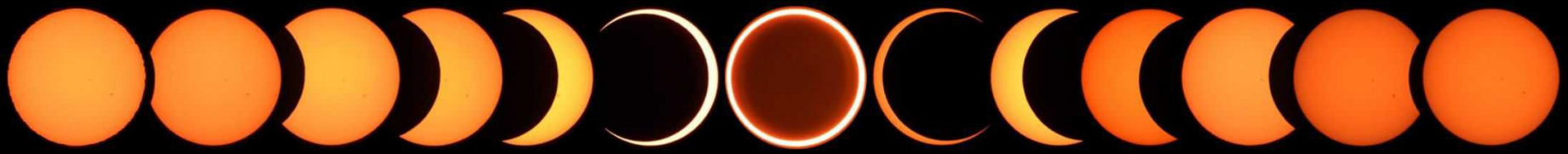
Annular Eclipse

14 October 2023

Midland, TX
31.964522° N 102.14014° W

Timothy Parsons



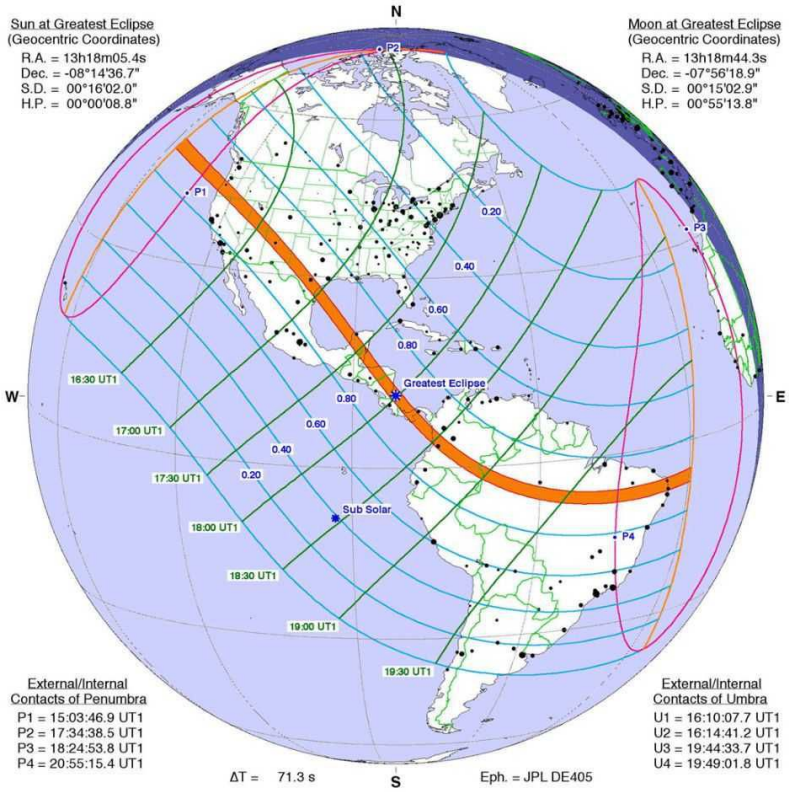
Times are UTC except as noted
Time format HHMM:SS
Time from AT&T cellular network

Annular Solar Eclipse of 2023 Oct 14

Greatest Eclipse = 18:00:40.6 TD (= 17:59:29.3 UT1)

Eclipse Magnitude = 0.9520 Saros Series = 134

Gamma = 0.3753 Saros Member = 44 of 71



Sun at Greatest Eclipse (Geocentric Coordinates)
R.A. = 13h18m05.4s
Dec. = -08°14'36.7"
S.D. = 00°16'02.0"
H.P. = 00°00'08.8"

Moon at Greatest Eclipse (Geocentric Coordinates)
R.A. = 13h18m44.3s
Dec. = -07°56'18.9"
S.D. = 00°15'02.9"
H.P. = 00°55'13.8"

External/Internal Contacts of Penumbra
P1 = 15:03:46.9 UT1
P2 = 17:34:38.5 UT1
P3 = 18:24:53.8 UT1
P4 = 20:55:15.4 UT1

External/Internal Contacts of Umbra
U1 = 16:10:07.7 UT1
U2 = 16:14:41.2 UT1
U3 = 19:44:33.7 UT1
U4 = 19:49:01.8 UT1

ΔT = 71.3 s Eph. = JPL DE405

Circumstances at Greatest Eclipse: 17:59:29.3 UT1

Lat. = 11°22.1'N Sun Alt. = 67.9°
Long. = 083°06.1'W Sun Azm. = 208.0°
Path Width = 187.4 km Duration = 05m17.2s

Circumstances at Greatest Duration: 18:13:09.2 UT1

Lat. = 08°14.6'N Sun Alt. = 66.8°
Long. = 080°24.1'W Sun Azm. = 225.1°
Path Width = 191.1 km Duration = 05m17.8s

0 1000 2000 3000 4000 5000
Kilometers

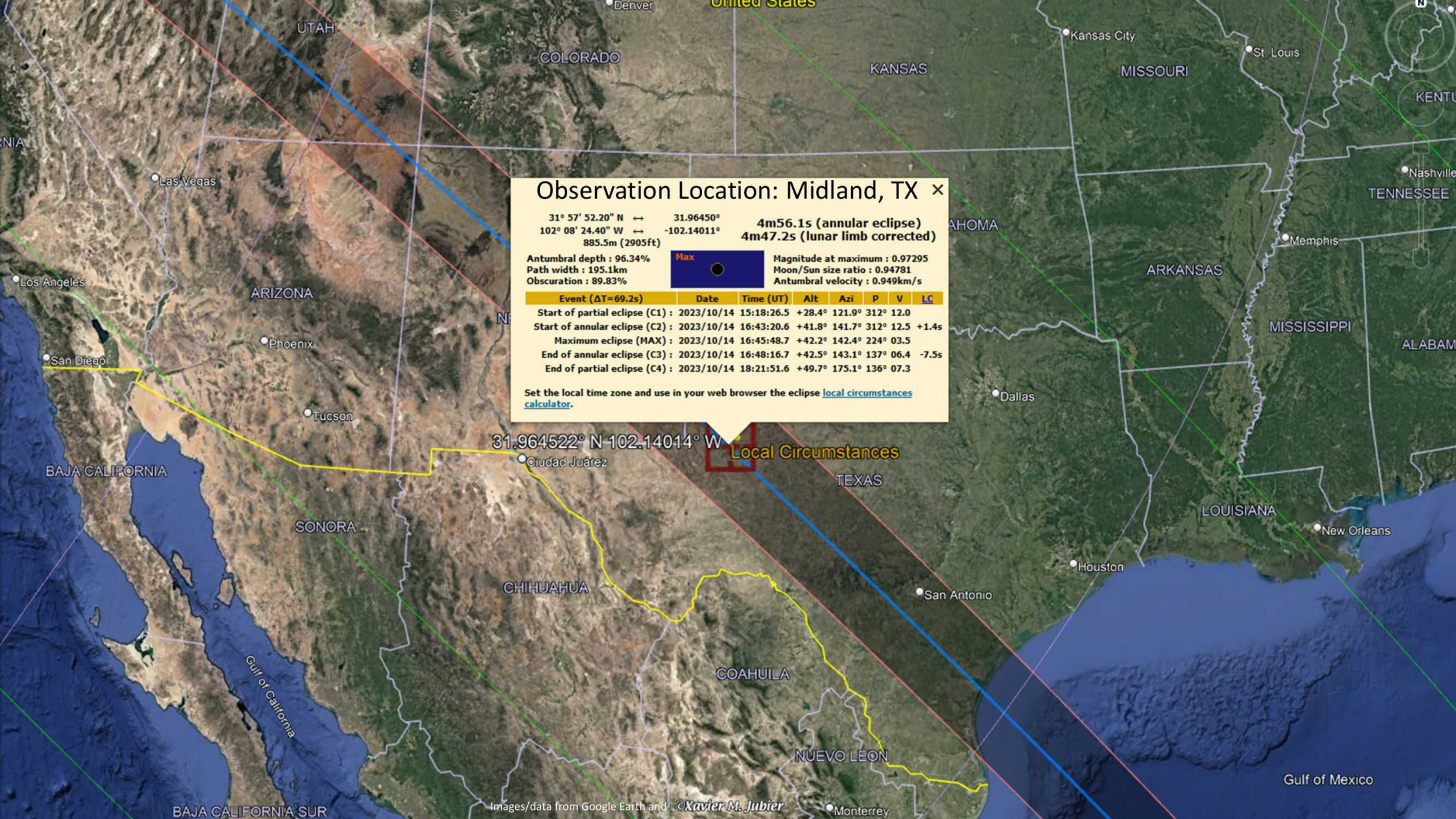
COURTESY OF *21ST CENTURY CANON OF SOLAR ECLIPSES*, FRED ESPENAK, ASTROPIXELS PUBLISHING, 2016

