Supernatural Sciences 102 Lecture 2

FIRST MOON

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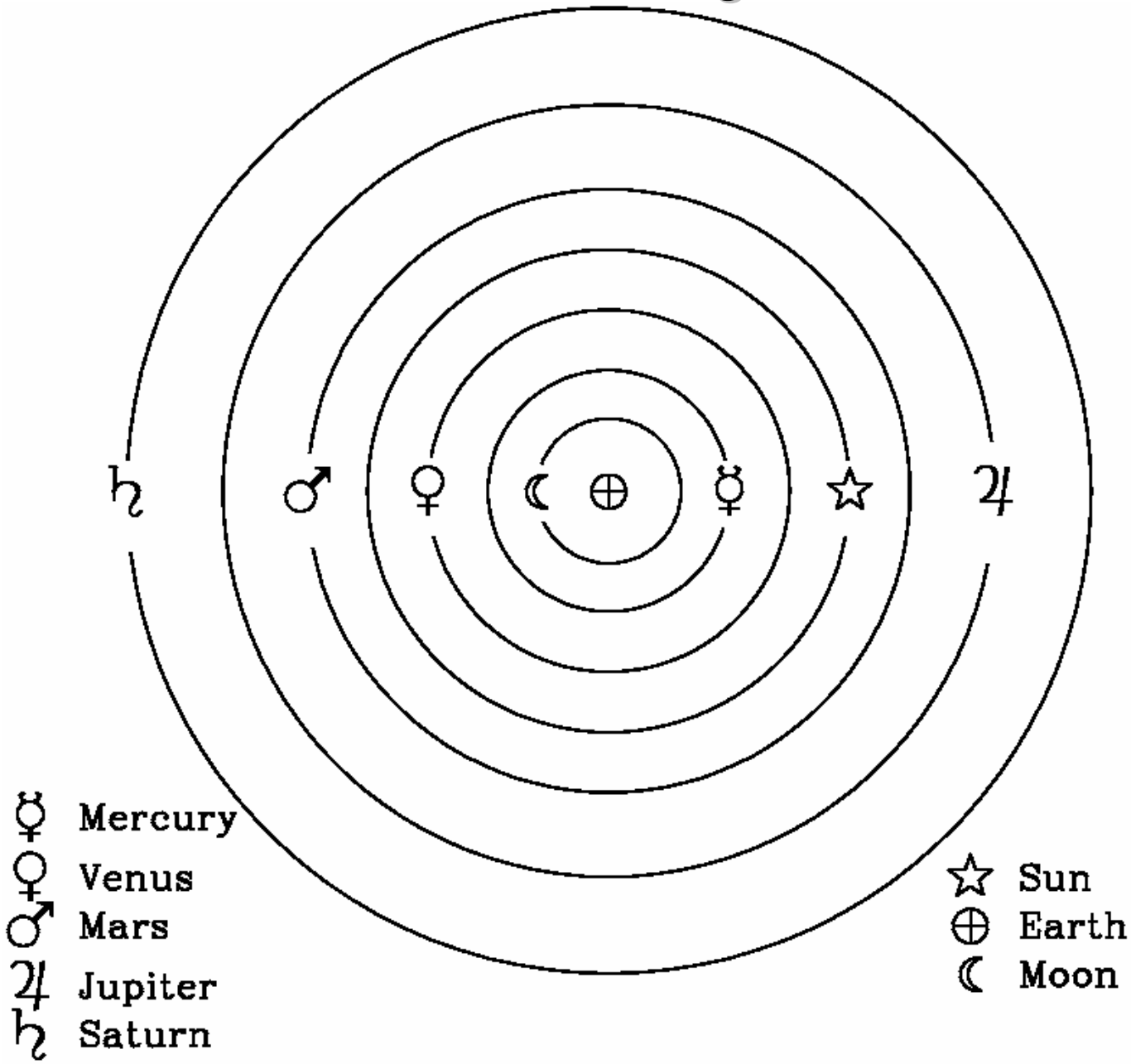
The Ptolemaic Universe

Aristotle (ca. 350 BCE) – groundwork of “natural philosophy”

Aristarchus (ca. 270 BCE) – proposed heliocentric model and stressed that motions are circular (Earth moves).

The Universe According to Aristotle



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Apr 1
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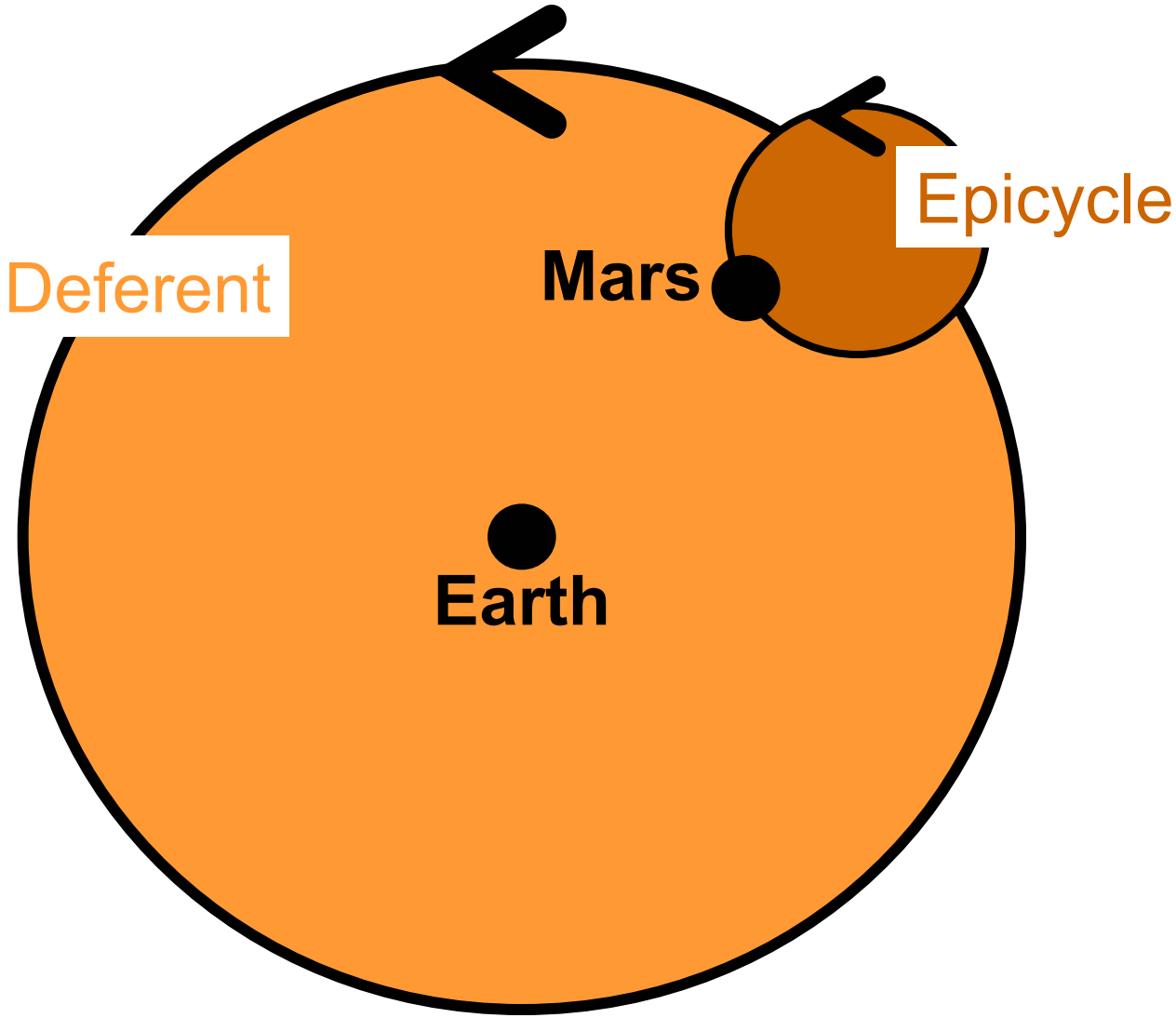
α
Path of Mars
LIBRA
Aug 1
5°

