

# Analytical Study and Astronomical Calculation of the Sunset Alignment with the Main Entrance of the Principal Tower at Phimai Khmer Temple

Theerapong Putphimai, Phromphiriya KhamKhem and Aitsarakon Saephimai  
Phimai Wittaya School, Nakhon Ratchasima, Thailand

## Abstract

This project investigates and calculates the sunset alignment phenomenon with the main entrance of the principal tower at Phimai Khmer Temple in Phimai Historical Park (Thailand). By applying principles of spherical trigonometry, the study identifies the specific dates on which this alignment occurs. The findings indicate that on November 16, 2024, and January 25, 2025, the sun sets at an azimuth of approximately 249.5 degrees, aligning precisely with the central axis of the principal tower's entrance. This alignment suggests intentional design rooted in astronomical knowledge. The study demonstrates that such phenomena can be accurately predicted using mathematical and astronomical methods, revealing the close relationship between solar movement and ancient architecture. The results contribute not only to a deeper understanding of archaeoastronomy and historical architecture but also offer a framework for further research in cultural heritage and historical interpretation.

## Objectives

1. To investigate the sunset alignment phenomenon with the main entrance of the principal tower at Phimai Khmer Temple in Phimai Historical Park.
2. To calculate the sunset alignment phenomenon with the main entrance of the principal tower at Phimai Khmer Temple in Phimai Historical Park.

## Hypothese

The sunset alignment phenomenon with the main entrance of the principal tower at Phimai Khmer Temple in Phimai Historical Park occurs in November, January, and February.

