



“It’s only during an
eclipse that the Man in
the Moon has a place
in the Sun”
Unknown

What We Will Learn Today

- What causes a solar eclipse?
- What are the different types of solar eclipses?
- What causes a lunar eclipse?
- What are the different types of lunar eclipses?

Eclipses: Shadow Play

- Lunar Eclipse
 - Earth is between Sun and Moon
 - Moon passes through Earth's shadow
 - Occurs during which lunar phase?
- Solar Eclipse
 - Moon is between Sun and Earth
 - Moon's shadow falls on Earth
 - Occurs during which lunar phase?

Lunar Eclipse: Earth's Shadow

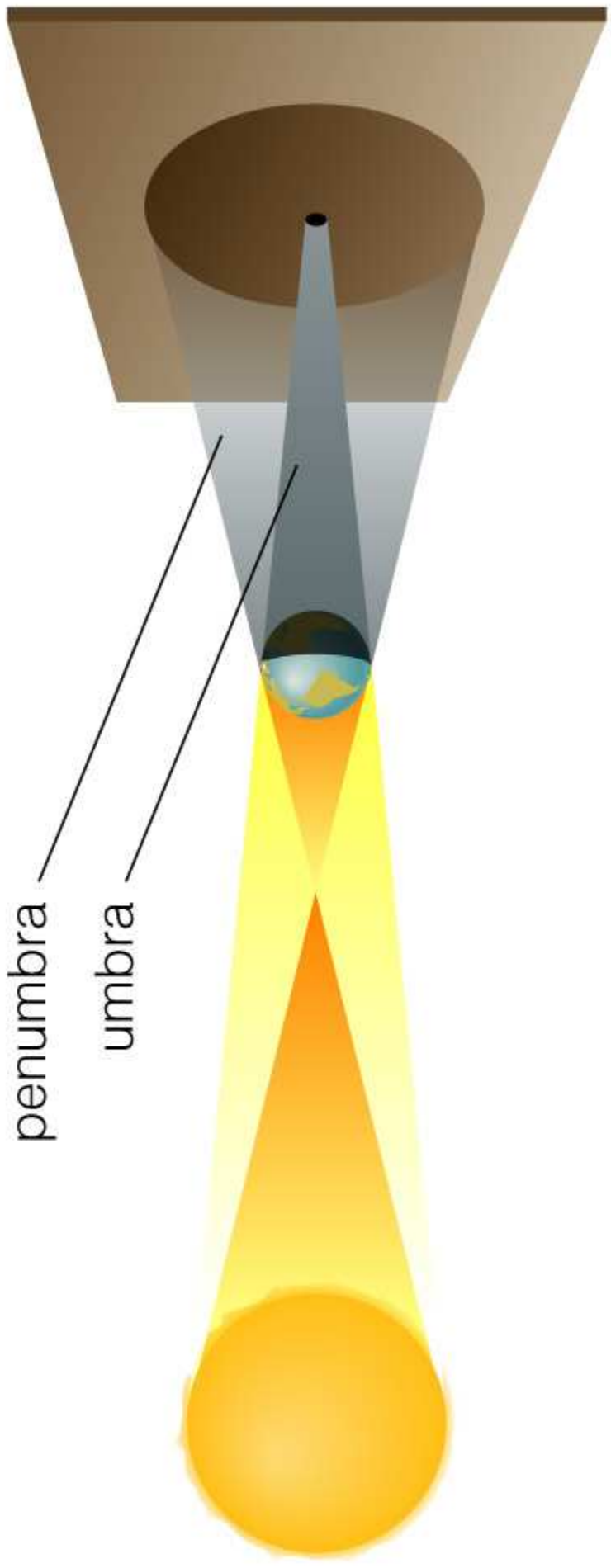


Fig 2.25

- Umbra: Sunlight is fully blocked
- Penumbra: Sunlight is partially blocked

Types of Lunar Eclipses



Total Lunar Eclipse



Moon passes
entirely within
the umbra



Partial Lunar Eclipse



Moon passes
partially within
the umbra

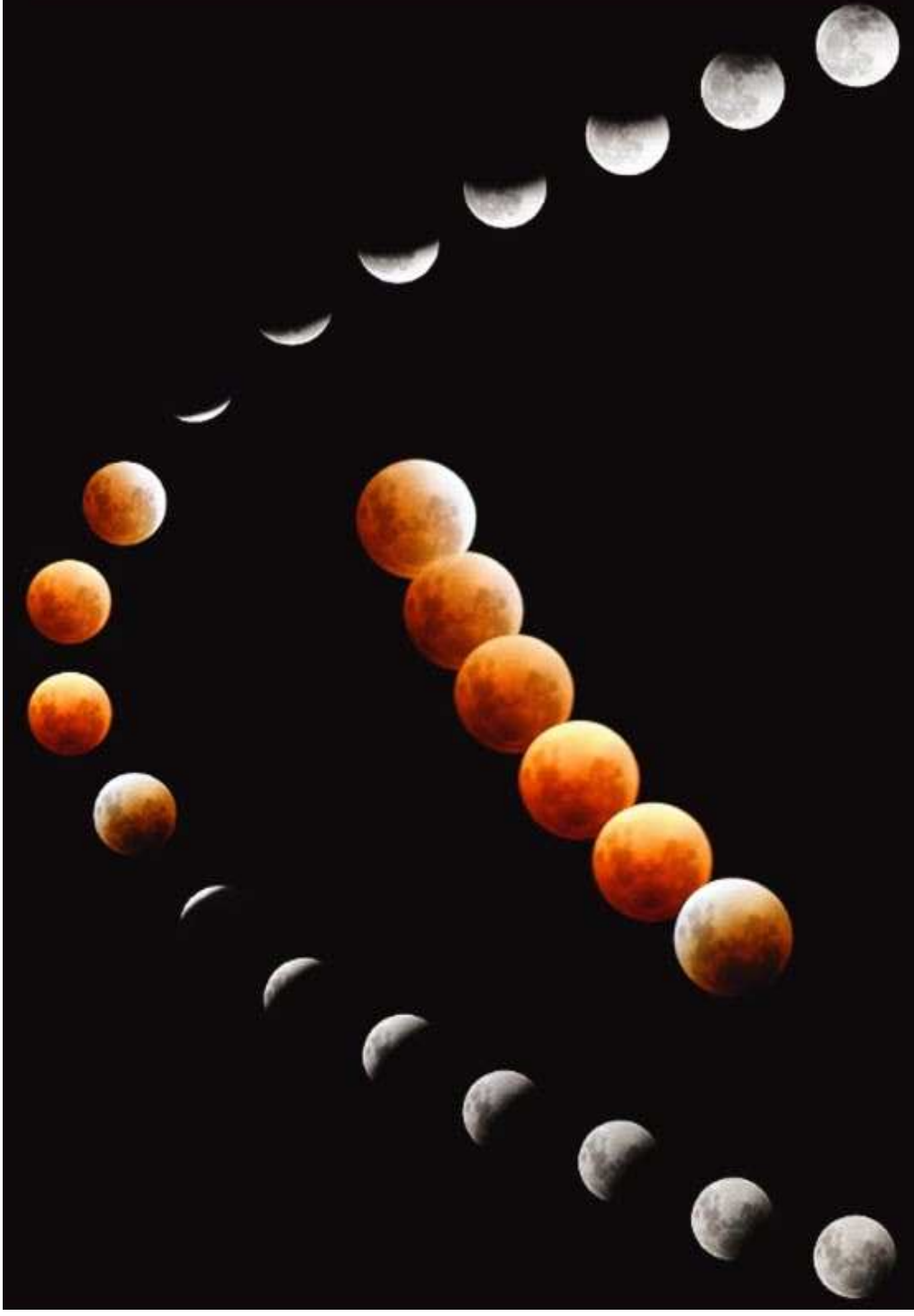


Penumbral Lunar Eclipse



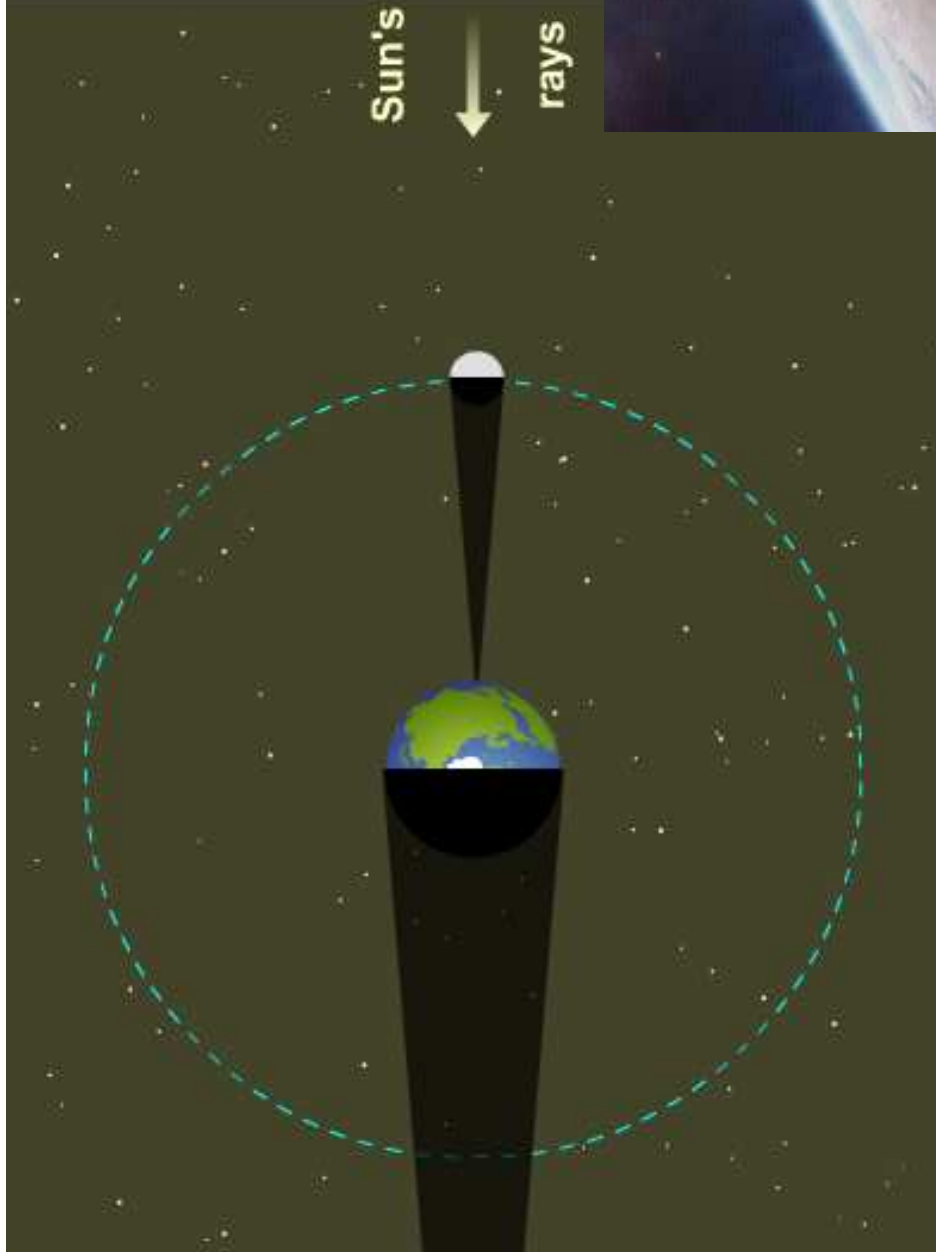
Moon passes
within the
penumbra

Progression of Lunar Eclipse



- Notice Earth's curved shadow
- Why is the Moon visible & during totality?