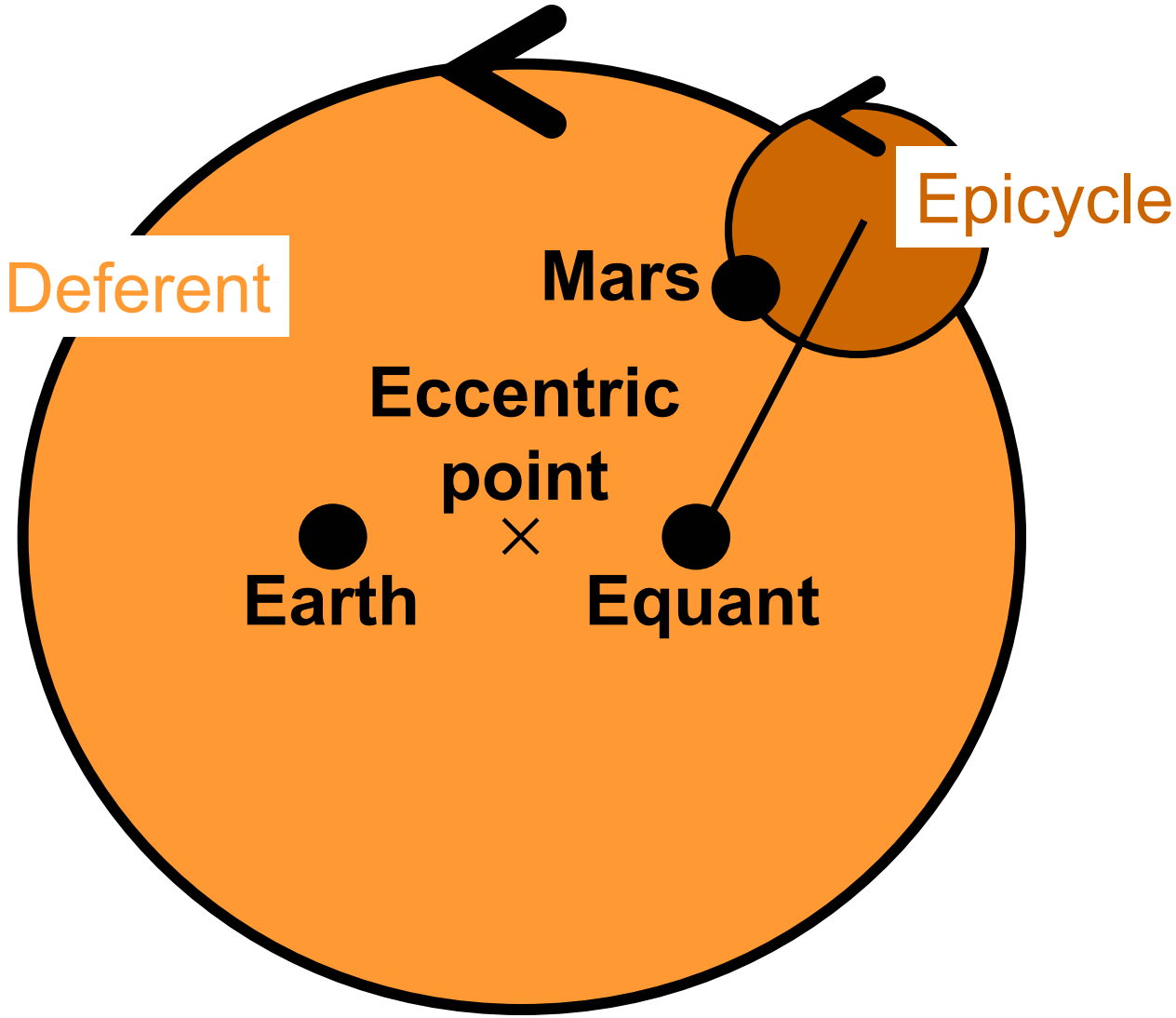
The Ptolemaic Universe

Aristotle	(ca. 350 BCE) – groundwork of “natural philosophy”
Aristarchus	(ca. 270 BCE) – proposed heliocentric model and stressed that motions are circular (Earth moves).
Hipparchus	(ca. 130 BCE) – Influenced Ptolemy. Many reasonable arguments against motion of Earth. Introduced epicycles for motion of Moon.

