

Measuring the Universe

Key Stage 4

Topics covered: constellations, parallax, parsecs, arcseconds, scatter graphs

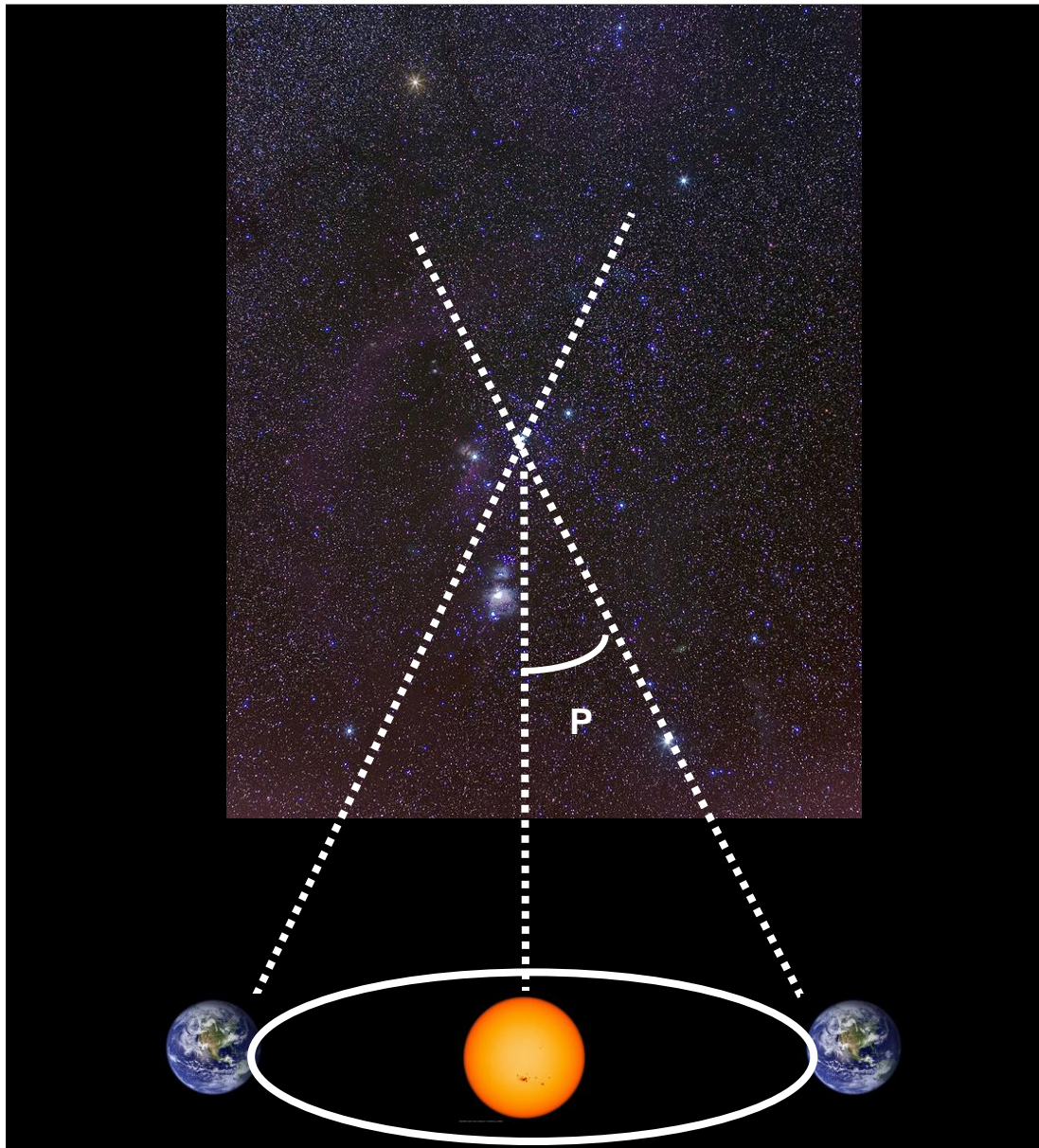
Watch the video "Measuring the Universe" <https://vimeo.com/41434123>

Using Parallax to measure the distance to Orion

Orion is a winter constellation visible in the northern night sky from November to April. The easiest way to find Orion is to look for the three stars in a row that make up his belt.