Solar Eclipse: Moon's Shadow

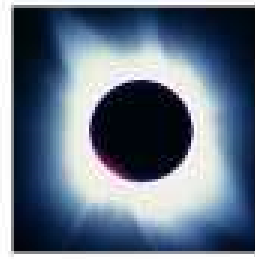


Sun's
rays



Fig 2.28 b

Types of Solar Eclipses



Total



path of total eclipse



Partial



path of annular eclipse



Annular

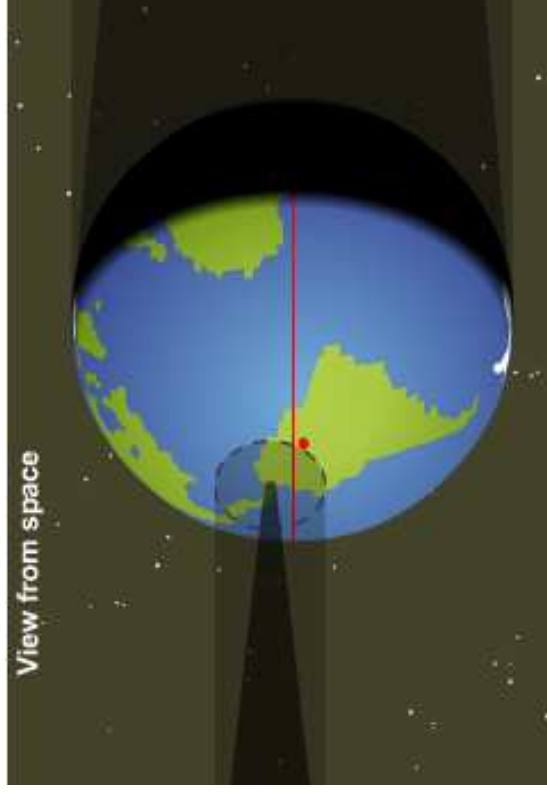
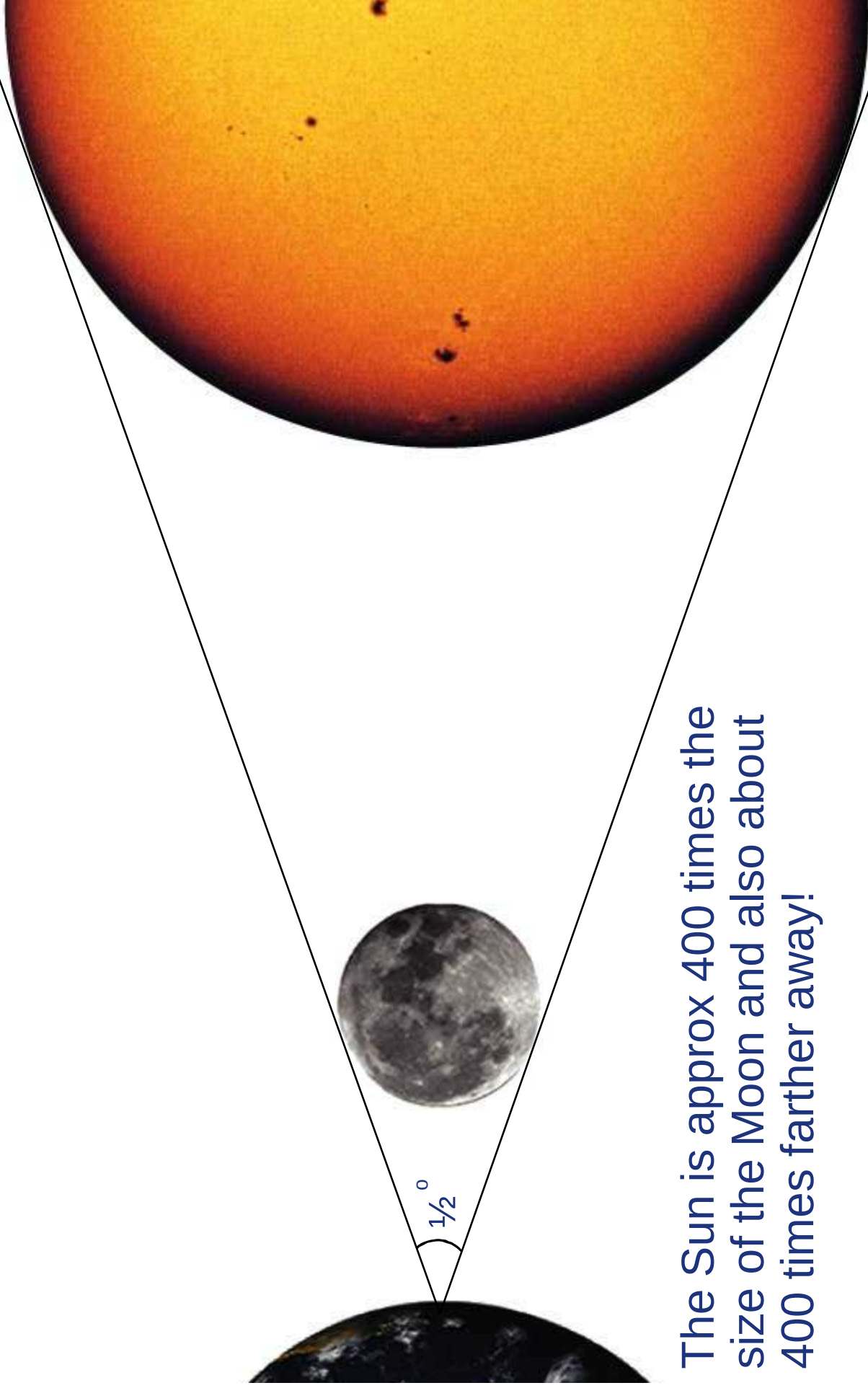


