Venustransit

Skip to content

- Home
- Getting involved
  - Educational resources
  - Experimental archaeology
  - Mark that site!
  - Measure the Sun's distance
  - Phone app
- Observing
  - Black drop
  - Build a Sun Funnel
  - Eye Safety
  - Six ways to see the transit
  - The aureole effect
  - Venus before the transit
- Past transits
  - 1639 December 4
  - 1761 June 6
  - 1769 June 3
  - 1874 December 9
  - 1882 December 6
  - Bibliography 1631 & 1639
  - Bibliography 1761 & 1769
- Where & when
  - General circumstances
  - Inferior conjuctions
  - Local transit times
- Newsletters
  - Newsletter #1
  - Newsletter #2
  - Newsletter #3
  - Newsletter #4
  - Newsletter #5
  - Newsletter #6
  - For educators

- Store
- Phone app
- Wheren & when
- Workbook

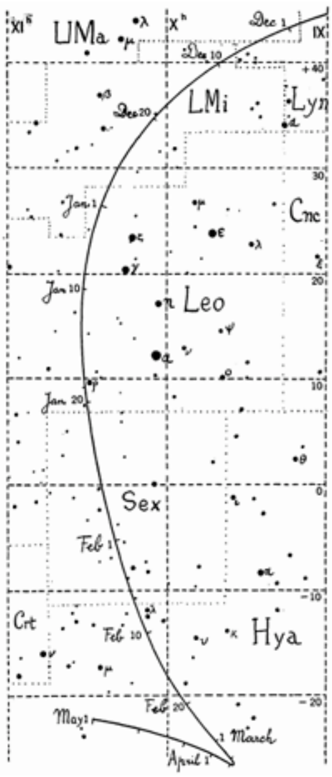
Eros and the solar parallax

By Steven van Roode and Michael Richmond

The year 2012 offers us the unique possibility to measure the size of the solar system with two classic and historical important methods: using the transit of Venus (in June) and the opposition of Eros (in January). This page has all backgrounds and instructions for you to join a special outreach project measuring the distance to the asteroid Eros during its opposition in late January 2012.

January 1931: telescopes aimed at Eros



When the asteroid Eros came into opposition in January 1931, it was closer to earth than it had been since the opposition of January 1901. This close opposition was taken advantage of to find the distance to Eros with unsurpassed accuracy through parallax measurements. It was a welcome opportunity after it had dawned upon the astronomical community that the transits of Venus hadn't fulfilled the high expectations with regard to the determination of the sun's distance.

When a celestial body comes close to earth, and is viewed at simultaneously from two widely separated locations on earth, the observed positions of the body with respect to the background stars are a little different. If this so-called parallactic displacement is measured and the distance between the two observing locations is known, the distance to the body can be computed through trigonometry. Once the distance between Eros and earth is established, the distance to the sun is also known from Kepler's Third Law.

Eros is an asteroid discovered in 1898. It's a Mars-crosser asteroid, which means it comes within the orbit of Mars. The highly elliptical orbit brings Eros to within 0.2 AU from earth's every 1.76 years. No other then-known asteroid came ever as close to earth as Eros. Such a close apparition made it an ideal object to perform parallax measurements. Close encounters like these, however, are quite rare. After the January 1931 opposition, Eros came close to earth again in January 1975. After this year's opposition, the next time Eros comes close to earth will be in January 2056.

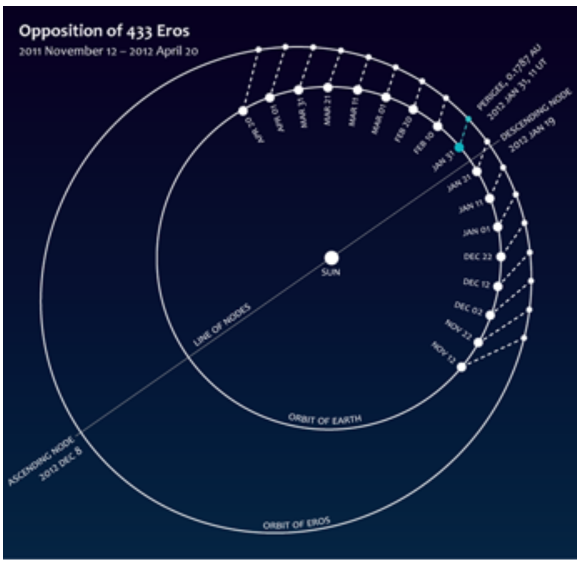
The preliminary work for the 1931 opposition already started in the 1920s. To be able to accurately measure the parallax angle, the position of all reference stars up to the 9th magnitude along the path of Eros (see picture to the left) had to be determined with high precision. A list of 419 reference stars was carefully prepared by the Rechen-Institut in Berlin. To account for atmospheric dispersion, also the brightness, spectrum and colour index of the stars was to be determined.

