Selenology Today

Special Lunar eclipse

GLRGROUP.org
Geological Lunar Researches Group

ECLISSE TOTALE DI LUNA

21 Febbraio 2008, h. 2:50 - 04:00 u.t. Canon EOS 20D + Sigma 17-70 (30mm F/D=18), 100 ISO Cristian Fattinnanzi, Macerata - ITALY

Selenology Today Addendum to # 9

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SELENOLOGY TODAY
addendum to #9

Cover : Images taken by Mario Del Bianco (top) and Cristian Fattinnanzi (bottom)

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Total Lunar Eclipse: February 20-21 2008

By Maria Teresa Bregante

Geologic Lunar Research (GLR) group

Introduction

Weather permitting, on Wednesday February 20, 2008 in the U.S., (Thursday, February 21 in the rest of the world) a total eclipse of the Moon was visible in most of North America, all of South America as well as Western Europe and portions of North Africa. It is an exciting event for astronomers and it provides great photos opportunities as well. Photographing the moon is relatively easy compared to other celestial bodies, because it's so bright being relatively close to the earth. Hopefully the weather will cooperate as the next total lunar eclipse is not until December 2010. Fortunately, there will be several partial eclipses before that, the next one is on August 16, 2008. During the penumbral phase it is very difficult to see any major change in the Moon's appearance. In total the umbral phase of the eclipse lasts just under 3.5 hours, with totality lasting just 50 minutes. At mid-eclipse the sub-lunar point will be located over the European Spaceport in French Guiana. The northern edge of the Moon will pass much deeper into the Earth's shadow than the southern edge and it is likely, therefore, that there will be considerable variation in shadow brightness across the lunar surface. Throughout history, lunar eclipses have had an unusual effect on people. Some feared them as a bad omen; others used them to their advantage. One of the most famous examples of this is Cristoforo Colombo (Columbus). Stranded in Jamaica and running out of food, Colombo found himself at odds with the locals who had tired of providing sustenance for him and his crew. Colombo studied his astronomical tables and learned that a lunar eclipse was forthcoming. Seizing the opportunity, he told the native leaders that the Christian God was angry with the people because they refused to supply food. To prove his point, he warned that the moon would disappear. The following night, the moon turned red and was hidden by earth’s shadow during the eclipse. The natives were terrified. They came to Colombo with food and pleaded for him

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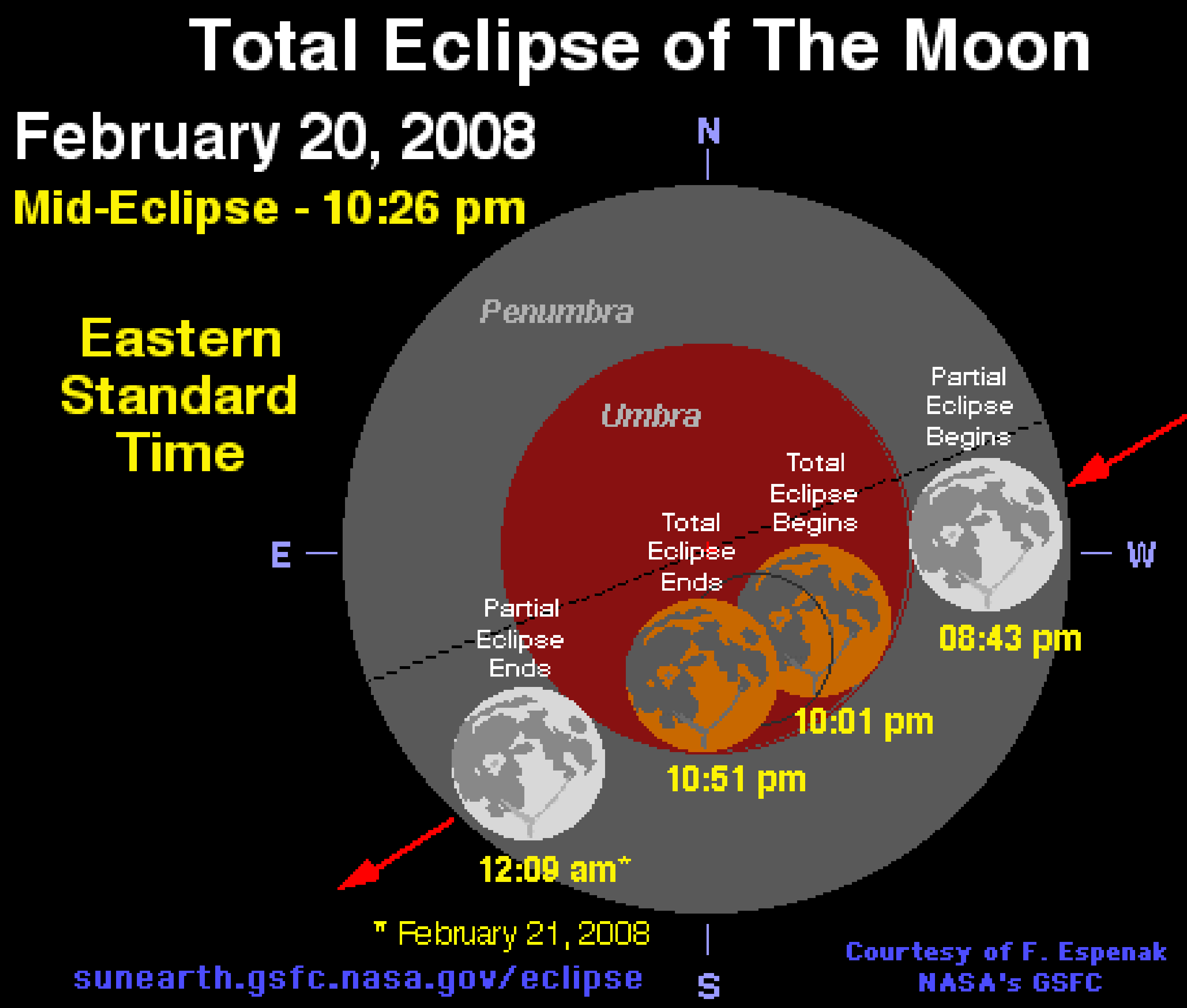
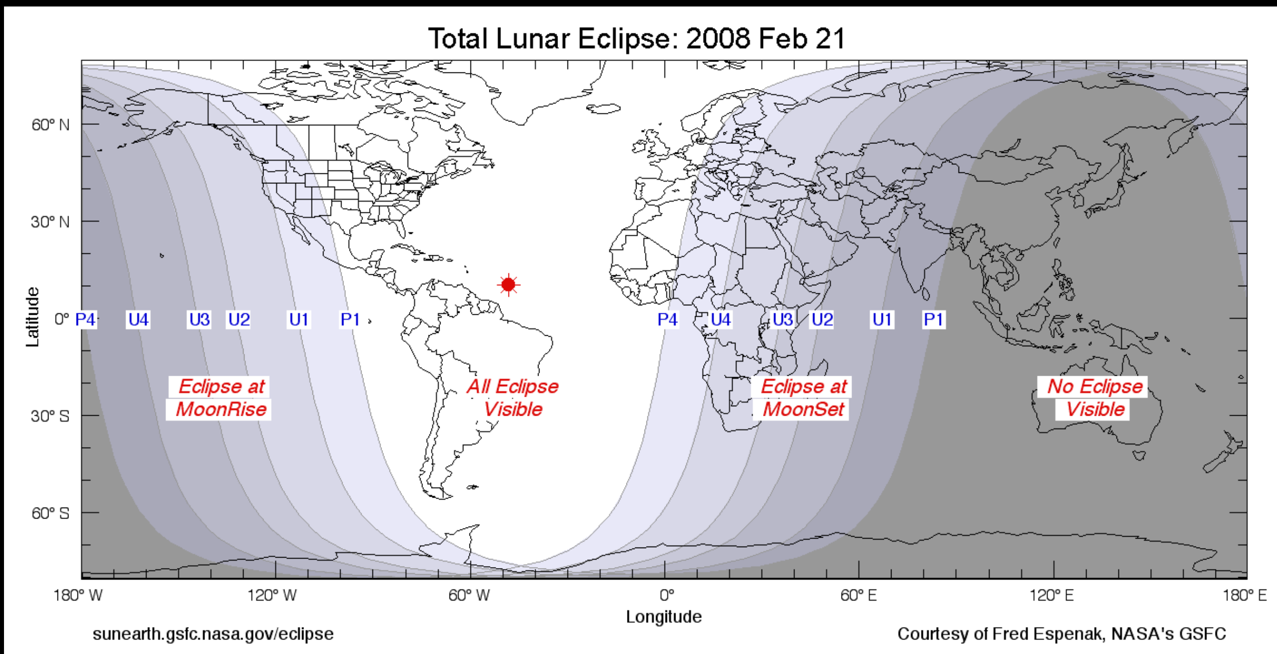


