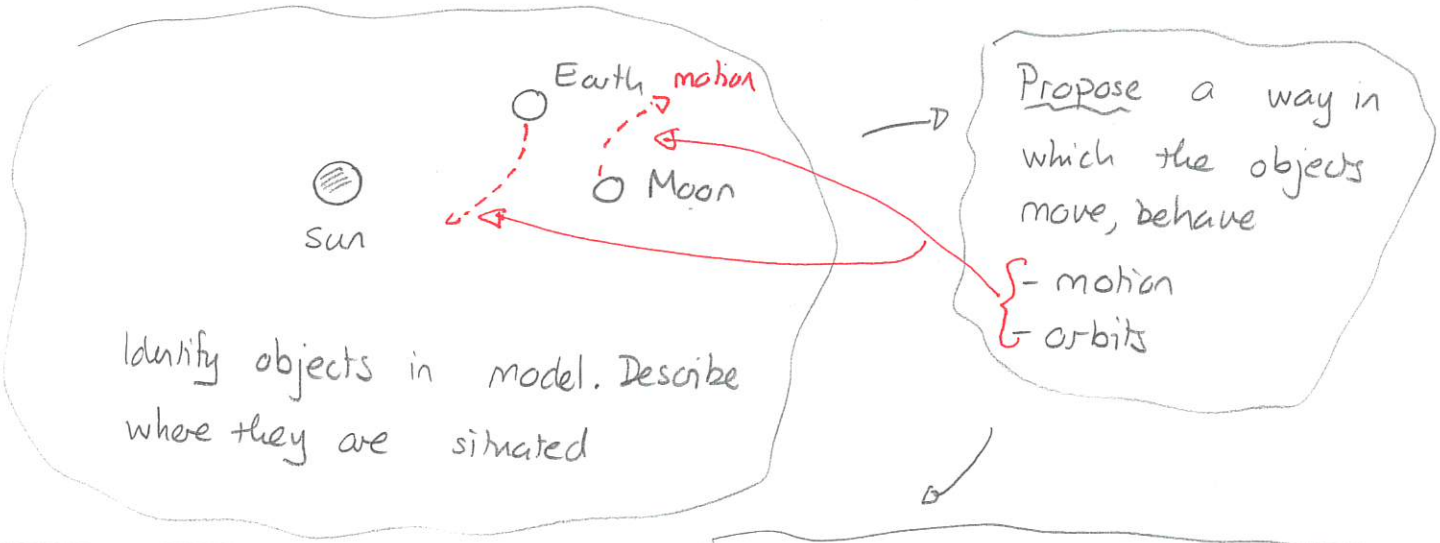
Lecture 3

* Turn in Survey
* Monday - Cover 1.4 - 1.5
  - Read in advance 1.4, 1.5
* Friday - HW by 5pm
  - Seek help with HW

Solar System Models

Consider the various celestial objects - Sun, Moon, Earth, planets, stars. We want a model for how they behave. This is an idea that we construct:

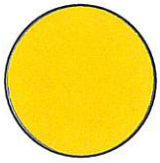


We can apply this to describe the motion of Moon

3 Phases of Moon

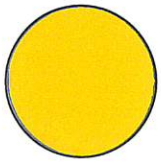
Consider various arrangements of the Sun, Earth and Moon. For each, illustrate the shaded side of the Moon and describe how the Moon appears when viewed from Earth.

a) Earth between Moon and Sun.



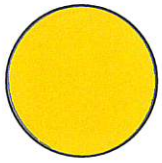
Full

b) Moon between Earth and Sun.



New

c) Perpendicular arrangement.



Between new & full

d) Use this model to describe whether a "full" Moon can be viewed at midnight or midday.

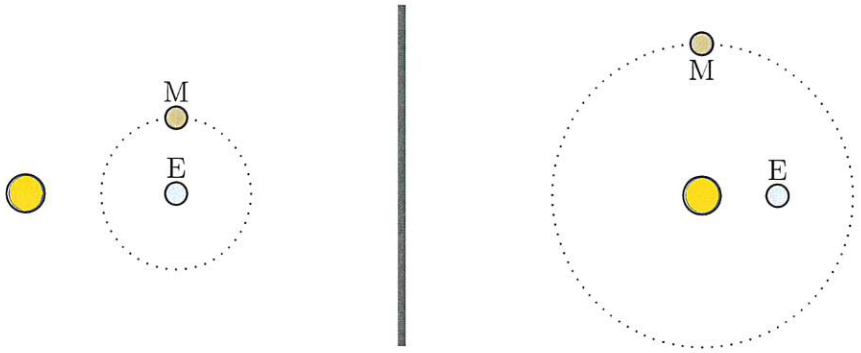
e) Use this model to describe whether a "new" Moon can be viewed at midnight or midday.

d) In each case 1 = midday
2 = midnight

Midnight can see full, midday not

e) Midday can see new, midnight not.

f) The previous model assumes that the Moon orbits around the Earth. Consider a model in which the Moon orbits around the Sun in the illustrated circle.



How could you use the Moon's phases to decide which one of these models is correct? Describe *what* you would observe, *what each model would predict about such observations* and then *how to decide.*

Observe the phases of moon.

