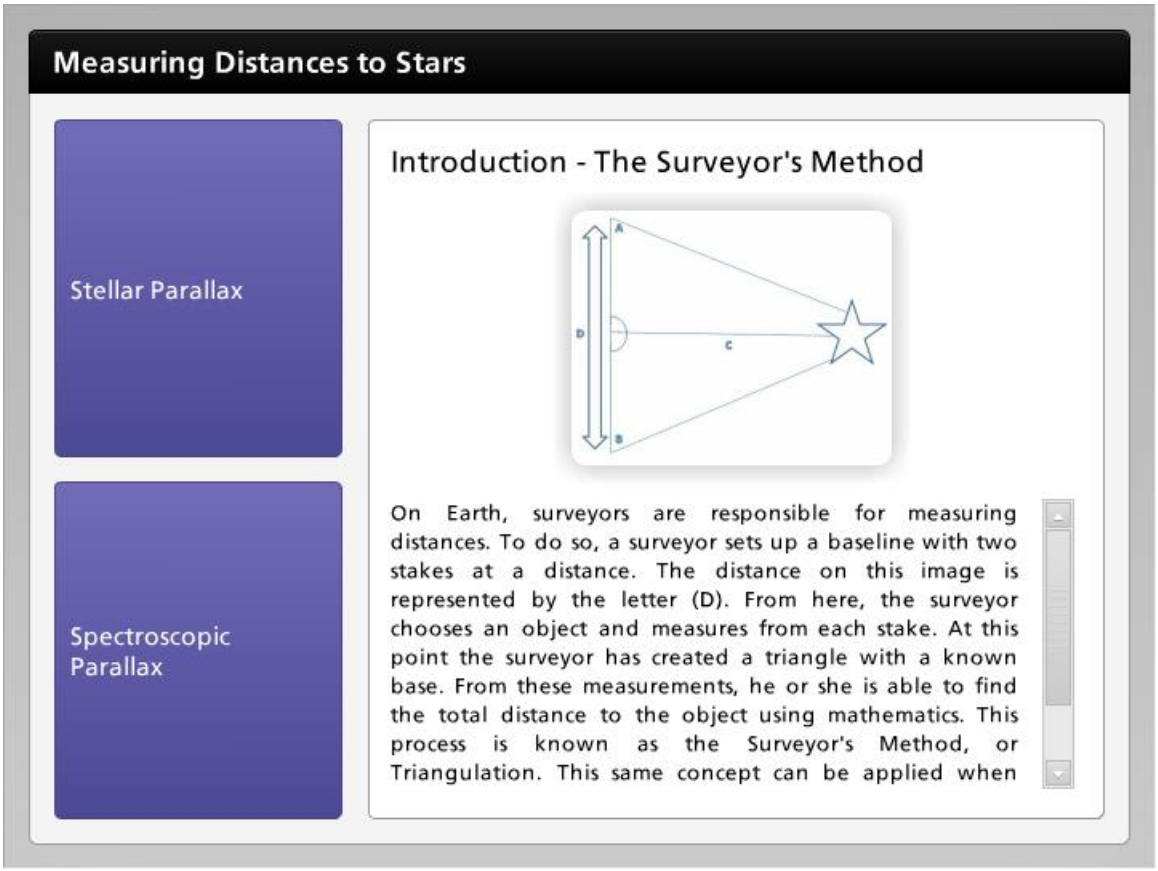
Module 7: Stars
Topic 3 Content: Measuring Distances to Stars Notes

Introduction - The Surveyor's Method



On Earth, surveyors are responsible for measuring distances. To do so, a surveyor sets up a baseline with two stakes at a distance. The distance on this image is represented by the letter (D). From here, the surveyor chooses an object and measures from each stake. At this point the surveyor has created a triangle with a known base. From these measurements, he or she is able to find the total distance to the object using mathematics. This process is known as the Surveyor's Method, or Triangulation. This same concept can be applied when finding the distance to stars. In this interactivity, click on each of the tabs to learn more about how astronomers measure distance as it relates to stars.