SPECIAL LUNAR ECLIPSE



to intercede on their behalf. Of course, he did, and the rest is history. His men were well supplied until they were rescued a few months later. On February 21, 2008, the partial eclipse began with first umbral contact at 01:43 UT. Totality began at 03:01UT until 03:51 UT. The partial phases ended at 05:09 UT. Keen amateurs, alongside professional astronomers, were encouraged to make estimates of the Moon's brightness every 10 minutes throughout totality using the Danjon scale. Shortly after sunset on Wednesday, February the 20th, skywatchers across the Americas were treated to a beautiful total lunar eclipse. This was the last total lunar eclipse until 2010. Depending on where you live, you have seen all or at least most of the event. Those located to the east observed the snow Moon rise as the Sun was setting. Shortly after that, the partial phase of the eclipse began. For those located in the mid-west and west, the moon rose with the partial phase already underway. Regardless, most everyone in the view area were able to see all of the totality phase.

In Europe the eclipse happened not long before moonset. As usual during an eclipse the moon turns a coppery or reddish color during totality. This is caused because the eclipse will block all direct light, but not all light. Some light will filter through Earth's atmosphere and still shine upon the Moon. This will give it a beautiful reddish color. Although total eclipses of the Moon are of limited scientific value, they are remarkably beautiful events which do not require expensive equipment. They help to cultivate interest in science and astronomy in children and to provide a unique learning opportunity for families, students and teachers. To the nature lover and naturalist, the lunar eclipse can be appreciated and celebrated as an event which vividly illustrates our place among the planets in the solar system. The three dimensional reality of our universe comes alive in a graceful celestial ballet as the Moon swings through the Earth's shadow. Table 1 shows every lunar eclipse from 2007 through 2012. Although penumbral lunar eclipses are included in this list, they are usually quite difficult to observe because of their subtlety. The penumbra is a partial shadow which still permits some direct sunlight to reach the Moon.

Table 1

Date	Eclipse Type	Umbral Magnitude	Eclipse Duration	Geographic Region of Eclipse Visibility
2007 Mar 03	Total	1.238	03h42m **01h14m**	Americas, Europe, Africa, Asia
2007 Aug 28	Total	1.481	03h33m **01h31m**	e Asia, Aus., Pacific, Americas
2008 Feb 21	Total	1.111	03h26m **00h51m**	c Pacific, Americas, Europe, Africa
2008 Aug 16	Partial	0.813	03h09m	S. America, Europe, Africa, Asia, Aus.
2009 Feb 09	Penumbral	-0. 083	-	e Europe, Asia, Aus., Pacific, w N.A.
2009 Jul 07	Penumbral	-0. 909	-	Aus., Pacific, Americas
2009 Aug 06	Penumbral	-0. 661	-	Americas, Europe, Africa, w Asia
2009 Dec 31	Partial	0.082	01h02m	Europe, Africa, Asia, Aus.
2010 Jun 26	Partial	0.542	02h44m	e Asia, Aus., Pacific, w Americas
2010 Dec 21	Total	1.262	03h29m **01h13m**	e Asia, Aus., Pacific, Americas, Europe
2011 Jun 15	Total	1.705	03h40m **01h41m**	S.America, Europe, Africa, Asia, Aus.
2011 Dec 10	Total	1.110	03h33m **00h52m**	Europe, e Africa, Asia, Aus., Pacific, N.A.
2012 Jun 04	Partial	0.376	02h08m	Asia, Aus., Pacific, Americas
2012 Nov 28	Penumbral	-0. 184	-	Europe, e Africa, Asia, Aus., Pacific, N.A.

