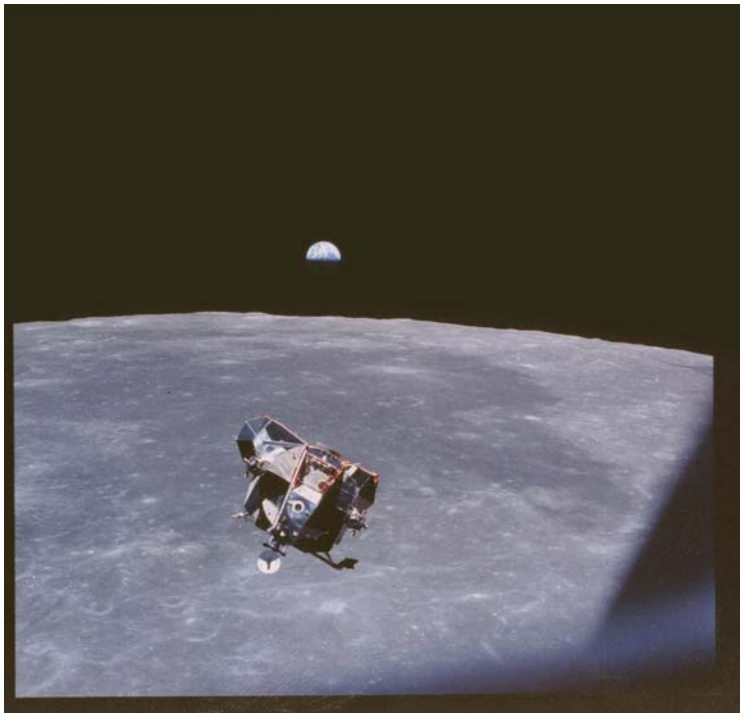
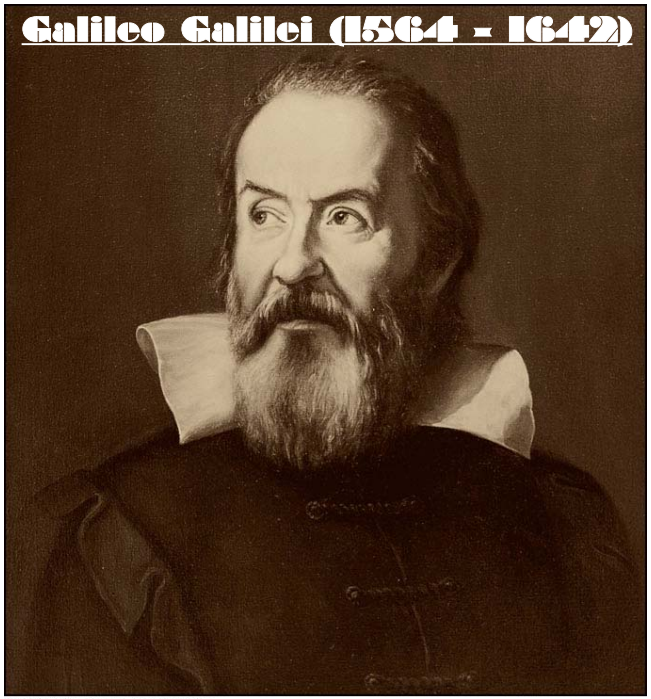
Lecture 5: The Takehome Message

The essence of modern science is its ability to make testable predictions.



Galileo Galilei (1564 - 1642)



(Fraknoi,Morrison, & Wolff: *Voyages to the Stars and Galaxies,* 3rd Edition, Figure 1.17, Page 36)

Week #4 Handout, 2009.02.10
Astronomy 101, Professor Douglas Leonard

Announcements

- **First on-line Reading Quiz due tonight!** The first on-line reading quiz ("Quiz 1"), based on material from your reading for the last two weeks, is due tonight, Tuesday, February 10, by 11:55 PM. After that time, the reading quiz will no longer be available, and **no late assignments will be accepted for any reason.**
- **Reading Quiz solutions available online.** Complete solutions to all reading quizzes are posted to the textbook website ten minutes after the quiz is due, and are called, e.g., "Quiz 1: Solutions". Note that these are complete, worked-out solutions with explanations, not just answers. You can access these solutions by logging onto the textbook website, clicking on the "Assignment/Tests" tab, and then clicking on either the "Print blank assignment" link or the "Take" button. Clicking on the "Print blank assignment" link produces a pdf file of the solutions that can be printed out. Clicking on the "Take" button allows you to "take" the quiz again, but this time with the solutions included. Note that if you "take" the quiz again, your score does not count; re-taking the quiz is just for your own practice.