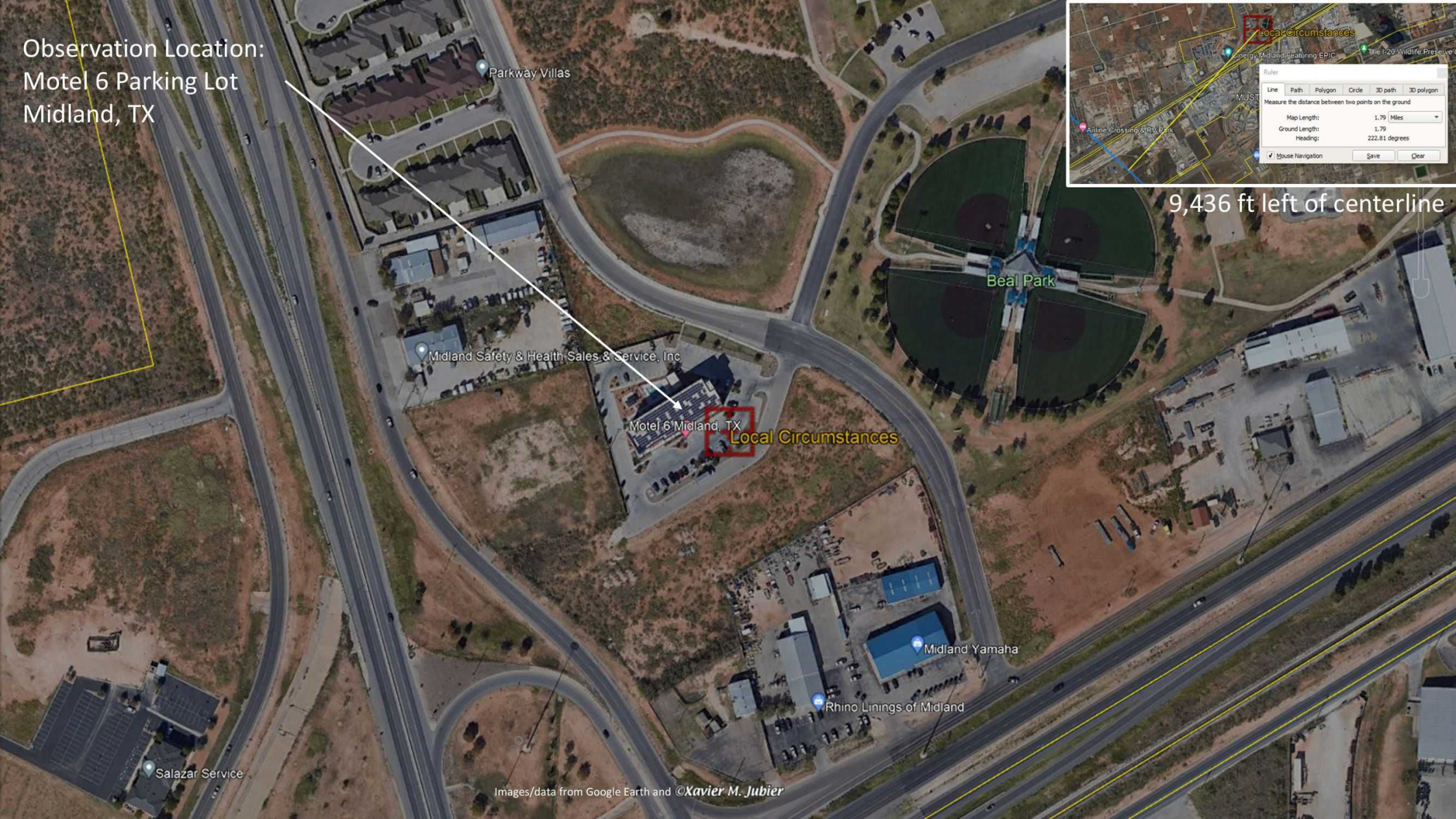
Images/data from Google Earth and

Observation Location:
Midland, TX

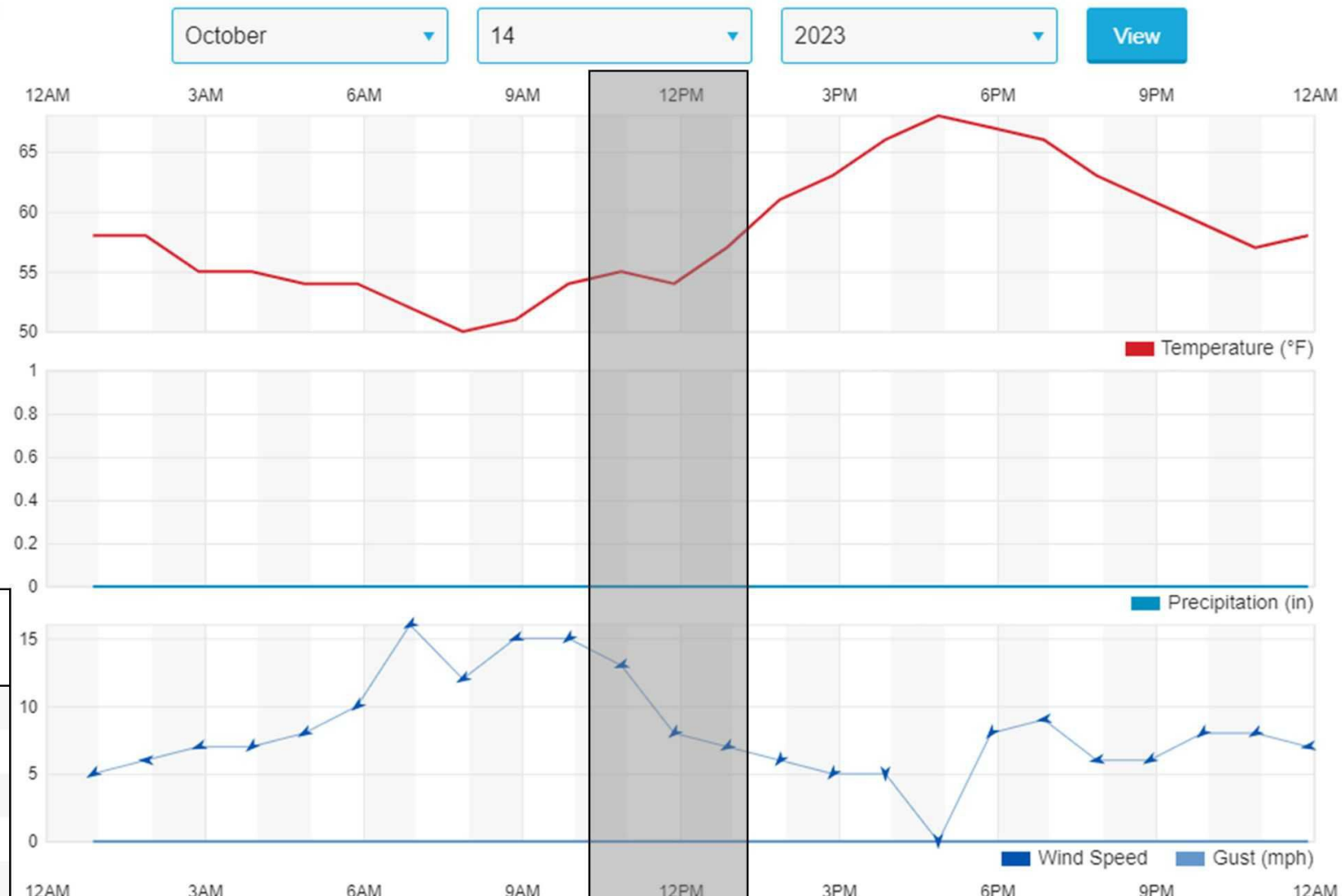
http://xjubier.free.fr/en/site_pages/Solar_Eclipses.html

