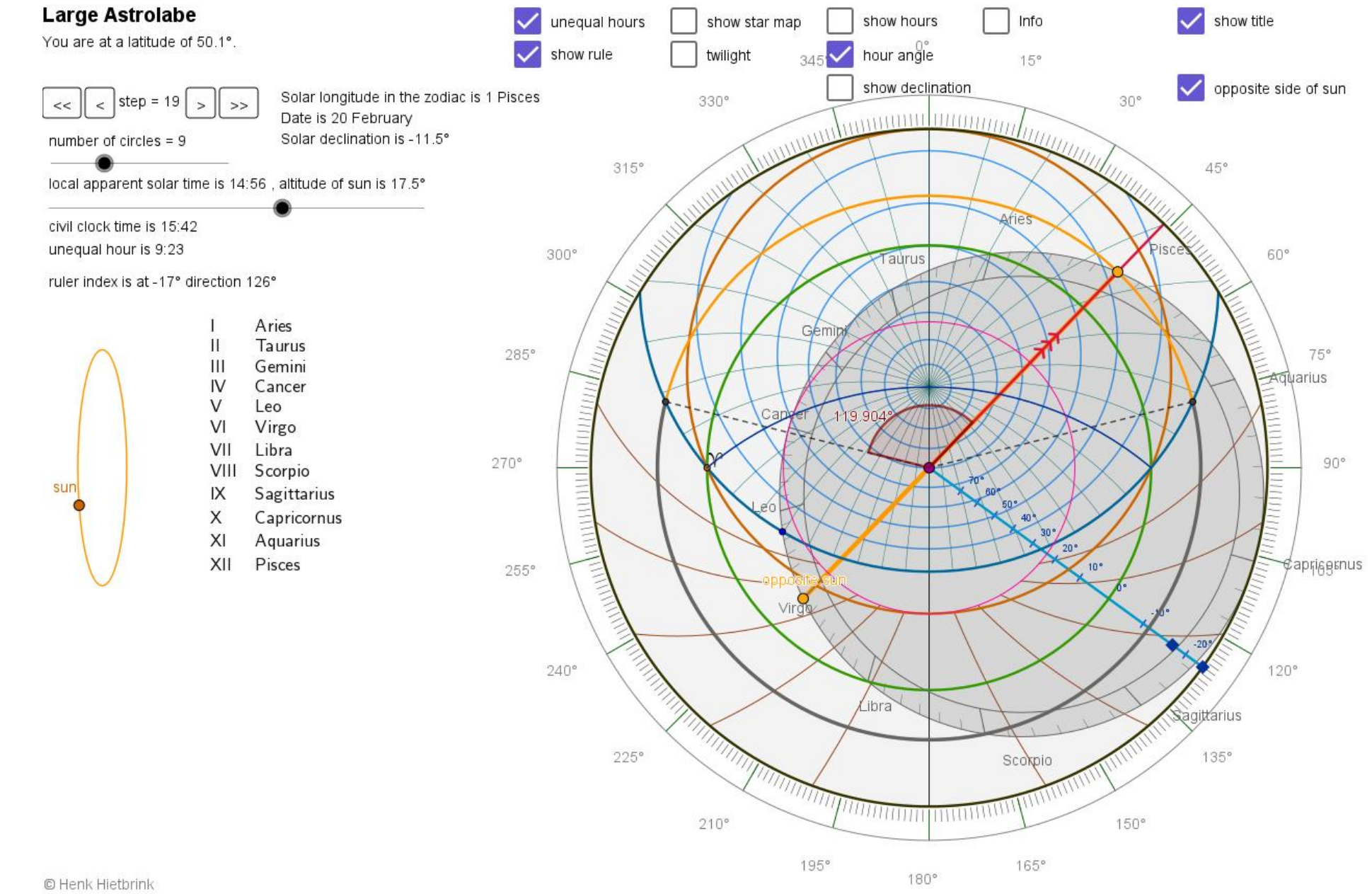
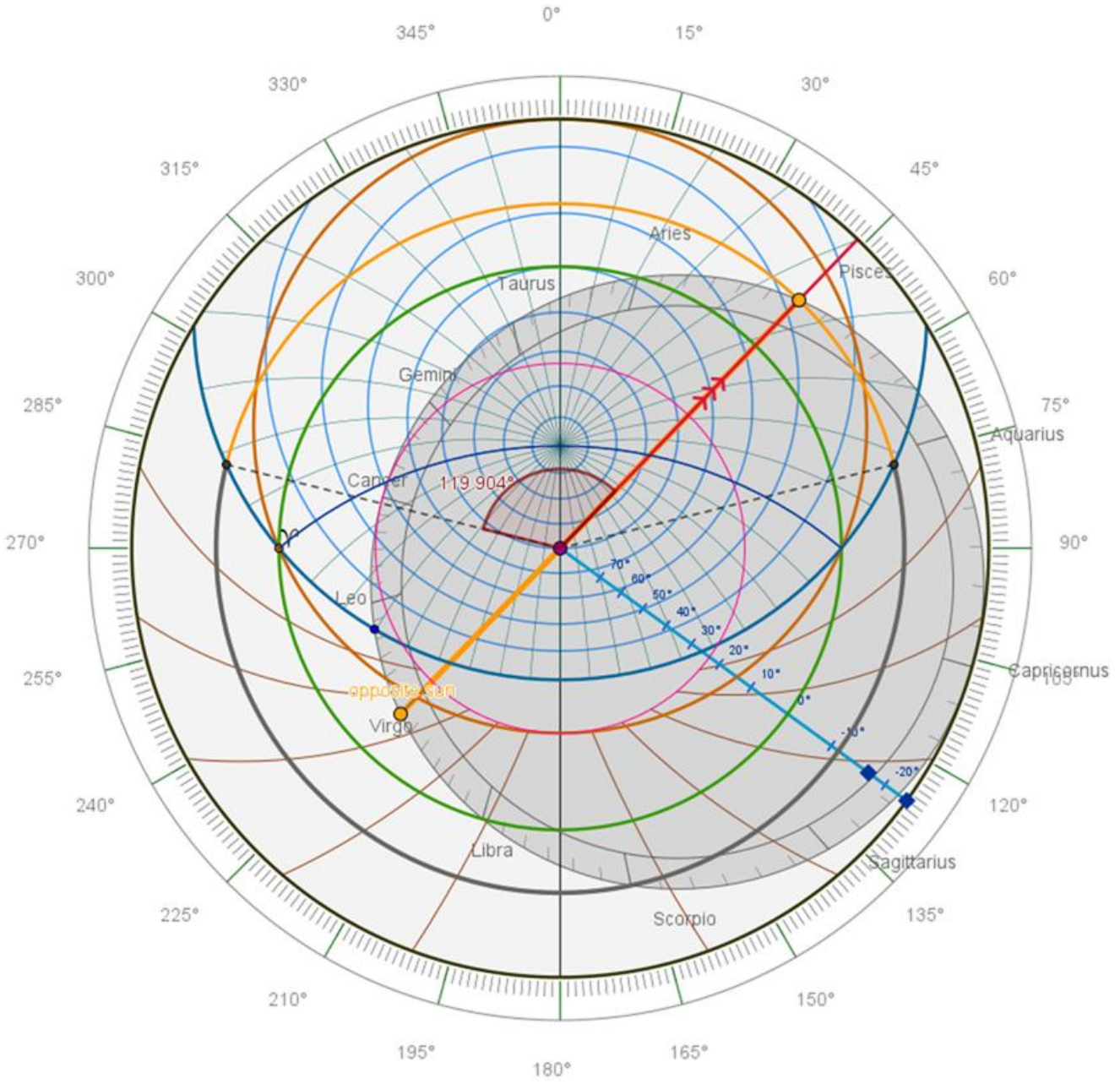
A Great Scientific Instrument
Zaragoza Astrolabe

Germanisches Nationalmuseum. CCA 1099. AHP no. A10

A Great Instrument for Teaching Mathematics



Earn Money as an Astrologer: find ascendant and sun's degree



Introduction

Henk Hietbrink

- math teacher in the Netherlands
- Went to Utrecht Univ. for a teaching licence
- Invited for the Sezgin summerschools
- Invited by science centers in Turkiye

Recent projects

- Nesin Math Village: astrolabe workshops
- ibn Al-Samh: Kitäb Al-Amal Bi-L-Asturlab
- Muqarnas workshops

