Introductory Astronomy

Week 1: Positional Astronomy

Clip 6: The Moon Moves Too

Moon Moves Too

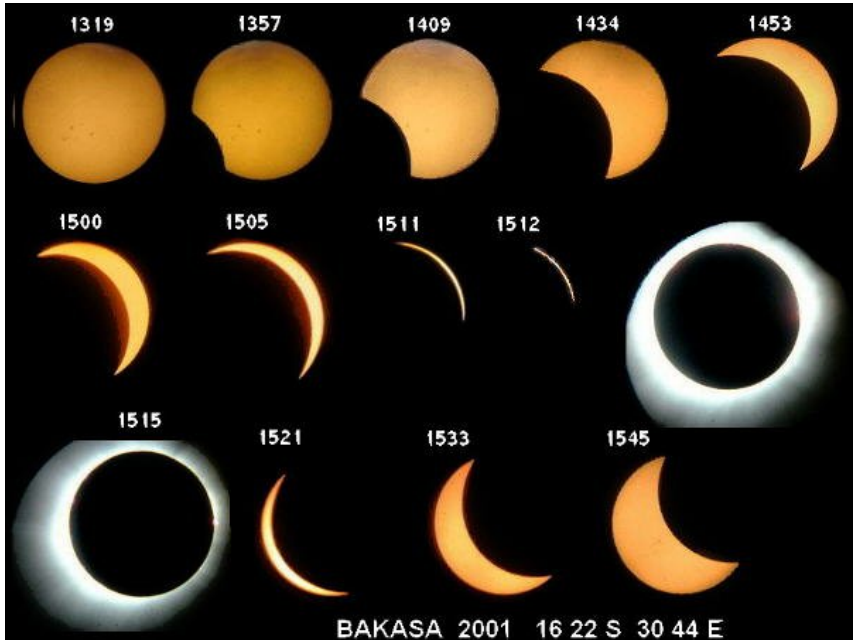
- Like Sun, Moon moves around celestial sphere as it orbits Earth West to East
- Moon is faster: orbits in a sidereal month (27.32 days)
- RA increases by 48min per day
- Spin locked to orbit – same side always faces Earth
- Moon moves relative to Sun by 44min per day
- Full rotation relative to Sun in synodic month (29.53 days)
- Position relative to Sun controls rise/set times as well as phases

Moon's Declination

- Moon's orbit inclined 5° to ecliptic about line of nodes
- Like Sun, Moon higher in Summer
- Twice a year line of nodes aligns with Sun: Eclipse Season
- Tilt precesses to the West every 18.6 years so twice an eclipse year of 346.6 days
- At New/Full Moon during eclipse season have Solar/ Lunar eclipse

Solar Eclipse

- Moon almost same angular size as Sun
- With near perfect alignment can completely obscure Sun – from up to 250km shadow – total eclipse
- More common – partial eclipse
- When Moon farthest from Earth – annular eclipse