Imagery Date: 12/13/2015 lat 31.96


Observation Location: Midland, TX
31° 57' 52.20" N ↔ 31.96450°
102° 08' 24.40" W ↔ -102.14011°
885.5m (2905ft)
4m56.1s (annular eclipse)
4m47.2s (lunar limb corrected)
Antumbral depth : 96.34%
Path width : 195.1km
Obscuration : 89.83%
Max
Magnitude at maximum : 0.97295
Moon/Sun size ratio : 0.94781
Antumbral velocity : 0.949km/s
Event (ΔT=69.2s) | Date | Time (UT) | Alt | Azi | P | V | LC
Start of partial eclipse (C1) : 2023/10/14 15:18:26.5 +28.4° 121.9° 312° 12.0
Start of annular eclipse (C2) : 2023/10/14 16:43:20.6 +41.8° 141.7° 312° 12.5 +1.4s
Maximum eclipse (MAX) : 2023/10/14 16:45:48.7 +42.2° 142.4° 224° 03.5
End of annular eclipse (C3) : 2023/10/14 16:48:16.7 +42.5° 143.1° 137° 06.4 -7.5s
End of partial eclipse (C4) : 2023/10/14 18:21:51.6 +49.7° 175.1° 136° 07.3
Set the local time zone and use in your web browser the eclipse local circumstances calculator.
31.964522° N 102.14014° W
Local Circumstances
Denver
United States
UTAH
COLORADO
KANSAS
Kansas City
St. Louis
MISSOURI
Las Vegas
Los Angeles
ARIZONA
Phoenix
San Diego
Tucson
Nashville
TENNESSEE
Memphis
ARKANSAS
MISSISSIPPI
ALABAM
Dallas
Ciudad Juárez
BAJA CALIFORNIA
TEXAS
LOUISIANA
New Orleans
SONORA
Houston
CHIHUAHUA
San Antonio
COAHUILA
NUEVO LEON
Gulf of California
Gulf of Mexico
BAJA CALIFORNIA SUR
Monterrey
Images/data from Google Earth and ©Xavier M. Jubier


Observation Location:
Motel 6 Parking Lot
Midland, TX
Parkway Villas
Midland Safety & Health Sales & Service, Inc
Motel 6 Midland, TX
Local Circumstances
Beal Park
Midland Yamaha
Rhino Linings of Midland
Salazar Service
Images/data from Google Earth and ©Xavier M. Jubier
Local Circumstances
Energy Midland featuring EPIC
Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the distance between two points on the ground
Map Length: 1.79 Miles
Ground Length: 1.79
Heading: 222.81 degrees
Mouse Navigation
Save
Clear
Airline Crossing & RV Park
9,436 ft left of centerline

Weather: clear and very good for eclipse viewing



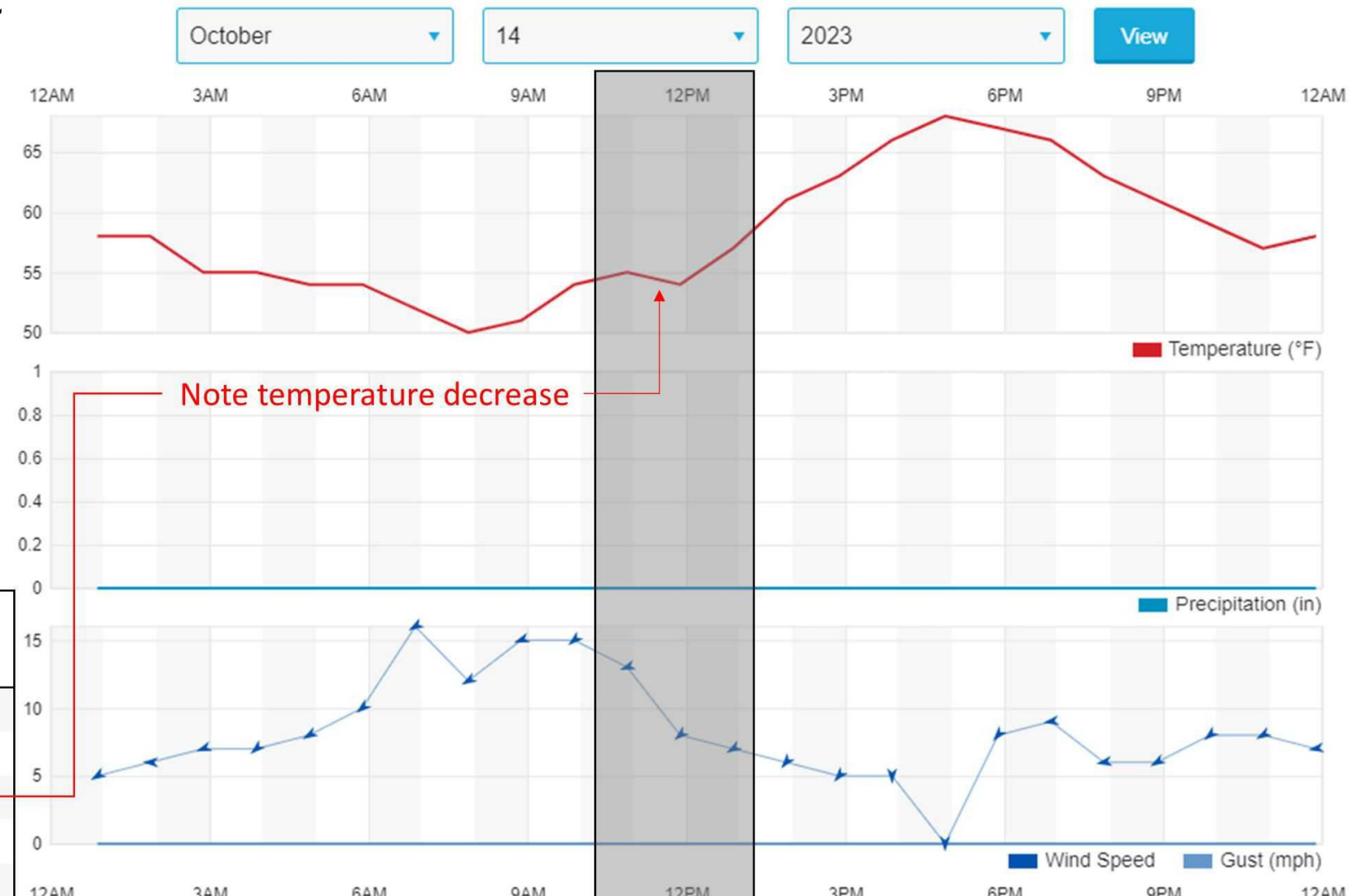
Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Pressure	Precip.	Condition
9:53 AM	54 °F	34 °F	47 %	NE	15 mph	27.29 in	0.0 in	Fair
10:53 AM	55 °F	33 °F	43 %	ENE	13 mph	27.29 in	0.0 in	Fair
11:53 AM	54 °F	33 °F	45 %	NE	8 mph	27.29 in	0.0 in	Fair
12:53 PM	57 °F	33 °F	40 %	ENE	7 mph	27.29 in	0.0 in	Fair
1:53 PM	61 °F	33 °F	35 %	NE	6 mph	27.28 in	0.0 in	Fair

