Planetary Motion & Conclusion
Part I

Motion in versus of the Sky

- We should be past daily motion: we get that EVERYTHING rises in the east, culminates on the meridian (south) and sets in the west

- Much more interesting: how are the sun, moon, planets move with respect to the stars while EVERYTHING moves east to west

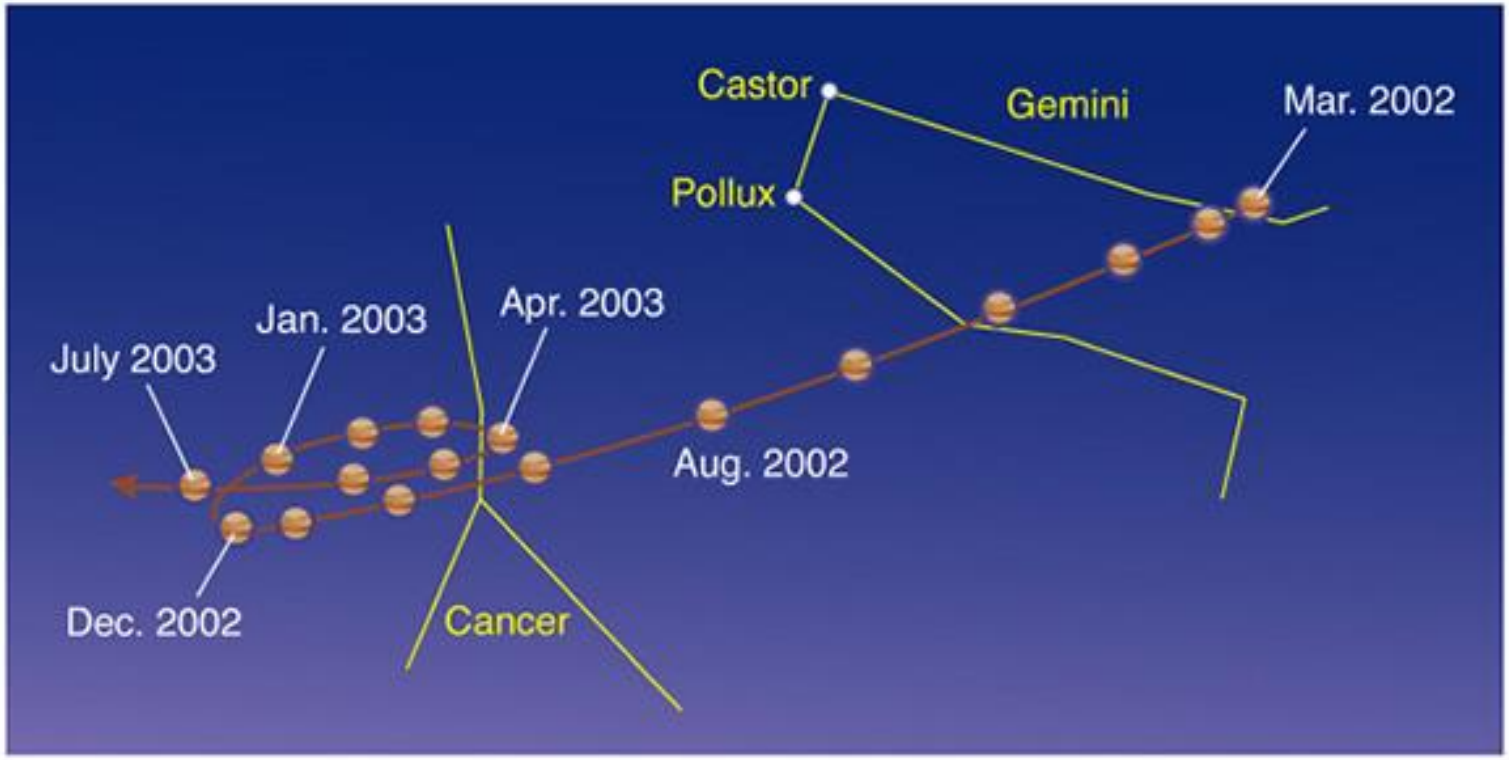
Review: Motion of Sun and Moon

- The sun appears to move along the ecliptic
  - It changes celestial latitude (seasons!) and longitude (seasonal visibility of stars)
  - It moves 1º degree per day along the ecliptic, one zodiac constellation (30º) per month
- The moon appears to move along a path slightly (5º) tilted wrt the ecliptic
  - It moves 12º per day wrt stars, so 360º per month
  - Its appearance changes → phases