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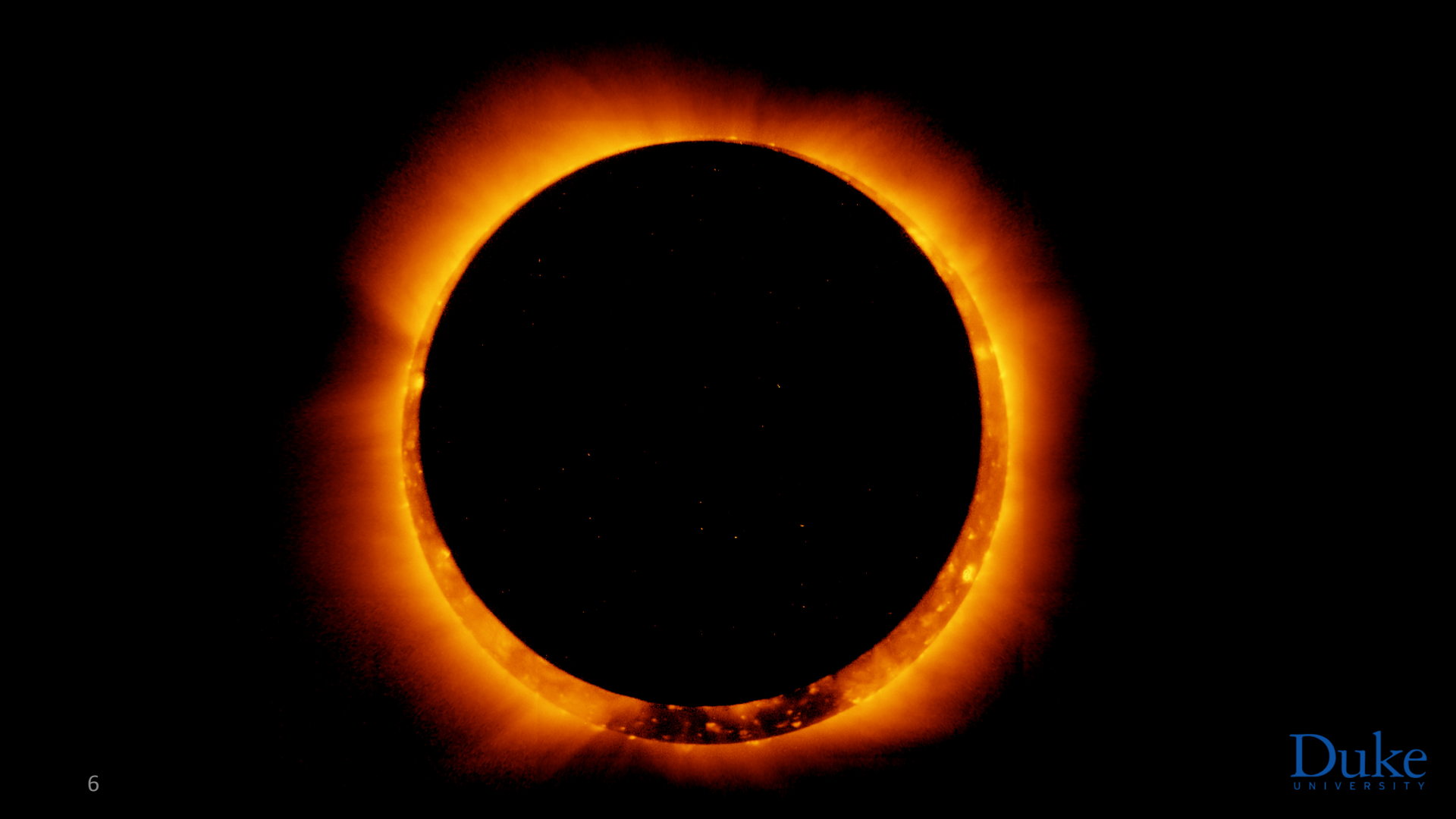

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Lunar Eclipse

- Moon enters Earth shadow from West
- Eclipse can be total or partial. Penumbral eclipse when Moon in partial shadow – dims slightly
- During totality Moon illuminated through atmosphere looks red

Fun with the Moon

- Moon appears larger near horizon
- This is a psychological illusion not shared by optical instruments
- Various theories as to mechanism

- Can see dark part of crescent Moon – *"old moon in new moon's arms"*
- This is physical viewing dark part by reflected Earthlight

Signs of the Times

- Astronomy and timekeeping are always closely related – we want our time to match what happens.
- Our 24-hour days are adjusted to mean solar day.
- Our months are approximately lunar.
- Our years match orbit – 365.2564 days is a sidereal orbit.
- Tropical orbit is 365.2422 days (precession).
- Julius Caesar got 365.25 so invented leap years.
- Pope Gregory XIII (1582) corrected for the .0078

Summary

- Our cosmos now has moving parts
  - Sun moves around Celestial Sphere to the East, completes one revolution in a year. The ecliptic tilted relative to celestial equator by 23.5° about equinoxes and precesses West every 26,000 years
  - Moon moves around Celestial Sphere to the East, completes one revolution in a month. Moon's orbit tilted relative to ecliptic by 5° about line of nodes and precesses West every 18.6 years
- The model now explains day/night, lunar phases, eclipses
- What else moves?

Credits

- Sky Simulation: Starry Night http://www.starrynight.com/
- Astronomy Animations: University of Nebraska-Lincoln Astronomy Education Group http://astro.unl.edu/
- Solar Eclipse series, Shadow on Earth: NASA, courtesy nasaimages.org
- Annular Eclipse: Hinode/XRT http://www.nasa.gov/mission_pages/sunearth/news/news20110106-annulareclipse.html
- Moon demonstration video: Duke Media Services