



Extrait du Observatoire de Paris

<http://www.obspm.fr/5th-6th-june-2012-transit-of-venus-in-front-of.html>

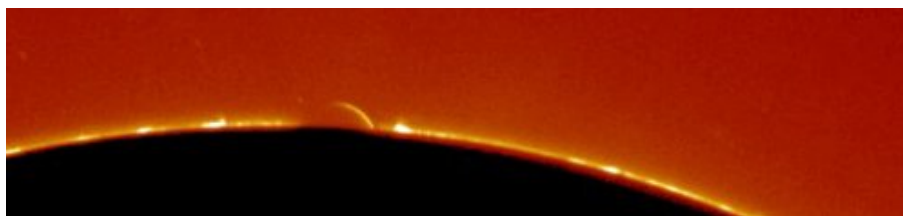
5th-6th June 2012 : transit of Venus in front of the Sun. A new instrument. A french scientific expedition



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Observatoire de Paris

This will be the last time this century. Between the 5th and 6th of June, 2012, the planet Venus will transit in front of the Sun. This is a rare phenomenon, but it is a rich source of information about the atmosphere of the « Evening Star ». Astronomers world-wide are organizing themselves to observe the transit from Asia, the Pacific, America ... Among them, French astronomers have foreseen unusual observations and are preparing to leave, in the tracks of their illustrious predecessors, such as James Cook, Cassini de Thury in the XVIIIth century and Jules Janssen in the XIXth. Nine mobile telescopes, five major solar observatories and six satellites will be involved. At stake : prepare the search for other, distant and maybe inhabited, worlds. At the head of this mobilisation, two scientists from the Observatoire de Paris and the Observatoire de la Côte d'Azur, have devised a special and original instrument - the cytherograph.



Lever d'un croissant de Vénus sur le Soleil, lors du passage du 8 juin 2004 (Sylvain et André Rondi)

This will be an exceptional opportunity. Transits of Venus happen in pairs separated by eight years, at intervals of a century. The last ones took place in : in 1761 and 1769, 1874 and 1882, then June 8th 2004. Each time, teams from the Observatoire de Paris the Observatoire de Nice worked in close association with international campaigns and with the maritime expeditions which were organized. The names of James Cook (1728-1779), César-François Cassini de Thury (1714-1784), Guillaume Le Gentil de la Galaisière (1725 - 1792), Jules Janssen (1824-1907) and Henri-Joseph Perrotin (1845-1904) are brilliant reminders of these actions. And again in 2004 encore, the transit of Venus in front of our star led to an unprecedented pedagogical operation. Piloted by the Institute of celestial mechanics and ephemeris calculations (l'Institut de mécanique céleste et de calculs des éphémérides) of the Observatoire de Paris, it was possible to reproduced the determination of the size of the solar system : it was a resounding popular success. For the first time also, new information about the Venusian atmosphere was obtained, and gave rise to a collaborative effort between two scientists from the Observatoire de Paris and from the Observatoire de la Côte d'Azur. They have decided to continue their scientific adventure in 2012.

This year, in effect, Venus is again preparing to slide in front of the bright solar disc, on Tuesday June 6th from 0h10 to 6h50 French civil time. Thus, in mainland France, the spectacle will be shortened to just the last hour, at Sun rise.

Overseas territories and departments in the Pacific however, will have front seats. Nouvelle-Calédonie as well as Polynesia, the Tahiti islands and the archipelagos of Wallis-et-Futuna, Tuamotu and the Marqueses will benefit fully. However, great care must be taken to adhere scrupulously to the advice concerning solar observation given in the box at the end of this press release.

A specially tailored scientific expedition

For this exceptional event, the scientists will go to the Pacific area, to Asia or to America. Their objective is to obtain new data, till now considered as inaccessible, on that part of the Venusian atmosphere which is above the clouds, at an altitude of 70 km. This is an essential, but still badly known, item in the climatology of Venus. This planet, the twin of our Earth, comparable in size and mass, has nevertheless evolved completely differently : in effect, a formidable green-house effect is responsible for surface temperatures of up to 465°C, temperatures at which tin and

lead will melt. The apparent youth of its surface, even the colour of its clouds, are still a mystery.

