

Scientists study atmosphere of Venus through transit images

July 9 2015, by Sarah Frazier

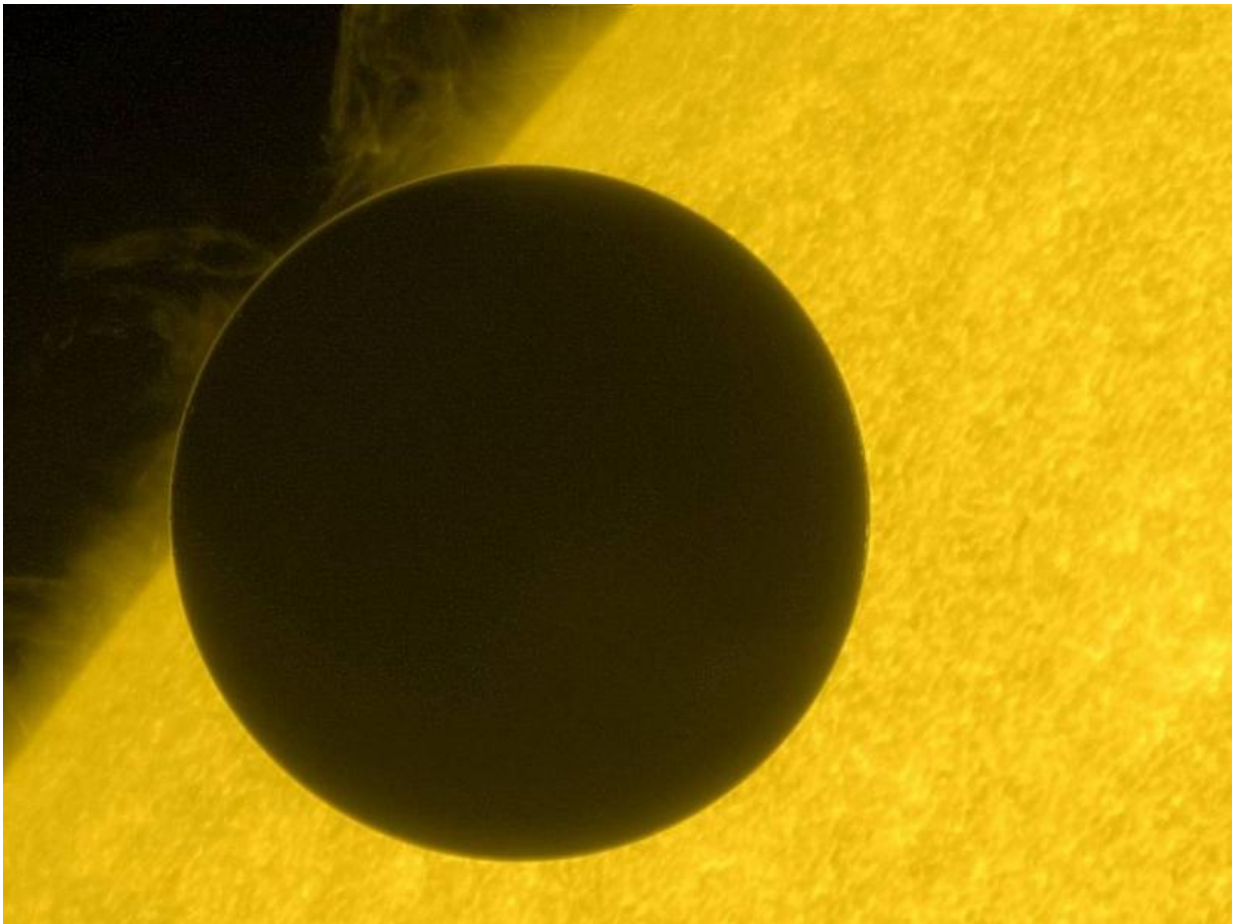


Image of Venus taken by Hinode's Solar Optical Telescope. In this image, Venus is just beginning its journey across the face of the sun. Its atmosphere is visible as a thin, glowing border on the upper left of the planet. Credit: JAXA/NASA/Hinode