All times this page local (CDT)

Time of Eclipse

Data and graphs https://www.wunderground.com/history/daily/us/tx/midland/KMAF/date/2023-10-14

Weather: clear and very good for eclipse viewing



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11:53 AM	54 °F	33 °F	45 %	NE	8 mph	27.29 in	0.0 in	Fair
12:53 PM	57 °F	33 °F	40 %	ENE	7 mph	27.29 in	0.0 in	Fair
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All times this page local (CDT)

Data and graphs https://www.wunderground.com/history/daily/us/tx/midland/KMAF/date/2023-10-14

Visual Astronomy Equipment:

- Oberwerk 20x65ED Deluxe Binoculars
- iPad Pro 12.9” and pencil for sketching
- Seymour Solar Filters
  - ND5
  - Film
  - Friction mount specific to binoculars
- Oberwerk 4000 Tripod
  - Altitude-Azimuth
  - 5000-series fluid head
  - 3000-series aluminum legs

Stock images from www.oberwerk.com

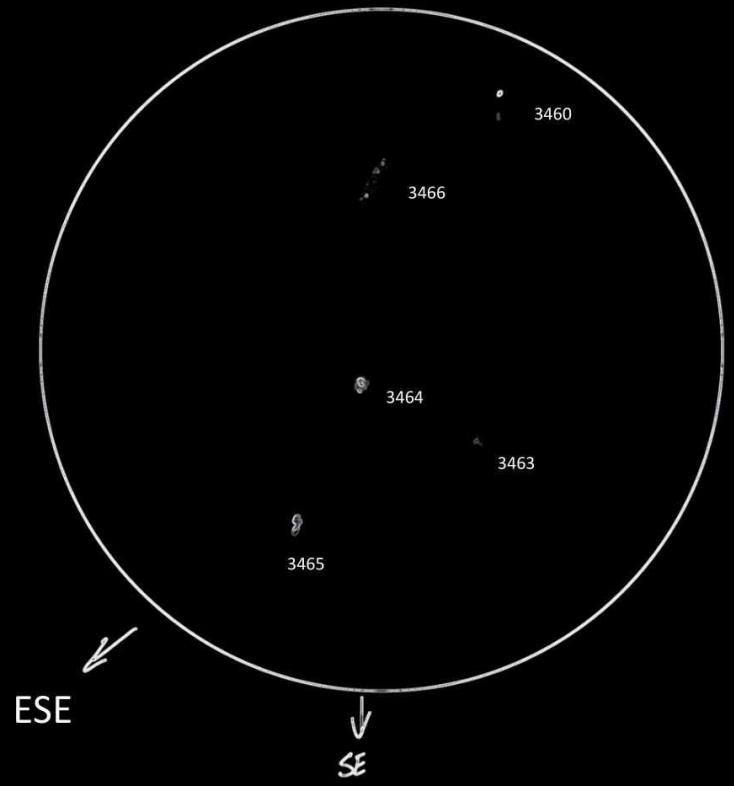
Solar Photography Equipment

- Nikon P1000 point-and-shoot camera
  - Remote shutter (corded)
  - GPS time/location from SnapBridge on Apple iPhone 7
  - 3000mm equivalent max focal length (*f*8)
  - Most photos at 1800mm to 2200mm
  - Capture in 16MP JPEG and RAW
- Seymour Solar Filter
  - ND5
  - Film
  - 77mm screw-on
- Oberwerk 4000 Tripod
  - Altitude-Azimuth
  - 5000-series fluid head
  - 3000-series aluminum legs

Solar filter stock image from www.seymoursolar.com
Camera and remote stock image from www.nikonusa.com

