Internet Project

Observing, Photographing and Evaluating the Transit of Venus, June 8th, 2004

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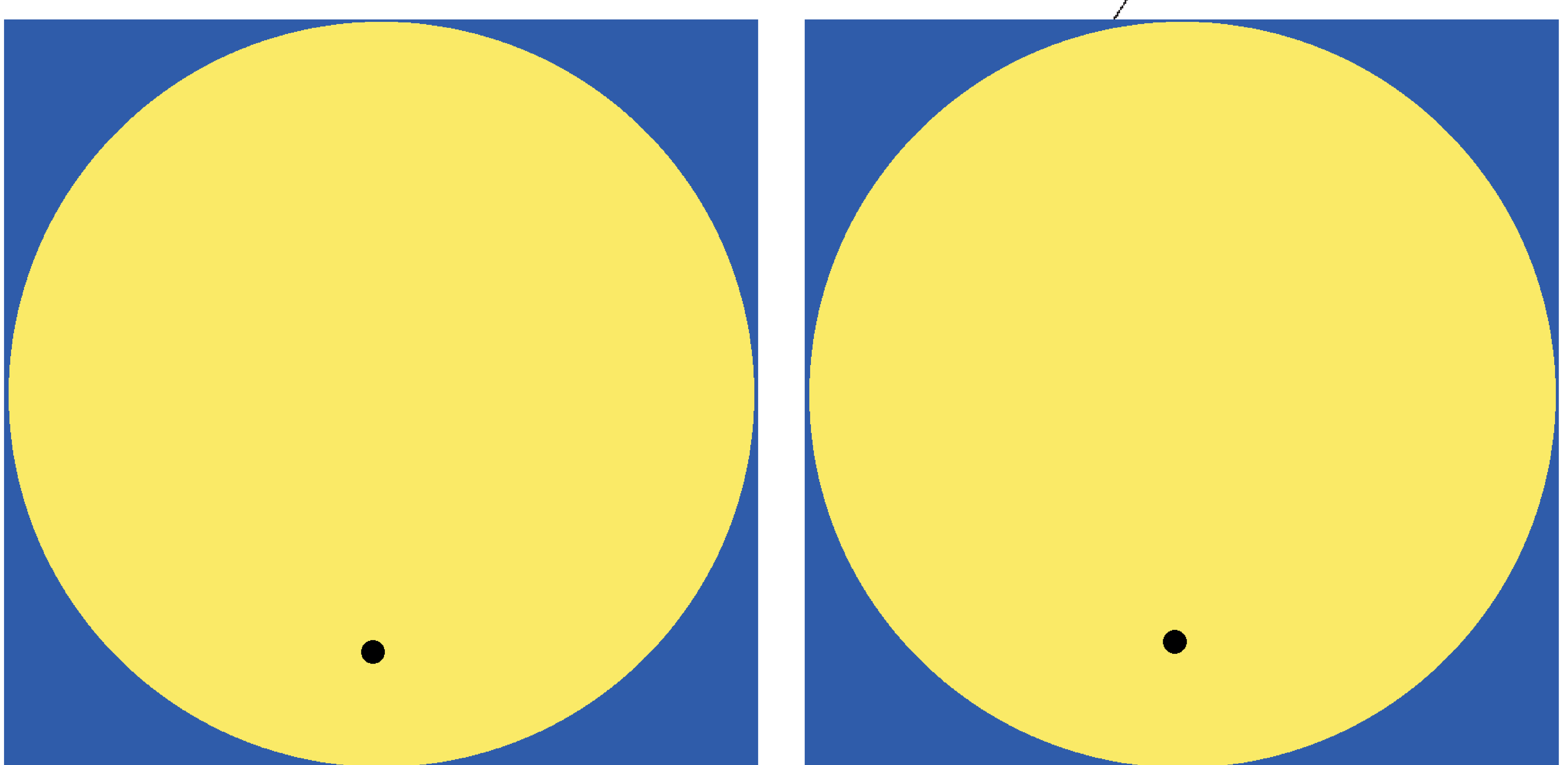
http://didaktik.physik.uni-essen.de/~backhaus/VenusProject.htm
http://www.stadtgymfw.de/venus/index.htm

On June 8th, 2004 Venus will pass the sun's disc - an event the last of which happened in 1882. Those so called **Venus transits** played an important role for the determination of the distance between the sun and the earth, the so called **Astronomical Unit**.