The Ptolemaic Epicycle



The Ptolemaic Epicycle



The Ptolemaic Universe

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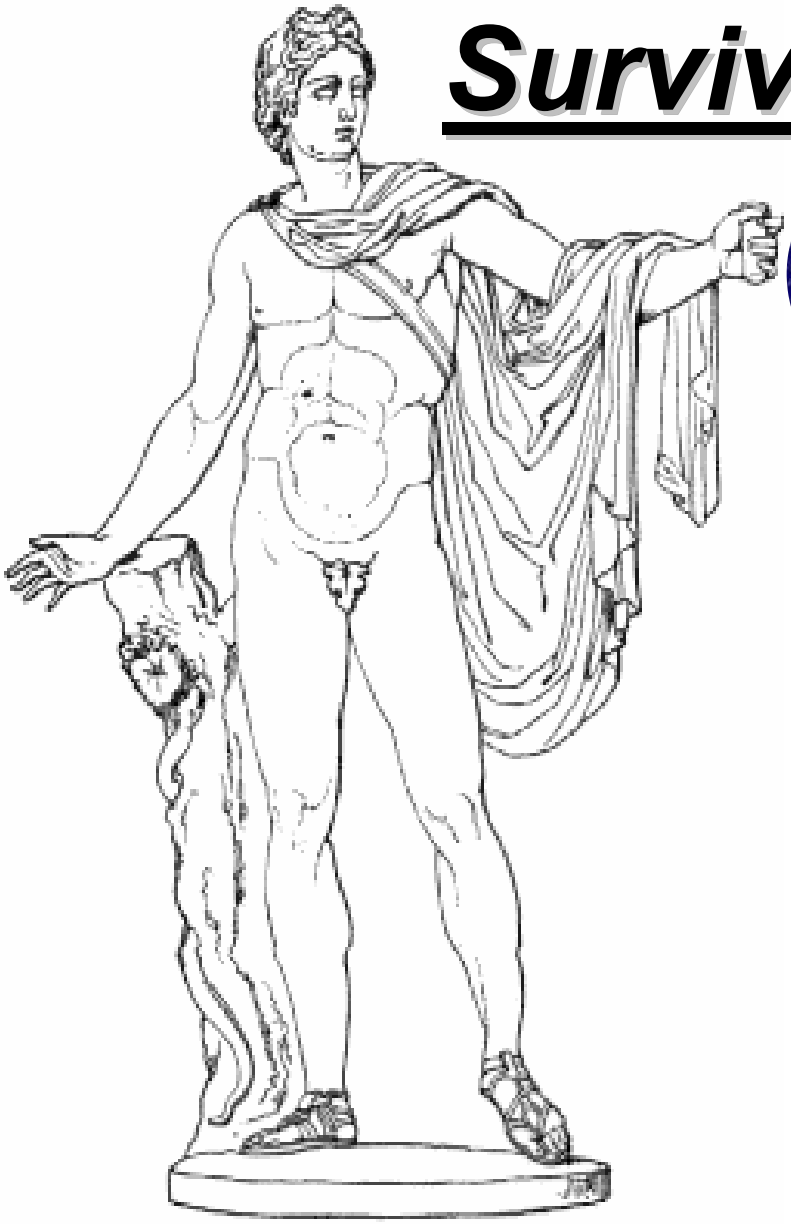
Ptolemy	(ca. 130 CE) – Greek astronomer lived in Alexandria. Astronomer, mathematician, cartographer. Books include *Almegest* & *Planetary Hypothesis*

Survivor, Greece



Aristotle (350 BC)
(Earth stationary)

Aristarchus (270 BC)
(Earth moves)

Survivor, Greece

A
Rocky Kolb–GnatSigh
Production

Original play (2002)
Eduardo Rozo
Timothy Donaghy
Jim Chisholm

Adapted (2004)
Rocky Kolb

Featuring the "Not Ready for Class Time Players":

Aristotle Jones:	Sein Ahn
Aristarchus Johnson:	Jim Chisholm
Ptolemy Thompson:	Brian Wilhite
Chorus:	Justin Johnson
	Vasileios Paschalidis
	Anibal Medina
Lighting & Music:	Kurt Henrikson
Best Boy:	Don M. Randel
Key Grip:	Richard Saller

Neither animals nor graduate students were harmed in this production!

Rocky Kolb-GnatSigh Productions Presents

The Dialogue C
Two Chi

UNRATED!!!!!!
contains cosmologically explicit material

, 2004

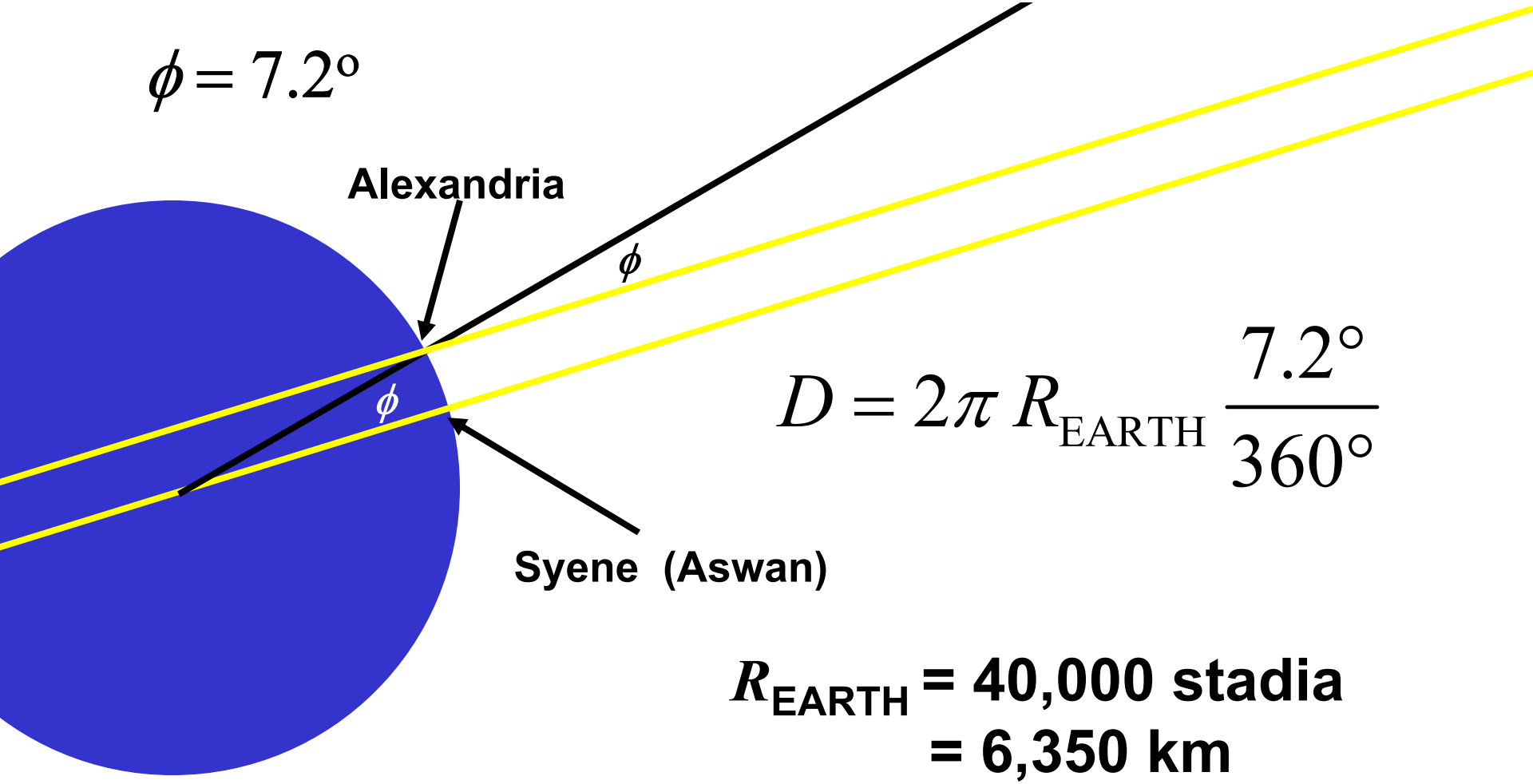
Need three thespians

Size does matter

Size of Earth (Erathosthenes ~ 250 BC)

