

Welcome to **Astro 120:** **The Sky and our Solar System**

Prof. Steven Kawaler

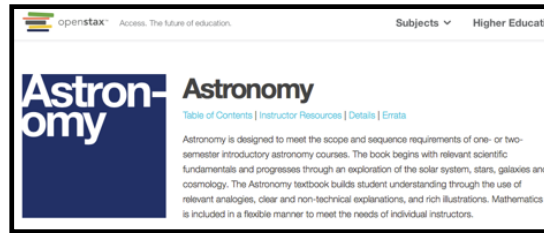
TAs: Dr. Angela Zalucha
Mr. Travis Yeager
Mr. Matthew Small
Mr. Youssef Eweis

Recitations begin *next Friday*, September 6

syllabus at:

<http://course.physastro.iastate.edu/astro120>

Textbook:
free online



This week: read Chapter 1 & Chapter 2, Sec. 2.1



“There are only two worthwhile professions: medicine and astronomy. Medicine, because you are sure to help someone, and astronomy, because you are sure you won’t hurt anyone.”

-Aldous Huxley

- Astronomy concerns things that are
 - too large to imagine
 - too far to fathom
 - too old to comprehend, and
 - too small to see

The Universe is a BIG Place

Object	Distance [km]	One Way Travel Time		
		55 mph	100,000 mph	LIGHT *
Moon	384,000	174 d	2.4 hr	1.25 s
Venus	42,000,000	54.5 yr	11 d	2.33 min
Sun	150,000,000	193 yr	2 months	8.33 min
Pluto	6,000,000,000	7,800 yr	4.25 yr	5.25 hr
α Centauri	40,000,000,000,000	30,000 yr	4.25 yr	4.25 yr

*speed of light = 300,000 km/s
677,000,000 mph
 6.77×10^8 mph

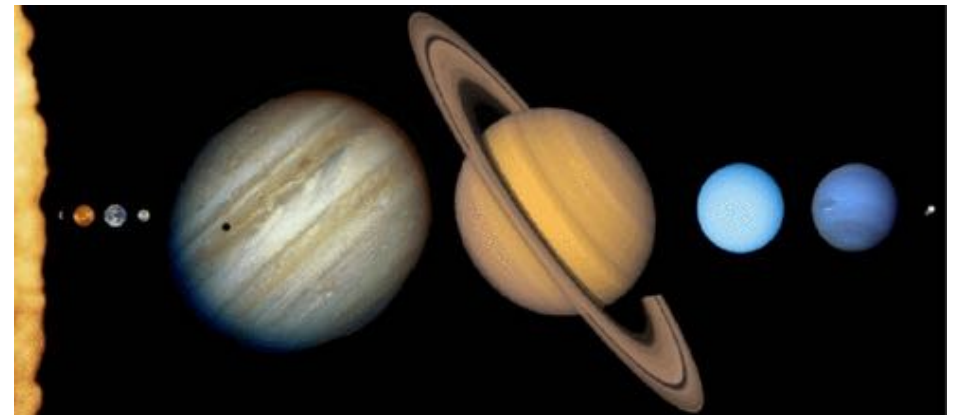
Nearest star to the Sun

Astronomical Distance Units:

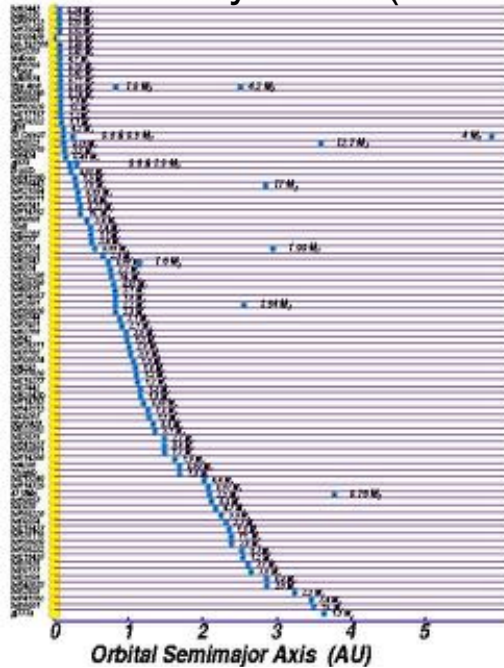
- an “a.u.” = mean distance between Earth and Sun
- a light-year = distance light travels in 1 year (=67,000 a.u.)
- 1 l.y. = 10,000,000,000,000 km = 10^{13} km = 10 trillion km