Click on a figure to open the corresponding webpage at www.henkhietbrink.nl

Nesin Math Village
one week intensive course

NESİN MATEMATİK KÖYÜ

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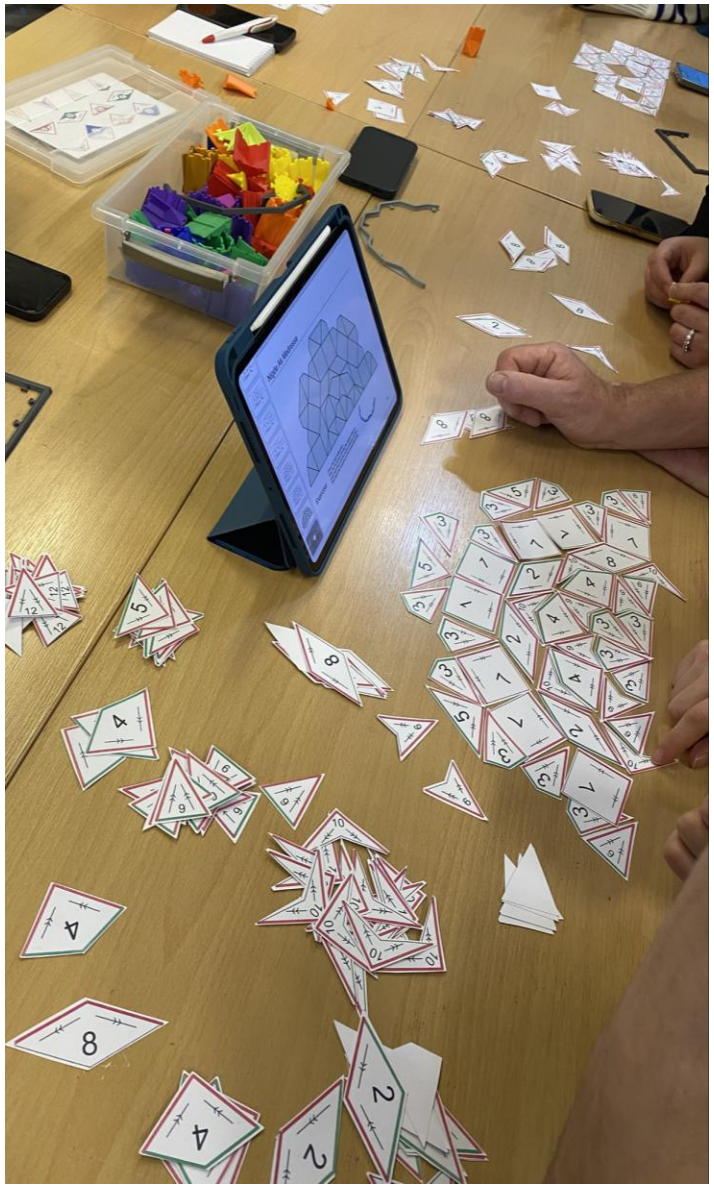
Istanbul Design Center

İSTANBUL TASARIM MERKEZİ ISTANBUL DESIGN CENTER



November 30, 2025 - 04:00 pm
Participation is free

Muqarnas Design Workshop

with Henk Hietbrink

İSTANBUL TASARIM MERKEZİ ISTANBUL DESIGN CENTER

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Why do today's students mathematics ?

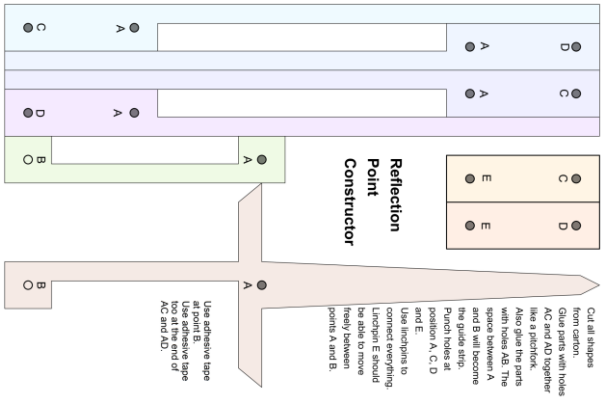
Point of view of many students

- A prerequisite for admission to university
- Prepare for exams

My aim

- Math is a tool for real life problem solving

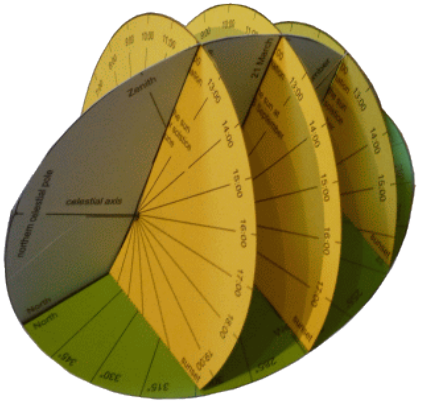
My Approach



Start with easy problems

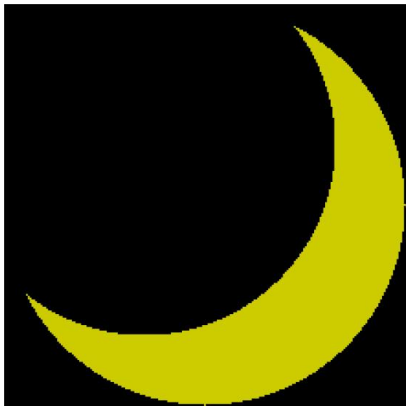
(which are not that easy)

- Cut out sheets
- Mix math, optics, cosmography
- Focus on history



My aim

- Intuitive mathematics
- Solve the problem yourself



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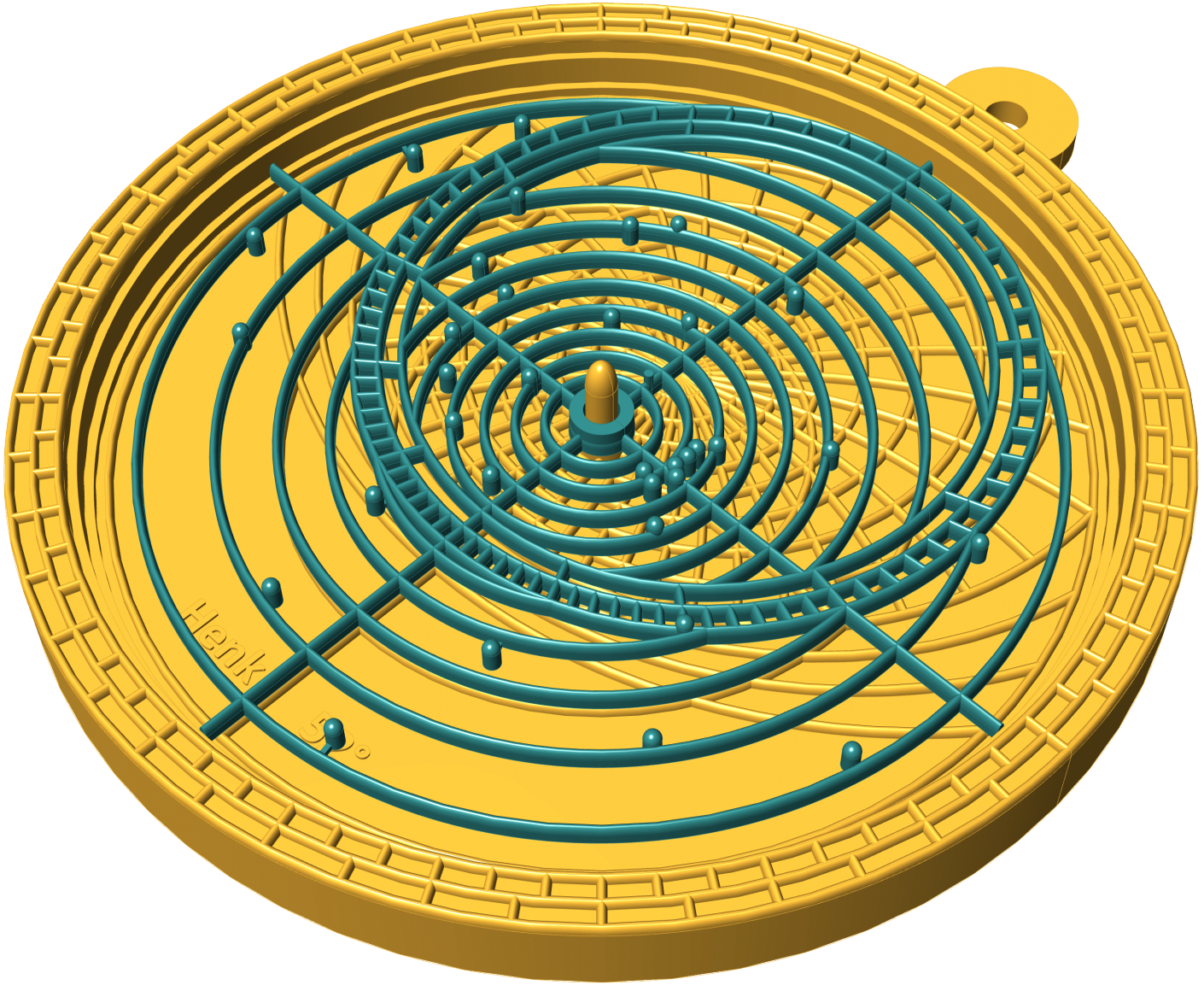
Affordable 3D printed astrolabe



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Why workshops ?