  The quiz solutions are also available at the course website (http://sciences.sdsu.edu/~leonard/astro101) by the end of each week that a quiz is due, and are accessed by clicking on the "On-Line Reading Quiz Solutions" link on the course homepage.
- **Planetarium shows:** As mentioned in last week's handout ("*Week #3 Handout*"), *optional* planetarium shows continue to be given this week in the astronomy department's planetarium, Rm. PA 209 (physics-astronomy building). While it is not required that you attend a show, I *strongly encourage* you to take advantage of this opportunity to enhance your understanding of the night sky. Shows last less than 1 hour, and are being given at the following times (all shows are similar):

  Tue. Feb 10: 4:00 PM
  Wed. Feb 11: 1:00 PM
  Thu. Feb 12: 11:00 AM and 2:00 PM
  Fri. Feb 13: 11:00 AM

  Since the planetarium can only accommodate 45 students per show, to attend a show *you must first* sign up on the sheets posted on the door to the planetarium (Rm. PA 209). See the *Week 3 Handout* for additional details.

Reading Guide and Homework Assignment
(Second On-Line Reading Quiz Due: Tuesday, February 17, 11:55 PM)

This week, we begin Chapter 2 of your text. These sections complement the largely descriptive lectures by presenting the material in a somewhat more mathematical manner. While the lectures focused on gaining an understanding of the concepts, this reading will help you get a more quantitative understanding of the mathematics underlying the physical relationships that were described to you in class.

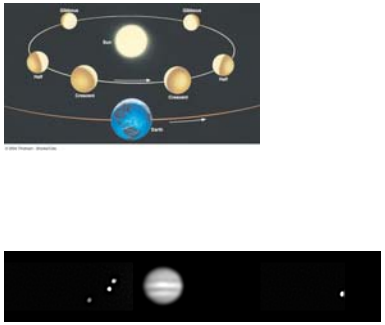
1. **Text – Chapter 2, Section 2.1:** *The Laws of Planetary Motion.*

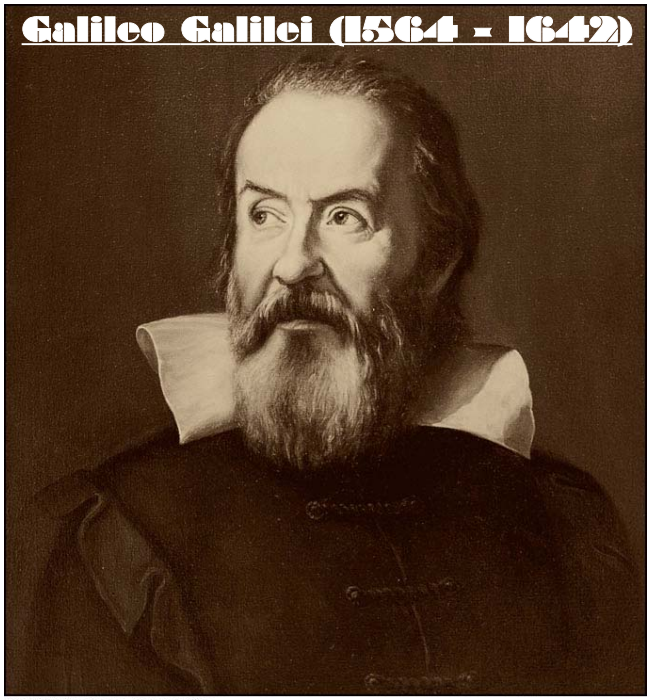
   This section focuses on Johannes Kepler and his discovery of three important laws of planetary motion. It also provides some background concerning his relations with the great Danish observer, Tycho Brahe. The concepts underlying the laws that Kepler discovered were described in class in some detail; in your text, the description of them is given a bit more quantitatively. We'll add this math in next week in class.

2. **Text – Chapter 2, Section 2.2:** *Newton's Great Synthesis.*

   Here you read about Newton's Three Laws of motion, as encapsulated in his masterwork, *The Principia*. These were all discussed in class, and so should be relatively familiar to you. Finally, read about the important physical concepts of mass, volume, density, and angular momentum.

