

PHYS 1403 Stars and Galaxies



Questions for Today's Class?

1. Angles are important in Astronomy, What do I need to know about Angles?
2. What is a Celestial Sphere?
3. How do I Find Objects with my Telescope?

What Do I Need to Know About Angles?

Topics

1. Angles, degrees, arc minutes and arc seconds
2. Fist: Crude way to measure angles
3. Hand: For small angles
4. Two ways of representing angles

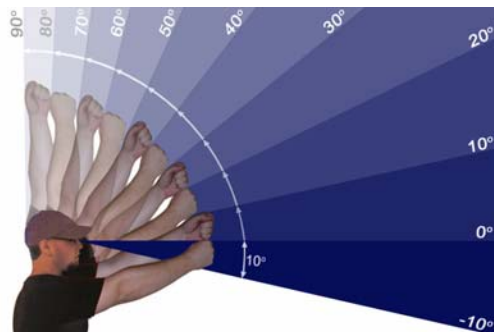
Degrees, Arc Minutes and Arc Seconds

▪ Angles

- Circle = $360^\circ = 2\pi$ radians
- Two Perpendicular lines = 90°
- $1^\circ = 60'$ (arc minutes)
- $1' = 60''$ (arc seconds)
- 1 radian = $360 \times 60 \times 60 / 2\pi = 206265''$

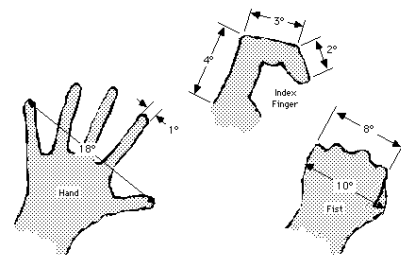


Crude but quick method



ClassAction: Astronomy Education at the University of Nebraska-Lincoln Web Site (<http://astro.unl.edu>)

The Hand as a Crude Measuring Tool



Two ways of Representing Angles

Measuring Angles in Degrees, Arcminutes and Arcseconds

One Circle:
 360° degrees
 21,600' minutes
 1,296,000" seconds

$1 \text{ degree} = 60 \text{ minutes}$
 $1 \text{ minute} = 60 \text{ seconds}$

$60^{\circ}35'18'' = 32 + (35 * \frac{1}{60}) + (18 * \frac{1}{60} * \frac{1}{60}) = 60.588333^{\circ}$

ClassAction: Astronomy Education at the University of Nebraska-Lincoln Web Site (<http://astro.unl.edu>)

What is a Celestial Sphere?

Topics

1. Definition
2. Celestial Sphere
3. Horizon and the Observer
4. Looking North
5. Different Latitude Different View of Sky
6. The Celestial Equator
7. The Ecliptic

Definition

A celestial sphere is an imaginary sphere of the Universe.

- Earth is assumed to be in the Center
- Stars are fixed on the inside surface of the sphere

The Ecliptic and Seasons Markers

The Celestial Tilt. The celestial equator is tilted by 23.5° to the ecliptic. As a result, North Americans and Europeans see the Sun north of the celestial equator and high in our sky in June, and south of the celestial equator and low in the sky in December.

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Celestial Sphere

Zenith
 Celestial Equator
 Earth Tilt
 North Celestial Pole

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Horizon and the Observer

Horizon is the horizontal circle on which the observer is standing. Zenith would be on the top of the observer. If you move to a different city, your horizon will change.

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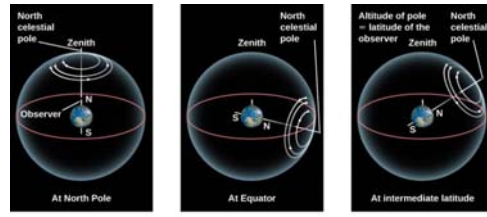
Looking North and Latitude of North Pole



Latitude: This is the angle at which your north pole is from the horizon. Latitude can be found easily using google or a map.

Stellarium

Different Latitudes and Different View of the Sky

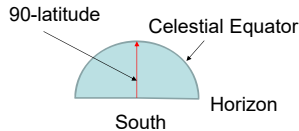
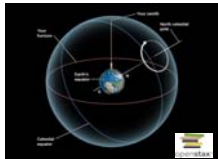


Star Circles at Different Latitudes. The turning of the sky looks different depending on your latitude on Earth.