Pre-Eclipse

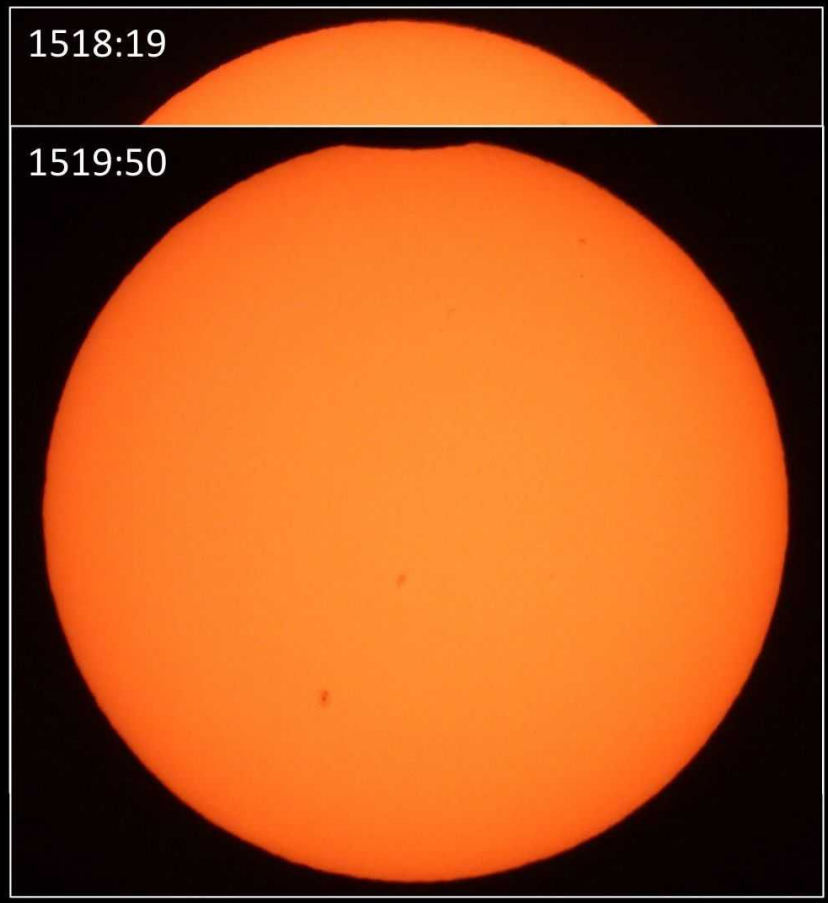
Sunspots visible, obvious in binoculars



1518

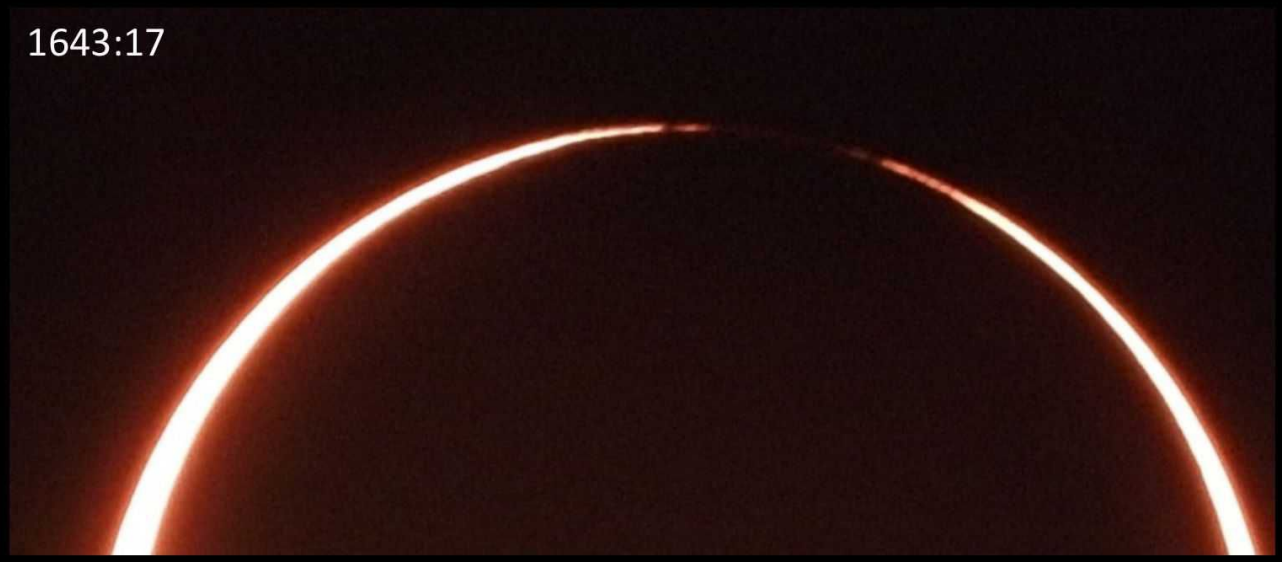
Contact 1

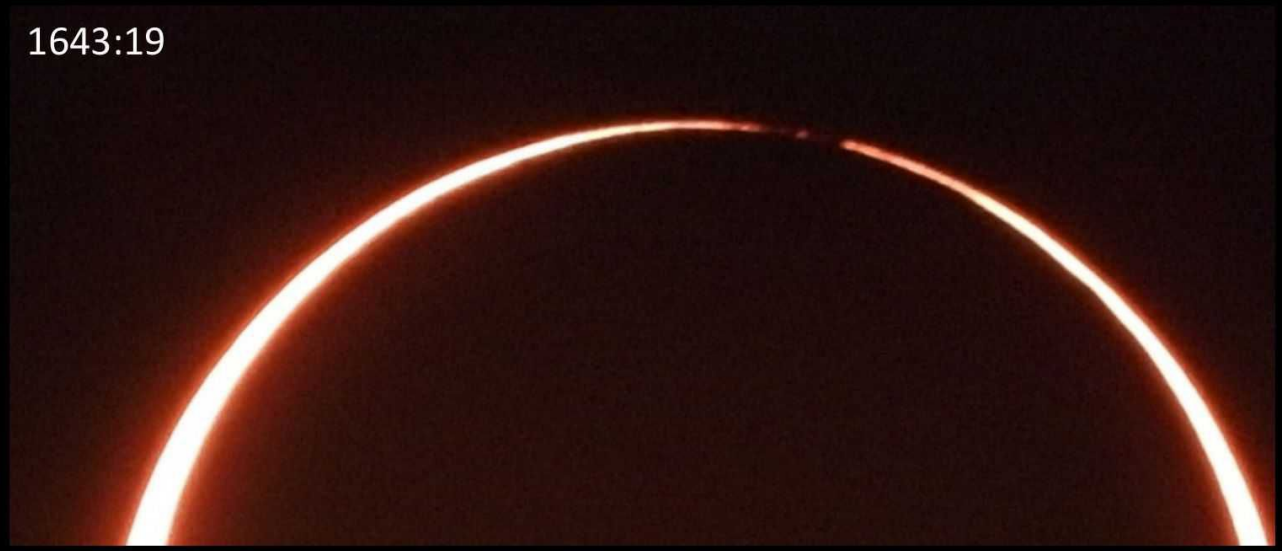
Predicted 1518:27



Contact 2

Predicted: 1643:21





Greatest Eclipse

Predicted 1645:49

Circular shadows noted immediately before, during, and after annularity.

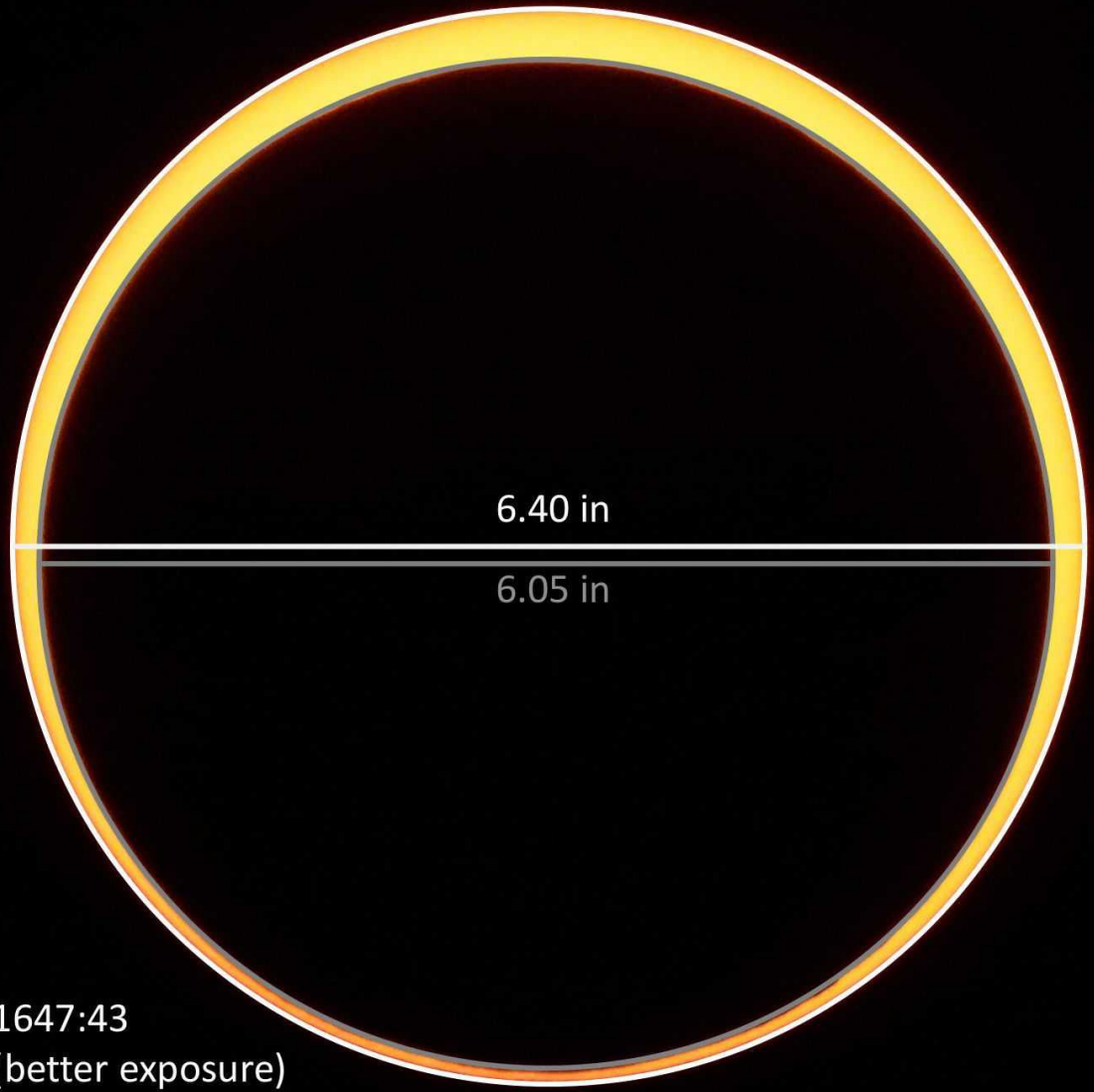
Ambient light similar to early twilight. Brighter than when sky is overcast.

No noted changes in insects/animals.

