Lecture 3

Learning Goals:
By the end of class today you should be able to …
•Use scientific notation to write very large and very small numbers
•Define the celestial sphere

Reading for Today: Units 3, 5.1, 5.2
Reading for Next Time: 5, 6

Scientific Notation
•As we have seen in astronomy we typically deal with numbers that are very large (or small).
–Distance of earth from sun: 93,000,000 miles
–Velocity of light: 186,000 miles/second
–Density of interstellar space: 0.000,000,000,000,000,000,000,0017 that of water

•Need a way of dealing with this
→ scientific notation

•Way of writing numbers as a decimal between 1 and 10 multiplied by a power of 10

•Benefits of using scientific notation:
–Easier to write large and small numbers
–Easy to see how many significant figures a number has
•I.e. how well a number is known
Makes arithmetic easier

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Scientific Notation

•In scientific notation, 2000 would be written as $2x10^3$ =

_____

•To convert, count the number of spaces to the left, between the decimal point and the leftmost non-zero digit.

Scientific Notation

•For positive numbers less than one, exponent is negative

E.g. 0.002 would be written as $2x10^{-3}$ = _____

–To convert, count the number of spaces to the right, between the decimal point the leftmost, non-zero number.

Units

•In this course we will primarily use the metric system.
–Length (meter, m)
–Mass (kilogram, kg)
–Time (second, sec)
•Units for other measured quantities can be written in terms of these fundamental units.
•Speed (distance/time): [m/s]
•Density (mass/volume)
= mass/(length x length x length):
[kg/m^3]

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Special Astronomy Units
•Even in scientific notation hard to think about what a number like 1.99×10^{30} kg means
•So, often use special units

•Astronomical Unit (Earth – Sun distance)
  •1 AU = 1.50×10^{11} m
•Solar Radii
  •1 R_{Sun} = 6.97×10^{8} m
•Solar Masses
  •1 M_{Sun} = 1.99×10^{30} kg
•Earth Radii
  •1 R_{Earth} = 6.37×10^{6} m
•Earth Masses
  •1 M_{Earth} = 5.97×10^{24} kg

•For more practice with scientific notation and units see the Basic Mathematics Review Guide
–Under 'Course Documents' on Blackboard

•Excellent illustration of the scale of the Universe:
–Video: *Powers of 10* by Charles & Ray Eames
–Watch the video online for homework – 'External Links' on BB

Celestial Sphere
Treat stars as if they are all at the same distance from us with the Earth at the center
  → Useful fiction

Finding Your Way Around The Celestial Sphere
•Zenith – _____

•Nadir – _____

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•Extend poles and equator of Earth out to celestial sphere
- **Celestial poles**
- **Celestial equator**

•Meridian –
_____

_____

Celestial Sphere
•Stars (and the Sun and Moon) rise and set as Earth rotates on it's axis
- celestial sphere appears to rotate around celestial poles

Daily Motion
•As Earth rotates, stars rise in the East, move across the sky, and set in the West.
•We see stars rise in the East and Set in the West because the Earth rotates counterclockwise (as looking down on the North Pole)