Two of NASA's heliophysics missions can now claim planetary science on their list of scientific findings. A group of scientists used the Venus transit - a very rare event where a planet passes between Earth and the sun, appearing to us as a dark dot steadily making its way across the sun's bright face - to make measurements of how the Venusian atmosphere absorbs different kinds of light. This, in turn, gives scientists clues to exactly what elements are layered above Venus's surface. Gathering such information not only teaches us more about this planet so close to our own, but it also paves the way for techniques to better understand planets outside our solar system.

Transits of Venus are so rare that they only happen twice in a lifetime. About every 115 years, Venus will appear to cross over the face of our home star twice, with eight years passing between the pair of transits. This stunning phenomenon is not only incredible to watch, but it provides a unique opportunity for scientific observations of one of our nearest neighboring planets.

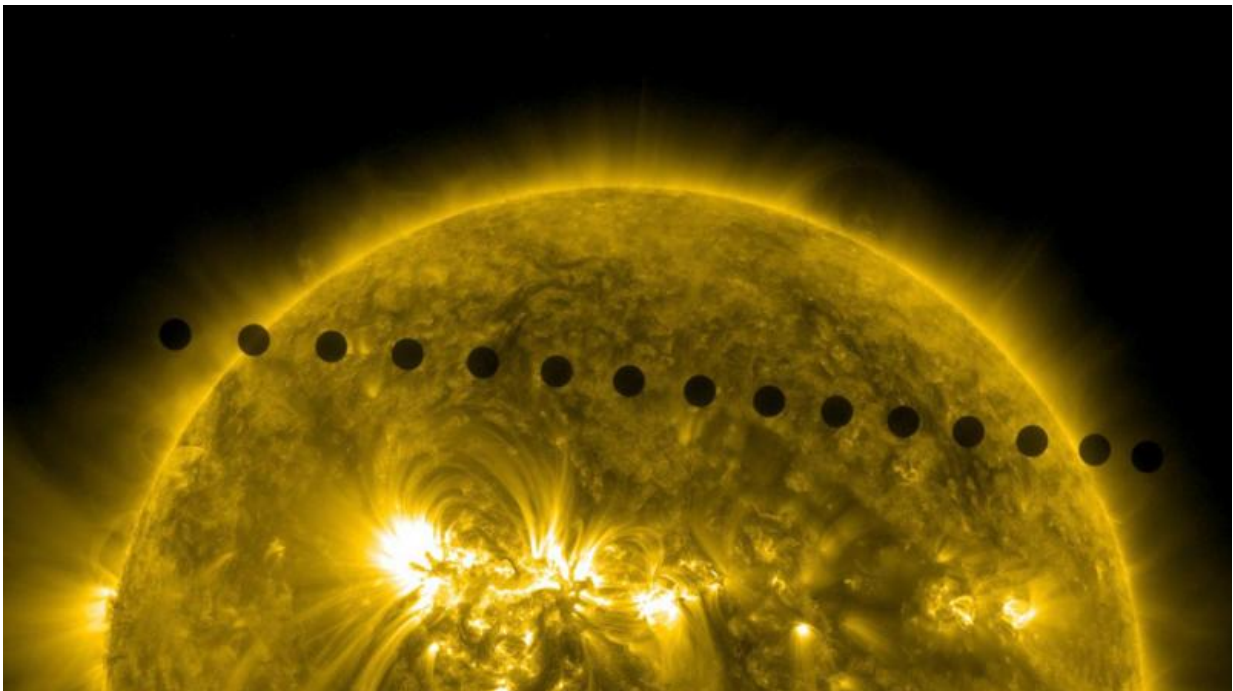
NASA'S Solar Dynamics Observatory, or SDO, and the joint Japanese Aerospace Exploration Agency and NASA's Hinode mission took pictures of the entire event in several wavelengths of light. A team of scientists led by Fabio Reale of the University of Palermo used these pictures to watch the backlit planet as it crossed in front of the sun. By observing the planet's [atmosphere](#) in different wavelengths of light during its journey, they learned more about what kinds of atoms and molecules are actually in its atmosphere. This work was published in [Nature Communications](#) on June 23, 2015.