Not enough

- Only listening
- Watching videos
- A nodding audience

Aim high

- Touch / See / Discuss
- Verify experiments
- Check calculations

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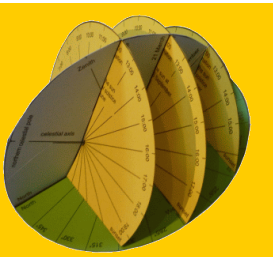
My Most Popular Project: The Geometry of a Sundial



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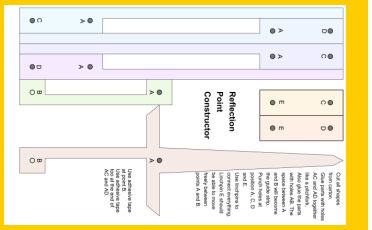
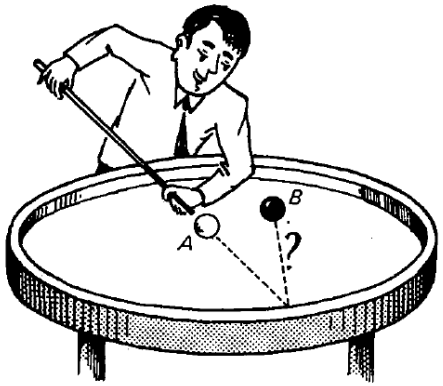
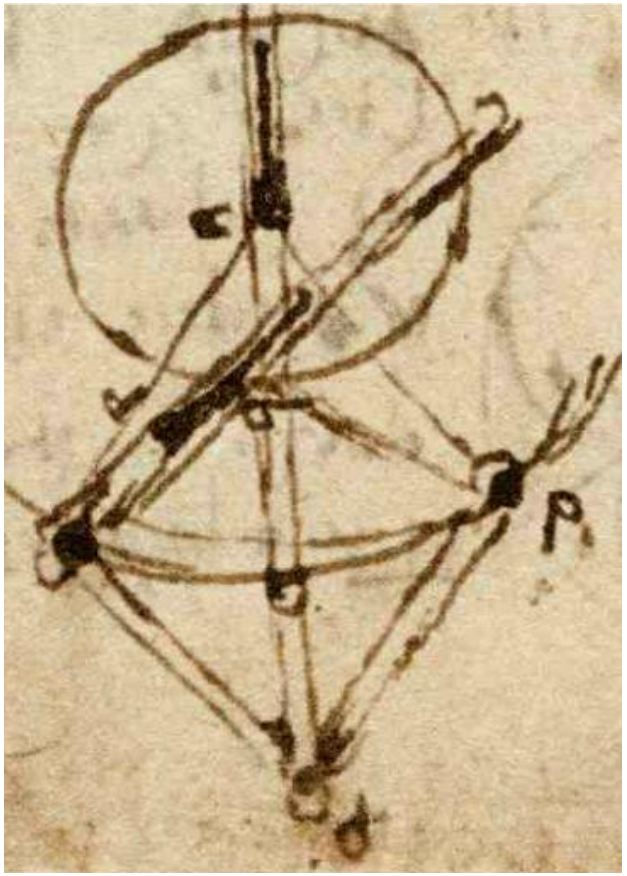
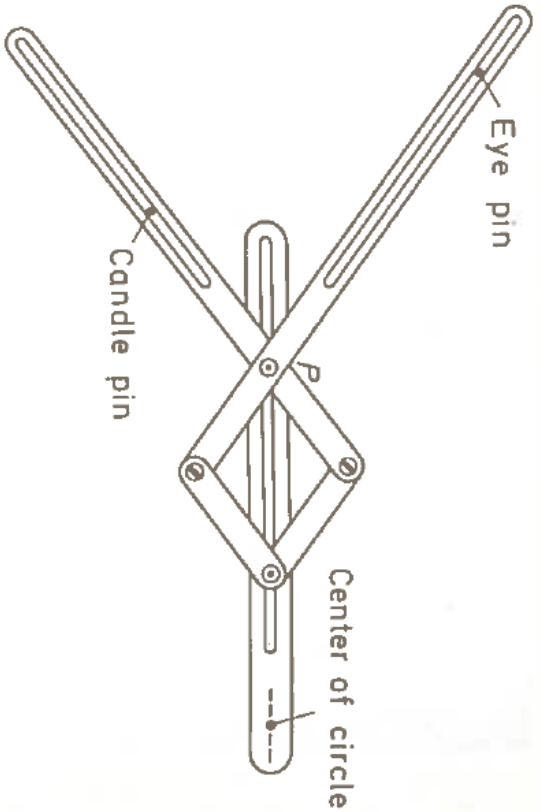
My Most Surprising Project: Leonardo da Vinci ←→ Marcolongo





Lo strumento inventaro da Leonardo da Vinci per la risoluzione del problema di Alhazen





Click on a figure to open the corresponding webpage at www.fransvanschooten.nl/alhazen.htm

My Favorite Starter: A Long Exposure Photo at Doğu Anadolu Gözlemevi

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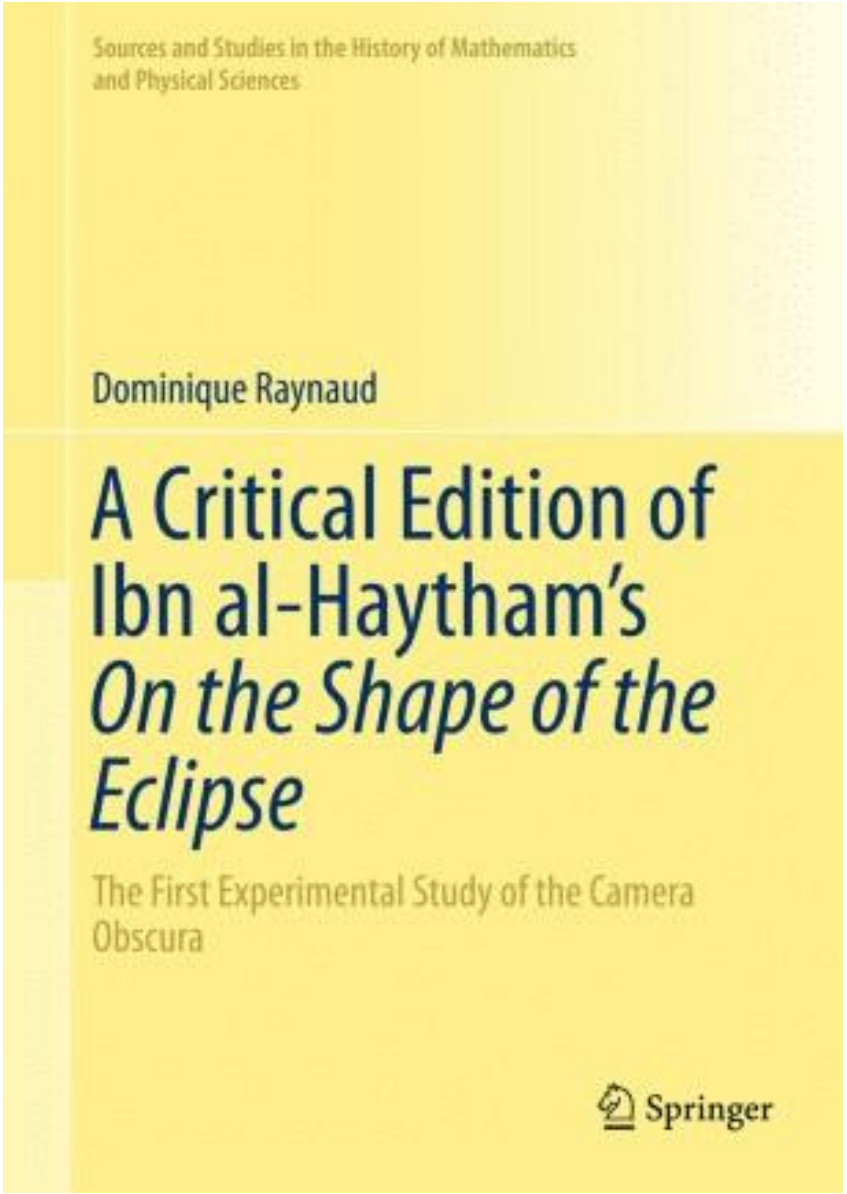
My favorite Project
Ibn al-Haytham and the crescent moon



A crescent-shaped image of the light of the Sun can be seen at the time of the eclipse, if its light has passed through a narrow circular aperture and has reached a plane opposite the aperture, provided the eclipse is not a total one and the shape of its remaining part [of the Sun] is crescent-shaped. No such thing happens with the eclipse of the Moon. (…) Subsequently, no matter how large the aperture afterwards, the light will always be displayed as circular provided that the aperture is circular.

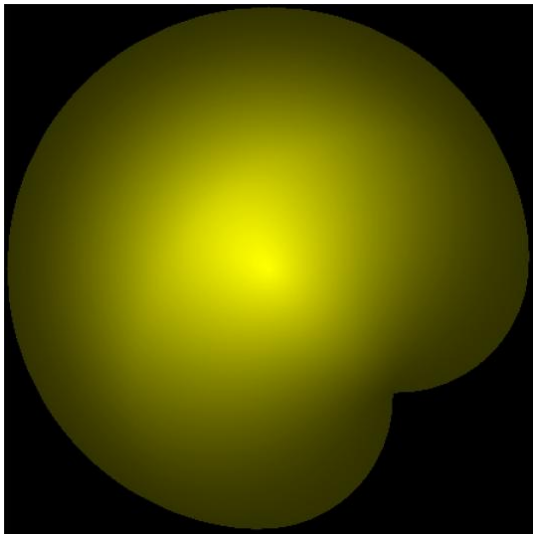
Click on a figure to open the corresponding webpage at www.henkhietbrink.nl/astrolabe.htm

Ibn al-Haytham wonders
Can you explain what is happening?