References

Espenak F. sunearth.gsfc.nasa.gov/eclipse/LEmono/TLE2008Feb21/TLE2008Feb21.html

Imaging and Photometric Studies of the Total Lunar Eclipse of February 21, 2008

By Richard Evans
Geologic Lunar Research (GLR) Group

Abstract

The lunar eclipse of February 21, 2008 was imaged between 01:43 and 05:11 UT from the east coast of the United States (42.35 N, 71.5 W). The telescope used was a 90 mm catadioptric lens at F5.6. Prime focus imaging was performed using a Watec 120N videocamera with a frame rate of 1/30 sec. An 850 nm +/- 5 nm bandpass filter was used in the acquisition of all images. A total of forty three videoclips ranging in duration from about one minute to two minutes were made. Each videoclip was converted from wmv to avi format and processed using Registax, IRIS, and Photoshop CS2 to produce a high resolution still image. These still images were assembled into a separate montage for each each half of the eclipse. A selected image taken at 02:12 UT was used to calculate the approximate size of the Earth's umbra (i.e. inner shadow). An unprocessed wmv frame from each videoclip was corrected for frame integration time and used to produce relative photometric curves for Tycho and for the moon as a whole. These curves were not corrected for atmospheric extinction or for scattering of light by features near Tycho. Results obtained were compared to those obtained by Cuffey for the lunar eclipse of September 26, 1950.

Introduction

During the total lunar eclipse of September 26, 1950 Cuffey observed that Tycho dimmed by 8.01 magnitude in red light and by 14.05 magnitude in the ultra-violet. He also observed that the flat bottom of the photometric curve for Tycho corresponded to a time interval of 100 minutes in red light, but only 40 minutes in ultra-violet light. The goal of the present study was to both image each half of the total lunar eclipse of February 21, 2008 and to produce a photometric curve obtained for Tycho in the near infra-red at 850 nm to determine the time duration of the flat bottom of the photometric curve. A similar photometric curve was produced for the moon as a whole. Imaging was performed as described in the abstract above. Seeing conditions were estimated at 6/10 with a transparency of about 4/5. The temperature was about –18 degrees Centigrade.

Methodology

Processing of high resolution images:

Each videoclip was acquired in wmv format using Windows Movie Maker software. The wmv files were converted to uncompressed avi format using Movie Studio 3.0 software. Avi clips were viewed using VirtualDub software and the sharpest frame sequences were selected for further processing in Registax 4.0. Single point alignment was performed in Registax and following optimization the best frames were stacked to produce a fit32 image for each videoclip. The fit32

Lunar Eclipse February 21, 2008 01:43 - 03:26 UT

Richard Evans
42.35N, 71.5W

Seeing 6/10 Transparency 4/5
90 mm F5.6 Catadioptric Lens
Watec 120N Camera
850 nm +/- 5 nm filter

Fig. 1

Lunar Eclipse February 21, 2008 03:07 to 05:11 UT

Richard Evans
42.35N, 71.5W

Seeing 6/10 Transparency 4/5
90 mm F5.6 Catadioptric Lens
at 850 nm +/- 5 nm

Fig. 2

image was imported into IRIS software and unsharp masking and crisping was applied. The image was converted into bmp format and imported into Photoshop CS2 where further smart sharpening and unsharp masking was applied. Processed images were re-sized and assembled into a montage for each half of the lunar eclipse. The image taken at 02:12 UT was used to calculate the approximate size of the Earth's umbra or inner shadow. The outline of the umbral shadow was approximated using Digimizer software and the radius of the best fit circle whose edge best fit the contour of the umbral shadow on the moon was calculated.

Processing of images for photometric studies:

One unprocessed frame was selected from each wmv videoclip and converted into an 8 bit jpg image in Windows Movie Maker. Each jpg image was imported into ImageJ software. Tycho was identified on each image and a histogram greyscale value average with standard deviation was obtained. The process was then repeated for the moon as a whole by enclosing the lunar disk by circular loop and measuring the histogram average with standard deviation for the interior of the loop. Histogram and standard deviation values were corrected for camera frame integration time. An initial relative photometric plot of greyscale value vs eclipse duration in minutes was made using Microsoft EXCEL software. Data was imported into TableCurve II software where a cubic constrained smoothing spline was applied to the data set.

Discussion

The montage of eclipse images shows the progression of the total lunar eclipse in good resolution considering that the images were acquired using a 90 mm F5.6 catadioptric lens. Selection of the 850 nm bandpass filter helped to avoid oversaturation of the images given that the Watec 120N camera is ultra light sensitive. It also facilitated in reducing glare and improving image contrast. The approximate radius of the Earth's umbral shadow was calculated as approximately 4699 km from the image taken at 02:12 UT. The relative photometric curve produced for Tycho has a flat bottom corresponding to between about 95 and 100 minutes of duration during the eclipse when Tycho was at minimum brightness. This compares favorably to Cuffey's observation that the duration in red light was about 100 minutes. The flat bottom of the relative photometric curve for the moon as a whole in the present study had a duration of about 90 minutes during which it was at minimal brightness. The present study was intended to revive interest in the colorimetric study of specific lunar features during a lunar eclipse. Photometric curves for many lunar features at specific wavelengths from the ultraviolet through the infrared remain to be defined during eclipse events. This may be an area of interest for amateur astronomers in the future.