A solar system (one of many)

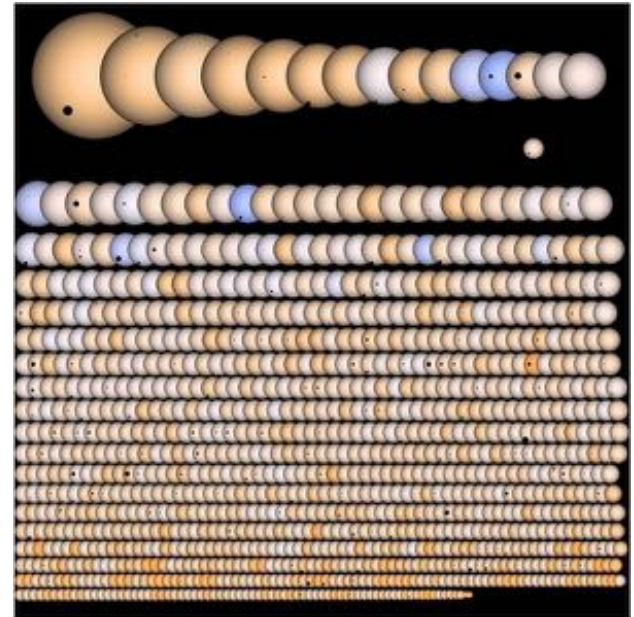
Relative sizes:



Some Other Solar Systems (~ 4000 known)



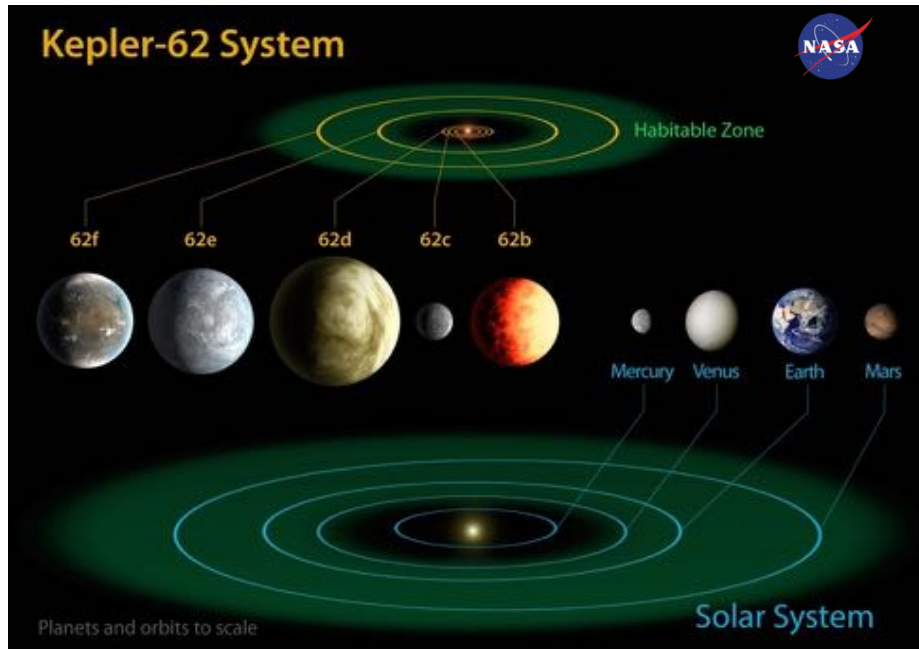
Some Other Solar Systems (~ 4000 known)