- **Why don't we see a crescent moon in a camera obscura?**

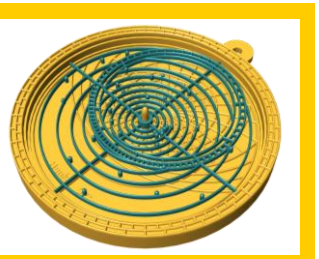
- **When the aperture is small, moonlight is too faint, we can not see the shape.**

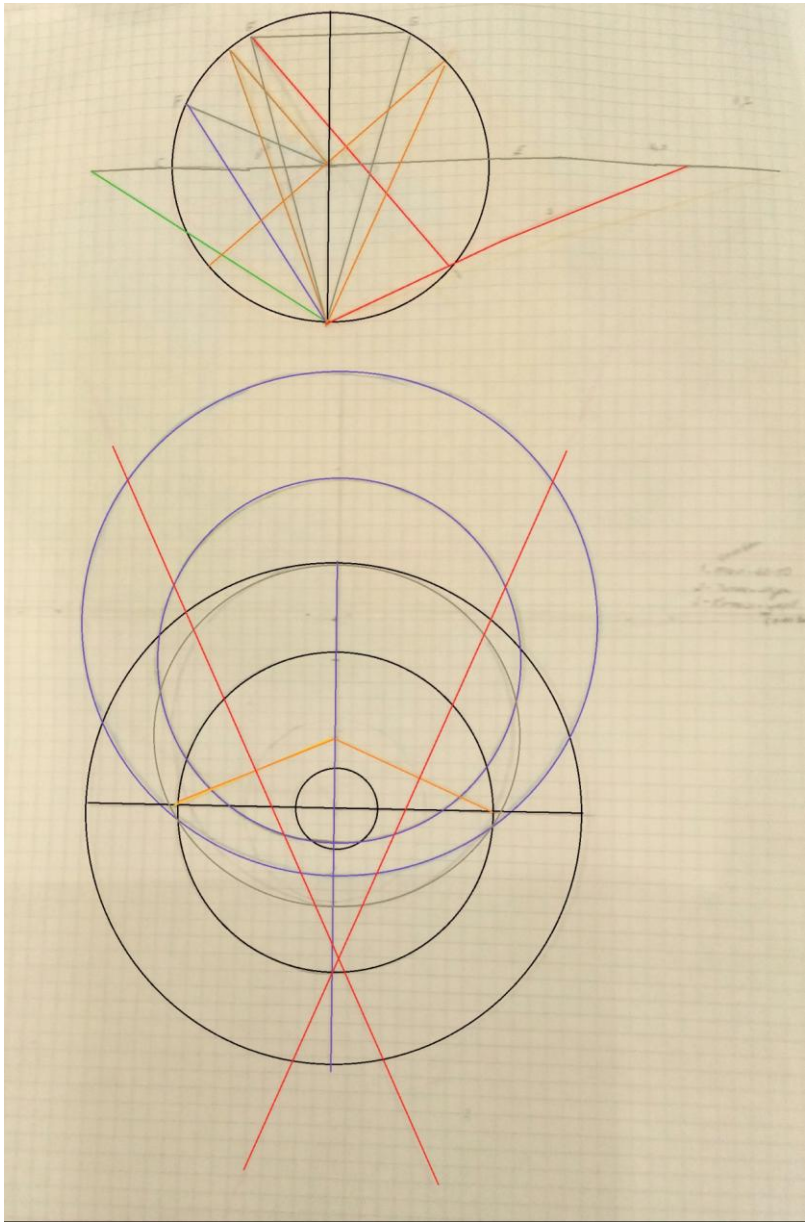
- **When we enlarge the aperture, we see almost a full disc.**



Click on a figure to open the corresponding webpage at www.henkhietbrink.nl/camera.htm

Astrolabe Project





Geometry

understanding the circles

- Sphere
- Geometric properties
- Stereographic projection
- Accuracy

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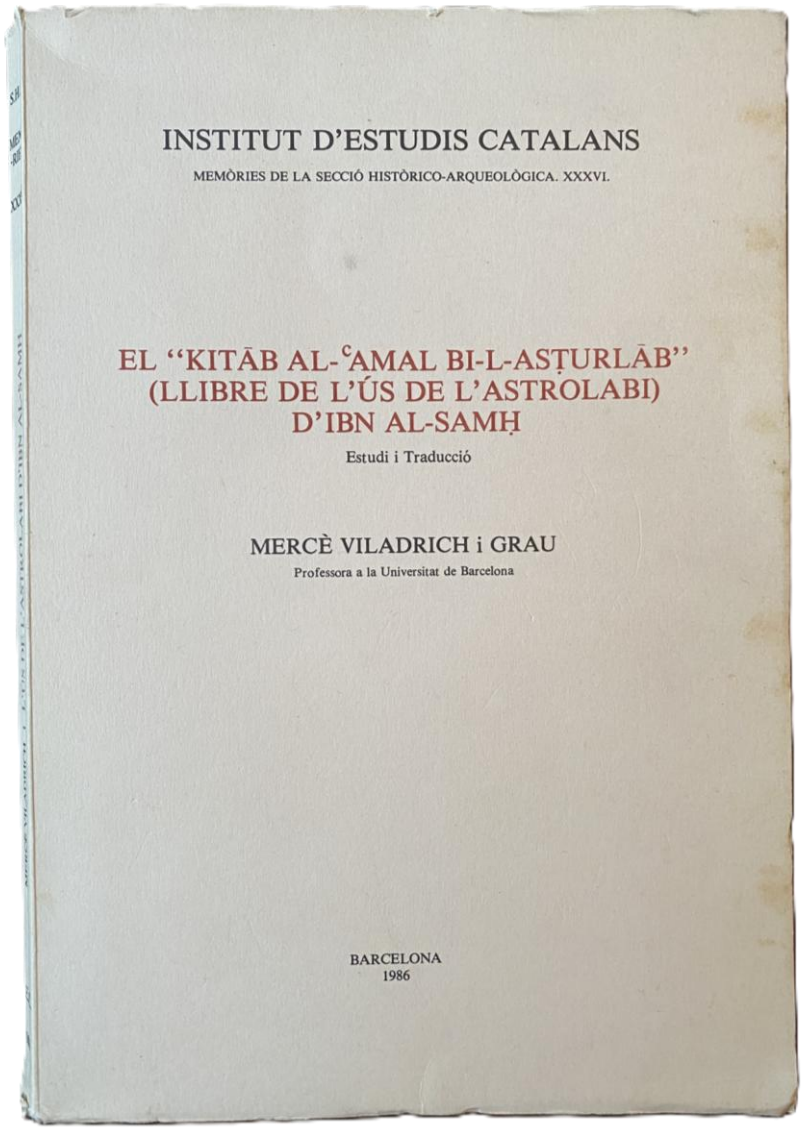
Recent Project



Manuscript

in Arabic by Ibn al-Samh

Critical edition

in Catalan by
Mercè Viladrich i Grau

Raw translation

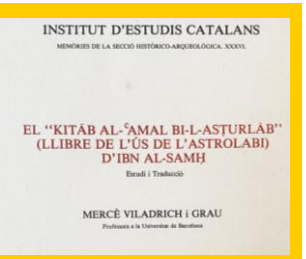
in English by me

Click on a figure to open the corresponding webpage at www.henkhietbrink.nl/astrolabe.htm

What is this Ibn al-Samh manuscript about?

