

ON TWO SEVENTEENTH CENTURY PERSIAN PAINTINGS DEPICTING COMETS OR FIREBALLS: A CORRECTION

R.C. Kapoor

Indian Institute of Astrophysics, Koramangala, Bengaluru 560034, India.

Email: rckapoor@outlook.com and rck@iiap.res.in

Abstract: In a recent issue of the *Journal of Astronomical History and Heritage* I looked into two seventeenth century Persian paintings depicting tailed objects (comets or possibly fireballs) in the sky (Kapoor, 2019). One of these, the painting by Muhammad Zaman, has a date inscribed at the lower left as 'sana 7'. Elsewhere, the date has been interpreted as the seventh year of the reign of the Mughal Emperor Aurangzeb (r. CE 1658–1707). Two bright comets, one in December 1664 (C/1664 W1) and another in April 1665 (C/1665 F1), had appeared during the Emperor's seventh regnal year and it was suggested by others that the comet of December 1664 could be the one portrayed by Zaman. In my work, I had inadvertently considered that the seventh regnal year ended on 24 July 1664, which therefore ruled out either of the comets, but since the recorded date of the coronation was 1 *Dhu l-Qa'da* 1068 AH (31 July 1658 CE Greg), Aurangzeb's seventh regnal year should be 1 *Dhu l-Qa'da* 1074–29 *Shawwal* 1075 A.H. (≅26 May 1664–15 May 1665), which revives the suggestion that the comet of December 1664 or of April 1665 was the one portrayed by Zaman. The December 1664 comet rose in the morning in the S-E during its best-view dates, while the April 1665 comet remained a morning object through its visible phase. I have computed ephemerides of the comets and compared their positions in the sky with respect to some bright stars that also were observed on the best-view dates. A late night or early morning sky-watcher in Isfahan would have seen the comets rise in the S-E, or, in the N-E, but their respective orientations in the sky would have been the opposite to that portrayed in Zaman's painting where the tailed form is shown headed S-W, suggestive of an evening apparition. While the period of Aurangzeb's seventh regnal year stands corrected, this does not affect the inferences and the conclusions drawn in Kapoor (2019).

Keywords: Comets, astronomy in art, Medieval Persian paintings, Farangi-Sazi, Muḥammad Zaman, astronomy in seventeenth century Persia.

1 INTRODUCTION

In a recent paper I have examined two paintings in the Theodore M. Davis Collection of the Metropolitan Museum of Art, New York that depict what appear at first sight to be comets (Kapoor, 2019). The paintings, namely 30.95.174, fol. 1 & 2, are attributed to two prominent Persian painters of the seventeenth century, Muḥammad Zamān and 'Alī Qulī Jubbahdār respectively.

Landau (2011: 115) and The Metropolitan Museum of Art (The Met, 2018; 2020) identify the comets as the ones seen in the years CE 1664 and in CE 1674/1675 respectively. Zamān's painting (Figure 1) has a date inscribed at its lower left as *sana 7 (in the year 7)*. The date has been suggested as the seventh year of the reign of the Mughal Emperor Aurangzeb (r. 1658–1707 CE), vide Landau (2011:115) and The Met (2018; 2020).

2 AURANGZEB'S SEVENTH REGNAL YEAR

Dr Navina Haider Haykel (pers. comm., 23 July 2020) has raised the question of Aurangzeb's seventh regnal year as considered in Kapoor (2019). She also adds that

... there are many problems with dating these works, also because we cannot confirm that indeed the year 7 mentioned refers to Mughal regnal years or something else.

Upon review, I find that I had erred in considering the seventh regnal year as ending on 24 July 1664 (Gregorian calendar) and thereby in questioning Zamān's work being dated with the Emperor's seventh regnal year if the comet of December 1664 was yet to appear (Kapoor, 2019: 275). The date 24 July 1664 actually corresponds to the last day of the Hijri year 1074 A.H., i.e., 30 *Dhu l-Hijja* 1074 A.H.

Aurangzeb ascended the throne in 1068 A.H. Aqil Khan Razi (d. 1108 A.H.; Hasan, 1946) who was in the service of Aurangzeb has chronicled his reign in *Waqiat-i-Alamgiri* (in Persian). About the events of 1068 A.H., he wrote that

Aurangzeb stayed three days at the Baghi-Sarhindi and on the fourth day, marching from there, he took up his residence at the Baghi-Aizzabad ... On Friday, the 1st of Ziqad, 1068 A.H. (31st July, 1658 A.D.), at a moment considered propitious by astrologers, Aurangzeb ascended the throne of 'Khilafat and kingship' and exalted the high and low with favours and largesses. (Hasan, 1946(VI): 35).

As remarked by Hasan (1946: Introduction), apart from the *Alamgir Nama* by Muhammad Kazim, Razi's is the only contemporary record of the fratricidal war that culminated in Aurangzeb's ascension to the throne. The coronation date in the brackets in the quote above is Gregorian. Counting from 1 *Dhu l- Qa'da*

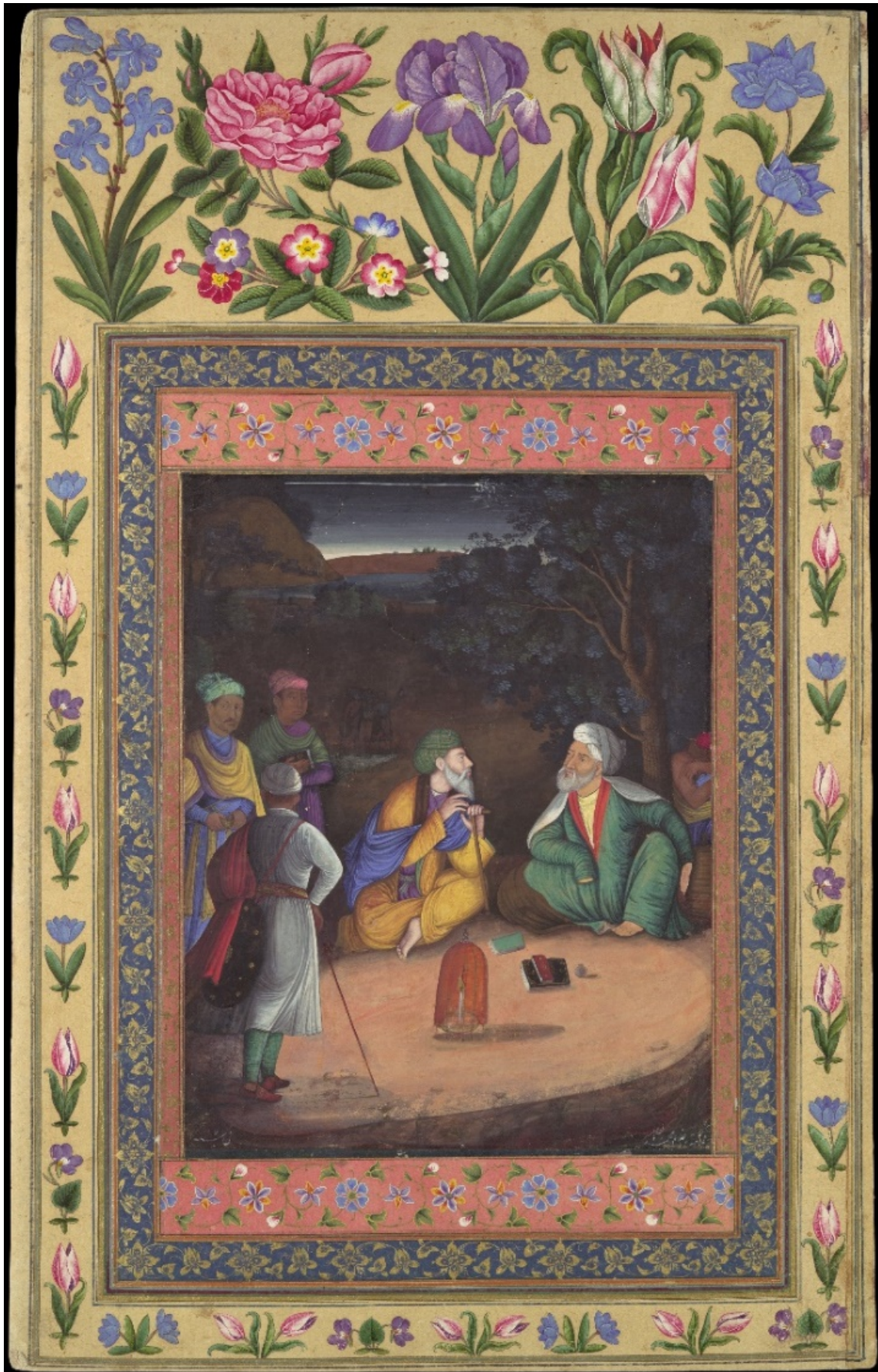


Figure 1: A *Nighttime Gathering*, by Muḥammad Zamān; Theodore M. Davis Collection, Bequest of Theodore M. Davis, 1915, Accession Number: 30.95.174.2 (source: The Metropolitan Museum of Art; accessed 05.08.2019).

Table 1: The first seven regnal years of Aurangzeb's reign.

Regnal Year	Hijri Year	CE Year
1st	1 Dhu l-Qa'da 1068 – 29 Shawwal 1069	31 July 1658 – 20 July 1659
2nd	1 Dhu l-Qa'da 1069 – 29 Shawwal 1070	21 July 1659 – 08 July 1660
3rd	1 Dhu l-Qa'da 1070 – 29 Shawwal 1071	09 July 1660 – 27 June 1661
4th	1 Dhu l-Qa'da 1071 – 29 Shawwal 1072	28 June 1661 – 17 June 1662
5th	1 Dhu l-Qa'da 1072 – 29 Shawwal 1073	18 June 1662 – 06 June 1663
6th	1 Dhu l-Qa'da 1073 – 29 Shawwal 1074	07 June 1663 – 25 May 1664
7th	1 Dhu l-Qa'da 1074 – 29 Shawwal 1075	26 May 1664 – 15 May 1665

1068, Aurangzeb's seventh Regnal year would be 1 *Dhu l-Qa'da* 1074–29 *Shawwal* 1075 A.H. (\equiv 26 May 1664–15 May 1665), see Table 1. Therefore, the comets of December 1664 and April 1665 indeed appeared during the seventh regnal year of Aurangzeb. Does either of these now fit the portrayal by Muḥammad Zamān?

3 ZAMAN'S PAINTING AND THE APPEARANCE OF COMETS C/1664 W1 AND C/1665 F1 IN THE NIGHT SKY

The comets of December 1664 (C/1664 W1) and of April 1665 (C/1665 F1) were noticed early in the mornings during their high visibility phase. For either to be the candidate for Zamān's portrayal, it is necessary to know how they appeared in the Isfahan sky. I have computed the ephemerides of both comets using the Horizons program (JPL, 2020) for a few best-view dates. A cross-check with the positions of certain bright stars that also were observed helps us ascertain the aspect of each comet in the sky (see Subsections 3.1 and 3.2 below).

The starry pattern in Zamān's painting could be the artist's imagination, but I had suggested that it bears a vague semblance to the constellations of Canis Major and Orion (Kapoor, 2019: 275). On 21 and 25 December, Comet C/1664 W1 was far away from both constellations. Furthermore, the starry background that Comet C/1665 F1 moved in was nothing like the Canis Major-Orion region.

Scenarios are now constructed from the ephemerides of Comets C/1664 W1 and C/1665 F1 to see how these would have appeared in the sky on a few specific dates. The necessary observational data was taken from Hevelius (Hevelii, 1668), Dale (1707) and Kronk (1999), and the comet positions were generated using the Horizons program (JPL, 2020) and matched against certain stars that were observed on those dates. All of the computed values are apparent, topocentric, as at Isfahan (32° 39' 14.0" N, 51° 39' 57.6" E; $h \sim 1590$ m). The reference stars were precessed to the epoch of observation. The respective altitude-azimuth values help us visualize the orientations of the comets when they were

rising, and when they were at the observer's meridian.

3.1 Comet C/1664 W1

This comet was discovered on 17.9 November 1664, and was last seen on 20.83 March 1665. It was closest to the Earth on 29 December 1664 (0.1699 AU). Full Moon was on 3 December 1664 and 01 January 1665.

Kronk (1999: 350) states:

This comet was discovered in the morning sky in mid-November 1664, and remained visible for over 4 months. It became a very prominent object around the time of its closest approach to Earth near the end of December.

The Comet of 1664 grew to be impressive in the second half of December and was at its best during 23–27 December after which moonlight began to interfere. On the morning of 21 December, the tail was observed to extend at least 10° towards the heart of Hydra (Dale, 1707: 2350–2351), say, α Hydrae. On 25 December, the tail extended towards Procyon, ending halfway to the star, which implies a length of 24°. As the moonlight increased the tail looked smaller. It was 4° on the 28th and not very noticeable on 29 December, the day the comet was to pass its closest to the Earth (Kronk, 1999: 352–353).

On 21 December, the tail reportedly pointed in the direction of α Hydrae. On 20 December, the comet rose in the S-E at 20:50 UT. Canis Major and Orion would have been visible to the S-W and S-W-W respectively. The circumstances are listed in Table 2.

At rise, the comet's head and α Hydrae had similar azimuths, suggesting that the tail was nearly vertical, but with a slight southward tilt. As the night wore on, the comet would have been seen towards the south. It passed the meridian at 01:34 UT, reaching the highest altitude of 31.08°, the head to the observer's left and the tail sloping up to the N-W, towards α Hydrae. The comet was visible in the sky until the sunrise.

On 24 December, the comet rose in the S-E at 19:33 UT, just as the Moon was about to set. The comet was in the constellation of

Table 2: Details of Comet C/1664 W1 and α Hydrae on 20 and 21 December 1664.*

Date 1664	Object	UT h s	RA h m s	Dec ° ' "	Az N-E °	Alt °	Moon E °	Moon Illu %
20 Dec	Comet	20 50	11 04 17.86	-26 06 47.9	121.4624	-0.0748	122.1	9.8683
	α Hyd		09 11 06.25	-07 13 56.23	125.903	32.548		
21 Dec	Comet	01 34	09 45 51.06	-26 15 53.9	179.9847	31.0811	124.6	11.4563
	α Hyd		09 11 06.25	-07 13 56.23	218.492	42.190		

* In this table and in Tables 3 and 4 following, Az is the azimuth, Alt is the altitude, Moon E is the Target-Observer-Moon angle or the apparent lunar elongation, and Moon Illu% the Moon's illumination.

Table 3: Details of Comet C/1664 W1 and Procyon on 24 and 25 December 1664.

Date 1664	Object	UT h s	RA h m s	Dec ° ' "	Az N-E °	Alt °	Moon E °	Moon Illu %
24 Dec	Comet	19 33	09 51 20.94	-29 27 31.8	125.6657	-0.0955	135.4	40.4599
	Procyon		07 21 28.38	+05 56 31.9	125.541	50.380		
25 Dec	Comet	00 02	09 45 51.06	-29 36 10.1	179.8921	27.7432	133.7	42.5533
	Procyon		07 21 28.38	+05 56 31.9	239.297	47.176		

of Antila. When it rose, the comet and Procyon had similar azimuths, implying that the tail was almost vertical. On 25 December, the tail reportedly pointed in the direction of Procyon, ending halfway to it. The Comet passed the meridian at 00:02 UT on 25 December. The circumstances are listed in Table 3. As the night wore on, with the head to the S-W and the tail towards Procyon, but to its right, in the N-W.

There are seven drawings by the Reverend John Ray (1627–1705) with the Picture Library of *The Royal Society* (RS, 2020) that show the comet's form and movement among stars during the period 10/20–19/29 December 1664. These are from his observations made at Rome (Dale, 1707) and show the orientation as inferred above. The Reverend made his observations around three in the morning. The computed values above match the circumstances as in the drawings. One of the drawings (Archive Ref. MA/131/116-A) presents the situation of 17/27 December. On that day, the Reverend observed:

It was still Westward, and a little to the South, as before. The Body of the Star was still brighter, and the *Cauda* about it greater, and more bushy, and yet as long as before; it pointed almost directly against *Canis major*. The Body of it was among the Stars of *Argo*. (Dale, 1707: 235).

This implies that the tail was in the direction of *Canis Minor* in the N-W. Another drawing by Reverend Ray (Archive Ref. MS/131/116-B)

presents the situation of 18/28 December. Here, the comet's head is shown east of the stars 1 and 3 Puppis, about 2° from the pair. The tail is directed to the N-W, apparently towards the foot of Gemini in the distance. The comet was, in the Reverend's own words, "... within 4 or 5 Degrees of the most Eastern Stars in the bright Triangle in the Buttocks of *Canis major*." (Dale, 1707: 2351).

3.2 Comet C/1665 F1

This comet was discovered on 27.8 March 1665 and was last seen on 20.8 April 1665. It was closest to the Earth on 04 April 1665 (0.5683 AU). Full Moon was on 31 March and 29 April 1665.

Comet C/1665 F1 was a morning object. Although it was not as spectacular as Comet C/1664 W1, it was well noticed in the first half of April. It made its closest approach to the Earth on 04 April. Observing from Danzig (Gdańsk), on the morning of 06 April Hevelius found the comet in Pegasus. Its tail was 17° long and projected towards the west (Hevelius, 1668: 913). On 12 April, the comet was within 1.5° of the stars α Andromedae and γ Pegasi, and its tail was 5° long (Kronk, 1999: 357–360).

The comet passed through Pegasus moving N-E while rising progressively late in time with tail towards the west. In Table 4, the computed positions correspond to the sunrise time.

Table 4: Details of Comet C/1665 F1 and the Sun on 4, 6 and 12 April 1665.

Date 1665	Object	UT h s	RA h m s	Dec ° ' "	Az N-E °	Alt °	Rising?	Moon E °	Moon Illu %
4 April	Comet	02 18	21 48 59.09	+15 03 54.9	100.0921	42.9813		87.2	80.8909
	Sun	02 18			82.633	-0.684	Rising		
6 April	Comet	02 17	22 20 36.56	+18 18 07.1	92.4957	39.3842		73.3	62.5618
	Sun	02 17			81.945	-0.356	Rising		
12 April	Comet	02 09	23 56 34.64	+24 45 31.0	75.7829	25.4816		36.8	10.8955
	Sun	02 09			79.233	-0.451	Rising		

4 CONCLUDING REMARKS

By inscribing *sana 7* if he meant it to be the seventh regnal year of Aurangzeb, Zamān was honouring a ruler from another land, who had gone to war with the Persians over Kandahar and had lost it to them. He would not have been liked in the court of Shāh Abbās II (r. 1642–1666 CE). In light of the relations between the two Empires at the time, the presence of Zamān in Isfahan would only have invited the wrath of its ruler and would not have invited the Royal patronage that was to come his way in later years. Aurangzeb's relations with the Safāvid Dynasty were not good even during the interchange of embassies in the early 1660s and till the Shāh's last. Aurangzeb chose to be entitled 'Alamgir' and it was Shāh Abbās II who, while congratulating him on his accession, also looked down on him for assuming the title Alamgir, saying: "You style yourself a World-conqueror (*Alamgir*), while you have only conquered your father ..." (Sarkar, 1928(III, xxix): 111). A date as exceptional as *sana 7* could be out of convention, reverence or gratitude, and there seems no compelling reason to relate it to Aurangzeb's regnal year.

Regardless of this, neither of the comets fits the portrayal depicted in Zamān's painting. In the early hours, the comet of 1664 rose in the S-E with its tail almost vertical. While passing the meridian, the comet would have been seen towards the south, with the head to the viewer's left and the tail sloping up to the N-W. Post-meridian, the head was in the S-W (i.e. to the viewer's left), and the tail sloping up to the N-W. The comet of 1665 rose in the N-E and when high up, the head would have been down or to the viewer's left. The orientation in each case is the opposite to the portrayal in Zamān's painting (Figure 1) where the head is to the right.

Thus, although the period of Aurangzeb's seventh regnal year stands corrected, this does not affect the inferences and the conclusions drawn in Kapoor (2019).

5 ACKNOWLEDGEMENTS

I am grateful to Dr Navina Haider Haykel, Curator at the Metropolitan Museum of Art, New York for helpful comments. The figure in this paper is gratefully adopted from the collections of The Metropolitan Museum of Art, New York (<https://www.metmuseum.org/>). I acknowledge the support by the Director, Indian Institute of Astrophysics (IIA), and the Library, IIA. This work has gratefully made use of NASA's Astrophysics Data System, the "On-Line Solar System Data Service" of the

Jet Propulsion Laboratory and the classical reference material available on the internet. Finally, I wish to thank Professor Wayne Orchiston for helping finalise this short paper.

6 REFERENCES

- Dale, S., 1707. Observations made at Rome, by the late Reverend Mr. John Ray, of the comet which appeared Anno 1664. *Philosophical Transactions of the Royal Society*, 25, 2350–2352.
- Hasan, Z. (ed.), 1946. *The Waqiat-i-Alamgiri of Aqil Khan Razi*. Delhi, Mercantile Printing Press.
- Hevelii, J., 1668. *Cometographia, Totam Naturam Cometarum*. Gedani, Simon Reiniger.
- JPL, 2020. *JPL Small-Body Database Browser* (<https://ssd.jpl.nasa.gov/horizons.cgi#results>).
- Kapoor, R.C., 2019. On two seventeenth century Persian paintings depicting comets or fireballs. *Journal of Astronomical History and Heritage*, 22, 273–293.
- Kronk, G.W., 1999. *Cometography: Volume 1*. Cambridge, Cambridge University Press.
- Landau, A.S., 2011. From poet to painter: allegory and metaphor in a seventeenth century Persian painting by Muhammad Zaman, master of Farangī-Sāzī. *Muqarnas*, 28, 101–131.
- RS, 2020. The Royal Society Pictures Library, "Comet observed in Rome, December 1664" (dated 28 December 1664), (<https://pictures.royalsociety.org/image-rs-16458>; accessed 13 August 2020).
- Sarkar, J., 1928. *History of Aurangzeb. Volume III*. Calcutta, M.C. Sarkar & Sons.
- The Met, 2018, 2020. "A Nighttime Gathering", Folio from the Davis Album, dated 1664–65, Painting by Muhammad Zaman; The Metropolitan Museum of Art, New York (<https://www.metmuseum.org/art/collection/search/448460> and (<https://www.Metmuseum.org/art/collection/search/448461>; accessed 10 May 2018, 11 June 2018, 22 June 2018, 26 July 2020).



Professor Ramesh Chander Kapoor began his career in 1971 at the Uttar Pradesh State Observatory (now the Aryabhata Research Institute of Observational Sciences, ARIES) at Naini Tal in observational astronomy. His main interest was flare stars. His

PhD is from Agra University.

From 1974 until 30 September 2010, he was on the faculty of the Indian Institute of Astrophysics (IIA), Bangalore where he worked on various topics in relativistic astrophysics: observational aspects of black holes, white holes, quasars and fast pulsars etc. He has published in peer-reviewed journals and presented papers at national and international conferences.

Ramesh has participated as an observer and organizer of IIA solar eclipse expeditions in India (1980, 1995, 1999, 2009 and 2010) and Indonesia (1983), and he independently visited the USA for the eclipse of 21 August 2017 and Chile for the

eclipse of 02 July 2019 and published his experiences. His current interest is the history of astronomy and in particular historical aspects of comet sightings and observations made from the Indian region. He has all along been active in popularizing astronomy through the print and visual media. He has published also on the heavy metal medicinal preparations in the Indian Systems of Medicine.

Ramesh has been a Member of the IAU (since 1985), and a Life Member of the Astronomical Society of India (since 1973). He also is an Associate of the National Institute of Advanced Studies (since 2002) and an Associate of COSPAR Commission E (since 2005).