STUDY OF ABSORPTION FEATURES OF THE MARS

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Abstract: This Dissertation in Astronomy is focused in the study of the absorption features of the surface of Mars using Meade 16" LX200GPS Schmidt-Cassegrain telescope at National Observatory, Nagarkot, Nepal during the period from October 2010 to November 2011. This work may be regarded as an initiation to understand the absorption features of the red planet, Mars. The images of the planet were captured with the help of the interface software AUTOSTAR SUITE in fits format. The images were processed with the software ALADIN 2.5. The data so obtained were analyzed in ORIGIN 5.0. The variations of relative flux density were observed along eight portions of four different diameters. The inner portion of the red planet showed homogeneous relative flux density while the outer portion appeared inhomogeneous. There is consistent decrease in relative flux density from inner to outer regions of interest of its surface. The relative flux density per pixel was observed to be ranging from 111.78582 (standard error 3.99182) to 120.68200 (standard error 5.75829). The overall measurement of absorption features of Mars surface that was conducted here was very preliminary one. However, this will act as a very good basis for further study of similar nature using the same or better telescope in this particular geographic region.

Keywords: Mars; Relative flux density; Google Sky Map; Deimos; FITS image; Pixels; Schmidt-Cassegrain 16 inch LX200GPS telescope.

INTRODUCTION

A simple red dot observed in the sky by our ancestors, or the planet across which our modern robots trundle in their explorations, however we see it, Mars never ceases to thrill humanity. Earth's sister planet, the Mars has been the subject of many science fictions of the extraterrestrial beings, leading lives parallel to ours. Such a view of Mars was indeed the fruit of over-stimulated imaginations and a few sparse data, and today's probes, revealing the true nature of the planet, have dashed most of the ancient myths. However, recent findings have sprung their own surprises, and Mars is, if anything, an even more fascinating place than it was before.

The planet Mars, first planet beyond the orbit of the Earth, has always been of special interest because recently it was thought that life might exist there. Most knowledge of the evolution of Mars and the present Martian climate outcome from instruments on various missions to the red planet. Mars can approach us to a distance of 35 million miles. It is therefore always at least 150 times as remote as the moon, with a diameter of only 4,200 miles and it is much smaller than earth. Fortunately, it is better placed than either Mercury and Venus. Since it lies beyond the Earth's orbit, it can never appear as a half or a crescent, while at its most gibbous it looks like the shape of the Moon two or three days from full Moon. The main trouble about observing Mars is that it comes to opposition only at intervals of nearly two years. Things are at their best for only a few weeks before and after the opposition date, so that the observer has to make the best use of the limited time at his disposal. Not all oppositions are equally favorable because the orbit of Mars is much more elliptical than the Earth and the best oppositions occur when Mars is near prehelion. The opposition of 2003 was much better than that of 2010. At the end of August 2003 Mars was slightly less than 35,000,000 miles from us, as close as it can never be. For a few weeks Mars outshone even Jupiter, but when the planet is at its furthest from Earth it is not much brighter than the Pole star.

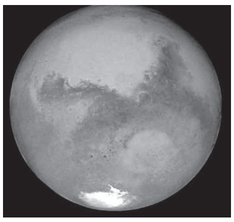

Figure 1: The red planet, Mars observed by Hubble Space Telescope on 26 August 2003(Courtesy NASA) (Source: Francois Forget et.al, Planet Mars, 2008)

In this research work, we used 16" LX200GPS Schmidt-Cassegrain telescope located at the National Observatory, Nagarkot, Bhaktapur, Nepal. We studied the flux density variation in the surface and absorption features of the red planet, Mars. We operated and

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calibrated the telescope for that purpose. This research work on the red planet is a very basic work. The images captured in the high-tech telescope and camera may not be error free. This fundamental work is an initiation of research work on the Mars from the high altitude of Nepal. The measurement of absorption features of any planet like Mars is a very primitive work. It may create a future basis for students who are interested in thered planet.

OBJECTIVE

The prime objectives of our research work are as follows:

1. To operate and calibrate the telescope "Schmidt-Cassegrain 16 inch LX200GPS Telescope" installed in the National Observatory Nagarkot, Bhaktapur, Nepal.
2. To carry out some observations in the certain period of time focusing the red planet, Mars.
3. To capture images of Mars and process them in the data reduction softwares, and study the variations of relative flux density to measure absorption features of surface of Mars.
4. To compare our result with previously published data.

OBSERVATION

National Observatory

The National Observatory, Nagarkot is situated at latitude 27° 41' 60" N and longitude 85° 31' 0" E, 32 km east of the capital city, Kathmandu. High altitude, clear sky, narrow population and noiseless environment are the basic features of Nagarkot that provided the idea of constructing the observatory there. Because of its high altitude, the weather is cold throughout the year. Most of the time the climatic condition is a bit humid, therefore, to minimize errors owing to humidity, we used an electric absorbent inside the dome while taking observations. The National Observatory at Nagarkot is the only observatory in our nation and is also popular as Nagarkot observatory. It constitutes a two-storey building in which a 16" LX200GPS Schmidt-Cassegrain telescope has been installed. In addition there is a rest house that offers all the facilities to the observers.

Observation Techniques

A Google Sky Map is used to identify the heavenly bodies with naked eyes. Before observing a particular heavenly body (the red planet, Mars), we identified Betelgeuse of Orion constellation and it is defined as the reference frame with the telescope at its centre while the Rigel of same constellation is taken as another reference frame. We manually set the telescope so that the Rigel was at the center of the field of view. After this star was set in the memory of the telescope, we set it again to focus on the Betelgeuse. When this star was set in the memory, we got the message "Alignment Successful". This message ensured that the reference frame was set and we were ready to use the telescope to view any possible object in the sky. Once a reference frame is set, the telescope works automatically as per the commands given to it through the AUTOSTAR II handbox. When we give the command to go to the planet Mars, the telescope would rotate itself to focus on it. The planet would appear in or near the field of view, depending on the accuracy with which we fix a reference frame. Once the telescope aligns itself to focus on the desired object, the only effort we have to make is to bring it in the center of the field of view.

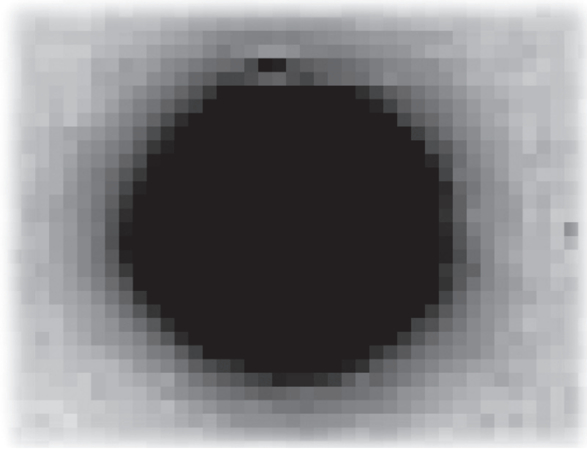

Figure 2: FITS image captured by 16" LX200GPS Schmidt-Cassegrain telescope.

A numbers of attempt have been made for the better telescopic view and capturing of the red planet, Mars between October 2010 to November 2011. Fortunately, our long term efforts are succeeded with clear images of Mars in the FITS format and JPEG format.

METHOD OF ANALYSIS

- With the help of software ALADIN 2.5, contour regions are drawn to determine the region of our interests.
- We recorded the position and relative flux density associated with each of the clicked pixels.
- We further administered two other types of data to correct for the observed values of relative flux density.
- A background data is the average value of the minimum relative flux density per pixel, observed in the field of view captured in the image.
- We obtained it by clicking on the pixels with minimum relative flux density .