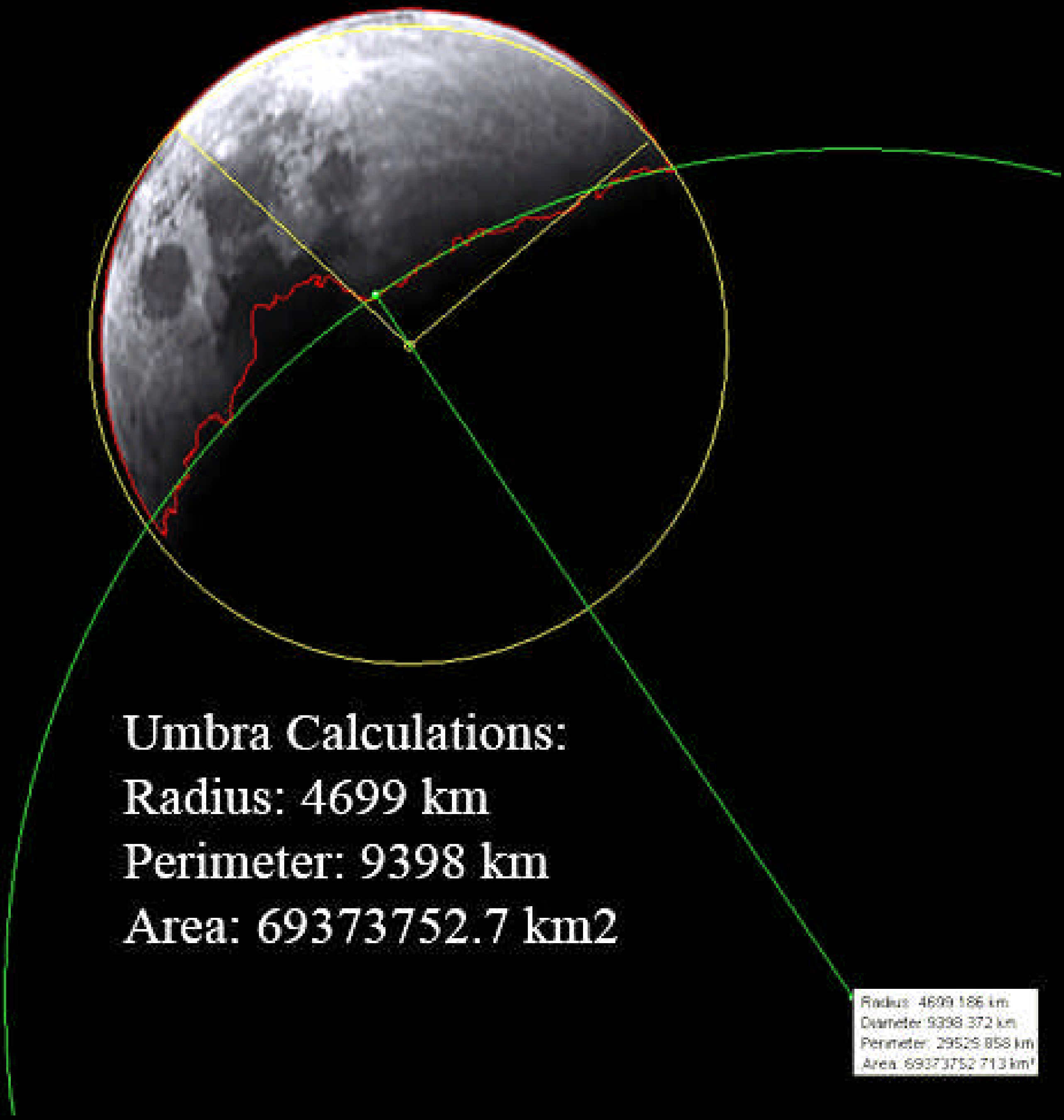

Umbra Calculations:
Radius: 4699 km
Perimeter: 9398 km
Area: 69373752.7 km2
Radius: 4699.186 km
Diameter: 9398.372 km
Perimeter: 29525.858 km
Area: 69373752.713 km²