D = distance between Syene & Alexandria = 5000 stadia

$$\phi = 7.2^{\circ}$$



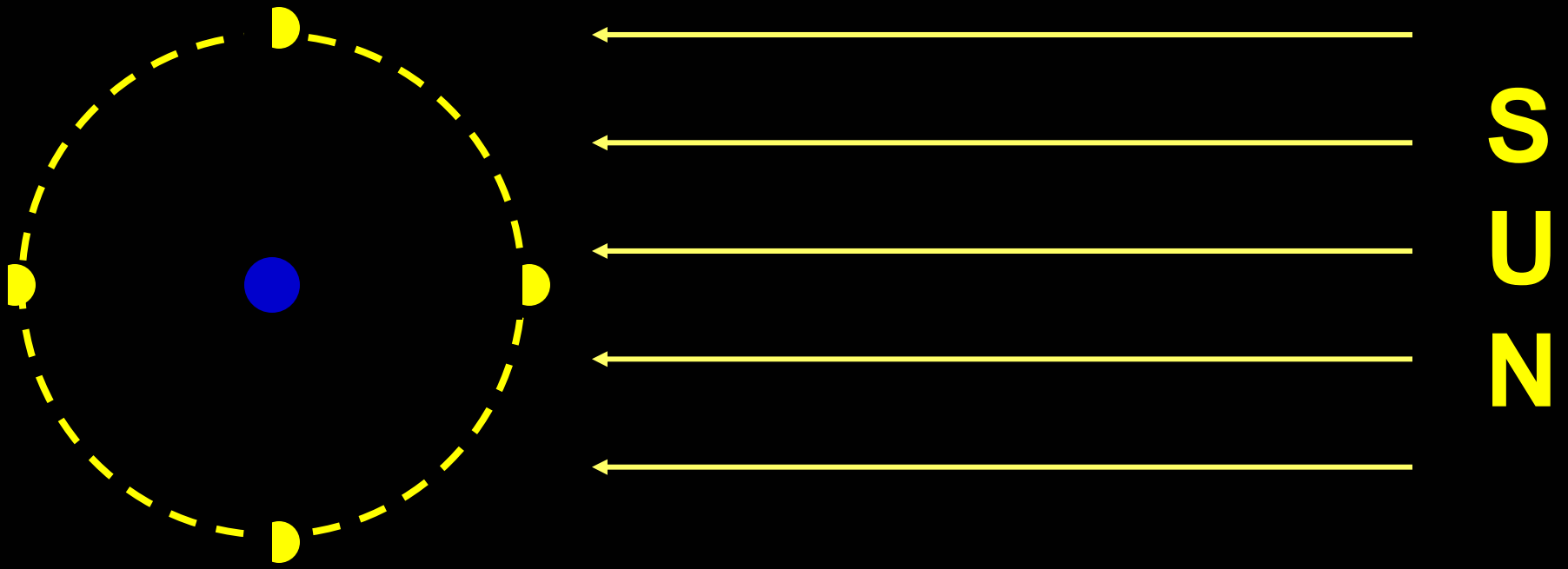
$$D = 2\pi R_{\mathrm{EARTH}} \frac{7.2^{\circ}}{360^{\circ}}$$

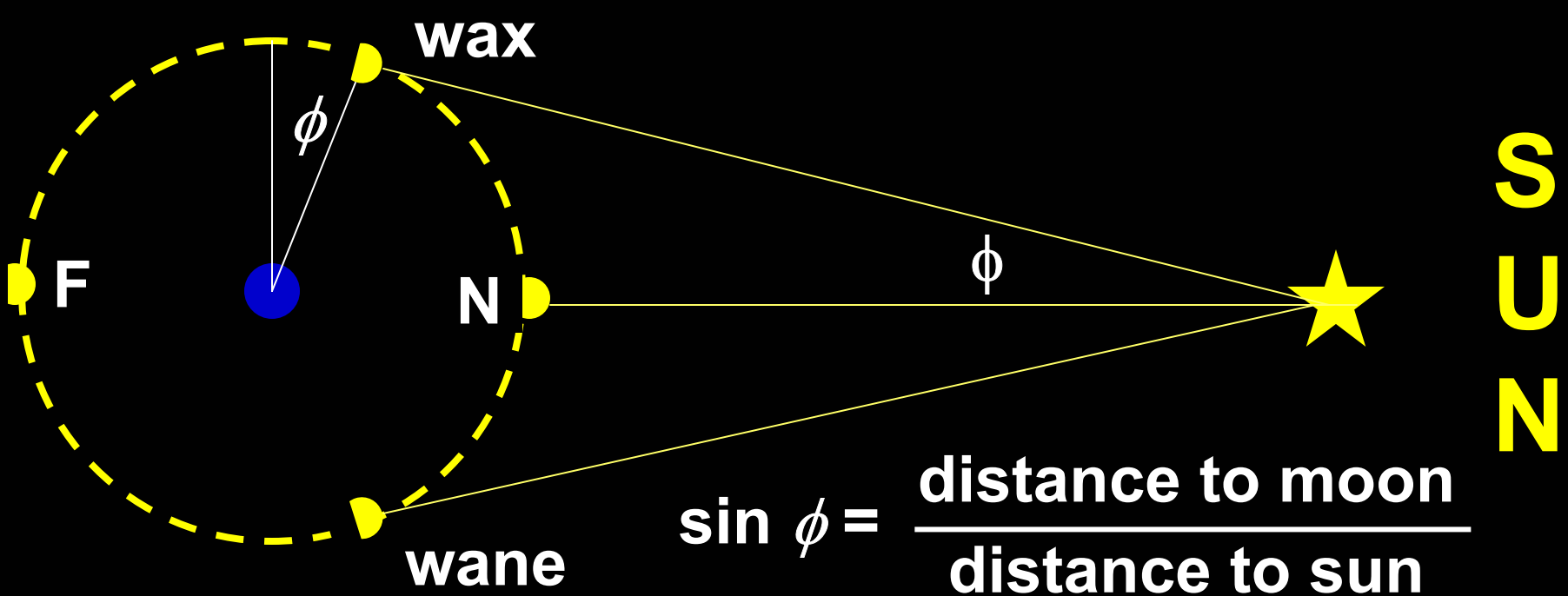
R_{EARTH} = 40,000 stadia
= 6,350 km

$$\frac{\text{distance to the sun}}{\text{distance to the moon}}$$

(Aristarchus ~ 270 BC)

sun always illuminates half the moon





$$\sin \phi = \frac{\text{distance to moon}}{\text{distance to sun}}$$

Aristarchus said time between new moon and waxing moon was 12 hours shorter than the time between the full moon and the waning moon.

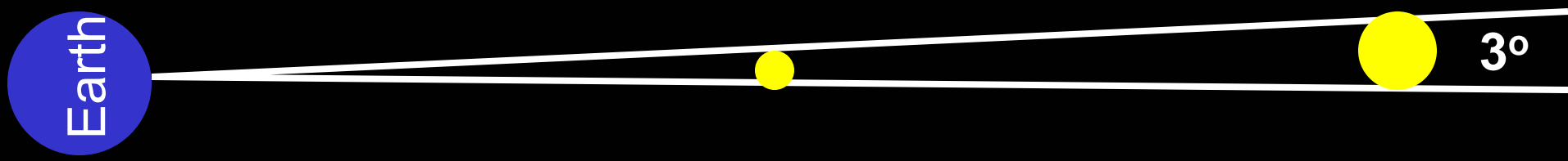
$$\frac{\text{distance to moon}}{\text{distance to sun}} = 19$$

390 is correct
but geometry is perfect

The distance ladder

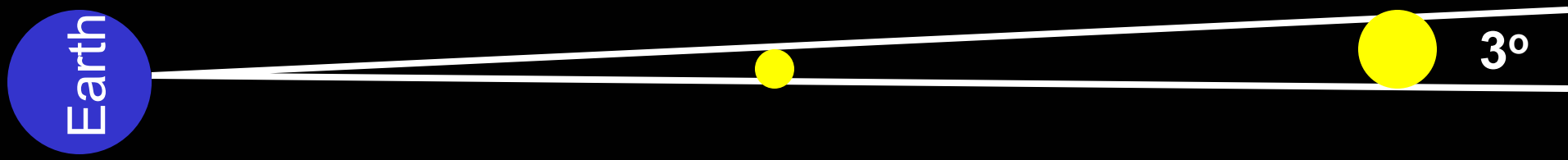
- The radius of Earth is known
- Distance to the moon in terms of Earth's radius
- Distance to the sun in terms of the distance to the moon, which in turn is known in terms of the radius of Earth
- Leads to a knowledge of the "size" of the object

- How big are things?
- How far away are things?

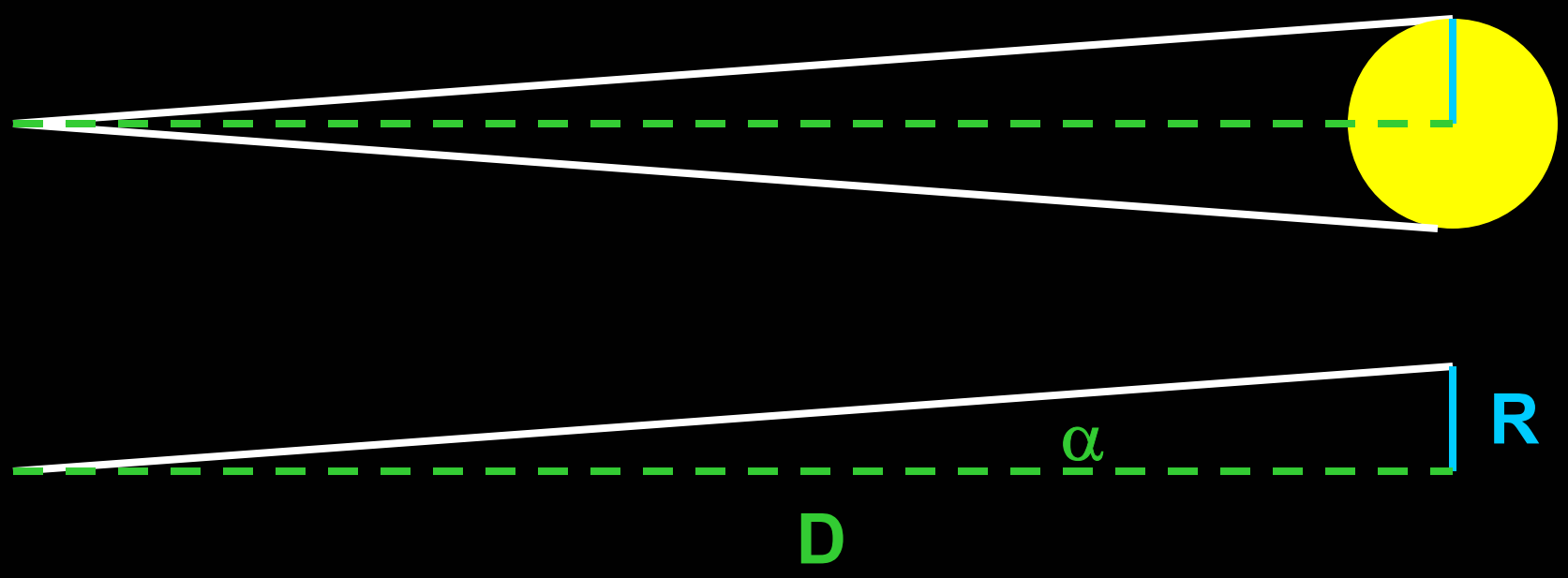


Both objects have an <u>angular size</u> of 3°

How far away are stars? How big are stars?

