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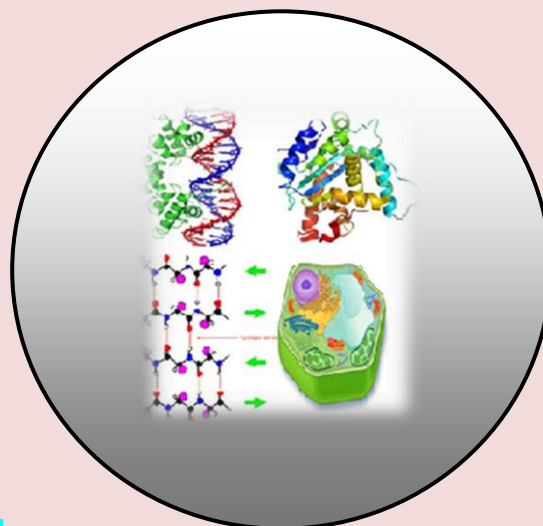
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Witnessing the Ring of Fire: Annular Solar Eclipse June 21, 2020 - From the Eyes of an Amateur

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Solar eclipse is one of the most unique astronomical events and to be able to witness the same is an exciting experience in itself. A solar eclipse occurs when a portion of the Earth is engulfed in a shadow cast by the Moon, which fully or partially blocks sunlight. The said event occurs when our Sun, the Moon and the Earth are aligned coinciding with a new moon. India became a witness to this rare event on June 21, 2020. Like the eclipse of December 26, 2019 this solar eclipse was also annular but this time around the annularity was seen from the parts of Rajasthan, Haryana, Punjab, Uttar Pradesh and Uttarakhand of Northern India with annularity path width of approximately 22 km only and the rest of India witnessing the partial solar eclipse. Path of the central line of the annular eclipse June 21, 2020 can be seen in the Image 1. Whilst in a total eclipse, the disk of the Sun is fully obscured by the Moon; in partial and annular eclipses, only part of the Sun is obscured. This phenomenal moment is always eagerly awaited by all the astronomy enthusiasts, amateurs along with the professionals, scientists, researchers and students. An annular eclipse occurs when the Sun and the Moon are exactly in line with the Earth, but the apparent size of the Moon is smaller than that of the Sun; thereby making the Sun appear as a very bright ring, or *annulus*, surrounding the black dark disk of the Moon. The name "annular" comes from the Latin word for ring, "*annulus*". These eclipses are named for their darkest, or maximum, point. As mass gatherings were restricted due to the Covid-19 pandemic, arrangements were made for viewing the annular solar eclipse by the astronomy lovers and institutions like Vigyan Prasar, Govt. of India, along the line of annularity. One major Centre for such a purpose to observe this unique spectacle of nature was established by Vigyan Prasar at Bhor Saidan, Pehowa, near Kurukshetra in the state of Haryana. Scientists from Vigyan Prasar under the leadership of Dr. Arvind C. Ranade, researchers, amateur astronomers and members of Vigyan Prasar Network of Science Clubs (VIPNET) enjoyed the unhindered view of the annular solar eclipse during the course of the entire event.



(Image 1. The path of the Central Line of Annular Solar Eclipse June 21, 2020 through India. Path Courtesy: Google Earth Files by Xavier Jubier).

Our team from Ignited Minds VIPNET Club Farrukhabad (VP-UP-0103) and SKY Amateur Astronomers VIPNET Club Lucknow (VP-UP-0149) comprising of Dr. Sangharsh Rao, Amritanshu Vajpayee, Swapnil Rastogi and Pushkar Pathak, was present at Bhor Saidan, Pehowa to witness the event. A second team from B.M. Birla Planetarium Jaipur, Dr. Vikram Sarabhai Science & Technology Foundation (VP-RJ-0048), Dr. APJ Abdul Kalam National Council of Young Scientist (VP-RJ-0064) comprising of Govind Dadhich, Mohan Ram Inaniyan, Gajendra Gepala was also present at Patroda, Rajasthan for the same.



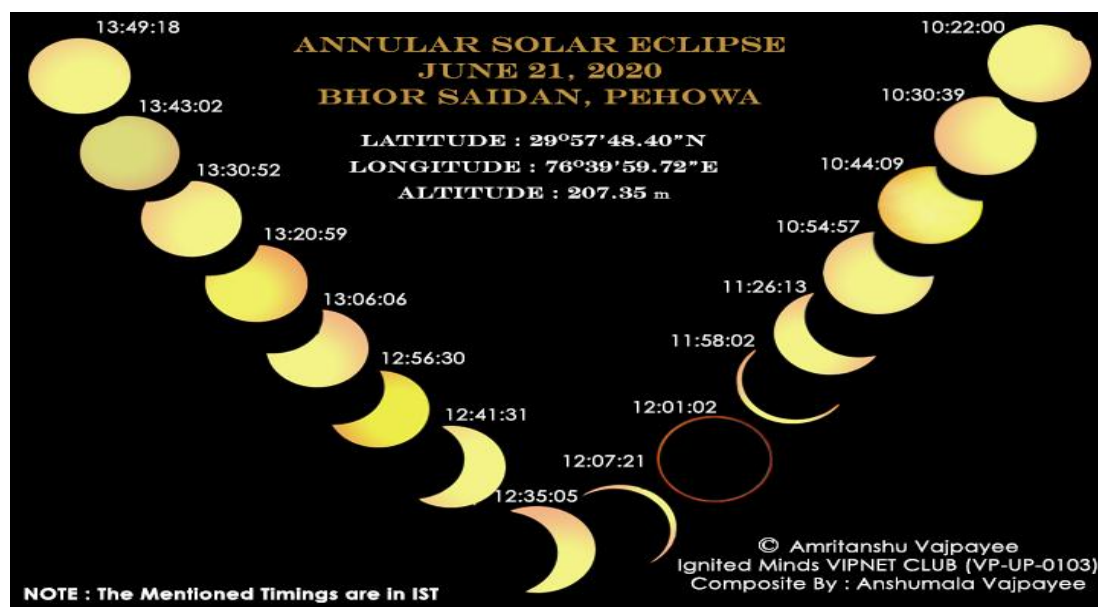
(Image 2. The three locations of observation of Annular Solar Eclipse June 21, 2020. Path Courtesy: Google Earth Files by Xavier Jubier).

Also, from Bikaner the partial eclipse was observed by Mr. Anil Thanvi, Convenor, Bikaner Thar Desert Astronomy Society. In total, the annularity observation was done from two points one at Bhore Saidan, Pehowa (29°57'48.40"N, 76°39'59.72"E), District Kurukshetra, Haryana and second at Patroda (29° 6'6.04"N, 73° 8'44.81"E), District Sri Ganganagar, Rajasthan, whilst the partial solar eclipse was observed at Bikaner (28° 1'12.00"N, 73°17'60.00"E). The Sun at Bhore Saidan, Pehowa was playing hide and seek in the clouds the early morning before it became clear just before the contact one of the eclipse, whilst it Patroda and Bikaner, it was a clear sky since the morning. The desire to observe the phenomenon took the entire team at Pehowa to a distance of about 800 km and when we saw the moment of Annularity we realized that nothing could be more joyous than the moment. The above mentioned annular solar eclipse observation points can be seen with reference to the Central Line of the Eclipse in Image 2.

At Bhore Saidan, Pehowa, District Kurukshetra, Haryana location (29°57'48.40"N, 76°39'59.72"E), the circumstances of the eclipse were calculated as mentioned in the Table 1.

Table 1.				
LOCATION ONE VIGYAN PRASAR SCIENTISTS, VP-UP-0103, VP-UP-0149	Place Bhor Saidan, Pehowa, Kurukshetra, Haryana	Latitude 29°57'48.40"N 29.96344558°N	Longitude 76°39'59.72"E 76.66659017°E	Altitude 207.35m
Event	Timings (UT)	Timings (IST)	Altitude	Azimuth
Contact 1	04:50:42.1	10:20:42.1	+61.5°	095.7°
Contact 2	06:30:50.4	12:00:50.4	+81.5°	138.8°
Maximum Eclipse	06:31:09.8	12:01:09.8	+81.6°	139.2°
Contact 3	06:31:29.8	12:01:29.8	+81.6°	139.6°
Contact 4	08:17:00.0	13:47:00.0	+70.6°	255.2°

At Pehowa, with lunar limb corrections, the annularity was seen for around 22s, with a moon/sun size ratio as predicted to be 0.99389 and magnitude 0.99683 at maximum along the path width annularity of 21.6 km. See for the composite of the eclipse images in Image 3.

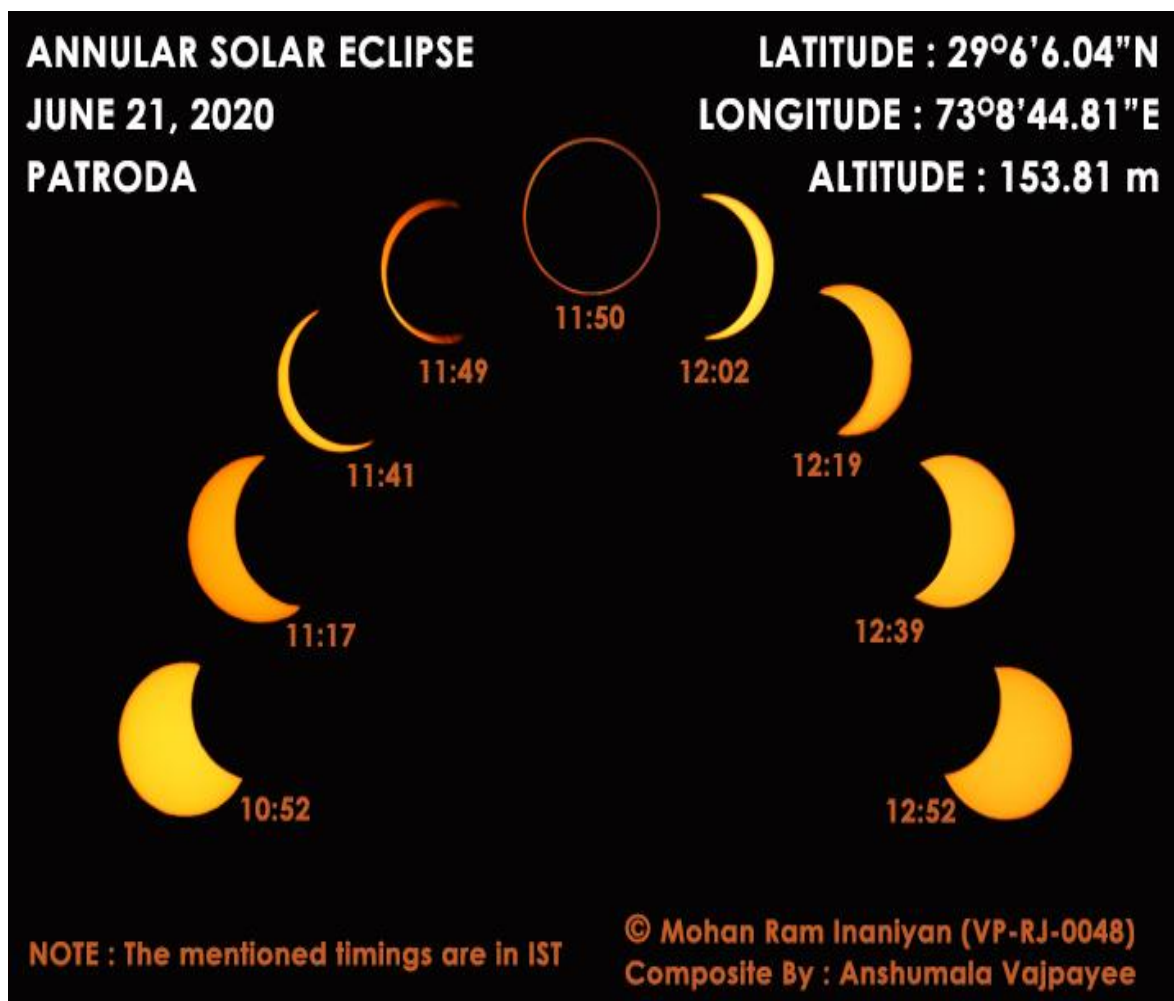


(Image 3. Solar Eclipse Images from Bhore Saidan, Pehowa, Kurukshetra, Haryana Team).

At Patroda, District Sri Ganganagar, Rajasthan location (29°6'6.04"N, 73° 8'44.81"E), the circumstances of the eclipse were calculated as mentioned in the Table 2.

Table 2.				
LOCATION TWO	Place	Latitude	Longitude	Altitude
VP-RJ-0048, VP-RJ-0064	Patroda, Sri Ganganagar, Rajasthan	29° 6'6.04"N 29.1016788° N	73° 8'44.81"E 73.1457804° E	153.81m
Event	Timings (UT)	Timings (IST)	Altitude	Azimuth
Contact 1	04:42:40.0	10:12:40.0	+56.8°	091.1°
Contact 2	06:20:15.3	11:50:15.3	+77.6°	114.5°
Maximum Eclipse	06:20:35.3	11:50:35.3	+77.7°	114.6°
Contact 3	06:20:55.3	11:50:55.3	+77.8°	114.8°
Contact 4	08:07:10.0	13:37:10.0	+75.9°	249.8°

At Patroda, with lunar limb corrections, the annularity was seen for around 23s, with a moon/sun size ratio as predicted to be 0.99362 and magnitude 0.99671 at maximum along the path width annularity of 21.6 km. See for the composite of the eclipse images in Image 4.



(Image 4. Solar Eclipse Images from Patroda, Sri Ganganagar Rajasthan Team).

At Bikaner, Rajasthan location (28° 1'12.00"N, 73°17'60.00"E), the circumstances of the eclipse were calculated as mentioned in the Table 3.

Table 3.				
LOCATION THREE BIKANER THAR DESERT ASTRONOMY SOCIETY	Place Bikaner, Rajasthan	Latitude 28° 1'12.00"N 28.0200000° N	Longitude 73°17'60.00"E 73.3000000°E	Altitude 242 m
Event	Timings (UT)	Timings (IST)	Altitude	Azimuth
Contact 1	04:41:20.3	10:11:20.3	+56.6°	089.4°
Contact 2	-	-	-	-
Maximum Eclipse	06:19:51.1	11:49:51.1	+78.1°	109.9°
Contact 3	-	-	-	-
Contact 4	08:07:24.2	13:37:24.2	+76.0°	254.2°

The obscuration at Bikaner was 95.1% and magnitude 0.963. See for the composite of the eclipse images in Image 5.

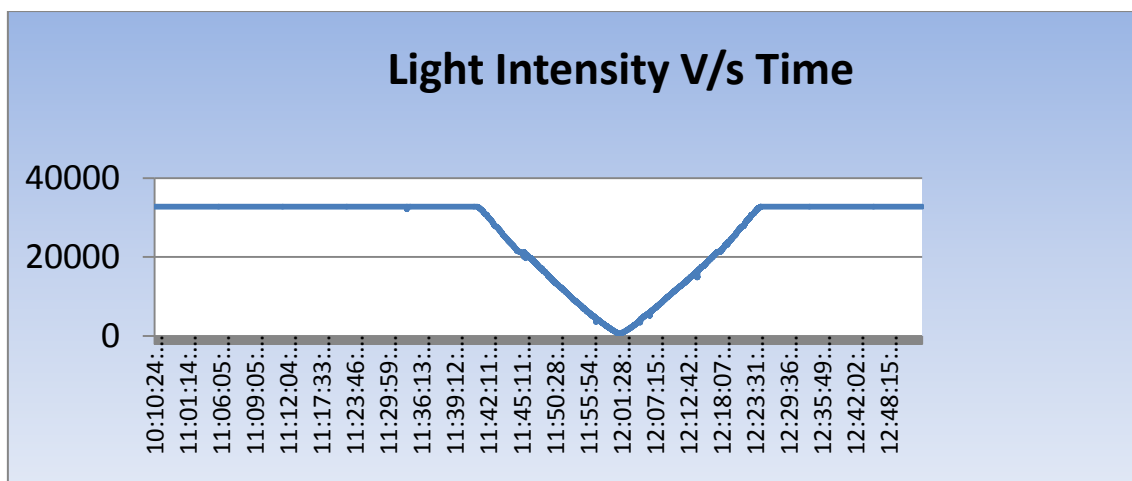


(Image 5. Solar Eclipse Images from Bikaner, Rajasthan Team).

All the stages of Annular Solar Eclipse from the first contact of moon with the sun to annularity period to the fourth contact were clearly seen from our location at Pehowa, Haryana and Patroda, Rajasthan.

At both the observation points the annular solar eclipse lasted for more than three hours. The annularity or the ring of fire lasted for about 22 seconds and it was a breathtaking moment for everyone. In a rare case, as the Moon covered approximately the 99.6 percent of the Sun as the clock struck a minute past 12 hours IST (Pehowa, Haryana) and at 11:50 am IST (Patroda, Rajasthan), the Baily's Beads and Prominences were also visible during the annular solar eclipse which is usually seen during the Total Solar Eclipse. The organizers made sure that everyone viewed the eclipse with full safety using the certified filters and for all the spectators it was an unforgettable experience.

Our members of Vigyan Prasara Network of Science Clubs not only enjoyed with the spectacular view but also recorded and collected data for further research. There were some goals that we had set for ourselves to be met and we are glad that we met most of our goals. The first and foremost goal was to observe the scientific event that was going to occur. Secondly and equally important, was the scientific analysis of the phenomenon. Readings were taken to measure the changing ambient daylight, detecting any change in the ambient magnetic field, measuring temperature variations. The analysis of the data collected is still on. Image 6 gives an insight into one of the experiments conducted at Pehowa, Haryana.



(Image 6. Graph of Light Intensity variation with Time, readings taken from Bhore Saidan, Pehowa, Kurukshetra, Rajasthan).

During the course of the event, various scientific experiments and activities were also carried out by astronomy lovers around at Bhore Saidan, Pehowa. The most spectacular of the moments was when during the annularity the flock of birds suddenly came out mistaking it for dusk and flew overhead the observers. People also viewed the eclipse by making ball-mirror projections and pin-hole cameras as well. Mr. Rajpal Panchal of IRADA was instrumental in carrying out science popularization activities at the spot. Live webcast was also done from here. No expedition is complete without team work and helping hands.

Now the next solar eclipse will be a total solar eclipse that will occur in December 14 this year. This eclipse will be seen mainly from the South America and will not be visible in India. But the next such phenomenon where the land mass of India shall again be a witness of will be only on May 21st, 1931 when once again “the ring of fire” of an annular solar eclipse becomes visible from the southern part of India. However, Indian subcontinent shall continue to witness lunar eclipses and partial solar eclipses in the years to come. Nonetheless, the annular solar eclipse observation of June 21, 2020 shall remain etched in the memories of all in the times to come as a perfect combination of Man.....Moment.....Machine.....

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Glimpses of the teams that made this article a reality

(See: Image 7, Image 8, Image 9 and Image 10)



Image 7. Team VIPNET at Pehowa with Dr. Ranade.



Image 8. Team B.M. Birla Planetarium at Patroda.



Image 9. Team VIPNET at Patroda.

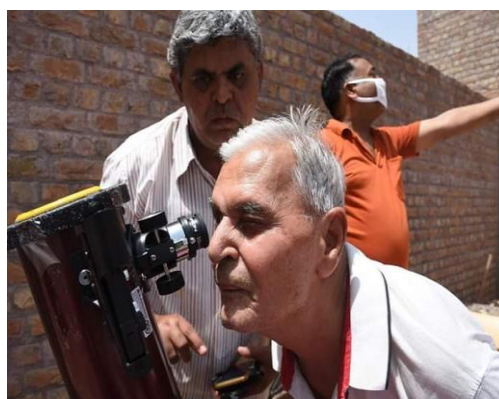


Image 10. Team Bikaner Thar Desert Astronomy Society.



Image 11. Annular Solar Eclipse at Pehowa, taken by telescope.

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