Introductory Astronomy

Week 1: Positional Astronomy

Clip 2: The Celestial Sphere

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Laws for the Heavens

"The ancients gave to the Gods the heaven or upper place, as being alone immortal; and our present argument testifies that it is indestructible and ungenerated. Further, it is unaffected by any mortal discomfort, and, in addition, effortless; for it needs no constraining necessity to keep it to its path... Such a constrained movement would necessarily involve effort…-and would be inconsistent with perfection. Hence we must not believe the old tale which says that the world needs some Atlas to keep it safe" Aristotle (350 BC)

We seek Universal laws governing heaven and Earth

This week: Understand apparent motion of the sky; what we can see when and where. Intuitive and mathematical description

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The Celestial Sphere

- Pattern of stars unchanging: can imagine them fixed on a sphere surrounding Earth
- Celestial Sphere is large and rigid
- Celestial Sphere rotates daily about axis through poles from East to West
- Equivalently, Earth rotates from West to East inside stationary Celestial Sphere
- Stars occupy fixed positions on Celestial Sphere: use Celestial coordinates to specify this with mathematical precision

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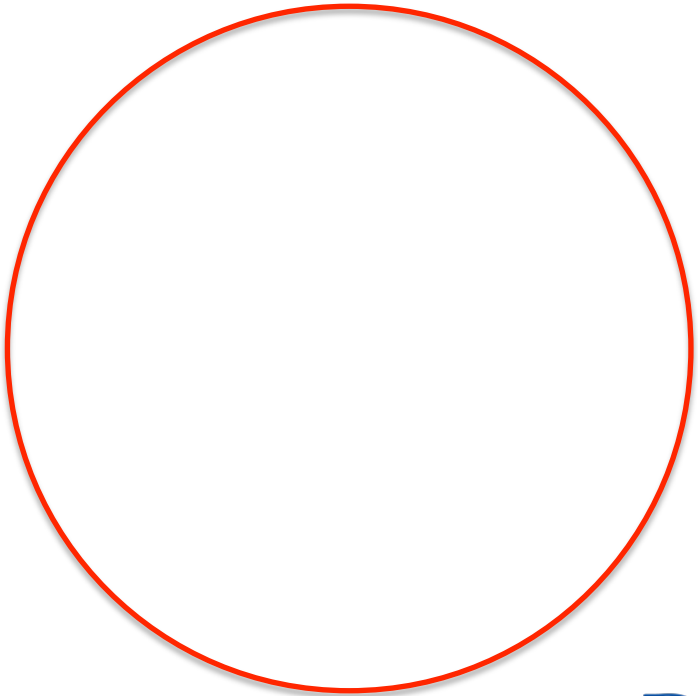
Coordinates on Earth

- Locations on Earth usefully labeled by
  - Latitude: angular distance from equator - natural
  - Longitude: angular distance from prime meridian
- Location determines half of sky visible
  - Latitude:
  - Longitude: instantaneously



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Celestial Coordinates

- Use same coordinate system on Celestial Sphere
  - Celestial Poles are directly above terrestrial poles
  - Celestial Equator is directly above terrestrial equator
  - Celestial Latitude is called Declination
- As on Earth, choice of prime meridian is random.
  - Celestial Longitude measured East is called Right Ascension
  - Measured in hours according to rotation

360° = 24h 15° = 1h

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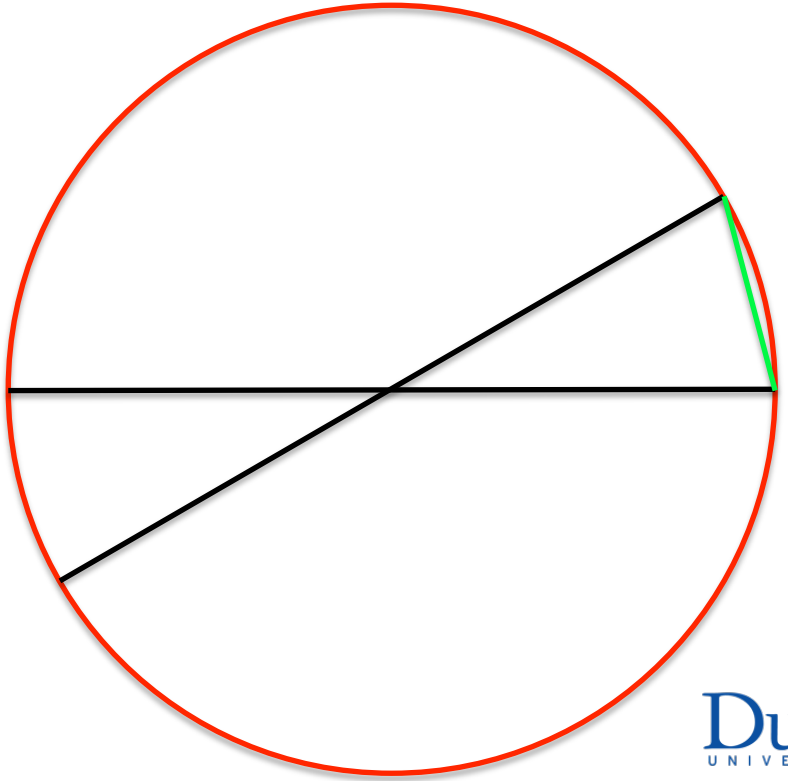
Angles and Distances

- How large is Celestial Sphere?
- Every point on Earth can be taken to be in center to within accuracy of measurement



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Numbers and Units

Your may see the formula $AB = (\alpha/206265'') R$

I had $AB = (\alpha/57.3°) R$

Who's wrong?

Neither. For convenience, small angles are often measured in units other than degrees. In particular, we use arcminutes and arcseconds

$1^o = 60' = 3600''$ $57.3° = 206265''$

In Physics numbers are ratios and must remember units! For example, in above can use any units for AB and R so long as we use the same units for both

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Summary

- Stars fixed on large Celestial Sphere concentric with Earth
- Sphere rotates daily from East to West
- Declination is Celestial Latitude
- RA is Celestial Longitude measured in hours to the East

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Credits

- Sky Simulation: Starry Night
  http://www.starrynight.com/
- Astronomy Animations: University of Nebraska-Lincoln Astronomy Education Group
  http://astro.unl.edu/

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