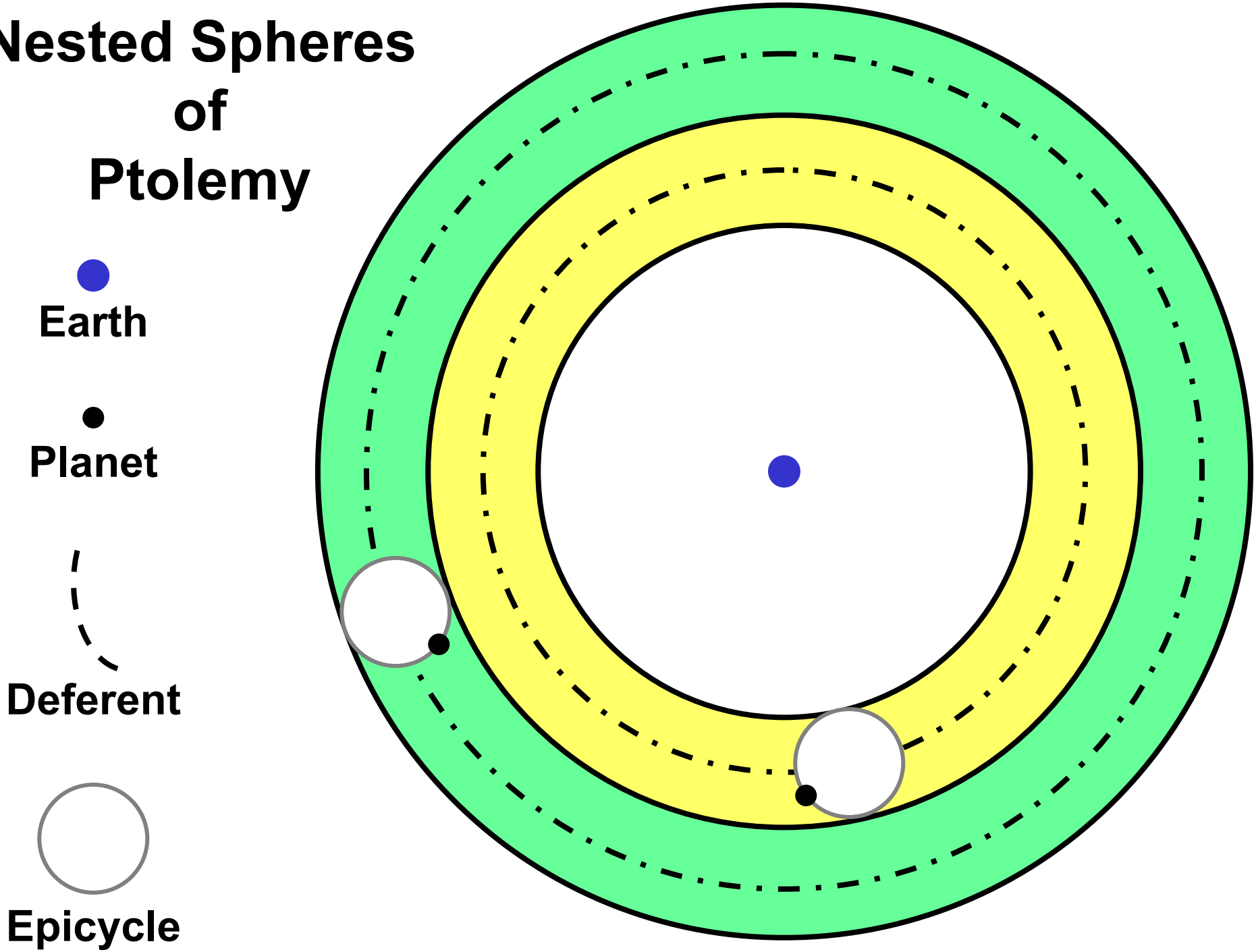


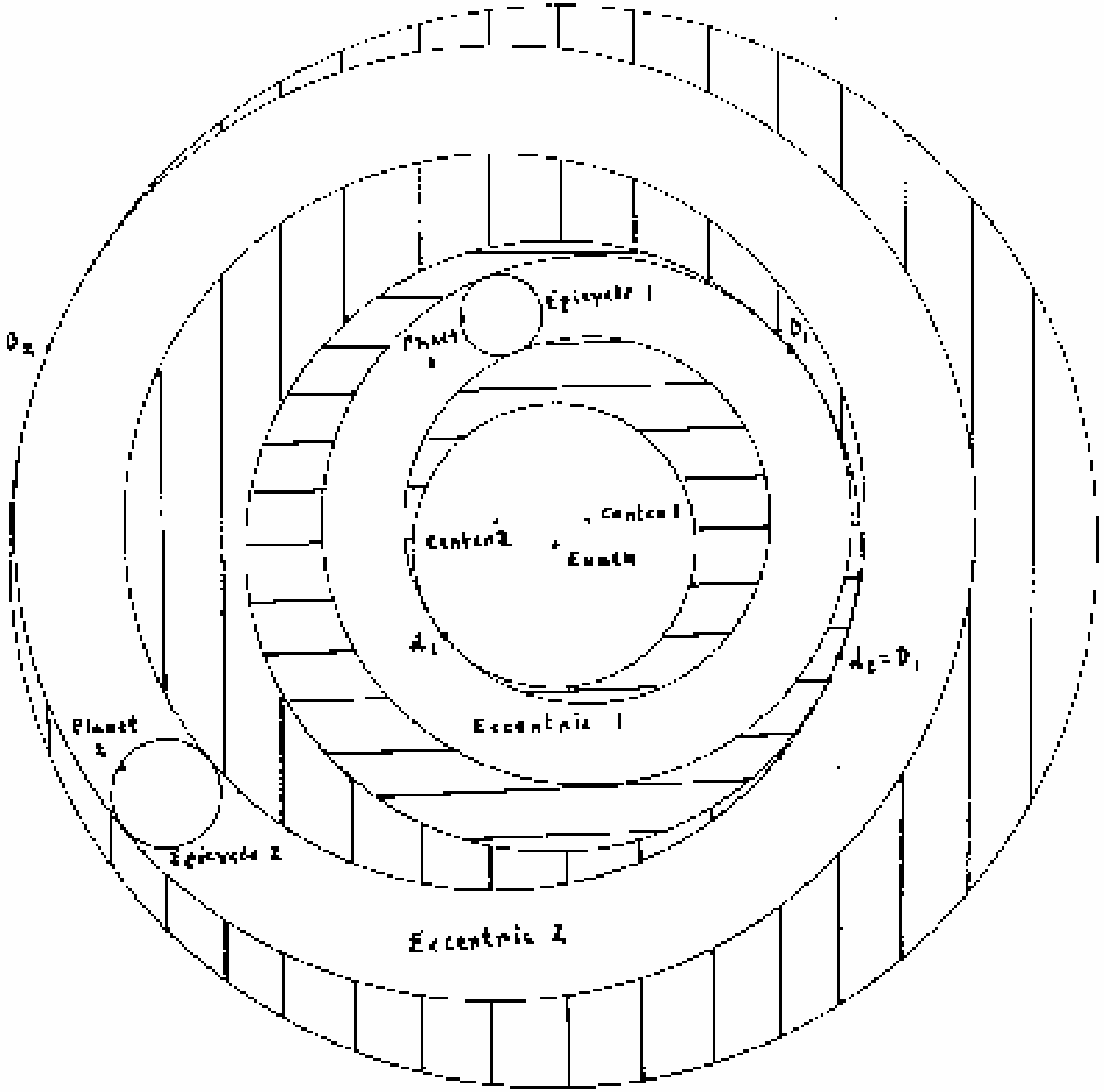
Both objects have an angular diameter of 3°



Object	Distance from Earth (in miles)		Radius (in miles)		Angular Size (in degrees)	
	Ptolemy	True	Ptolemy	True	Ptolemy	True
Earth	———	———	3,750	3,960	———	———
Moon	225,000	239,000	940	1,080	1/2	1/2
Sun	4,700,000	92,900,000	21,000	432,000	1/2	1/2

