Venus Transit 2012

Expeditions to Svalbard (Norway), and Canberra (Australia)

EPSC2012-687 2012-09-27

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Contents of the presentation:

- Historical importance of the Venus transit
- The Venus Transit 2012 expeditions to Svalbard and Canberra
- Some results of the observations

Historical importance of the Venus transit

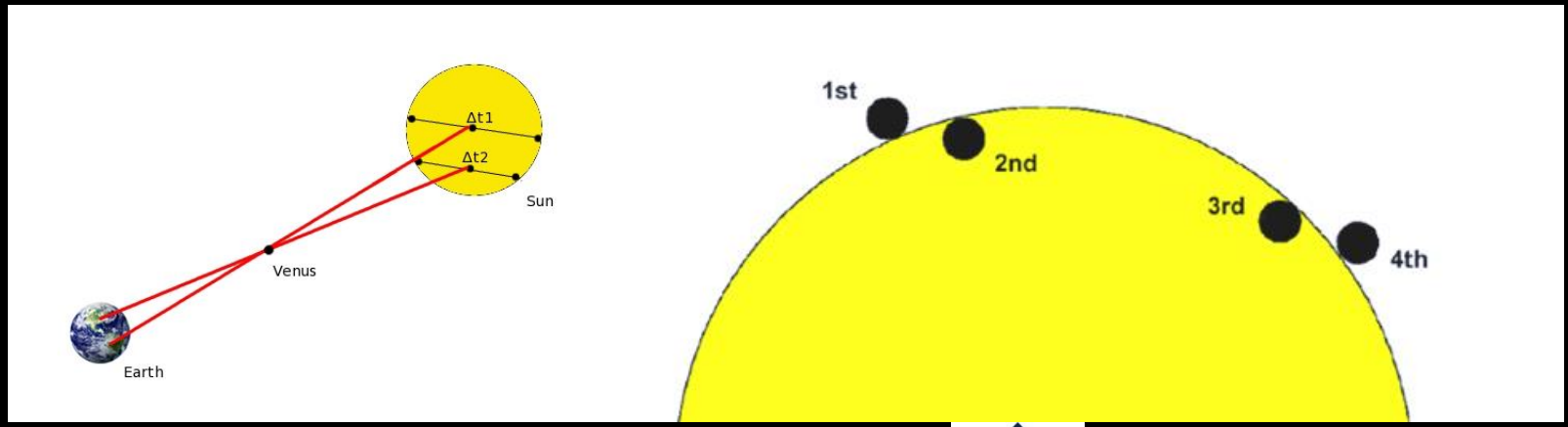
Historical importance of planetary transits

- Johannes Kepler (†1630) predicted in 1627 the transits of Mercury in 1631 and Venus in 1761
- Pierre Gassendi observed the first transit ever documented (Mercury) on November 7, 1631 from Paris
- Jeremiah Horrocks reworked Keplers calculations and predicted and observed the first documented Venus Transit on December 4, 1639 from England

Historical importance of planetary transits

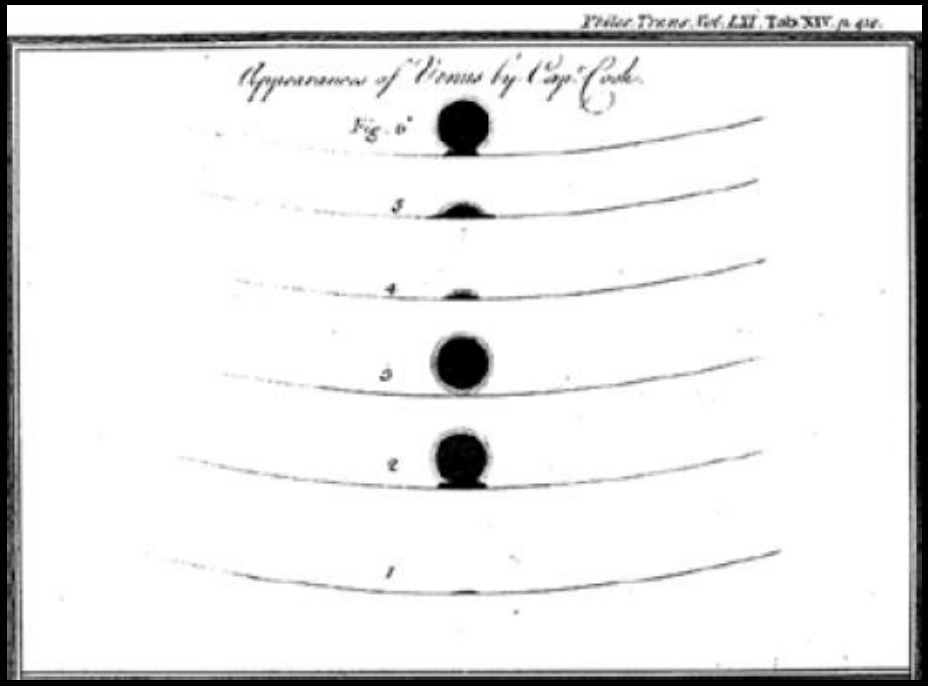
- Edmond Halley (†1742) observed in 1677 a transit of Mercury and realized that transits, preferably those of Venus because of better visibility, could be used to determine the Earth-Sun distance.

  He proposed in 1716 to replace the parallax measurements with measurements of time of 2nd and 3rd contact from several widely spaced observing sites on Earth to calculate the distance to Venus with better precision for the Venus transits in 1761 and 1769



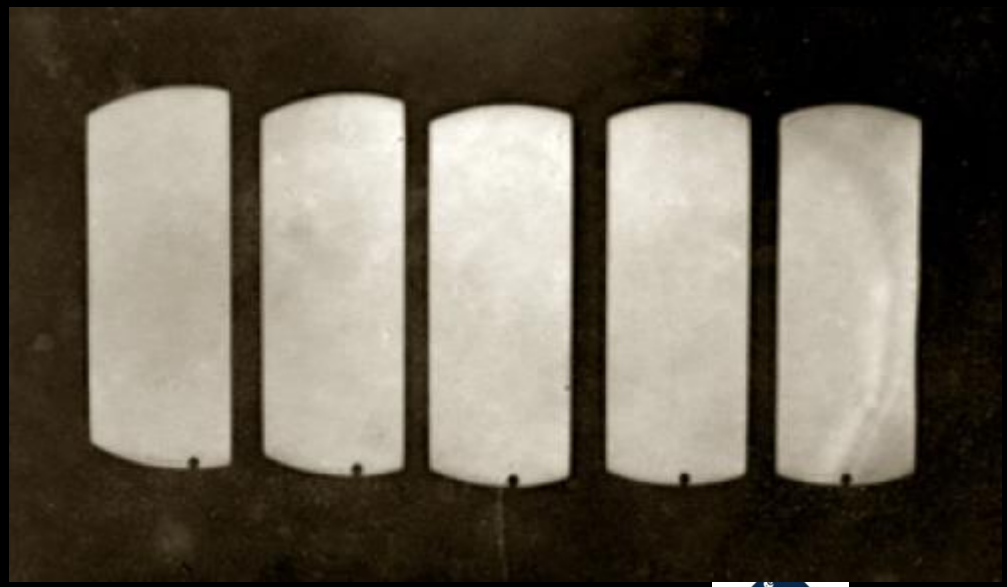
Historical importance of planetary transits

- Following Halley's recommendation the Venus transits in 1761 and 1769 were observed (at least tried to) from about 125 places around the globe.
- Johann Franz Encke applied in 1824 the new mathematical method of least squares to the data and calculated the Earth-Sun distance as 153.4 million km.
- One big problem to get accurate measurements was the black drop effect.



Historical importance of planetary transits

- The Venus transit on December 8, 1874 was observed with the new technique of photography. However the accuracy of the results did not improve very much in spite of the great efforts of expeditions from astronomers from all over the world because of the poor quality of the obtained pictures.



Historical importance of planetary transits

- The Venus transit on December 6, 1882 was visible from Western Europe and the US and was the first to attract wide Public attention.
- Improvements of observation techniques led finally to a calculated Earth-Sun distance of 149,158,000 km.
- Finally the transit on June 8, 2004 was the first during the age of digital photography.
- Currently the best value derived from radio measurements is 149,597,870 km.

Venus Transit 2012 expeditions

VT2012 Objectives

- Transit coverage in 2 wavelength bands, from two afar locations
- Web live transmission worldwide
- Archive transit images for public use
- Educational purposes in the frame work of the CESAR project
  - Reproduce classical transit measurements
  - Calculate the distance Earth-Sun
  - Measurement of parallax
  - 3D observation of transit

Coope search

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- Prov ch univ
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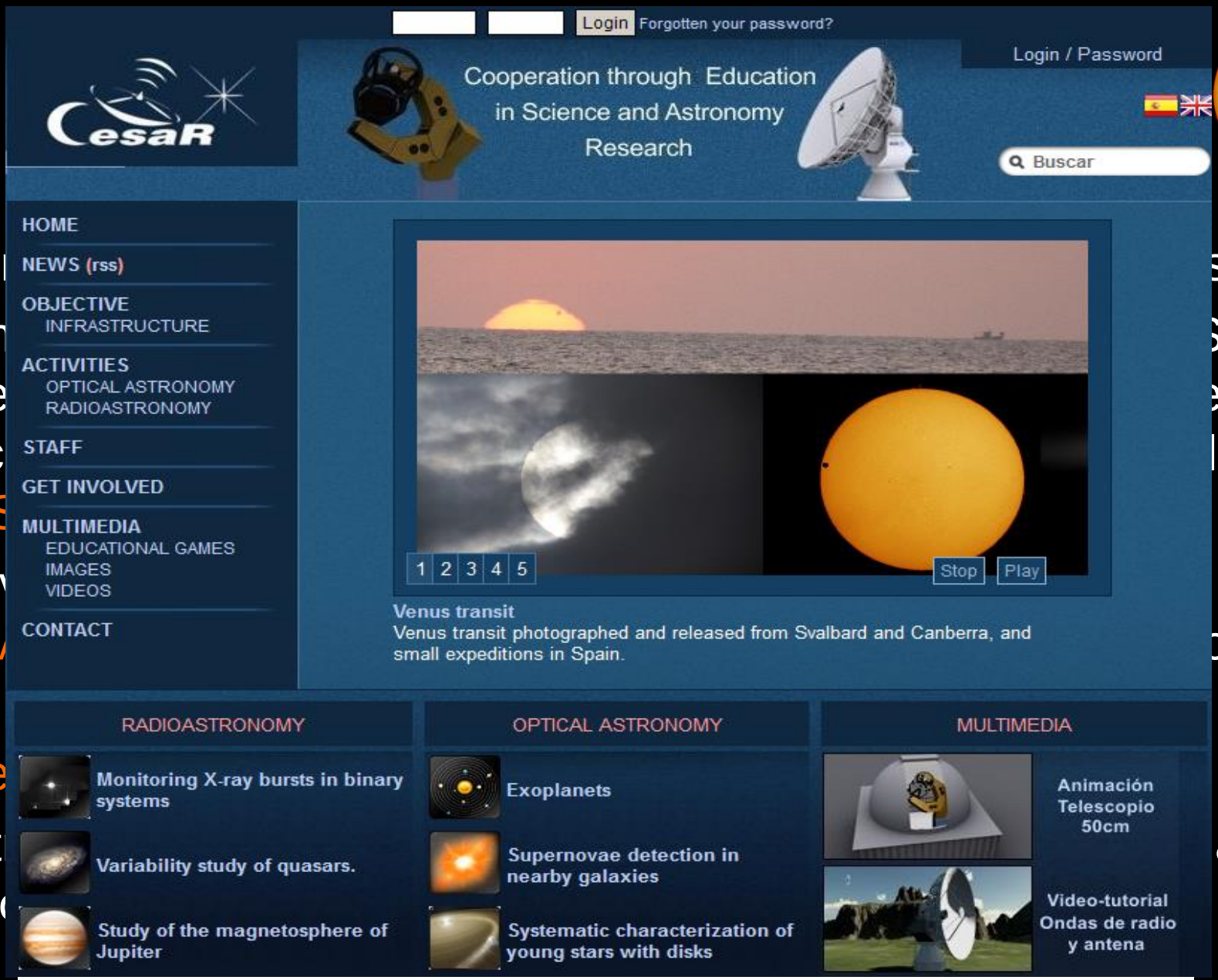
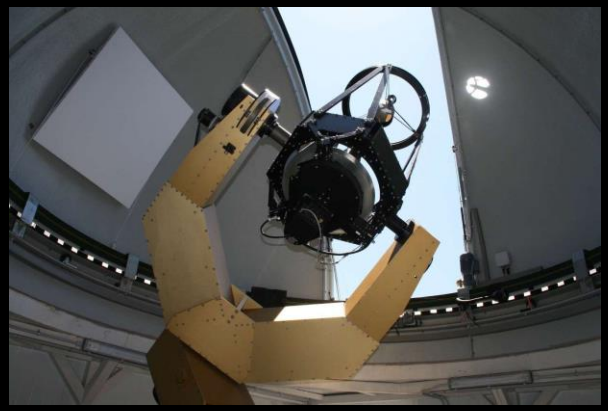