## Results

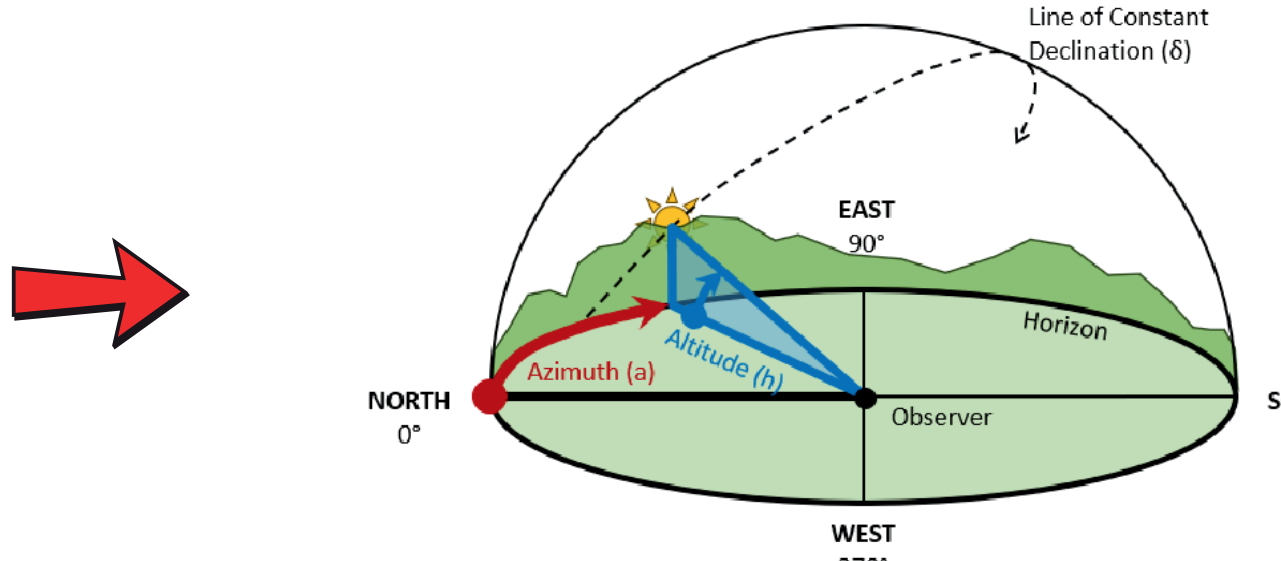
### Record Table for November 2024

Date of calculated (YYYY-MM-DD)	Sun azimuth — calculated (°)	Sun azimuth — observed (°)	Sun azimuth — Stellarium (°)	ΔAzimuth (calc - obs) (°)	ΔAzimuth (calc - Stellarium) (°)	Observation Result
2024-11-09	251.50	—	251.49	—	0.01	—
2024-11-10	251.19	251.12	251.20	0.07	0.01	Occurrence
2024-11-11	250.92	250.84	250.91	0.08	0.01	Occurrence
2024-11-12	250.64	250.55	250.63	0.09	0.01	Occurrence
2024-11-13	250.36	250.28	250.35	0.08	0.01	Occurrence
2024-11-14	250.08	250.00	250.08	0.08	0.00	Occurrence
2024-11-15	249.82	249.74	249.81	0.08	0.01	Occurrence
2024-11-16	249.49	249.48	249.55	0.01	0.06	aligns with the head
2024-11-17	249.23	249.22	249.30	0.01	0.07	Occurrence
2024-11-18	248.98	248.98	249.05	0.00	0.07	Occurrence
2024-11-19	248.74	248.73	248.81	0.01	0.07	Occurrence
2024-11-20	248.51	248.50	248.57	0.01	0.06	Occurrence
2024-11-21	248.28	248.27	248.34	0.01	0.06	Occurrence
2024-11-22	248.05	248.04	248.12	0.01	0.07	Occurrence
Mean Δ (°)				0.04	0.04	—
Standard Deviation (°)				0.04	0.03	—

### Record Table for January-February 2025

Date of calculated (YYYY-MM-DD)	Sun azimuth — calculated (°)	Sun azimuth — observed (°)	Sun azimuth — Stellarium (°)	ΔAzimuth (calc - obs) (°)	ΔAzimuth (calc - Stellarium) (°)	Observation Result
2025-01-23	249.04	249.03	249.11	0.07	0.07	Occurrence
2025-01-24	249.29	249.36	249.37	0.07	0.08	Occurrence
2025-01-25	249.55	249.62	249.57	0.07	0.02	aligns with the head
2025-01-26	249.81	249.88	249.89	0.07	0.08	Occurrence
2025-01-27	250.08	250.15	250.15	0.07	0.07	Occurrence
2025-01-28	250.36	250.43	250.43	0.07	0.07	Occurrence
2025-01-29	250.64	250.71	250.73	0.07	0.09	Occurrence
2025-01-30	250.93	251.00	250.94	0.07	0.01	Occurrence
2025-01-31	251.22	251.29	251.28	0.07	0.06	Occurrence
2025-02-01	251.52	251.52	251.60	0.00	0.08	Occurrence
2025-02-02	251.82	251.83	251.89	0.01	0.07	Occurrence
Mean Δ (°)				0.06	0.06	—
Standard Deviation (°)				0.03	0.03	—

## Introduction



## Materail and Methods

### Practical section



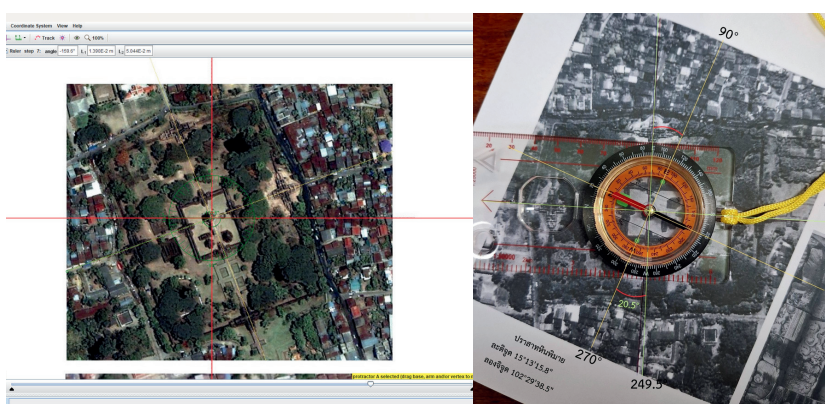
Step 1: Measured doorway to calculate horizontal and vertical field of view.



Step 2: Measured distance from observer to the western gate of Phimai Temple.

