National Aeronautics and Space Administration

Shadows of the Sun

The Transit of Venus / June 5-6, 2012

- Visible to the (protected) naked eye
- Crosses in front of the Sun for 6 hrs., 40 mins.
- Important event in astronomical history
- Will not occur again until 2117

First contact: 22:09:29 UT 18:09:29 EDT
Last contact: 04:49:27 UT 00:49:27 EDT

Venus
(not to scale)
Eclipses

The shadow from the Moon creates a path of darkness that is at most 170 miles wide. The Moon orbits Earth once every 29.5 days with respect to the Sun. During this period, the Moon undergoes all its familiar phases: new, first quarter, full, last quarter and back to new. During the new phase, the Moon passes between the Sun and Earth so that some portion of the Moon’s shadow falls onto Earth’s surface. The Sun is 400 times wider than the Moon, but it is also 400 times farther away, so they coincidentally appear to be almost exactly the same size in our sky. So, at that time, the Moon is seen to pass across the Sun and we experience an eclipse of the Sun.

The shadow from the Moon creates a path of darkness that is at most 170 miles wide. Outside the path of either a total or annular eclipse, the Moon’s penumbra produces a broad band about 400 miles wide where a partial eclipse can be seen. How often do eclipses occur? There will be 36 solar eclipses from 2012 to 2015 of which 25 will be total eclipses on some portion of Earth’s surface—a little less than the average of about one a year. The common myth that eclipses don’t occur very often has evolved because the Moon varies by a few degrees from a specific point on the surface of the Earth is not correct. Most people think that solar eclipses are quite rare but there are actually two to five eclipses every year. They only seem rare because each eclipse can only be seen from a small part of Earth. The next total solar eclipse visible in North America will occur in 2017.

Every total eclipse begins with a partial eclipse in which the Moon gradually covers more and more of the Sun’s disk. It usually takes about an hour for the Moon to completely cover the Sun before the start of the total phase or totality. During most of this time, the Sun and sky remain remarkably bright so that you would never know an eclipse was happening.

In the final seconds before totality, the eclipse becomes an accelerated process. The sky is in the direction of the Moon’s shadow grows dark like an approaching thunderstorm. Suddenly, darkness reveals a crescent of brilliant shapes on the ground below. Shadows take on an odd sharpness and daylight appears weak and grey.

In the final seconds, the Moon’s dark shadow rises above the horizon like a curtain rushing towards you. The Sun’s remaining crescent breaks up into a series of brilliant points along one side of the Moon. These ‘Baily’s’ beads are caused by sunlight shining through deep valleys along the edge of the Moon. The last flash of light as the Sun disappears behind the Moon gives the appearance of a diamond. At the same instant, the Sun’s ghostly white corona encircles the Moon forming the so-called diamond ring effect.

As totality begins, the solar corona (extended outer atmosphere of the Sun) blazes into view. The corona is a million times fainter than the surface of the Sun. It is only visible when a total eclipse blocks the Sun’s bright disk from view or an eclipse that is dark enough to see the planets and the bright stars. Animals often behave as if night has fallen and the temperature can drop 15 degrees F.

The period of totality rarely lasts more than a few minutes. The Moon’s disk begins to uncover the Sun as totality ends. Baily’s beads and the diamond ring are seen once again as the corona fades from view and daylight returns. A total eclipse is the most spectacular and awe-inspiring sight in all of Nature. Once seen it will never be forgotten. If you ever have an opportunity to observe a total solar eclipse, don’t miss it!

Safe Solar Viewing

The transit of Venus is a rare and striking phenomenon you won’t want to miss— but you must carefully follow safety procedures. Don’t let the requisite warnings scare you away from witnessing this singular spectacle! You can experience the transit of Venus safely, but it is vital that you protect your eyes at all times with the proper solar filters. No matter what kind of photographic technique you use, do not stare continuously at the Sun. Take breaks and give your eyes a rest! Do not use sunglasses: they don’t offer your eyes sufficient protection. See the NASA site at http://eclipse.gsfc.nasa.gov/Safety/Safety2.html for definitive advice on safe solar viewing!

Viewing with Protection – Experts suggests that one widely available filter for safe solar viewing is number 14 welder’s glass. It is imperative that the welding hood houses a #14 or darker filter. Do not view through any welding glass if you do not know its shade number. Be advised that arc welders typically use glass with a shade much lower than #14. A welding glass that permits you to see the landscape is not safe. Inexpensive Eclipse Shades have special filters that appear similar to sunglasses, but these filters permit safe viewing. Eclipse shades are available through retailers listed at http://www.mercury.com/Totality/TotalityAP.html under “Solar Filters.”

Telescopes with Solar Filters – The transit of Venus is best viewed directly when magnified, which demands a telescope with a solar filter. A filtered, magnified view will clearly show the planet Venus and sunspots (http://www.skyandtelescope.com/observ ing/objects/sun/Solar_Filter_Safety.html). Never look through a telescope without a solar filter on the large end of the scope. Never use small solar filters that attach to the eyepiece (as found in some older, cheaper telescopes.) See “Solar Filters” cited above for details.

Pinhole Projectors – These are a safe, indirect viewing technique for observing an image of the Sun. While popular for viewing solar eclipses, pinhole projectors suffer from the same shortcomings as unmagnified views when Venus approaches the edges of the Sun. Small features like the halo around Venus will not be likely discernible. Pinhole projectors and other projection techniques are at http://solar-center.stanford.edu/observer.


• The Exploratorium demonstrates how to view a planet in transit safely by projecting the image with binoculars. http://www.exploratorium.edu/transit/how.html

• The Sunspot telescope viewer (recommended for younger viewers) is commercially available from Edmund Scientific at http://www.edmund.com/search.php?st=0&stid=1&sttype=3&x=0&y=0&z=0

• Pins in pinhole – A series of pins are inserted in the “don’t use” pinhole, resulting in a series of pinholes which act as a pinhole projector.

More information on viewing the transit can be found at http://www.amo.gov/nss/transitinfo.html. You can also ask your local observatory if they have any upcoming viewing events at http://www.amo.gov/nss/obs.html.

Harper's Weekly

Thousands of photographs were taken with calibrated instruments. Only a few astronomers were trusted to carry out the complex calculations from the resulting data. In 1896, Simon Newcomb’s value, a distance from Earth to Sun of 92,702,000 plus or minus 53,700 miles, was adopted by the international scientific community. Today most textbooks report the Astronomical Unit (AU) as “93 million miles.” The Venus transit has continued to yield fascinating new information for scientists and the public. Take this unique opportunity to make your own observations and calculations.

Jupiter’s Great Storms

The Voyager 1 camera captured images of Jupiter’s Great Storms for the first time. These storms are the most massive storms in the Universe and last for hundreds of years. This storm is about 60,000 miles across and is located in the southern hemisphere of Jupiter. It is the largest storm in the Solar System and is visible from Earth.

Check out these links

Space Weather Media Viewer – presents the Sun and surrounding corona in real time http://spwms.gsfc.nasa.gov/

Space Weather Action Center – students make their own space weather predictions and produce multimedia reports http://spaceweather.gsfc.nasa.gov/casowavac/


Solar Dynamics Observatory – shows near real-time clips of the Sun in many wavelengths of light http://sdo.gsfc.nasa.gov/