1

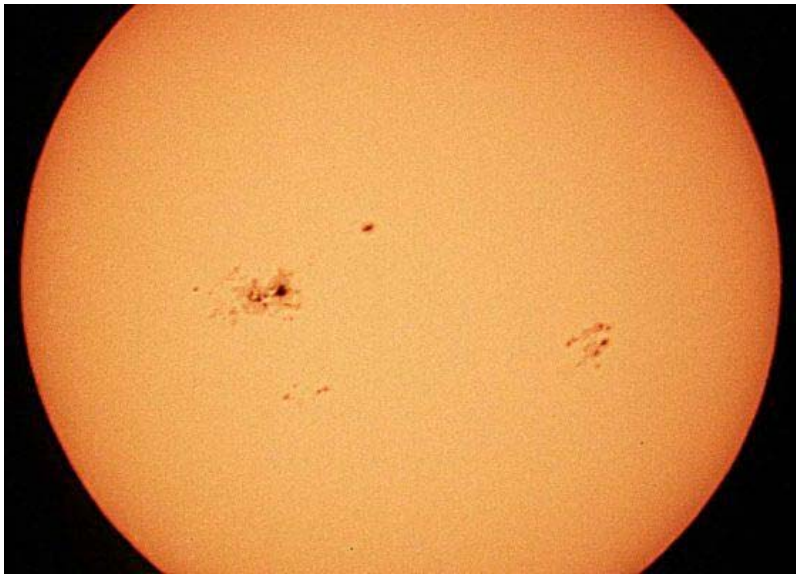




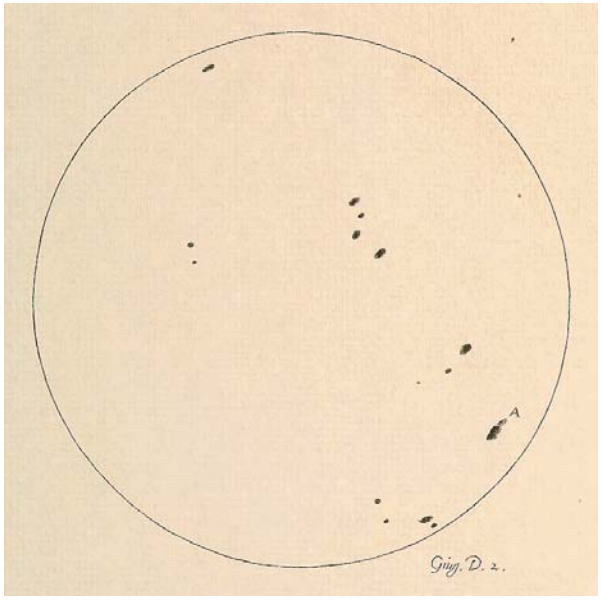
(Fraknoi,Morrison, & Wolff: *Voyages to the Stars and Galaxies,* 3rd Edition, Figure 1.17, Page 36)

Galileo's Telescopic Discoveries

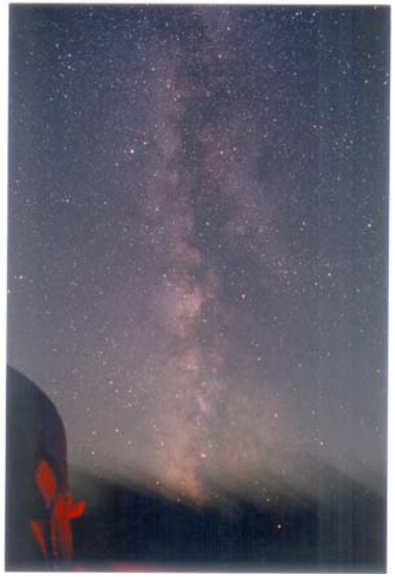
- **Phases of Venus**
- **Jupiter's moons**



Galileo's Drawing of "Sunspots"

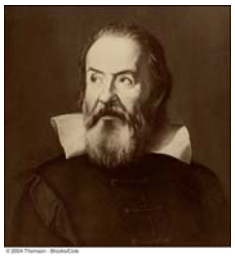


The “Milky Way”



Galileo's Telescopic Discoveries

- Phases of Venus
- Jupiter's moons
- Moon's craters
- Sunspots
- Milky Way made up of "innumerable stars"

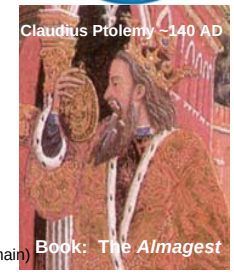


Cosmology

The study of the Universe as a whole: its contents, structure, origin, evolution, and ultimate fate.

