# Venus Transit 2004

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# The Observations and the Results from the Taurus Hill Observatory

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# Contents

# Introduction

Taurus Hill Observatory (THO) participated to the Venus Transit 2004 observation campaign that was organized by the European Southern Observatory (ESO). The research team of the Taurus Hill Observatory had a good fortune because the weather was very good during the transit despite the bad forecasts. Research team managed to measure all four contacts and took over 12000 individual pictures from the transit. In this document the results of the measurements and the used equipment are presented. This research campaigns main purpose was to measure the distance between the Sun and the Earth.

# Chapter 1

# The Research Team

## 1.1 People Behind the Measurements

There were five people who made the most of the measurements and the photographing. These people were Harri Haukka, Jari Juutilainen, Markku Nissinen, Veli-Pekka Hentunen and Henri Taino. Haukka and Juutilainen operated the main telescope and the camera, rest of the team made contact measurements with other telescopes (TAL-1 and Helios Skyliner).

## 1.2 Meetings in Brandys nad Labem and Paris

Harri Haukka and Jari Juutilainen participated one month before the actual Venus transit to a conference that was organized by the ESO in Brandys nad Labem, April 2004. In this conference the teams all over the Europe presented their plans for the transit day and the activities what they intend to organize. Taurus Hill Observatory's research team also presented their plans about the making of the measurements.

After the transit Harri Haukka participated to "The Venus Transit Experience" -conference that was held in Paris, November 2004. There all teams told how their plans realized and what kind of results they got.

Figure 1.1: Conference in Brandys nad Labem, Czech Republic, April 2004.

Figure 1.2: "The Venus Transit Experience" -conference in Paris, November 2004.

# Chapter 2

# The Equipment Used for Measurements

## 2.1 Telescope

The used telescope was standard 12 inch Meade LX200GPS UHTC that was bought to the Taurus Hill Observatory in the end of the year 2002. Telescope is Schmid-Cassegrain type of telescope with 3048 mm optical length. The main mirror is 12 inch, which is about 305 mm. The focal length, due these parameters, is F10 (optical length / main mirror diameter).

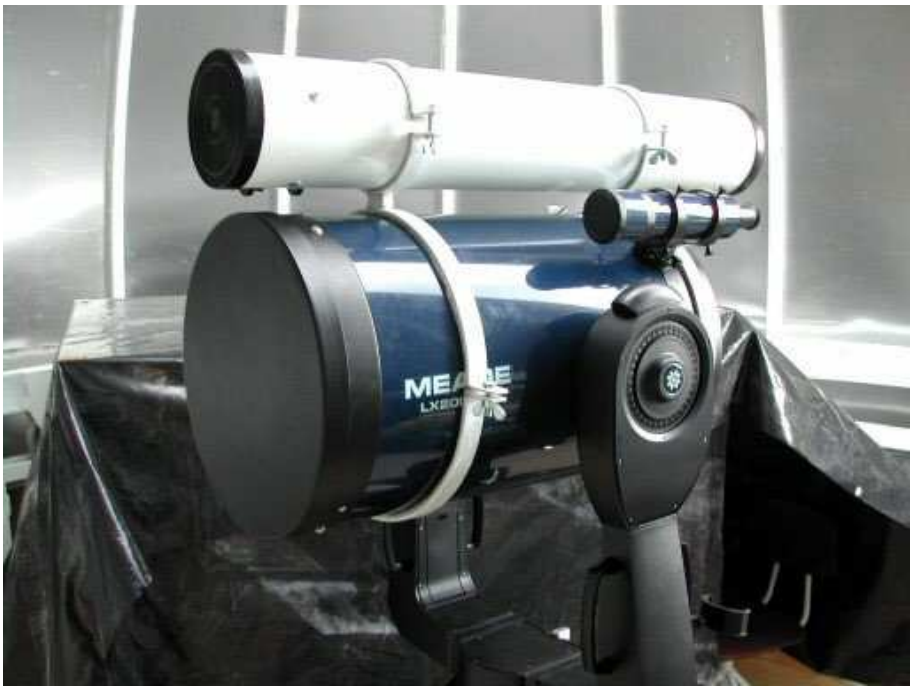

Figure 2.1: 12 inch Meade telescope with TAL-1 mounted on the top of it.