1. At the North Pole, the stars circle the zenith and do not rise and set.
2. At the equator, the celestial poles are on the horizon, and the stars rise straight up and set straight down.
3. At intermediate latitudes, the north celestial pole is at some position between overhead and the horizon. Its angle above the horizon turns out to be equal to the observer's latitude. Stars rise and set at an angle to the horizon.

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The Celestial Equator



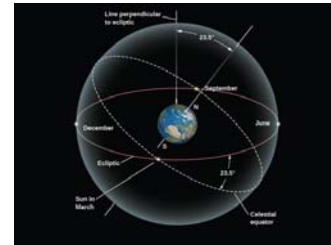
Stephenville: $90 - 32.2 = 57.8$

It's a circle in your southern sky.

How to find the celestial equator in your night sky?

1. Subtract your latitude from 90 degrees
2. Face south, the celestial equator culminates due south at this angle.

The Ecliptic



It is a circle that represents the path of the Sun in the Sky

How do I find a Celestial object with my telescope?



Topics

1. Horizon Coordinate System
2. Equatorial Coordinate Systems

amy.com

World on a Flat Map



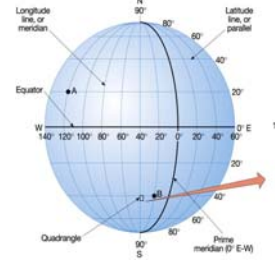
How do you locate county seat on a Texas map?



pinterest.com

Celestial Coordinate Systems

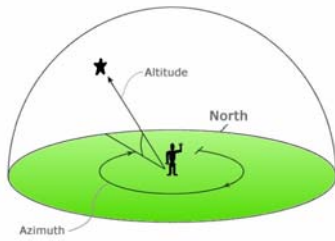
- Astronomer use coordinate systems just like the one we use to describe the position of cities on a map.
- We will study two different commonly use systems. Each have their advantage.



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Horizon Coordinate System

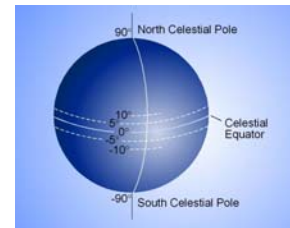
- Altitude (Alt) and Azimuth (Az)
- Depends on the Observers horizon



Source: www.nmm.ac.uk/tserver.php?f=altaz-star2.jpg

Equatorial Coordinate System

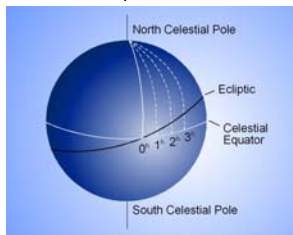
- Right Ascension (α or R.A.)
- Declination (δ or Dec.)
- Equatorial Coordinates are Universal.
- Declination are circles parallel to the celestial equator



<http://astro.unl.edu/classaction/>

Equatorial Coordinate System

- To find R.A. of any object in the sky we have to first know where the vernal equinox is.
- What is vernal equinox? It is a point in the sky where the ecliptic crosses the celestial equator
- This point defines the 0h, however its position is not fixed in the sky, we have to find it

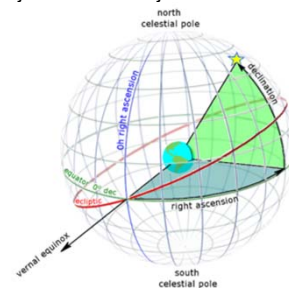


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Equatorial Coordinate System

- R.A. is the angle in hours, minutes and seconds from the vernal equinox to the projection of the object on the celestial equator.

In the figure show here, each declination circle is 20o and each R.A. circle is one hour



https://en.wikipedia.org/wiki/Declination#/media/File:Ra_and_dec_on_celestial_sphere.png

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How to find where the vernal equinox is on any date and time?

1. We know that the celestial equator culminates at 90-degree latitude from our south ($90 - 32 = 58$ degrees for Stephenville).
2. The angle between the two equinox is 180 degrees so
180 degrees = six months or
1 month = 30 degrees or
1 day = 1 degree (base on 30 day month for approximate calculations)
3. So if we compute how many days have elapsed from the last equinox, we can calculate approximately where the vernal equinox is on any date and time.
4. Computers can do these very precisely.



Acknowledgment

- The slides in this lecture is for Tarleton: PHYS1411/PHYS1403 class use only
- Images and text material have been borrowed from various sources with appropriate citations in the slides, including PowerPoint slides from adopted text book.