Credit: Jason Rowe, NASA Ames Research Center and SETI Institute



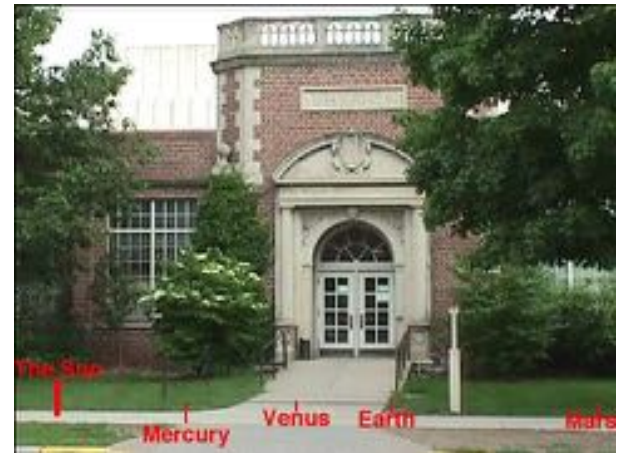
Borucki et al. 2013
announced 17 April 2013



A Scale Model: Solar System Distances

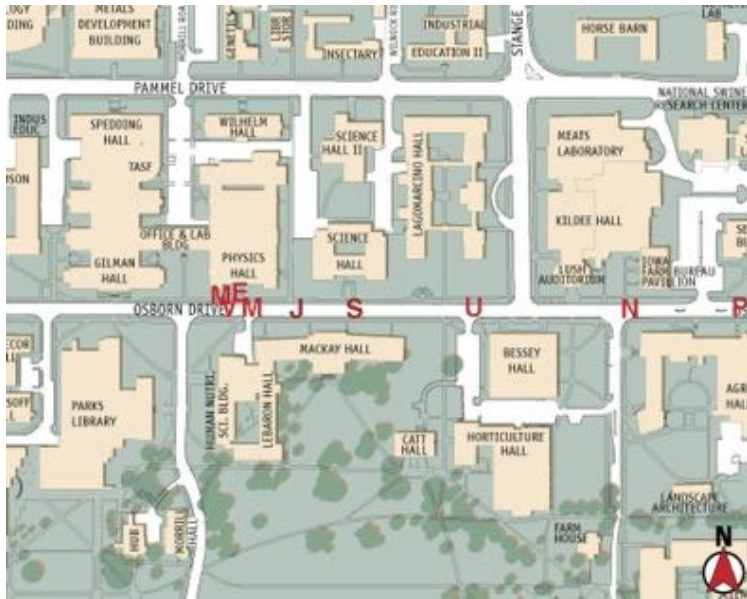
1 a.u. = 10 meters

the Sun = a softball
Jupiter = a grape
Earth = a poppyseed



each step you take - 10 million miles!

The Rest of our Solar System



The Universe is now expanding, following a Big Bang

Age of the Universe: ~ 14 billion years
 Age of the Sun: 4.5 billion years

The Universe is (almost) empty

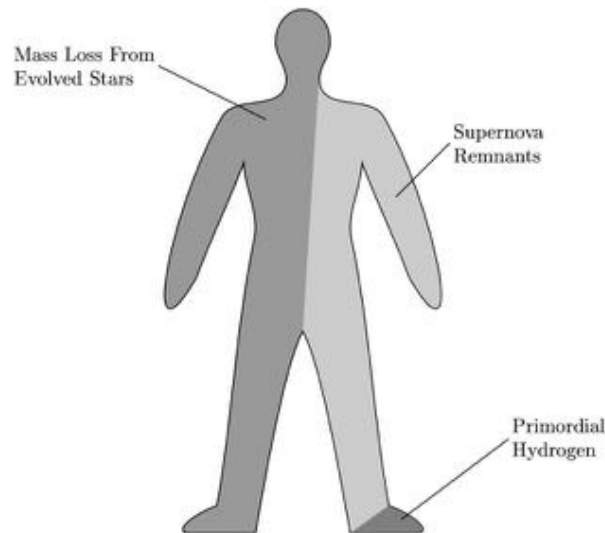
Density of water = 1 g/cc
 Density of Earth = 5 g/cc

Density of the Universe = 0.000000000000000000000001 g/cc = 10^{-23} g/cc

Chemical Composition: ~75% Hydrogen
 ~25% Helium
 < 1% everything else

All matter heavier than helium (carbon, oxygen, calcium, gold) was transformed in the centers of long-dead stars billions of years ago.

we are stardust...



courtesy Everett Lippman (UCSB)

