

What's a Parsec?

A parsec (pc) is a unit of distance that is often used by astronomers. But before we define the parsec, let's look at some more familiar units of astronomical distance: the light year (ly), and the astronomical unit (AU).

A **light year** is the distance light travels in an average *Gregorian* year (365.2425 days) in the near-vacuum of space. The speed of light is very fast: 299,792,458 meters per second, *exactly*. In fact, this speed defines the exact length of a meter. The speed of light in terms you may be more familiar with is 186,282.4 miles per second, or a whopping 671 *million* miles per hour. Even so, the nearest known star beyond our solar system, Proxima Centauri, is 4.23 ± 0.01 ly away. In a year, then, light travels 9.5 trillion kilometers, which is 5.9 trillion miles.

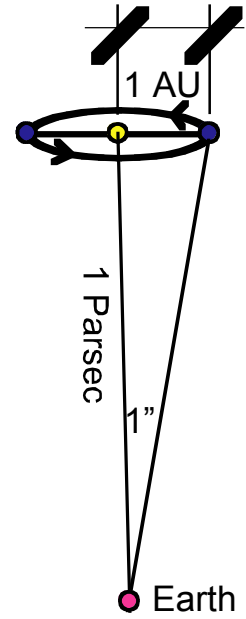
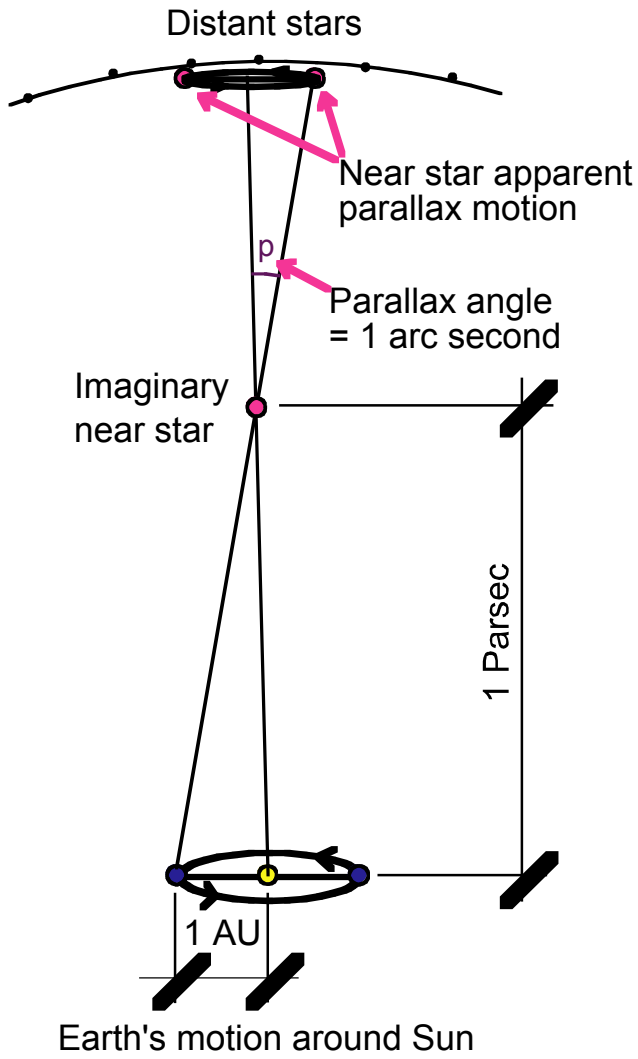
A very useful property of using the light year as a measure of distance is that it also tells you how many years ago the light left the object you are observing. When we look out into space, we also look back in time. The brightest star in the night sky, Sirius, for example, is 8.6 light years away. So, when you look at Sirius, you are seeing the star as it looked 8 years and 7 months ago. It could disappear today (highly unlikely), and you wouldn't see it disappear until 8 years and 7 months from now!

In the solar system—which is much smaller than a light year—astronomers like to use the **astronomical unit** as the distance unit of choice. An astronomical unit is very nearly equal to the average distance of the Earth from the Sun, i.e. $1.0 \text{ AU} = 149,597,871.5 \text{ km} = 92,955,807.8 \text{ miles}$.

What's a **parsec**, then? Parsec is an abbreviation of *parallax arcsecond*. What this means is at a distance of one parsec, a nearby star would undergo a one arcsecond ($1/3600^\circ$) trigonometric parallactic shift relative to very distant stars across a one AU baseline, as shown in the diagram on the next page. Actually, the nearby star's parallax across the entire baseline of the Earth's orbit (2 AU) would be twice as much: 2 arcseconds at a distance of one parsec.

An equivalent way to define the parsec is to say it is the distance at which 1 AU subtends an angle of 1 arcsecond, also shown in a diagram on the next page.

So, how far is a parsec? $1 \text{ pc} = 3.261631 \text{ ly}$. Given the information provided here, can you derive this?



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