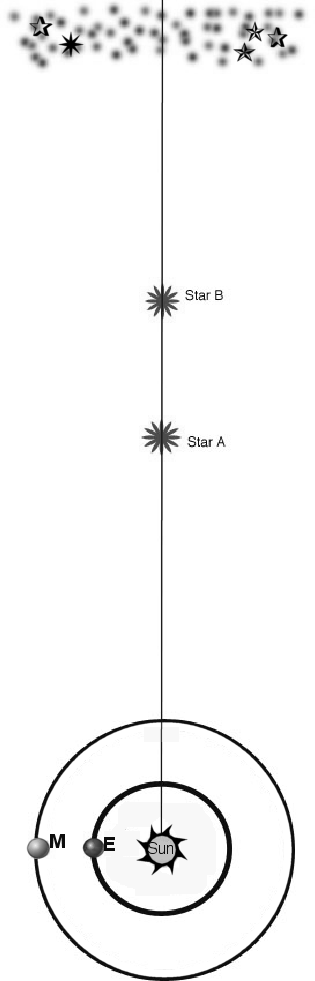
**Stellar Parallax**

**Purpose:** To investigate the use of the measured parallax method to determine distances to nearby stars.

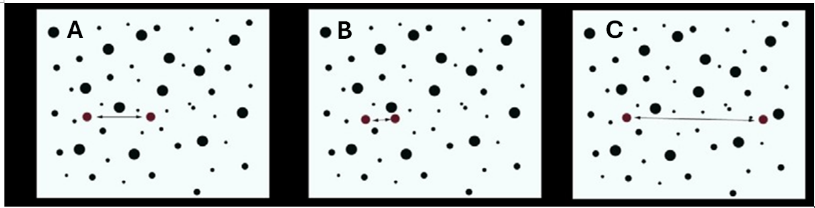
**Items:** Calculator

**Introduction:** One of the most difficult problems in astronomy is determining the distances to objects in the sky. Because stars are **so** far away, and their parallax shifts so extremely small. Even when observed with the largest telescopes, stars are still just points of light.

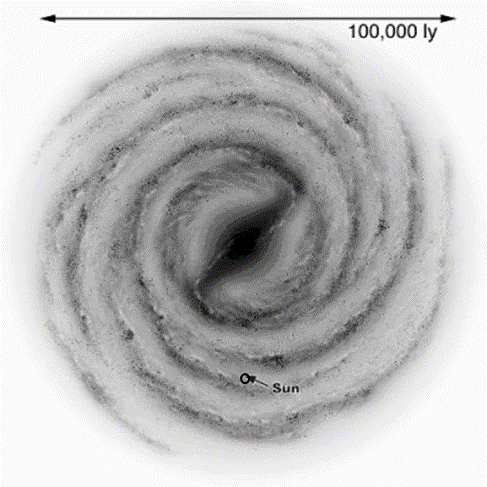
**Part I : Understanding Parallax as a Measurable Angle**

The circle labeled E in the diagram on the right represents the Earth in its orbit in January.

1. Draw a line from the Earth to the background stars going through star A. Next, find where the Earth will be 6 months later. Draw a second line from the Earth (6 months later) to the background stars going through star A. Mark the angle between the above two lines at Star A. This is parallax angle.
2. Repeat the above step in 1) for star B using different color for the lines. Is the parallax angel for star B is smaller larger compare to that of star A?
3. The circle labeled M is Mars, repeat the above step in 1) for star A by draw lines from Mars use different color. Is the parallax angel for star A when measured from Mars is smaller or larger comparing to that measured from the earth?



1. Above are a set of parallax observations of the different stars from earth using earth’s location six months apart. Rank them from nearest to farthest. Explain your logic.



**Part II : Mathematical Explanation of Parallax**

The limit to our measurements of parallax angles is about 0.005 arc seconds, or about 650 light years. The diagram at the right represents the Milky Way from a top- down view. A circle on this diagram around the location of the Sun that indicates the range of usefulness of measured parallax.

1. Below is a list of stars and their parallaxes. Rank use 1-4 where 1 is the nearest and 4 is the farthest.

|  |  |  |
| --- | --- | --- |
| Rank | Star Name | Parallax in arc seconds |
|  | Antares | 0.024 |
|  | Ross 780 | 0.213 |
|  | Regulus | 0.045 |
|  | Betelgeuse | 0.009 |

1. Complete the table below by calculating the distances to the stars. The distance in parsecs is just the inverse of the parallax in arc seconds.
2. Calculate the distance in light years and record in the table using the conversion factor: 1 parsecs = 3.3 light years, using distance in parsecs multiple 3.3

|  |  |  |  |
| --- | --- | --- | --- |
| Star Name | Parallax (arc seconds) | Distance (parsecs) | Distance (light years) |
| Arcturus | 0.090 |  |  |
| Procyon | 0.288 |  |  |
| Hadar | 0.006 |  |  |
| Sirius | 0.379 |  |  |
| Altair | 0.194 |  |  |

**Part III : Scientific Uncertainties in measurements**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***SOURCE:*** [***http://haydenplanetarium.org/universe/duguide/mwg\_err.php***](http://haydenplanetarium.org/universe/duguide/mwg_err.php) | | | | |
| **Star Name** | **Parallax Angle** | **Distance** | **Distance** | **Uncertainty Range** |
|  | **(arcsecs)** | **(parsecs)** | **(light-years)** | |
| Ain (ε Tauri) | 0.021 | 48 | 155 | 149-161 |
| Bellatrix (γ Orionis) | 0.013 | 75 | 243 | 226-262 |
| Spica (α Virginis) | 0.012 | 80 | 262 | 245-282 |
| Betelgeuse (α Orionis) | 0.009 | 113 | 368 | 352-544 |
| Polaris (α Ursae Minoris) | 0.008 | 132 | 431 | 405-460 |
| Antares (α Scorpii) | 0.007 | 144 | 469 | 460-876 |

1. Review the information in the table above. What do you notice about the relationship between the distance to a star and the uncertainty connected with that distance measurement?
2. Discuss briefly whether or not this trend makes sense, and why astronomers would still use a measured parallax distance even though the uncertainty is very high.