ASTRI10G: Review

Main subjects:

Solar System Laws of Motion History of Astronomy

Solar System

Notions and effects: Density Convection Tides and tidal heating

Solar System

The Solar System consists of 3 kinds of planets:

The Terrestrial planets include Mercury, Venus, Earth, and Mars. These are Earth-like planets that are small, dense, rocky worlds with less atmosphere than Giant planets.

The Jovian planets include Jupiter, Saturn, Uranus, and Neptune. They do not have a solid surface and consist mainly of hydrogen and helium gas.

Dwarf planets include <u>Ceres</u>, <u>Pluto</u>, <u>Haumea</u>, <u>Makemake</u>, and <u>Eris</u>. These planets are smaller than the Jovian and Terrestrial planets. They have solid surfaces, but not as dense as Terrestrial planets

The Solar System



The Mercury

Mercury is a heavily cratered planet closest to the Sun. In some ways, it most resembles the Moon. The density of Mercury is 5.4 gm/cm³.

Distance to the Sun: 0.4 AU.

Radius: 0.4 Radius-of-Earth.

There is no atmosphere on Mercury.

Daytime temperature on the equator is 700K (800F)

Special feature on the surface: long (100s of km) Scarps



Venus

Distance to the Sun = 0.72 AU Radius =6,050km =0.95 Radius-of-Earth Surface temperature = 900F Pressure of atmosphere = 98 atm

In mass and density, Venus is nearly the Earth's twin. Venus' atmosphere is very thick and opaque. The atmosphere is about 95% carbon dioxide. Other components are also present: Nitrogen, water vapor, sulfuric acid





Mars

Distance to the Sun = 1.52 AU Radius =3390 km = 0.53 Radius-of-Earth Mass =0.11 Mass-of-Earth Period of rotation = 24.6 hrs Orbital period = 687 days Density = 4 g/cm³ Atmosphere: 95% CO₂, few % of N and Ar Temperature: from -220F to 60F









Jovian planets:

Large, gaseous objects. They are composed mostly of hydrogen and helium. Each jovian planet has rings. There are many moons of all sizes.



Moons of Jupiter

lo Europa Ganymede Callisto







Saturn

Solar System Debris

Comets are like dirty icebergs which heat up near the Sun, partially vaporize, and leave a tail of gas & dust behind them. There are two reservoirs of comets.

Beyond Pluto's orbit extending to 500 AU there is the <u>Kuiper belt</u>, where comet's nuclei move around the Sun close to the plane of ecliptic.

Another place for comets is the <u>Oort cloud</u>, which extends out at least 50,000 AU, one third the distance to the nearest star. Most of the comets never (or very rarely) come close to the Sun.

Asteroids are large chunks of rock that lie primarily between the orbits of Mars & Jupiter. The largest asteroid is named **Ceres**. Its diameter is 940 km. Only three asteroids have diameters between greater than 300km: Ceres, Pallas, and Vesta. About thirty other asteroids have diameters between 200 and 300 km. Most of asteroids are very small.

Meteors are pieces of rock & ice, coming from asteroids & comets, which fall into the Earth's atmosphere (so-called ``shooting stars"). A few large ones strike planetary surfaces & produce *impact craters*.

Asteroids and Comets:

Solar System







Asteroids and Comets:

Solar System





Sun

Solar System



Sunspots: magnetic fields and convection Granulation

Sunspots: 11 years cycle of solar activity

MINIMUM

MAXIMUM





NATIONAL SOLAR OBSERVATORY / SACRAMENTO PEAK, N.M.

Prominence

History of Astronomy

Aristotle: 384-322 BC **Ptolemy:** second century AD. Author of Almagest

Geocentric model:

- The cosmos is a sphere
- The Earth is a sphere
- The Earth is at the middle of the cosmos
- The Earth is motionless





History of Astronomy

Nicolaus Copernicus Tacho Brahe Johannes Kepler Galileo Galilei 1546-1601 1571-1630 1564-1642 1473 - 1543 33 GAILILEVS GAILILEVS MATHVS: ATATIS SW REFIGIES TYCHONE BRAKE OTTONIOIS

1543). Copernicus is holding a model with a central sun circled by the earth, and the earth by the moon.





Isaac Newton

1642 - 1727



Laws of Motion

Every object persists in its state of rest, or uniform motion (in a straight line); unless, it is compelled to change that state, by forces impressed on it.



II. The relationship between an object's mass *m*, its acceleration a, and the applied force *F* is

F = ma.

Acceleration and force are vectors; in this law the direction of the force vector is the same as the direction of the acceleration vector.



III. For every action there is an equal and opposite reaction.





Kepler's laws





Newton's law of gravity



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Main Components

Disk, Bulge, Halo





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Distances:

1pc - typical distance between stars.8,500pc - distance to the center

OTHER GALAXIES



Spiral Galaxies

Elliptical Galaxies Irregular Galaxies

Sombrero Galaxy • M104

Barred Spiral Galaxy NGC 1300



Hubble Heritage

Elliptical Galaxy NGC 1132





Hubble Heritage

NASA and The Hubble Heritage Team (AURA/STScl) • Hubble Space Telescope ACS • STScl-PRC03-28



Rotational velocities of galaxies do not decline with the distance to the center of galaxies. This phenomenon is called <u>flat rotation curves.</u>

In order to account for the rotation, mass inside galaxies should increase linearly with the distance. Most of the mass needed for flat rotation curves is not observed. It is likely in the form

of some particles, which do not emit or absorb light. This is called the Dark Matter