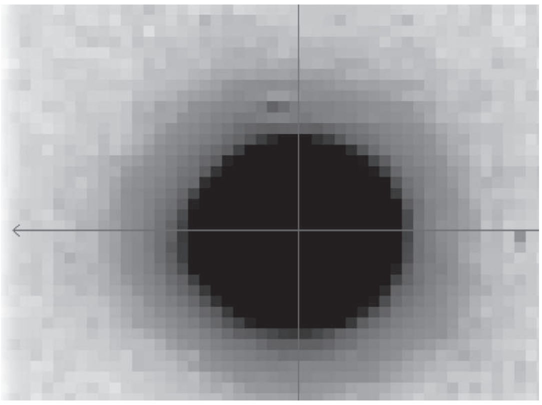

Figure 3: Determination of Center

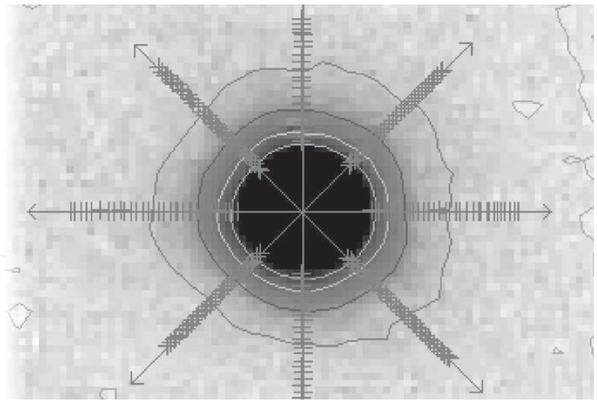

Figure 4: Clicks along four diameters.

- A homogeneous background is the average value of relative flux density per pixel.
- We obtained it by clicking on the circular region just outside the outermost contour.

Sample Data: Relative Flux density along diameter

Table 1: Diameter three: right portion

P_N	X	Y	R_D
1	339.2500	297.3125	204.00
2	339.6875	297.1875	204.00
3	340.2500	297.3750	156.66
4	340.9375	297.2500	156.66
5	341.5626	297.4375	142.00
6	341.0625	297.4375	142.00
7	342.0625	297.4375	125.66
8	342.5000	297.4375	125.66
9	343.0000	297.4375	120.66
10	343.6250	297.4375	120.66
11	344.1250	297.4375	115.33
12	1344.7500	297.4375	115.33
13	344.2500	297.4375	113.33
14	346.0625	297.4375	106.66
15	346.8125	297.4375	106.66
16	346.5625	297.4375	108.00
17	349.3125	297.4375	103.66
18	349.0625	297.3125	119.00
19	349.8750	297.3750	119.00
20	350.4357	297.3750	103.00
21	351.3750	297.4375	102.00
22	352.0625	297.3750	101.00
23	353.0625	297.3750	99.000
24	353.9375	297.4375	99.000
25	354.6875	297.6875	99.000
26	355.0625	297.0625	98.333
27	355.8750	297.5000	98.333
28	356.1250	297.5000	98.000
29	357.0000	297.5000	96.333
30	357.5000	297.5635	96.333
31	357.0375	297.5625	96.333
32	358.5625	297.5625	97.666
33	359.2500	297.4375	96.666
34	359.8750	297.5000	96.666
35	360.3750	297.5000	98.333

Table 2: Diameter three: left portion

PN	X	Y	RD
1	319.6875	207.3750	213.00
2	318.8750	207.4375	176.33
3	318.5000	207.4375	176.33
4	317.8750	207.5000	158.66
5	316.8750	207.4375	142.33
6	316.3750	207.2500	142.33
7	315.6250	207.3125	126.66
8	315.2500	207.4375	126.66
9	314.5625	207.5000	114.33
10	313.8135	207.5000	114.33
11	313.0625	207.4375	112.00
12	312.6250	207.4375	106.66
13	311.7500	207.4375	106.66
14	311.0625	207.4375	106.66
15	310.6875	207.4375	107.33
16	319.9375	207.4375	104.66
17	309.0000	207.4375	104.66
18	308.1250	207.4375	104.00
19	307.4375	207.4375	103.00
20	306.6875	207.4375	102.00
21	305.9375	207.4375	100.66
22	305.0625	207.4375	100.66
23	304.1250	207.4375	100.33
24	303.2500	207.5000	100.66
25	302.7500	207.3125	100.66
26	301.7500	207.3750	99.333
27	300.6250	207.3125	101.66
28	299.6250	207.3750	101.00
29	298.6875	207.3750	97.666
30	297.6875	207.3750	96.666
31	297.0000	207.3750	96.666
32	296.0000	207.3750	98.000
33	295.3750	207.3750	98.333

