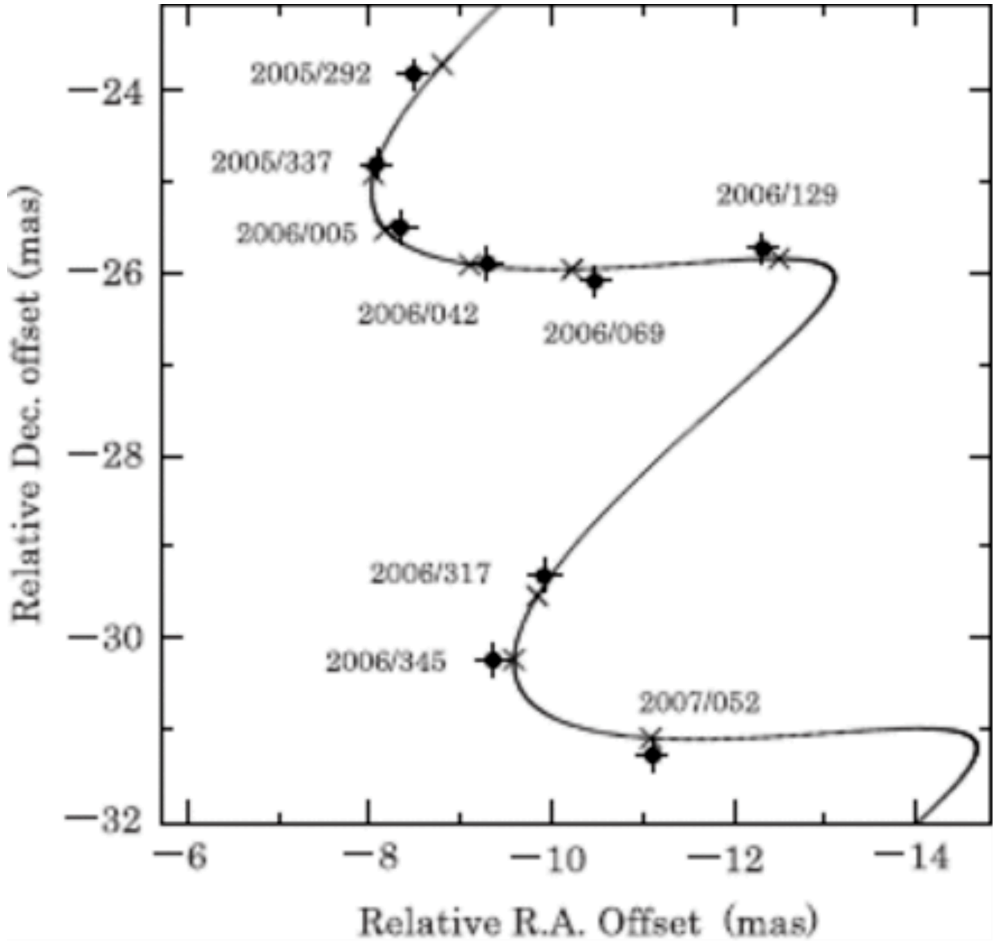


Hence,

$$d(pc) = \frac{1}{p(")}$$

Use the above definition to draw the right angle triangle that defines the parsec and use this to determine how many metres are in a parsec. Compare this to 1 light-year.

2. Objects can also exhibit so-called proper motion due to genuine motion across the sky due to relative to the Sun. The diagram below shows the motion of a particular type of radio source originating from an evolved star called S Crateris. The radio emission is from a very strong spectral line called a water maser at around 22 GHz. The accurate positions of the maser 'spot' were taken with radio VLBI observations using the VERA array with a maximum baseline of 2300 km. The positions at different epochs labelled with year and day number are shown in the diagram below. The motion is due to a combination of parallax and proper motion. Use these data to estimate both the distance of the star and the velocity of its proper motion across the sky.



3. The rest frequency of the maser spectral line above is 22.23508 GHz, but the line was actually observed at a frequency of 22.23256 GHz. Evaluate further what this tells us about the motion of the maser.