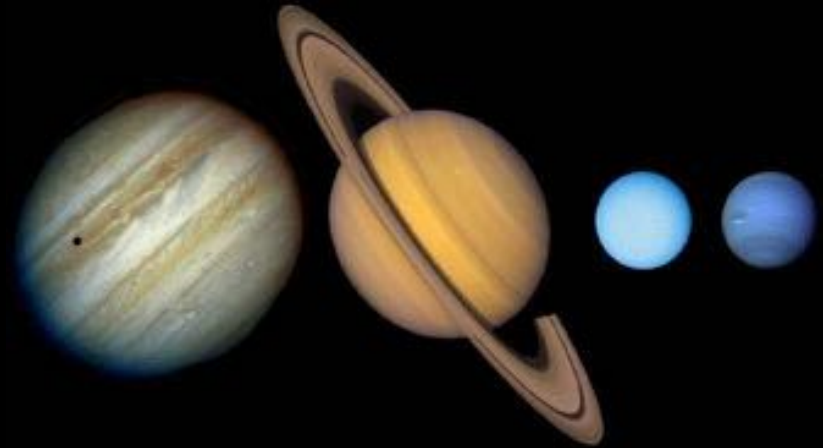
How did that stuff become us?

- **That is (ultimately) what Astro 120 is all about!**
 - structure and motions of our Solar System
 - content of our Solar System
 - planets
 - comets
 - asteroids
 - origin of the Sun and solar systems
 - other solar systems
- **Along the way we will explore**
 - worlds stranger than you have imagined
 - processes linking our Earth with these alien worlds
 - volcanos
 - weather, erosion, life?
 - impacts between bodies
 - catastrophes bigger than Hollywood has dreamed of, and
 - whether we are the only civilization in the Galaxy

The Terrestrial Planets



The Jovian Planets



Big Moons



Ganymede 5262 km	Titan 5150 km	Mercury 4880 km	Callisto 4806 km
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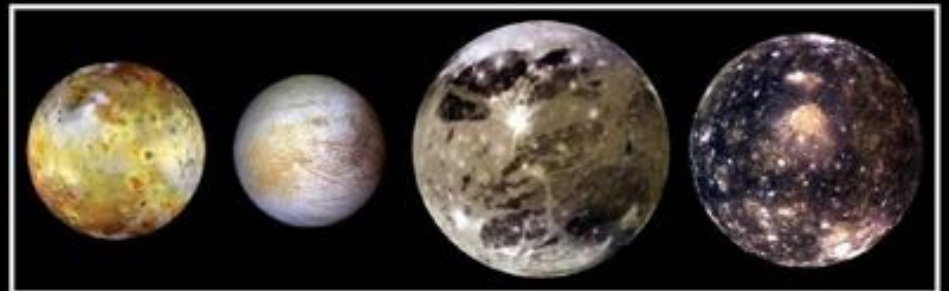


Io 3642 km	Moon 3476 km	Europa 3138 km	Triton 2706 km	Pluto 2300 km	Titania 1580 km
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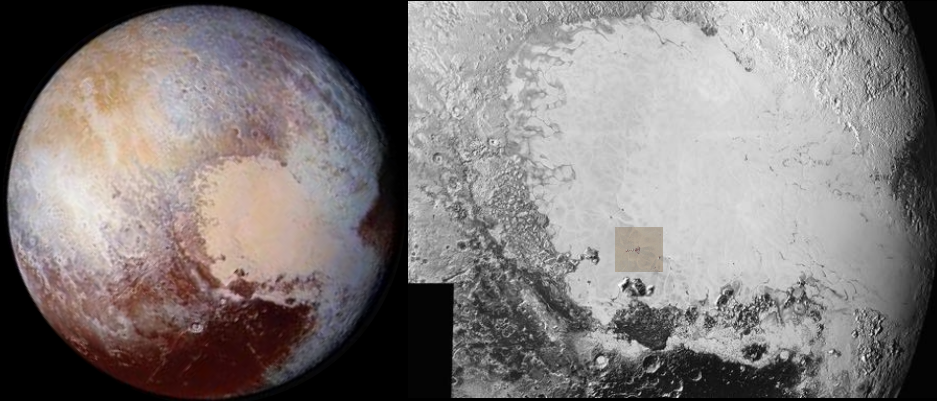
The Largest Moons and Smallest Planets

