

Study on the Applications of Astronomy in Buddhist and Hindu Calendar in the Sources of Indian Knowledge System

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Abstract

The Vedas are the oldest and most authoritative sources of Indian Knowledge. They contain hymns, philosophical ideas, rituals and early scientific observations. The four Vedas are: Rigveda, Yajurveda, Samaveda and Atharvaveda.

These texts provide insights into astronomy, ecology, mathematics and early medicines, forming the foundation of many later knowledge traditions. Each Veda consists of four parts : Samhita (hymns), Brahmana (ritual explanations), Aranyaka (forest treatises) and Upanishads (Philosophical teachings).

Epics (Itihasa):-

Ancient Indian epics serve as major sources of social, ethical and political wisdom. Smriti means “**That which is remembered**”. These texts were composed by sages based on the principles of Shruti and are considered secondary authority, which include Dharmashastras, Manusmriti, Epics, Puranas. Many ancient texts were originally written in Sanskrit, Pali, and Prakrit making translation essential for modern scholars. Several translated versions exist in English and other languages enabling wider study. Scholars from India and abroad have translated these texts to make them accessible to modern readers.

Keywords: Dharmashastras, Manusmriti, Epics, Puranas, Upanishads, Arthashastra, Vedas, Brahmana, Traditions.

1. Introduction

Academic journals publish studies on Indian Philosophy, science and history. Many Universities and institutions now digitize ancient manuscripts to preserve them. These secondary materials help scholars understand, interpret and contextualize ancient knowledge. Vidyasthanas are traditional categories of knowledge in the Indian Intellectual tradition. The classical tradition recognizes fourteen branches of knowledge.

(i) Four Vedas

The four vedas are:

- Rigveda : Rigveda which contains hymns and philosophical reflections about nature and cosmic order.
- Yajurveda : Yajurveda focuses on rituals, sacrifices and procedural knowledge.
- Samaveda : Samaveda primarily related to music and chanting traditions.
- Atharvaveda : Atharvaveda includes knowledge about medicine healing practices and daily life.

Each vedas contains of four parts:

- Samhita (hymns) : Samhita is collection of hymns and mantras.
- Brahmana (ritual explanations) : Brahmana prove texts explaining rituals and ceremonies.
- Aranyaka (forest treatises) : Aranyaka Philosophical Interpretations of rituals, often composed for forest-dwelling sages.
- Upanishads (Philosophical teachings) : Upanishads Philosophical texts discussing metaphysics, the self and ultimate reality.

(ii) Six Vedangas

The Six Vedangas are:

- Shiksha (शिक्षा): Phonetics and pronunciation (the nose of the Veda).
- Kalpa (कल्प): Rituals and practical rules (the arms of the Veda).
- Vyakarana (व्याकरण): Grammar and linguistic analysis (the mouth of the Veda).
- Nirukta (निरुक्त): Etymology and explanation of difficult words (the ears of the Veda).
- Chandas (छंदस): Poetic meter and rhythm (the feet of the Veda).
- Jyotisha (ज्योतिष): Astronomy and timekeeping for rituals (the eyes of the Veda).

(iii) Mimamsa

(iv) Nyaya

(v) Purana

(vi) Dharma Shastra.

so that,

$04(\text{vedas}) + 06(\text{vedangas}) + (\text{mimamsa}) + (\text{Nyaya}) + (\text{Purans}) + (\text{Dharm Shastra}) = 14 \text{ Branches of Knowledge.}$

This structure organizes knowledge related to religion, philosophy, language and ritual practice. Later traditions expanded the list to eighteen branches of knowledge. They include the fourteen vidyasthanas, plus. Ayurveda (Medicine), Dhanurveda (military science), Gandharvaveda (music and performing arts) Arthashastra (politics and economics). This expansion reflects the development of applied sciences and practical disciplines in Indian scholarship. The term Tantra Yukti is composed of two Sanskrit words. Tantra literally means system, treatise, framework or scientific text. In classical scholarship, tantra refers to any structured body of knowledge organized systematically. Yukti means method, logical device, strategy or rational technique. Thus Tantra Yukti means the logical or methodological devices used in constructing and interpreting a systematic treatise Tantra Yukti provides the intellectual tools to understand a scientific text properly .

L.B.G. Tilak opines: “We can thus satisfactorily account for all the opinions and traditions current about the age of Vedas amongst ancient and modern scholars in India and Europe, if we place the Vedic period at about 4000 years B.C. in strict accordance with the astronomical references and facts recorded in the ancient literature of India”. We also find that the inspirations to Brahmanic literatures to geometrical knowledge primarily comes from Rgveda itself, where there is a reference to the three places (Trisadhasthe) of the Agni implying the Garhapatya, Ahavaniya and Dakshinagni.

We come across different types of chariots in Rgveda (1.102.3;1.53.9;1.55.7;11.12.8;11.18.4; iv.46.2 etc). In Rgveda we also find that the river is praised for getting the country flourished by filling the canals^[1]. The river water used to be regulated and it is mentioned as such^[2].

2. Study on the Applications of Astronomy in Buddhist and Hindu Calendar

The Buddhist Calendar is a lunisolar calendar, meaning that it is based on both the motions of the moon and the sun. Astronomy plays a central role in determining months, years religious festivals and auspicious dates. The Buddhist calendar primarily follows the phases of the moon. Each month begins with a new moon or follows lunar cycles depending on regional traditions. A lunar months lasts about 29.5 days. Twelve lunar months total about 354 days, which is about 11 days shorter than the solar year. To keep the calendar aligned with the seasons, an extra (intercalary) month is added periodically. This adjustment is based on astronomical observations of the Sun's apparent motion.

Many important Buddhist observances are fixed according to astronomical events. Vesak is celebrated on the full moon day of the month of Vesakha. Other holy days, known as Uposatha days, occur on new moon, full moon and quarter moon phases. Astronomical calculations were historically used to determine sunrise, sunset and lunar phases. These measurements helped regulate meditation, chanting and monastic schedules. Ancient Buddhist scholars in India, Srilanka, Tibet and Southeast Asia developed sophisticated calendrical

systems using astronomical knowledge. Their calculations helped predict eclipses, lunar phases and seasonal changes.

3. Mathematical Calculations Used in the Buddhist and Hindu Calendar

The Buddhist and Hindu Calendar relies on several astronomical and mathematical calculations.

3.1. Length of a lunar month

The average lunar month (synodic month) is approximately 29.53059 days. Thus 12 lunar months contain $12 \times 29.53059 \approx 354.37$ days.

3.2. Differences

$$365.2422 - 354.37 \approx 10.87 \text{ days.}$$

So, the lunar calendar falls behind the solar year by about 11 days each year.

3.3. Intercalary (Leap) Month

To correct this difference

$3 \times 10.87 \approx 32.6$ days which is close to one lunar month. Therefore, an extra month is inserted roughly every 2-3 years.

3.4. Determining Full Moon Days

A full moon occurs about half way through a lunar cycle.

$$\frac{29.53059}{2} \approx 14.77 \text{ days after the new moon.}$$

3.5. Buddhist Era (B.E)

In many Buddhist countries, the Buddhist Era is calculated as

$$\text{B.E.} = \text{C.E.} + 543.$$

(for the Thai Buddhist calendar).

For example:

$$2026 + 543 = 2569.$$

So, the year 2026 CE corresponds to 2569 BE.

4. Geometrical Calculations in the Buddhist and Hindu Calendar

Geometry is used indirectly in the Buddhist calendar through astronomy. Ancient astronomers modeled the motions of the Sun, Moon and stars using geometric ideas. The apparent paths of the Sun and Moon are treated as circular paths around the Earth.

$$C = 2\pi R$$



$$C = 2\pi r$$

This formula helps describe the circumference of a circular orbit.

The Ancient mathematical works in Jaina's religious literature are considered to be created in 5th century B.C. and they are the Sūryaprajñapti, the Chandraprajñapti, deal with the peculiar configuration and measurement of the paths of the heavenly bodies worked out in the minutest details. In Jaina's works we come across astronomical knowledge in depth.

The Jaina had a peculiar notion of two suns, two moons and the two set of nakshatras (asterisms). The Sūryaprajñapti ;10.22.11 states (quotation number 2.3 -1)^[3].

"In Jambūdvīpa (Isle of Jambu trees) two moons illumined are illumining and will be illumining. Two Suns shone are shining and will be shining, 56 Nakshatras (asterism) viz 2 Abhijits (α layrae), 2 Sṛarānas (α Aquilae), 2 Uttrasadhas (σ Sagittarii) occulted are occulting and will be occulting (two moons)." The

Jambūdviprajñapti states Abhijit combines with moon for $9^{27/67}$ muhūrtas.^[4] Śatabhisâ ,Bharanī ,Ārdrâ , Āślesâ , Sṛvati ,and Jyesthâ (6 nakshatras) combine with moon for 45 muhūrtas each. The rest of the 15 nakshatras combine with moon for 30 muhūrtas each.

1 muhūrta = 48 minutes.

Some Nakshatras (Asterisms) is given as Abhijit, Śravan , Dhanishthâ, Śatabhisâ, Purvâbha drâpada, Uttarâbhadra Pada, Revati, Āśvinī, Purnarvasu, Pusya, Āśleśa, Meghâ, Pûrvâphâlgunī, Uttarâphâlgunī, Hasta, Citrâ, Svâtī, Viśâkhâ, Anurâdhâ, Jyesthâ, Mûla, Pûrvâsâdhâ, Uttarânsâdhâ.

67 nakshatra month = 1 Yuga (5 Year cycle)

= 1830 days of 30 muhūrtas each.