The main stars that make up Orion are all much bigger and brighter than the Sun. The central object of Orion's sword is fuzzy and looks like a cloud – this is the Orion Nebula, a huge star forming region 1300 light-years away and visible to the naked eye. How do we know how far away the Orion Nebula and all of the stars are from us? We use a technique called Parallax.



Nearby stars appear to shift relative to background stars as we orbit the Sun. Stars that are close are seen to shift more than stars that are further away. By measuring the angular shift we can then calculate the distances to nearby stars.

$$D = 1/P$$

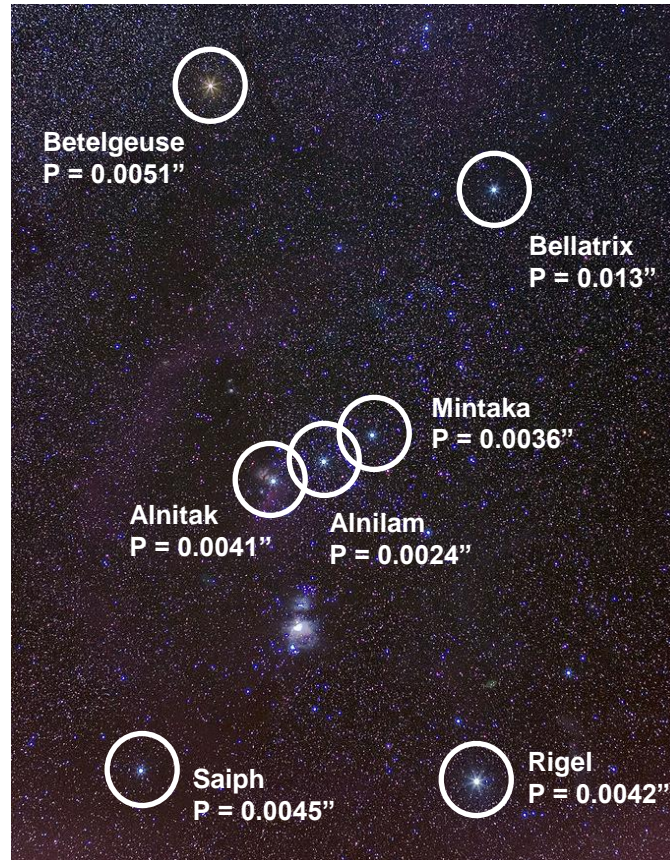
D = distance to star from Earth in parsecs

P = parallax angle in arcseconds

1 parsec = 3.26 light-years = 3.09×10^{13} km

1 arcsecond = $1/3600^\circ$

Use the information below to find the distances to the stars of Orion in parsecs.