Motion of the Planets

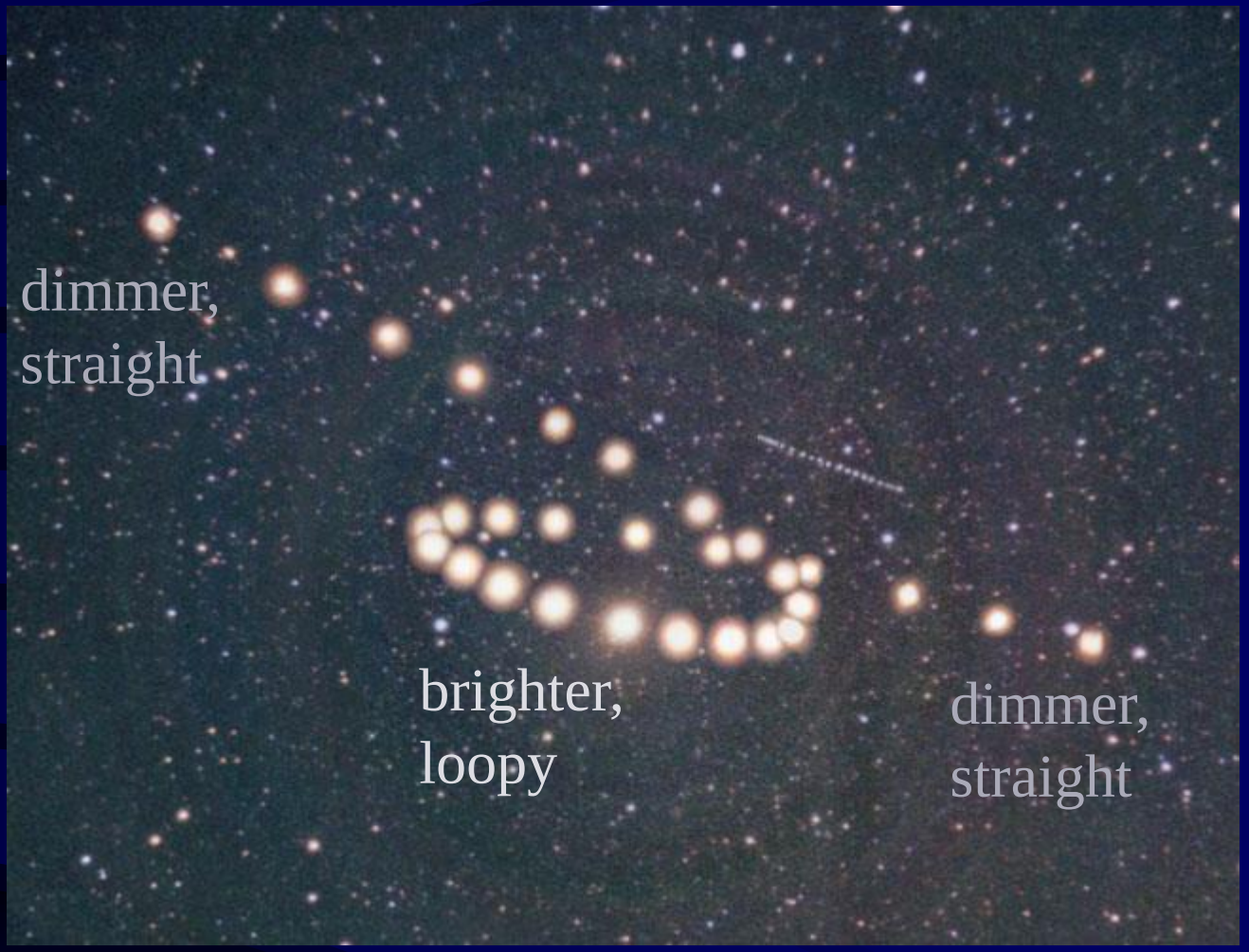
- Planets move more or less along the ecliptic, too
- Planets appear star-like, but sometimes they are brighter than at other times
- New feature (compared to sun and moon motion): planets slow down and turn around (wrt stars, not ground !) → retrograde motion

“Strange” motion of the Planets



Dots represent Jupiter's approximate position at 1-month intervals.
(Jupiter not to scale.)

