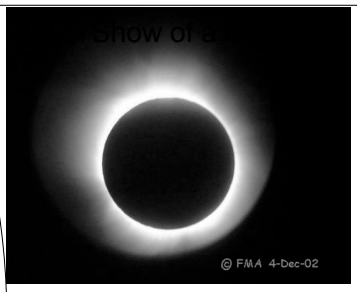
Eclipses
of the Sun and Moon

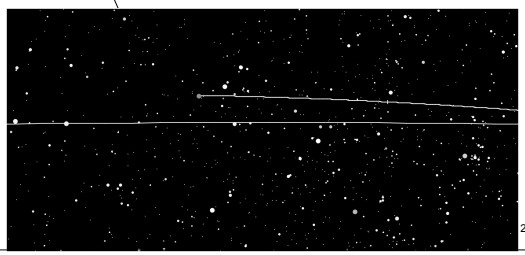


Astronomy 20 1

Eclipses

The Moon's Cycle

- **New moon:** the Moon passes the Sun
- **Sidereal period** (relative to stars) = 27 days
- **Synodic period** (new to new) = 29.5 days

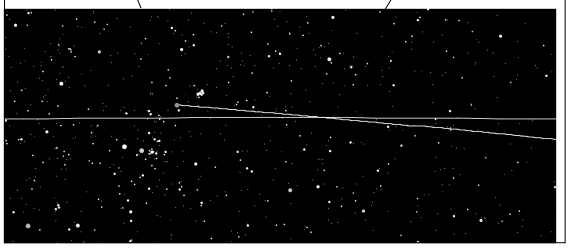


2

Eclipses

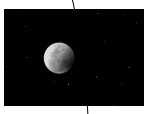
The Moon's Orbit

- 5° angle to the ecliptic
- Crosspoints: the **nodes**



Solar vs. Lunar Eclipses

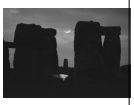
- **Lunar eclipse**
  - The *Earth's* shadow falls on the *Moon*
  - Full Moon



- **Solar eclipse**
  - The *Moon's* shadow falls on the *Earth*
  - New Moon

Eclipse seasons

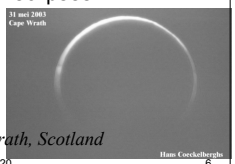
- Eclipses occur when the Sun is *near* a node.
- **Eclipse season** = period of about 33 days when the Sun is *close enough* to a node
- Since 33>29.5, each eclipse season has *at least*
  1 solar eclipse at new moon, and
  1 lunar eclipse at full moon.
- Occasionally, 3 eclipses.



Total Lunar Eclipse
Stonehenge 4 May 2004

Number of Eclipses

- Each eclipse season has 2 or 3 eclipses.
- Eclipse seasons occur 6 months apart - 2 eclipse seasons per year.
- Every *year* has *at least* 4 eclipses:
  2 solar
  2 lunar
- Maximum: 7 eclipses



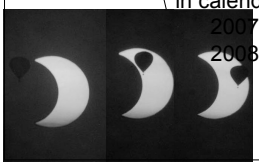
Annular Solar Eclipse
31 May 2003 Cape Wrath, Scotland

Check Question

- Suppose there is a lunar eclipse tonight. We can be sure that the Moon is in the ____ phase.
  1. New
  2. 1st quarter
  3. Full
  4. Last quarter

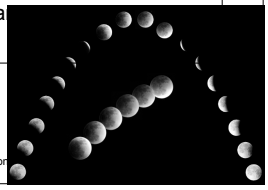
Regression of Nodes

- Nodes gradually slip to the west.
- 19 years to go all the way around.
- Time for Sun to go from node to node = *9 days less* than 6 months
- Eclipse seasons occur 18 days earlier in calendar from year to year
  2007: early March & early Sept.
  2008: late Feb. & late Aug.



Eclipses in 2008

- 1st eclipse season
  - 7 Feb. Annular solar eclipse
  - 21 Feb. Total lunar eclipse*
- 2nd eclipse season
  - 1 Aug Total solar eclipse
  - 16 Aug. Partial luna
- *Visible in L.A.