Nested Spheres of Ptolemy

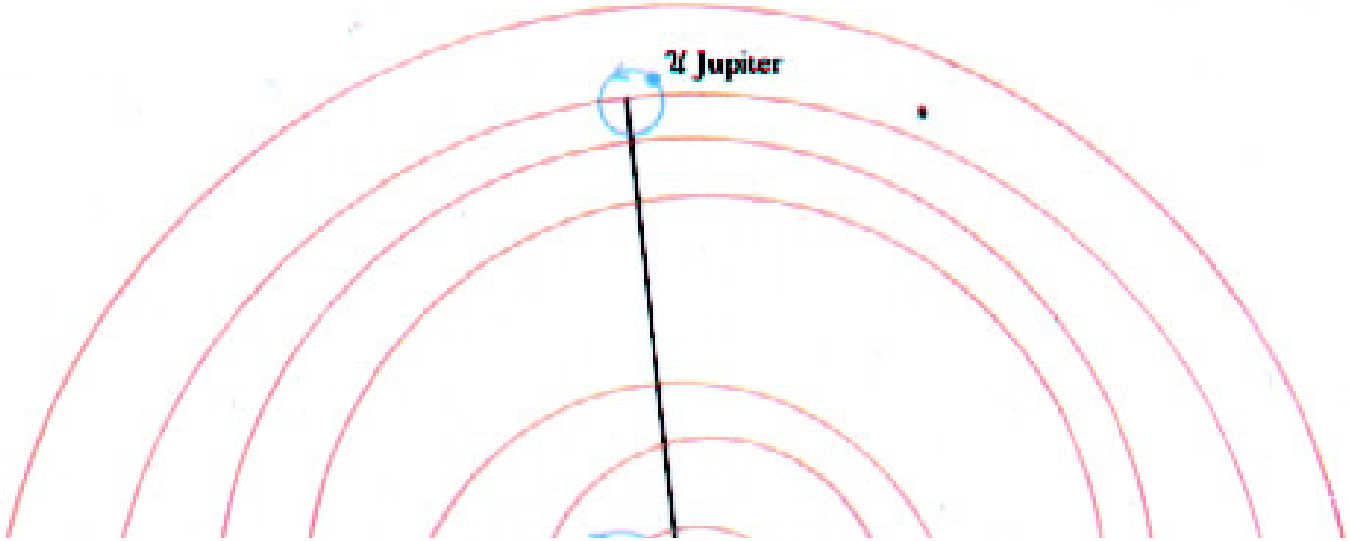



Epicycle 1
Planet 1
D_1
D_2
Center 1
Center 2
Earth
d_1
$d_2 = D_1$
Eccentric 1
Planet 2
Epicycle 2
Eccentric 2

Planet	Distance from Earth (in millions of miles)		Angular Diameter (in minutes)		Actual Diameter (in miles)	
	Ptolemy	True	Ptolemy	True	Ptolemy	True
Earth	———	———	———	———	7,500	7,900
Mercury	0 .6	147	2	0.01	300	3,000
Venus	4	66	3	0.5	1,900	7,500
Mars	33	126	1.5	0.15	8,600	4,200
Jupiter	53	1,000	2.5	0.4	32,500	89,000
Saturn	74	2,000	1.7	0.2	32,000	75,000