- How to use the astrolabe
- No mathematics, no geometry
- Only recipes “do this and here is the result”
- 129 chapters
- Basic calculations only
- Systemetic and complete discussing all permutations of givens and results

Ibn al-Samh Three Examples



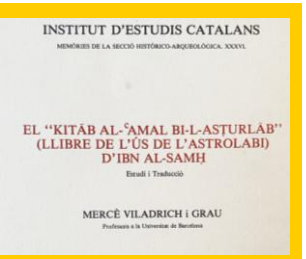
- **CHAPTER 24**
- ***Measurement of the hour angle based on the degree of the sun and the ascendant during the day and night***

- **CHAPTER 25**
- ***Obtaining the degree of the sun from the hour angle and the ascendant during the day and night***

- **CHAPTER 26**
- ***Determination of the ascendant by the degree of the sun and the hour angle during the day and night***

Click on a figure to open the corresponding webpage at www.henkhietbrink.nl/astrolabe.htm

Ibn al-Samh Defintions



- ***hour angle:***
  number of equatorial degrees that the sphere has rotated since a significant astronomical event has occurred, for example, the sunrise or sunset
  - it is not temporal hour
  - It is not modern hour angle from meridian
- ***degree of the sun:***
  the point on the ecliptic circle where the sun is on a day of the year
- ***ascendant:***
  the degree of the ecliptic that is on the line of the known temporal hour (often the eastern horizon where sun and stars rise)
- ***hour:***
  unequal (temporal) hours since sunrise or sunset

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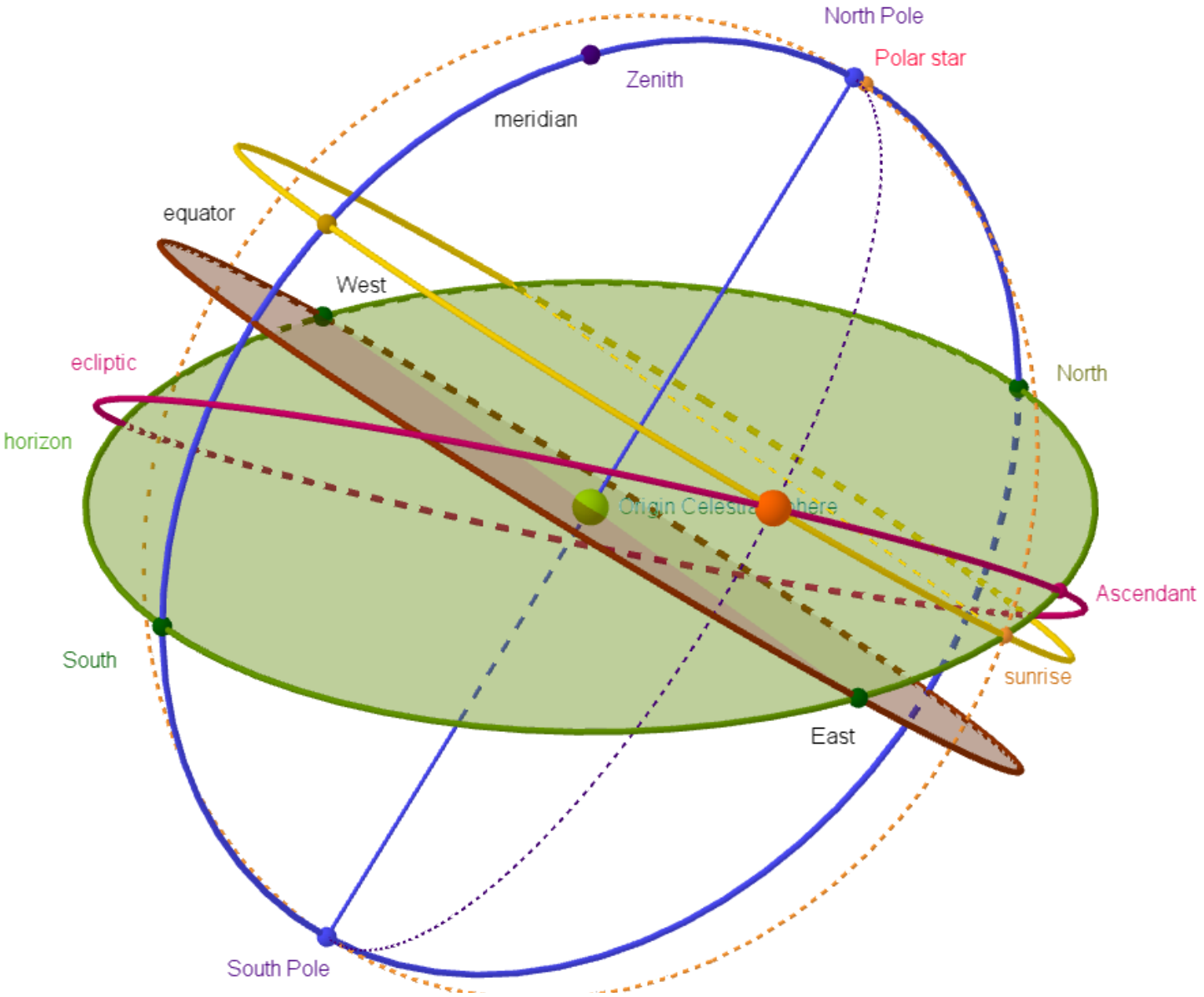
Spherical Trigonometry: Ascendant – Degree of the Sun –Hour Angle



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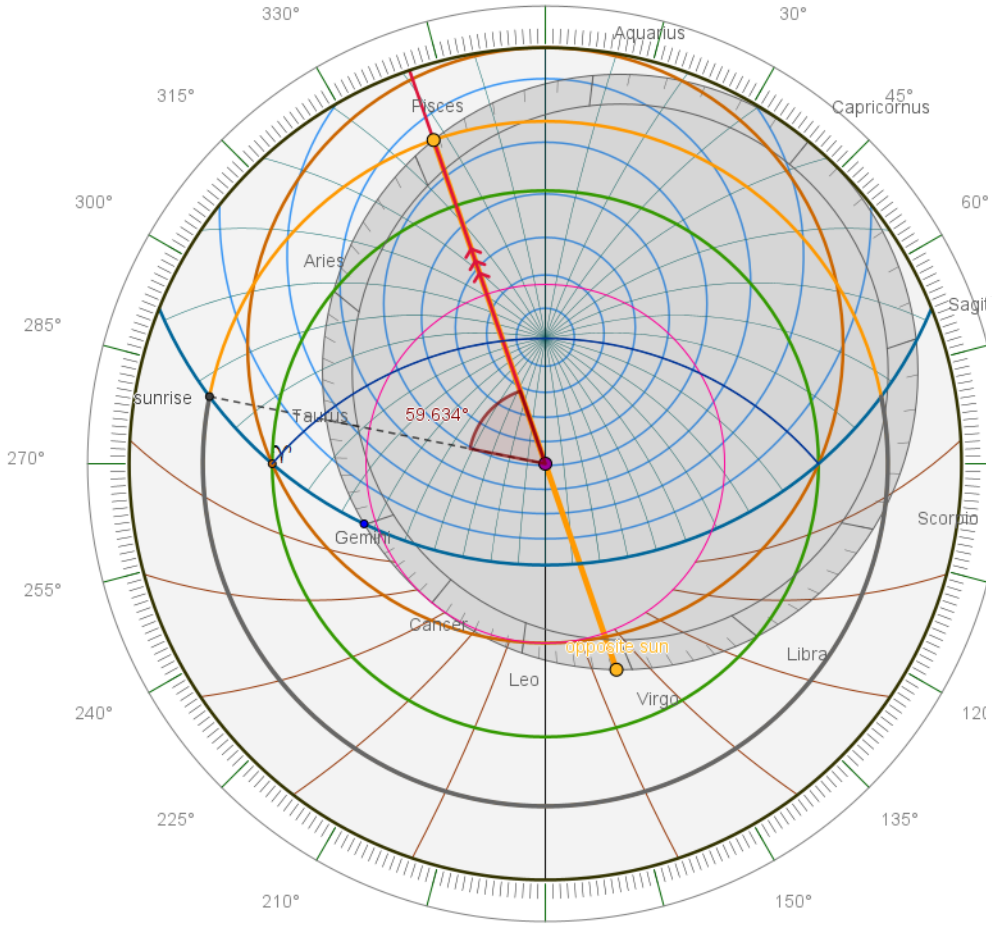
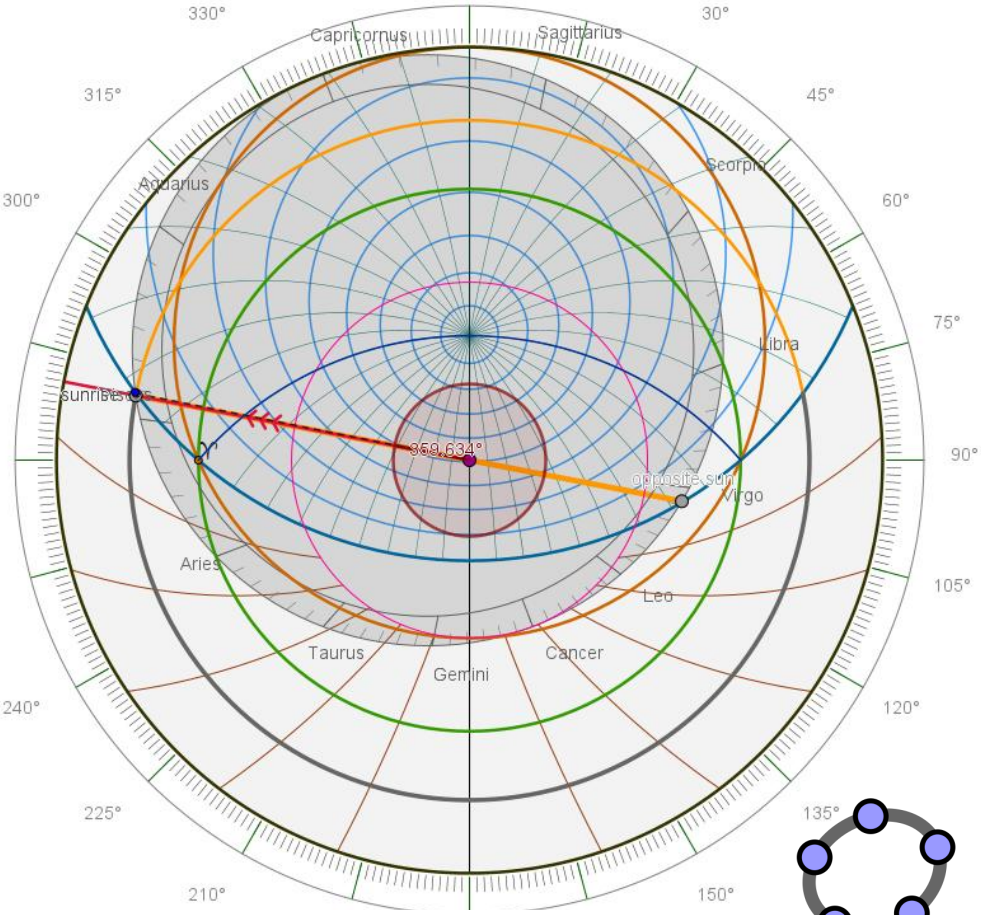
Chapter 24: Hour Angle