Fig 2.28 a

A Coincidence in Astronomy

- Generally do not like to explain observations as a coincidence
 - Example: Moon's rotational period = its orbital period (NOT a coincidence!)
- But, Sun & Moon have roughly the same angular size in our sky!
 - This is a coincidence!

Angular Sizes of Size and Moon

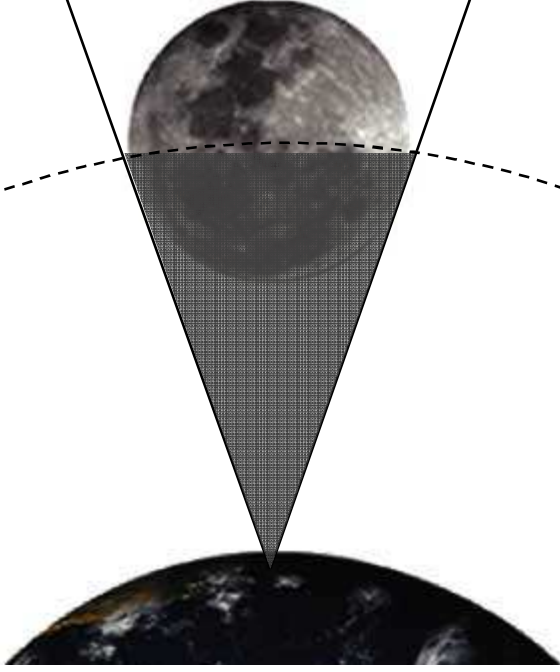
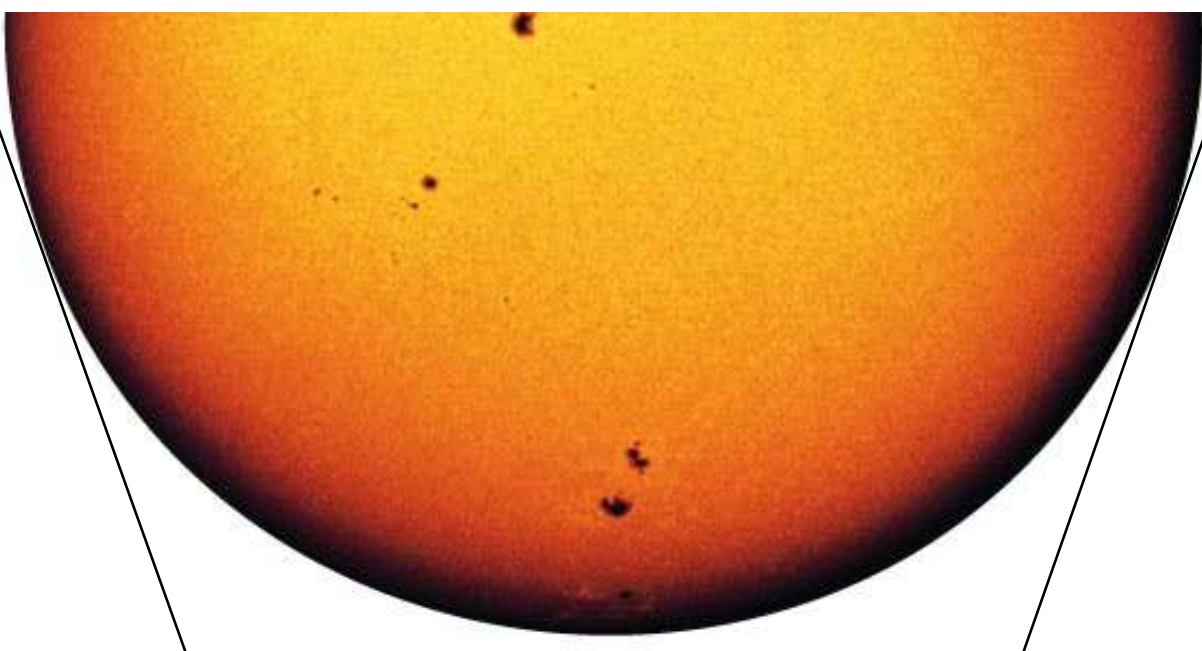


The Sun is approx 400 times the size of the Moon and also about 400 times farther away!

