

# Overview of Unit 2

*Quickly dispense with the ancient (Earth-centered)  
view of our Solar system: Ptolemy*

*Spend most of Unit 2 on the modern (Sun-centered) view:  
Copernicus, Kepler*

*Physics 090*

*2020-03-02*

## Unit 2 - Looking Ahead

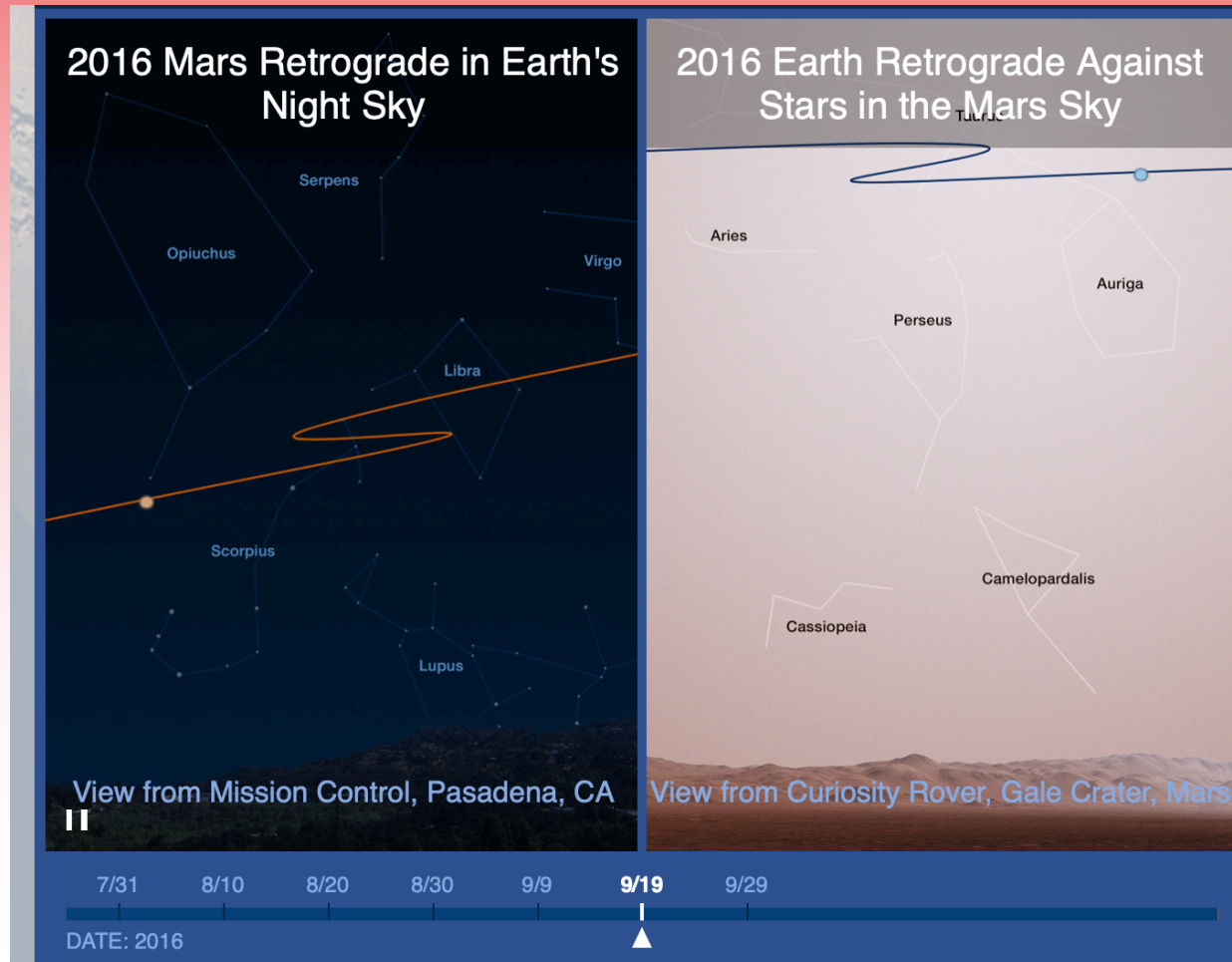
- This unit is on the Motions of the Moon and Planets.
- We'd like positions, including distances, and we'd like sizes too.
- We will trust that most others have been calculated correctly without knowing the method, and simply try to appreciate the astronomical distances and sizes.
- We'd like explanations in terms of a small number of principles.
- We will spend little time on the history wherein Ptolemy's (Earth-centered Solar system) was overthrown by Copernicus' (Sun-centered Solar system).
- The modern explanation was established in a sequence of great leaps driven by both observation and inspiration (starting with Brahe and Kepler). Galileo cemented the Copernican view with his telescopic observations.
- Newton will have to wait until Unit 3.

OK, let's have a little Ptolemy....

*Ptolemy's view is scientific, but not modern. Just a small amount of historical development and then the overthrow of the Ptolemaic view.... Ptolemaic and Copernican and what they refer to, including epicycles, and what happened to Galileo. We will focus on modern ideas and only use the historical ideas to help understand them.*

- For some reason, it became dogma that (a) the Earth was the center of all of creation, and (b) that anything that moved around the Earth had to move in divinely perfect circles.
- Anyone who watches very carefully can see that there are five visible planets — no telescope required! — and that the planets do not follow paths in the stars that match up with the idea that they are going in perfect circles. This is "The Problem of the Planets" (Plato).
- In particular, the planets have prograde motion (west to east through the stars) most of the time, but sometimes for a few weeks in the case of Mars, they have retrograde motion (east to west through the stars).

# Retrograde Motion



[NASA Web Page on Mars Retrograde Motion](#)

## The overthrow of Ptolemy

- Mars moves prograde, then briefly retrograde, then prograde again.
- The modern understanding of this is that the Earth is moving too!
- Anyway, if you are stuck with perfect circles and an Earth-centered view, you have a problem.
- Ptolemy solved that problem in *The Almagest*. Although it was a mess that got more tangled with time, he got the theory and observation to agree well enough that his view was the majority view from his lifetime (100-170) until past Copernicus (1473-1543).
- Kepler (1571-1630) with his ellipses and Galileo (1564-1632) with his telescopic observations settled the argument in favor of Copernicus.
- In a deep sense, the argument wasn't possible to fully settle until parallax was detected in 1839 (by Bessel). Ignore this fact for now. It will mean much more later. I just added it for completeness.
- Without further ado here is an animation of Ptolemy's view.



Ptolemy's Universe — a lovely animation showing epicycles  
[principiauniversi.com](http://principiauniversi.com) — <https://youtu.be/EpSy0Lkm3zM>