Fig. 3

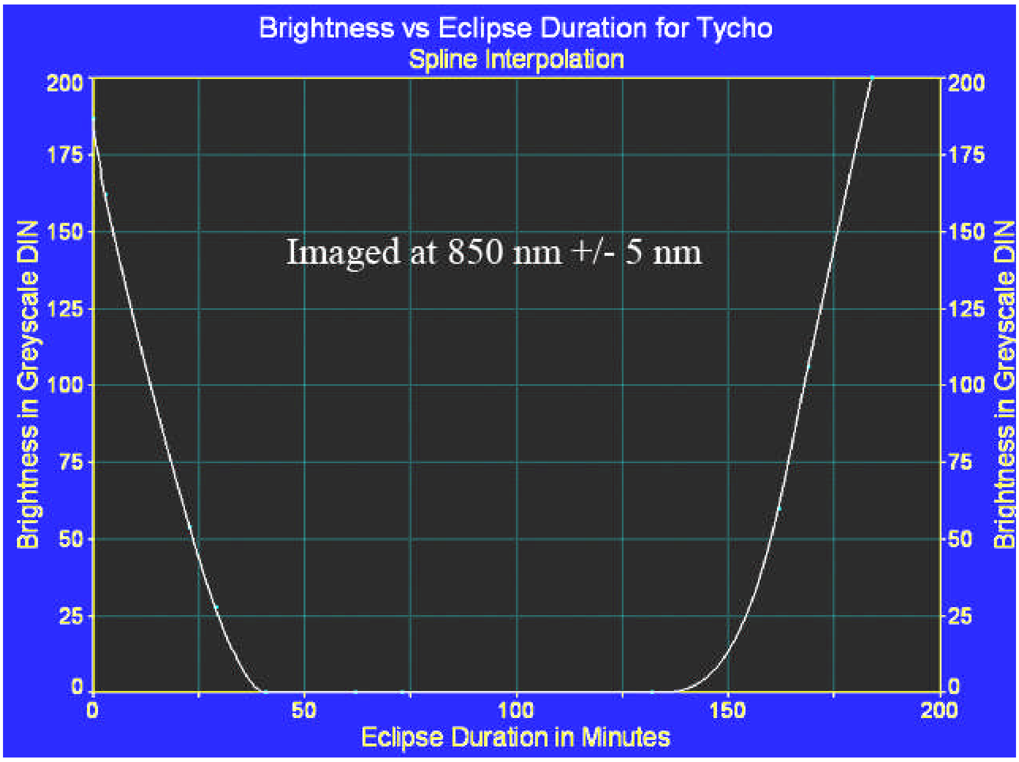


Fig. 4 Image montage of first half of lunar eclipse of February 21, 2008

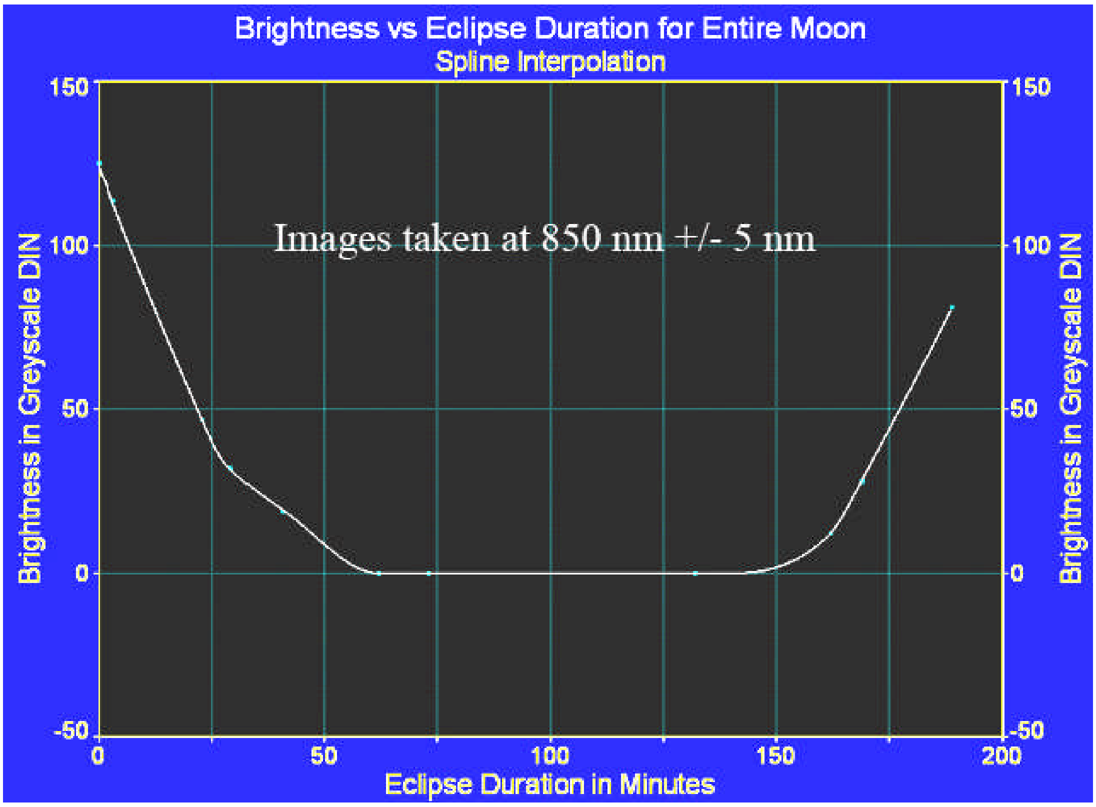


Fig.5 Relative photometric curve of the whole moon during eclipse of February 21, 2008

References

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2. Reaves, G and Walker, MF (1952) Photoelectric Photometry of the Lunar Eclipse of 1950 September 26. Publications of the Astronomical Society of the Pacific. Vol. 64 No. 376 pp. 15-19.
   Dvorak, S. (2005) Serendipitous Photometric Observations of the October 2004 Lunar Eclipse. JAAVSO Vol. 34 pp. 72-75.

Lunar eclipse of February 21 2008 Colour Photometry

By Raffaello Lena
Geologic Lunar Research (GLR) group

Introduction

As part of the photometric analysis concerning the lunar eclipse of February 21, 2008 a study was carried out using digital images taken by Mario Del Bianco from Montecassiano (Macerata) Italy.

Del Bianco used a 200 mm Newtonian telescope at F/4.5. The photos were acquired using a Canon EOS 300D camera at 400 ISO and with varying exposure times. No band pass filter was used in the acquisition of all images. Photographs were taken from 01:57 UT to 04:47 UT.

A mosaic of some images is shown in Fig.3.

Methodology

Unprocessed digital images in RGB format were analyzed with ImageJ software by enclosing the lunar disk by circular loop and measuring the histogram average with standard deviation for the interior of the loop. Histogram and standard deviation values were corrected for varying exposure time. The measurements were not corrected for atmospheric extinction. The measurements are reported in Table 1. Every sequence of the images was split into Blue and Red channels. In order to trace the light curve of the whole moon the technique of relative photometry has been adopted. The medium ADU (Analog to Digital Unity) value was calculated also for the B and R channel. In this way it is possible to show the variations of lunar eclipse brightness regarding the red colour.

Results

Figure 1 shows the brightness variation as the eclipse progressed with the U1 (Partial eclipse begins), U2 (Total eclipse begins) and U3 (Total eclipse ends) times marked. Towards the end of totality, the sky background level started to rise slowly due to thin cloud and an evident scattered light was present. For this reason the images taken in the U4 time (Partial eclipse ends) were not analyzed. The light curve (see Fig.1) is rather flat, without peaks that goes beyond the measure uncertainties. The asymmetry present near 04:48UT resulted from scattered light and a saturation of the images during the U4 time. Elimination of this component producing distortion was, unfortunately, impracticable. Fig.1b displays the re-scaled curve on the y axis to a maximum of 2580 which emphasize the increase in brightness after totality.

The flat bottom of the relative photometric curve for the moon as a whole had a duration of about 80 minutes during which it was at minimal brightness.

The first image analyzed was taken at 01:57 UT, just 14 minutes after the U1 time. It was used as reference image: when the moon enters the umbra its brightness suddenly decrease by 4.6 mag. This measurement is to be regarded as provisional because the images of the moon before the Penumbra ingress (P1 time) are lacking.

Figure 2 shows the brightness variation

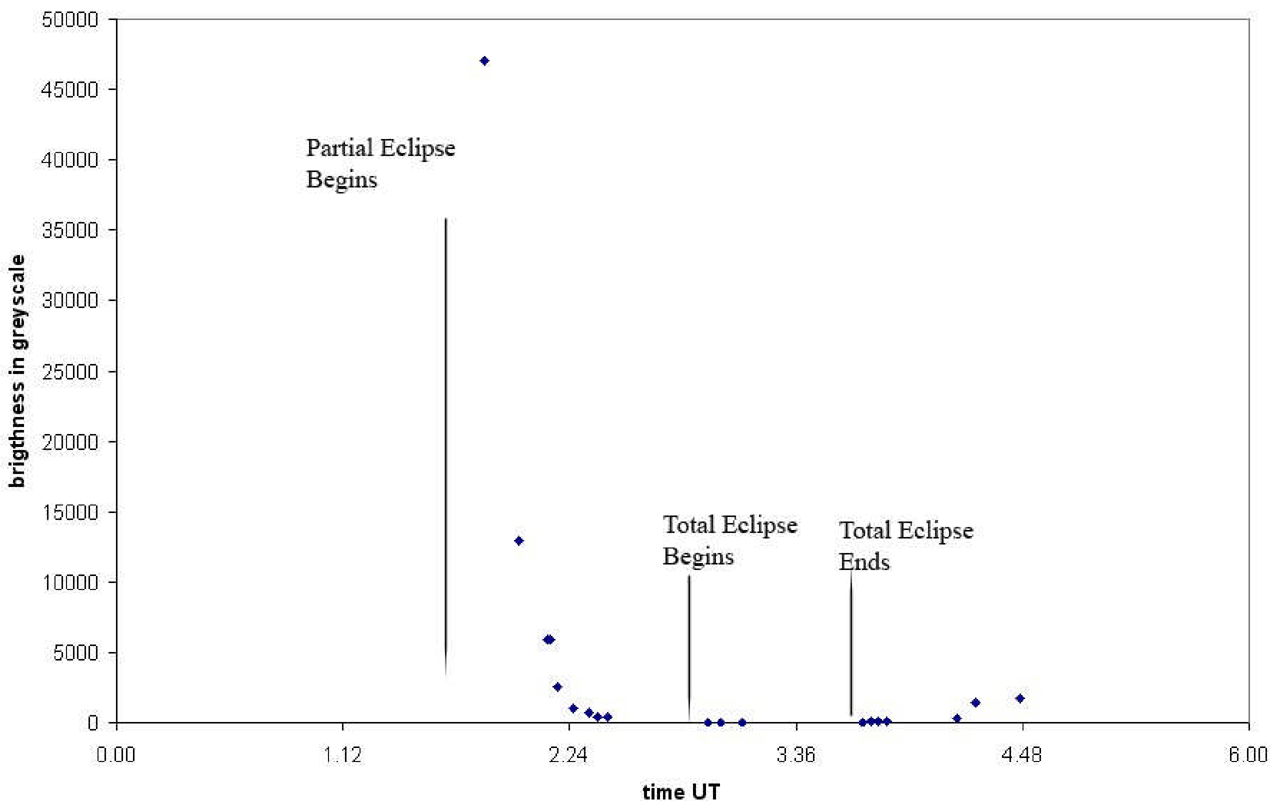
Partial Eclipse
Begins
Total Eclipse
Begins
Total Eclipse
Ends
brigthness in greyscale
time UT
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0.00
1.12
2.24
3.36
4.48
6.00