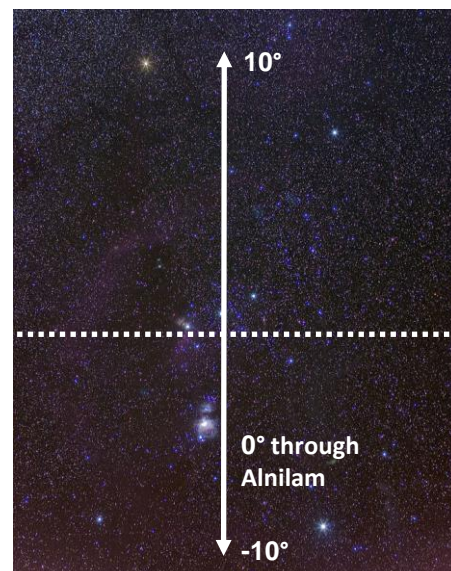


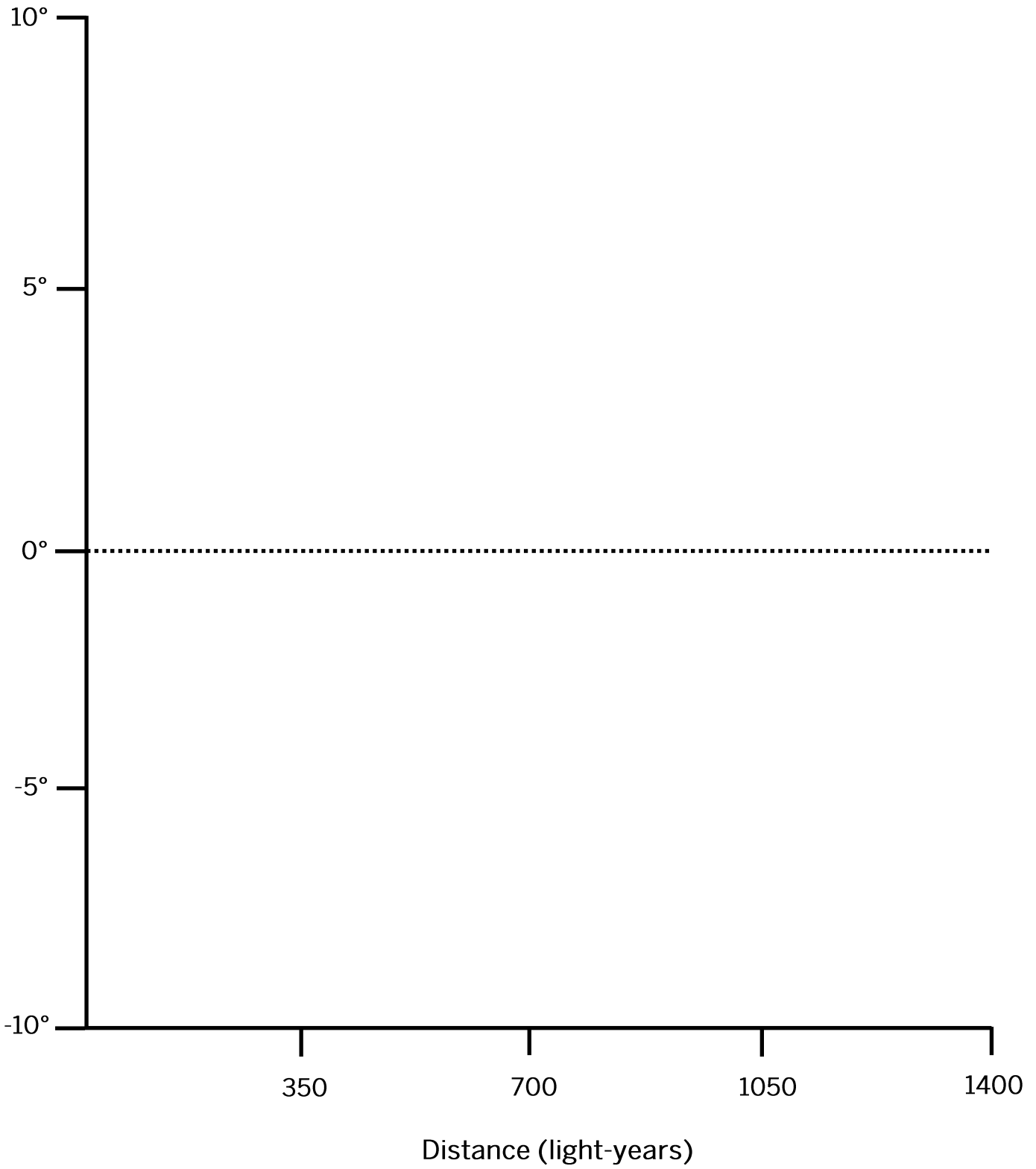
Q. How long does it take light to reach us from these stars?

Q. What do your answers tell you about the physical nature of Orion?

Draw a side-on view of Orion in the graph below (the y-coordinates of the stars in degrees can be determined from the image on the right).

Label the stars in your diagram.





Measuring the Universe: **ANSWERS**

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Distance to the stars in Orion (in parsecs and light years):

Star	Distance (parsecs)	Distance (light years)
Betelgeuse	197	643
Bellatrix	75	243
Alnitak	245	800
Alnilam	417	1359
Mintaka	276	900
Saiph	221	724
Rigel	237	772