Geocentric: Earth-centered

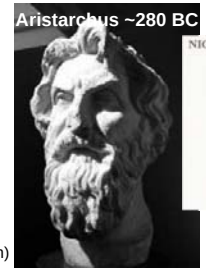
(Figure: Fraknoi, *Voyages*, Figure P.5, Page 8)



(image: public domain)

Heliocentric: Sun-centered

(image: public domain)



(image: public domain)

Galileo's Telescopic Discoveries

79

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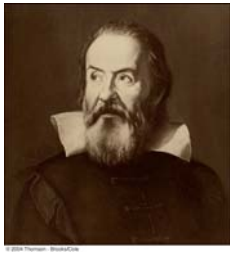

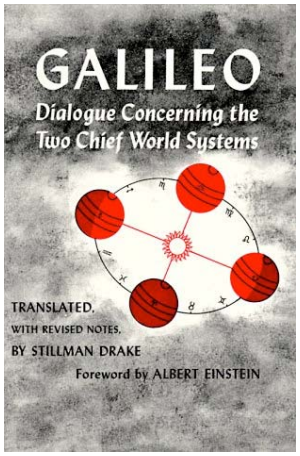

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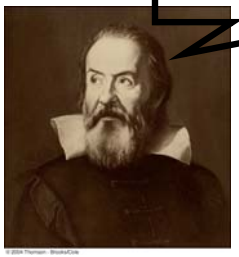

Galileo's Contributions to Science and Mechanics

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Mechanics: The branch of physics that concerns the study of motion and the action of forces on bodies.

Galileo's Contributions to Science and Mechanics

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14

(Fraknoi,Morrison, & Wolff: *Voyages to the Stars and Galaxies,* 3rd Edition, Figure P.5, Page 8)

Galileo's Contributions to Science and Mechanics

Mechanics: The branch of physics that concerns the study of motion and the action of forces on bodies.

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Galileo's Contributions to Science and Mechanics

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- Law of Inertia: Every body tends to continue doing what it is already doing -- being in a state of rest, or moving uniformly in a straight line -- unless it is compelled to change by an outside force.

→ Only a change in motion requires a force.

Galileo's Contributions to Science and Mechanics

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→ **Only a change in motion requires a force.**

→ **Galileo's Principle of Equivalence: There is no way to tell locally the difference between being in a reference frame that is at rest or one that is moving at a constant speed in a constant direction.**

Two Fundamental Questions about the Planets

83

What are the precise paths taken by the planets as they revolve around the Sun?

Why do the planets follow the paths that they do?

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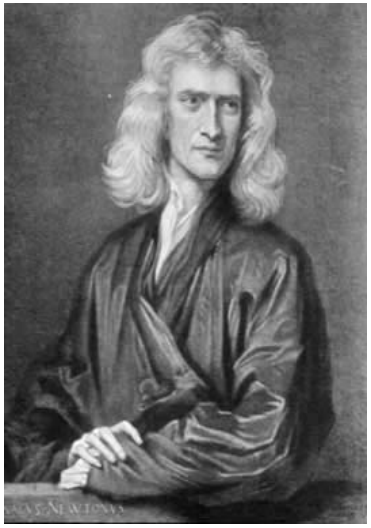

(Fraknoi,Morrison, & Wolff: *Voyages to the Stars and Galaxies,* 3rd Edition, Figure 2.2, Page 44)

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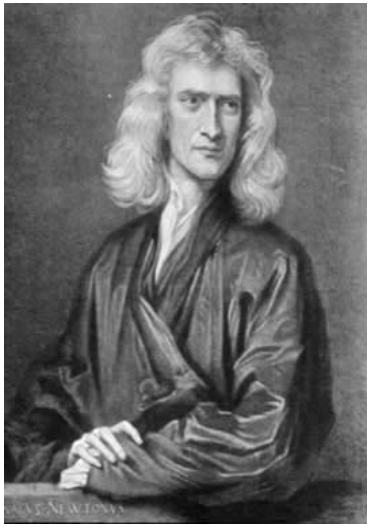

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(Fraknoi,Morrison, & Wolff: *Voyages to the Stars and Galaxies,* 3rd Edition, Figure 2.2, Page 44)

Law of Inertia: Every body tends to continue doing what it is already doing -- being in a state of rest, or moving uniformly in a straight line -- unless it is compelled to change by an outside force.

Lecture 6: The Takehome Message

The foundation upon which modern physical science is built was established during the 16th and 17th centuries by the work of Kepler, Galileo, and Newton.