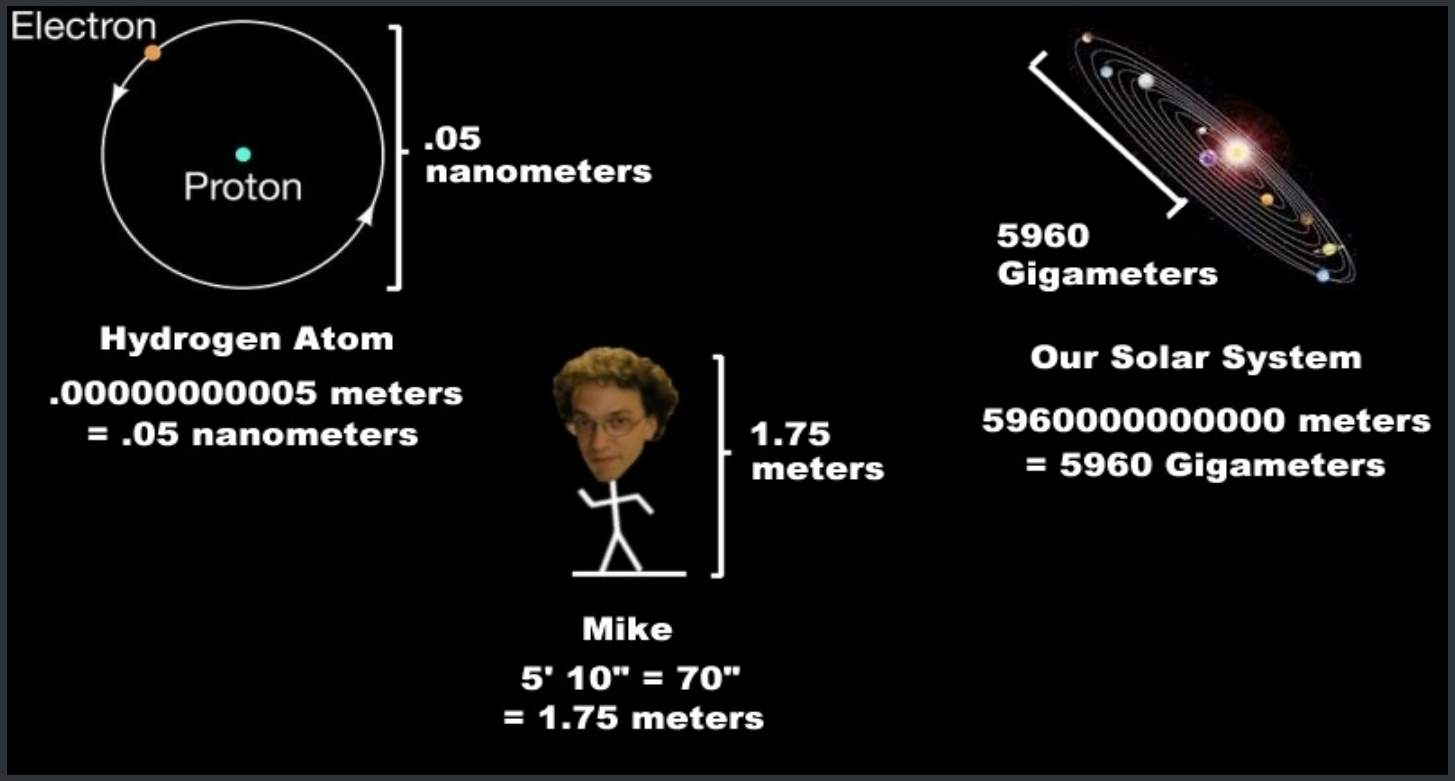
Welcome to ASTR 105 Lab!