Greatest Eclipse: Magnitude

Solar diameter=6.40 inch
Lunar diameter=6.05 inch

Observed magnitude = 0.945
Predicted magnitude = 0.973



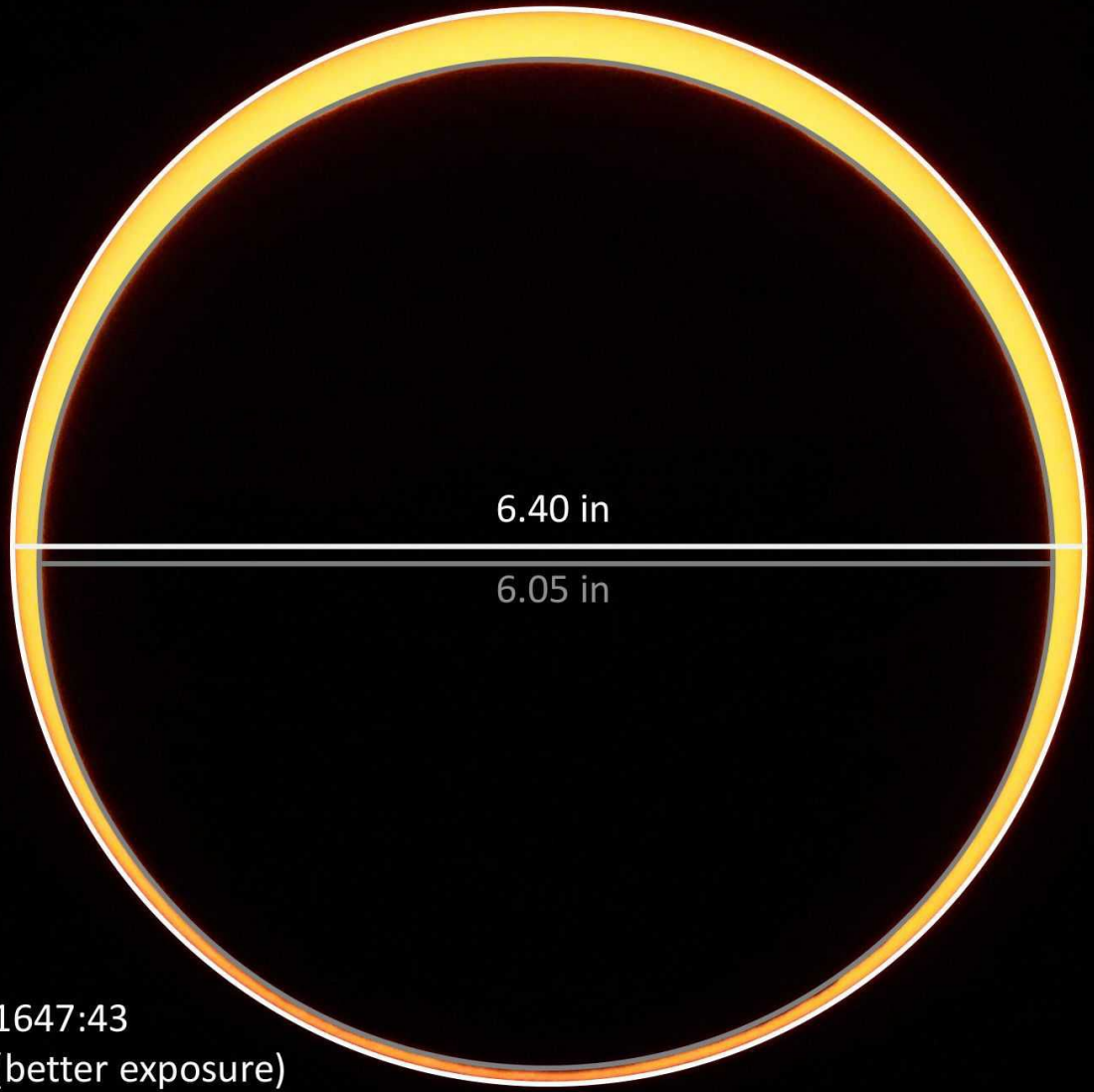
1647:43
(better exposure)

Greatest Eclipse: Obscuration

Solar diameter=6.40 inch
Solar area=32.17 in²

Lunar diameter=6.05 in
Lunar area =28.75 in²

Observed obscuration=0.894
Predicted obscuration=0.898



1647:43
(better exposure)

Greatest Eclipse: Minimum Separation

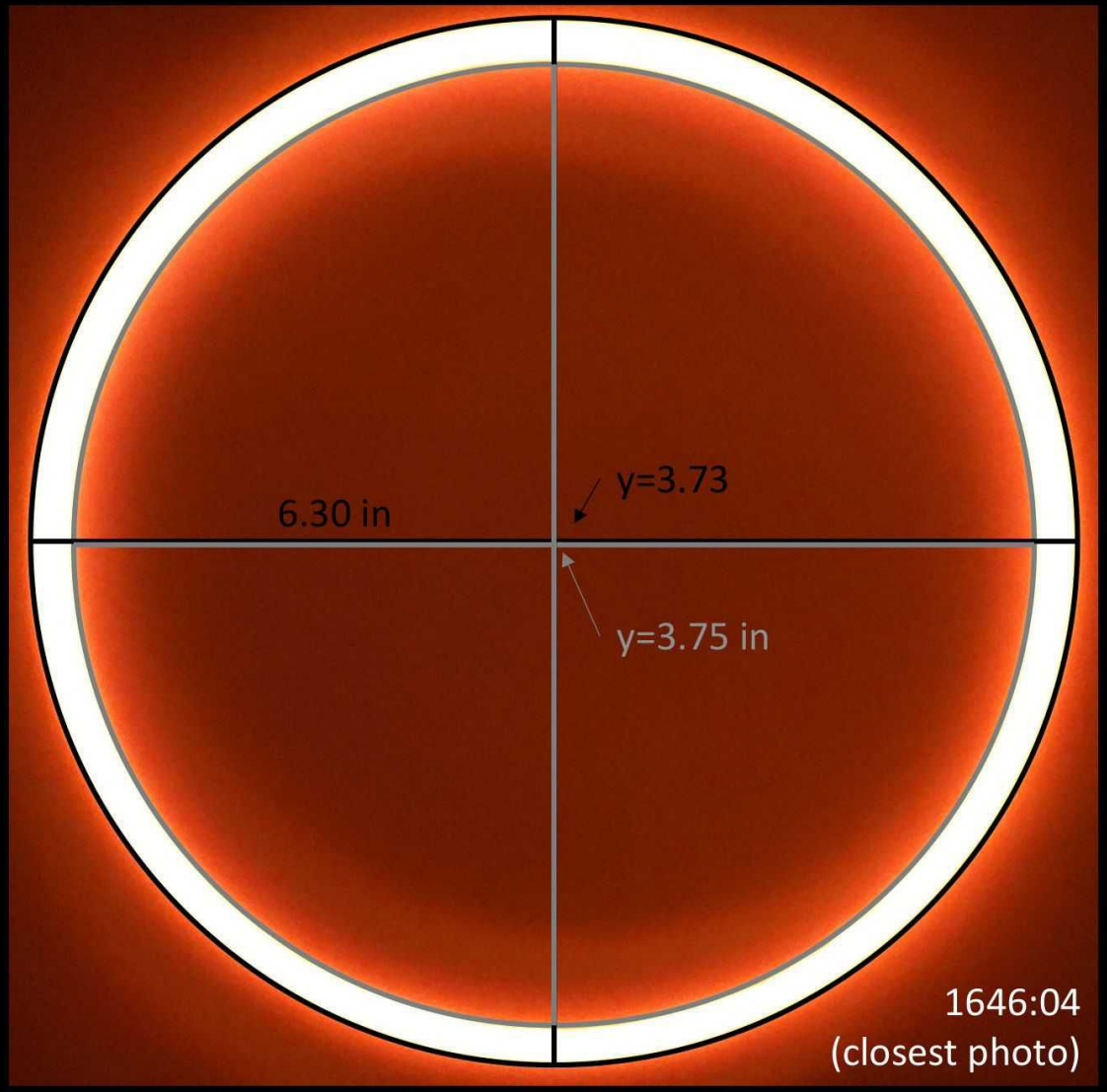
Off centerline 9,436 feet
∴ minimum separation not 0°

Solar distance =149,224,860km
Lunar distance=397,178km
Distance from Central Line = 9,436ft = 2.876km
$\tan^{-1}(2.876/397178) = 0.0004148°$
Calculated separation = 1.49”

Center location in photo (inches, from top of slide):
Solar: 3.73
Lunar: 3.75

Separation:
Solar diameter 32’ = 6.30in
Separation: = 0.02in*32’/6.30in
= 0.102’
= 6.10”

Observed separation 4x larger than predicted separation
- Late photo?
- Pencil width error?
- Being bad at orbital mechanics/spherical geometry?



