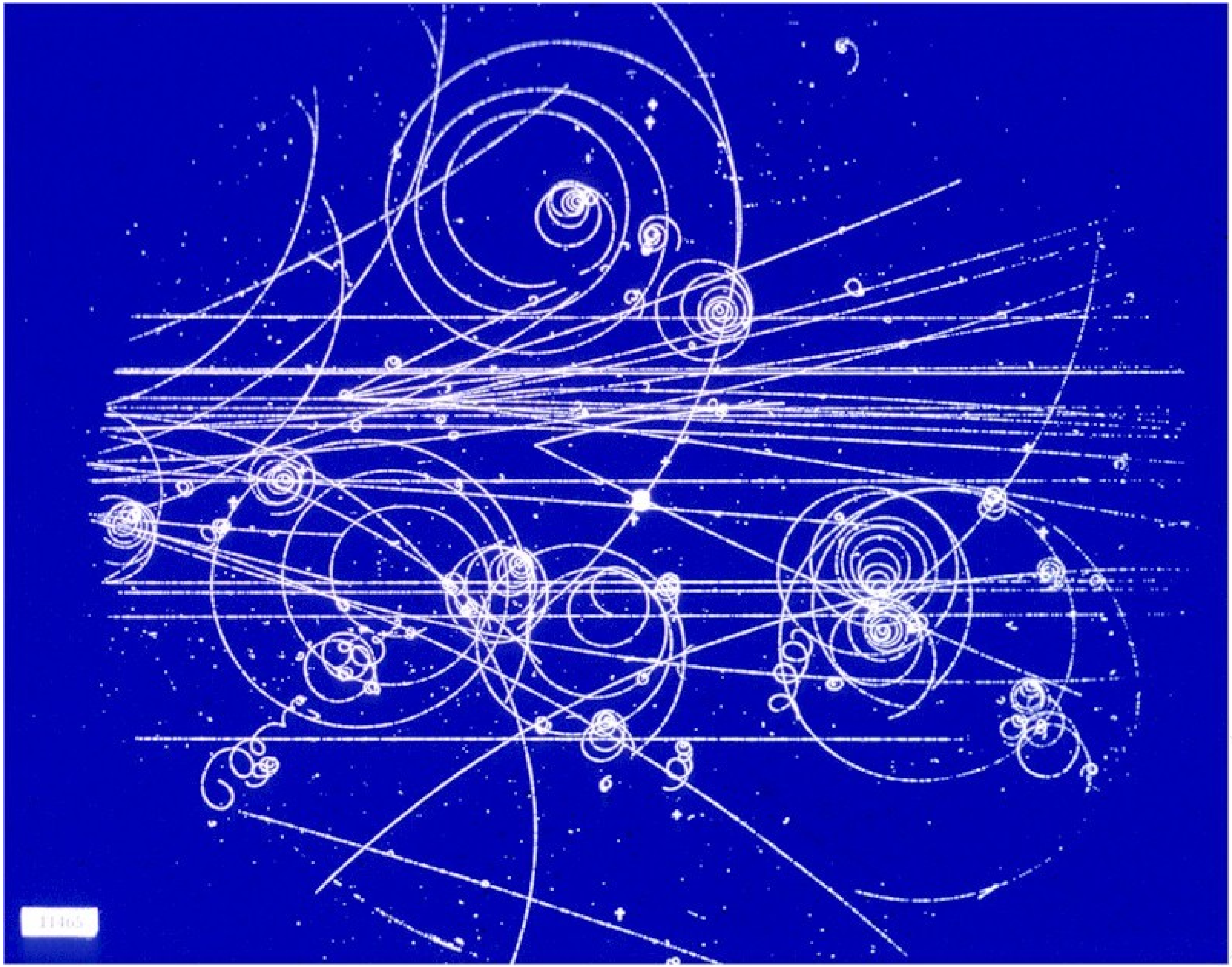
The gnomonic bloc at the Mont Ste Odile, Alsace, France