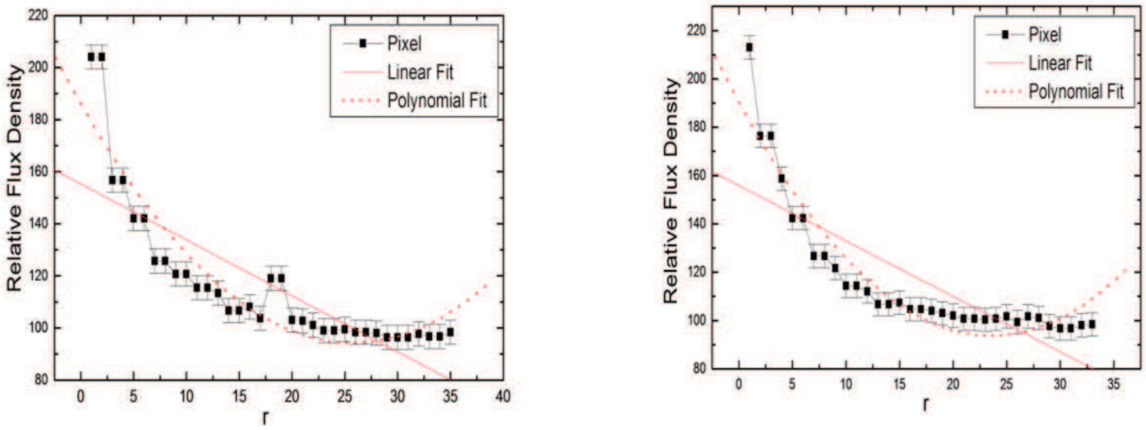

Figure 5: Variation of relative flux density along right portion of diameter three (top) and left portion of diameter three (bottom).

RESULT

The innermost contour on the image of the Mars are almost homogeneous in the inner region. This implies homogeneous absorption and reflection of flux density in the central region. As we move from inner to outer contours, we can observe some increase in fluctuations. The outermost contour shows maximum fluctuations which reveals the features of the atmosphere, the absorption and reflection features are inhomogeneous in the atmosphere. It is found that there is simultaneous variation of the relative flux density, i.e., there is significant at continuous decrease in relative flux density from inner to outer surface of Mars. However, there is no variation in flux density in different dimensions of the Mars.

DISCUSSION

The innermost contour on the image of the Mars are almost homogeneous in the inner region. This implies homogeneous absorption and reflection of flux density in the central region. As we move from inner to outer contours, we can observe some increase in fluctuations. The outermost contour shows maximum fluctuations which reveals the features of the atmosphere, the absorption and reflection features are inhomogeneous in the atmosphere. It is found that there is simultaneous variation of the releative flux density, i.e., there is significant at continuous decrease in relative flux density from inner to outer surface of Mars. However, there is no variation in flux density in different dimensions of the Mars.

CONCLUSION

The fits format image of the red planet, Mars is captured utilizing Meade 16 inch Schmidt-Cassegrain telescope. Image is processed in the software ALADIN 2.5. Initially, the observed two-dimensional image of the planet is divided into four quadrants. Each quadrant is subdivided into two sections. In this way, we studied the variation of relative flux density along 8 directions. The relative flux density of region of intersect ranges from 96.333 to 255.000. The graphical and statistical analyses are executed in the software ORIGIN 5.0.

With the help of fits image, processed fits image, graphical analysis and statistical analysis, the following conclusions can be drawn.

i. The inner portion of the red planet showed homogeneous relative flux density, i.e., inner portion of the Mars have homogeneous absorptivity.
ii. The outer portion of the planet red planet showed inhomogeneous relative flux density.
iii. The values of relative flux density per pixel ranges from 111.78582 with standard error 3.99182 to 120.68200 with standard error 5.75829.
iv. There is consistent decrease in relative flux density from inner to outer regions of interest of surface of the red planet, Mars.

The relative flux density so obtained in our effort is not distinctive. It depends on region of interest under our considerations, i.e., relative flux density may vary within same fits image on what regions of image one considers. The solar radiations that incident on varies significantly in different seasons. Therefore, relative flux density do not depend on sole factor and the relative flux density that observed on our work is not absolute and distinctive.

A specific and absolute data is not available for comparison of our work. Such data might have been phase out. The advanced technology can measures variation of absorption features of every moment and different zenith angles. We believe that this research work will be the better guidelines for the future research work in the red planet, Mars.

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