Left model predicts a full cycle new → full → new

Right model predicts full → partial → never new

Check whether new occurs. If it does right is incorrect

If it does not left " "

Geocentric Model

The planets appear to move relative to the stars as the nights pass. The oldest and maybe most intuitive model that describes this is a geocentric model, due to the ancient Greeks (~2000-2500 years ago).

Text pg 9 Fig 1.5

DEMO: Villanar left side
Video

The ingredients of this model are:

1) Earth is stationary
2) Earth is at the center of all celestial objects
3) All celestial objects orbit in circular paths centered on Earth.
4) The motion of any given planet is uniform (same direction and same angle every hour). The rate of motion of one object is different to another.
5) Stars are all the same distance from Earth and are very much further than any other objects.

We will use this to predict what we could observe about planetary motion. The particular observation is recording the position of the planet compared to the stars.

We can observe — position of planet relative to background stars

We can use model — predict what it says about position of planet relative to background stars

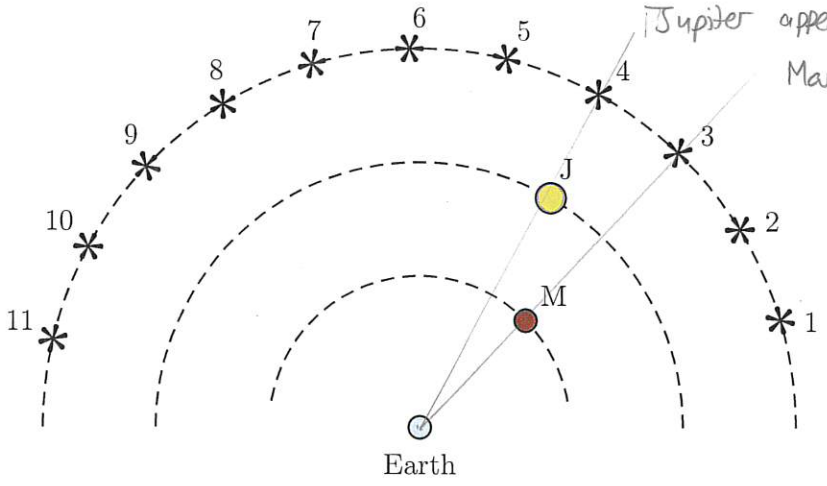
COMPARE PREDICTION AND OBSERVATION

2 Geocentric model predictions

Consider Mars (labeled M) and Jupiter (labeled J) in a geocentric model. They orbit along the indicated trajectories. One can observe the apparent positions of against the background stars (labeled 1,2,3,...) when viewed from Earth.

a) On one particular day, the planets and stars are arranged as illustrated.

Construct a line of sight from Earth to planet

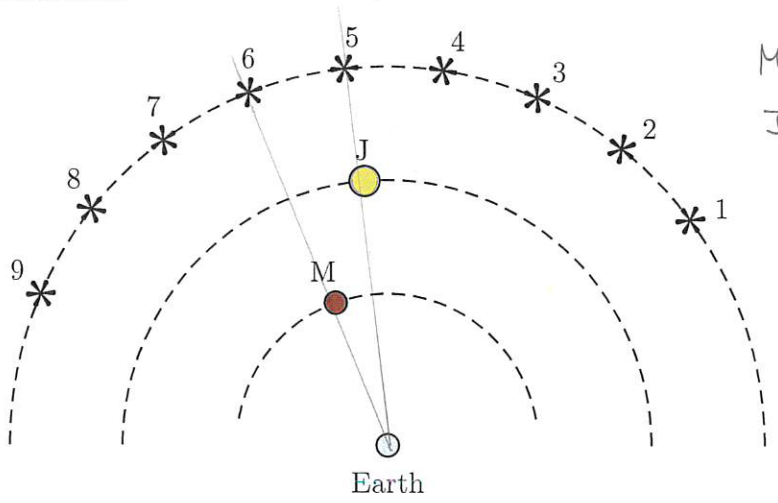


Jupiter appears at Star 4

Mars appears at Star 3

Mars and Jupiter are observed from Earth. Where do they appear to be relative to the background stars?

b) Many days later, a particular geocentric model predicts that the planets and stars are arranged as illustrated.



Mars appears at Star 6

Jupiter appears at Star 5.

Mars and Jupiter are observed from Earth. Where do they appear to be relative to the background stars? In this particular model, does Jupiter appear to move (relative to the background stars) at the same (angular) rate as Mars? Explain your answer.

Jupiter seems to move at a slower rate only 4→5

Mars " " " " " faster rate 3→6

We can use models like this to predict the apparent position and motion of the planets. We will need to supply more details

Quiz 1 80%

Quiz 2

If the planets rate of orbit is different to the background stars then it will appear to move steadily in one direction. So we have

Construct model

Example → Geocentric, planet + background stars move at different angular rates

↓ predict

Use model to predict what observations might yield

↓ Mars (and other planets) appear to move steadily in one direction against background stars

↕ compare

Do actual observation

↕ compare

Planets do not move steadily against background stars. They occasionally reverse direction of motion. (this reversal is called retrograde motion)

DEMO

APOD - Mars
- Saturn
- Venus

AGREE? → keep model

DISAGREE? → reject model

In this case the prediction disagrees with the observed behavior.

So

The simple geocentric model of the solar system is not correct