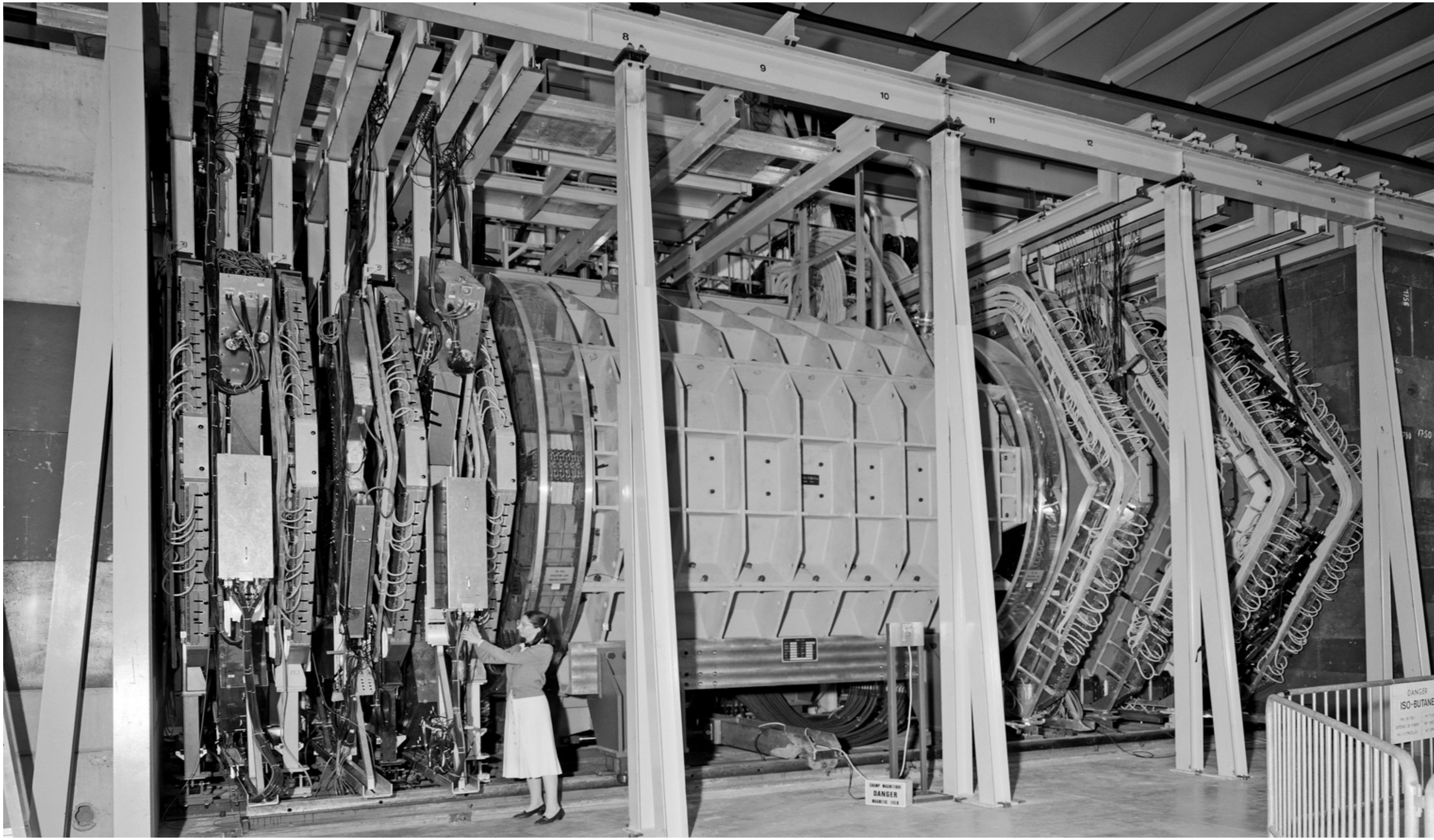
Bubble chamber physics

70^{th}

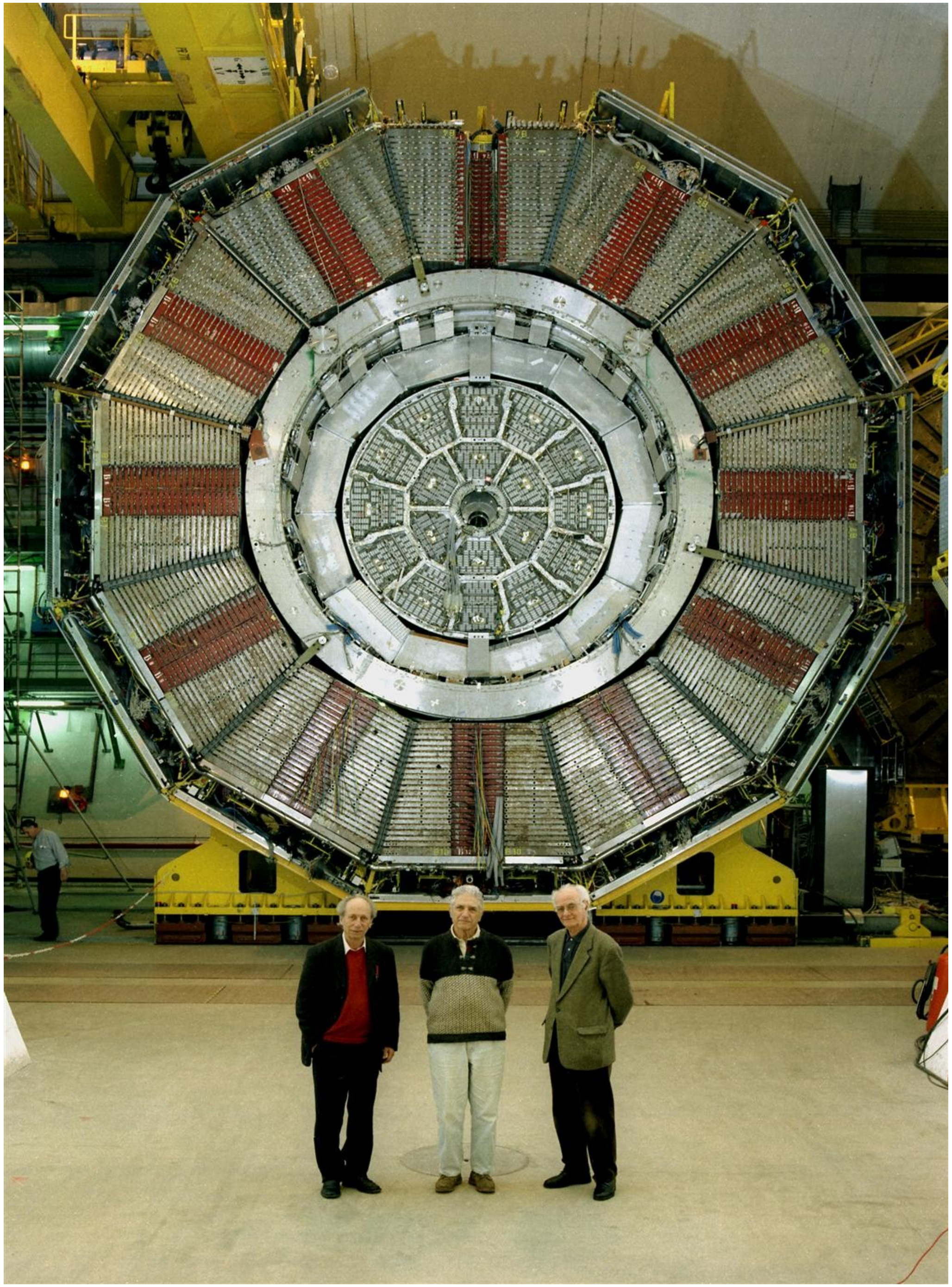


Experiment NA10 at the SPS: Drell Yan process; structure function of the pion

80th



Godfather of the Alice dimuon arm



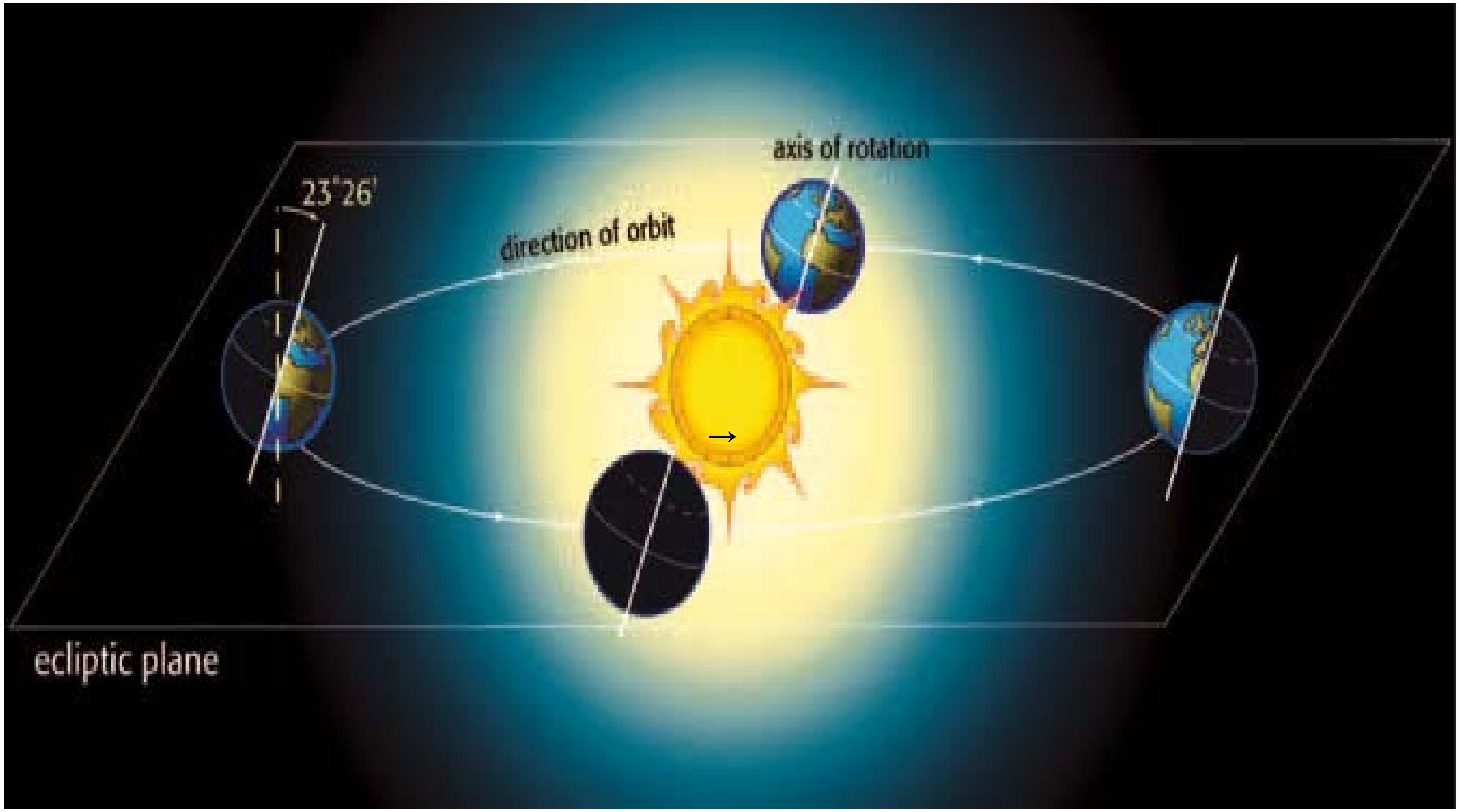
Physics at LEP

ALEPH detector

90^{th} – 2000^{th}

COSMOGRAPHY

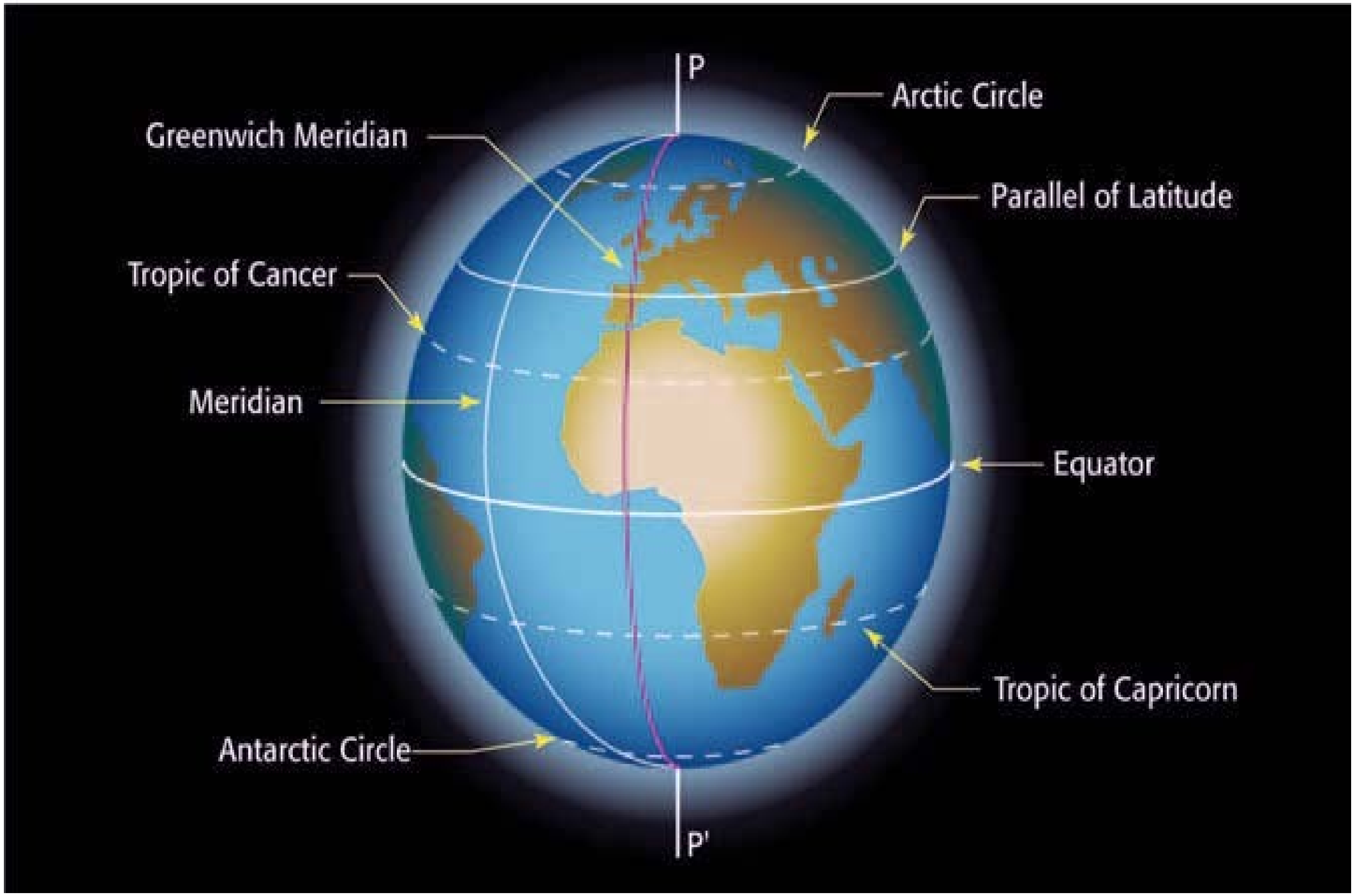
The moving Earth



1. the Earth rotates on its axis every ~ 24 hours → *day*

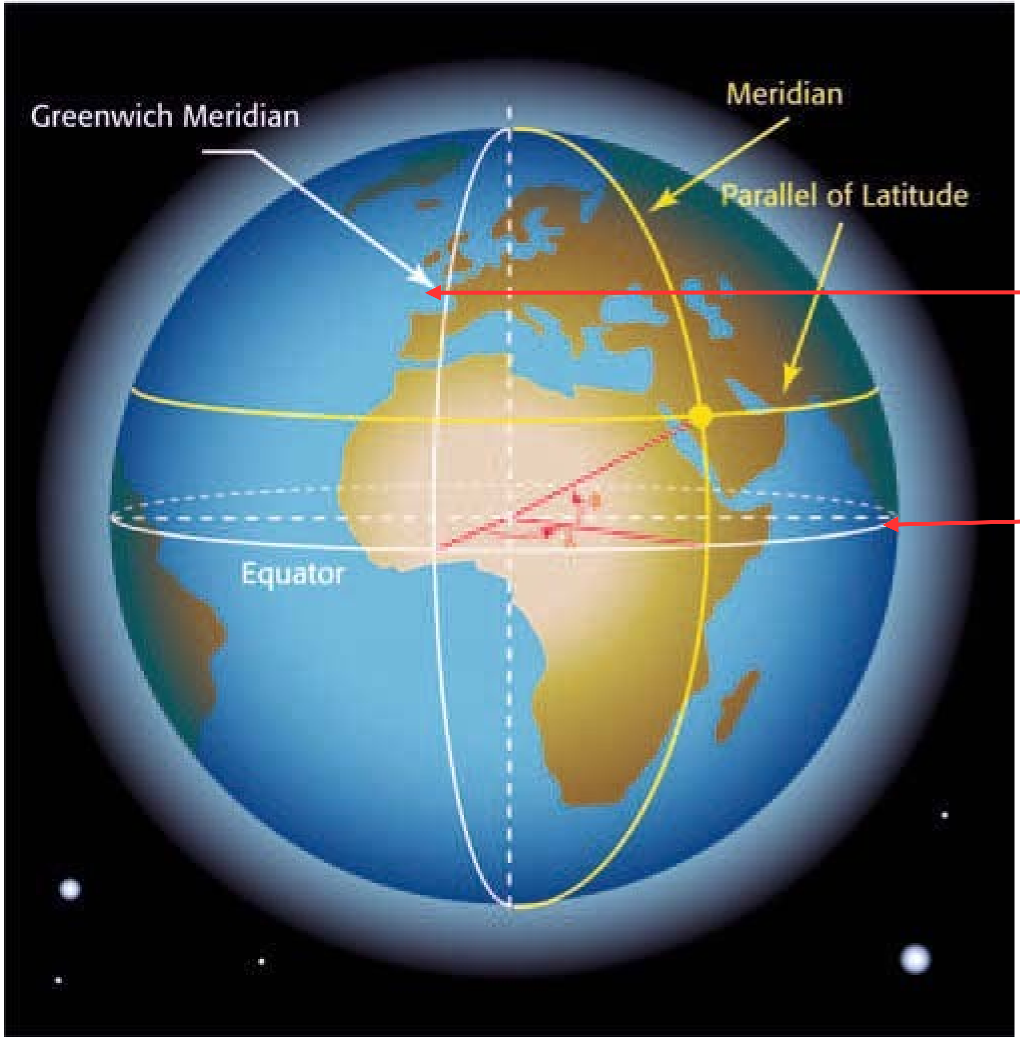
2. the Earth orbits the Sun in ~ 365.25 days → *year*

Geographical coordinates on the Earth



The surface on the Earth with its parallels and meridians

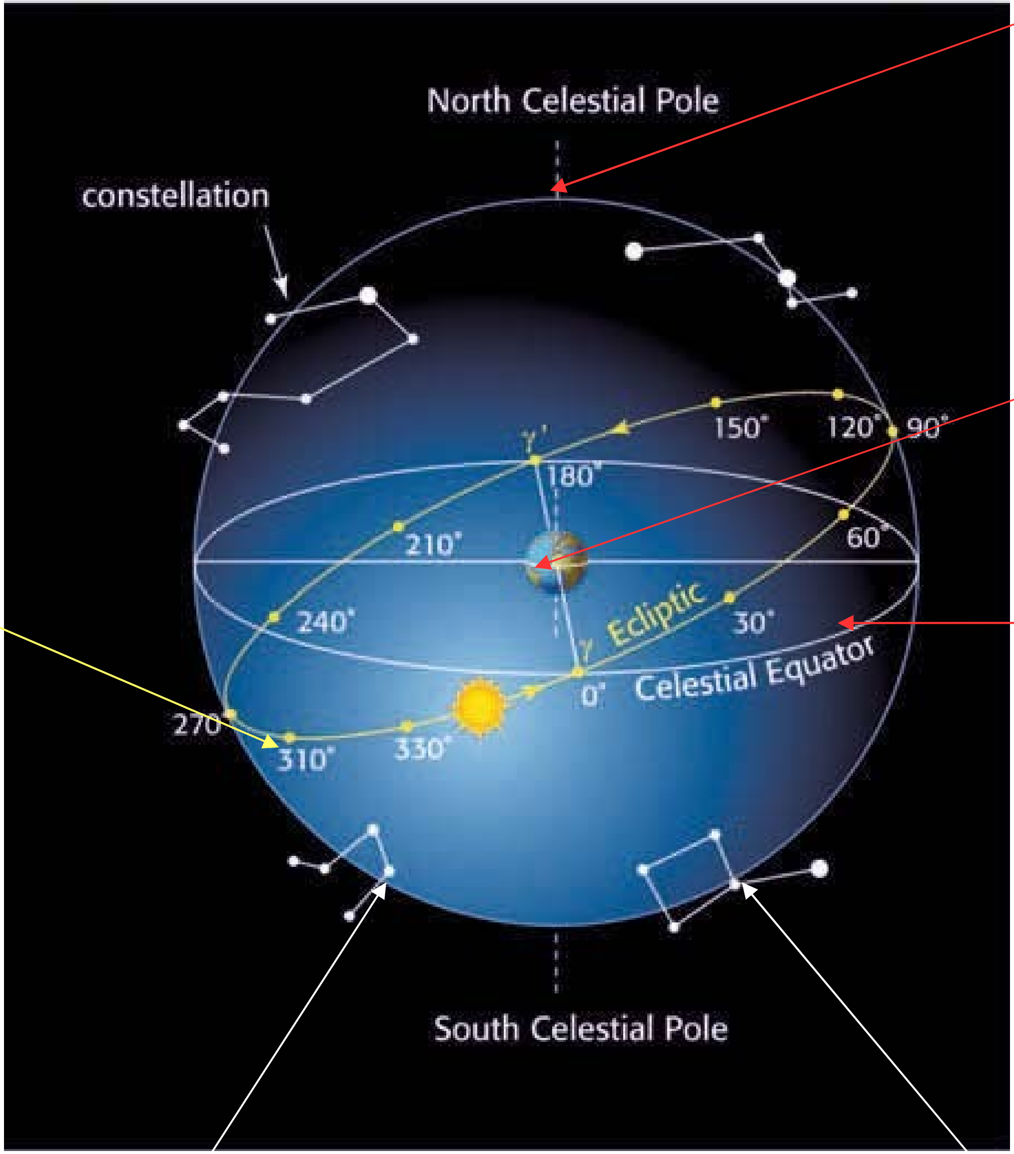
Latitude ϕ and longitude λ
of a place at the surface of the Earth



the Greenwich meridian is the meridian of reference for longitudes

the Equator is the // of reference for latitudes

The Celestial Sphere



North celestial pole

the Earth is at the center of the celestial sphere (the Earth is point-like)

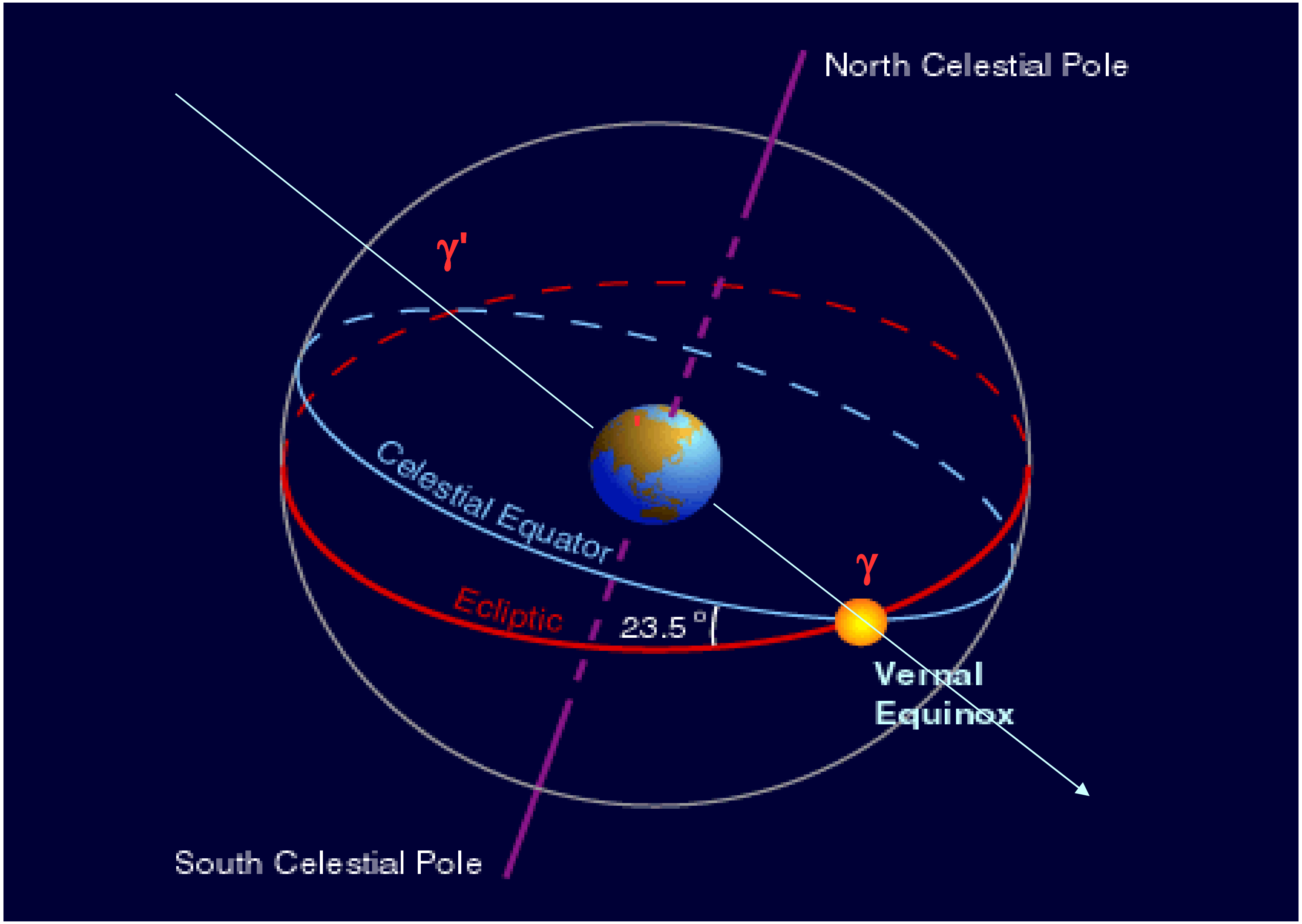
celestial equator

the Sun moves in the ecliptic

the stars seem fixed on the celestial sphere

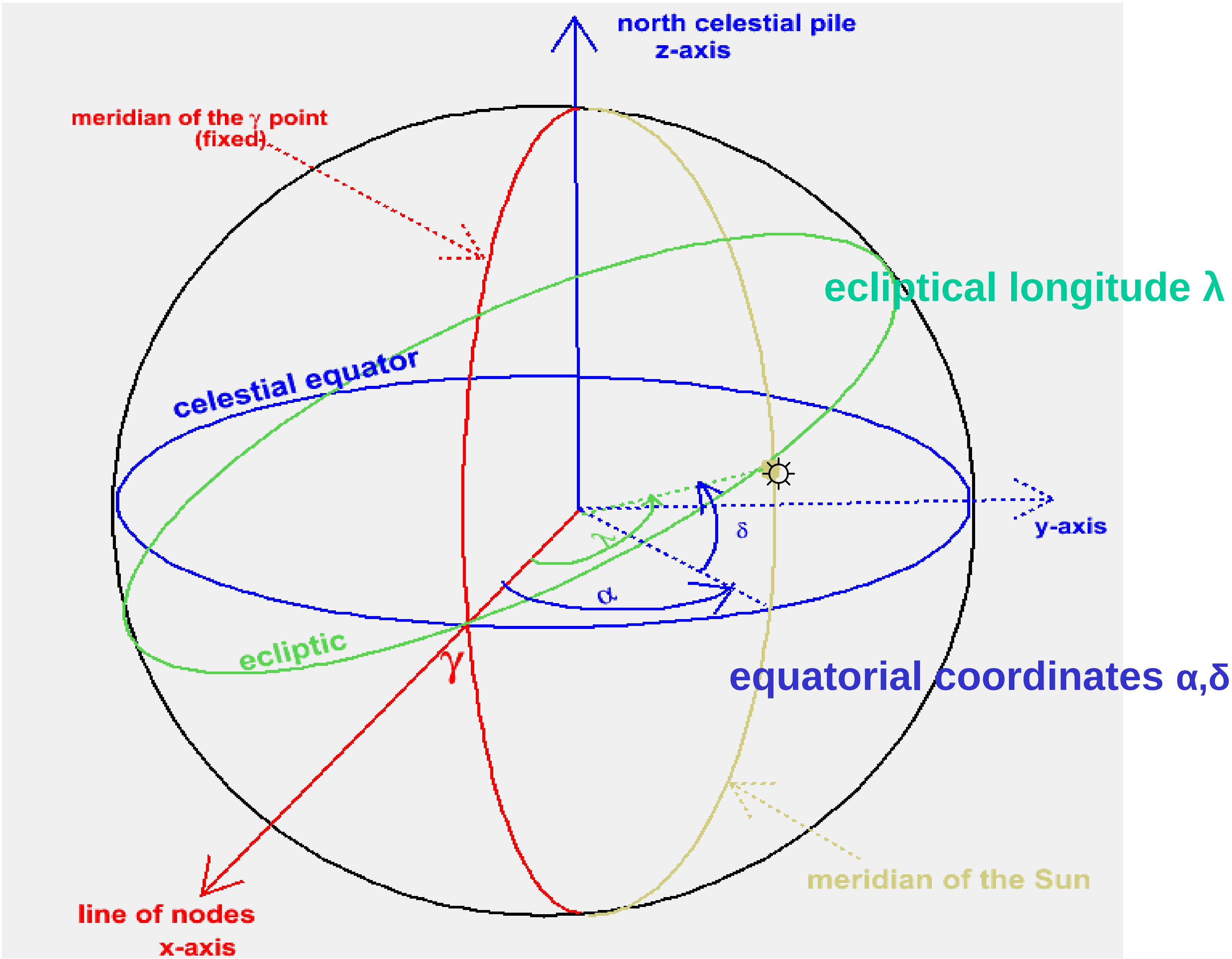
1st. physical fact

the plane of the ecliptic and the celestial equator make an angle ε

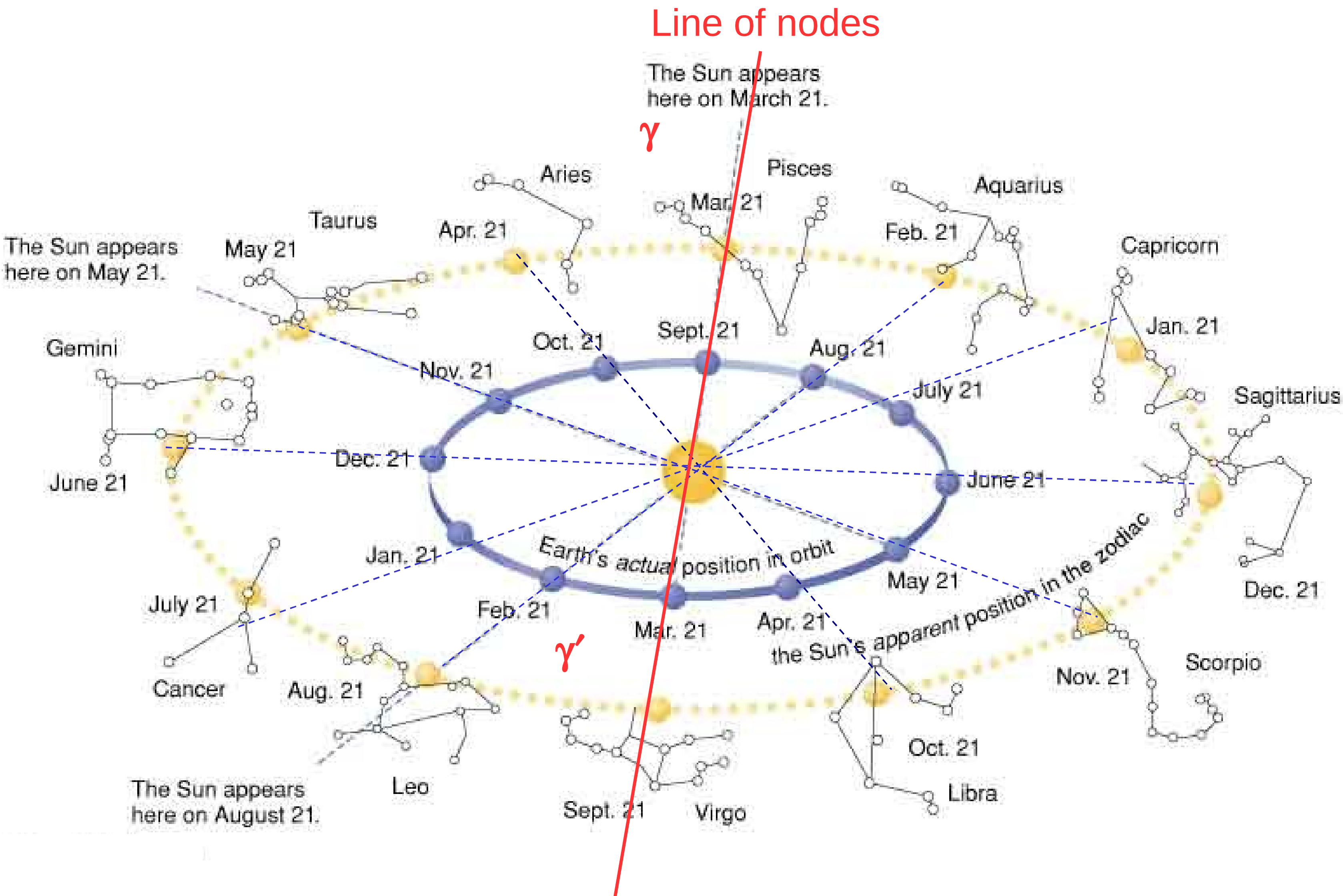


The ecliptic and the equator cut along the line of nodes γ γ'

Celestial coordinates of the Sun

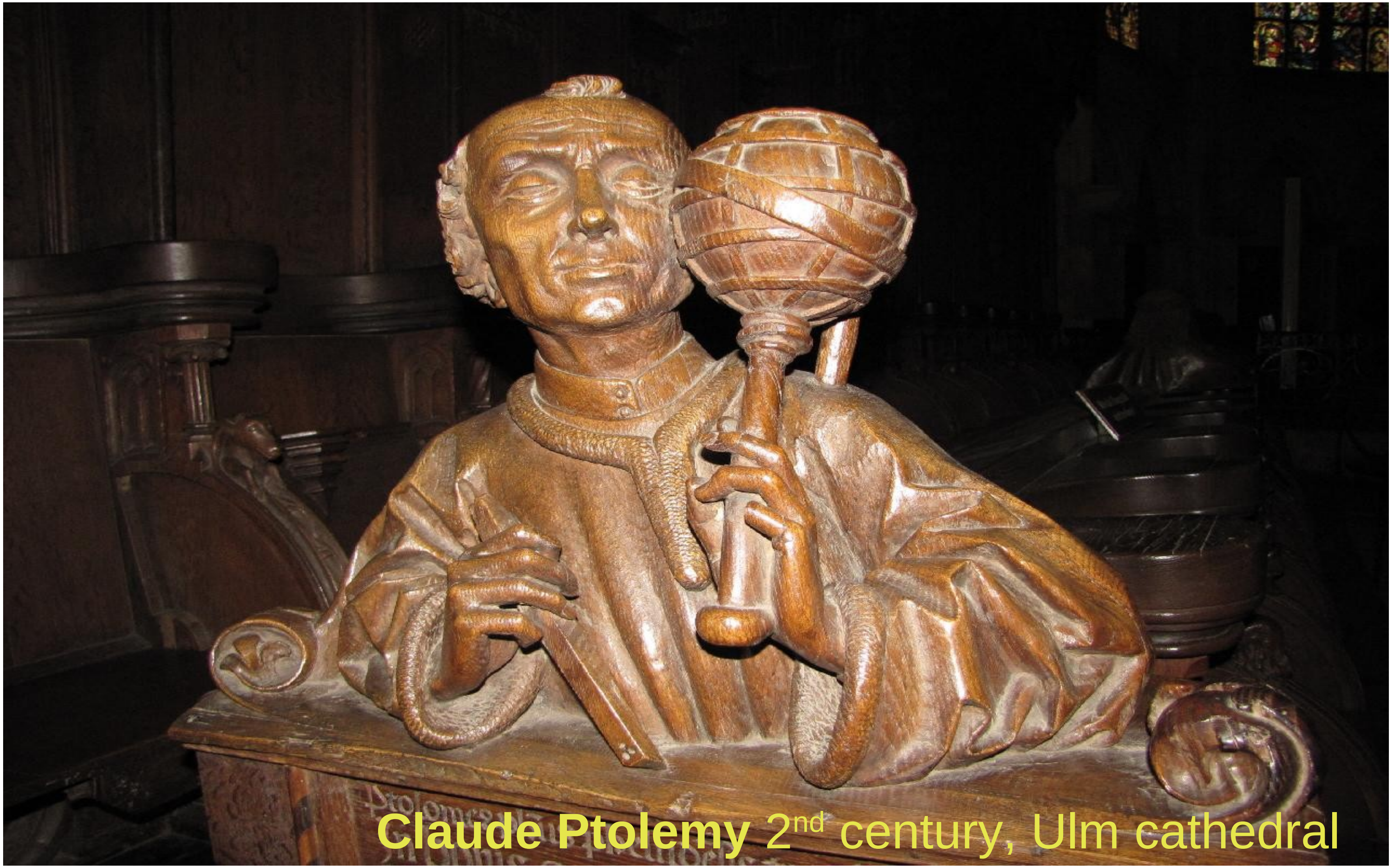


The monthly zodiacal calendar



Each of the 12 constellations of the zodiac corresponds to a 30° zone of longitude on the ecliptic and lies between two circles situated on either side of the ecliptic

What is the exact Sun's annual motion?

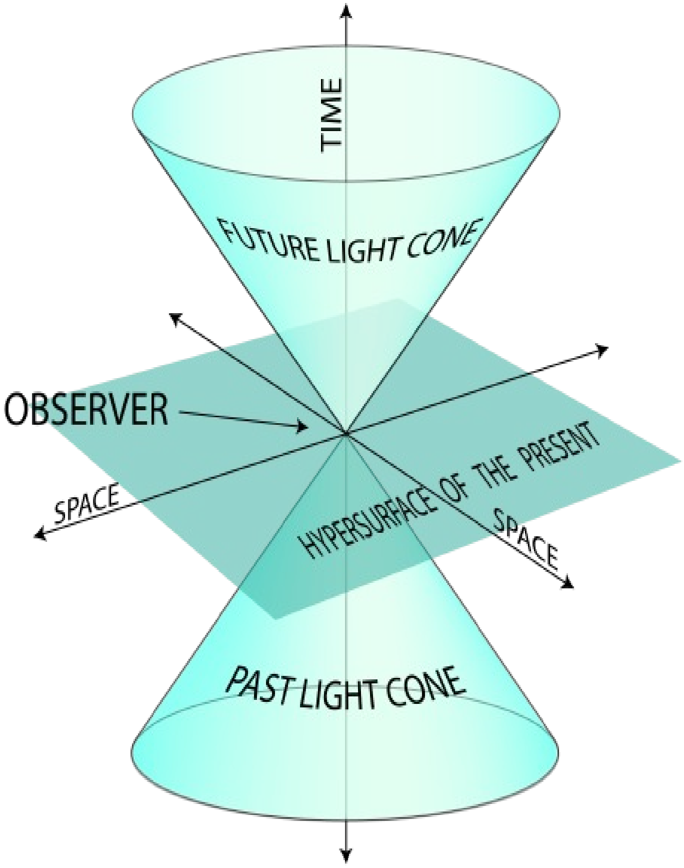


Claude Ptolemy 2nd century, Ulm cathedral

⇒ can the Sun give the time in the day and the date in the year?

Ulm, Baden Württemberg

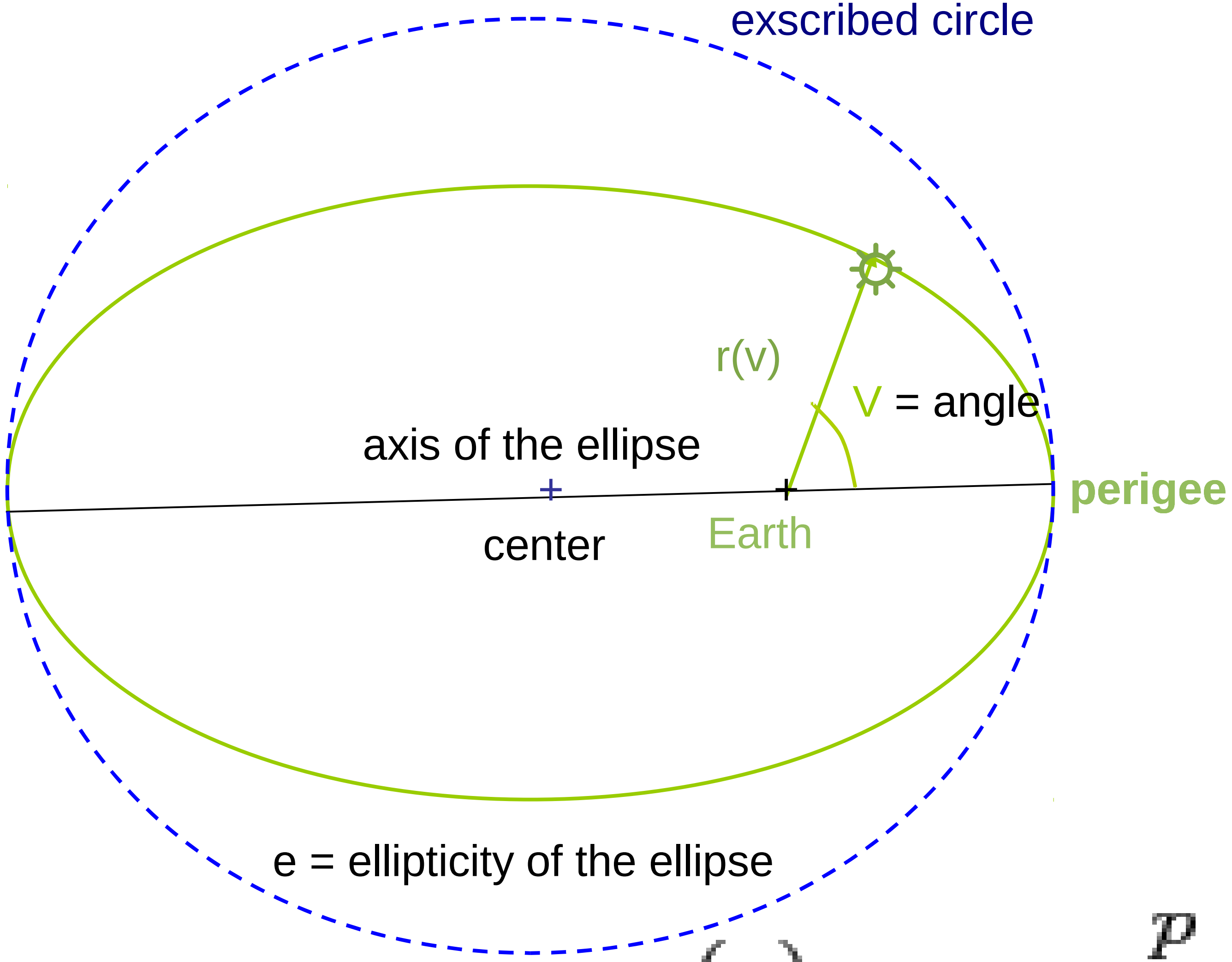
At this place, stood the house where on March 14th 1879 Albert Einstein came to the world



The time is a dimension of space

Birth of Modern Science, Prague, 17th cent.

Kepler's 1st law: the planets move along elliptic orbits around the sun which is sitting in the focus of the ellipses



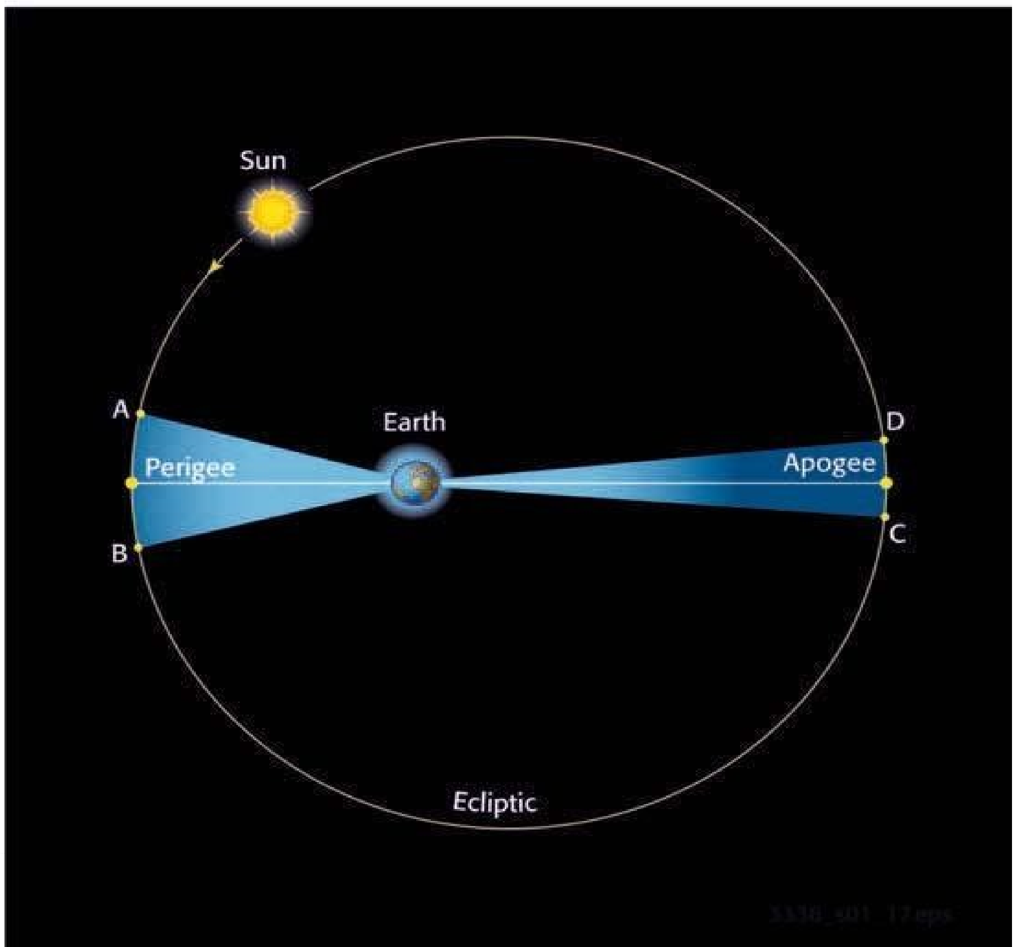
r(v) = radius of apparent Sun from focus

V = true anomaly

$$r(v) = \frac{p}{(1 + e\cos v)}$$

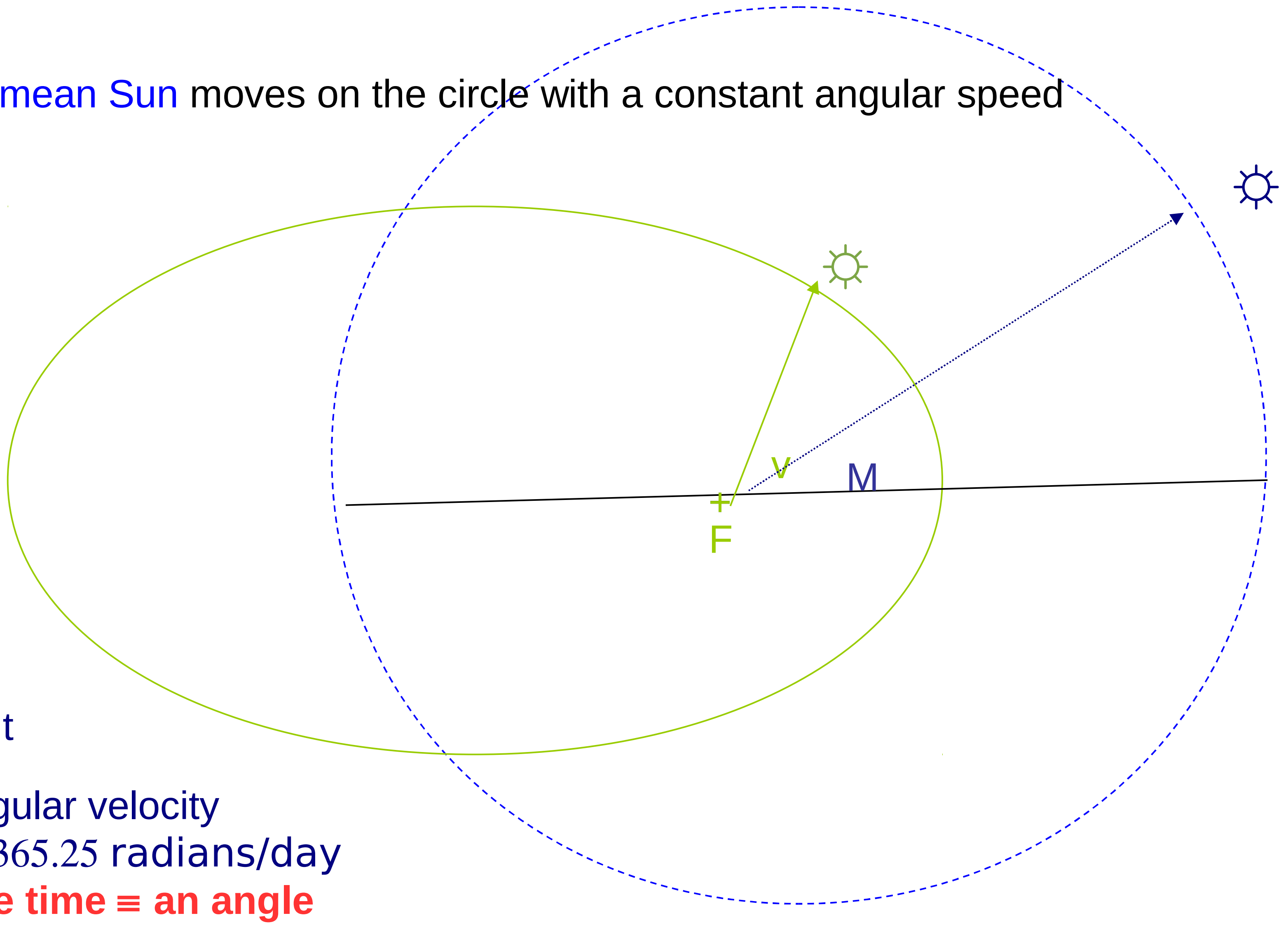
Kepler's 2nd law: the connecting line between Earth and Sun covers equal areas in equal times

$$r^2(\phi)\frac{d\phi(t)}{dt} = C = cste$$



The equation of center

A fictitious mean Sun moves on the circle with a constant angular speed



$M = \omega t$

ω =angular velocity

$= 2\pi / 365.25$ radians/day

t is the time ≡ an angle

equation of center: **C=v-M** $\leftrightarrow$ (algebrical) advance of the mean Sun vs. true Sun

So?

The true Sun moves 1) on the ecliptic 2) with an angular speed which is not constant

To obtain a regular time, we have to build a fictitious regular Sun
1) moving on the equator
2) with a constant speed

How?

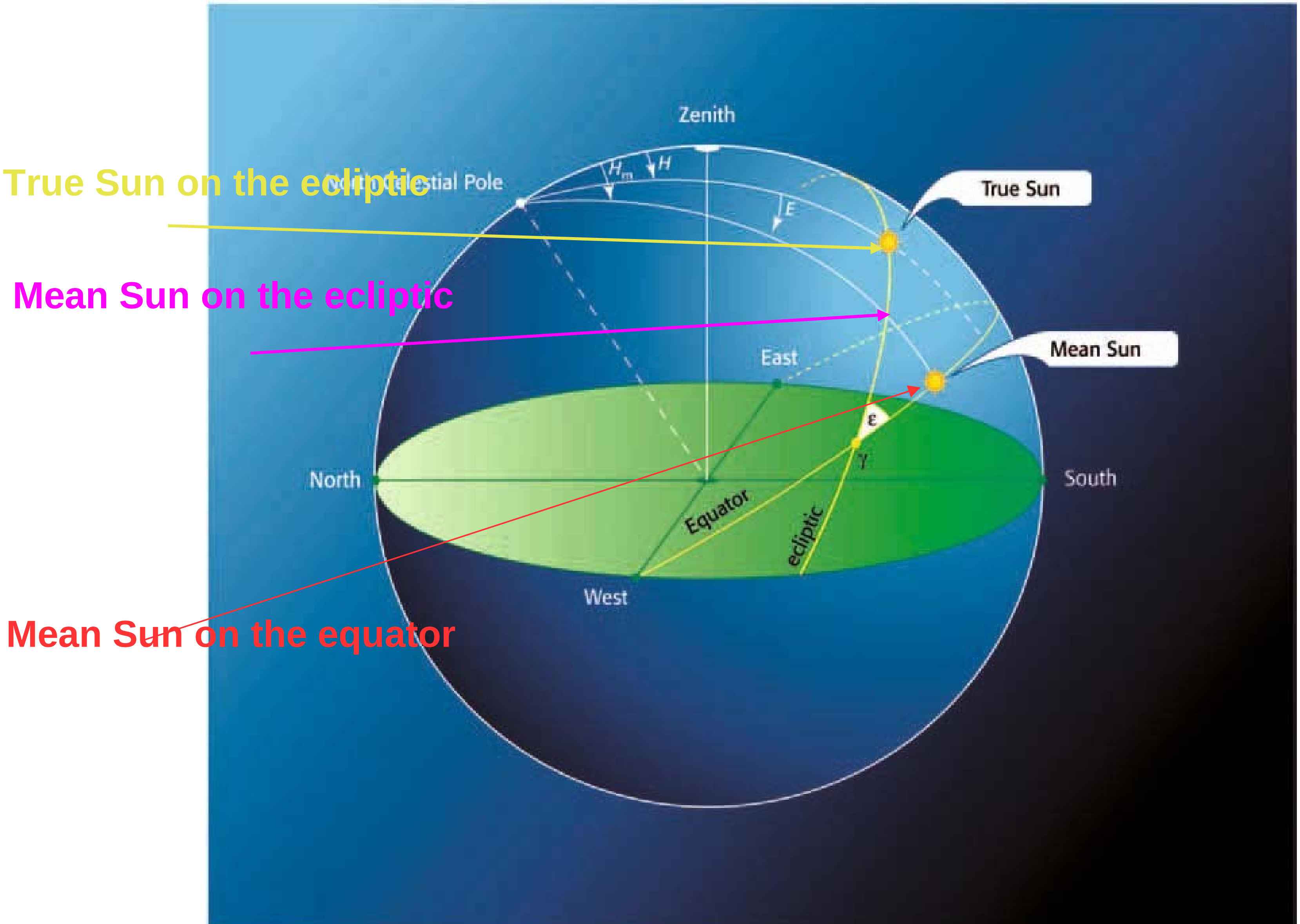
1) compute the equation of center
i.e the deviation of the real Sun with the fictitious one in the ecliptic from Kepler's second law

2) project this Sun on the equator through a rotation matrix of $-\varepsilon$
the reduction to equator

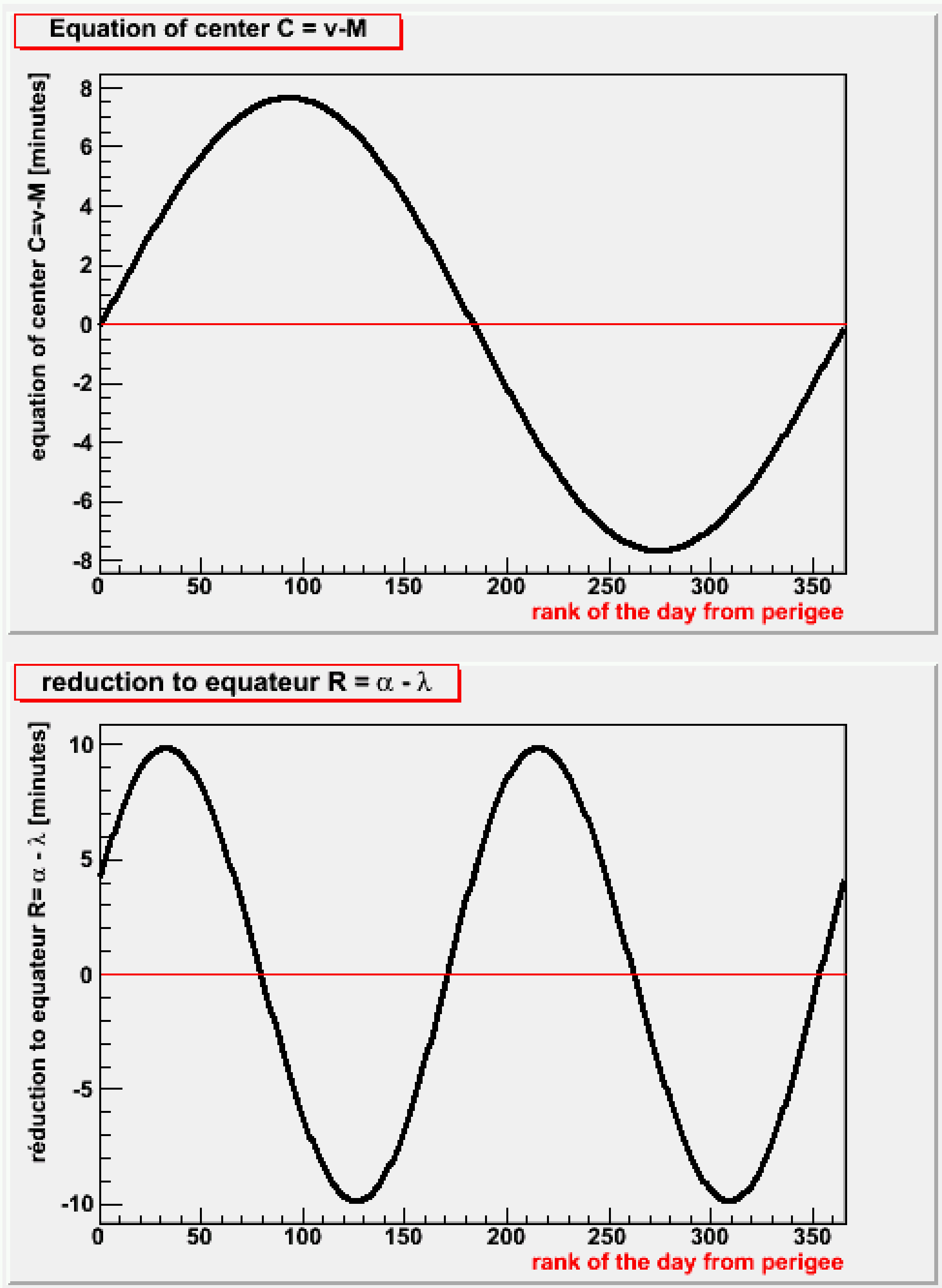
The sum of these two contributions gives the Equation of Time

The Equation of time is the algebraic difference between the right ascension of the true Sun minus the one of a fictitious regular Sun

The reduction to equator

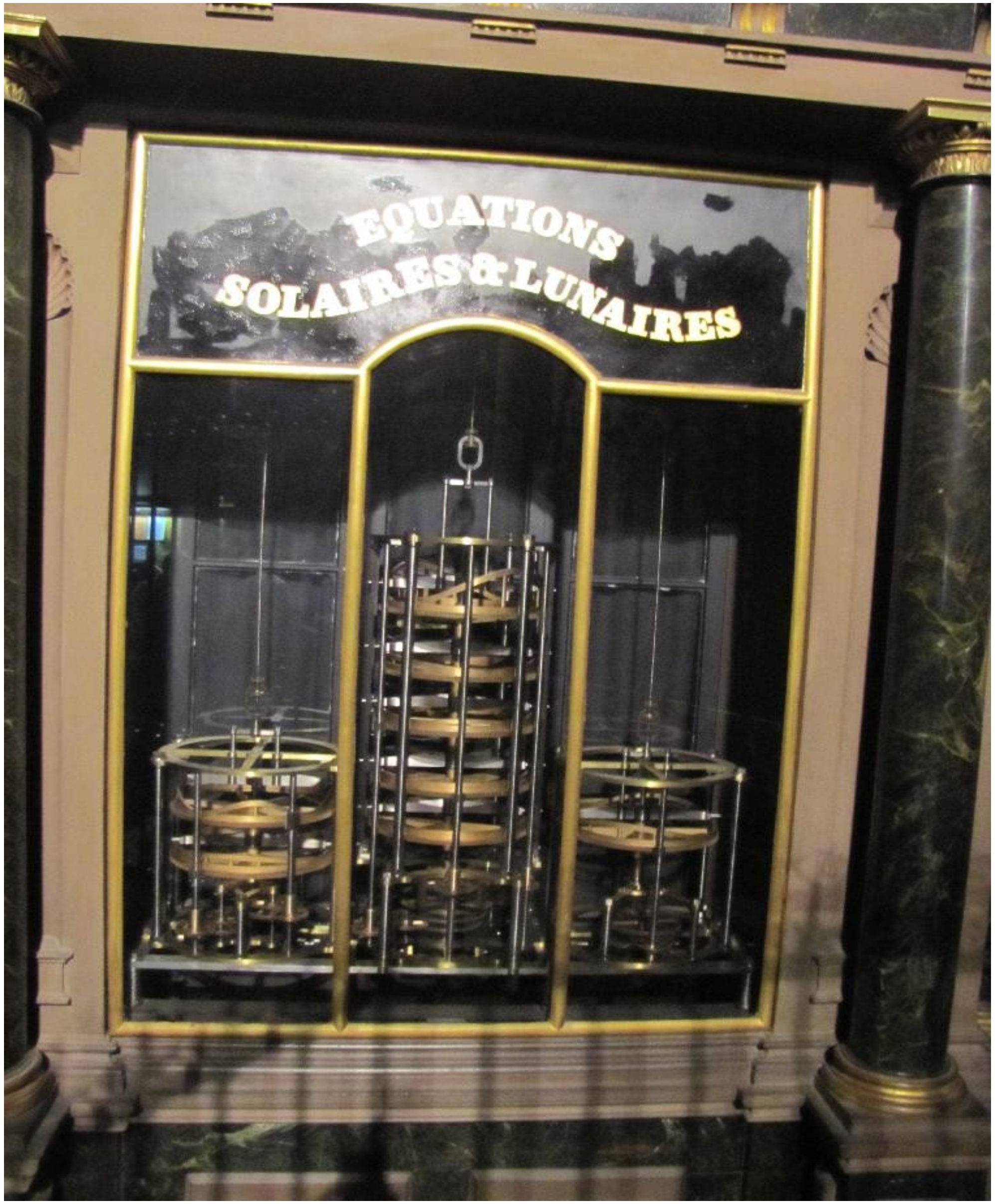


The two components of the Equation of Time



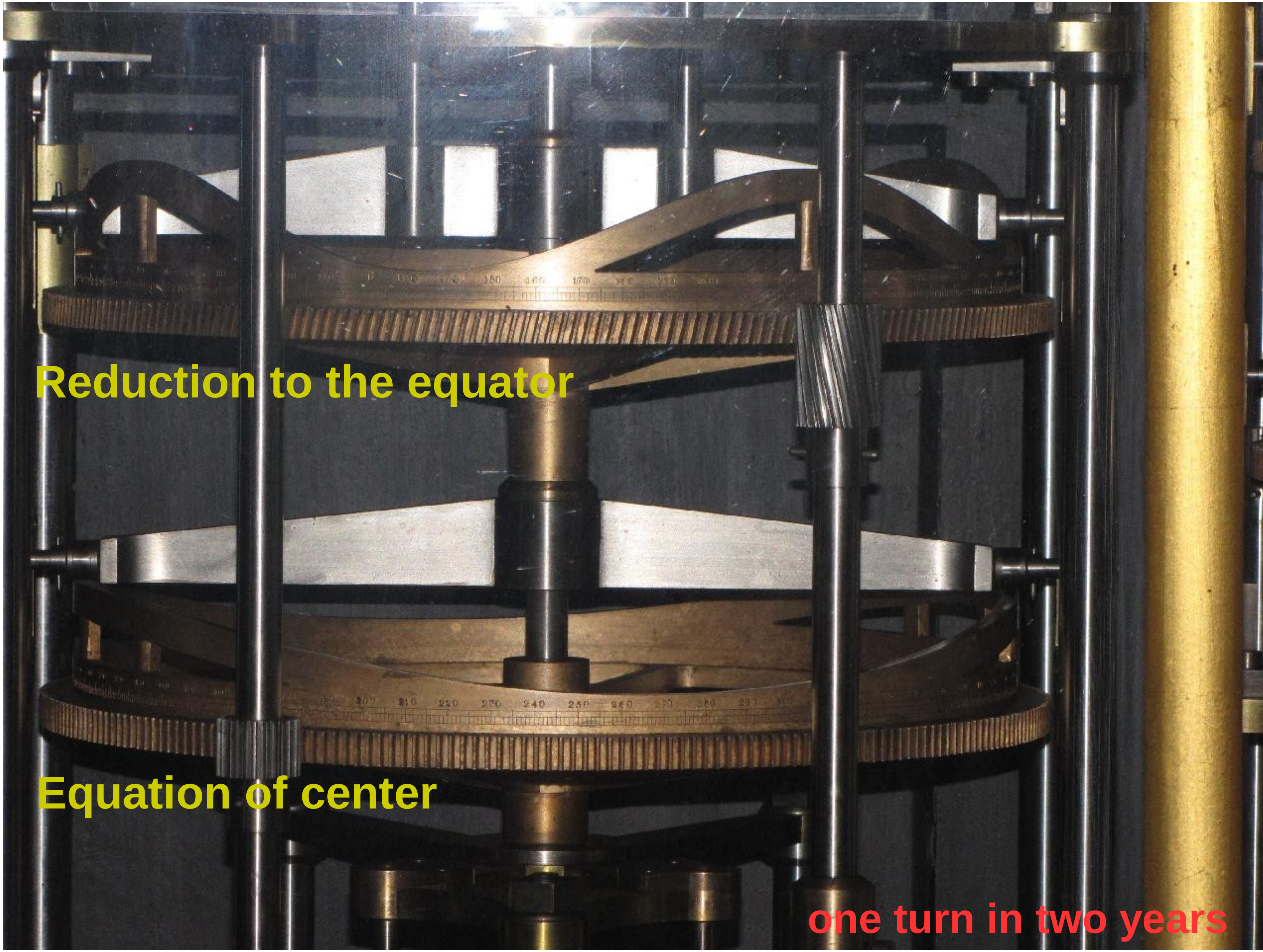
equation of center C = v-M

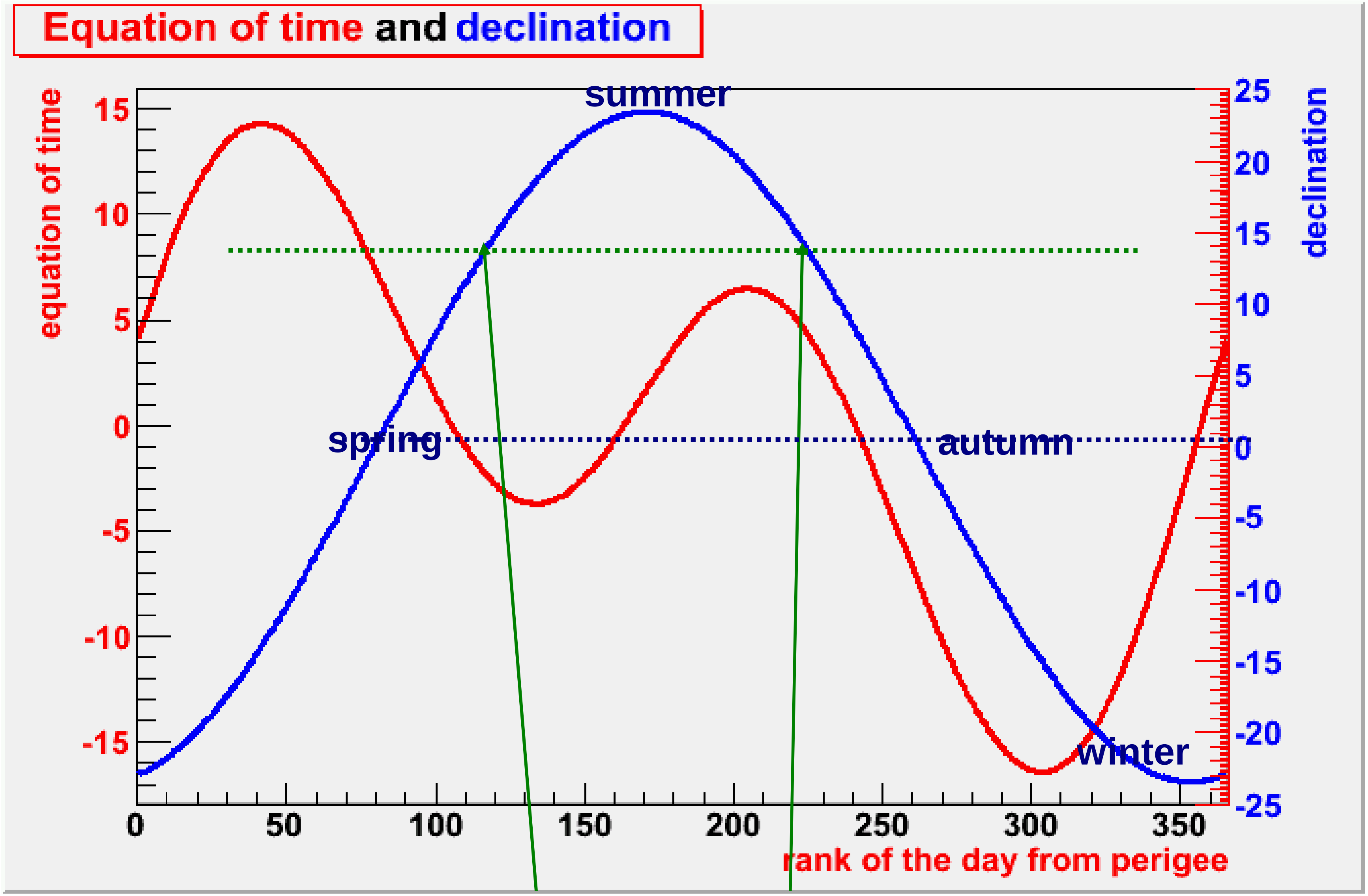
reduction to equator R = α - λ



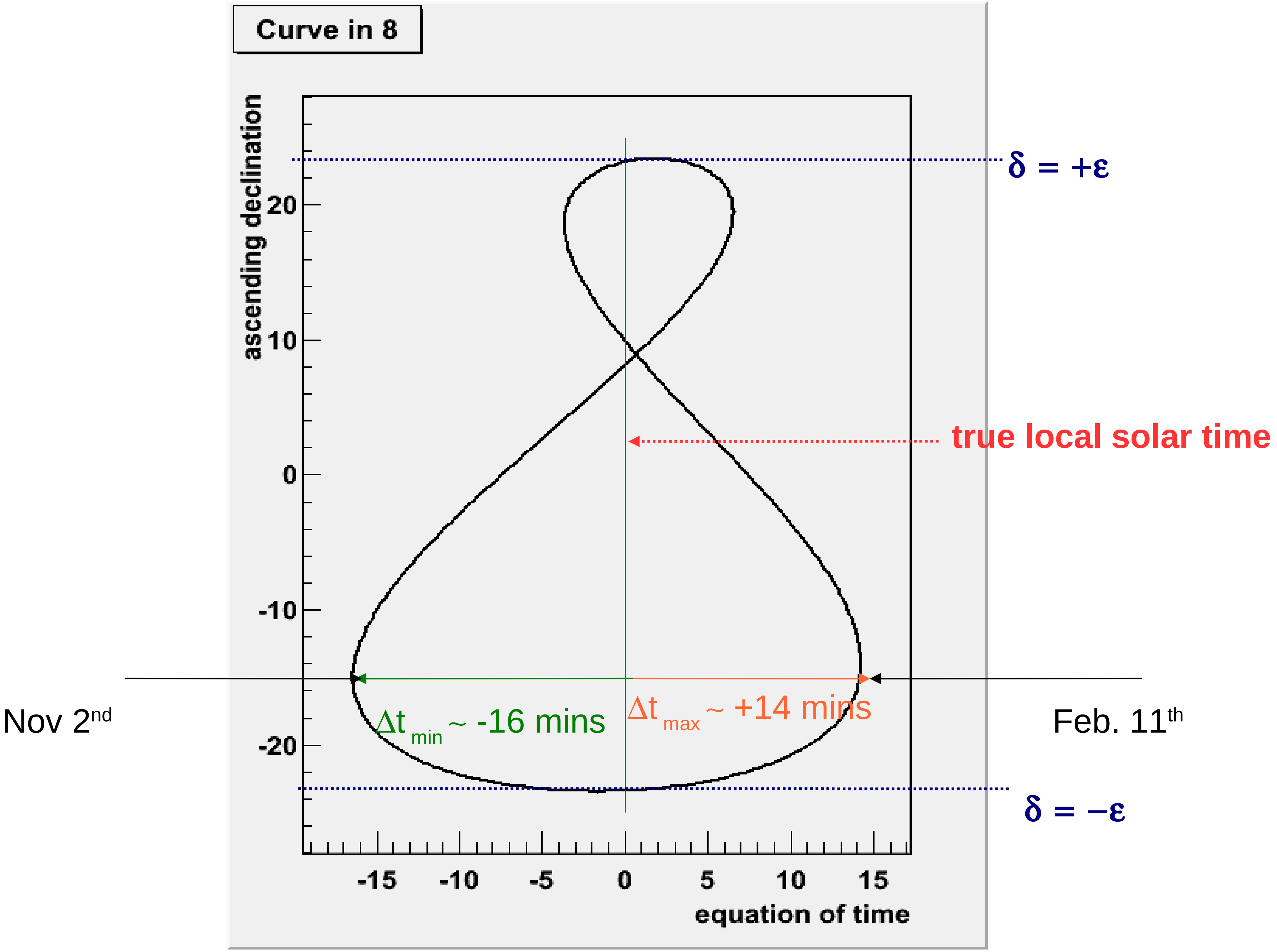
Strasbourg Cathedral

astronomical clock

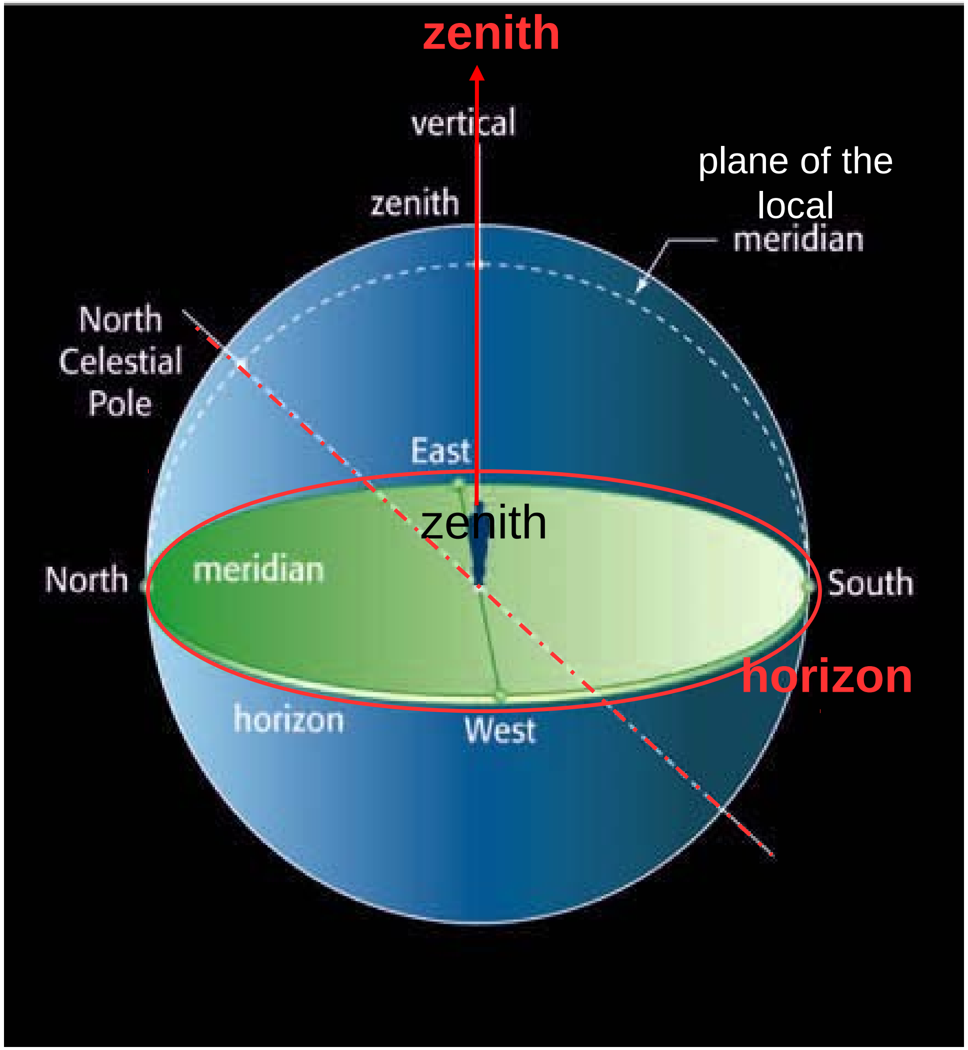

Reduction to the equator
Equation of center
one turn in two years



The same value of the declination of the Sun occurs twice per year

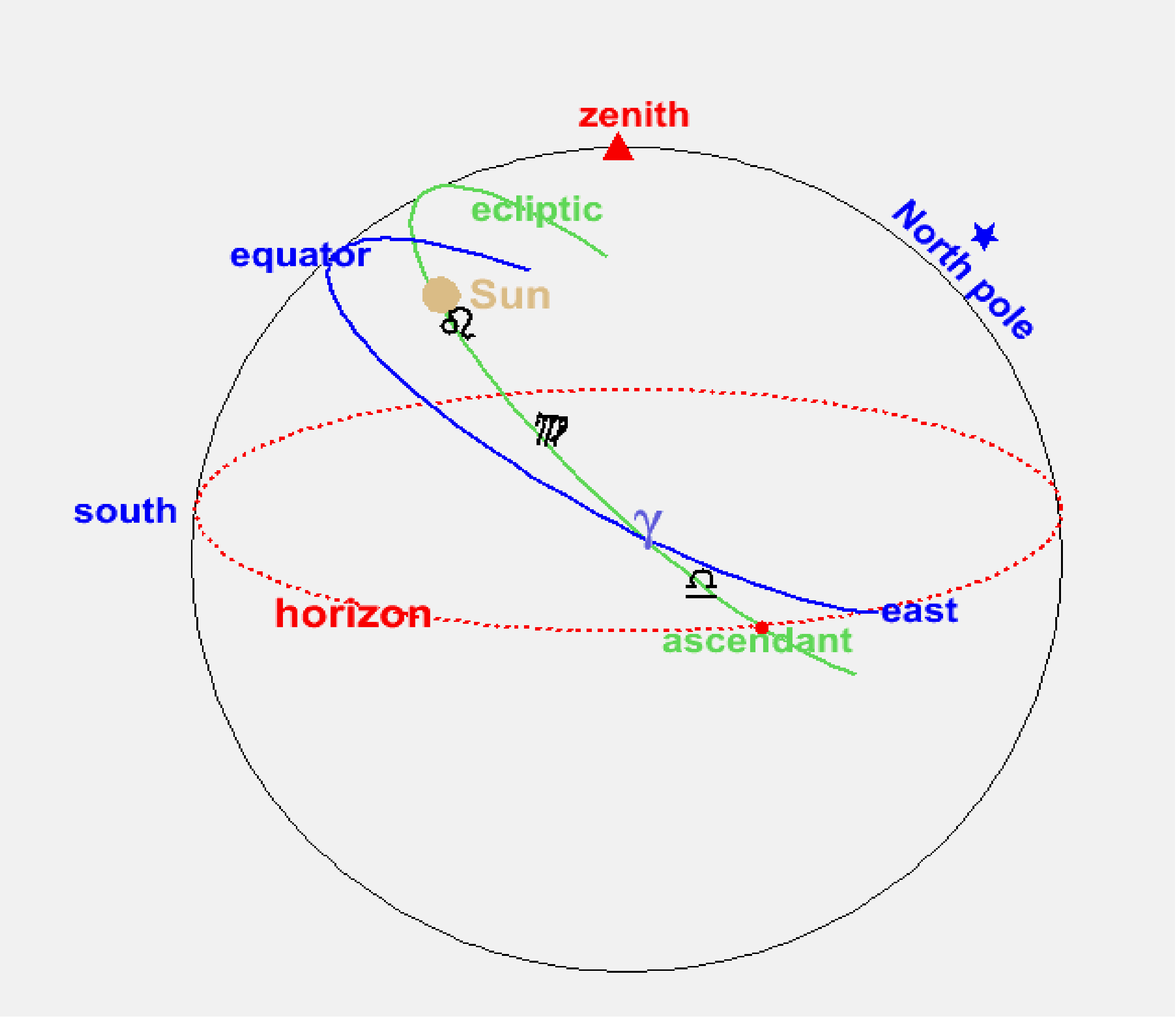

Curve in 8
ascending declination
20
10
0
-10
-20
-15
-10
-5
0
5
10
15
equation of time
δ = +ε
δ = −ε
true local solar time
Δt min ~ -16 mins
Δt max ~ +14 mins
Nov 2nd
Feb. 11th

The plan of the local meridian



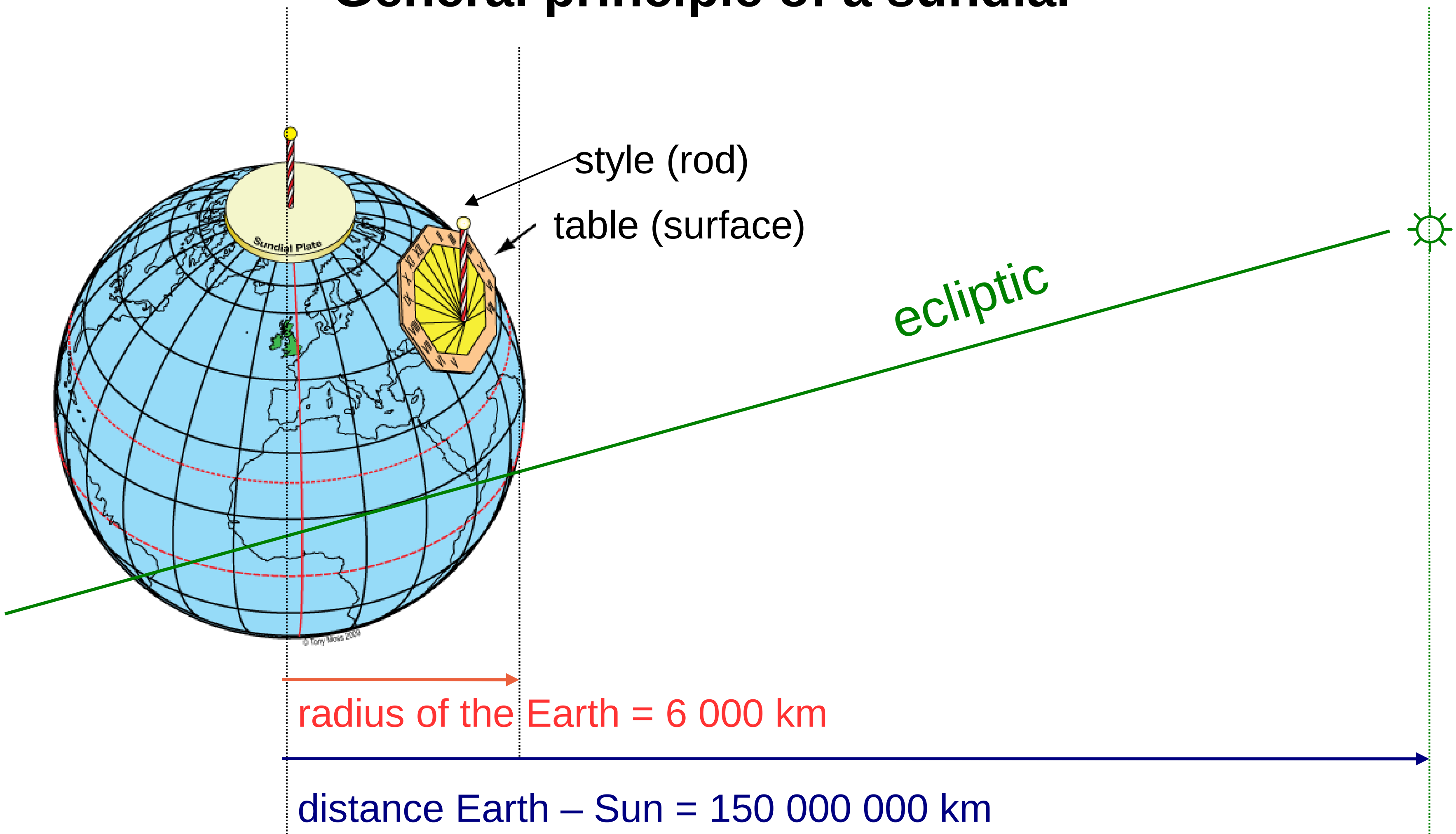
The **plane of the local meridian** is defined by **the zenith** and **the axis of the terrestrial poles**

The ascendant



ascendant = zodiacal sign that was ascending on the eastern horizon at the specific **time** and **location** (latitude) of an event

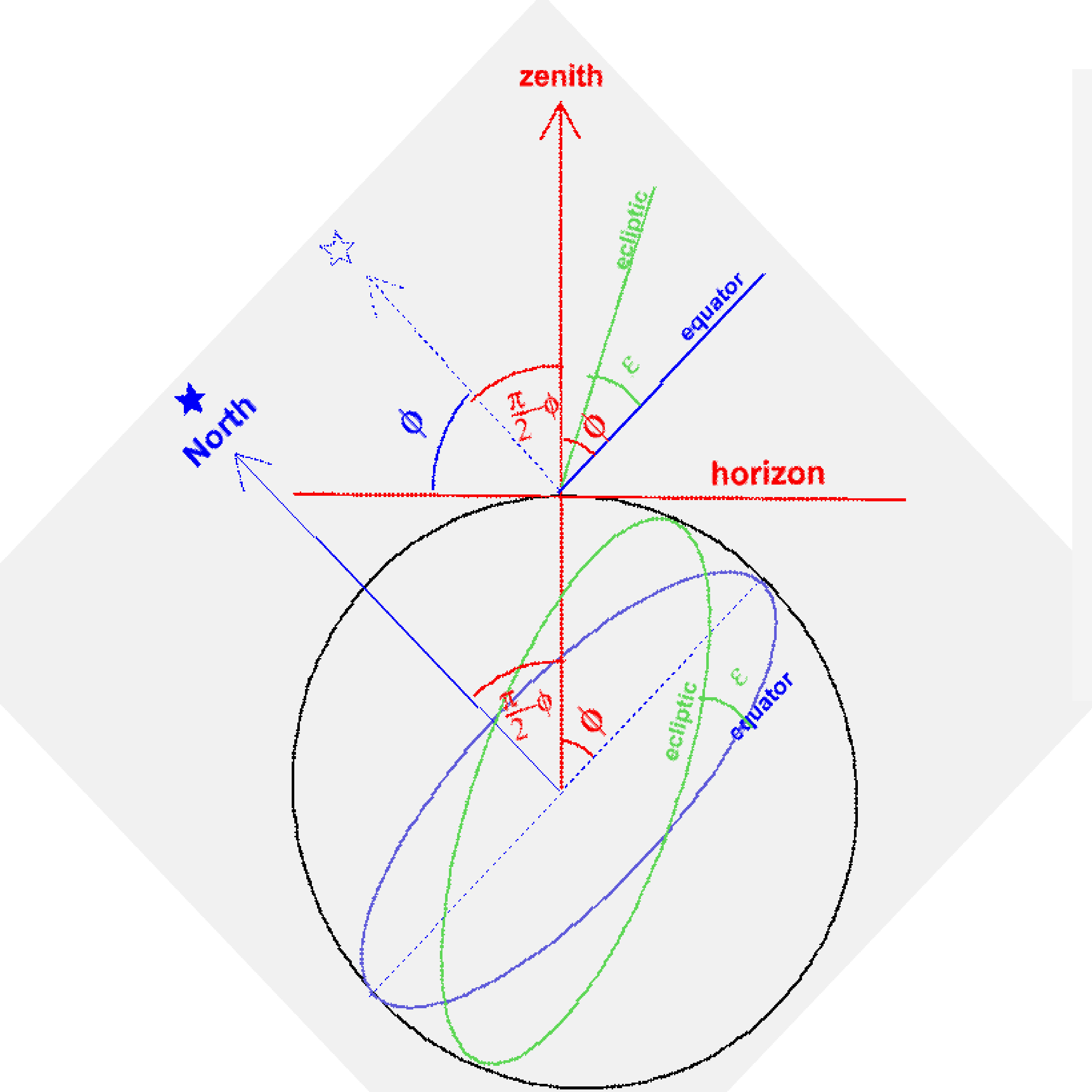
General principle of a sundial



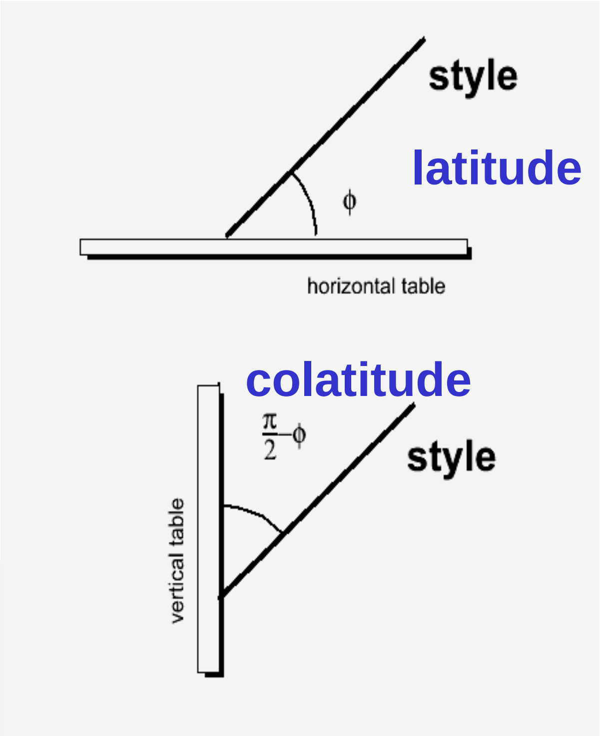
$*$ at a point of latitude ϕ, install a rod (style): 1) parallel to the axis of the poles 2) in the plane of the meridian

* assume that the Sun moves around this style

* obtain the Sun's position from its shadow by this style on same surface



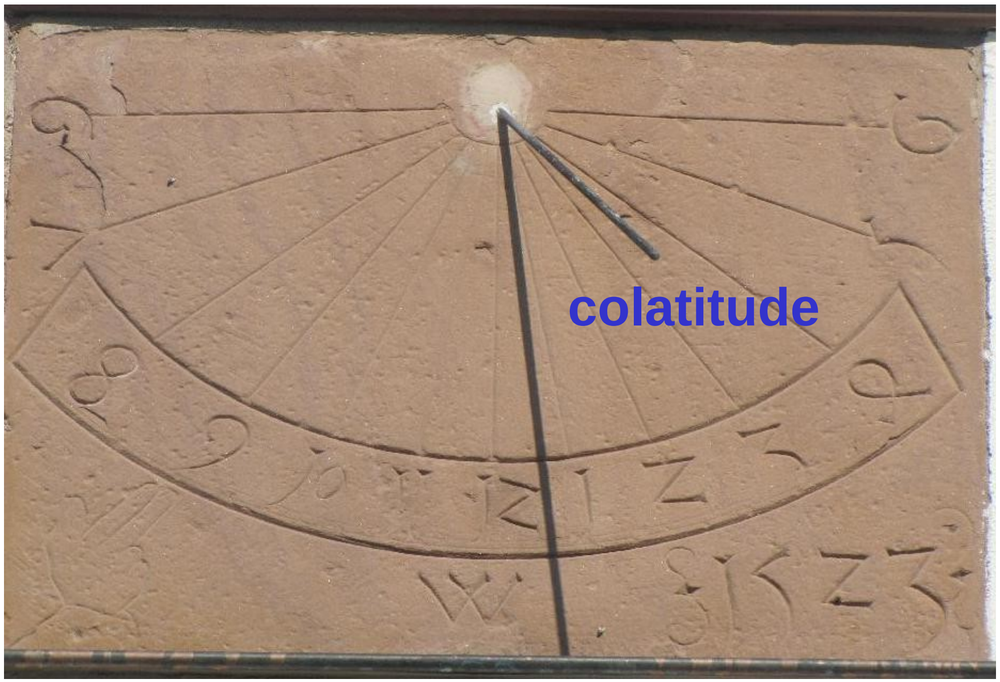
The plane of the meridian is determined by the zenith and the axis of the poles



This is what it looks like to the local people.

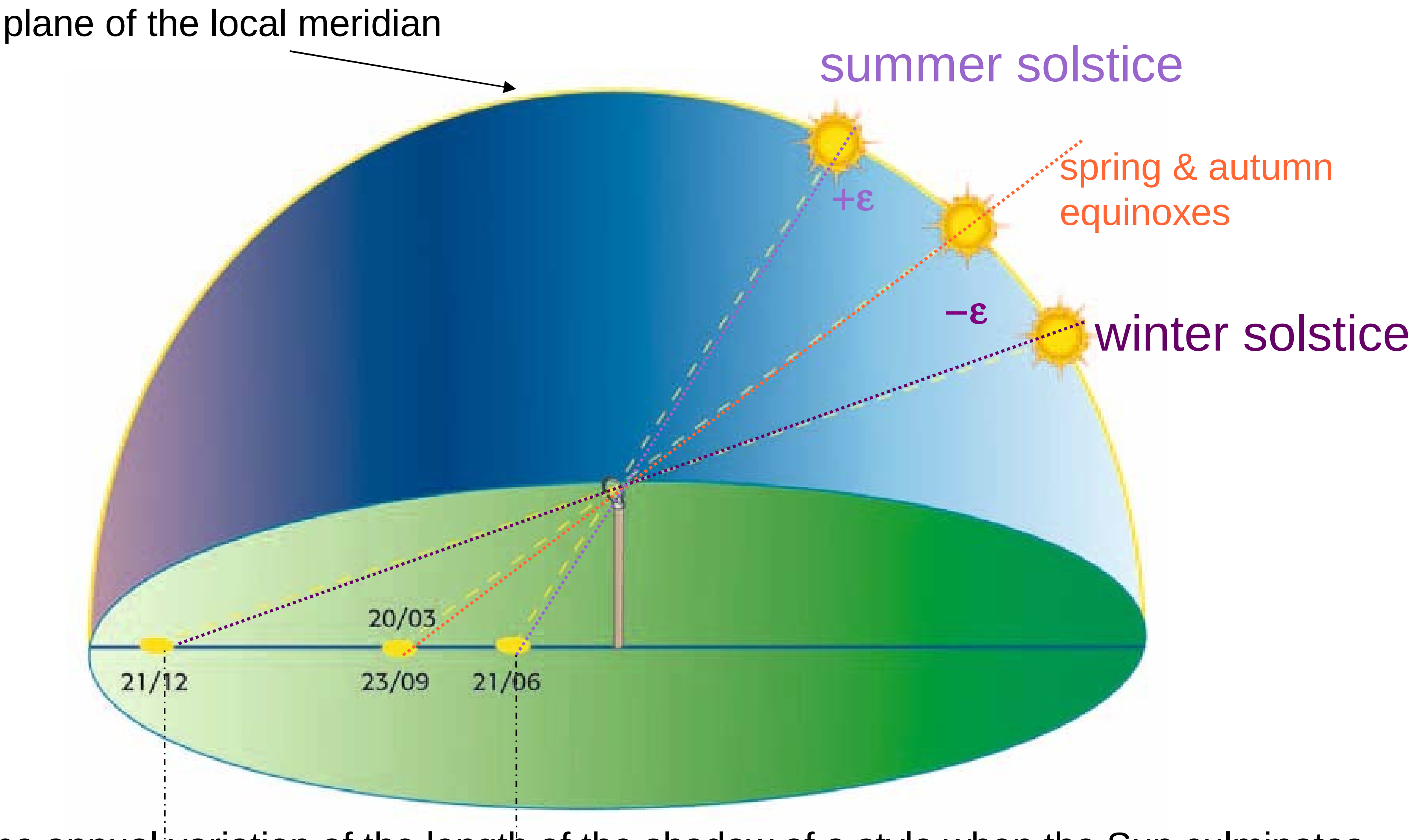
Two sundials

Vertical dial on a church



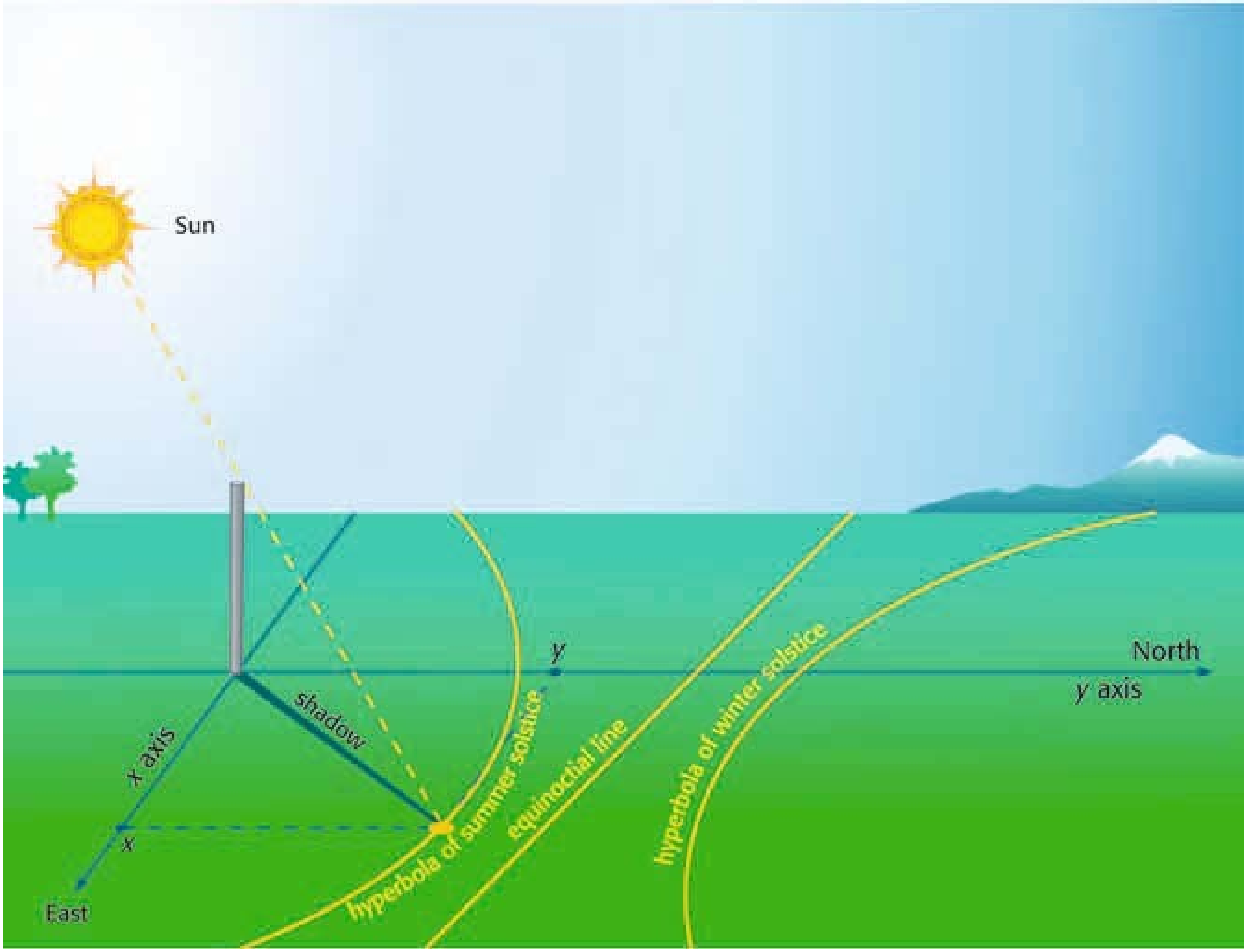
Horizontal dial in a park

Sundials as solar calendars



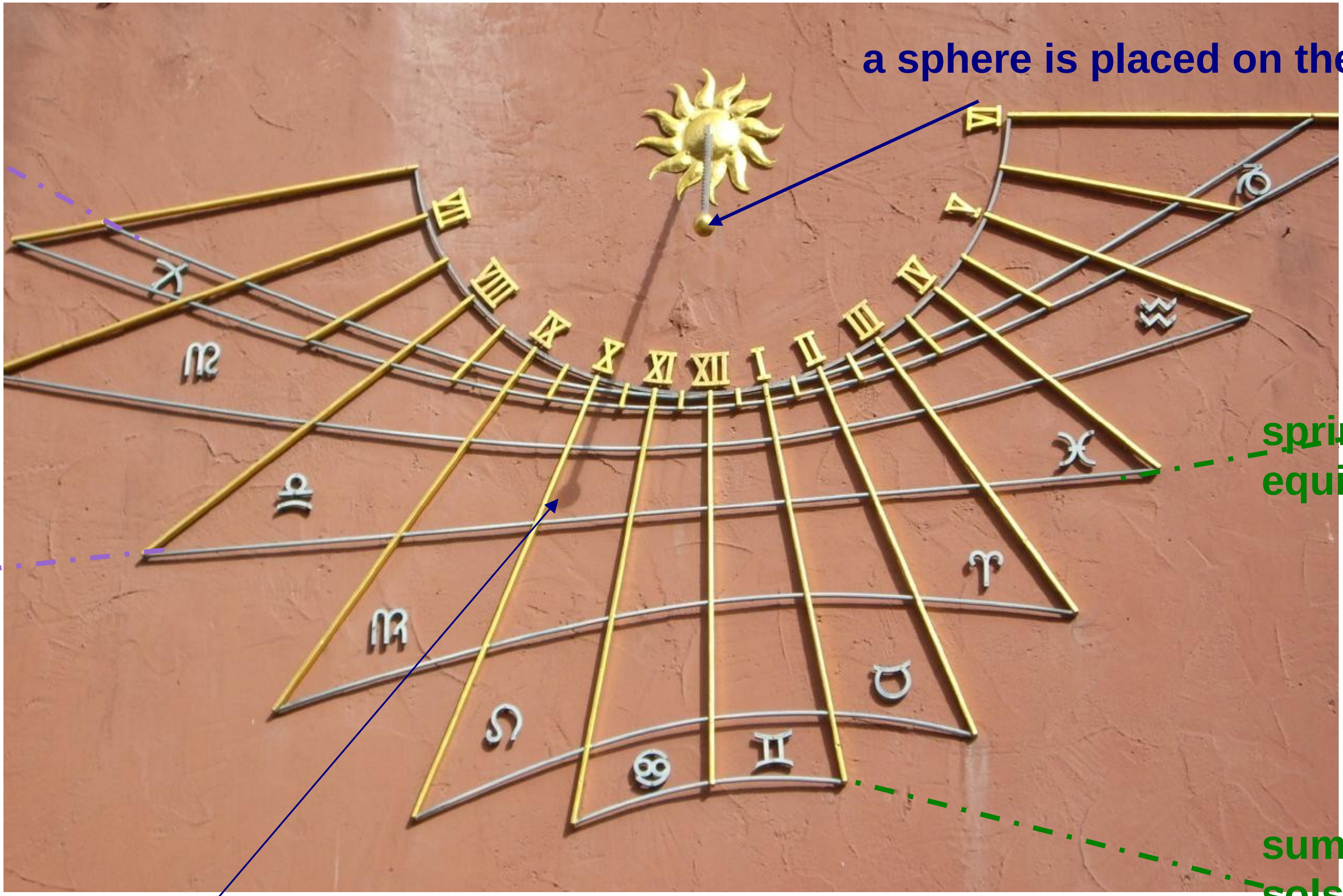
The annual variation of the length of the shadow of a style when the Sun culminates can be used to establish a solar calendar

Sundials as seasonal indicators



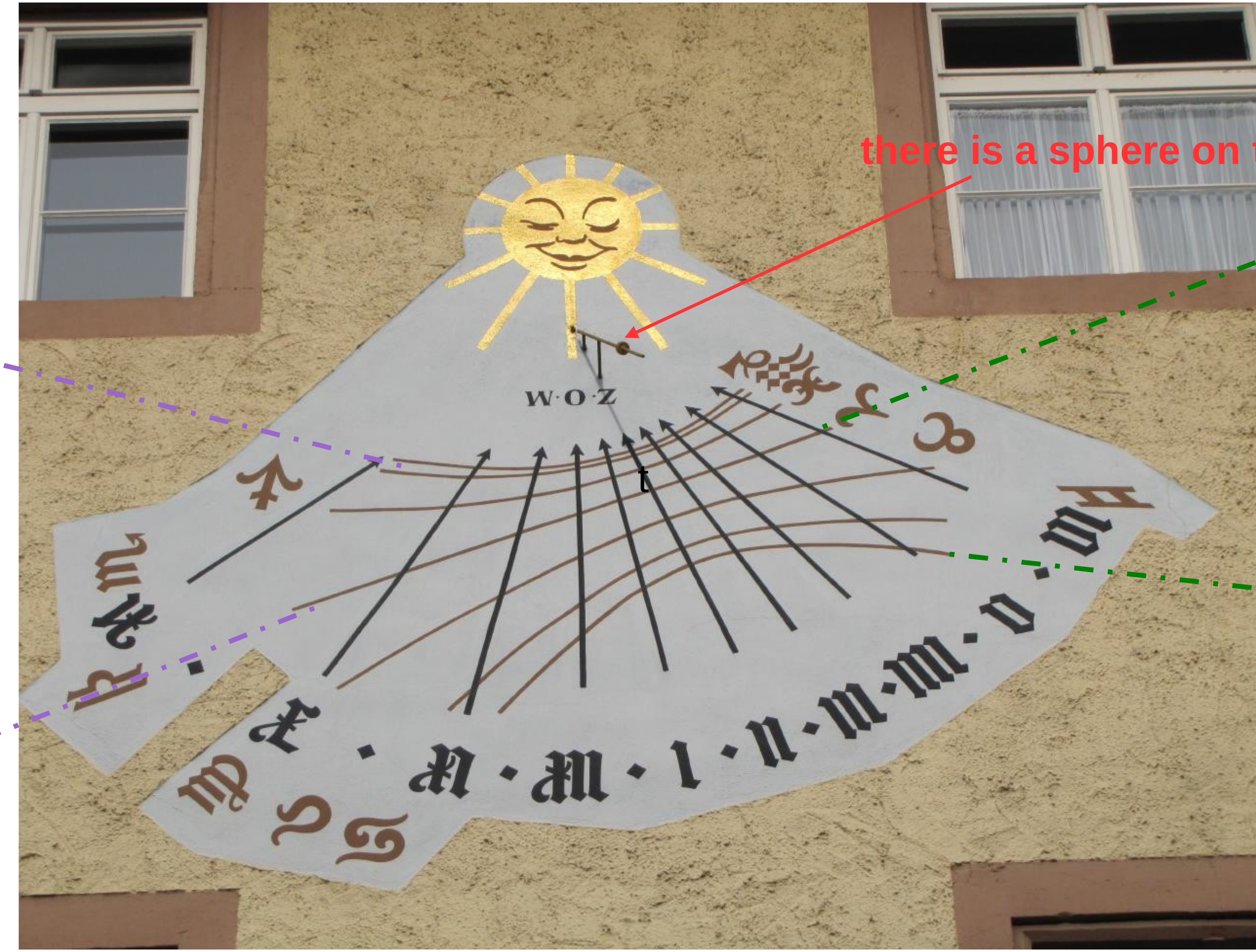
The Sun describes a straight line at the equinoxes and the hyperbolae at the solstices

A sundial can also indicate the date



The date is given by the shadow of the sphere on the zodiacal lines

A sundial can also indicate the date



The date is given by the shadow of the sphere on the brown lines

What is a meridian dial?

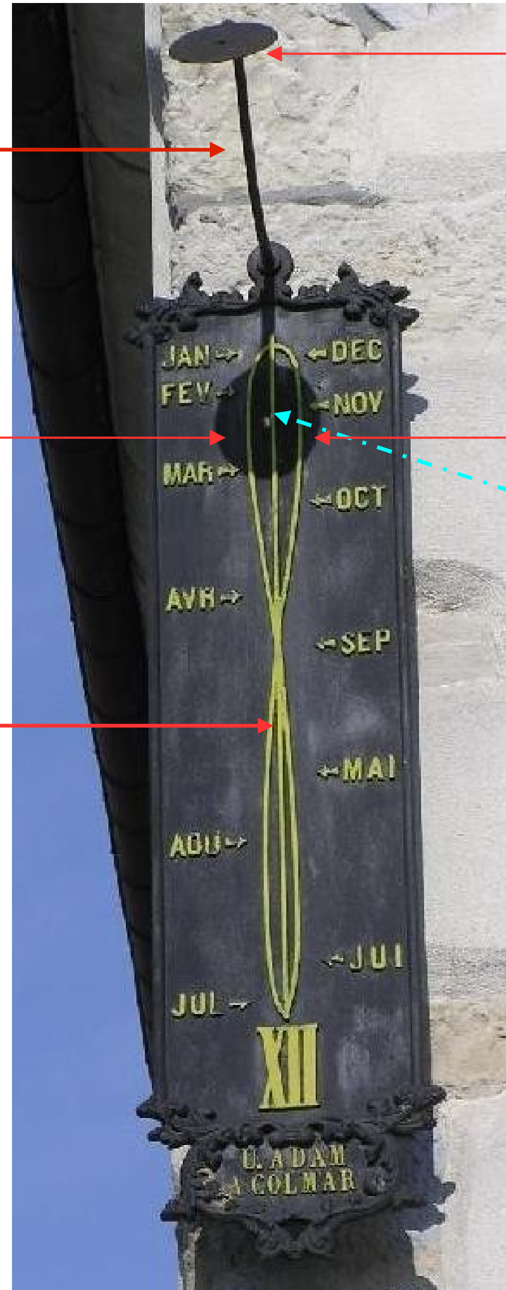
disk with a hole

style

mean 12 hours
in february

mean 12 hours
in november

true local 12 hours

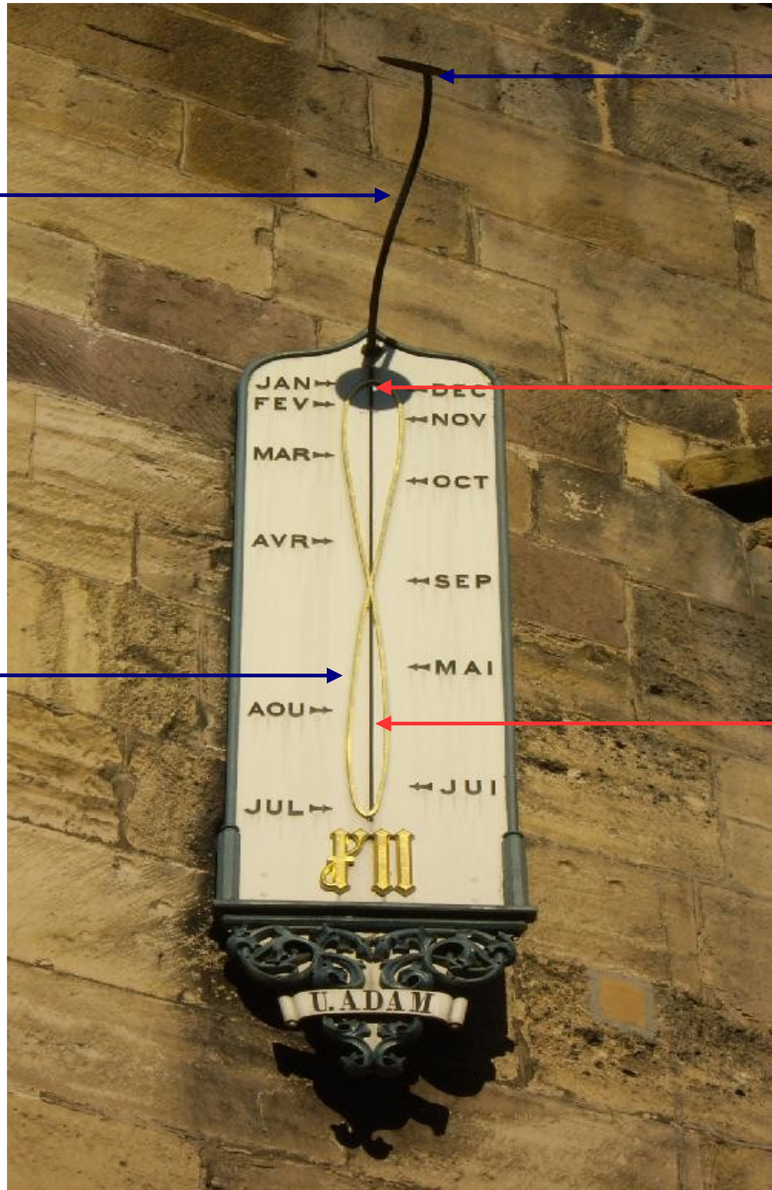


curve
in 8

⇒ it allowed the regulation
of clocks on churches
or public monuments

What is a meridian dial?

style



disk with a hole

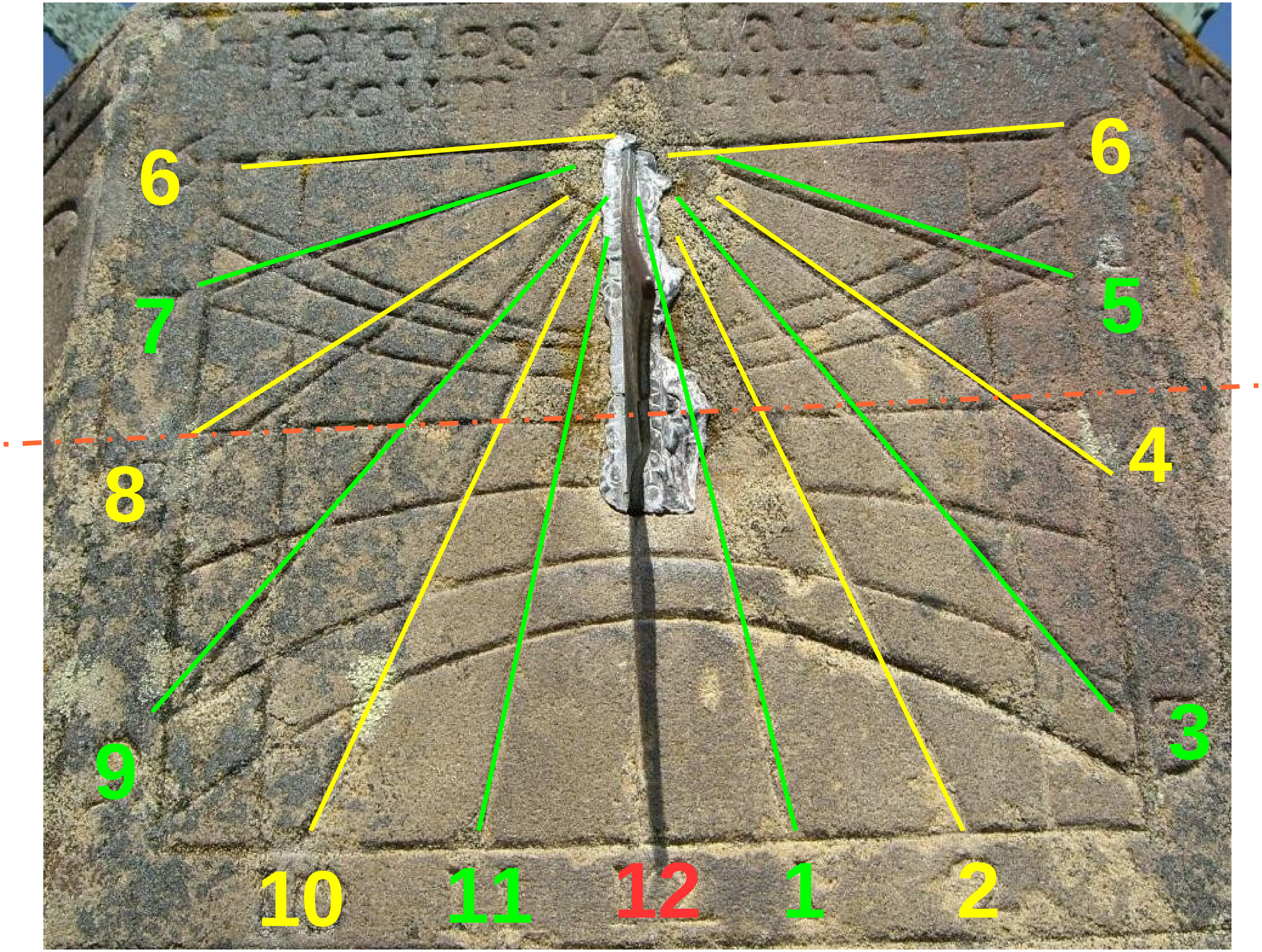
true local 12 hours

curve in 8

mean 12 hours at that date

⇒ it allowed the regulation of clocks on churches or public monuments

Each surface of the monument is a clock and a calendar



History of the monument

around 1780: the monument is computed and manufactured by monks in the abbay of Neubourg, North of Strasbourg
It copies a model from the Louvre Museum at Paris.

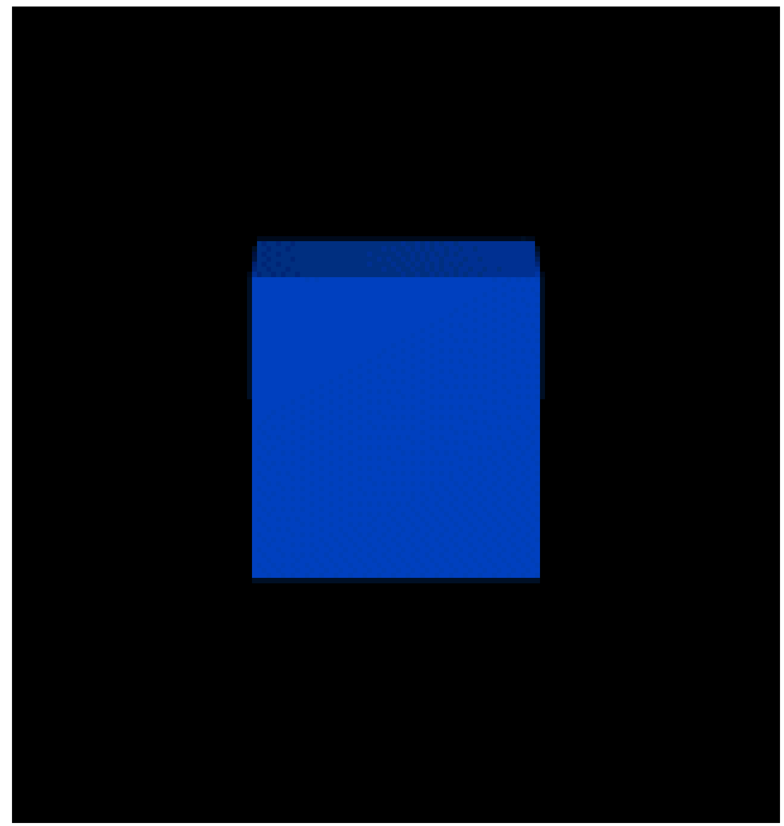
Nov. 1789 – july 1790: the French Revolution suppress the religious orders and seize their properties
⇒ dispersion of the monks

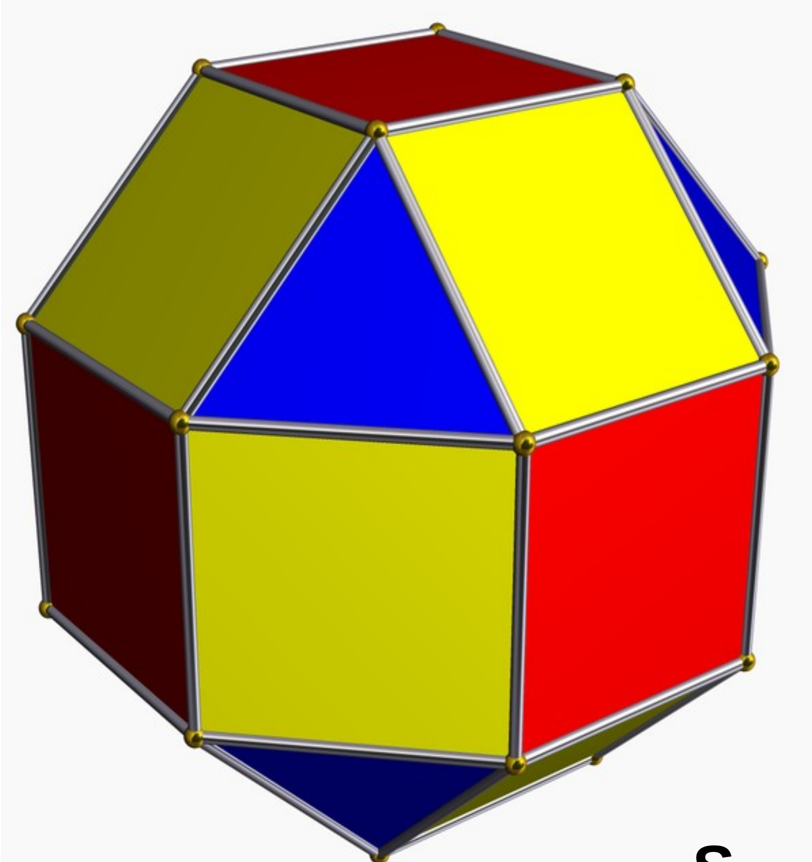
1856: the Strasbourg's Bishop moves the monument into the garden of the seminar

1935: the Strasbourg's Bishop (owner of the Mont St Odile) starts the renovation of the Mont and installs the monument at its today's place

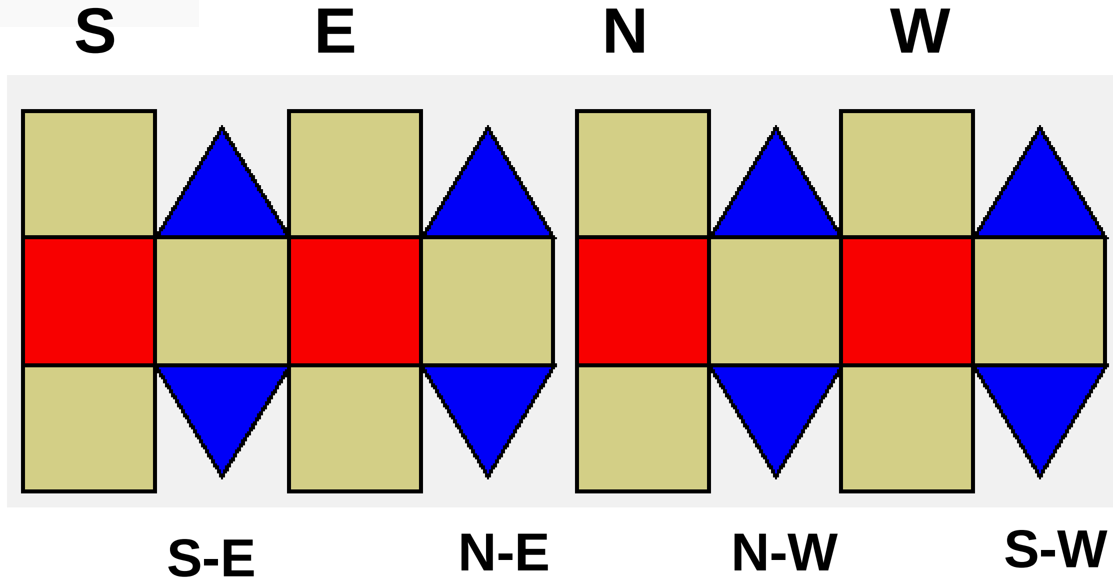
The central bloc is a rhombicubocahedron

A kind of expanded cube



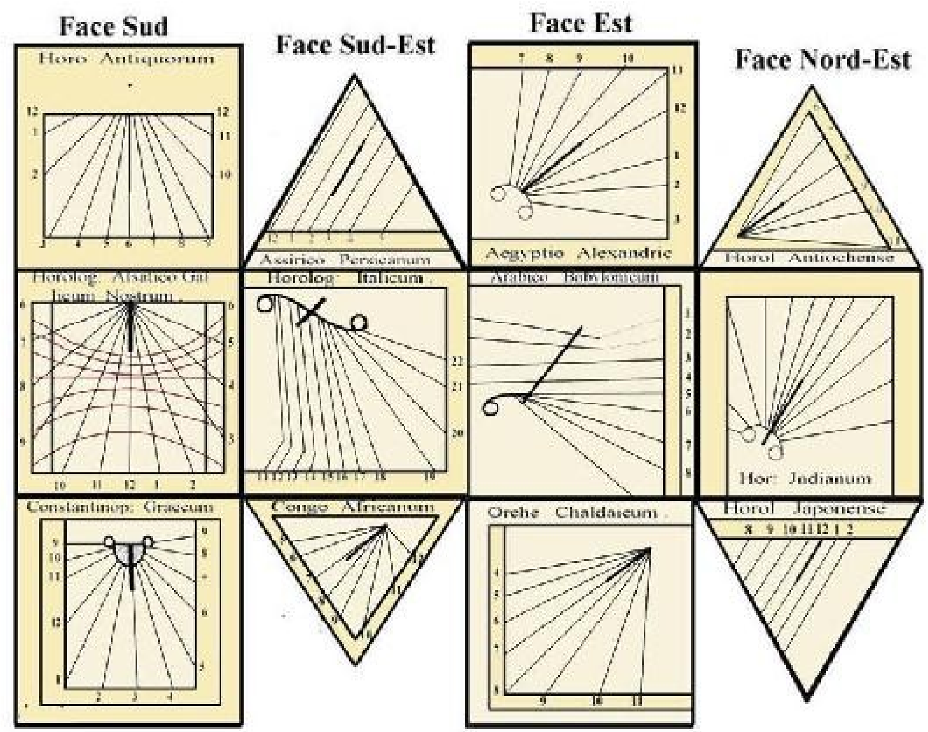


A **rhombicubocahedron** has 26 faces:
8 triangular and 18 squares faces.
Removing the 2 square bases, the monument presents **24 faces with each a sundial**



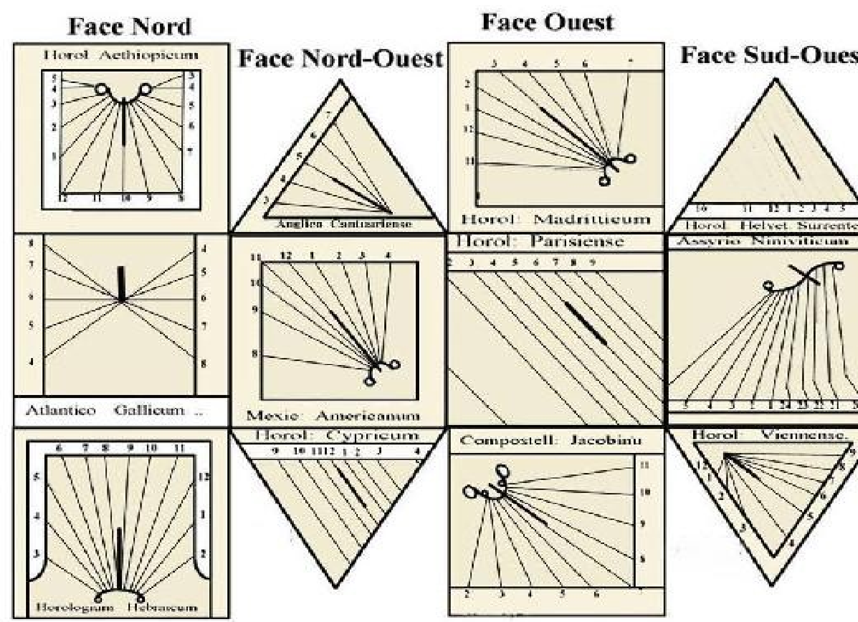
S

E


Face Sud
Face Sud-Est
Face Est
Face Nord-Est
Horo Antiquorum
Assirico Persicanum
Aegyptio Alexandrie
Horol Antiochense
Horolog: Italicum
Arabico Babylonicum
Hor: Indianum
Constantinop: Graecum
Congo Africanum
Orche Chaldaicum
Horol Japonense

N

W


Face Nord
Face Nord-Ouest
Face Ouest
Face Sud-Ouest
Horol Aethiopicum
Horol: Madritticum
Horol: Parisiense
Atlantico Gallicum ..
Mexic: Americanum
Horol: Cypricum
Compostell: Jacobinu
Horol Viennense.
Horologium Hebraicum

Some local different times

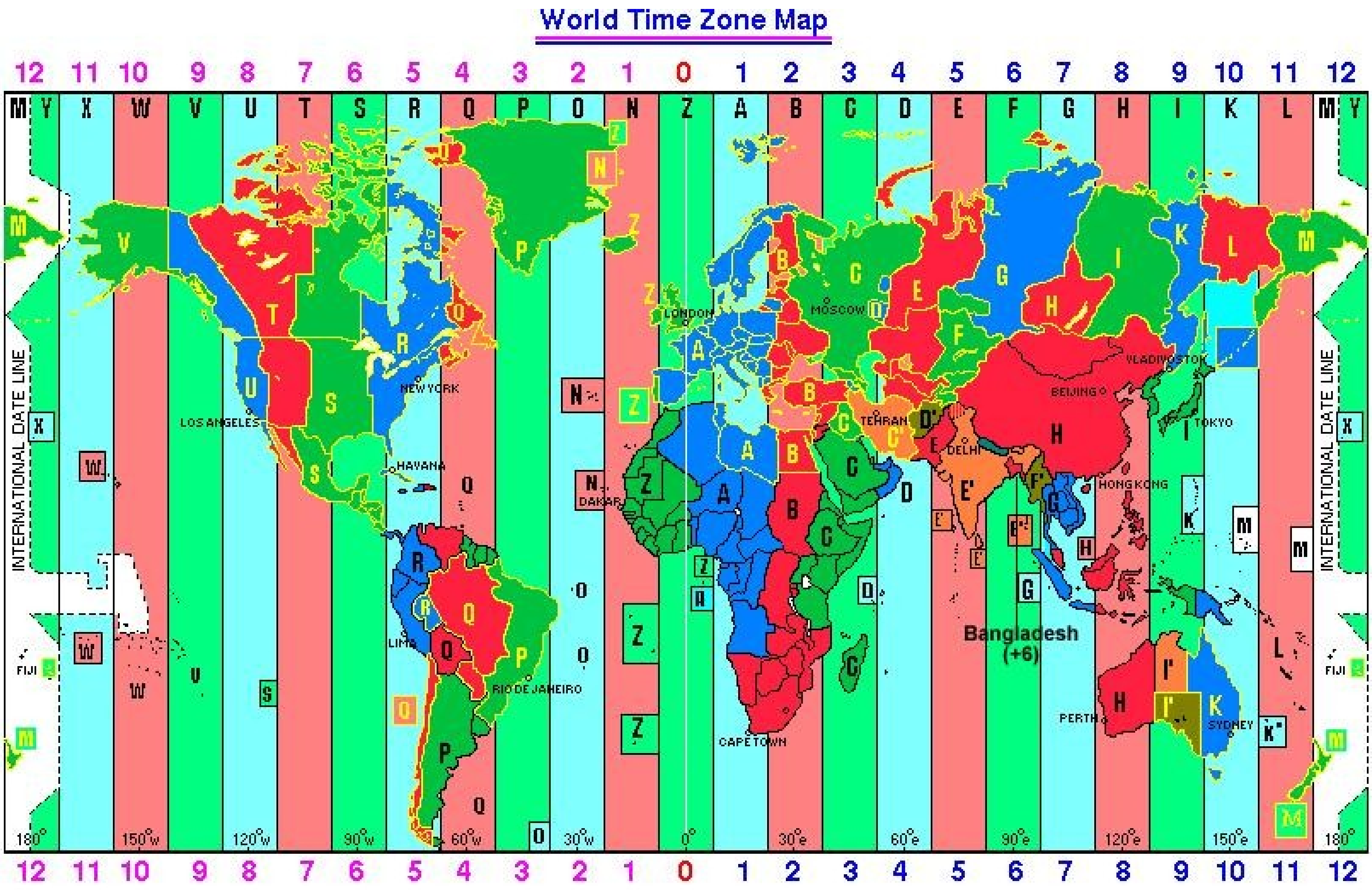
In the Antiquity, **1 day ≡ 12 hours** ∀ the season

«When thosed hired about the eleventh hour came, each one received a denarius»
*the Gospel according St Matthew 20:*6

Depending on local considerations, a time may can be registered as starting from

1) the sunrise: **babylonic hours**

2) the sunrise: **italic hours**
(jewish & islamic calendars)



The Earth is divided into 24 **time zones** of 15° each

From the local solar time to civil time

1. correct for the equation of time
→ mean time: 10h 08

2. correct for the difference
$\Delta\lambda$ = (longitude – central meridian of the time zone)
= 31 mins East
→ universal time: 9h 39

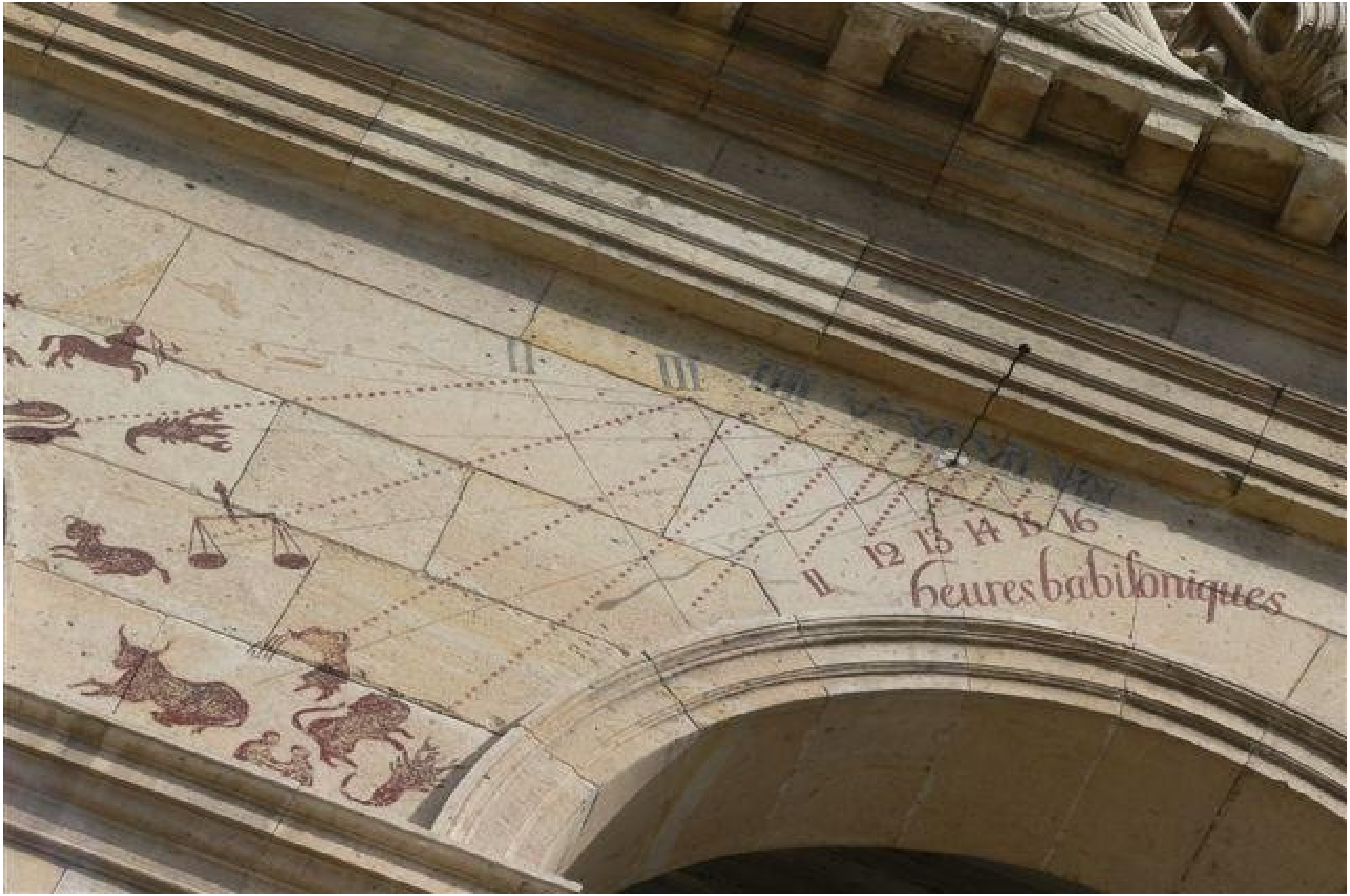
3.→ civil time: 11h 39 mins
UTC+1 in winter;
UTC+2 in summer

The italian hour

true solar time

time elapsed since the sunset

The babylonian hour



true solar time

time elapsed since the sunrise