Planets usually move from W to E relative to the stars, but sometimes strangely turn around in a loop, the so-called retrograde motion, see Skygazer



MARS AND URANUS

SEE SKYGAZER: PATH OF THE PLANETS

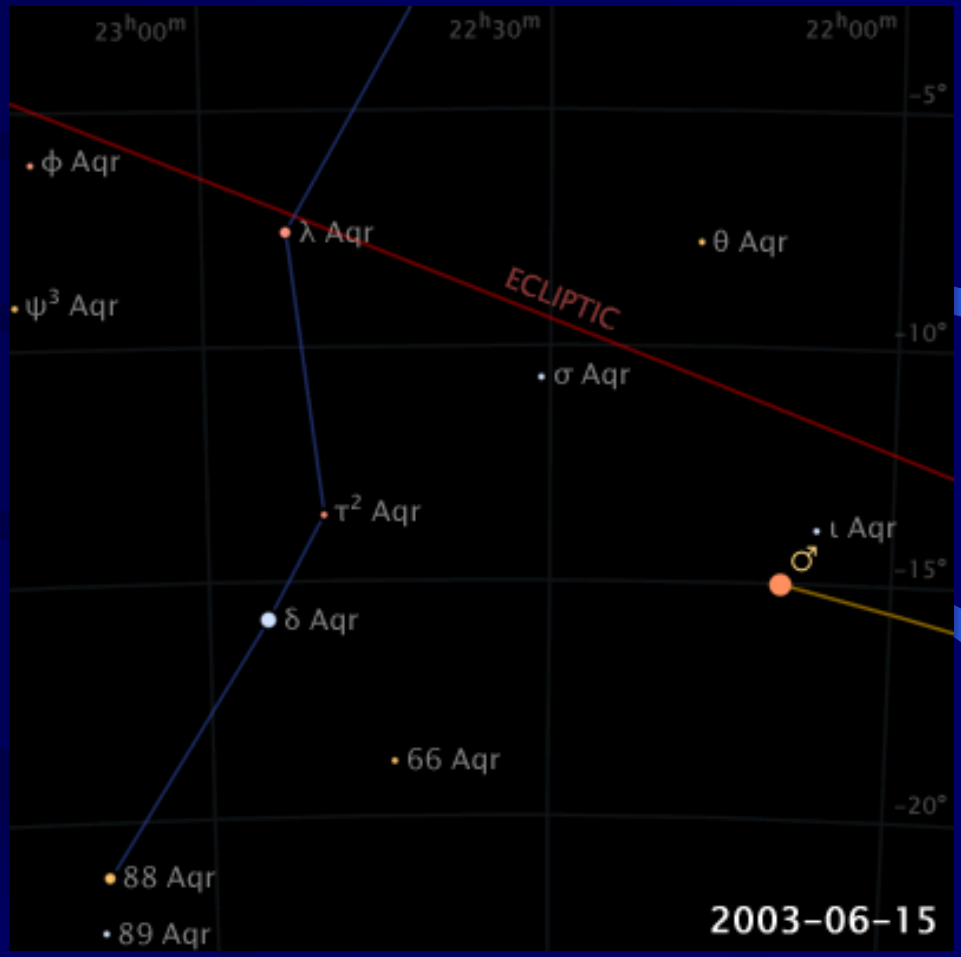
Tunc Tezel

MARS 2005

