Department of Physics and Astronomy

Astronomy 1X

Session 2007-08

Solar System Physics I

Dr Martin Hendry

5 lectures, beginning Autumn 2007

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Course information and handouts:
access via A1X moodle site

http://moodle.gla.ac.uk/physics/moodle/

Astronomy A1X 2007-08
Solar System Physics I – Lecture Plan

2 lectures

Introductory Tour of the Solar System

- Qualitative description of the Sun, planets, moons and minor bodies, contrasting Jovian and terrestrial planets
- Some Solar System vital statistics
- Overview of Solar System formation

Gravitation and Solar System physics

- Newton's law of gravitation
- Surface gravity and escape speed
- Tidal forces

Links to A1X Dynamical Astronomy

Astronomy A1X 2007-08
Solar System Physics I – Lecture Plan

3 lectures

The physics of planetary atmospheres

- The ideal gas law and velocity of gases
- Hydrostatic equilibrium and atmospheric scale heights

The Jovian planets and their moons

- Internal and atmospheric structure and composition
- Ring systems and Roche stability
- Physical properties of the main satellites
- Case study: the Galilean moons

Section 1: A Tour of the Solar System

Some vital statistics:-

The Solar System consists of:-

- the Sun,
- its **8** planets,
- their moons,
- dwarf planets, asteroids and comets,
- the 'Solar wind'

- Astronomers have studied the motions of the Sun, Moon and planets for thousands of years (see A1X Positional Astronomy)

- Before the invention of the telescope, however, we knew almost nothing about their true nature.

The Sun: some vital statistics:

The Sun is a *star*: a ball of (mainly) hydrogen gas, 700,000 km in radius (about 100 Earth radii)

It generates heat and light through **nuclear fusion**:

Surface temperature = 5800K

Central temperature = ~15 million K

Balance (hydrostatic equilibrium) maintained between *pressure* and *gravity*

The Sun's outer atmosphere, or *corona*, is very hot (several million K) – heated by twisting of the Sun's magnetic field

Section 1: A Tour of the Solar System

The Planets: some vital statistics:-

Name	Diameter* (Earth=1)	Mass (Earth=1)	Mean distance from the Sun
Mercury	4880 km (0.383)	3.302×10^{23} kg (0.055)	5.79×10^{7} km (0.387 AU)
Venus	12104 km (0.949)	4.869×10^{24} kg (0.815)	1.082×10^{8} km (0.723 AU)
Earth	12756 km (1.000)	5.974×10^{24} kg (1.000)	1.496×10^{8} km (1.000 AU)
Mars	6794 km (0.533)	6.418×10^{23} kg (0.107)	2.279×10^{8} km (1.524 AU)
Jupiter	142984 km (11.209)	1.899×10^{27} kg (317.8)	7.783×10^{8} km (5.203 AU)
Saturn	120536 km (9.449)	5.685×10^{26} kg (95.16)	1.432×10^{9} km (9.572 AU)
Uranus	51118 km (4.007)	8.682×10^{25} kg (14.53)	2.871×10^{9} km (19.194 AU)
Neptune	49528 km (3.883)	1.024×10^{26} kg (17.15)	4.498×10^{9} km (30.066 AU)
Pluto	~2300 km (0.18)	1.3×10^{22} kg (0.0021)	5.915×10^{9} km (39.537 AU)

* Equatorial diameter

See also table 6.1 in Astronomy Today

Mean Earth – Sun distance = **Astronomical Unit**

149,597,870 km

1 A.U. = 107 solar diameters

The orbits of the planets are ellipses and lie in, or close to, a plane – the ecliptic. (See A1X Dynamical Astronomy).

The planets divide into two groups:

Inner *Terrestrial* planets: small, rocky — **Mercury, Venus, Earth, Mars**

Outer *Jovian* planets: gas giants — **Jupiter, Saturn, Uranus, Neptune**

Pluto is a 'misfit' – Kuiper Belt object; along with asteroids and comets, 'debris' from formation of the Solar System.