© Copyright 1999 by Calvin J. Hamilton

Jupiter's Main Moons



and then there's Pluto



Water ice mountains
floating in a sea of soft
nitrogen ice

Comets



Comets



ESO's spacecraft Rosetta at
Comet 67P/Churyumov-Gerasimenko

Asteroids

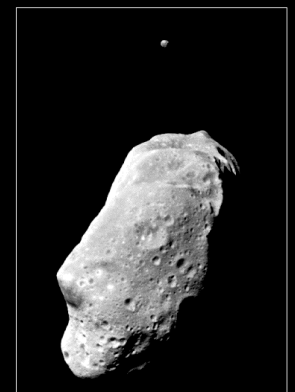


Mathilde



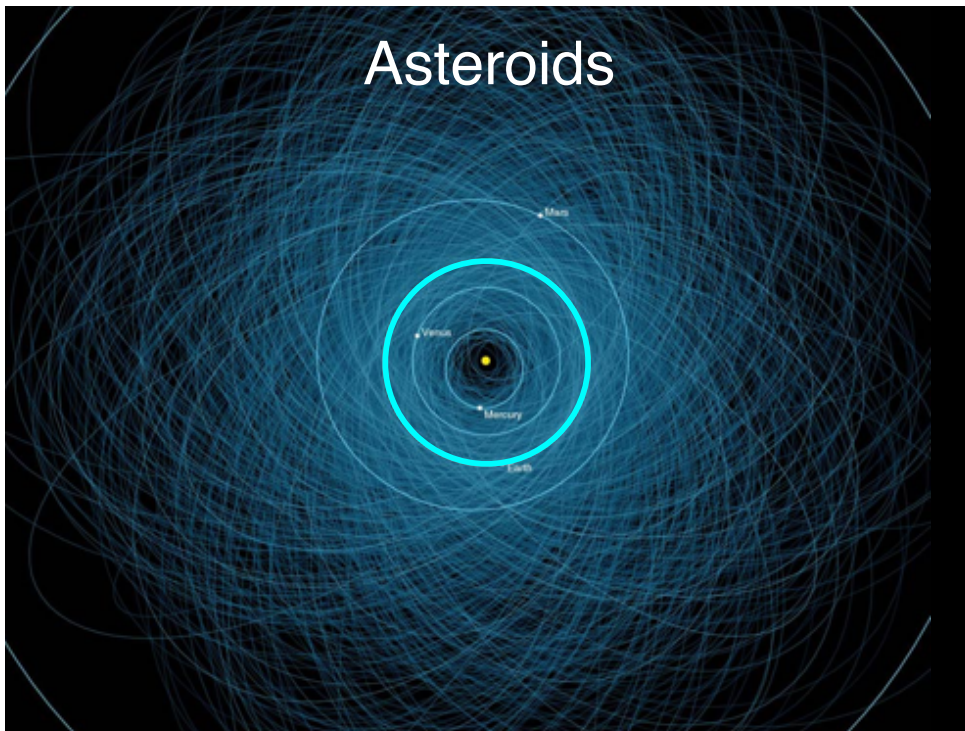
Gaspra

Ida



Ida and Dactyl

Asteroids



Impacts



65,000,000 years ago
Earth

G Impact Site

7:33 UT		Methane
7:38 UT		Red
7:41 UT		Green
7:44 UT		Blue
7:51 UT		Violet



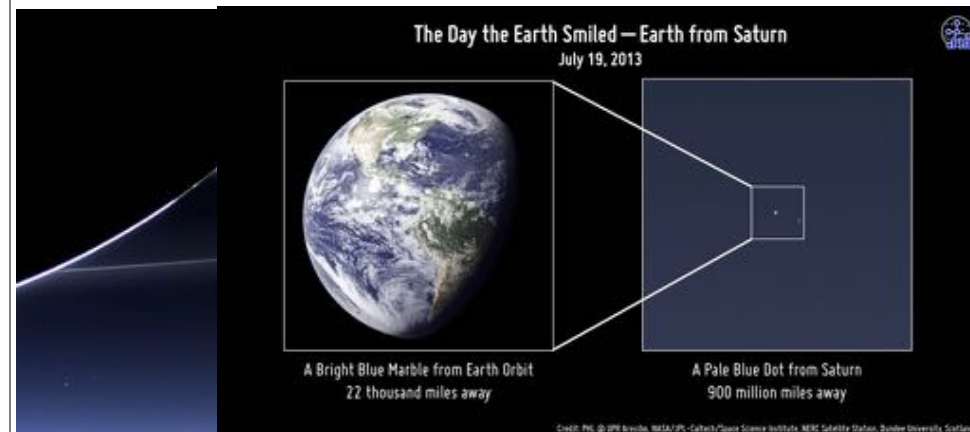
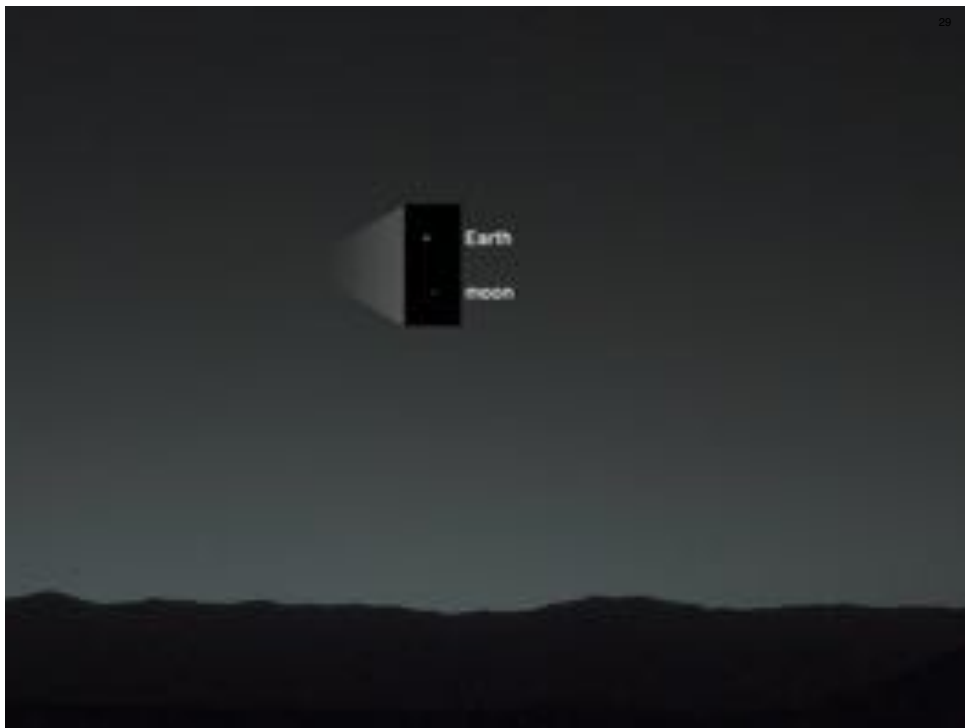
July 1994





where were you on July 19, 2013 at 4:30PM?

- chances are that you are in this picture
- taken from Saturn by the Cassini Spacecraft



A family portrait - from Voyager