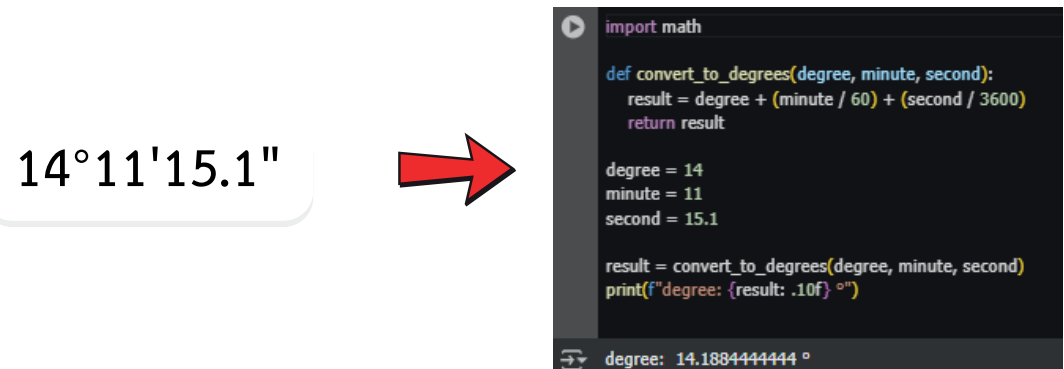


Step 3: Measure the Sun's azimuth with a telescope at the observer's position, elevation 3°.

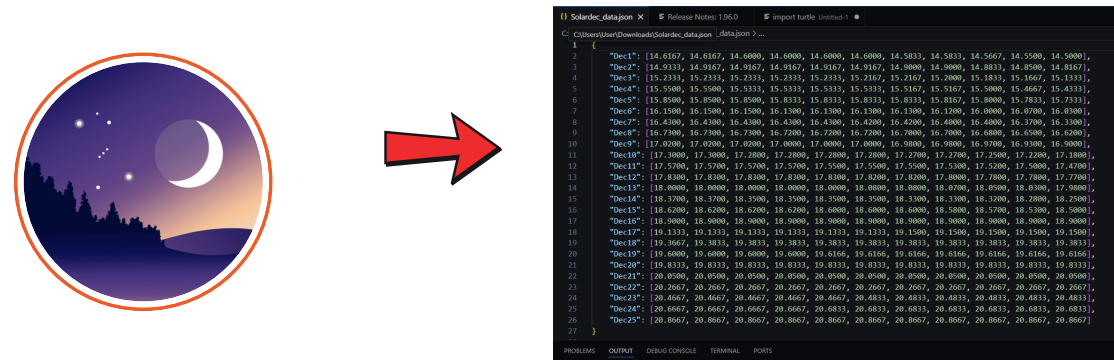


Step 4: Measured the orientation of the main sanctuary at Phimai using a compass and Tracker software.