Simulation of Mars 2003 is also on this Webpage by C. Seligman

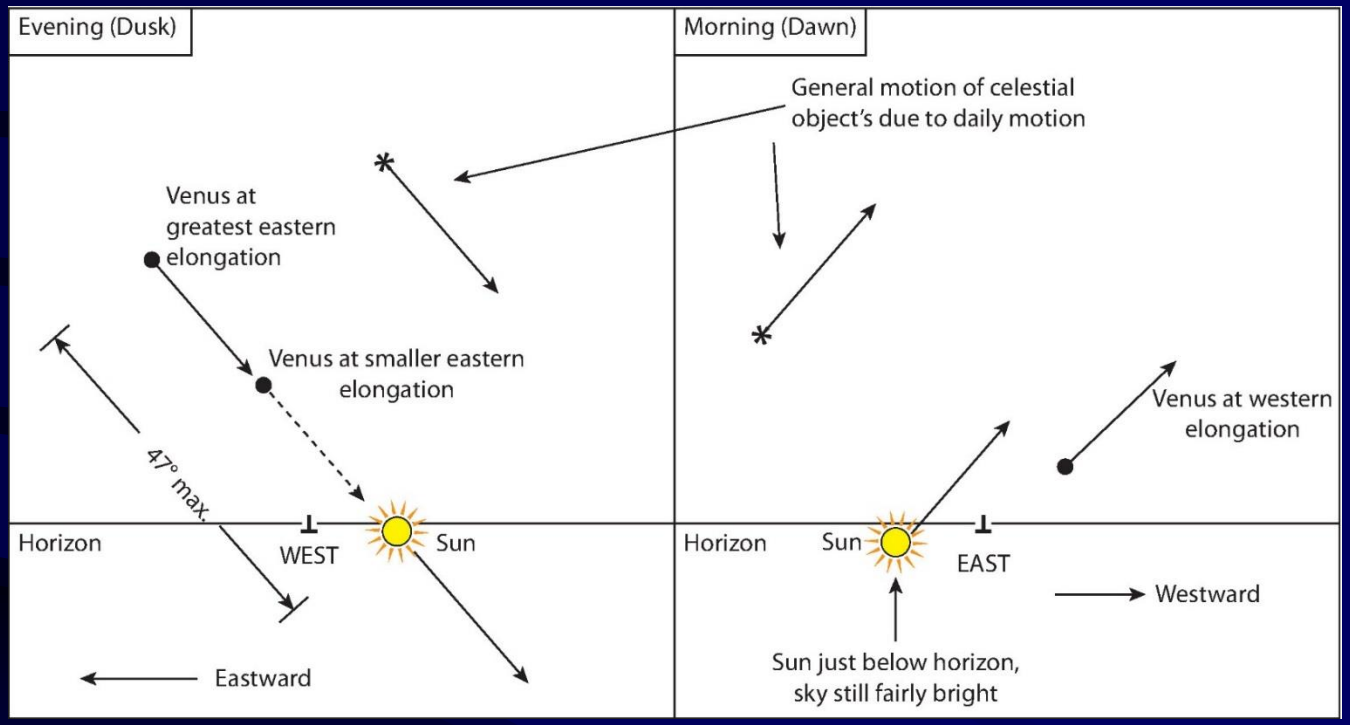
Apparent Motion of Planets in the Sky

- Here: Mars relative to (the stars of) Aquarius
- Note that Mars and Taurus would rise and set many times while this motion of Mars with respect to Aquarius happens!