A Scale Model of Time

From: *The Evolution of Life*, by Frank H.T. Rhodes

Event	Date	Time	Years ago
Big Bang	Jan. 1	12:00:00 AM	13,600,000,000 yr
Galaxies form	Jan. 24	12:00:00 AM	12,000,000,000 yr
Sun forms	Sept. 13	noon	4,500,000,000 yr
Earth forms	Sept. 13	12:17 PM	4,470,000,000 yr
1st life appears	Oct. 24	8:48 PM	2,800,000,000 yr
1st higher forms	Dec. 19	3:07 AM	570,000,000 yr
1st land animals	Dec. 25	4:29 AM	280,000,000 yr
1st dinosaurs	Dec. 26	12:36 PM	225,000,000 yr
DINOS RULE	Dec. 28	4:34 PM	136,000,000 yr
DINOS DIE	Dec. 29	10:02 PM	65,000,000 yr
Earliest "human"	Dec. 31	9:05 PM	5,000,000 yr
Neanderthal - C.M.	Dec. 31	11:50 PM	300,000 yr
Last Ice Age	Dec. 31	11:59:37 PM	11,000 yr
Pyramids	Dec. 31	11:59:53 PM	3,500 yr
USA	Dec. 31	11:59:59.6 PM	234 yr
YOU	Dec. 31	11:59:59.96 PM	20 yr