http://cesar-programme.cab.inta-csic.es/

CESAR instrumentation



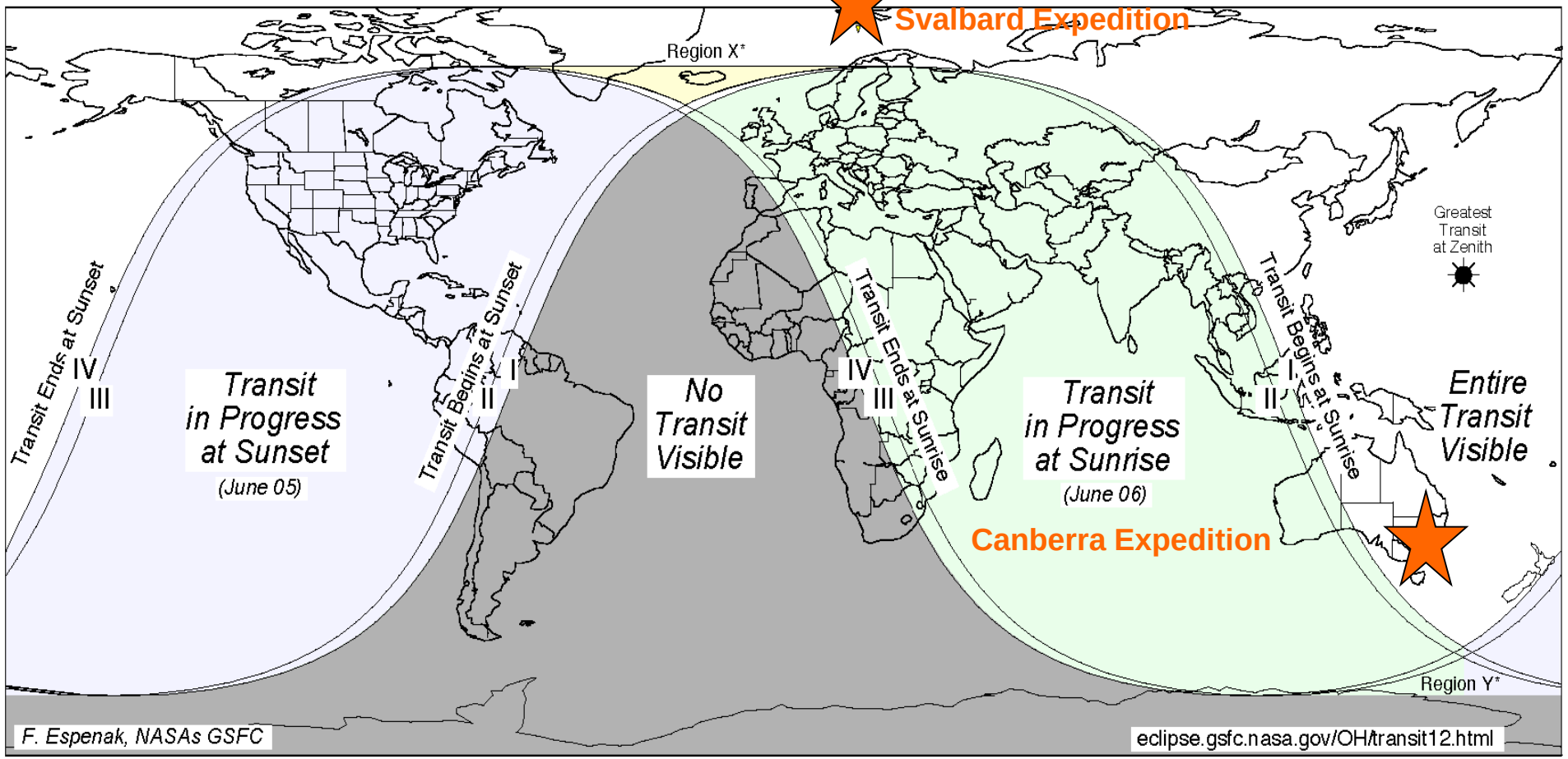
50cm optical telescope at ESA's satellite tracking station near Cebreros, Spain

30cm optical telescope at the INSA visitors' centre of the NASA satellite tracking station in Robledo de Chavela, Spain

2 sets of 9cm Hα and 10cm white light telescopes at ESAC

15m satellite tracking antenna at ESA's European Space Astronomy Centre (ESAC) converted into a radio telescope

VT2012 Visibility



* Region X - Beginning and end of Transit are visible, but the Sun sets for a short period around maximum transit.

* Region Y - Beginning and end of Transit are NOT visible, but the Sun rises for a short period around maximum transit.

VT2012 Expedition Svalbard

Expedition 1. Svalbard

- Only place in Europe with full coverage (and adequate elevation over horizon).
- Baseline to other locations large
- Venus Express Science Working Team hold during the transit days.
- Full media coverage and TV for the transit.

VT2012 Expedition Canberra

Expedition 2. Canberra

- Complete phenomenon visible from Australia
- Baseline to Svalbard very large
- NASA Canberra Deep Space Communications Centre (CDSCC) offered infrastructure (comms, power, human support).

VT2012 Expeditions

Surface distance, 14775 km !!