## 2.2 Camera

The camera that was used for photographing and measurements was also manufactured my Meade. The model of the camera was Meade LPI (Lunar Planetary Imager) and it was attached to the 12 inch Meade telescope. The LPI -camera is a VGA resolution (650x380 pixels) color CMOS chip camera. It is mainly designed for planetary and lunar photographing, but with the special Sun filter, it can be used for Sun observations also. Camera is very easy to use and therefore it was a perfect choice for the research team that has not so much experience in field of astronomical photographing.

Figure 2.2: Meade LPI -camera was ideal choice for Venus Transit.

## 2.3 Sun Filter

Because the Sun is so bright and you should never observe it without a proper filter, research team decided to use a AstroSolar film based filter in Meade telescope. The research team manufactured a large film filter that was attached to the front of the telescope optical tube. Research team tested two kind of filters, D3.5 and D5.0, and the D3.5 was chosen for the measurements.

Figure 2.3: AstroSolar type of film filter that was used in all telescopes during the Venus transit.

# Chapter 3

# The Measurements and the Results

## 3.1 Measurements

As described in chapter 2, the THO research team made it measurements with the 12 inch Meade LX200GPS UHTC -telescope and Meade LPI -camera. Research team took over 12000 pictures from the transit. The detailed measurements are based on these the pictures and the time stamps that they have. The time of the computer clock was checked out many times and the time variations are not more than a few seconds.

The first contact was missed by the camera group (Haukka and Juutilainen), because the correct place of the Suns disk where the Venus appears, wasn't so well known by the research team. Despite that, the second observation group (Nissinen, Hentunen and Taino) managed to get the first contact with good accuracy. The second, the third and the fourth contacts were also measured by the camera group.

The weather was good during the transit. Only the last 20 minutes were a little bit challenging, but the weather was good enough for making the needed measurements.

### 3.1.1 The Meaning of the Contacts

The thing that was crucial for successful measurements was the determing of the contacts T1 to T4. The first contact (T1) happens when the disk of the Venus touches the disk of the Sun. Second contact (T2) happens when the disk of the Venus is fully on the disk of the Sun. Third contact (T3) happens when the disk of the Venus touches the disk of the Sun again. The fourth and final contact (T4) happens when the disk of the Venus is fully off the disk of the Sun.

## 3.2 Results

Research team managed to get measurements from all four contacts and in this section the final measurements, tables and contact pictures are presented.

### 3.2.1 Measurements and Tables

In tables 3.1 to 3.4 (and pictures 3.1 to 3.4) are the four different results that research team calculated. In table 3.1 and figure 3.1 are the camera groups results combined to theoretical result and other observers results from the rest of the world. Table 3.2 and figure 3.2 presents the observing teams results combined to theoretical result and other observers results. Table 3.3 and figure 3.3 presents the observing teams and camera groups combined results combined to theoretical result and other observers results. And finally, the table 3.4 and figure 3.4 shows the camera groups results that is calculated from the pictures and combined to theoretical result and other observers results.

Table 3.1: Camera group result

| | |
|---|---|
| 1. contact: | Did not get |
| 2. contact: | 05.37.04 UT, error 0.454 % |
| 3. contact: | 11.01.51 UT, error 0.085 % |
| 4. contact: | 11.20.34 UT, error 0.311 % |
| | |
| Average AU: | 149569277 km |
| Average error: | 0.019 % |