Contact 3

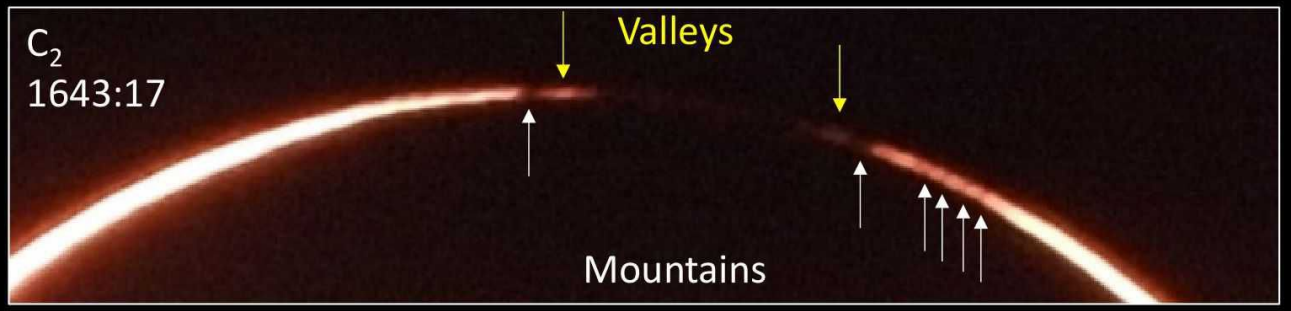
Predicted 1648:17

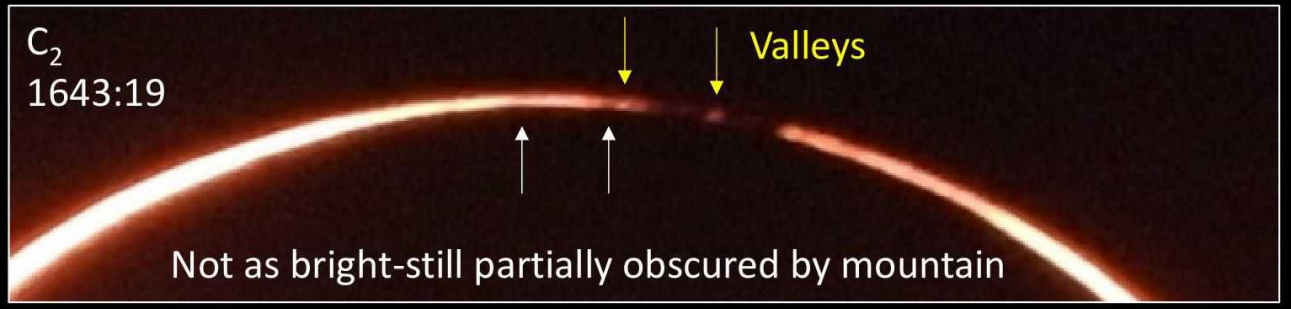
Lower limb detail

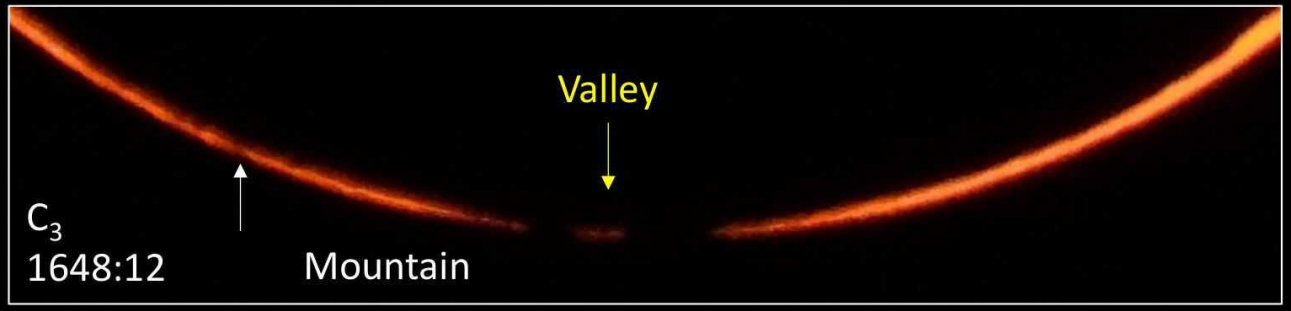
Lunar Terrain at C_2 and C_3

Mountains are dark spots on the lunar limb

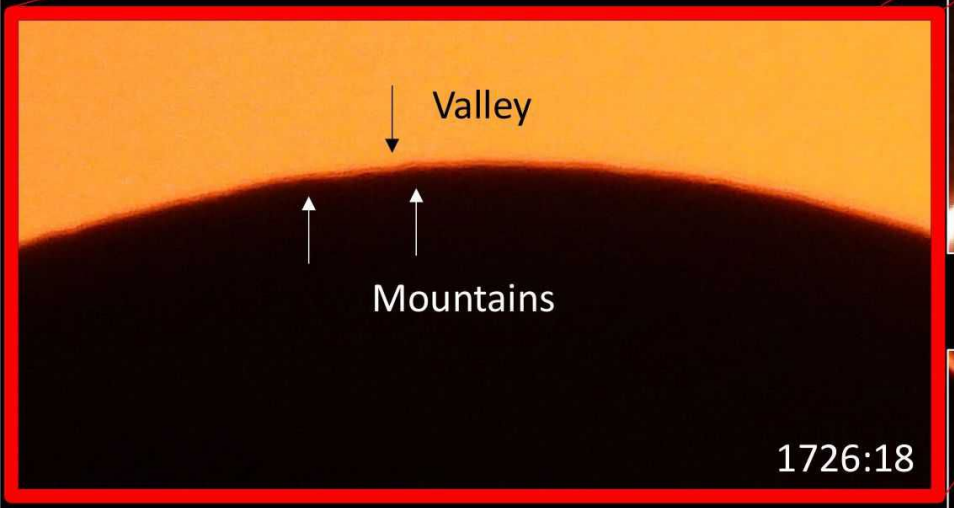
Valleys are light spots on the lunar limb