Pictures simultaneously taken from Essen (left) and Windhoeck (calculated prediction for 9.00 UT)

The passage looks slightly different when observed from different locations on earth. This so called parallax effect is due to the distance between Venus and earth or, more precisely, due to the ratio of the distances to the sun and to Venus. Therefore, measurements of the parallax effect allow the derivation of the distance to the sun.

But the angular differences are smaller than the apparent radius of Venus. They can be recognized only by exact measurements and by combinating simultaneously taken pictures. Therefore, an international cooperation between schools, amateur astronomers and universities has just started to prepare careful observations of the transit.

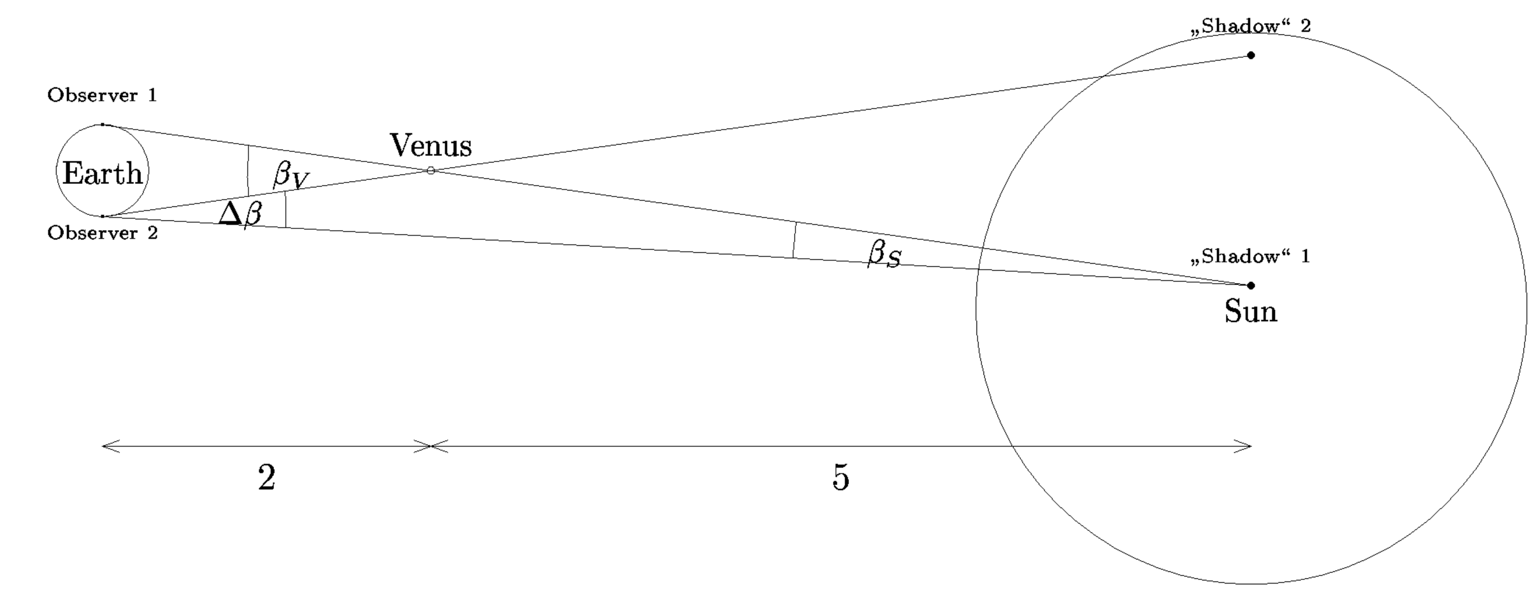
Projects for Preparation: Determination of
* the geographical positions (latitude and longitude) of the participants,,
* the radius of the earth,
* the orbital radius of Venus (without using Kepler's third law!),
* the siderical period of Venus and
* the dates at which Venus passes the nodes of her orbit.

Main goals of the project:
* to form new contacts between schools, amateur astronomers and universities,
* to get acquainted with internet collaboration,
* to gather information due to transits of Venus in history,
* to learn photographing the sun and determing the exact direction to north,
* to learn determing the exact position of an object on the sun's disc,
* to learn the mathematical methods of evaluating observations made from different locations and, finally,
* to get an own measure for the distance to the sun.

Daylight side of the earth when Venus enters the sun: From this part of the world the 1rst and 2nd contact can be observed.