4 May 2004

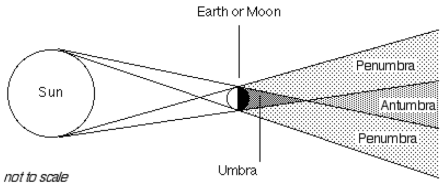
Eclipses

Check Question

- There will be a total solar eclipse on April 8, 2024. The next solar eclipse after that will be on
  1. May 8, 2024
  2. Oct. 2 2024
  3. April 8, 2025

Eclipses

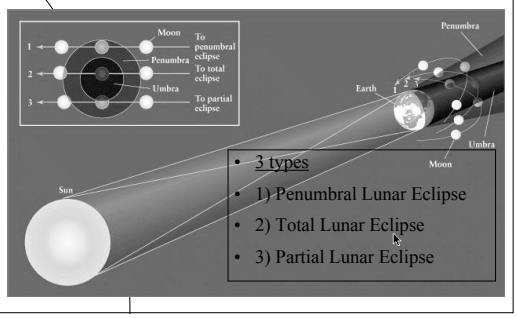
Shadow Structure



Umbra = total eclipse
Penumbra = partial eclipse
Antumbra = annular eclipse

Eclipses

Lunar Eclipses



- 3 types
- 1) Penumbral Lunar Eclipse
- 2) Total Lunar Eclipse
- 3) Partial Lunar Eclipse

Eclipses

Total Lunar Eclipse

Eclipses

Total Lunar Eclipse

July 6, 1982

Eclipses

Total Lunar Eclipse

Dec. 30, 1982

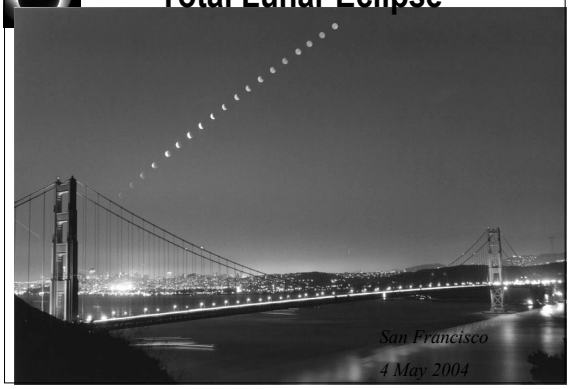
Eclipses

Total Lunar Eclipse

July 16, 2000

Eclipses

Total Lunar Eclipse



San Francisco
4 May 2004

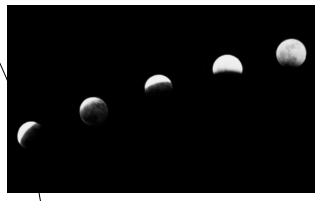
Eclipses

Check Question

- You are on the Moon during a total lunar eclipse. You are in the…
  1. Moon's umbra
  2. Earth's umbra
  3. Sun's umbra

Eclipses

Partial Lunar Eclipse

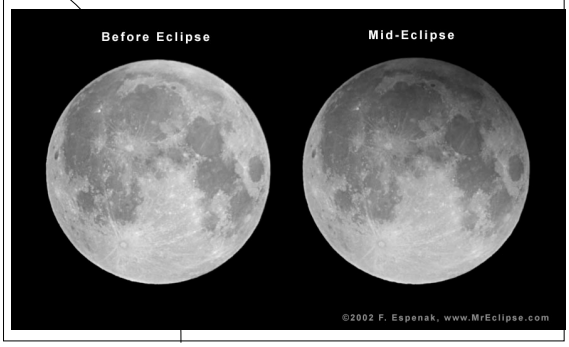


March 24, 1997

Doug Scobel

Eclipses

Penumbral Lunar Eclipse



Eclipses

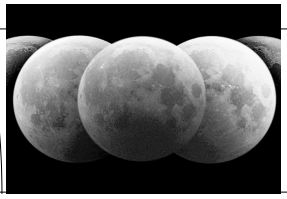
Check Question

- You are the Moon during a partial lunar eclipse. You are in the…
  1. Moon's penumbra
  2. Earth's umbra
  3. Earth's penumbra
  4. Could be 2, could be 3.

Eclipses

Upcoming Lunar Eclipses
visible in LA

21 Feb 2008	Total
22 July 2009	Penumbral
26 June 2010	Partial



22

Eclipses

Check Question

You are on the near side of the Moon. People on the Earth are seeing a Total Lunar Eclipse. You see:

1) A total solar eclipse
2) A total lunar eclipse
3) An annular solar eclipse
4) No eclipse of any kind

Astronomy 20 23

Eclipses

Solar Eclipses

3 types
Total Solar Eclipse

Partial Solar Eclipse

Annular Solar Eclipse