

ECLIPSES IN INDIAN ASTRONOMY

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An Eclipse of the moon occurs when the moon passes behind the earth in to its shadow. But eclipse of the sun occurs when the moon passes directly in front of the sun, so that its shadow falls on the earth, the people within the shadow see the sun hidden by the moon. It is stated by Bhaskara as follows –

भूमा वधुं वधुरिनं ग्रहणे पधत्ते।

The earth and the moon both are smaller than the sun so shadow of each one is a cone. The average length of the earth's shadow is 13,82,400 K.M. but the average distance of the moon from the earth is only 3,84,404 K.M. When the moon goes behind the earth certainly it has to pass through the earth's shadow. It is stated by Bhaskara as follows:

भानोर्बिम्बपृथुत्वादपृथुपृथुय्याः प्रभा हि सूच्यग्रा।
दीर्घतया श शकक्षामतीत्य दूरं बहिर्याता।। इति।

The longest lunar eclipse occurs when the moon passes centrally through the shadow and in such position the whole eclipse is about 3 hours 40 minutes. A lunar eclipse is visible wherever the moon is above the horizon.

At solar eclipses we get moon's shadow 3,73,370 K.M. which is almost 4,800 K.M. less than the mean distance of the moon. So when actual distance of the moon is less than its mean distance then only umbra of the moon's shadow falls on the earth and the people within the umbra see the dark circle of the moon completely hiding the sun's disk. At that time the length of the shadow-cone is greater than the distance between the earth and the moon so that moon hence looks larger than the sun. In such position total solar eclipse takes place. At the time of total eclipse sky darkens, birds and animals become disturbed and some stars and planets become visible to eye. Total eclipse of 1552 A.D. (1443 Shaka) is depicted by Sakalagamacharya as follows –

शाके त्रयब्धीन्द्र 1443 वृषशरदि मधौ मा स वाणेन्दुनाडी
तुल्ये दर्शोऽश्विघिष्णये दिनकरदिवसे भानुसर्वग्रहोऽभूत्।
तस्मिन् ग्रस्तेऽश्विमं चास्त मतम प बुधं काव्यसप्त षमुख्या
स्तारा दृष्ट्वान्धकाराकुतिल मह जगत् तत्र हा हा चकार।। इति।

The length of the moon's shadow is less than its mean distance from the earth, so that annular eclipses are more frequent than the total eclipses. An annular eclipse occurs when the umbra of the shadow does not reach the earth and we see the bright ring of the sun remaining un-eclipsed. Eclipses of the sun are visible only from a limited part of the earth's surface. As for example when people in Bihar see total eclipse people at Tirupati may see only partial

eclipse and people in Australia can not see any type of eclipse. Bhaskara explained solar eclipse as follows -

पश्चाद् भागाज्जलदवदधः संस्थितोऽभ्येत्य चन्द्रो
भानोर्बिम्बं स्फुरद सतया छादयत्यात्ममूर्त्या।
पश्चात् स्पर्शो हरिदि श ततो मुक्तिरस्यात एव
क्वा प च्छन्नः क्व चद पहितो नैव कक्षान्तरत्वात्।।
(सिद्धान्तशिरोमणौ गो.प्र.वा)

The total number of eclipses per year is not constant. Eclipses occur minimum two times which are solar and maximum 7 times (4 or 5 solar and 3 or 2 lunar) in a year.

The Moon's path is inclined 5h to the ecliptic. When the Sun and Shadow are near the inter sections of the moon's path and the ecliptic then only the moon can eclipse the sun or shadow can eclipse the moon.

The time when the Sun passes one of the nodes is eclipsed season. As Eclipse can not occur if Sun is nor ear the node. Nodes are also moving very slowly to the west so sun is coming again to the same node after 346.62 days only. This interval time is called eclipse year. The eclipse year is 18.63 days shorter than the calendar year. Consequently, we may see three eclipse seasons within a calendar year.

Eclipse limit is the distance of the sun from the node at which an eclipse is possible. In solar eclipse the major limit of the sun from the node is 18th, 31st and the minor liesut the sun's centre is beyond the major limit then an eclipse is impossible. When it is within the minor limit an eclipse is inevitable.

The node is moving to west ward and it is coming to same point after 18 years and 11 1/3 days. This internal time is called saros. After a saros (18 y 11 1/3 eclipse of the same series will be repeated)

In India people know reality of eclipses from about 6000 B.C. At the time of Rigveda Rishi Atri was Indian astronomer who was observing eclipsed sun by the astronomical instrument "Turiya" It is stated in Rigveda –

स्वर्भानोरघ यदिन्द्र माया अवो दिवो वर्तमाना अवाहन्।
गूल्हं सूर्यं तमसापव्रतेन तुरीयेण ब्रह्मण वन्ददत्रिः।।
यं यै सूर्यं स्वर्भानुस्तमसा वध्यदासुरः।
अन्नयस्तमन्व वन्दब्रह्मन्ये अशक्नुवान्।। ऋग्वेदे 5/40/6.1

Puranas described even Scientific factsthrough religion. Through puranas people started believing that rahu covers the beautiful full moon and after eclipse they should take bath. It is Sketched beautifully in the literature also –

झटिति प्र वश गेहे स्नाहि तत्रैव कान्ते
ग्रहणसमयवेला वर्तते शीतररश्मेः।

तव मुखमकललङ्कं वीक्ष्य नूनं स राहुः
ग्रसति तव मुखेन्दुं पूर्णचन्द्रं वहाय॥ इति

Puranas say that Frequency of eclipses is very harmful to the human beings During the time of MahaBharata was Sanjaya told Dharmasastra –

चतुर्दशी पञ्चदशी भूतपूर्वा तु षोडशीम्
इमां तु ना मजानेऽहममावश्यां त्रयोदशीम्।
सूर्यचन्द्रावुभौ ग्रस्तावेकमासौ त्रयोदशीम्।
अपर्वा ण ग्रहावेतावुत्पातं जनयिष्यतः॥ इति।
(महाभारते भीष्मपर्वा ण तृतीयाध्याये)