VT2012 Equipment

Coronado Solarmax II 90

- Aperture : 90mm
- Focal Length : 800mm
- Bandwidth : <0.7Å

Bresser AR-102

- Aperture : 102mm
- Focal Length : 1000mm

MEADE EXOS-2 GOTO

VT2012 Imaging

Hα and white light

BAADER AstroSolar™ Safety Film

Nikon D3100

- 23.1 x 15.4mm CMOS, 4608 x 3072 pixel = 14.2 MP

Canon 550D

- 22,3 x 14,9 mm CMOS, 5184 x 3456 = 18 MP

Images taken every half-minute in grey scale


MEADE
Canon

VT2012 Processing

Every raw image transferred to ESAC center in Madrid for on-the-fly fast processing and web release

- 4 x (8 MB/image x 400 = 3.2 GB) = 12.8 GB
- centered
- cropped
- contrast enhanced
- Hα images were color mapped
- archived

Videos were produced from individual images for media and TV news

VT2012 Svalbard Expedition

Team:

Miguel Perez Ayucar

Michel Breitfellner

Observation Site:

Longyearbyen, Svalbard

Lat: 78°13′N

Lon: 15°33′E

Transit Times:

	Time (GMT+2)
ING	2012-06-05 22:09
EGR	2012-06-06 04:49

Sunrise: N/A Sunset: none

Weather: **Artic** Summer

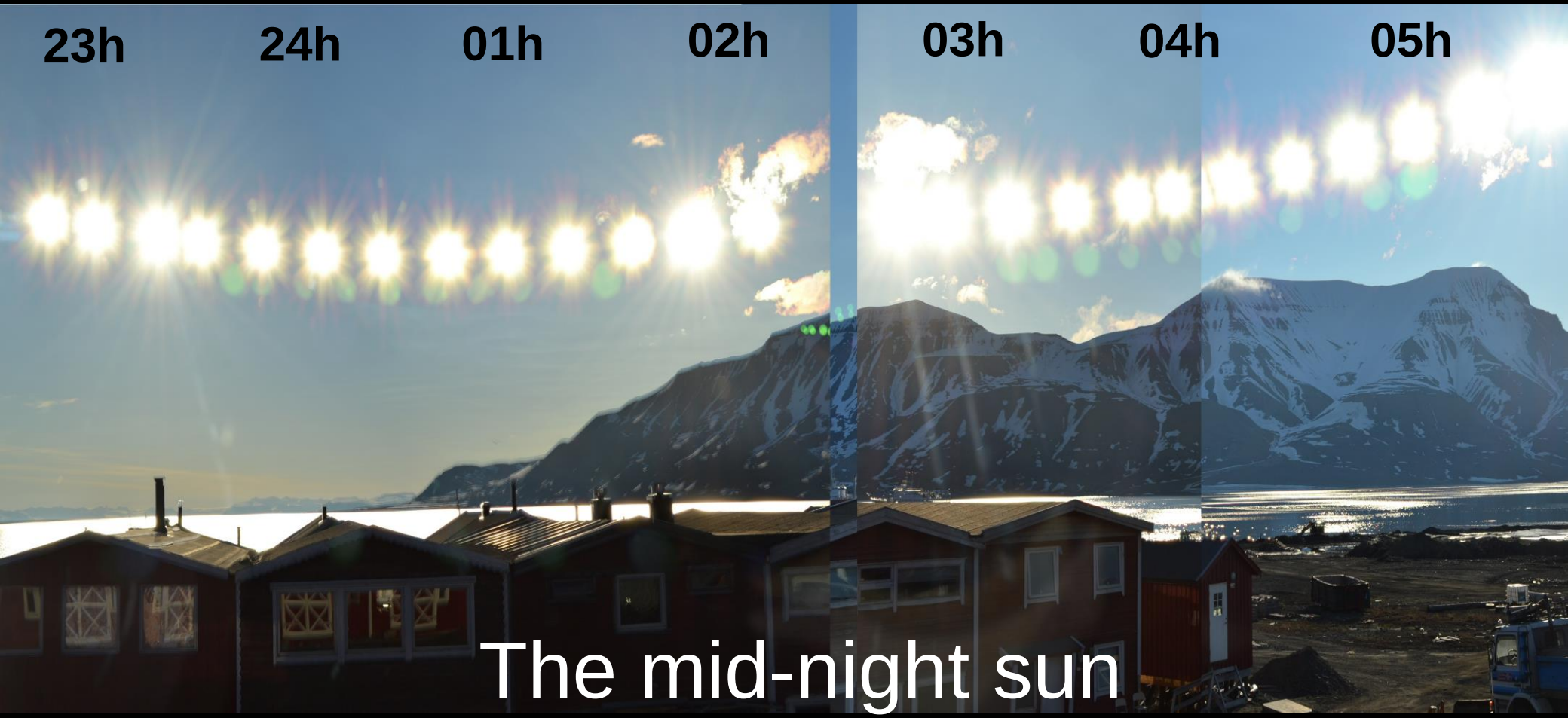
Seeing: Variable

Cloud Cover: Cloudy / Variable

Temp: 1 C deg to 5 C deg

VT2012 Svalbard Expedition

Local times



The mid-night sun

VT2012 Canberra Expedition

Observation Site:

CDSCC (Canberra Deep Space Communication Centre)

Lat: 35.4022361 S

Lon: 148.98285 W

Transit Times:

	Time (GMT+10)	Alt
IN1	2012-06-06T08:16:12	11.0 deg
IN2	2012-06-06T08:34:09	13.9 deg
TRC	2012-06-06T11:30:18	31.5 deg
EG1	2012-06-06T14:26:31	22.8 deg
EG2	2012-06-06T14.44.23	20.6 deg

Sunrise: 07:10:41 Sunset: 16:56:30

Team:

Manuel Castillo Fraile

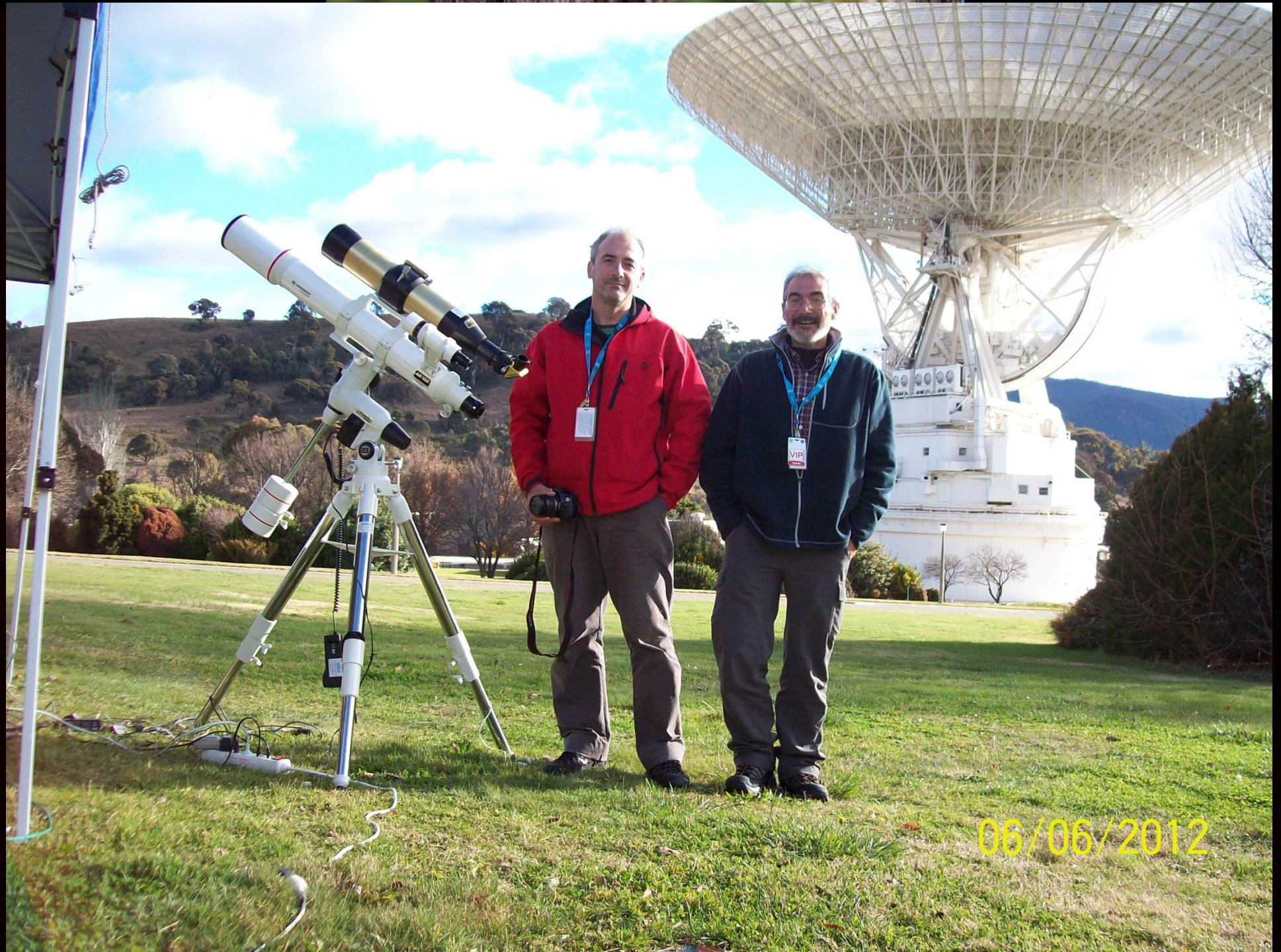
Miguel Sanchez-Portal

Weather: Southern Winter

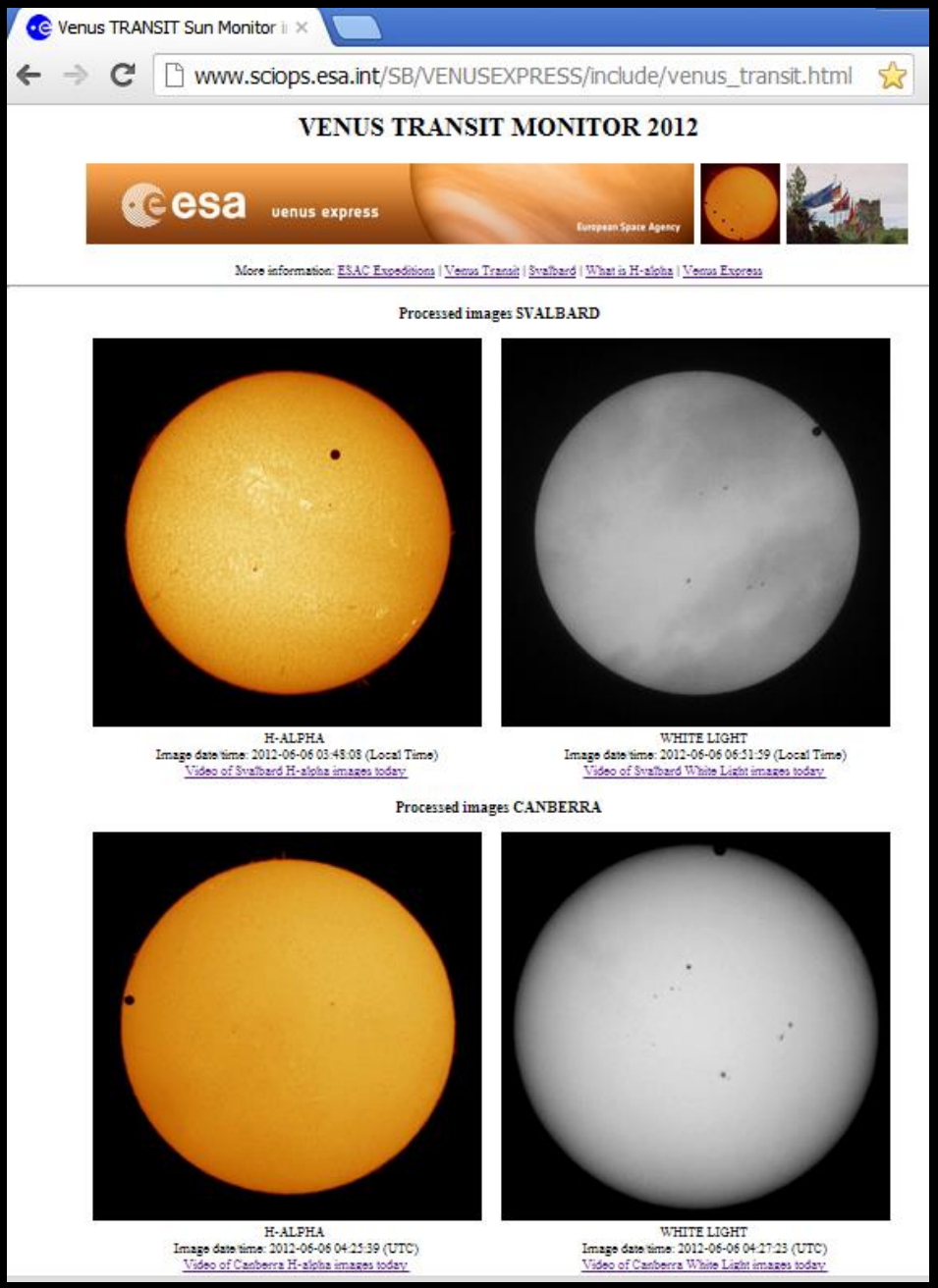
Seeing: Poor

Cloud Cover: Variable

Temp: -5 C deg to 12 C deg

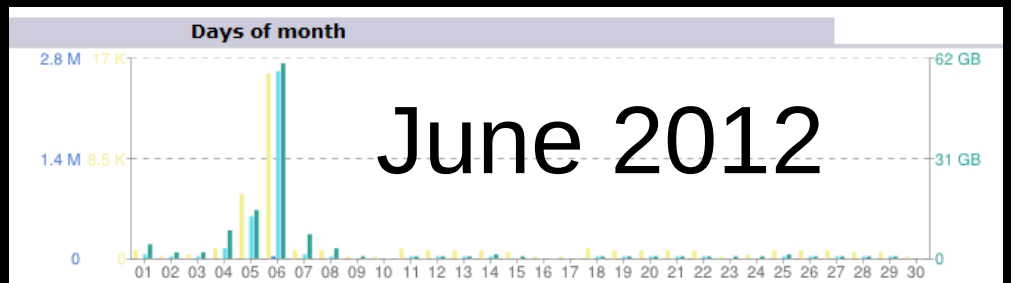

VIP
06/06/2012

Some results of the observations



http://www.sciops.esa.int/SB/VENUSEXPRESS/include/venus_transit.html

VT2012 web access



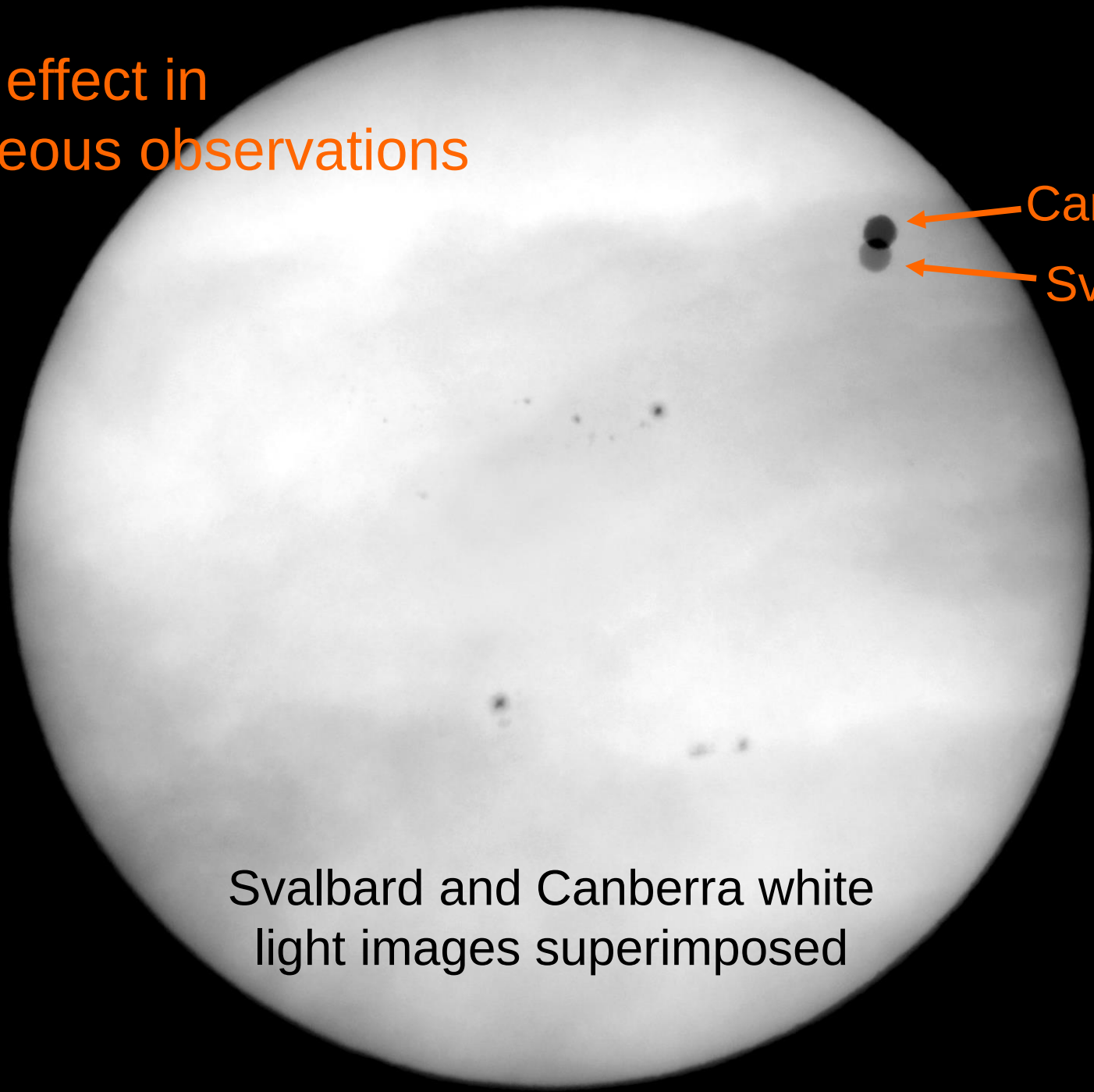
Day	Number of visits	Pages	Hits	Bandwidth
01 Jun 2012	799	7,900	85,956	4.52 GB
02 Jun 2012	349	3,154	29,692	1.77 GB
03 Jun 2012	403	3,195	37,637	2.24 GB
04 Jun 2012	1,042	8,260	152,364	8.62 GB
05 Jun 2012	5,876	16,599	622,580	14.31 GB
06 Jun 2012	16,560	44,207	2,707,385	57.09 GB
07 Jun 2012	887	4,405	71,545	7.23 GB
08 Jun 2012	830	5,678	43,918	3.16 GB
09 Jun 2012	350	3,130	15,305	706.08 MB

03 Jun 2012	403	3,195	37,637	2.24 GB
04 Jun 2012	1,042	8,260	152,364	8.62 GB
05 Jun 2012	5,876	16,599	622,580	14.31 GB
06 Jun 2012	16,560	44,207	2,707,385	57.09 GB
07 Jun 2012	887	4,405	71,545	7.23 GB
08 Jun 2012	830	5,678	43,918	3.16 GB