Raphael, School of Athens, in the Stanza della Segnatura

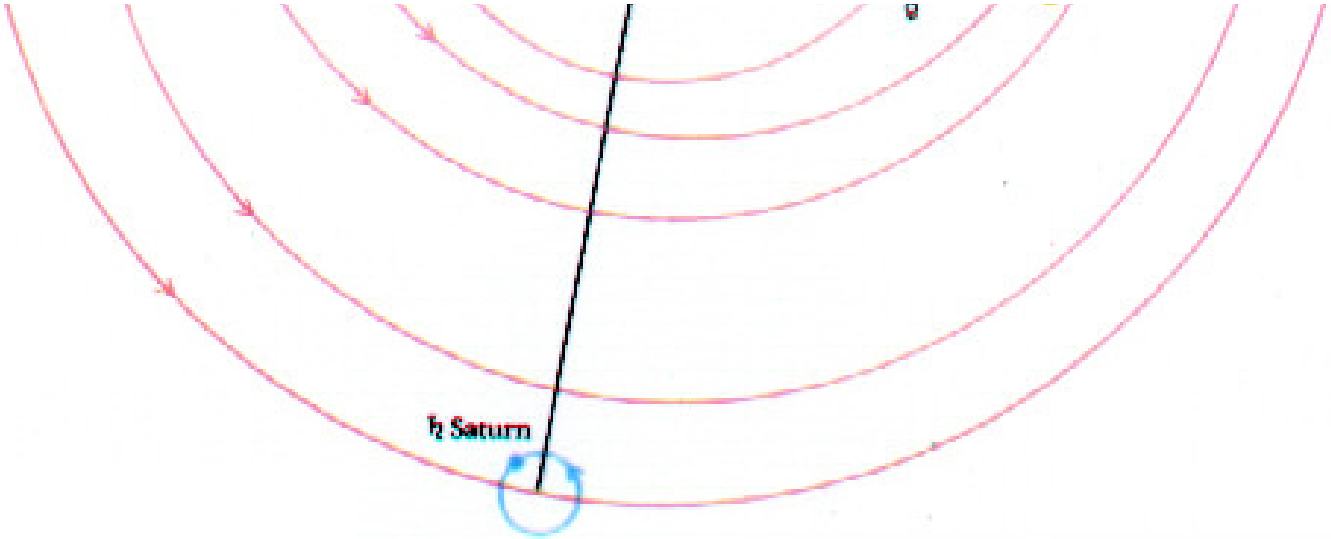
System

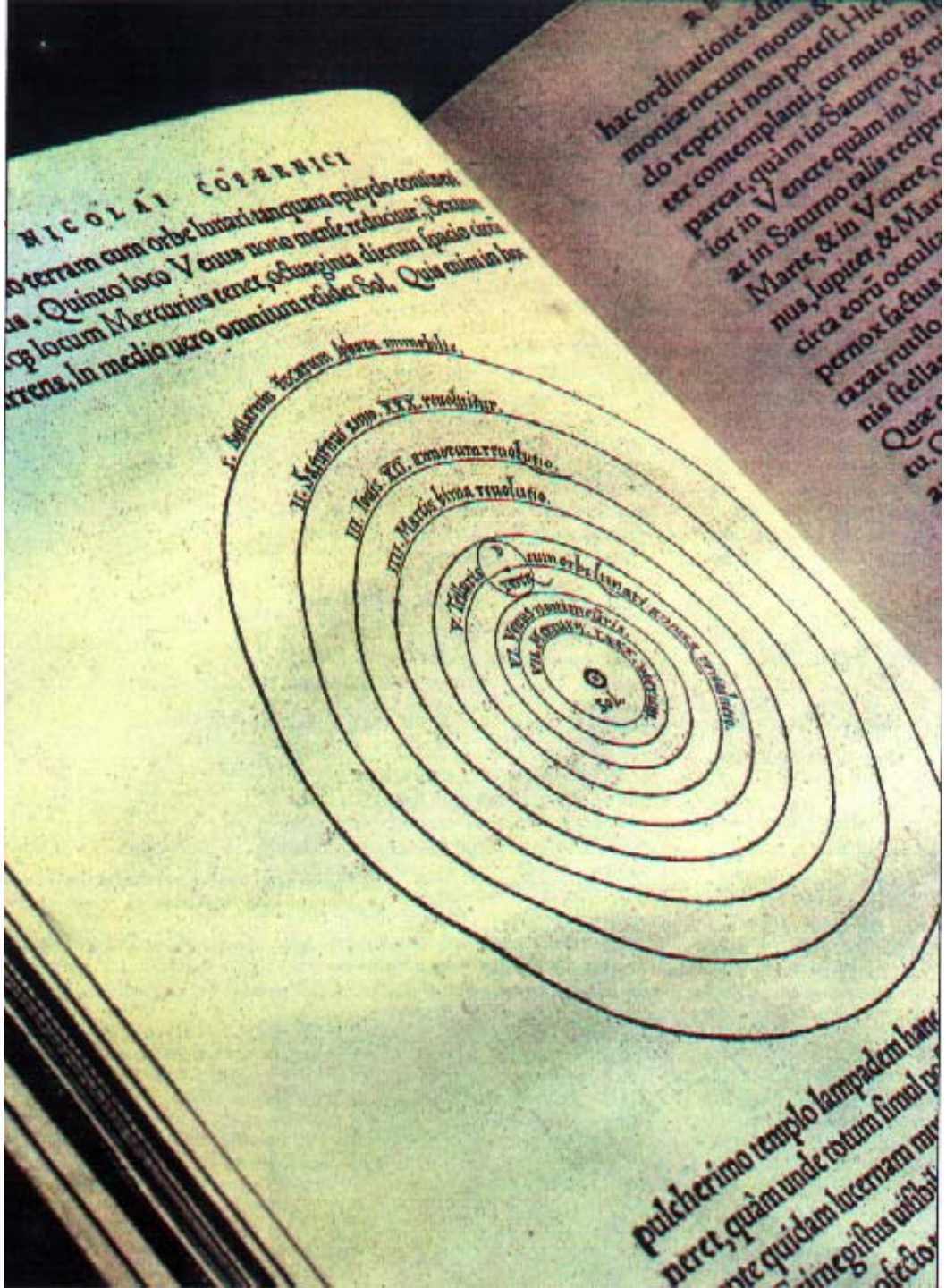


If I had been present at creation, I would have suggested a simpler scheme.

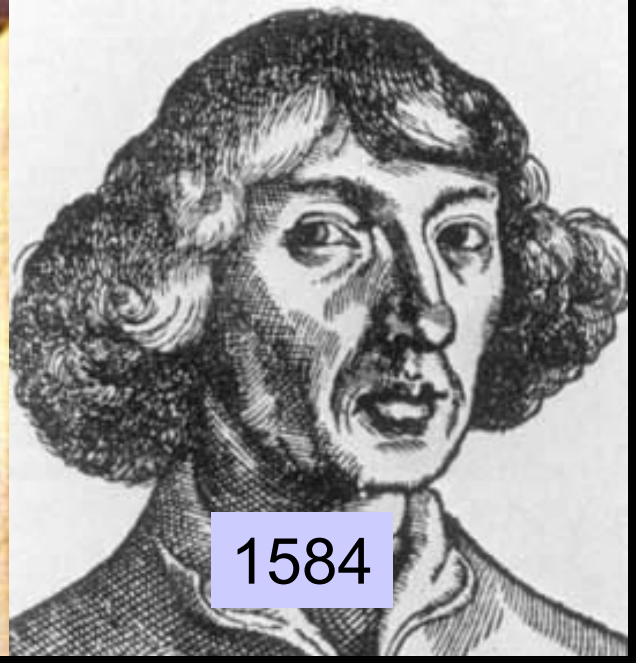
- Alfonse the Wise

The Ptol




NICOLAI COPERNICI
hacordinatione adm
moniæ nexum mouis &
do reperiri non potest. Hic
ter contemplanti, cur maior in
parcat, quàm in Saturno, & m
ior in Venere quàm in Me
at in Saturno talis recipr
Marte, & in Venere,
nus, Iupiter, & Mar
circa eorũ occulta
pernox factus
taxat ruitlo
nis stellas
Quae
cu.
terram cum orbe lunari tanquam epicyclo contineri.
ua. Quinto loco Venus uno mense redeunt. Sexto
cq locum Mercurius tenet, octuaginta dierum spacio cur
rens, In medio uero omnium residet Sol. Quis enim in hac
I. Saturnus tricenarium spacium consumit.
II. Iouis XII. annorum uertitur.
III. Martis biennio uertitur.
IV. Terra cum orbe lunari annuo uertitur.
V. Veneris nonimestris.
VI. Mercurius octuaginta dierum.
pulcherimo templo lampadem hanc
neret, quàm unde totum simul p
nte quidam lucernam mu
rimegistus uisibil
ofecto

1580


1584

NICOLAUS COPERNICUS
Nat. A° 1473. ob. 1543.
Borussus. Mathemat.
1597

SSSR·POLSKO
СССР·POLSKA
2 Kčs
INTERKOSMOS
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TYSIĄC ZŁOTYCH

NICOLAI CO-
PERNICI TORINENSIS
DE REVOLVTIONIBVS ORBI-
um cœlestium, Libri VI.

Habes in hoc opere iam recens nato, & æditó, studiose lector, Motus stellarum, tam fixarum, quàm erraticarum, cum ex ueteribus, tum etiam ex recentibus obseruationibus restitutos: & nouis insuper ac admirabilibus hypothesibus ornatos. Habes etiam Tabulas expeditissimas, ex quibus eosdem ad quoduis tempus quàm facillime calculare poteris. Igitur eme, lege, fruere.

ἀγεωμέτρητος μηδεὶς εἰσίτω.

Norimbergæ apud Ioh. Petreium,
Anno M. D. XLIII.

Let no one untrained in geometry enter here.

Nicolaus Copernicus of Torun

Six Books on the Revolutions of the Heavenly Spheres

Diligent reader, in this work, which has just been created and published, you have the motions of the fixed stars and planets, as these motions have been reconstituted on the basis of ancient as well as recent observations, and have moreover been embellished by new and marvelous hypotheses. You also have most convenient tables, from which you will be able to compute those motions with the utmost ease for any time whatever. Therefore buy, read, and enjoy *(eme, lege, fruere).*

Let no one untrained in geometry enter here.

Nuremberg
Johannes Petreius
1543

To the Reader Concerning the Hypotheses of this Work.

There have already been widespread reports about the novel hypotheses of this work, which declares that the earth moves whereas the sun is at rest in the center of the universe … it is the duty of an astronomer to compose the history of the celestial motions through careful and expert study. Then he must conceive and devise the causes of these motions or hypotheses about them. Since he cannot in any way attain to the true causes, he will adopt whatever suppositions enable the motions to be computed…. For these hypotheses need not be true nor even probable. On the contrary, if they provide a calculus consistent with the observations, that alone is enough.

So far as hypotheses are concerned, let no one expect any thing certain from astronomy, which cannot furnish it, lest he accept as the truth ideas conceived for another purpose, and depart from this study a greater fool than when he entered it.