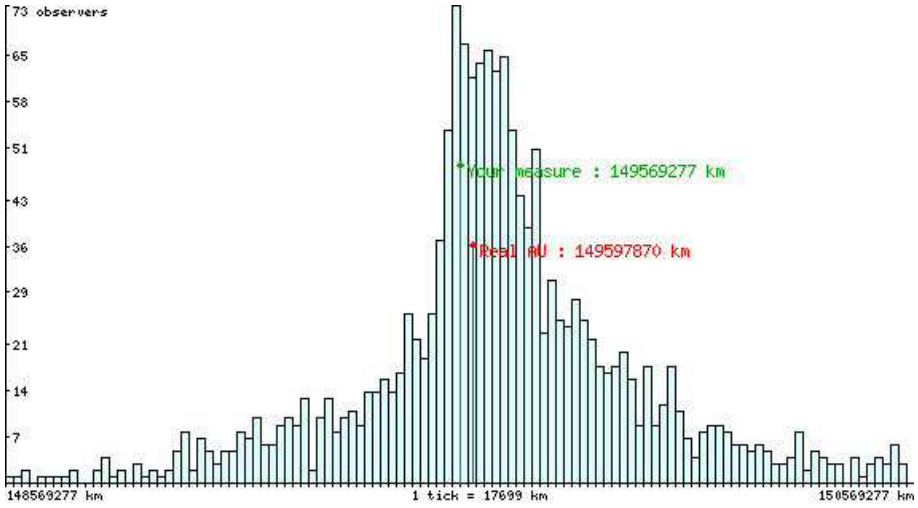


Figure 3.1: 12 inch Meade LX200GPS -telescopes results (ESO).

As the results shows, the measurements that were made in Taurus Hill Observatory were very good and therefore the Venus Transit 2004 campaign was very successful for the observatory and the research team.

Table 3.2: Observing teams results

| | |
|---|---|
| 1. contact: | 05.18.59 UT, error 0.036 % |
| 2. contact: | 05.37.09 UT, error 0.427 % |
| 3. contact: | 11.01.34 UT, error 0.177 % |
| 4. contact: | 11.15.45 UT, error 1.882 % |
| | |
| Average AU: | 150221967 km |
| Average error: | 0.417 % |

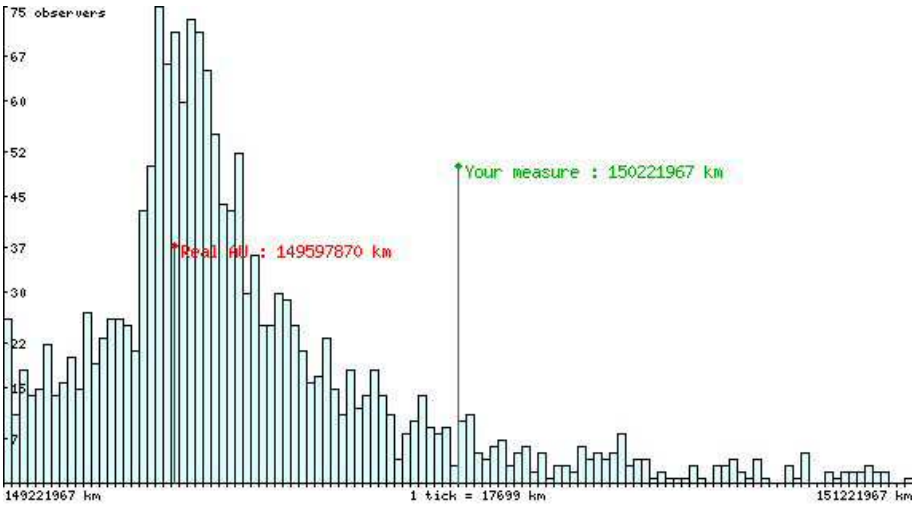


Figure 3.2: TAL-1 and Helios Skyliner -telescopes results (ESO).

Table 3.3: Observing groups and camera groups combined results

| | |
|---|---|
| 1. contact: | 05.18.59 UT, error 0.036 % |
| 2. contact: | 05.37.04 UT, error 0.454 % |
| 3. contact: | 11.01.51 UT, error 0.085 % |
| 4. contact: | 11.20.34 UT, error 0.311 % |
| | |
| Average AU: | 149589908 km |
| Average error: | 0.005 % |

### 3.2.2 The Contact Pictures

As mentioned, the camera group managed to photograph the contacts two, three and four, but missed the first one. In figures 3.5 to 3.7 are presented the photographed contacts.