Fig. 1

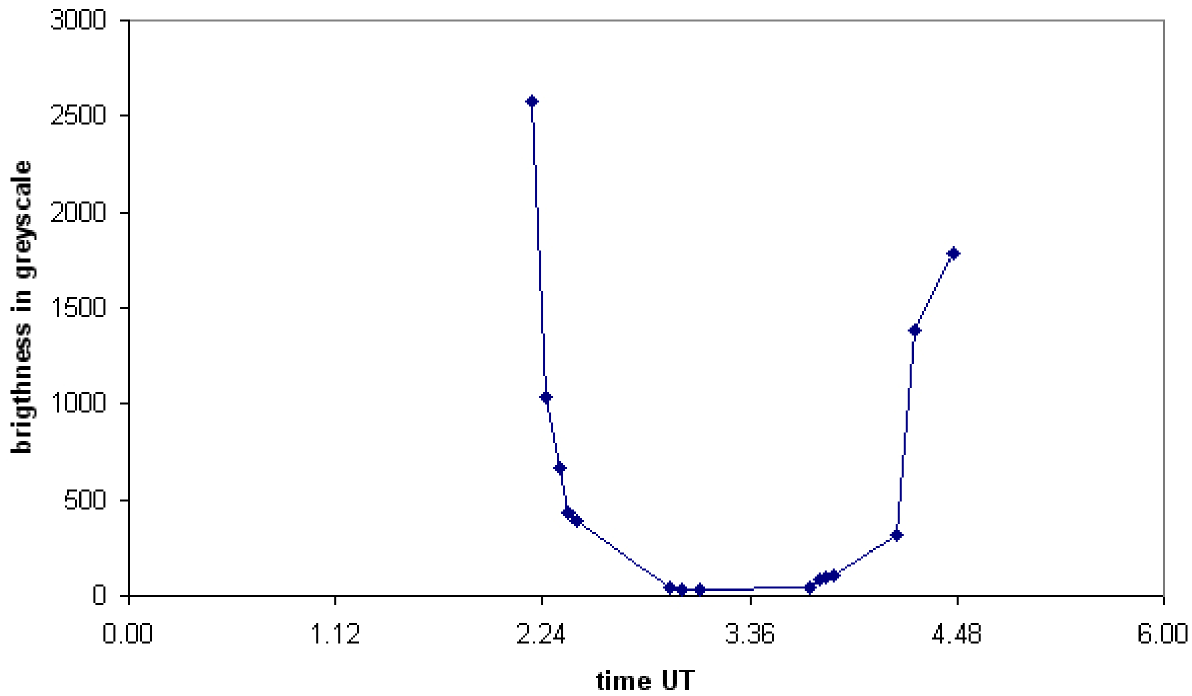
brigthness in greyscale
time UT
3000
2500
2000
1500
1000
500
0
0.00
1.12
2.24
3.36
4.48
6.00

Fig. 1 b

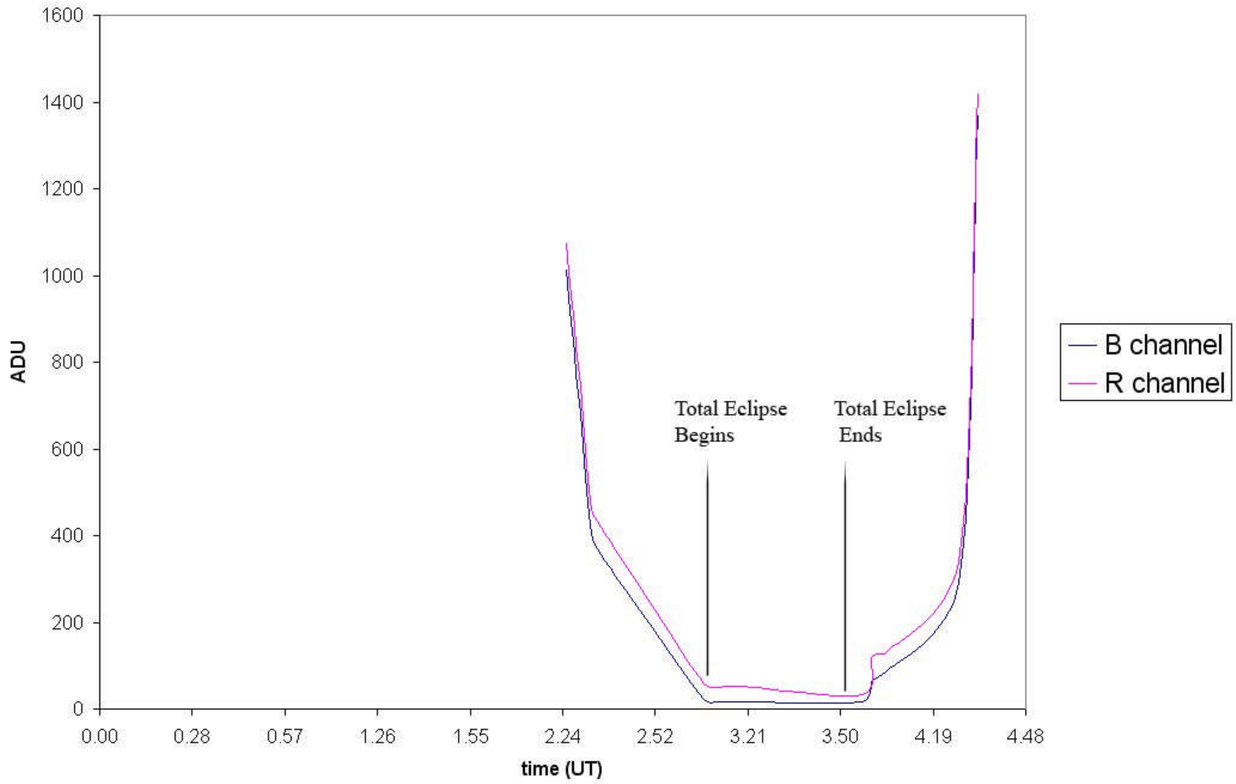

Fig. 2 Photometric curves in R and B channel

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measured in the B and R channel, with the U2 (Total eclipse begins) and U3 (Total eclipse ends) times marked.