- Review the Syllabus
- Notes for Lab 1

The Metric System

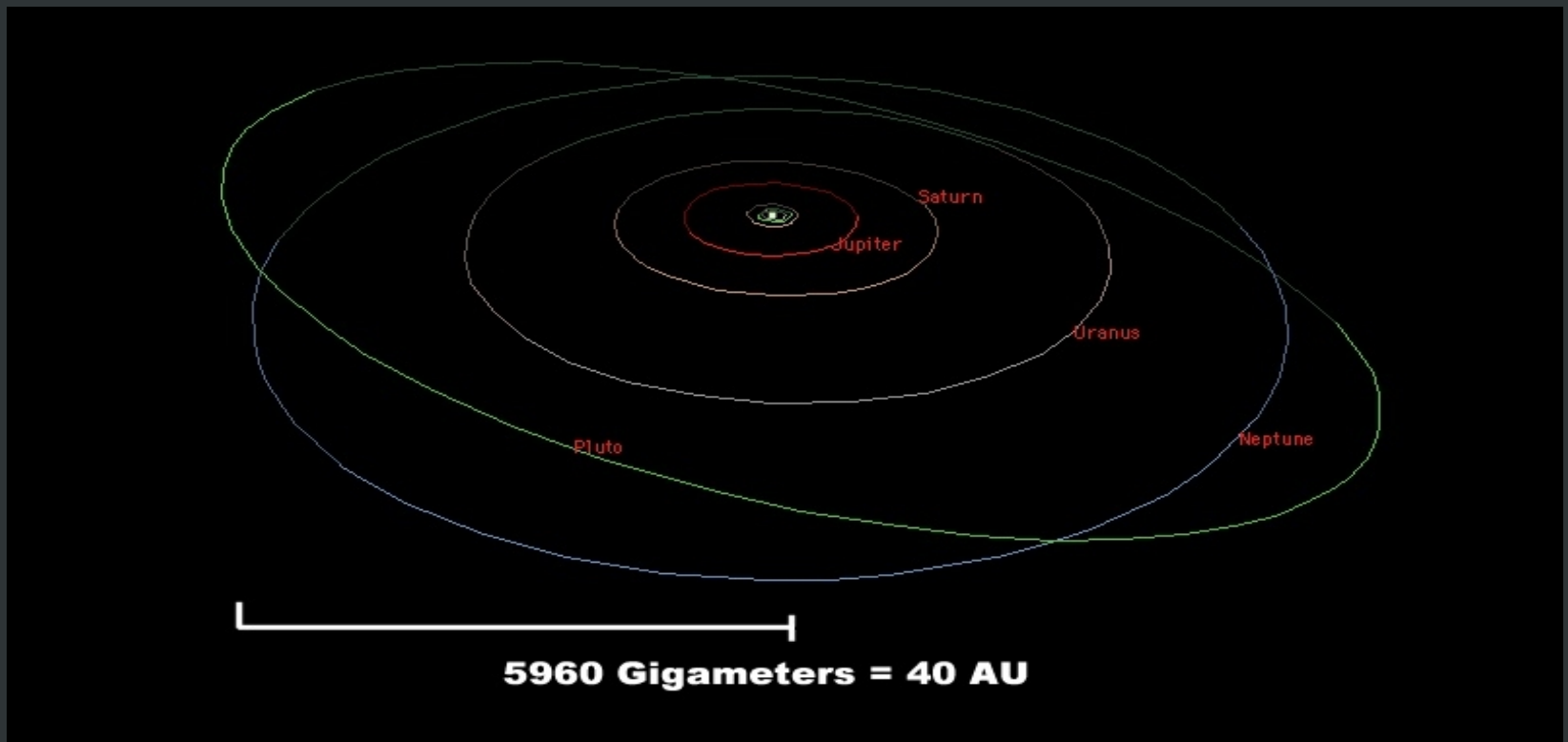
- Objects we deal with in astronomy cover many size scales:



- The metric system provides a useful notation to cover these scales.

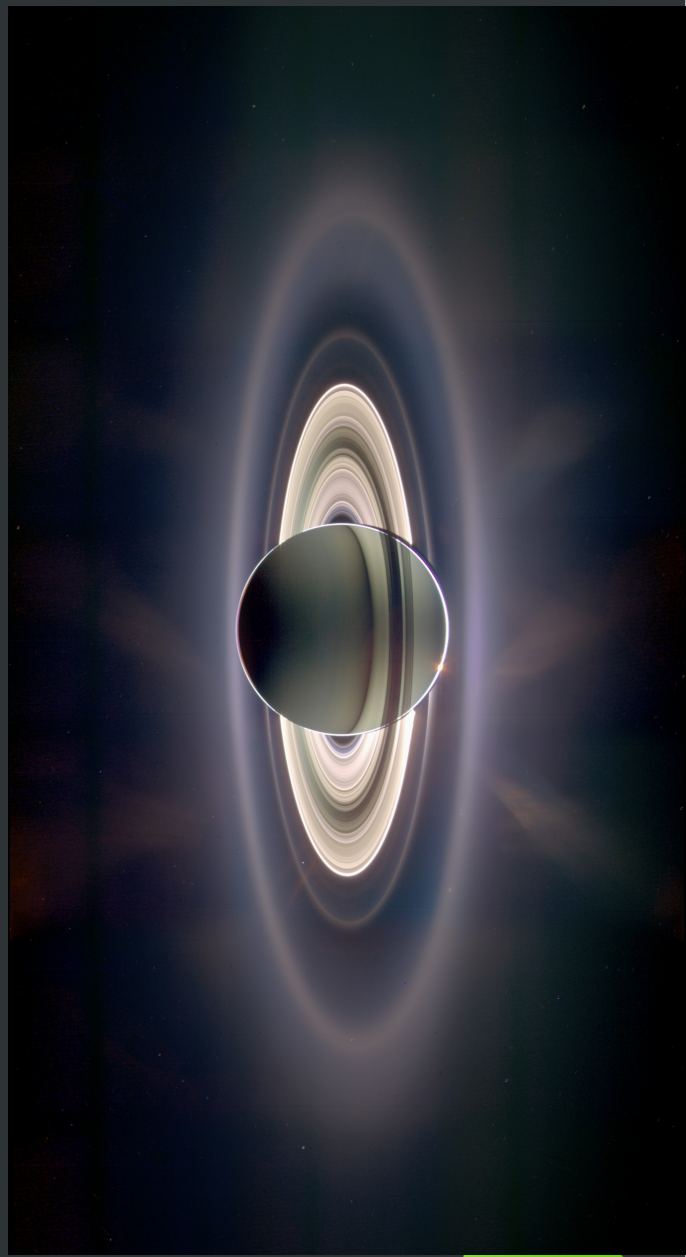
Astronomical Units

- In many cases we have to use units which span even larger size scales.
- The "Astronomical Unit" (AU) is shorthand for the distance between Earth and the Sun, and is useful for measuring solar system distances.
- The "light year" is the distance light travels in a year, and is useful for measuring the distance to stars.



Changing Units and Scale Conversion

I want to take a trip to Saturn for Spring breakto rollerblade around the rings. I know I can rollerblade at 10 feet per second. I want to know what this is in kilometers per hour so I can figure out how many hours this is going to take me.
This requires changing my units, and scale conversion with my Saturn map.



Changing Units

- First we need our distance conversion factor: 1 foot = 0.3 meters

$$10\frac{ft}{sec}=10\frac{ft}{sec}\,x\,0.3\frac{m}{ft}=3\frac{m}{sec}$$

The nice thing about the METRIC system is that conversion between metric units just involves powers of ten. (1000 m = 1 km)

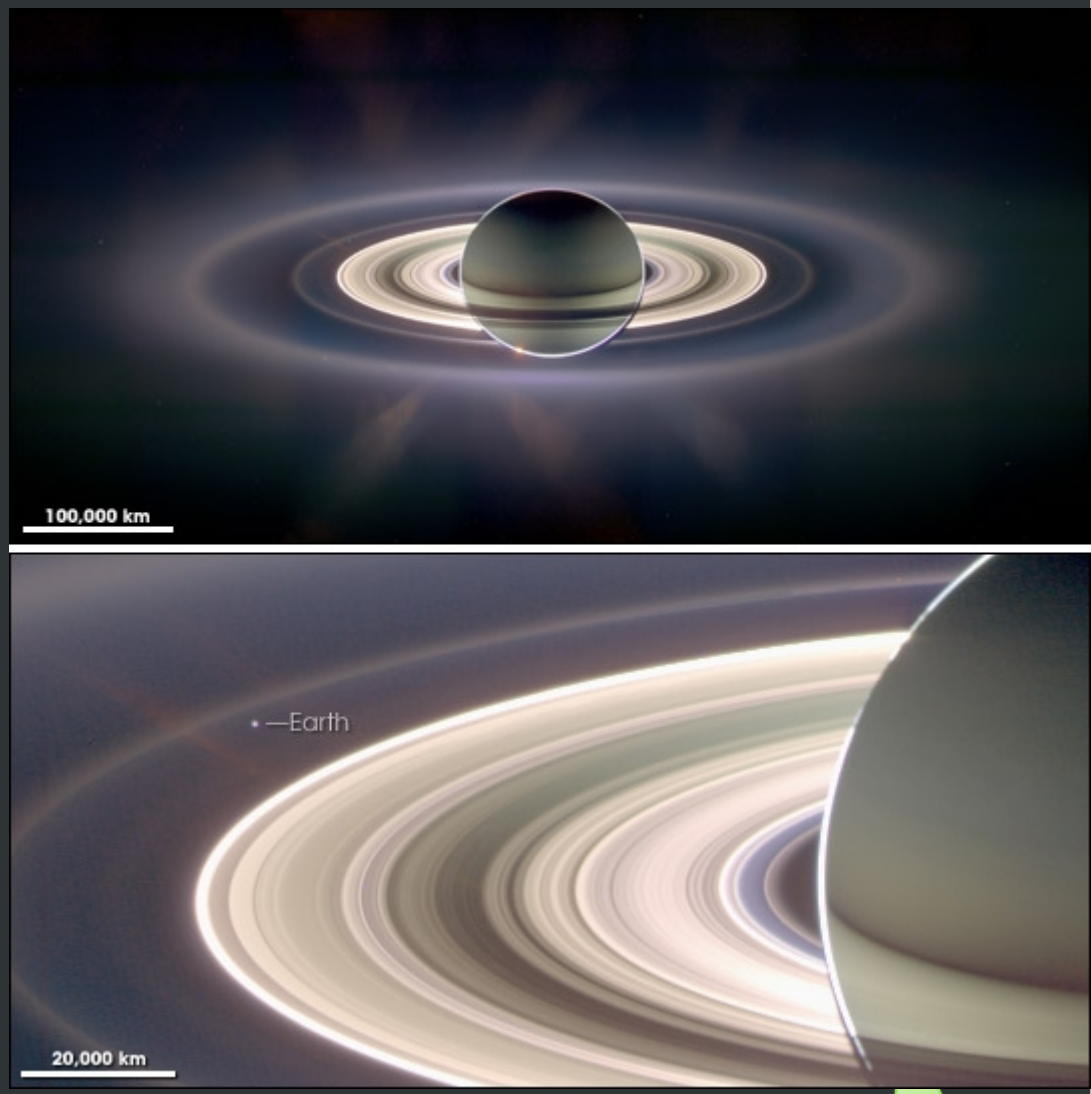
$$3\frac{m}{sec}\,x\,0.001\frac{km}{m}=0.003\frac{km}{sec}$$

There is nothing special about time in the metric system. We will continue to use hours, minutes, seconds, etc.

$$0.003\frac{km}{sec}\,x\,60\frac{sec}{min}\,x\,60\frac{min}{hour}=10.8\frac{km}{hour}$$

Scale Conversion

- Now I need to know the scale on this map to learn the distance around the rings.
- Using the scale given in the bottom left corner of the image, I measure with my ruler that 100,000 km is equal to five inches.



Scale Conversion, cont'd.

- This gives us a SCALE FACTOR of 1 in = 20,000 km
- I also measured the distance around the rings with my ruler to be 140 inches.
- To find the actual distance in km, I multiply my scale factor by the distance I measured on the map.

$$140\ inches\ x\ 20{,}000\ \frac{km}{inches} = 2{,}800{,}000\ km$$

Note, you probably will not be getting the exact answer, but you should be getting something close.