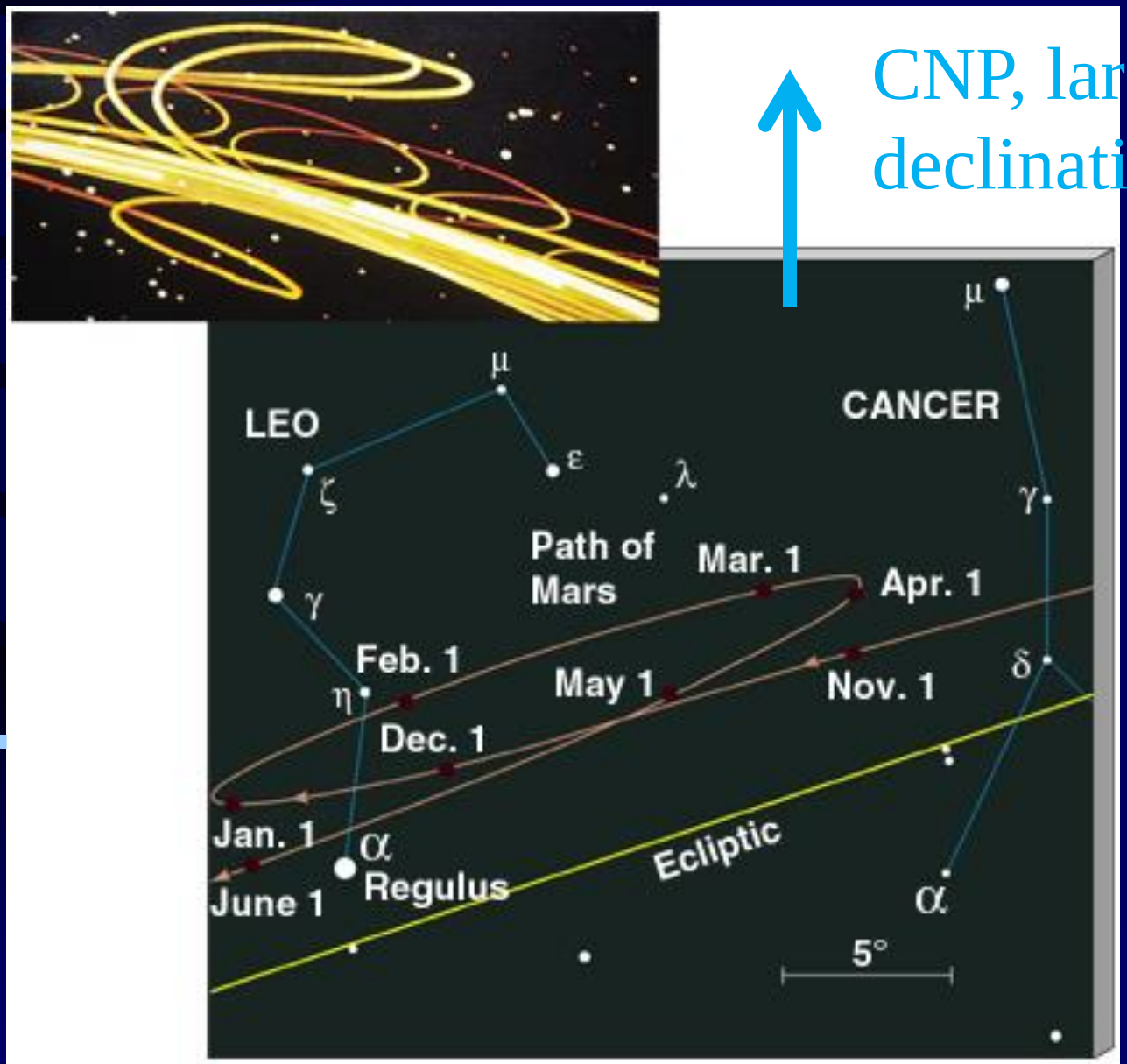
(by Eugene Alvin Villar)

Venus as Morning and Evening "Star"