23 Jun 2012	297	1,707	11,917	776.59 MB
24 Jun 2012	378	1,654	17,208	1.09 GB
25 Jun 2012	861	7,442	51,629	1.30 GB
26 Jun 2012	760	8,435	41,547	822.82 MB
27 Jun 2012	721	6,751	33,313	980.31 MB
28 Jun 2012	660	6,066	31,280	912.34 MB
29 Jun 2012	628	7,783	33,610	641.34 MB
30 Jun 2012	227	2,034	9,225	478.11 MB
Average	1,362	6,992	148,232	3.94 GB
Total	40,881	209,779	4,446,976	118.09 GB

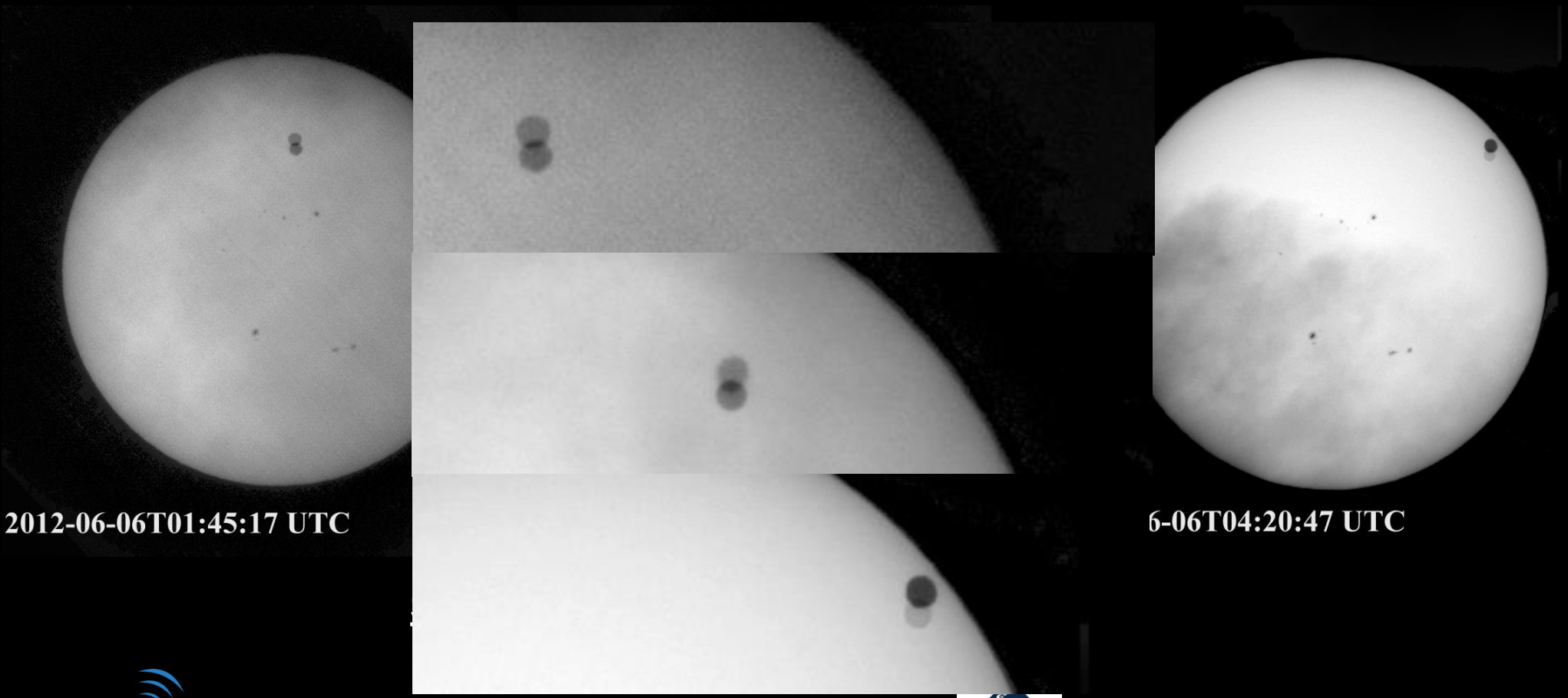
esa

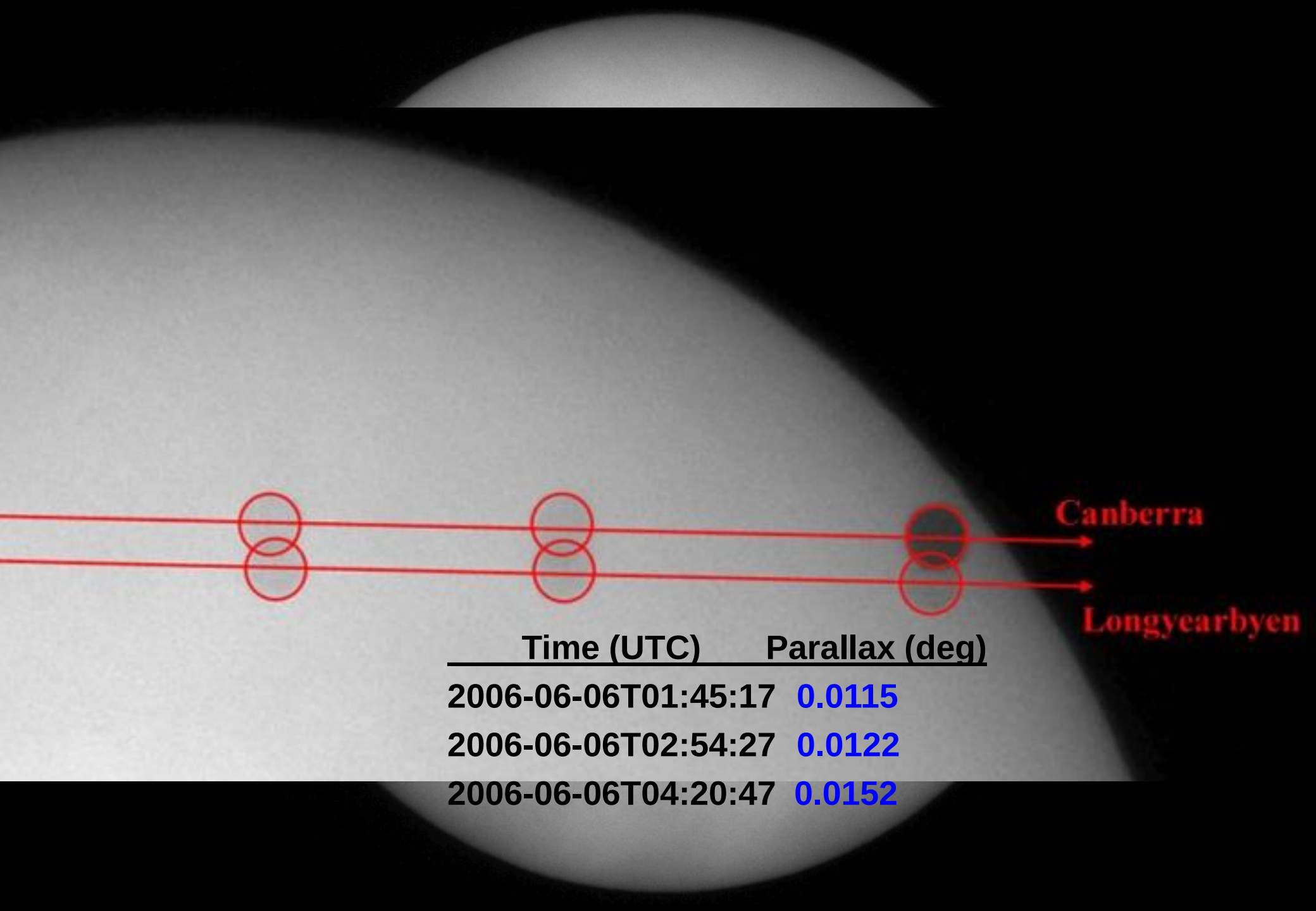
Parallax effect in simultaneous observations