To achieve a successful mission, a whole panoply of instruments will be deployed on the Earth and in space, in order to study simultaneously the atmosphere of Venus, observed by transmitted light against the solar disc. The intense luminous ring, the « aureole », which surrounds Venus at the start and end of the transit, will be studied for the first time at different wavelengths.

More details about exoplanets

Over and above the new information which these observations will produce, scientists are being presented with an opportunity to use the atmosphere of Venus as a standard for the study of exoplanets. In effect, the transit of the Evening Star in front of the Sun emulates the transit of an extrasolar terrestrial sized planet in front of its star. The CNES satellite CoRoT and NASA's Kepler satellite, as well as the ground-based telescopes such as those of ESO, have already detected over 750 such exoplanets¹, orbiting relatively neighbouring stars not unlike our Sun. However, it is not enough to know how far the planet is from its star in order to determine if life is possible there. By characterizing their atmospheres, a new step will be taken in the study of these new worlds. And that is precisely the step which the collaboration established by Thomas Widemann of the Observatoire de Paris and Paolo Tanga of the Observatoire de la Côte d'Azur, hope to take.

Nine cytherographs

To do this, the two scientists have perfected an original version of the astronomical telescope. which they have baptised the cytherograph, from the name of Cythera, the Greek island which was the sanctuary of the goddess Aphrodite, in the Aegean sea between the Peloponnesus and Crete. With a diameter of 9 cm, 9 copies have been made, for a total unit cost of 1 400 Euros the unit. The Observatoire de Paris, the Observatoire de la Côte d'Azur, the CNRS, the European Space Agency - ESA - and the Paris Diderot University have helped finance the project. The design of the instruments is inspired by the coronagraph, perfected by Bernard Lyot in 1930 in order to block the blinding light of the Sun. They are tailored to the size of Venus and the aureole which forms as the transit approaches. In order to take into account the effect of the mists in the atmosphere of Venus which the Venus Express mission (sent by the European Space Agency ESA) discovered, each instrument will operate in a different spectral range. The cytherographs, manufactured and assembled at the Observatoire de la Côte d'Azur, will be installed in specially chosen regions (Svalbard in Europe, the Extreme East, Central Asia, the West coast of America and Australia) by experienced teams ; each station will be autonomous.

The scientific expedition

Equipped with the cytherographs, the participants participants in the Venus Twilight Experiment (« expérience du crépuscule sur Vénus ») expedition, will be based at :

- the solar observatory at Haleakala, Maui, Hawaii
- the Pirka observatory at Nayoro, Hokkaido Island, Japan
- the Moondara locality in the vicinity of Mount-Isa, Southern New Wales,, Australia
- the astronomical observatory of Tien Shan, Almaty, Kazakhstan
- the solar observatory of Udaipur, Rajasthan, India
- a mobile station at Longyearbyen, Svalbard island, Norway, Arctic Ocean Lowell Observatory, Flagstaff, Arizona

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- a mobile station at Nuku Hiva, the Marqueses Islands
- the Khurel Togout observatory, Oulan-Bator, Mongolia, with another kind of telescope.

In parallel, observations using large professional telescopes will be carried out at Sacramento Peak (New Mexico), Kitt Peak (Arizona), Haleakala (Hawaii), Udaipur (India) et Yunnan (China). The state-of-the-art techniques which will be used include the Fabry-Perot spectro-imager and adaptive optics enabling 20 km size details in the atmosphere of Venus to be distinguished.

This setup will be enhanced by data from five satellites in orbit around the Earth and Venus : Venus Express (ESA), the euro-american Hubble space telescope (ESA/NASA), the Japanese Space Agency's (JAXA's) Hinode (Solar B), CNES' Picard and NASA's Solar Dynamics Observatory SDO. Finally, even the euro-american Cassini mission now in orbit around Saturn will be put to work. Since, by the luck of the ephemeris, a solar transit of Venus will also be visible ... from Saturn in December 2012.