Daylight side of the earth when Venus leaves the sun: From this part of the world the 3rd and 4th contact can be observed.

Some theory:



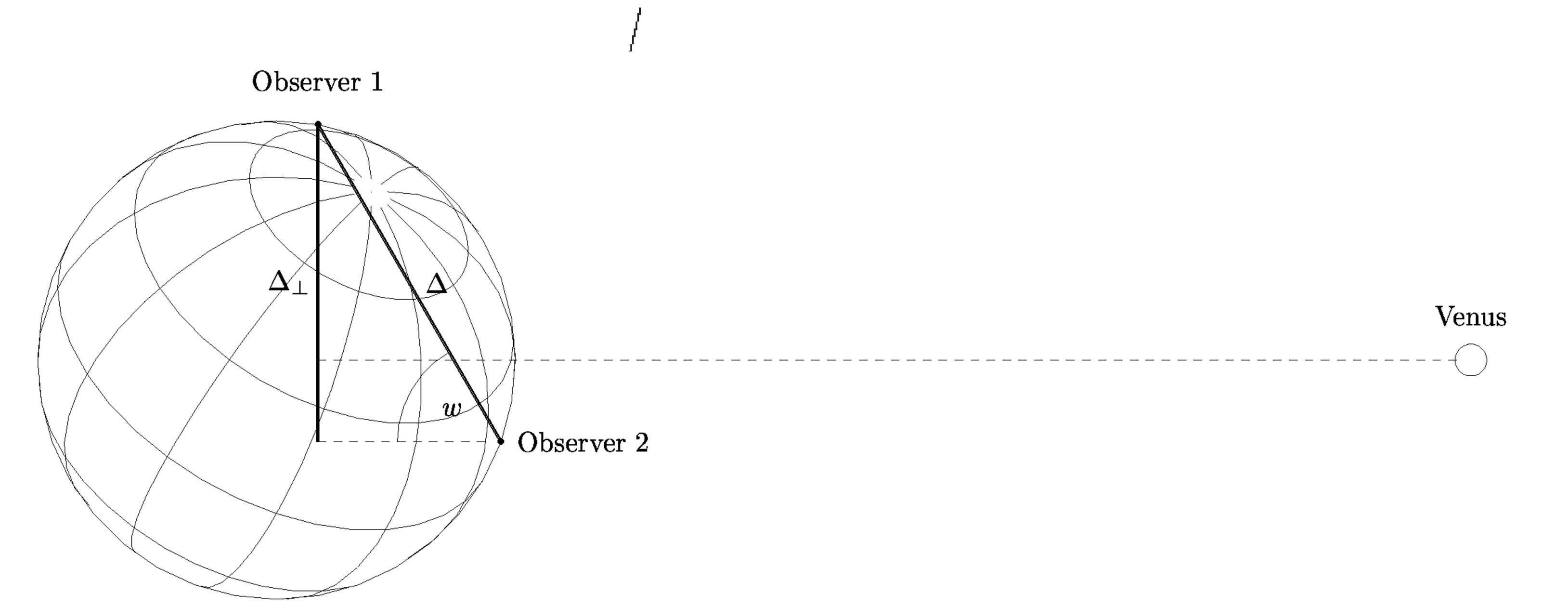
Usual explanation: Both "shadows" have positions on the sun with an angular difference of $\Delta\beta$

The following relation can easily be shown:

$$\Delta\beta = \beta_V - \beta_S$$

Because the relative distances of sun, Venus and earth are known the following relation holds:

$$\Delta\beta = \frac{r_E}{r_E - r_V}\beta_S - \beta_S \quad \Longrightarrow \quad \beta_S = \left(\frac{r_E}{r_V} - 1\right)\Delta\beta$$



In the more general case, the real distance between the both observers and the projection angle must be taken into account. Therefore, the final relation between measurable quantities and the Astronomical Unit is:

$$\boldsymbol{\pi_S} = \frac{\boldsymbol{R_E}}{\boldsymbol{\Delta \sin w}}\left(\frac{\boldsymbol{r_E}}{\boldsymbol{r_V}} - 1\right)\boldsymbol{\Delta\beta}$$

- π_S : parallax of the sun
- R_E : radius of the earth
- w : angle of projection
- $\frac{r_V}{r_E}$: relative radius of Venus' orbit
- $\Delta\beta$: parallactic displacement