Total Solar Eclipse

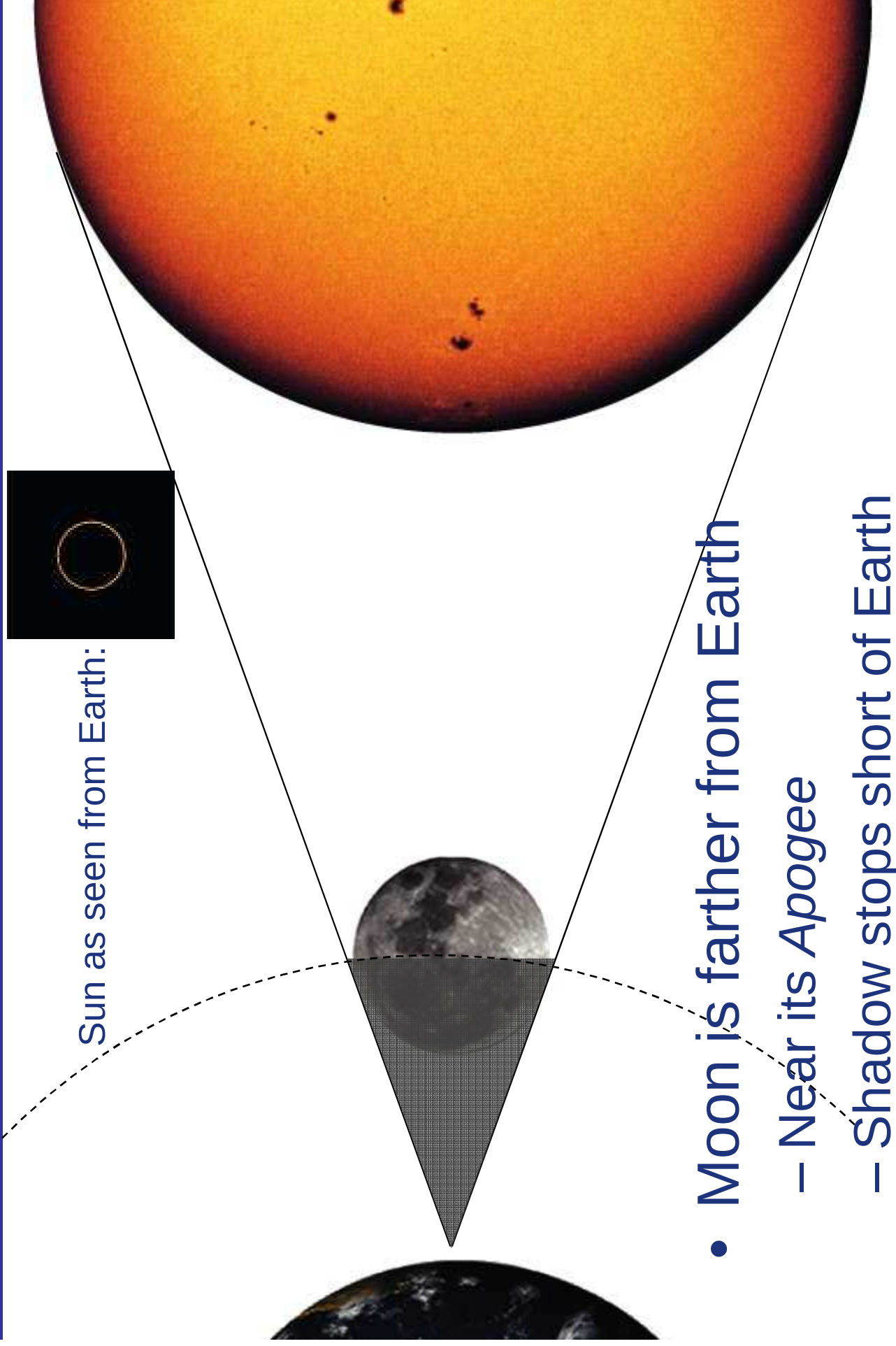


Sun as seen from Earth:



- Moon is closer to Earth
 - Near its *Perigee*
 - Shadow reaches Earth

Annular Solar Eclipse



Solar Eclipses are Rare and Brief



Fig 2.29

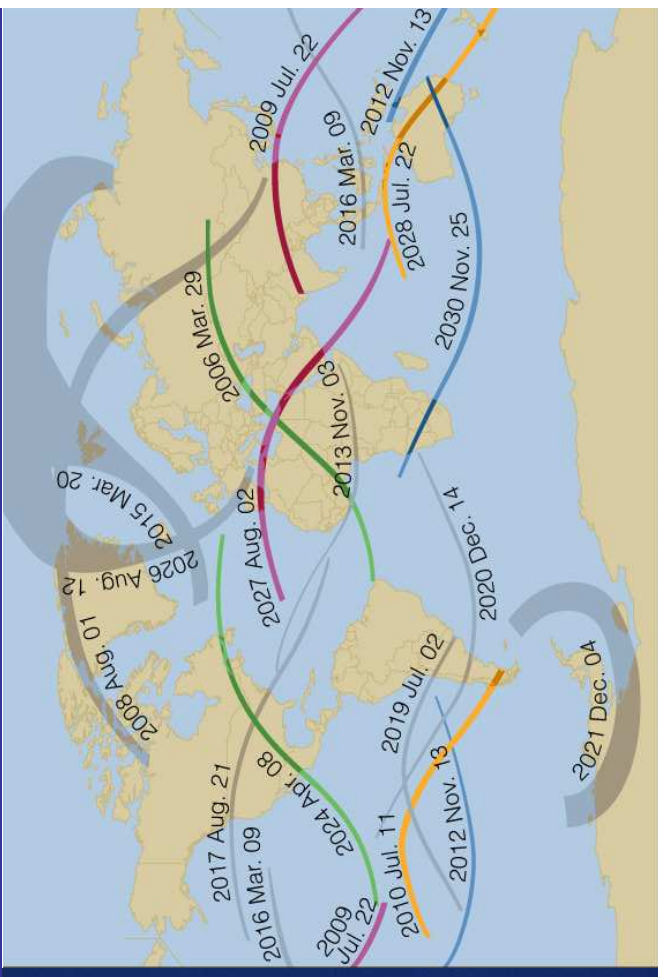


Fig 2.30

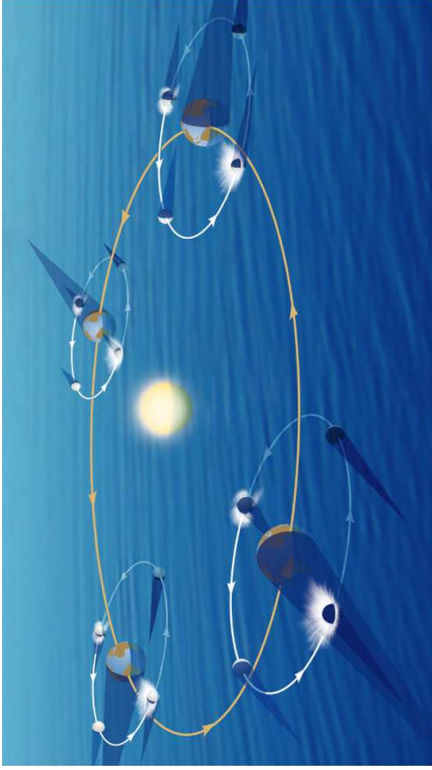
- Moon's shadow races across the Earth at over 1,000 mph
- Totality lasts only a few minutes

Eclipse Recap



Fig 2.24

Conditions for an Eclipse



- Sun, Earth, Moon must lie along a straight line
 - Earth in the middle: ? eclipse (? moon phase)
 - Moon in the middle: ? eclipse (? moon phase)
 - Sun in the middle: ?
- ***Line of nodes*** must pass through the three objects
 - Moon's orbit is inclined about 5° with respect to the ecliptic
 - Line of nodes connects the two points where the Moon's orbit crosses the ecliptic

Conditions for an Eclipse



- Sun, Earth, Moon must lie along a straight line
 - Earth in the middle: Lunar eclipse (Full moon phase)
 - Moon in the middle: ? eclipse (? moon phase)
 - Sun in the middle: ?
- **Line of nodes** must pass through the three objects
 - Moon's orbit is inclined about 5° with respect to the ecliptic
 - Line of nodes connects the two points where the Moon's orbit crosses the ecliptic

Conditions for an Eclipse



- Sun, Earth, Moon must lie along a straight line
 - Earth in the middle: Lunar eclipse (Full moon phase)
 - Moon in the middle: Solar eclipse (New moon phase)
 - Sun in the middle: ?
- ***Line of nodes*** must pass through the three objects
 - Moon's orbit is inclined about 5° with respect to the ecliptic
 - Line of nodes connects the two points where the Moon's orbit crosses the ecliptic

Conditions for an Eclipse



- Sun, Earth, Moon must lie along a straight line
 - Earth in the middle: Lunar eclipse (Full moon phase)
 - Moon in the middle: Solar eclipse (New moon phase)
 - Sun in the middle: Never!
- ***Line of nodes*** must pass through the three objects
 - Moon's orbit is inclined about 5° with respect to the ecliptic
 - Line of nodes connects the two points where the Moon's orbit crosses the ecliptic