These picture were used when the camera group determined the exact con-

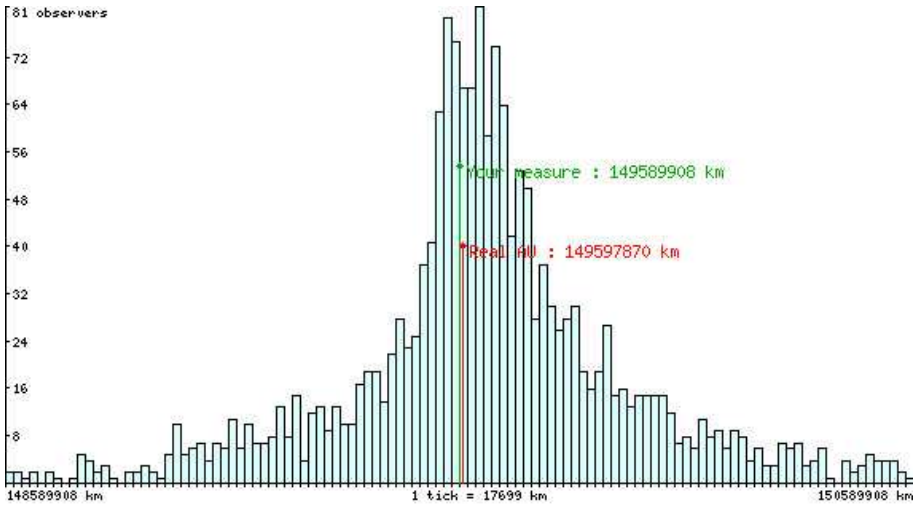


Figure 3.3: Combined result (ESO).

Table 3.4: Camera groups results from pictures (+observing groups T1)

| | |
|---|---|
| 1. contact: | 05.18.59 UT, error 0.036 % |
| 2. contact: | 05.38.22 UT, error 0.033 % |
| 3. contact: | 11.02.13 UT, error 0.034 % |
| 4. contact: | 11.21.28 UT, error 0.021 % |
| | |
| Average AU: | 149594215 km |
| Average error: | 0.002 % |

tact times (see 3.4 and table 3.4).

## 3.3 More information About the Results of the Venus Transit 2004

More information about the Venus Transit 2004 can be found from the ESO homepages (http://www.eso.org/public/outreach/eduoff/vt-2004/index.html) and THO's Project pages (http://projects.taurushill.net/vt2004/). You can also write email to THO research team members to address harri.haukka@wkassiopeia.net.

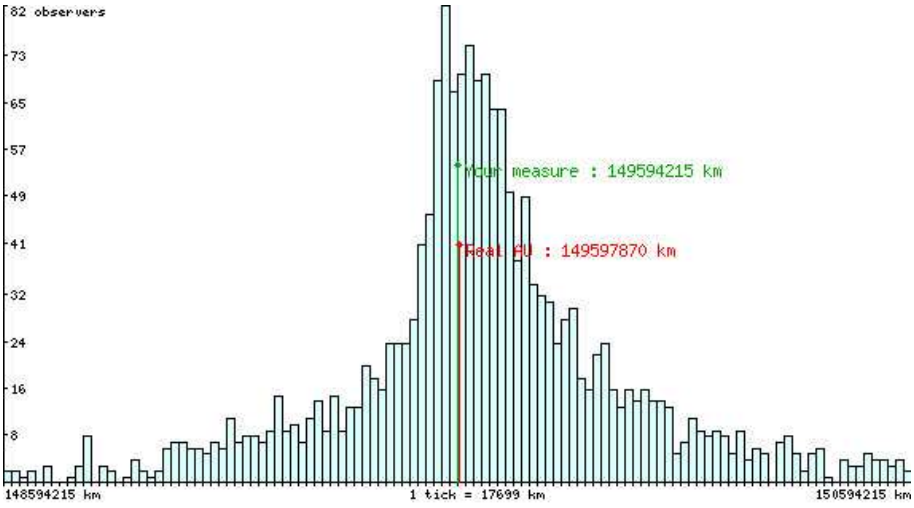


Figure 3.4: Combined results from pictures (ESO).