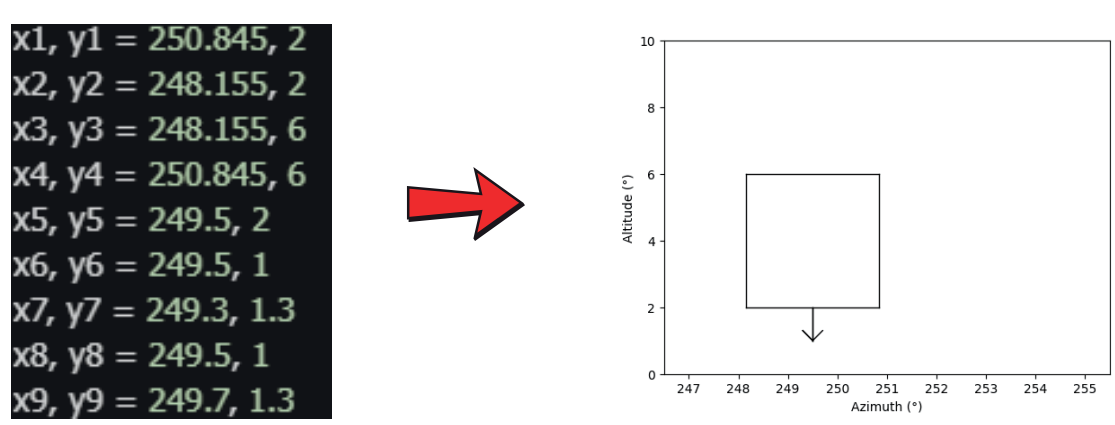
### Theoretical section



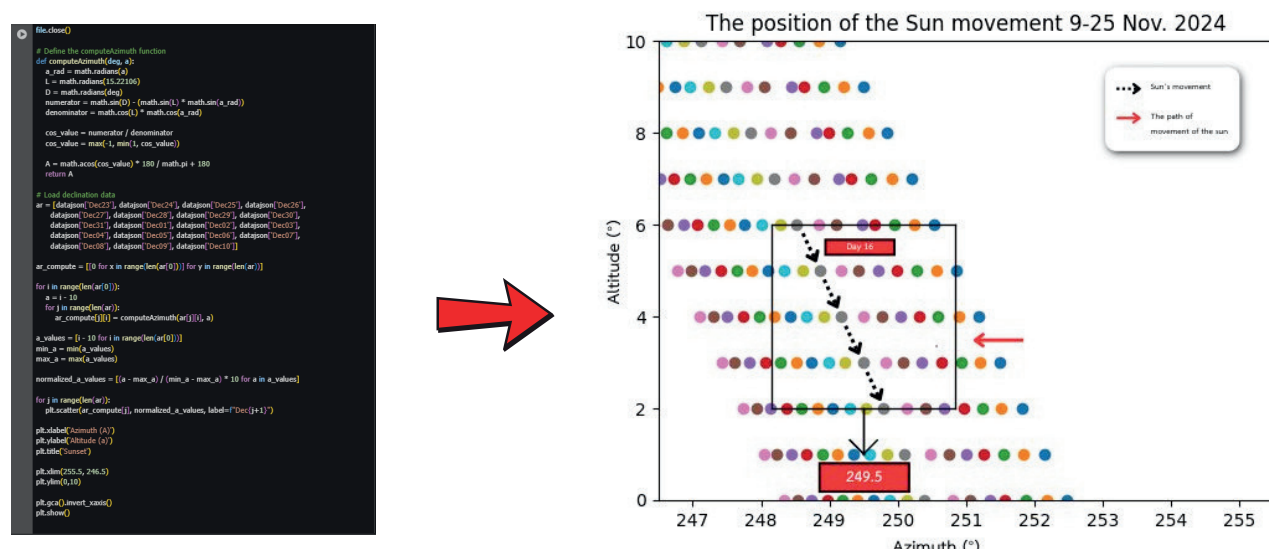
Step 1: Write code to convert declination values from base-60 to base-10.



Step 2: Sun declinations (Nov 2024, Jan–Feb 2025) from Stellarium, 11 values/day for 10°–0°, saved in JSON.



Step 3: Code experimental data to plot Azimuth–Altitude relation, then set doorway frame on the graph.



Step 4: Python code in Google Colab read the JSON file to calculate dates when the Sun sets aligned with Phimai main tower gate.

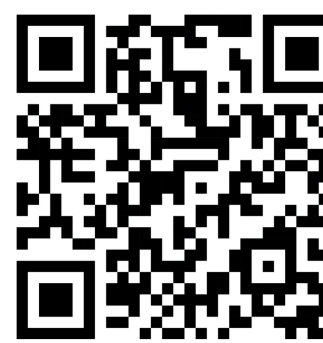
## Discussion

According to calculations, the sunset alignment phenomenon with the main entrance of the principal tower at Phimai Khmer Temple in Phimai Historical Park. will occur on November 16, 2024, and January 25, 2025. On these dates, the position of the Sun aligns with the head of the sandstone Naga-protected Buddha statue. However, the exact time of the phenomenon differs due to the elliptical orbit of the Earth around the Sun and the axial tilt of the Earth. These factors cause the position and apparent time of the Sun in the sky to change each day.

Calculated phenomenon  
dates: Nov 2024 & Jan , Feb 2025



Calculated phenomenon  
dates, 2026–2035



## References