Just as on Earth, each of the layers of Venus' atmosphere absorb light differently from one another. Some layers may completely absorb a certain wavelength of light, while that same wavelength can pass right through another layer. As Venus passes across the face of the sun—which emits light in almost every wavelength of the

electromagnetic spectrum—scientists get a rare chance to see how all different types of light filter through Venus's atmosphere.

A layer in the [upper atmosphere](#) around Venus—called the thermosphere—absorbs certain high-energy wavelengths of light. When looking at the planet against the sun in one of these high-energy wavelengths, the thermosphere will appear opaque, rather than transparent as it does in visible light.

"Radiation goes into the atmosphere and is absorbed, creating ions and a layer of the atmosphere called the ionosphere," said Dean Pesnell, SDO project scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Because the energy in this light is captured by the ions, it is not re-emitted on the other side. In certain wavelengths, Venus's atmosphere is as solid as a wall, blocking light from traveling to our eyes. To our telescopes, the atmosphere is as dark as the planet itself—so, Venus will appear to have a different size, depending on the wavelength of the telescope's pictures.



Composite of images of the Venus transit taken by NASA's Solar Dynamics Observatory on June 5, 2012. The image, taken in 171 angstroms, shows a timelapse of Venus's path across the sun in 2012. Credit: NASA/Goddard/SDO

Reale and his team chose images of the Venus transit taken in several X-ray and ultraviolet wavelengths and measured the apparent size of the planet to within several miles. For each set of pictures, the team calculated just how large the atmospheric blocking was—a measure of how high in Venus' atmosphere that particular wavelength of light is completely absorbed.

Because the various types of atoms absorb light slightly differently, the height of this light absorption lets scientists know how many and what types of molecules make up Venus's atmosphere. This information is important for planning missions to Venus, as those ions and molecules can change the amount of course-altering drag a spacecraft feels.

"Learning more about the composition of the atmosphere is very important for understanding the braking process for spacecraft when they enter the upper atmosphere of the planet, a process called aerobraking," said Reale.

The shape of Venus' atmosphere also gave scientists important clues to how the sun impacts the atmosphere. "If the atmosphere observed were asymmetric, that could tell us more about how the star is impacting the planet," said Sabrina Savage, NASA project scientist for Hinode.

During the transit, only the sides of the atmosphere could be seen, but they were particularly interesting areas. From the perspective of Venus,

these were the areas where day turns into night and night turns into day—on Earth, these transition areas can host interesting effects in the ionosphere. The data from the Venus transit showed that these two transition areas are virtually the same.

"The planet appeared very round in all wavelengths," said Pesnell. "If the transition from day to night were different from the transition from night to day, you would expect a bulge in the atmosphere on one side of the planet."

Studying the Venus transit can also help improve studies of planets around other stars. Such exoplanets are often discovered by transits just like this, as we can detect the very small amount of [light](#) the planets block as they pass across their home star. The more we can observe transiting [planets](#) close to home the more it will teach us about how to study distant exoplanets that we can't currently see in as much detail. When instrument technology advances, we may be able to gather better information about the atmospheres of such exoplanets as well.

"In the future, there might be missions that have enough sensitivity to detect the difference in radius in different wavelengths," said Reale. "In particular, if there are exoplanets with an extremely thick thermosphere, the size difference in different wavelengths will be larger and there will be a better chance of detecting the change."

Provided by NASA's Goddard Space Flight Center

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