Changing Units and Scale Conversion, *fin.*

- Now that I know my speed, and my distance, I can calculate the time it will take me to rollerblade around Saturn's rings!

$$\frac{٢,٨٠٠,٠٠٠\ km}{١٠.٨\ \frac{km}{hr}} = ٢٥٩,٢٥٩\ hr$$

Looks like I will not be wasting my time attempting this feat... further unit conversion reveals this is about 30 years.

Squares, Roots, and Exponents

Math Fun: Squares, Square Roots, Exponents

- The "square" of a number is just the number times itself:

$$3^2 = 3 \times 3 = 9$$

$$11^2 = 11 \times 11 = 121$$

- The "square root" of a number is just the reverse: which number, when multiplied by itself, will equal the number inside the square root symbol?

$$121 = 11 \times 11$$

$$\sqrt{121} = 11$$

- An exponent is a number taken to any "power". Just multiply the number by itself that many times:

$$3^5 = 3 \times 3 \times 3 \times 3 \times 3 = 243$$

Scientific Notation

- Scientific Notation is just a way to express a number with a lot of zeroes:

Distance between Sun and Earth = 1 AU = 149,000,000,000 meters

149,000,000,000 meters = 1.49×10^{11} meters

- All we have to do is count how many times we move the decimal point to the first non-zero number, and write "x 10 –".

Size of a hydrogen atom = .000000000053 meters

.000000000053 meters = 5.3×10^{-11} meters

- If we move the decimal point to the left, the blank is a positive number. If we move the decimal point to the right, it's a negative number.

Scientific Notation + Math

Multiplication and Division with Scientific Notation:

Multiplication

$$(2.5 \times 10^{17}) \times (5.0 \times 10^{14})$$

Multiply these two...

$$(2.5 \times 10^{17}) \times (5.0 \times 10^{14})$$

...And then add these two together.

$$2.5 \times 5.0 = 12.5$$
$$17 + 14 = 31$$

Division

$$\frac{2.5 \times 10^{17}}{5.0 \times 10^{14}}$$

Just divide these two...

$$\frac{2.5 \mid 10^{17}}{5.0 \mid 10^{14}}$$

Then subtract the bottom from the top.

$$2.5 / 5.0 = 0.5$$
$$17 - 14 = 3$$

Graphing/Plotting

- The basic equation for a line is:

$$y = mx + b$$

- To graph this, we start plugging in values for "x" and see what "y" pops out:

Example: $y = 2x + 1$

$x = 0$ $\quad y = 2(0) + 1$, $y = 1$

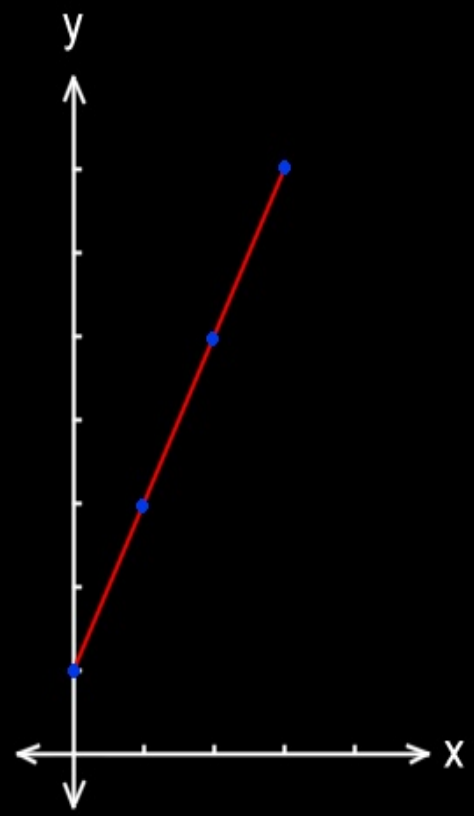
$x = 1$ $\quad y = 2(1) + 1$, $y = 3$

$x = 2$ $\quad y = 2(2) + 1$, $y = 5$

Plotting, cont'd.

- Now we take our list of values, plot the points on the graph, and draw a line through it:

x	y
0	1
1	3
2	5
3	7



- In y = mx + b, the "m" is the slope of the line: how quickly does it rise (or fall) as we move along the x-axis.
- The "b" is the y-intercept of the line: the place where it crosses the y-axis.