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LUNAR ECLIPSE COMPUTATION IN INDIAN ASTRONOMY WITH SPECIAL REFERENCE TO SIDDHNTIC TEXTS

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ABSTRACT

Indian astronomical texts have records of lunar astronomy since the Puranic age. In the Vednga Jyotia (1350 B CE), the algorithm for computing eclipses is not found. This phenomenon was interpreted in the Siddhntic texts as the occurrence of Vyatipati Yoga. This paper attempts to explain the computing and observational method found in astronomical texts of Siddhntic period.

Key words: Lunar astronomy; Puranic age; Siddhntic texts

1. INTRODUCTION

The earliest description of a solar eclipse can be found in gveda, the oldest document from India, dated between 1700 and 1400 B CE (Subbarayappa, 2008; Sarma & Subbarayappa, 1985). In later literature, dated between 900 and 600 BCE, a detailed description of the phases of an eclipse can also be found. Inscriptional records of the eclipses are also available from 580 CE onwards. Indian astronomers used to put to test their theories and computations with respect the positions of the heavenly bodies- especially the Sun and the Moon. The great Indian astronomer and mathematician Aryabhata explained that the eclipses occur because either the Moon comes between the Sun and the Earth or the Moon goes into the shadow of the Earth. Using purely geometrical arguments and the relative sizes of the objects, he gave an excellent formulation of the calculation of the eclipse parameters. Prior to him, the methods of tracing the line of movement of the Sun and the Moon were known and hence combining the two it became possible to scientifically understand and explain the date, time and nature of eclipses around 500 CE. Later Indian astronomical texts on mathematical astronomy have devoted chapters to calculating both lunar and solar eclipses. All texts discuss the prediction of eclipses.

2. LUNAR ECLIPSES IN INDIAN ASTRONOMY

Eclipses are an incident of natural phenomena which appears as a fear of early humans. The periodicity of eclipses is complex and early scholars tried to predict it. In India, Aryabhat was the first astronomer who explained the causes of the two types of eclipses and discussed their characteristics. The Moon covers the Sun and the great shadow of the Earth eclipses the Moon. He developed a formal theory of eclipses based on the transit of the Moon between the Earth and the Sun and in the shadow of the Earth. This observation is shown to have facilitated an accurate verification of the true longitude of both the Moon and the Sun on 23 March 517CE. Aryabhata's treatment of the lunar eclipse in Golapada mainly consisted of verses 38–46. In verse 46 of Golapada, he described that at the beginning and end of a lunar eclipse, the obscured disc appears smoky and during partial obscuration it is black. In totality the obscured part is yellowish brown and at maximum obscuration the disc appears bluish with a black tinge. This statement proves the observation of a total lunar eclipse by Aryabhata and the description of phases of different colors. Important observations were made on 23 March 517CE. The eclipse totality occurred on the meridian of Ujjain when the Moon was in con- junction with Citra (alpha-Virginis) and at the totality of the eclipse Citra must have been visible on the meridian. Right ascension and declination of the Moon and Citra for midnight of 23-24 March 517CE point towards a longitudinal conjunction. Citra (alpha-Virginis) = 12 h 09 m; delta = –03 deg 05 min Eclipsed Moon = 12 h 17 m; delta = –02 deg 13 min. It is therefore evident that during the totality of the eclipse both the Moon and the star had a meridian transit and aryabhata had the opportunity to obtain a check of the longitude of the Moon as well as its zero parallax by comparing it with the longitude of Citra. Bhaskara I explains the importance of meridian observations of the Moon in his book in verse no. 39. The approximate time of conjunction of the Moon with the meridian ecliptic point is determined and successively the Moon and the meridian ecliptic points are computed until agreement is reached. Varhamihira explains in his Bhatsamhit the real causes

of the eclipses.

3. MYTHOLOGY OF ECLIPSES

In Indian mythology eclipses are explained as follows. The god Brahma gives the news that there is an immortality giving elixir of life in a pot at the bottom of the sea. Neither the gods nor the demons (asuras) had the necessary capability to churn the great ocean. Hence they agree to cooperate. Using the large snake shesanaga as the rope and the mountain Mainak as the shaft, they began to churn the sea. After several strange happenings, the unity of gods and demons succeed. However when the elixir eventually comes, the gods try to capture the entire amount. God Vishnu takes the form of a beautiful maiden named Mohini. The demons are completely mesmerized by her beauty and forget about the nectar. Mohini instructs the gods and demons to sit in two parallel lines so that she can systematically distribute the nectar. However, she begins by distributing it to the gods. While most demons remain oblivious to the trickery, one of them, named Swarbhanu, realizes the trick and quietly goes and sits in the line of gods. Mohini dutifully hands out the nectar to him but before he can take it the Sun and Moon realize what is happening and complain. Mohini cuts off the head of Swarbhanu. However, since Swarbhanu has already tested the nectar he becomes immortal. This is Rahu. The body is looked after by a priest called Ketu. Rahu and Ketu are very angry with the Sun and Moon and are always trying to take revenge on them. Hence eclipses occur when Rahu gulps down the Sun or the Moon. Because Rahu is only a head, the Sun and the Moon escape Rahu as he gulps them down. Later on, Aryabhata used the concept of Rahu and Ketu to describe the ascending and descending node of the point of intersection of the lunar and solar orbits.

4. CONCLUSIONS

The accuracy of luni–solar mean and true longitudes at the full Moon is an indirect pointer towards the methods of Aryabhata. The early Indian astronomer failed to detect the inequalities, except the equation of center as the mean longitudes of Sun and Moon and equation of center were derived by the analysis of the times of eclipses. From the earlier records it is found that 340 distinct lunar eclipses are recorded in the period of 400 CE to 1800 CE covering the siddhantic period.

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