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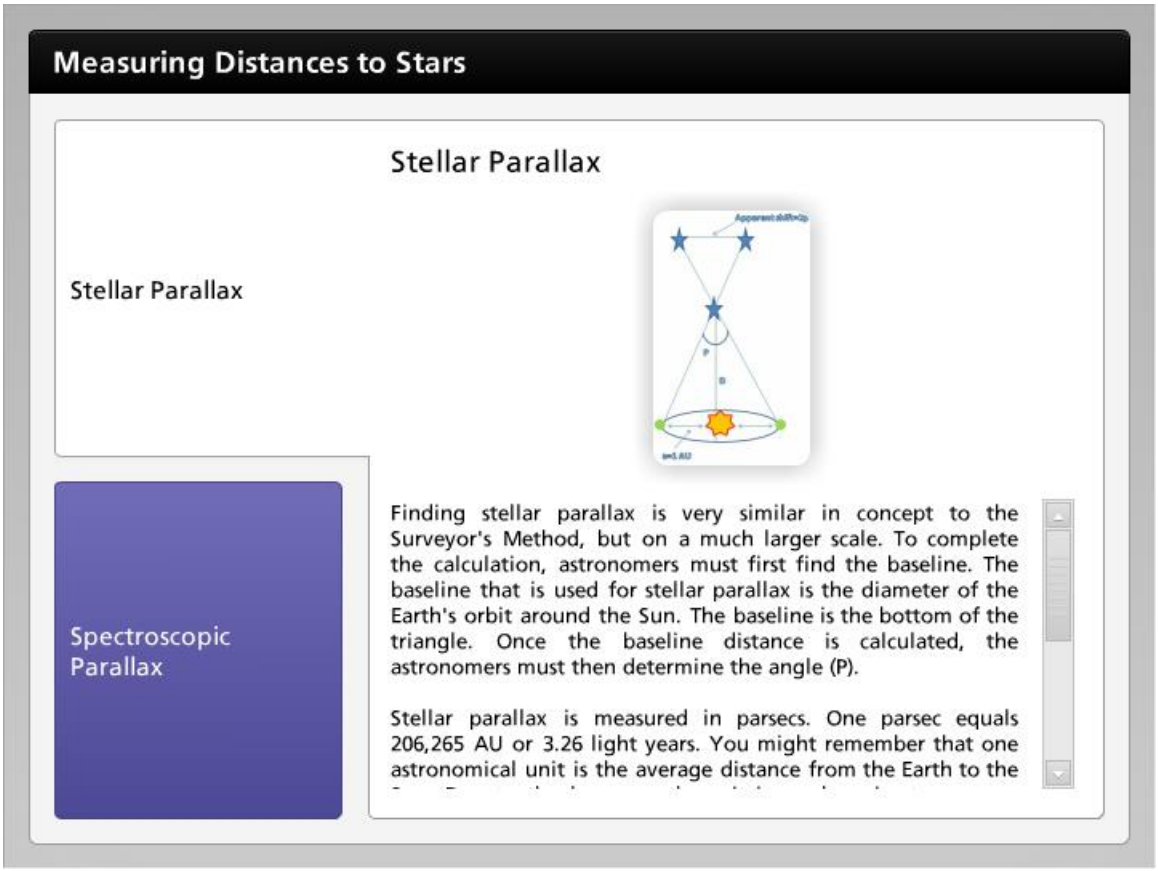
Stellar Parallax



Finding stellar parallax is very similar in concept to the Surveyor's Method, but on a much larger scale. To complete the calculation, astronomers must first find the baseline. The baseline that is used for stellar parallax is the diameter of the Earth's orbit around the Sun. The baseline is the bottom of the triangle. Once the baseline distance is calculated, the astronomers must then determine the angle (P).

Stellar parallax is measured in parsecs. One parsec equals 206,265 AU or 3.26 light years. You might remember that one astronomical unit is the average distance from the Earth to the Sun. Due to the large numbers, it is much easier to use one parsec in the formula instead of 206,265 AU to calculate stellar parallax. The formulas are listed below.

To calculate stellar parallax:
D=A/P
or D=1/P

Measuring parallax is useful for stars that are close to Earth. Stars located at a distance of 500 parsecs or 1600 light years from Earth can all be measured using the stellar parallax method described.