Measurement of the hour angle based on the degree of the sun and the ascendant during the day and night.

- **Suppose we are in Zaragoza.**
- **Its latitude is 40.7°.**
- **Given the ascendant, for example 1 Gemini.**
- **Given the degree of the sun, for example 27 Aquarius.**
- **Bring 1 Gemini to the horizon and read off the position of 27 Aquarius being 341°. So, the time is 10:44.**
- **Bring the sun position of 27 Aquarius to the horizon and read off its mark at the rim being 281°.**
  So the time of sunrise is 6:44.
- **Now, calculate the difference being 341° - 281° = 60°.**
  Therefore the *hour angle* is 60°.

Chapter 24: ascendant is 1 Gemini, degree of the sun is 27 Aquarius ➔ hour angle is 60°





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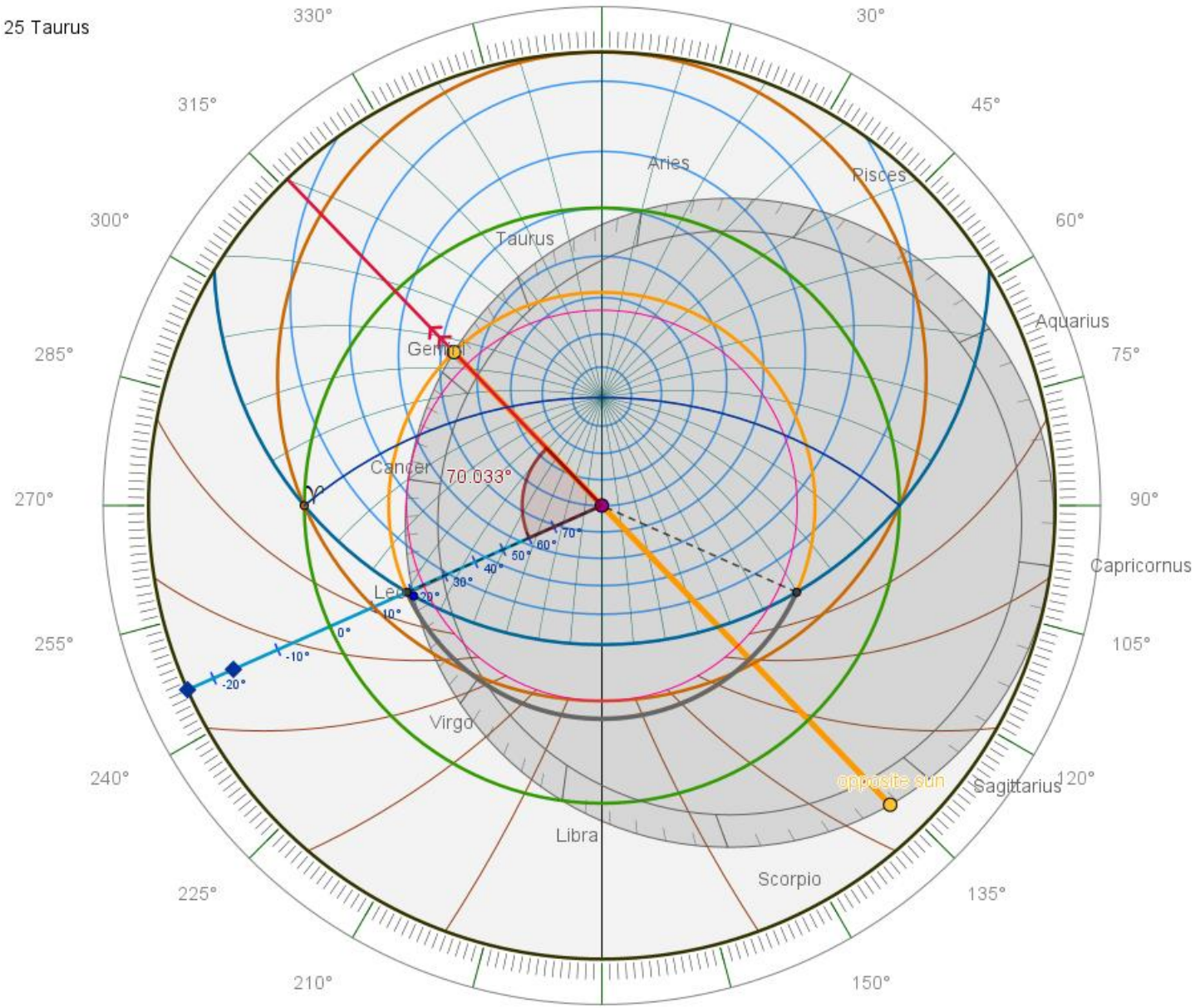
Chapter 24: Hour Angle

Measurement of the hour angle based on the degree of the sun and the ascendant during the day and night.

- **Suppose we are in Frankfurt am Main.**
- **Its latitude is 50.1°.**
- **Given the ascendant, for example 1 Leo.**
- **Given the degree of the sun, for example 25 Taurus.**
- **Bring 1 Leo to the horizon and read off the position of 25 Taurus being 316°. So, the time is 9:04 (equal) or 3:34 (unequal since sunrise).**
- **Bring the sun position of 25 Taurus to the horizon and read off its mark at the rim being 246°.**
  So the time of sunrise is 4:24.
- **Now, calculate the difference being 316° - 246° = 70°.**
  Therefore the *hour angle* is 70°.

Chapter 24: ascendant is 1 Leo, degree of the sun is 25 Taurus ➔ hour angle is 70°