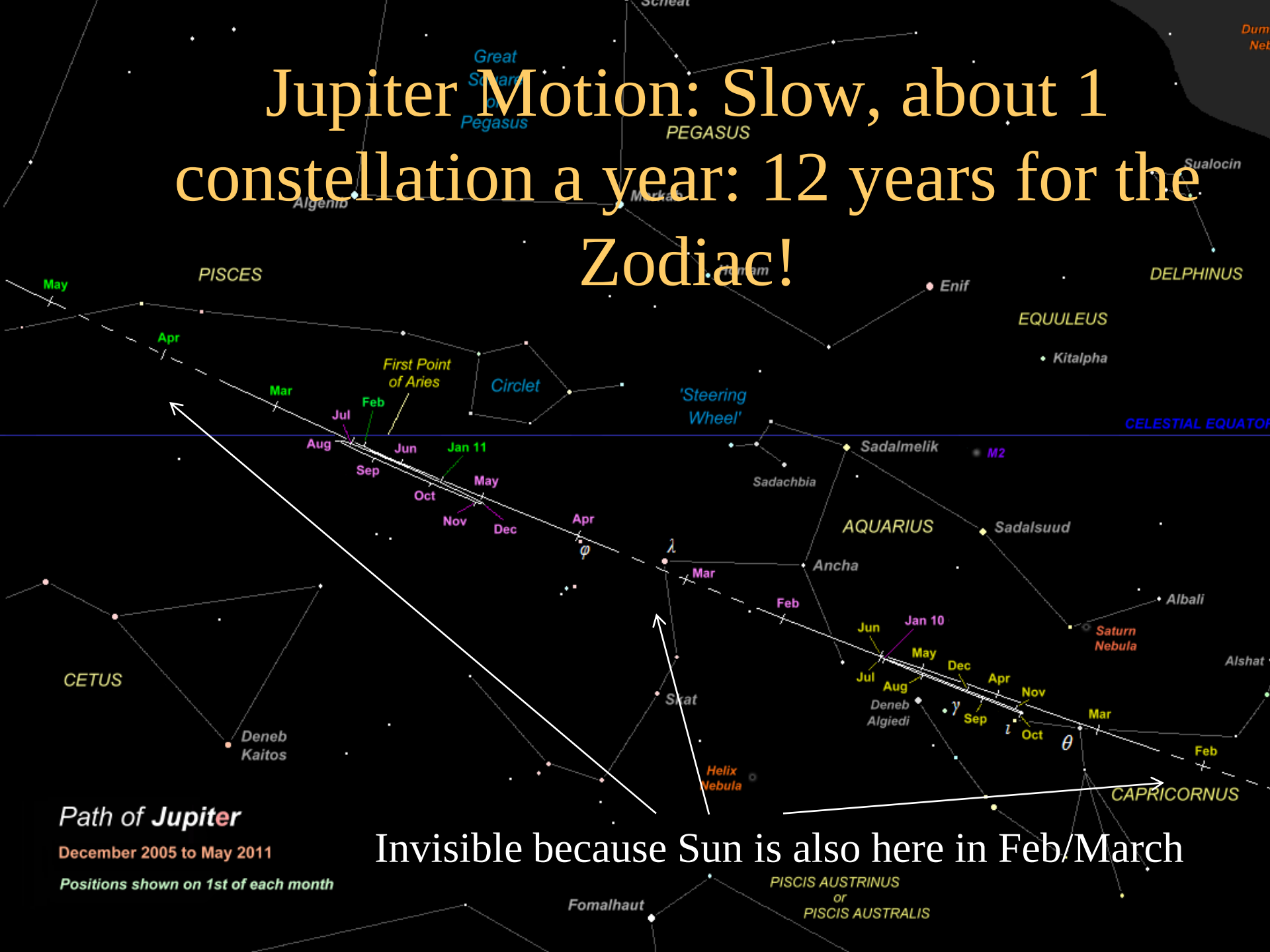
- Venus always appears close to the sun in the sky: visible before sun comes up or after sun has set

To Zenith at Midnight



Naked-Eye Observation of the Planets

- The planets change their position with respect to the stars
- The planets, unlike the Sun and the Moon, show retrograde motion
- The planets get brighter and dimmer
  - They are brightest when they are in retrograde motion
    - This must mean that they are closest to us at this point (Why?)


Jupiter Motion: Slow, about 1 constellation a year: 12 years for the Zodiac!
Great Square of Pegasus
PEGASUS
Scheat
Algenib
Markab
Sualocin
PISCES
May
Apr
Mar
Feb
Jul
Aug
Jun
Jan 11
Sep
May
Oct
Nov
Dec
Apr
First Point of Aries
Circlet
'Steering Wheel'
Enif
DELPHINUS
EQUULEUS
Kitalpha
CELESTIAL EQUATOR
Sadalmelik
M2
Sadachbia
AQUARIUS
Sadalsuud
Ancha
Albali
Saturn Nebula
Alshat
Jan 10
Jun
May
Dec
Jul
Aug
Apr
Nov
Sep
Oct
Mar
Feb
Deneb Algiedi
CETUS
Deneb Kaitos
Skat
Helix Nebula
CAPRICORNUS
Path of Jupiter
December 2005 to May 2011
Positions shown on 1st of each month
Fomalhaut
PISCIS AUSTRINUS
or
PISCIS AUSTRALIS
Invisible because Sun is also here in Feb/March

Describing the Motion in the Sky Quantitatively

- Can measure how long the planet takes to go once around the zodiac (recall: sun – 1 year, moon – 1 month)
- This is the synodic period (not the orbital period!)
  - Mercury: 116 days, Venus: 584 days, Mars: 780 days, Jupiter: 399 days, Saturn: 378 days
- Strange pattern! It is not immediately clear what this means for the motion in space

What can we **conclude** from observing patterns in the sky?

- Earth OR Celestial Sphere rotates
- Earth rotates around the Sun OR Sun moves about Earth
- Moon rotates around the Earth or v.v.?
  - Must be former, due to moon phases observed!
- Size of the earth from two observers at different locations
- Size of moon & moon's orbit from eclipses
- Much more from planetary motion …