Phys 100 2024

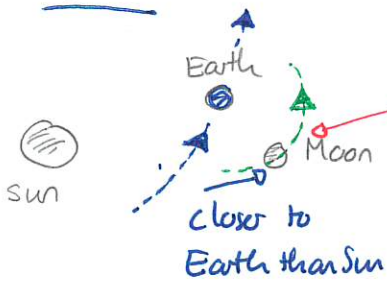
Lecture 3

* Survey - turn in
* Monday - read 1.4, 1.5 in advance
  - text on D2L
* Friday - HW due by 5pm
  - Slightly different style question to test
  - HW help - office hrs
  - Tutoring + Writing Center.

Solar system models

We would like to construct a model for the solar system that describes its behavior. The scheme is:

Identify objects and describe their locations



→ Propose a way in which the objects behave ie.
* pattern of motion
* orbits

→ Use the model to predict what we can observe from Earth.

→ Does the model predict correctly or not?

YES → model could be correct

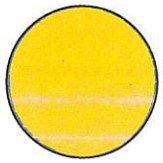
NO ⇒ model cannot be correct

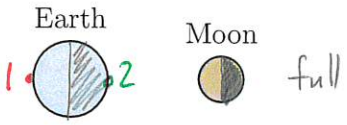
We apply this to the motion of the Moon.

1 Phases of Moon

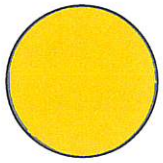
Consider the following arrangements of the Sun, Earth and Moon (assume that the Moon is slightly above the surface of the paper). For each, illustrate the shaded side of the Moon and describe how the Moon appears when viewed from Earth.

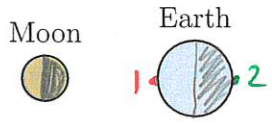
a) Earth between Moon and Sun.





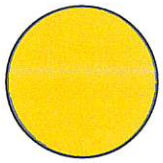
b) Moon between Earth and Sun.

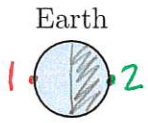




new

c) Perpendicular arrangement.





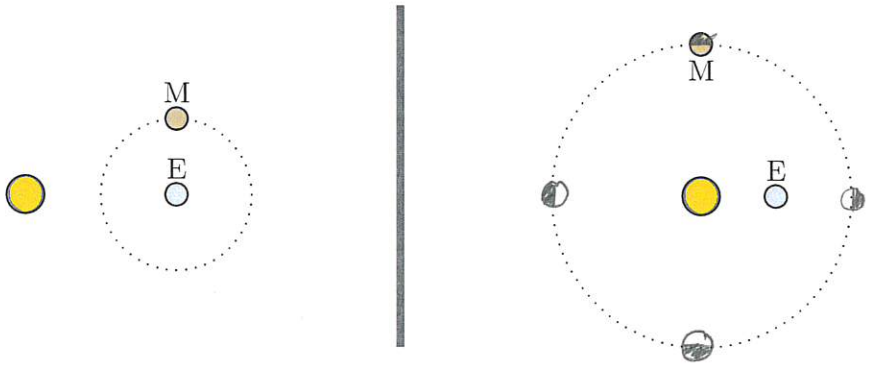
d) Use this model to describe whether a "full" Moon can be viewed at midnight or midday.

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

d) midday ~ 1 midnight can see full
midnight ~ 2 midday cannot see full.

e) mignight cannot see new
midday can see new

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.*

* Obseve phases of Moon
* Left model predicts a full cycle visible from Earth

  new -> full -> new

  Right model predicts that one will never see new.
* check whether observations show new moon
  - if yes left is correct
  - if no right is correct.

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: Villanova ~~left side~~ Brittanica 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

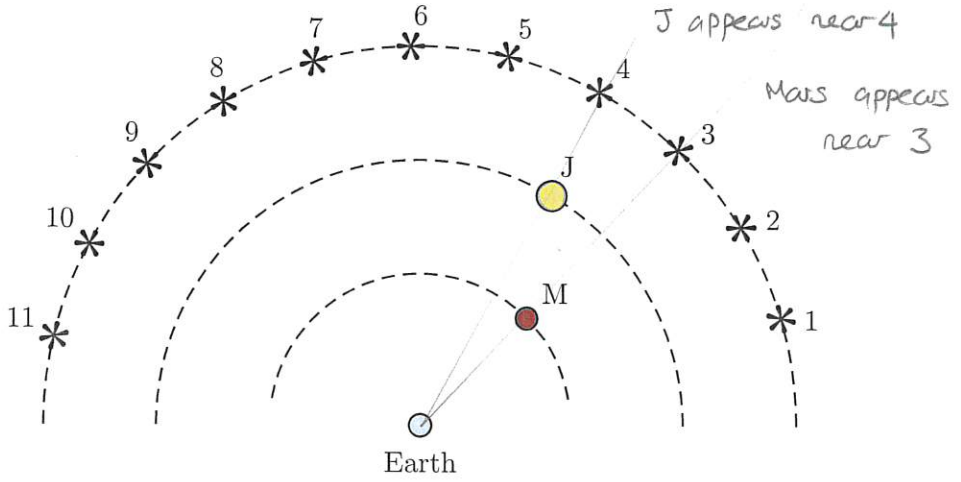
We can use model — predict what it says about position of planet relative to background stars

COMPARE PREDICTION AND OBSERVATION

2 Geocentric model predictions

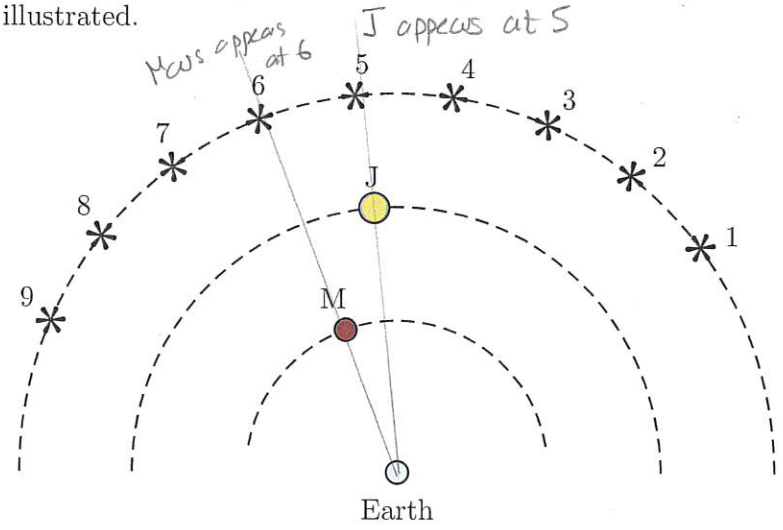
Consider Mars (labeled M) and Jupiter (labeled J) in a geocentric model. They orbit along the indicated trajectories. One can observe the apparent positions of against the background stars (labeled 1,2,3,...) when viewed from Earth.

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



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 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.

Mars appears to move faster

Jupiter " to move slower

Models like this predict how the planet appears to move relative to the background stars. This is the apparent motion of the planet.

Quiz1

Quiz2

Such models predict that if the planets rate of orbit (rate at which it covers angle) is different to the rate of the background stars then the planet appears to move steadily in one direction. We need to compare to what we actually observe. What do we actually observe?

Schematically we are doing a process used throughout sciences: