Astro 301/ Fall 2005

(48310)

Introduction to Astronomy

Instructor: Professor Shardha Jogee

TAs: David Fisher, Donghui Jeong, and Miranda Nordhaus

Lecture 8 + 9: Tu Sep 27, Th Sep 29

http://www.as.utexas.edu/~sj/a301-fa05/

Recent and upcoming topics in class

The upcoming topics are the most math-oriented chapters of this entire course, but we will go through them slowly and use plenty of examples in class.

--- The Four Fundamental Forces (L4-5)

--- Relating Motion to Forces using Newton's Three Laws of Motion
- Mass, speed, velocity, acceleration

- Newton's 1st and 2nd Law
- Applying Newton's 1st and 2nd laws to objects moving along a circular orbit
  - Centripetal acceleration and centripetal force (end of Lec 7)
    --> Centripetal acceleration of electrons orbiting the nucleus in an atoms
    -->.Centripetal acceleration of planets orbiting about the Sun in Solar system
    --> Centripetal acceleration of stars orbiting the center of a galaxy
    --> Centripetal acceleration of stars orbiting the central black hole of a galaxy

- Newton's 3rd law
- Using Newton's 2nd and 3rd laws to understand weight and weightlessness

--- Motion of galaxies on very large scales : Hubble's Law and the Expansion of the Universe (end of L9)

Lecture 8

Announcements

- Today: pick up homework 2 at END of class

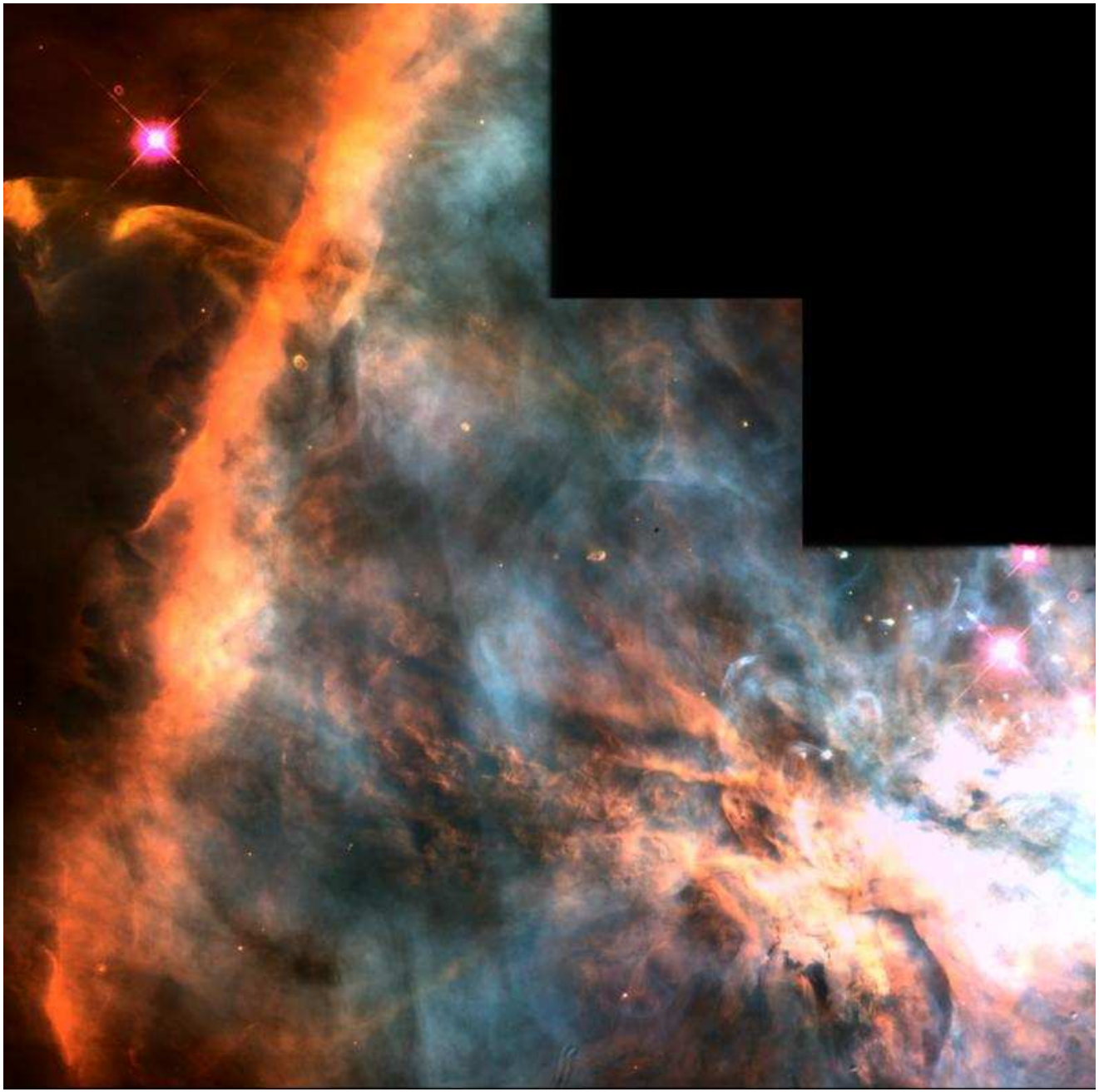
- Quiz 2 based on lectures 4,5,6,7, 8 on Th Sep 29
- Hwk 1 back on Th Sep 29. We will dicuss solution in class

- Exam 1 on Th Oct 6, 2005
We will have an in-class review on Tue Oct 4. Email me topics which are not clear for the review

Picture of the Day

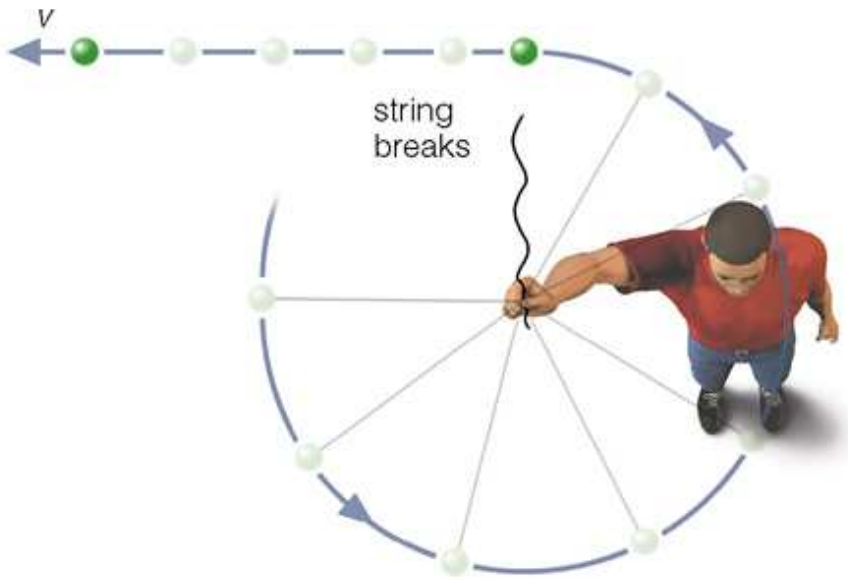
The famous Orion Nebula (M42) is an immense, nearby starbirth region: it spans ~ 40 light years across and is 1500 ly away from us, located in the same spiral arm of our Galaxy as the Sun. It contains glowing gas and dust around hot young stars **&** opencluster Trapezium.

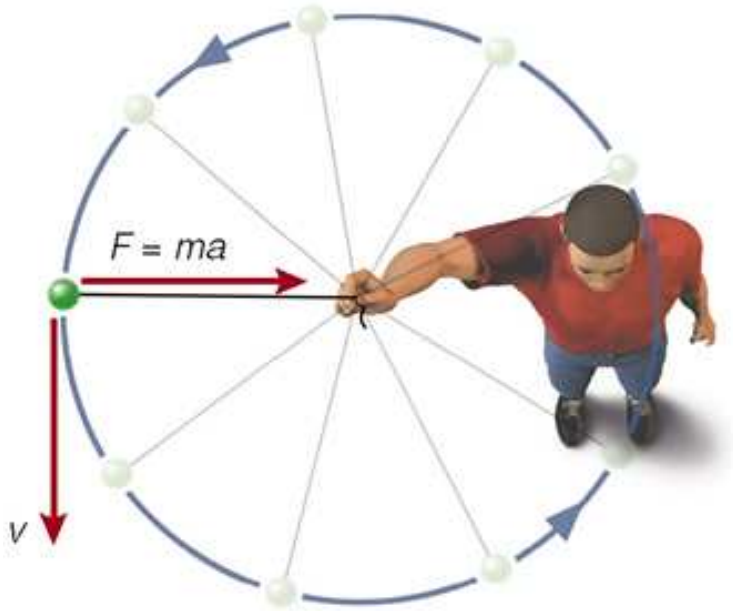
Picture of the Day



A NASA Hubble Space Telescope image of a region in M42 (the Great Orion Nebula)

Applying Newton's 1st and 2nd laws to objects moving on a circular orbit: centripetal acceleration





By Newton's 1st law: Without a net force (e.g., if string breaks), the rotating object would move at a **constant velocity** (i.e at constant speed along a straight line).

An object moving in in a circle of radius R at constant speed v experiences

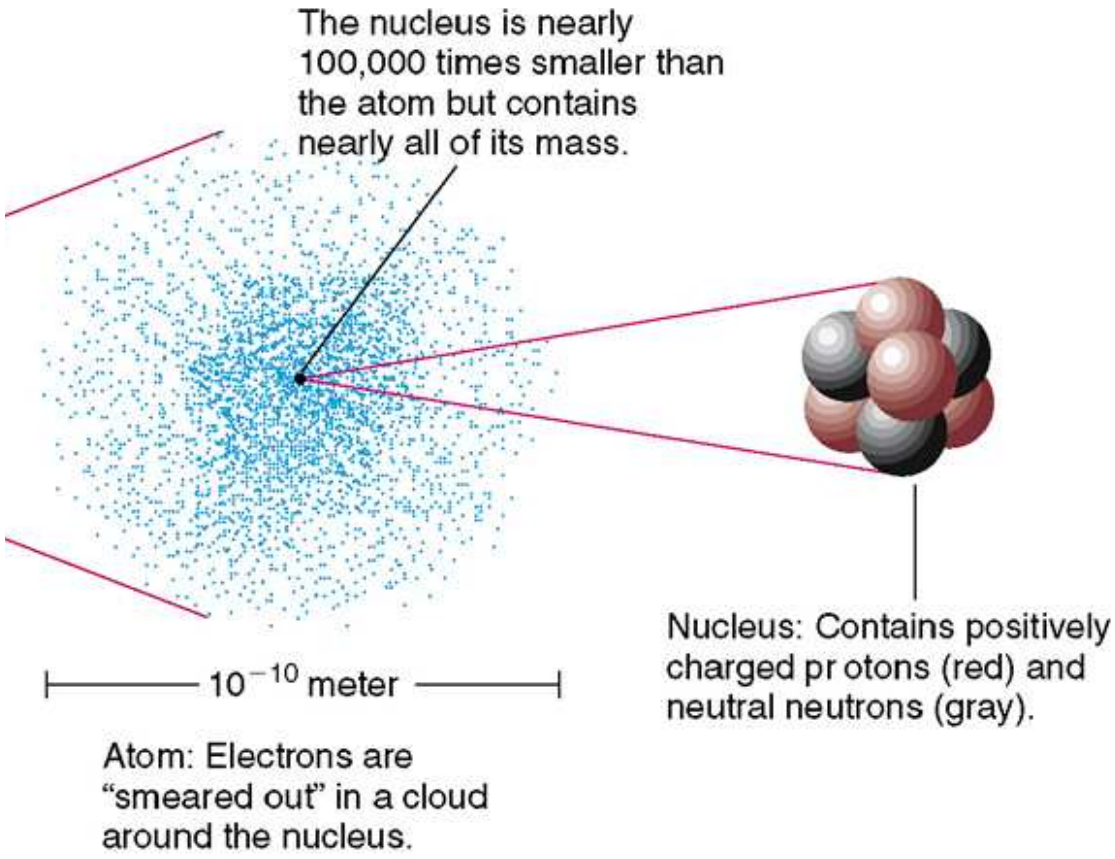
- à a continuously changing velocity
- à an acceleration ***a*** called a centripetal (center-seeking) acceleration

By Newton's 2nd law a force ***F*** **=** M***a*** must act on it to provide this acceleration.

Centripetal acceleration of different orbiting objects

--> Centripetal acceleration of electrons orbiting the nucleus in an atoms
-->.Centripetal acceleration of planets orbiting about the Sun in Solar system
--> Centripetal acceleration of stars orbiting the center of a galaxy
--> Centripetal acceleration of stars orbiting about a central black hole

Motion & centripetal acceleration of electrons orbting a positively charged nucleu

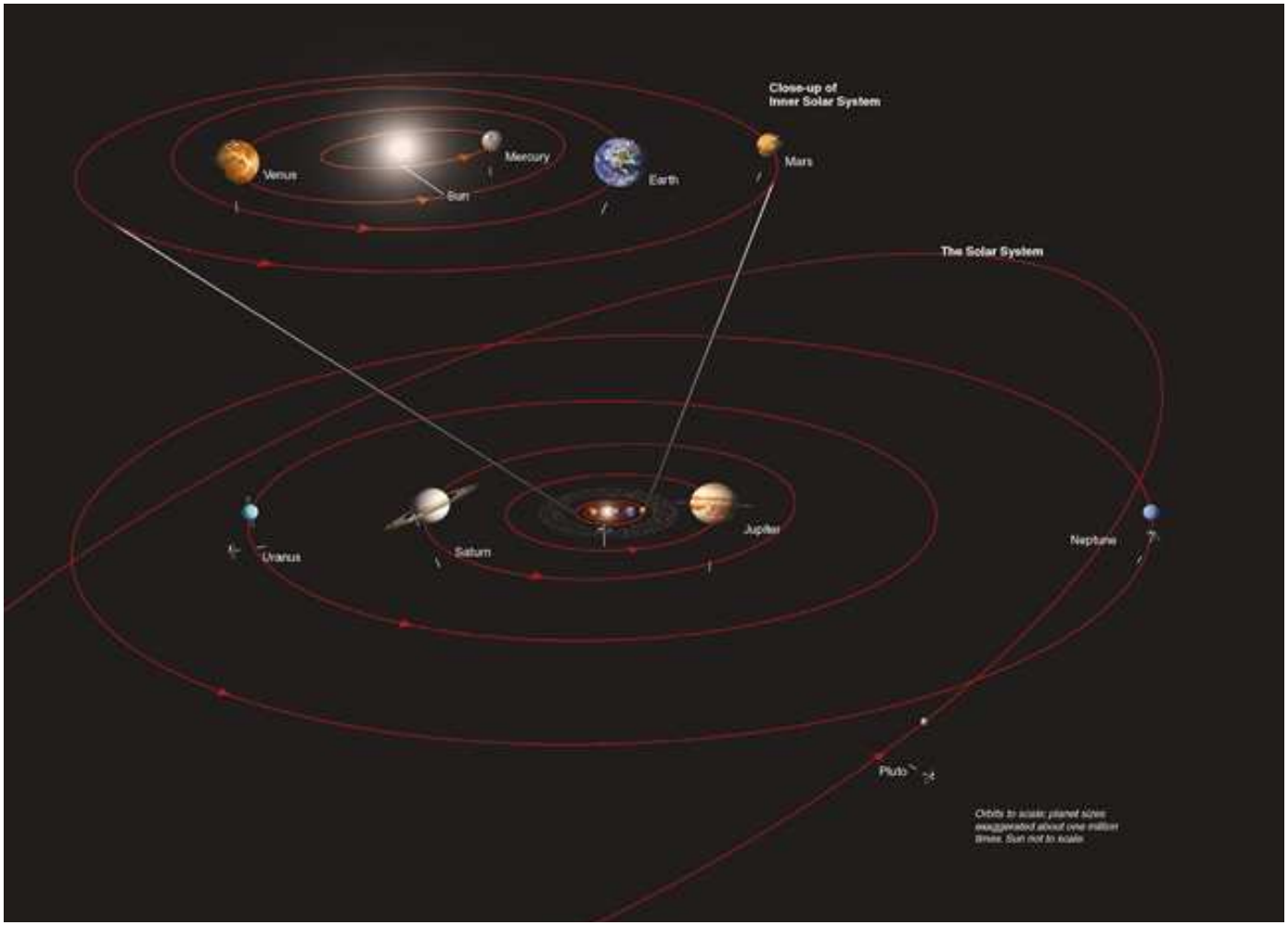


See in-class notes

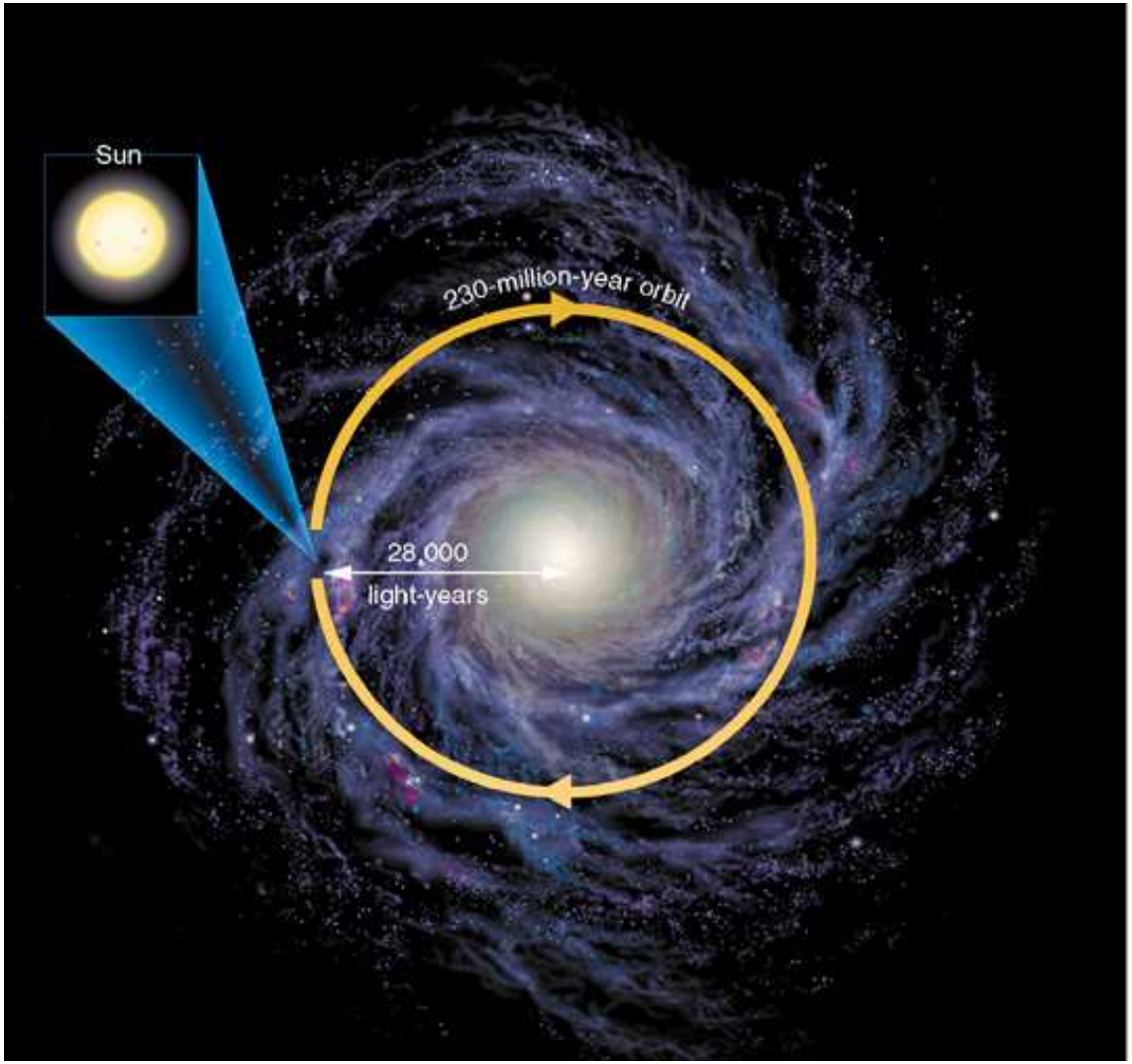
Motion & centripetal acceleration of planets in the Solar system

Planets orbit about the Sun in elliptical orbit.

Which force provides the centripetal acceleration **a?**

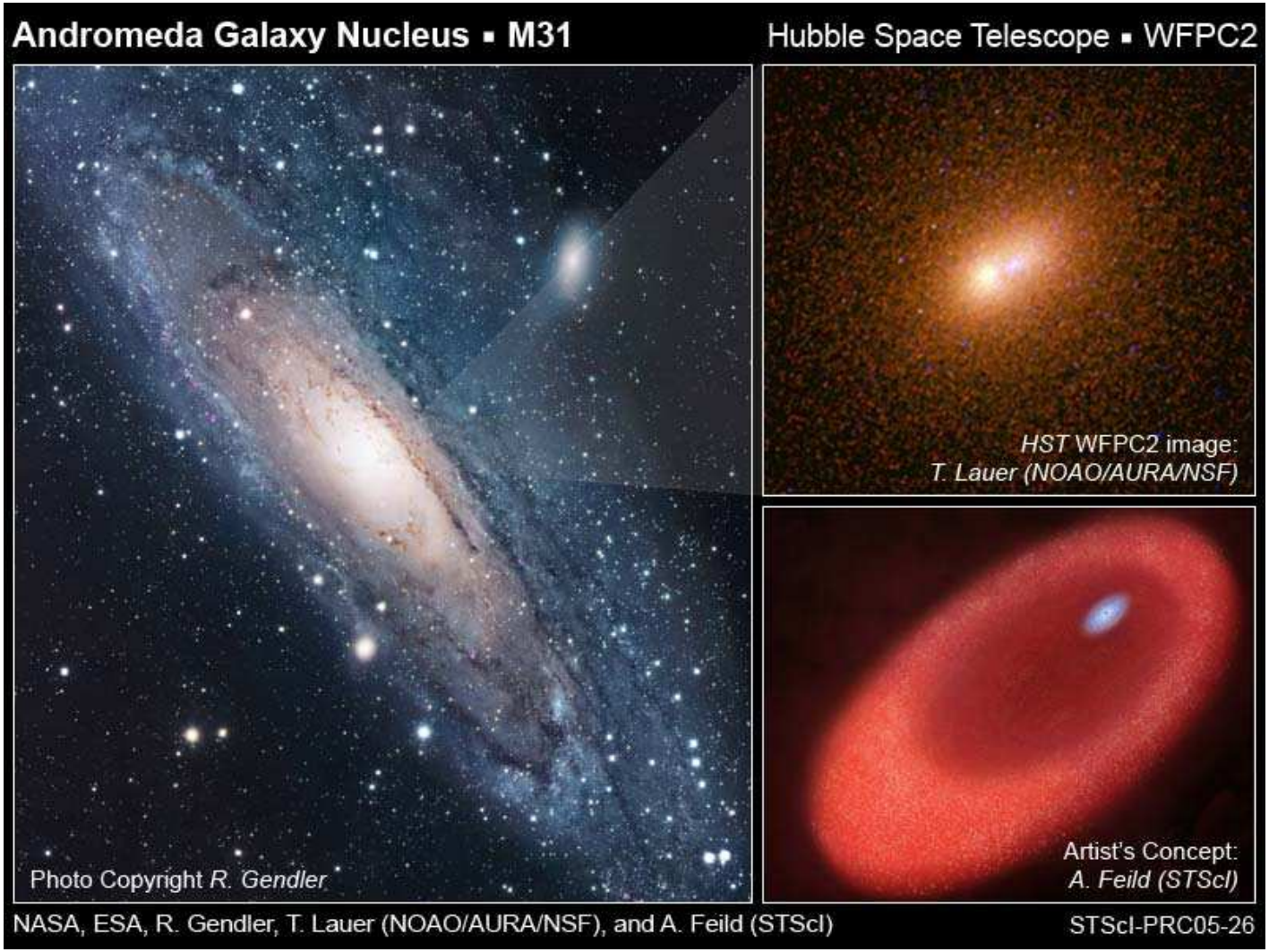


Motion and centripetal acceleration of stars about the center of a galaxy



A star at a radius R orbits about the center of a galaxy, moving in a circular orbit at a speed v.

Centripetal acceleration of stars orbiting a black Hole in M31

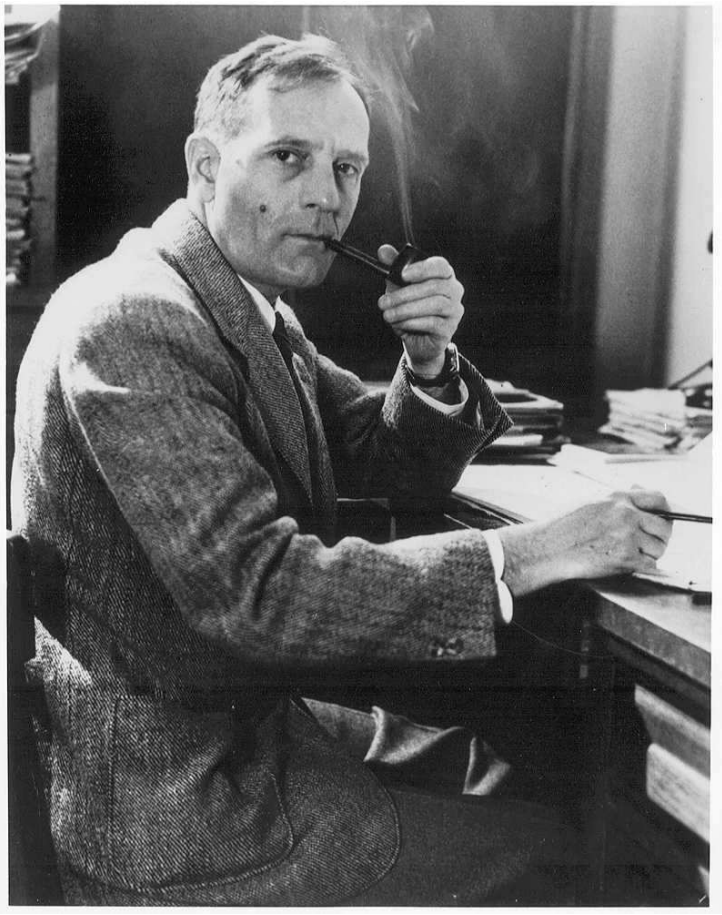


Pres release this week

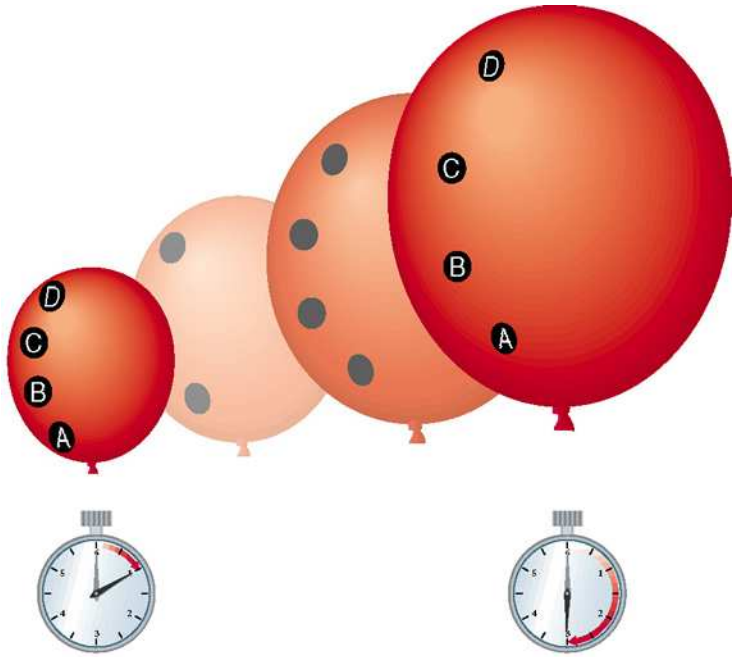
Stars close to BH experience tremendous force of gravity and orbit very fast: 1000 kilometers a second…. Would take 40 s to circle the Earth !

Motion of galaxies: Hubble's Law and the Expansion of the Universe

Motion of galaxies: Hubble's Law and the Expansion of the Universe



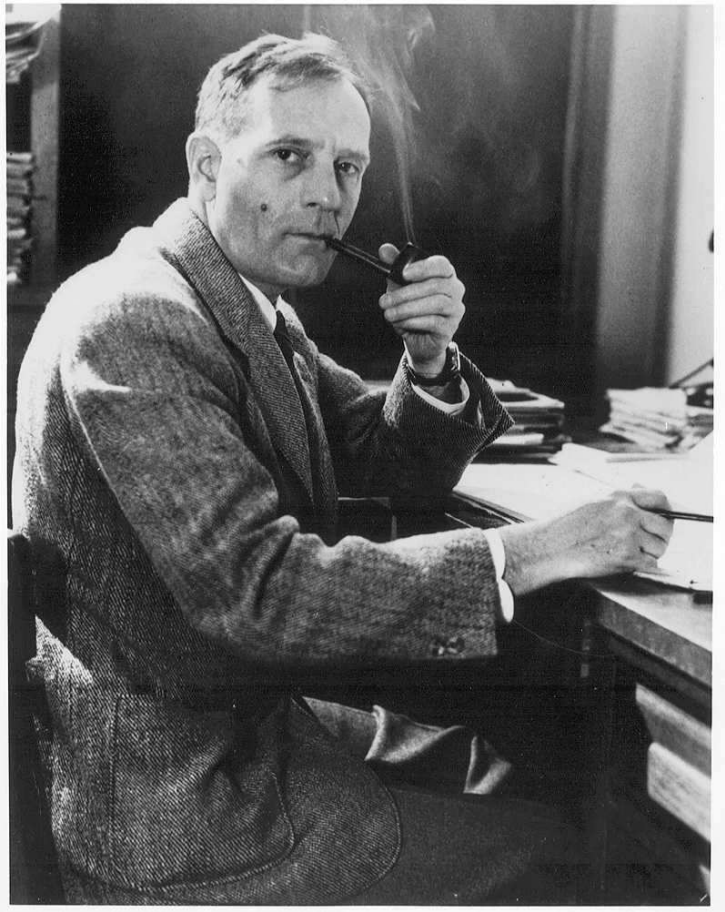
Edwin P. Hubble (1889-1953)



Hubble' law (1929) : galaxies separated by a large distance D recede from each other at speed v such that $v = H_0 \times D$

- à Evidence that the Universe is expanding…. the basis of modern cosmology
- à Einstein visited Hubble in 1931 to thank him for correcting his 'biggest blunder
- à Hubble Space Telescope named after Hubble

Motion of galaxies: Hubble's Law and the Expansion of the Universe



Edwin Powell Hubble (1889-1953)

"At the last dim horizon, we search among ghostly errors of observations for landmarks that are scarcely more substantial. The search will continue. The urge is older than history. It is not satisfied and it will not be oppressed.''

s

Edwin Hubble (1936)

Lecture 9

Announcements

- Homework 1 : pick up at start of class. 47% A, 15% B

- Quiz 2 today based on lectures 4,5,6,7, 8 on Th Sep 29

- Homework 2: due Tu Oct 4 in class

- Exam 1 on Th Oct 6, 2005 : see class website for topics included

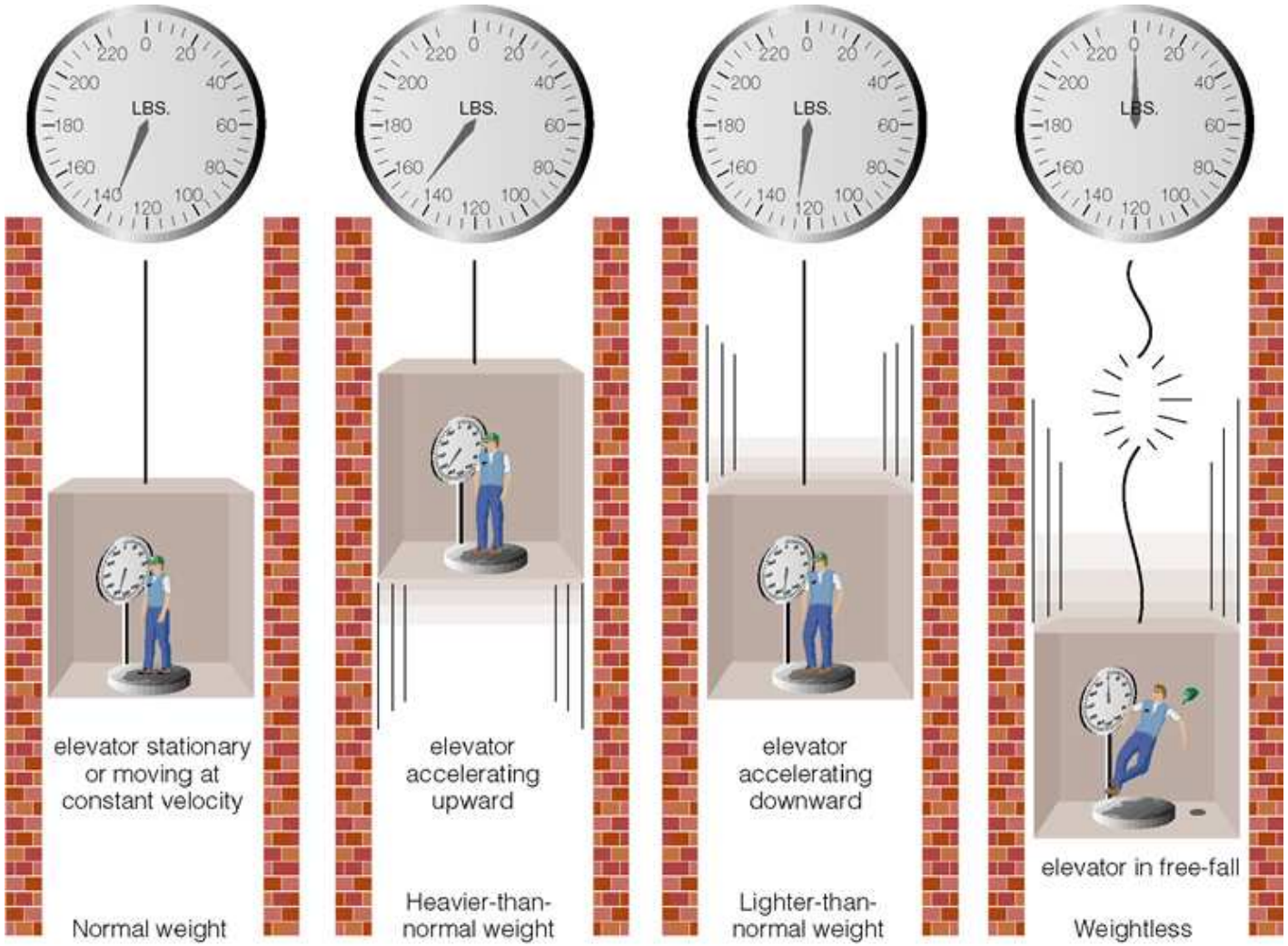
- **If you email me by Sun Oct 2** the question/topics to review, then we we will have an in-class review for the exam on Tue Oct 4. If there are no questions, then we have a regular class on Tue

Newton's 3rd law.
Weight and Weightlessness

Newton's 3rd Law of Motion

How is the rocket propelled upward?

Using Newton's 2nd and 3rd laws to understand weight & weightlessness



See in-class notes