Report

Nehru Planetarium

Nehru Memorial Museum & Library

Research Project: Jantar Mantar Positional Astronomy

PI – Mrs. Megha Rajoria

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Period: 1, Jan 2023 to 30, June 2023

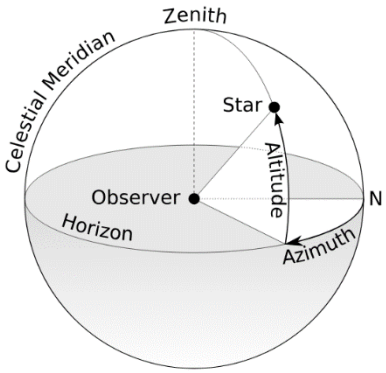
Subject: Observations On Dakshinottri Vitti Yantra

Under Jantar Mantar Positional Astronomy Observation Project, we worked on various instruments and took our observations. One of which is Dakshinottri Vitti Yantra.

Introduction:

Dakshinottri Vitti Yantra is an instrument built on the right-hand side wall of Mishra Yantra.

It is used to find the meridional altitude of the celestial object. It has a semi-circular structure of radius 162.55 cm with engraved markings. Starting from 0 in the middle and then going up to 15, on both sides. With a 6-degree change between two markings, it has a range of up to 90 degrees each on both sides of 0. It has a pointer that points toward zero marking.



What is Meridional Altitude?

The meridian is the north-south line of the observer in the horizon coordinate system. It is the “highest” point an object will be in the sky.

Procedure for finding Meridional Altitude:

Step 1: Draw and label the poles. Label the altitude arc of the pole above the horizon.

Step 2: Draw and label the celestial equator. Label its altitude arc above the horizon.

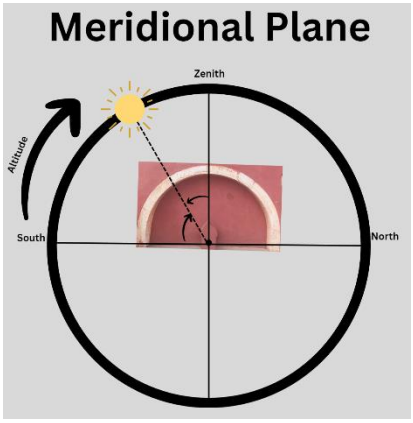
Step 3: Draw the object whose meridional altitude is being measured. Label its declination arc.

Step 4: Calculate meridional altitude: altitude of celestial equator + declination of the star

→Meridional Altitude of the star = 90°+ Declination of the star – Latitude of the observer

Note: If the meridional altitude is above 90° one must subtract the number from 180° as altitude is only defined up to 90°.

Observation Method:



At local noon the Sun enters the meridional plane of Dakshinottri Vitti Yantra and thus the instrument gets activated. One can take the reading at the instrument by placing his eyes at the center of the instrument and get the reading by coinciding the Sun with a particular reading.

The reading we get is the angle made by the sun with Zenith and for finding altitude we subtract that reading from 90° since altitude is measured from the observer plane.

Observation:

On 13, May 2023

Local Noon Time = 12:17 p.m.

Observed Reading on Dakshinottri Vitti Yantra = 9.5°

So, Calculated Altitude (α) = 90° – 9.5° = 80.5°

*Actual Altitude (α) = 79.7°

Percentage Error = $\frac{80.5-79.7}{79.7} \times 100 = 1.004$ %

On 14, May 2023

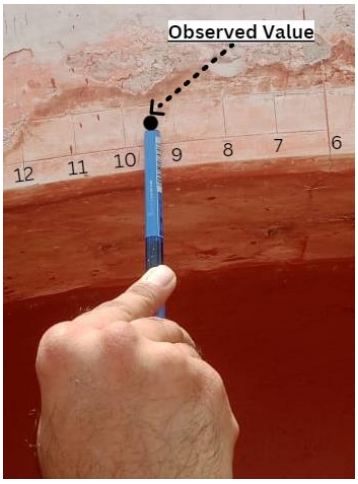
Local Noon Time = 12:17 p.m.

Observed Reading on Dakshinottri Vitti Yantra = 10.5°

So, Calculated Altitude (α) = 90° – 10.5° = 79.5°

*Actual Altitude (α) = 80°

Percentage Error = $\frac{80-79.5}{80} \times 100 = 0.625$ %



Observed Value on 13 May 2023

Verification:

By using Formula:

Meridional Altitude of the star = 90°+ Declination of the star – Latitude of the observer

Latitude of Delhi = 28.6° N

- Declination of the sun on 13 May 2023 = 18.452°

  So, the Meridional Altitude of the sun = 90° + 18.452° – 28.6° = 79.852°

  Percentage Error = $\frac{79.852-80.5}{79.852} \times 100 = 0.81$ %

- Declination of the sun on 14 May 2023 = 18.694°

  So, the Meridional Altitude of the sun = 90° + 18.694° – 28.6° = 80.094°

  Percentage Error = $\frac{80.094-79.5}{80.094} \times 100 = 0.74$ %

Conclusion:

The measurement of the Sun's meridional altitude using Dakshinottri Vitti Yantra has provided valuable insights into the instrument's methodology and capabilities. The study demonstrated the importance of data up to better accuracy.

Studying meridional altitudes of celestial bodies over time helps scientists track changes in the Earth's rotation and axis. Precise measurements of meridional altitudes can reveal variations in the Earth's axial tilt, rotation speed, and even the wobbling motion known as axial precession. These measurements contribute to our understanding of Earth's dynamics and long-term changes. The interplay between the rotation, axis tilt, and the resulting phenomena shape the planet's climate, weather patterns, and the conditions that support the diversity and distribution of life forms.

Acknowledgment:

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References:

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