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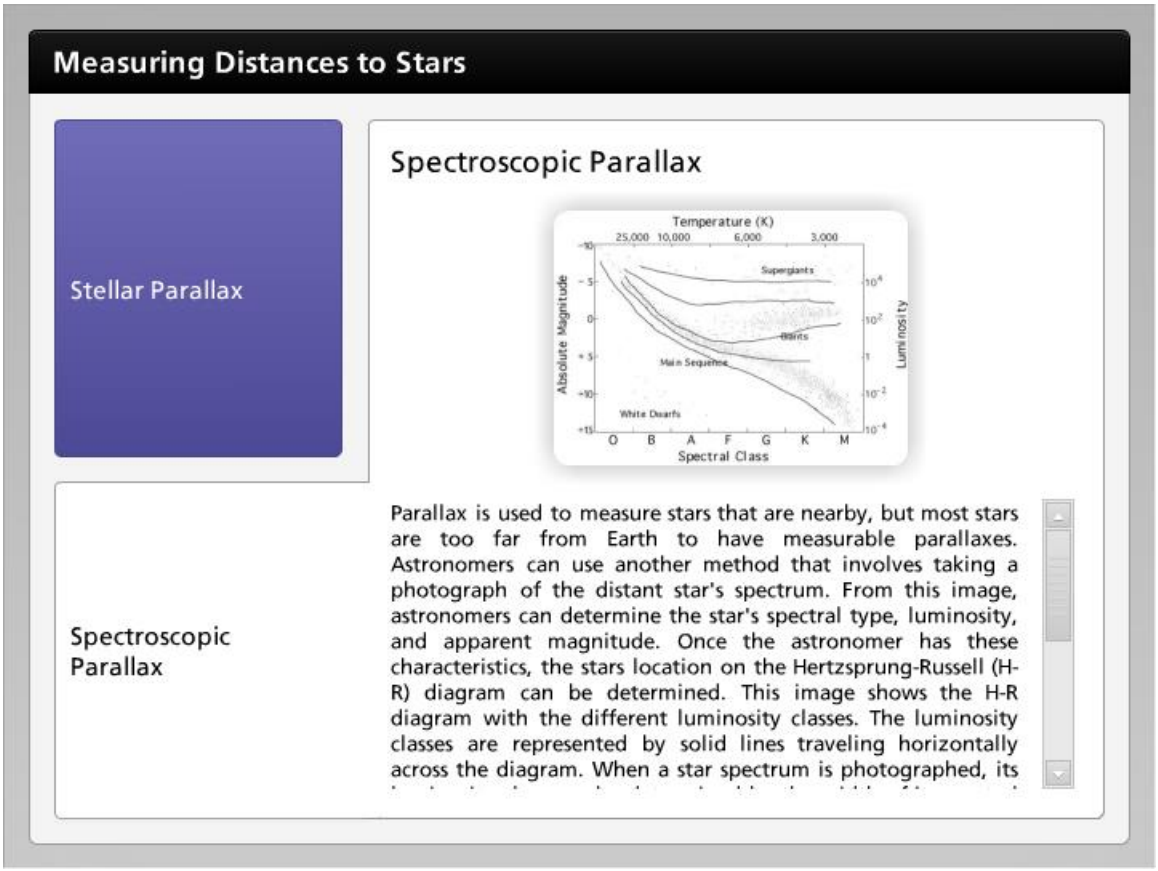
Spectroscopic Parallax



Parallax is used to measure stars that are nearby, but most stars are too far from Earth to have measurable parallaxes. Astronomers can use another method that involves taking a photograph of the distant star's spectrum. From this image, astronomers can determine the star's spectral type, luminosity, and apparent magnitude. Once the astronomer has these characteristics, the stars location on the Hertzsprung-Russell (H-R) diagram can be determined. This image shows the H-R diagram with the different luminosity classes. The luminosity classes are represented by solid lines traveling horizontally across the diagram. When a star spectrum is photographed, its luminosity class can be determined by the width of its spectral lines, and that tells astronomers where the star should be placed on the diagram.

How is the distance of the star calculated? The astronomer must then use a more complicated formula called the Distance Modulus Equation. This equation determines the difference between the absolute and apparent magnitude and gives the star a distance from Earth in parsecs. Technically speaking, spectroscopic parallax has nothing do with parallax, but it does provide an estimated distance to a star. This method works for stars that are about 10,000 parsecs or 50,000 lights years away.