Also in this case the light curve in red and blue channels, each corrected for several exposure times, is appreciably flat during the totality. This figure shows the colorimetric variation of the moon during the eclipse, showing how the moon becomes red during the eclipse. The red and blue measurements made during the maximum of the totality gave a R/B ratio of 2.8. although this ratio may qualitatively indicate the red colour of the total elipse, its value may be affected by the white balance of the camera which attempts to make the average R, G, and B pixel intensities as similar as possible.

The true R/B ratio is probably much larger.

Compared with the first image taken at 01:57 UT, just 14 minutes after the U1 time, the moon was dimmed at totality by about 4.5 magnit. in red light and by about 9.5 magnit. in blue light. Accordingly, dimming in blue light is 5 magnitudes stronger than in red light. The asymmetry of the light curve is probably caused by atmospheric absorption, as the eclipse took place not long before moonset. The same effect could explain the non-constant decreasing brightness during totality. As a final remark the atmospheric absorption should be taken into account and two images of the moon, just before entering the penumbra and just after exiting it should be acquired.

Since the true brightness of the "undisturbed" lunar disk does not change during that time interval, these two images would allow to compute the atmospheric absorption coefficient based on the corresponding elevation angles above the horizon.

Table 1

Digital image	exposure time (sec)	ADU (count)	Time UT	ADU (correct for exposure time)
1	0.003125	148	01:57	47360
2	0.0125	162	02:08	12960
3	0.02	119	02:17	5950
4	0.02	119	02:18	5950
5	0.05	129	02:20	2580
6	0.125	130	02:25	1040
7	0.166	111	02:30	668.67
8	0.25	107	02:33	428
9	0.25	97	02:36	388
10	3.2	120.6	03:08	37.68
11	4	128.3	03:12	32.07
12	3.2	105.78	03:19	33.05
13	2	75.15	03:57	37.57
14	0.6	50.72	04:00	84.53
15	1	96.82	04:02	96.82
16	0.5	53.09	04:05	106.18
17	0.5	157.24	04:27	314.48
18	0.1	138.26	04:33	1382.60
19	0.1	178	04:47	1780

February 20-21, 2008 Lunar Eclipse

By Neil Rothschild

GLR group

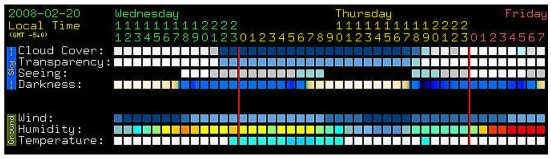


Figure 1

Based on internet reports, this was a very difficult eclipse for observers in many regions, including most of the USA and Europe. Most observers were clouded out. For myself, at N39d17m W76d36m, the day of the eclipse included several inches of snow. The snow storm tapered off only an hour or two before the initial umbral contact. As illustrated by the Clear Skies Clock map below (Fig. 1), that forecast (last updated at 11:22am local time) suggested full cloud cover (with snow) until 8pm - 9pm local time (UT -5), with full clearing by 10pm. First umbral contact was 8:42pm local time. My expectations were low. Our NOAA weather forecast predicted clearing around midnight local time, several hours too late!

Clear Skies Clock (www.cleardarksky.com) provides hourly forecasts, up to 48 hours in advance, of predicted cloud cover, seeing and transparency. It is an invaluable aid. It is based on data generated by the Canadian Meteorological Center and is only available for North America. Hopefully our European friends have, or will soon have, something similar to aid their own astronomical planning.

Skies cleared less than an hour before first umbral contact, with much snow swirling about, most likely blown from nearby trees. Although the skies were mostly clear, I thought it was still snowing! Within minutes of first umbral contact I mounted a Nikon 500mm F/4 photo lens and Nikon D200 camera on a Gitzo G1410 to shoot fixed tripod shots of the umbral ingress. About 20 minutes before the start of totality I set up and roughly polar aligned a Questar 7 on it's Questar fork mount. Just after the start of totality I moved the 500mm lens to the Questar fork for equatorially driven images of the total phase. Skies were surprisingly clear and transparent. The weather system producing the snow storm is known as a "clipper", a fast moving system followed by rapid clearing. Lucky for me!

Although I missed initial contact with the umbra by about 10 minutes as I waited for the swirling wind blown snow to subside, I was able to image the rest of the eclipse without incident. Temperatures steadily dropped from about 30F to about 17F at last umbral contact. I do not have a suitable table for the fork mounted Questar so I set it up on my patio. The image below was shot after the conclusion of umbral contact with a Nikon D2H. Lighting was moonlight assisted by a red astronomical LED flashlight, which I waved about to fill in the shadows. As seen in Fig.2, I attached a small external monitor in order to more easily view the histograms of the images. The unique design of the Questar fork allowed me to essentially mount a refractor to it. I do not have a fast astronomical refractor but I have had very good success with general lunar imaging with that 500mm lens. Considering that I only had time for a rough visual alignment to Polaris, I felt that the speed of the F/4 lens would work in my favor.

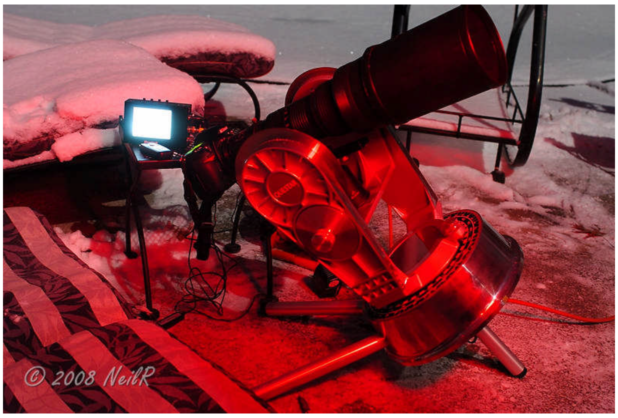


Figure 2

The image shown in Fig.3 illustrated the method of attachment. I placed a Markins M20 ballhead between the lens and fork to provide clearance for an alignment pin, which would have interfered had I mounted the lens foot directly to the fork.