Svalbard and Canberra white light images superimposed

VT2012: effect of parallax in simultaneous observations



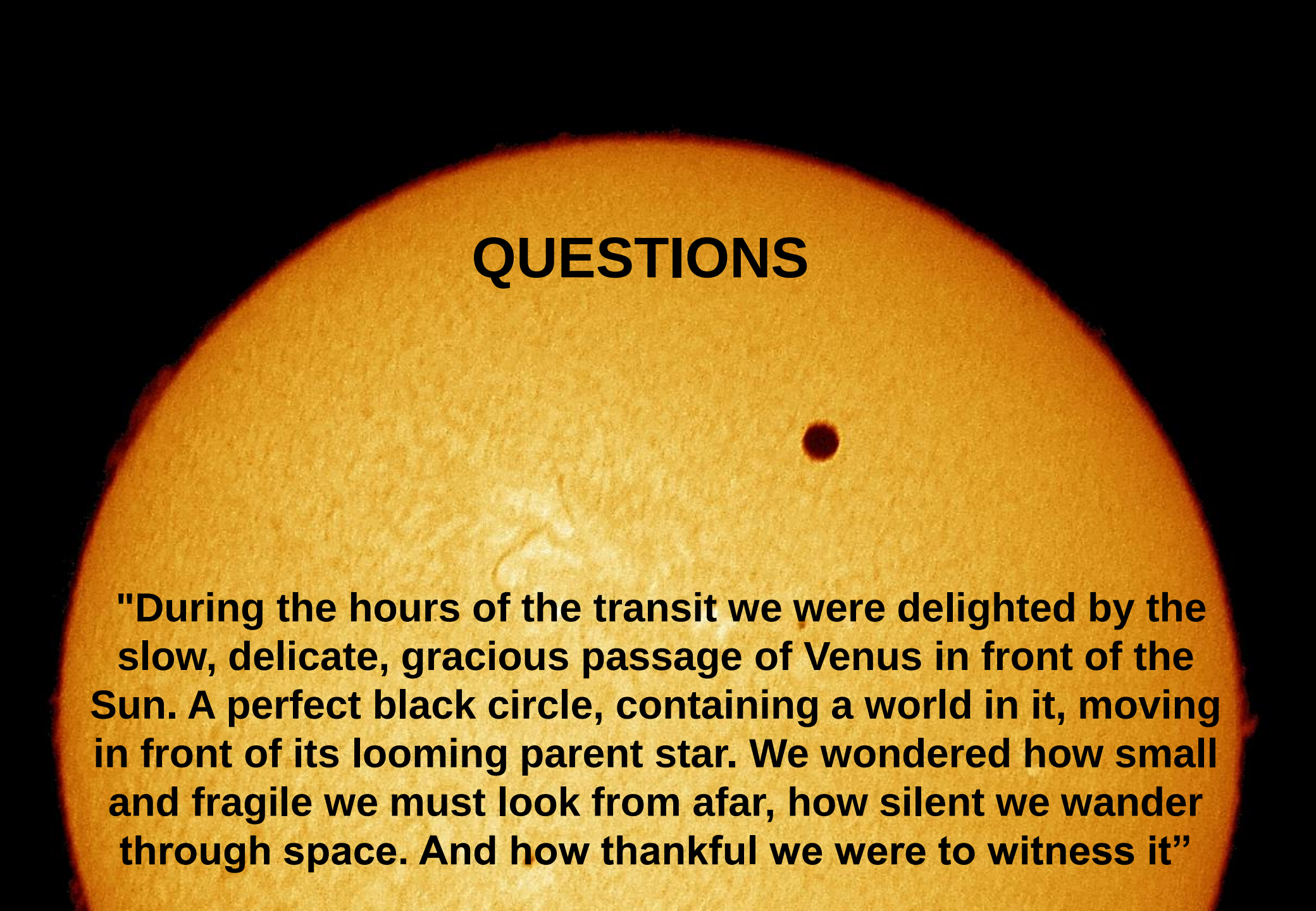


Time (UTC)	Parallax (deg)
2006-06-06T01:45:17	0.0115
2006-06-06T02:54:27	0.0122
2006-06-06T04:20:47	0.0152

- Complete coverage video (run outside ppt)
- Superimposed video (run outside ppt)

Remember: next Venus Transit

2117-12-11



QUESTIONS

"During the hours of the transit we were delighted by the slow, delicate, gracious passage of Venus in front of the Sun. A perfect black circle, containing a world in it, moving in front of its looming parent star. We wondered how small and fragile we must look from afar, how silent we wander through space. And how thankful we were to witness it”

Extra slides

VT2012: Sun Distance

"Light from the sun takes 8 minutes to reach you, thus you see the sun as it was 8 minutes ago. It might have blown up 4 minutes ago and you wouldn't know about it!"