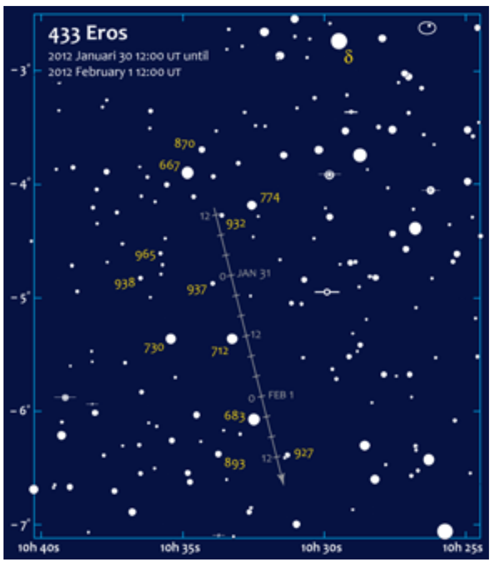
During the month January of 1931, numerous observatories measured the position of Eros with respect to the reference stars. This was done either visually, using micrometer measurements, or photographically, where the exposed plates were measured afterwards. The photographic method had some advantages over the visual observations. First, the photographic plates could be kept and measured carefully in peace and quiet. Secondly, the photographs of the sky could capture a wider star field, allowing more brighter reference stars to be on the exposure than would be visible in the narrower field of view of visual observations.

After reducing all observations, a solar parallax of 8″.790 was established. It was the most accurately known value for the solar distance up to that time, and this value would remain a standard until 1968, when radar measurements attained an even more accurate value for the distance to the sun.

January 2012: re-enactment of the 1931 campaign

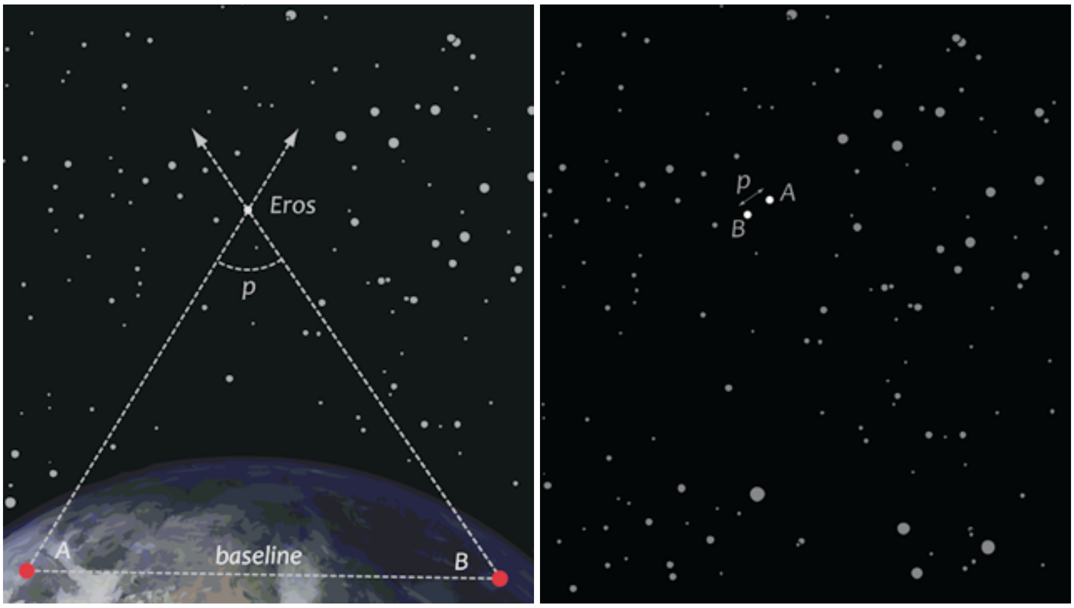
In many respects the opposition of Eros in January 2012 mimics that of 1931. The shortest distance to earth, the time of the year, the path through the stars and the maximum brightness are all nearly the same. The only difference will be the observers: instead of professionals, Eros will now be photographed chiefly by amateurs like you.





The picture to the left (click to enlarge) shows how Eros and earth approach each other during the months November through January. Perigee, the shortest distance to earth, will be reached on January 31. Eros will then be 0.1787 AU from earth, peaking in brightness with magnitude +8.56. The picture to the right (click to enlarge) shows how the position of Eros with respect to the background stars changes between January 30 and February 1. The asteroid moves south across the constellation Sextans with a rate of nearly 40″ per hour, making its movement apparent within an hour.

If Eros is observed simultaneously from two widely separated locations A and B, the asteroid will be seen at different positions between the background stars. If the two observers both make a picture of Eros and the surrounding stars, the angular separation *p* between these two positions can be established by comparing the two pictures. This can be done by overlaying the two pictures, as in the image below on the right. In our project, however, you will measure the position (right ascension and declination) of Eros directly from your own picture. From the positions submitted by all participants, the angle *p* can subsequently be derived. With trigonometry, using the baseline between the observers and the measured angle *p*, the distance to Eros can be found.



How to participate

Times and locations
Because Eros is be photographed simultaneously from different locations, some times should be agreed on at which Eros is visible in the night sky from widely separated populated regions. The three pictures below are showing earth as seen from Eros on three times on January 31. For clarity, the night side of earth has been made light, while the day side has been made darker. At 7:00 UT Eros will be highest in the sky for observers in North and South AMerica, creating a long north-south baseline. At 18:00 UT observers in Asia and Australia will see Eros low in the sky, after sunset and before sunrise respectively. At 23:00 UT observers from Europe can team up with observers from Africa or India.

Edit

Comments are closed.

- Search for: Search