Figure 3
A wider view of my "Eclipse Observatory", including a Questar 3.5 for visual observations. The Questar 7 fork is in the background (Fig.4).

Figure 4
The montage shown in Fig. 5 includes a sampling of images from the umbral and totality phases. The exposure of the total phase is F/4 4s ISO 100 and was acquired at 03:26:02 UT. The partial phases were generally imaged at F/5.6 to F/6.3 1/320s ISO 100, with some variance. First umbral contact imaged at 01:51:52 UT and the last umbral image at 05:17:27 UT. These were selected from a total of about 270 images.
All images were shot as raw Nikon NEF files, rendered in Nikon CaptureNX V1.2. The

montage images, all single images (no stacking), are essentially as captured with little or any additional post processing.

Figure 5 (see also the gallery section)
Same image from totality. This image was sharpened with FocusMagic (Fig.6).

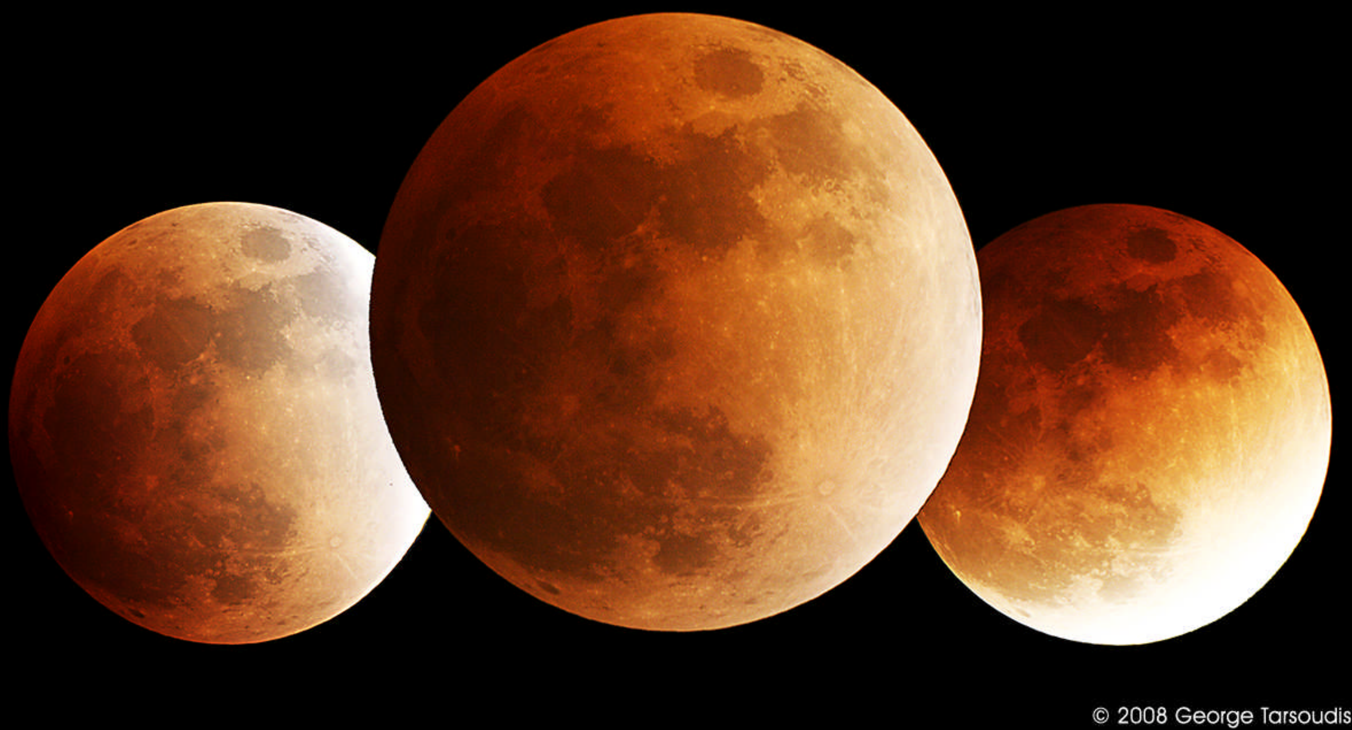
Figure 6 (see also the gallery section)

I have managed to photograph two of the three prior total eclipses. This is the only one of the three that I was able to shoot almost the entire eclipse from the start to finish of the umbral phases. The two prior eclipses were clouded out during either ingress or egress. This is the only eclipse, of the three, that I shot from a motorized mount. Overall I was very happy with the results, especially considering the uncertainties and difficulties of weather. Seeing the images in Selenology Today, I am motivated to shoot some high resolution lunar images with the Questar 7. I hope to be a regular contributor.

Gerardo Sbarufatti

Times 02:38 - 03:25 - 04:10 UT

Skywatcher 80ED and Canon 350D at 400 ISO.



George Tarsoudis 21/02/2008 03:51:40 UT

left image 02:49:37 UT right image 03:57:06 UT

Telescope Newtonian Orion Optics UK 250 mm at f/6.3, Canon EoS 350D at prime focus.

Alexandroupolis - Greece, 40° 50' 60" N Latitude, 25° 52' 10" E Longitude.

George Tarsoudis 21/02/2008 04:15:52 UT
Telescope Newtonian Orion Optics UK 250 mm at f/6.3, Canon EoS 350D at prime focus.

Alexandroupolis - Greece, 40° 50' 60" N Latitude, 25° 52' 10" E Longitude

Mario Del Bianco Newton 200 mm F/4.5

At the top Saturn and Regulus

Mario Del Bianco Newton 200 mm F/4.5

Mario Del Bianco Newton 200 mm F/4.5

Mario Del Bianco Newton 200 mm F/4.5

GALLERY SPECIAL LUNAR ECLIPSE

Neil Rothschild single image shot with a Nikon D200 + Nikon 500/4P at F/4 4s ISO 100 mounted to a Questar 7 fork mount with a Markins M20 ballhead to provide clearance over the alignment pin intended for the Questar 7 OTA. The fork mount was running in motorized equatorial mode, with only a very rough alignment on Polaris.

Neil Rothschild Mosaic of the lunar eclipse