“All the ending moments of the last 62nd Pûrnimâ (full moon day) of the five year cycle, which nakshatra is occulted by moon.^[5] The Pusya nakshatra with balance of

$19^{43/62} + 1/62 \times 1/67 \times 33$ muhūrtas.

= $19^{43/62} + 1/62 \times 1/67 \times 33$ muhūrtas balance of Pusya.

The time for which a nakshatra combines with the sun is given in Jambūdvipaprajñapti (9.8) i.e As Abhijit combines with sun for 4 days 6 muhūrtas only.^[6]

Two moon describe a mandala (diurnal circle) of 109800 parts in our lunar sâvana day (moon rise to moon rise)

Therefore Velocity of either moon = $109800/2$ parts / lunar sâvana day

= 54900 parts / lunar sâvana day

Also 1768 lunar sâvana day = 1830 day of 30 muhūrtas each.

1 lunar sâvana day = $1830 \times 30 / 1768$ muhūrtas

= 54900/1768 muhūrtas

Therefore, Velocity of either moon = 54900 parts / $54900/1768$ muhūrtas

= $54900 \times 1768 / 54900$ muhūrtas.

= 1768 parts /muhūrtas.

Similarly, velocity of either sun = $109800/2$ parts /day of 30 muhūrtas.

= 1830 parts /muhūrtas.

One five year cycle = 1830 days.

= 54900 muhūrtas.

(Since 1 day = 30 muhūrtas)

Therefore, One five year cycle = 67 nakshatras months.

Therefore, 54900 C.P. = 67 x length of a nakshatras month in muhūrtas.

Ancient Astronomers such as Āryabhata used mathematical calculations to predict eclipses and determine planetary positions. Āryabhata I has discussed the ratio of the circumference to the diameter of a circle in the following verse.

चतुरधिकं शतमष्टगुणं द्वाषष्टिस्तथा सहास्त्रानाम ।
अयुतद्वयविष्कम्भः सत्रो वृत्तपरिणाहः ॥^[7]

Bhāskara II ‘s formula for computing the circumference of a circle, when its diameter is given. In Bhaskara II’s Lilāvati, we have the verse:

व्यासे भनन्दाग्रिहते विभक्ते खबाणसुर्यैः परिधिस्तु सूक्ष्मः ।
द्वाविंशतिधे विहतेऽथे शैलैः स्थुलेभोऽथवा स्याद्ध्यवहारयोग्यः ॥^[8]

We can see that the value of π was even carried to Arabia in the 8th century A.D. and was adopted by Yakub ibn Tariq who introduced Indian Astronomy in Arabia^[9]. Al Khwarizmi adopted the original form of the value of π as given by Āryabhata I. Āryabhata correctly explained the Earth’s Rotation, Solar and lunar eclipses as shadows caused by the Earth and the Moon, rejecting mythological explanations. He also calculated the length of the solar year as about 365.25868 days. He developed the mathematical methods to predict the positions of planets and described their motions. In his work Āryabhatīya, he provided tables and rules for astronomical calculations. He introduced Sine tables that helped astronomers calculate distances, angles, and planetary

positions. Āryabhata's work laid the foundation for later Indian astronomy and influenced astronomers in India and beyond.

For a presentation or project on Aryabhata and Astronomy a famous Āryabhata verse:

अनुलोमगतिनैस्थः पश्यत्यचलं विलोमगं यद्वत् |
अचलानि भानि तद्वत् समपश्चिमगानि लङ् कायाम् ||^[10]

Which explains the apparent motion of stars as a consequence of Earth's rotation.

5. Conclusion

The study of astronomy in Buddhist and Hindu Calendars demonstrates the deep connection between the celestial observations, mathematics and timekeeping in the Indian Knowledge System (IKS). Both calendars traditions rely on the movements of the Sun, Moon, Planets and stars to determine months, years, festivals, religious observances and auspicious occasions. Hindu calendars employ sophisticated astronomical calculations based on lunar and solar cycles, while Buddhist calendars similarly use lunisolar principles to mark important religious events such as Vesak and other festivals. Ancient Indian astronomers developed advanced methods for calculating planetary positions, eclipses, solstices, equinoxes and lunar phases. These achievements reflect a strong tradition of observational astronomy and mathematical reasoning. The integration of astronomy into religious, cultural and social life highlights its practical importance in ancient India. The sources of the Indian Knowledge System include the Vedas, Vedāṅga, Jyotiṣa, Śūrya, Siddhānta, Āryabhaṭīya, Buddhist scriptures, astronomical siddhāntas, and traditional scholarly commentaries. These texts preserve valuable knowledge of Astronomy, Mathematics, calendrical science and their applications in daily life.

In conclusion, the astronomical foundations of Buddhist and Hindu Calendars illustrate the scientific excellence of ancient India and demonstrate how the Indian Knowledge System successfully combined observations, computation and cultural traditions to create accurate and enduring systems of time keeping.

References

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