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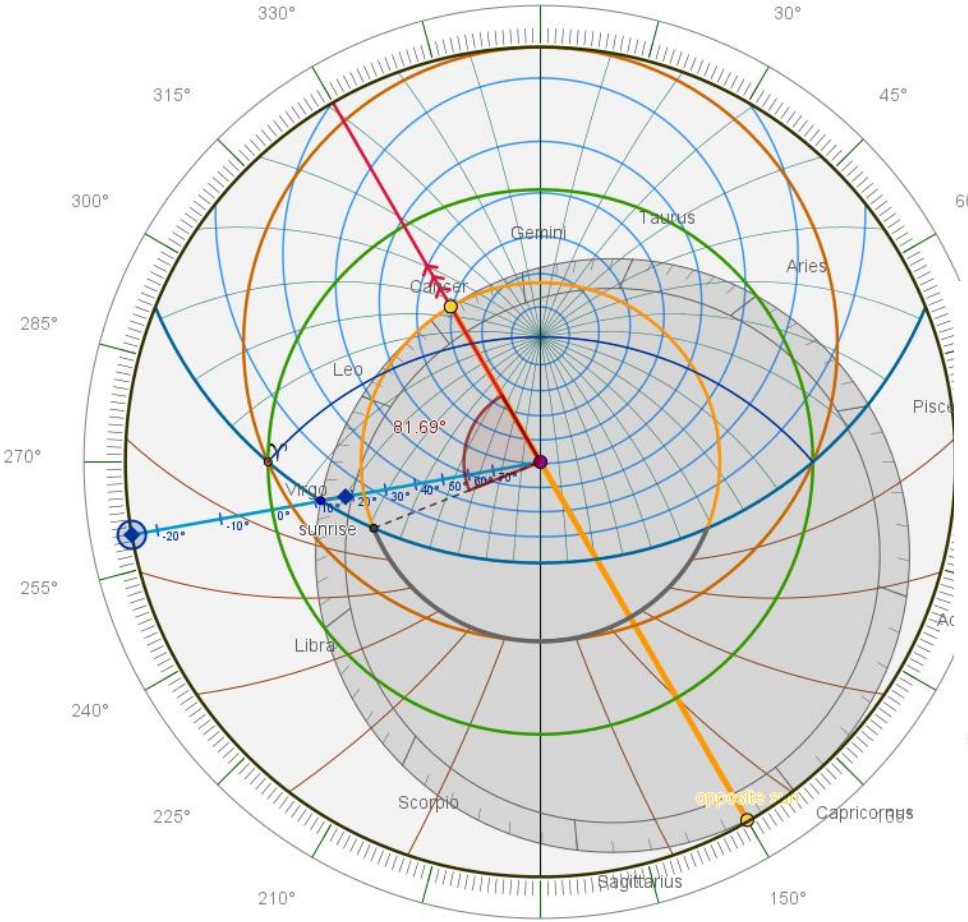
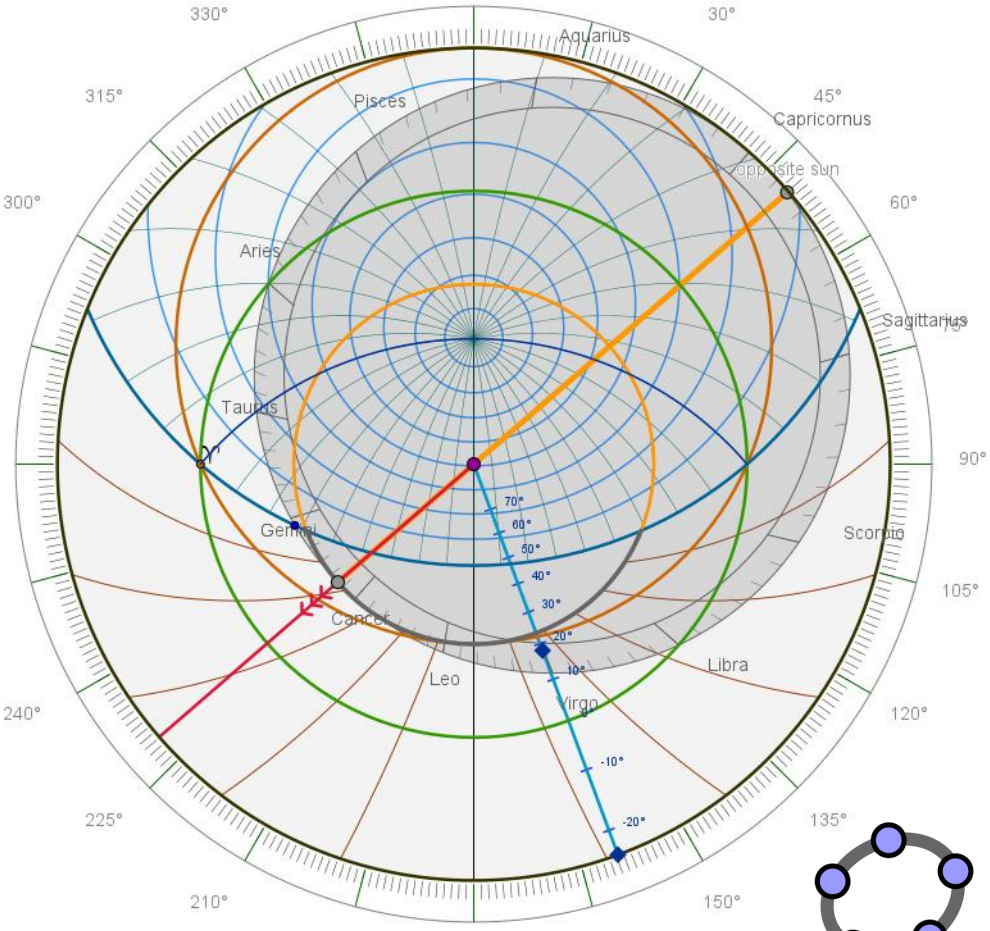
Chapter 25: Degree of the Sun

Obtaining the degree of the sun from the hour angle and the ascendant during the day and night

- **Suppose we are in Zaragoza. Its latitude is 40.7°.**
- **Given the ascendant, for example 1 Virgo.**
- **Given the hour angle, for example 100°.**
- **Bring 1 Virgo to the horizon, and read off the degree, being 260°.**
- **Compute 260° - 100° = 160°.**
- **Bring 1 Virgo to that direction of 160°.**
- **Read the ecliptic degree at the point of intersection with the horizon.**
- **That is 4 Gemini or 25 May.**
- **This is the *degree of the sun* that you are looking for.**

Chapter 25: ascendant is 1 Virgo, hour angle is 100° ➔ degree of sun is 4 Gemini





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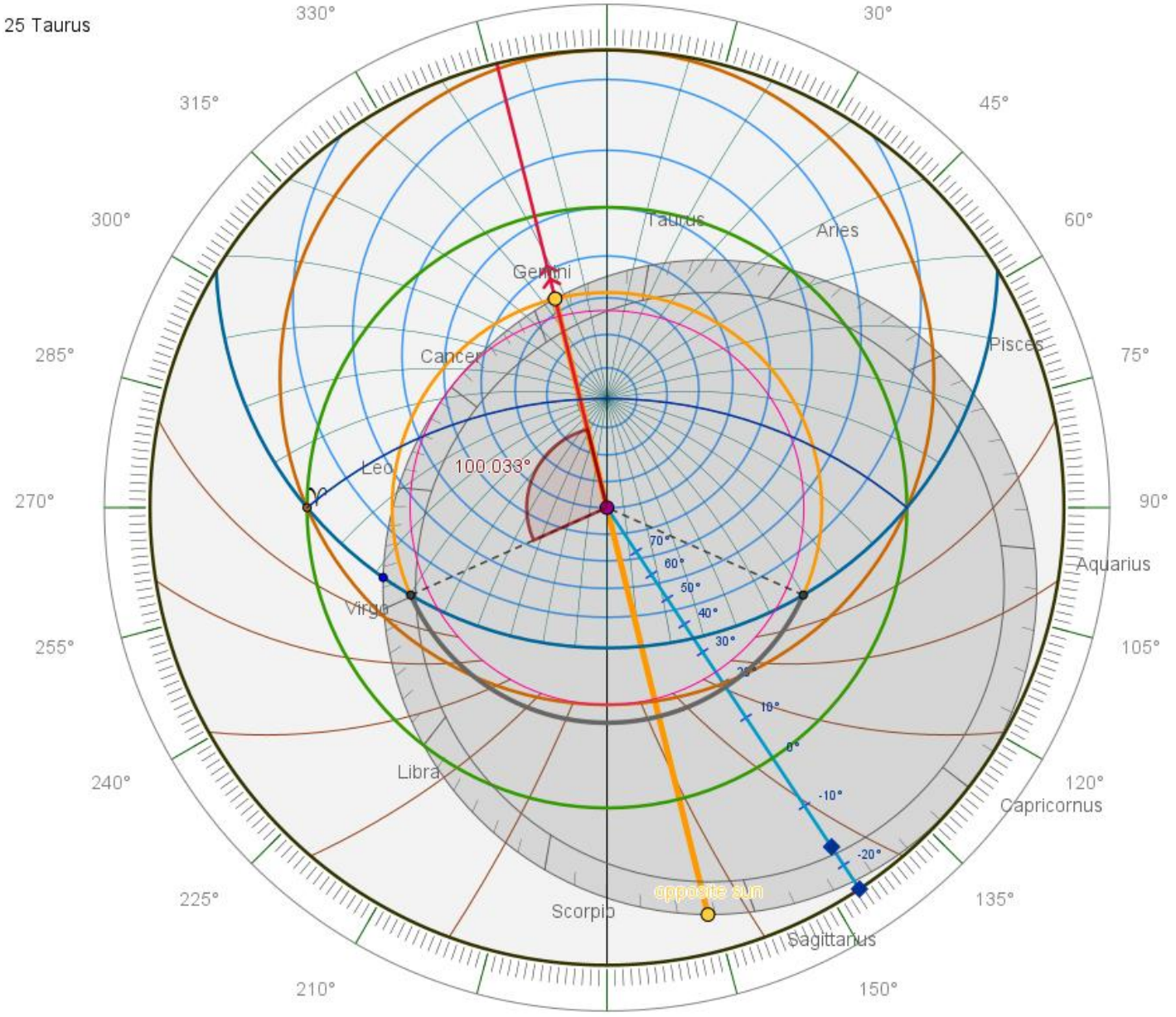
Chapter 25: Degree of the Sun

Obtaining the degree of the sun from the hour angle and the ascendant during the day and night

- **Suppose we are in Frankfurt. Its latitude is 50.2°.**
- **Given the ascendant, for example 1 Virgo.**
- **Given the hour angle, for example 100°.**
- **Bring 1 Virgo to the horizon, and read off the degree, being 246°.**
- **Compute 246° - 100° = 146°.**
- **Bring 1 Virgo to that direction of 146°.**
- **Read the ecliptic degree at the point of intersection with the horizon.**
- **That is 4 Gemini or 25 May.**
- **This is the *degree of the sun* that you are looking for.**

Chapter 25: ascendant is 1 Virgo, hour angle is 100° ➔ degree of sun is 25 Taurus