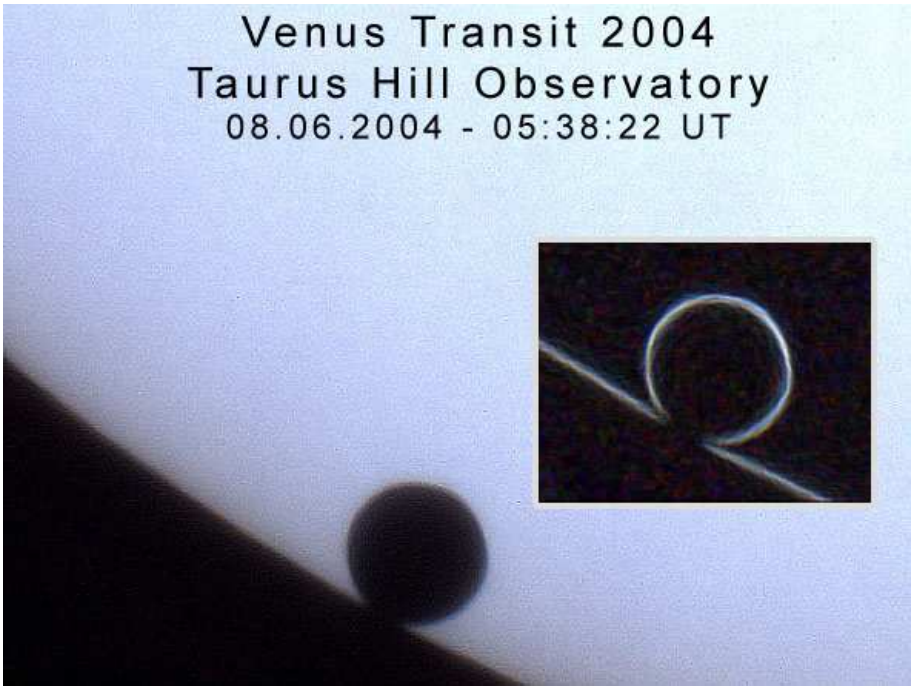


Figure 3.5: Second contact.

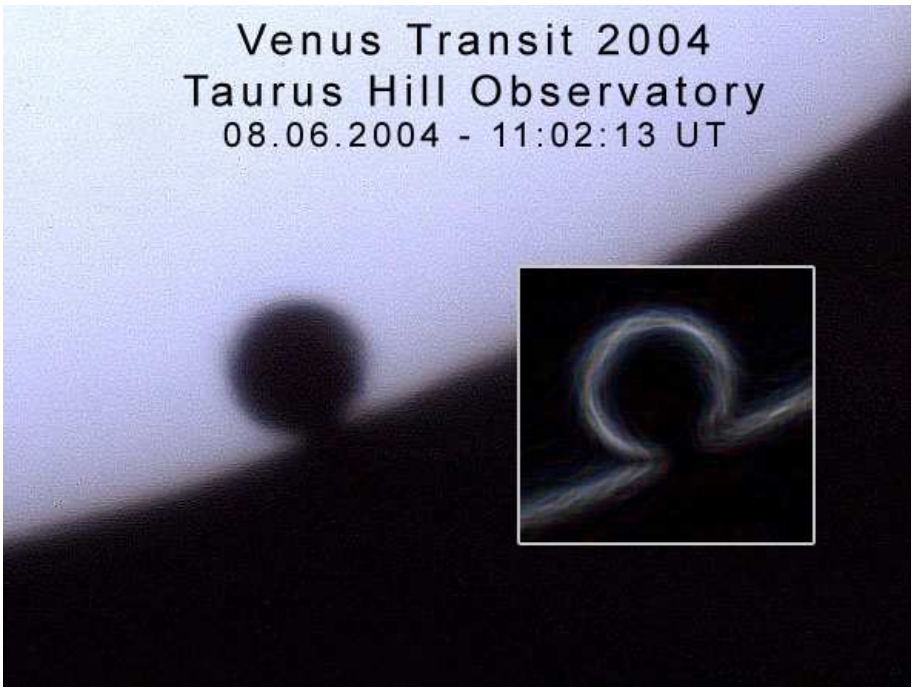


Figure 3.6: Third contact.


Figure 3.7: Fourth and final contact.

# Acronyms

**AU** Astronomical Unit

**ESO** European Southern Observatory

**GPS** Global Positioning System

**LPI** Lunar Planetary Imager

**THO** Taurus Hill Observatory

**UHTC** Ultra High Transmission Coating

**UT** Universal Time