New scientific ambitions

This saga will be a test bed for future techniques designed to analyse the structure, composition and dynamics of Earth-sized bodies. Exoplanet research will surely end up by finding Venus or Earth sized planets in the habitable zone of their star. Now, these two bodies are almost identical sister planets which have evolved very differently. If Venus were a transiting exoplanet, what could we deduce about its physical characteristics ? About its chemical composition ? Which measurements would be open to discussion ? The objective is to discover the spectral signature of Venus, and to test the detection limits for its atmospheric composition, which in fact we already know.

This work will prepare the ground for the Exoplanet Characterization Observatory (Echo) mission, proposed to ESA for launch in 2024. A Soyuz rocket, carrying a 1.26m telescope will be launched from Guyana. The objective will be to probe the atmospheric physics and chemistry of a significant and representative sample of about one hundred exoplanets, which will include hot Jupiters, frozen Neptunes and temperate super-Earths.

In the meantime, the next solar transits of Venus will take place on December 11th 2117 and December 8th 2125.

Take great care of your eyes !

We remind the public - and children - that one must never look at the Sun with the naked eye, nor through a binoculars nor a refractor nor a telescope. Retinal lesions will form immediately and are irreparable. You must use recent good quality « eclipse glasses », certified CE.

Collaboration

The French scientists involved in the expedition to observe the transit of Venus on the 5th-6th of June 2012 are members of :

the LESIA2 department and the l'IMCCE3 of the Observatoire de Paris

(Thomas Widemann, François Colas, Frédéric Vachier, Jérôme Berthier, Pedro Machado, Sylvain Bouley, Lucie Maquet, Vincent Coudé du Foresto)

the Lagrange4 laboratory of the Observatoire de la Côte d'Azur

(Paolo Tanga)

the Canada-France-Hawaii Telescope CFHT

(Christian Veillet)

Notes

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1. Consult the site <http://exoplanet.eu/>. updated regularly, it maintains a list of the known and confirmed exoplanets.
2. The Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique LESIA is a department of the Observatoire de Paris. It is associated with the CNRS, the Pierre and Marie Curie University and with the Paris Diderot University.
3. The Institute of celestial mechanics and ephemeris calculations is an Institute of the Observatoire de Paris. It is associated with the CNRS, with the Pierre and Marie Curie University and with Lille 1 University.
4. The Lagrange laboratory is a unité mixte de recherche of the Observatoire de la Côte d'Azur governed by the Nice Sophia Antipolis University, the CNRS and the OCA.

Reference

Sunlight refraction in the mesosphere of Venus during the transit on June 8th 2004, published in March 2012 in the journal Icarus.

More details

The Venus Twilight Experiment on the site of the Observatoire de la Côte d'Azur. The photographs and short videos of the aureole will soon be uploaded onto the wiki of the site.

2012 : the solar transit of Venus on the site of the IMCCE - Observatoire de Paris.

Prediction of the exact times, as a function of the observer's location IMCCE - Observatoire de Paris

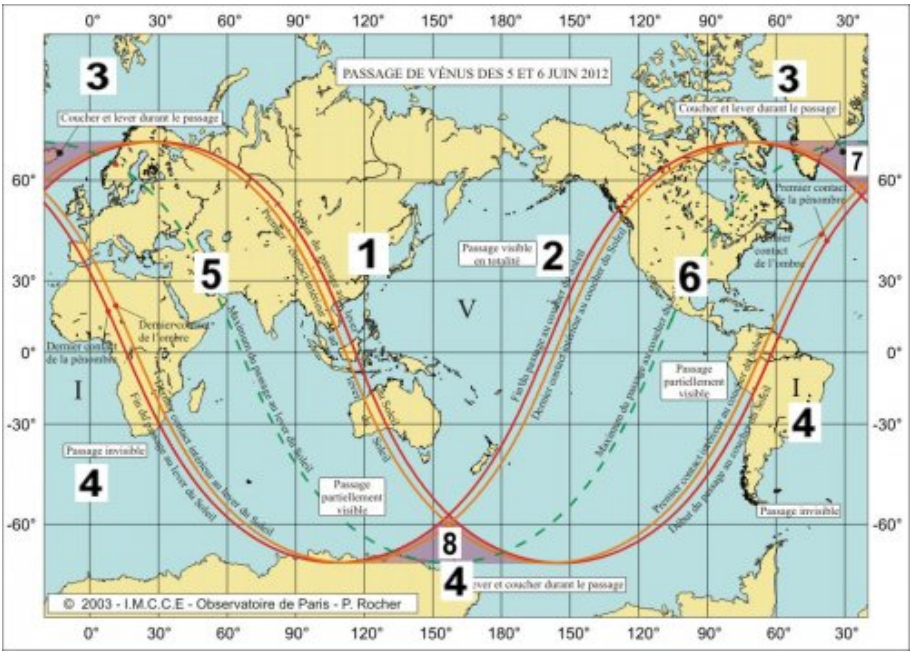
History of the transits : XVIIth, XVIIIth and XIXth centuries, including an animated video showing the observations of Jules Janssen in 1874 in Japan with his photographic revolver.

The Transit of Venus - 5th-6th June 2012 on the Europlanet site, including a list of the interviews of European scientists, available on request.

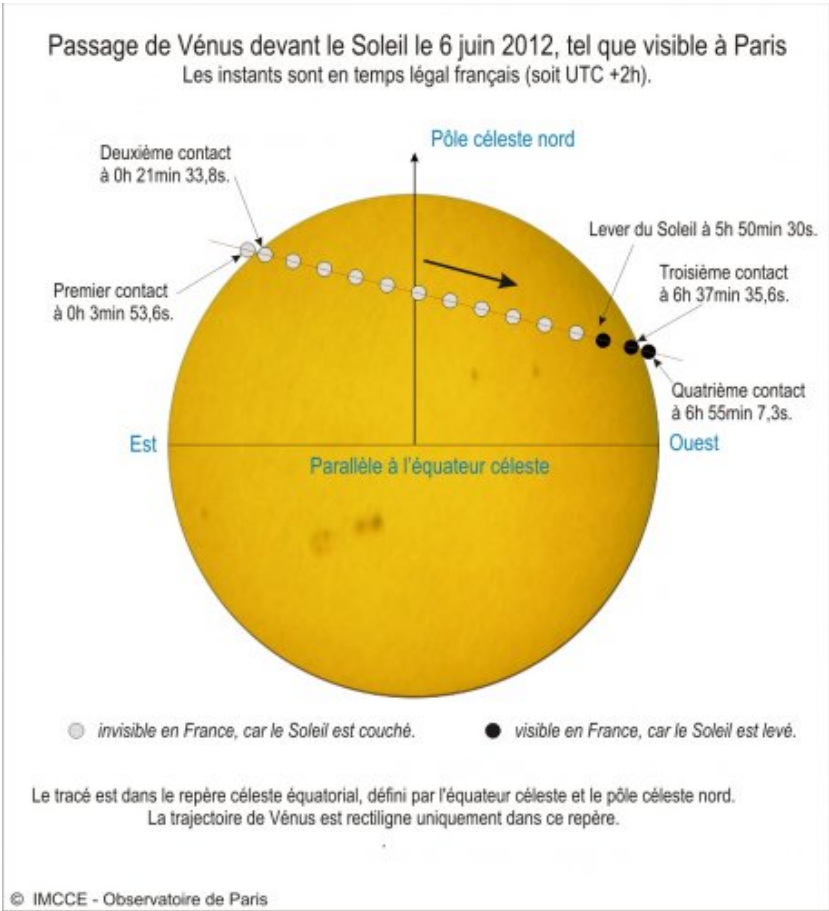
Images

Multimedia resources available for journalists

- ▶ Video. Solar transit of Venus on June 8th 2004, recorded using the heliograph on the Meudon site of the Observatoire de Paris.
- ▶ Video. Solar transit of Venus on June 8th 2004, observed by the Nasa's Transition Region and Coronal Explorer Trace satellite.



► The progress of the transit of June 6th 2012, seen from Paris.



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- ▶ Emplacement of the French cytherographs around the Pacific

Visibility map. The phenomenon is well visible from the Asia Pacific region.

Afficher les coronographes de l'expérience crépuscule sur Vénus sur une carte plus grande.