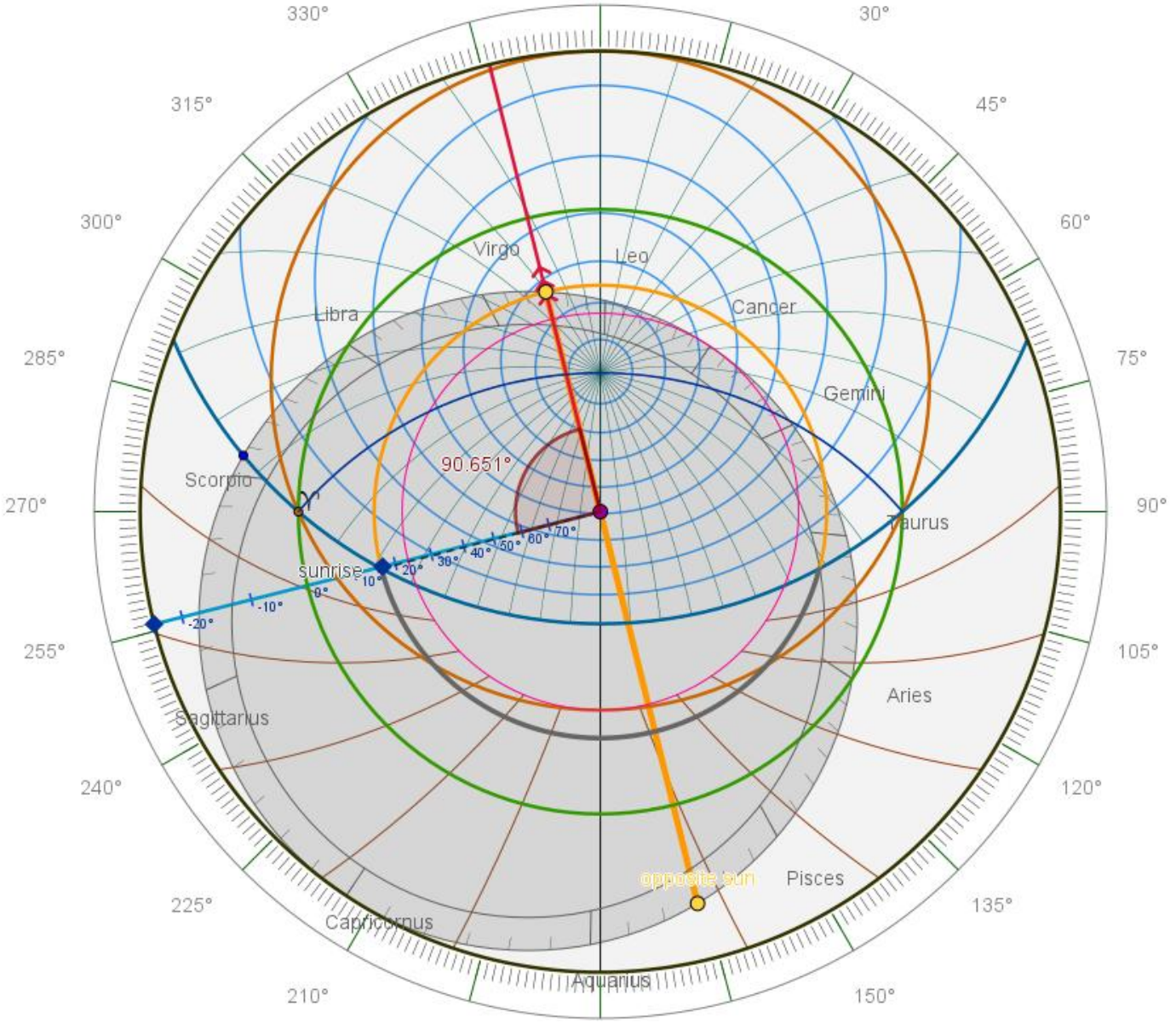


Chapter 26: Ascendant

Determination of the ascendant by the degree of the sun and the hour angle.

- **Suppose we are in Zaragoza. Its latitude is 40.7°.**
- **Given the degree of the sun, for example 16 Leo.**
- **Given the hour angle, for example 90°.**
- **Place the sun's degree on the eastern horizon.**
- **Bring the ruler to the sunrise point, which is 256°.**
- **Add the hour angle to this value to get 346°.**
- **Rotate the sun's degree to that position.**
- **Now, read off the ascendant. It is 27 Libra.**
- **This is the *ascendant* you are looking for.**

Chapter 26: degree of the sun is 16 Leo, hour angle is 90° ➔ ascendant is 27 Libra



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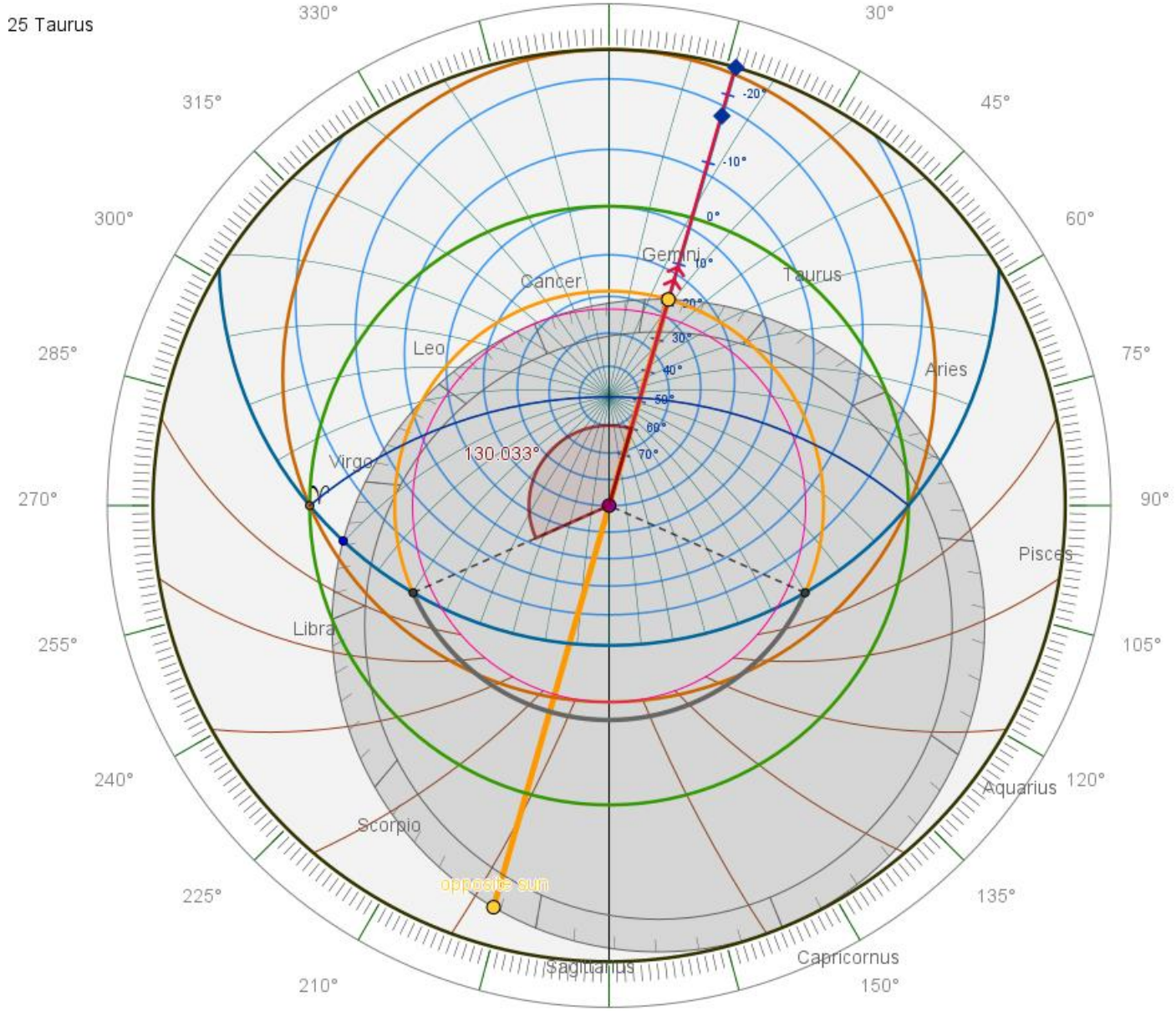
Chapter 26: Ascendant

Determination of the ascendant by the degree of the sun and the hour angle.

- **Suppose we are in Frankfurt. Its latitude is 50.2°.**
- **Given the degree of the sun, say 25 Taurus.**
- **Given the hour angle, for example 130°.**
- **Place the sun's degree on the eastern horizon.**
- **Bring the ruler to the sunrise point, which is 246°.**
- **Add the hour angle to this value to get 376° = 16°.**
- **Rotate the sun's degree to that position.**
- **Now, read off the ascendant. It is 14 Virgo.**
- **This is the *ascendant* you are looking for.**

Chapter 26: degree of the sun is 16 Leo, hour angle is 90° ➔ ascendant is 27 Libra



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Thank you for your attention

www.henk hietbrink.nl/astrolabe.htm