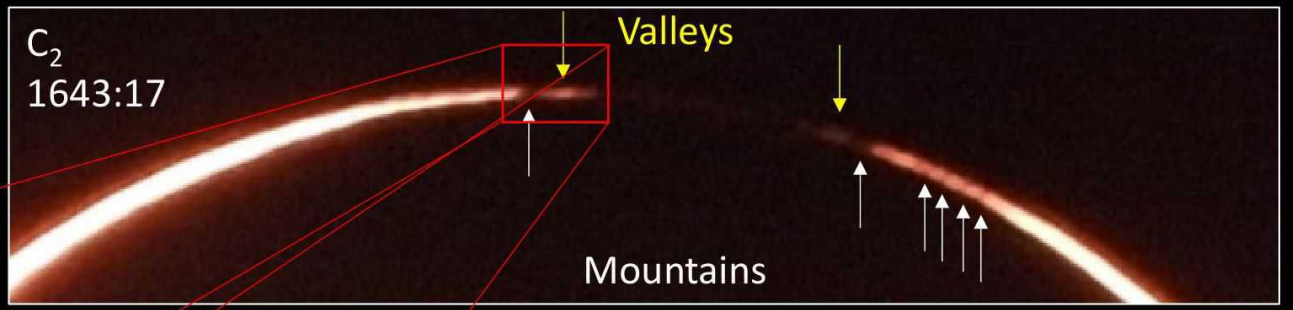


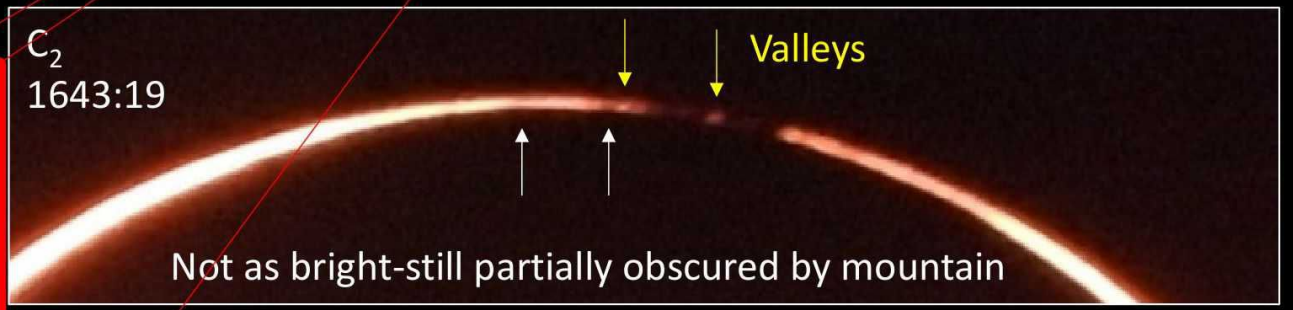


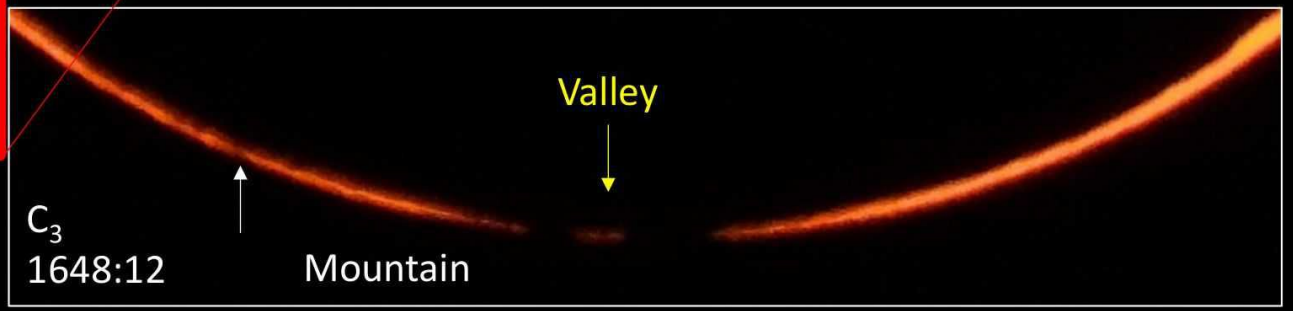
Lunar Terrain at C_2 and C_3



Also visible along limb during partial eclipse phase

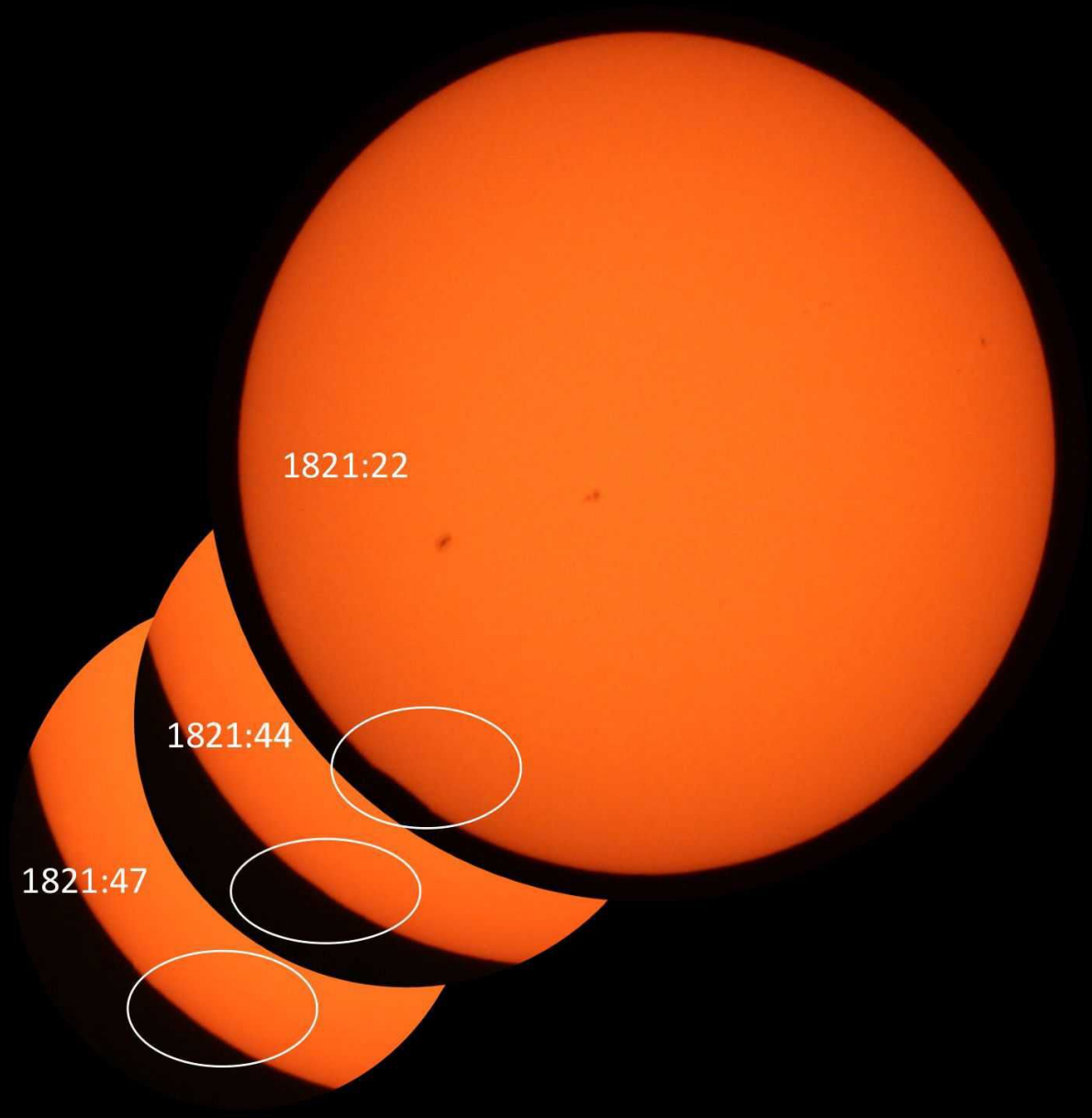






Contact 4

Predicted: 1821:52



Post Eclipse

Notice 42° apparent rotation over 3.07 hours
Due to rotation of camera, not sun
Measure using sunspot orientation: