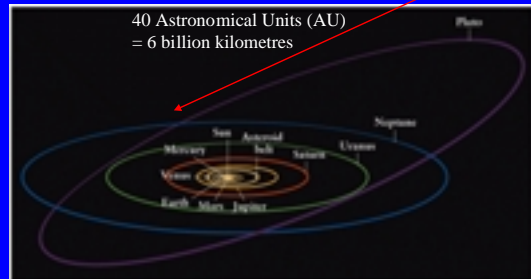


# GENS 4001 Astronomy

## Part 1: The Solar System— Introduction

Dr Michael Burton  
Department of Astrophysics, UNSW

# The Solar System to Scale

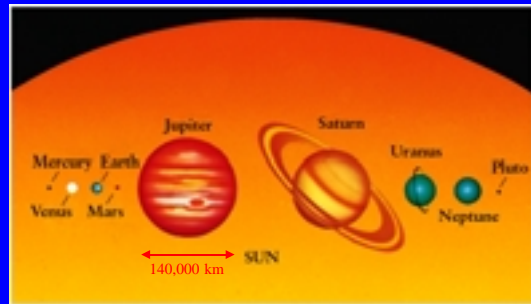


# Planetary Orbits: Obeying Kepler's Laws of Motion



- Planets move in Ellipses around the Sun
- Speeds are greater the closer the planet is to the Sun  
( $V \propto 1/\sqrt{R}$ ,  $T^2 \propto R^3$ )

# The Sun and the Planets: to Scale



The Outer Planets

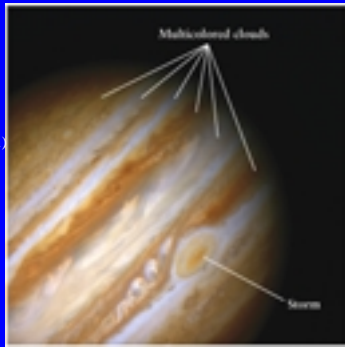
|  | Jupiter                | Saturn                 | Uranus                | Neptune                | Pluto                 |
|--|------------------------|------------------------|-----------------------|------------------------|-----------------------|
| Average distance from Sun (10 <sup>6</sup> km) | 778.30                 | 1433.6                 | 2877.6                | 4497.8                 | 5904.7                |
| Average distance from Sun (AU)                 | 5.2026                 | 9.53719                | 19.194                | 30.066                 | 39.537                |
| Orbital period (years)                         | 11.862                 | 29.461                 | 84.014                | 164.81                 | 248.69                |
| Orbital eccentricity                           | 0.048                  | 0.053                  | 0.043                 | 0.009                  | 0.250                 |
| Inclination of orbit to the ecliptic           | 1.30°                  | 2.48°                  | 0.77°                 | 1.77°                  | 17.12°                |
| Equatorial diameter (km)                       | 142,984                | 120,536                | 51,518                | 49,528                 | 2300                  |
| Equatorial diameter (Earth = 1)                | 11.209                 | 9.469                  | 4.007                 | 3.883                  | 0.180                 |
| Mass (kg)                                      | $1.899 \times 10^{27}$ | $5.972 \times 10^{26}$ | $4.62 \times 10^{25}$ | $1.024 \times 10^{26}$ | $1.31 \times 10^{22}$ |
| Mass (Earth = 1)                               | 317.8                  | 95.16                  | 14.53                 | 17.15                  | 0.0022                |
| Average density (kg/m <sup>3</sup> )           | 1.326                  | 0.687                  | 1.273                 | 1.638                  | 2080                  |

Table 2-2 The Seven Giant Satellites

|                                      | Moon                  | Io                    | Europa                | Ganymede              | Callisto              | Titan                 | Triton                |
|--------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Parent planet                        | Earth                 | Jupiter               | Jupiter               | Jupiter               | Jupiter               | Saturn                | Neptune               |
| Diameter (km)                        | 3476                  | 3642                  | 3120                  | 5268                  | 4826                  | 5150                  | 2706                  |
| Mass (kg)                            | $7.35 \times 10^{22}$ | $8.93 \times 10^{22}$ | $4.80 \times 10^{22}$ | $1.48 \times 10^{27}$ | $1.08 \times 10^{27}$ | $1.34 \times 10^{26}$ | $2.14 \times 10^{22}$ |
| Average density (kg/m <sup>3</sup> ) | 3340                  | 3530                  | 2970                  | 1940                  | 1830                  | 1880                  | 2030                  |
| Subspherical atmosphere?             | No                    | No                    | No                    | No                    | No                    | Yes                   | No                    |

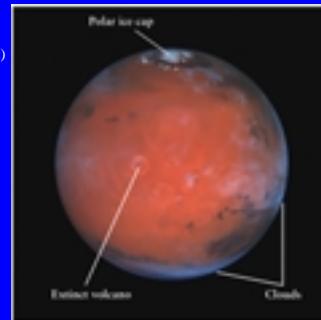
## A typical Jovian Planet: Jupiter

- Large (140,000 km)
- Gaseous
- Rapid Rotation
- Many Moons

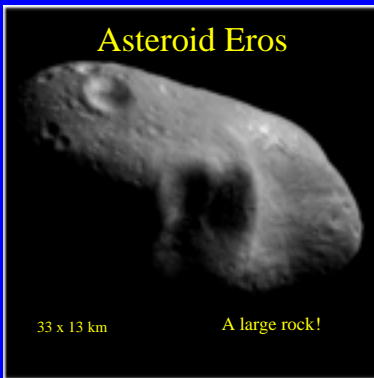


## A typical Terrestrial Planet: Mars

- Small (7,000 km)
- Rocky
- Slow Rotation
- Few Moons



## Asteroid Eros



33 x 13 km

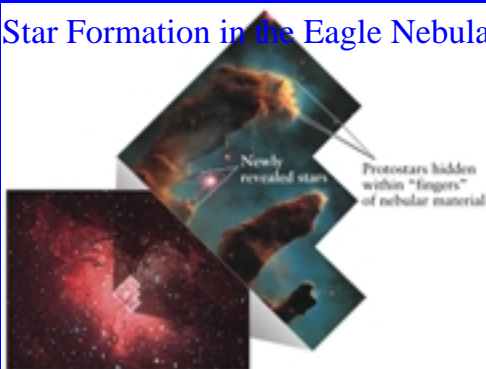
A large rock!

## Comet Hale-Bopp (1997)

A dirty snowball (sand + ice)

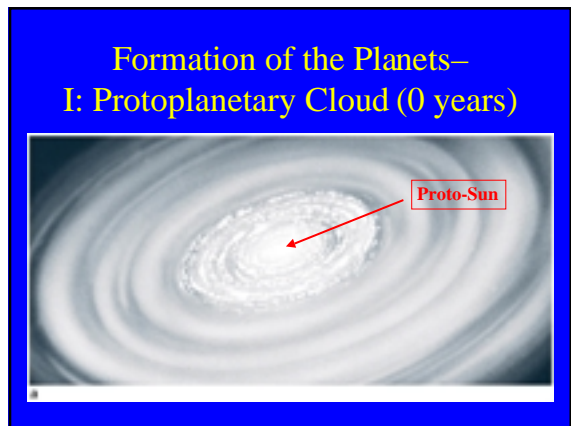
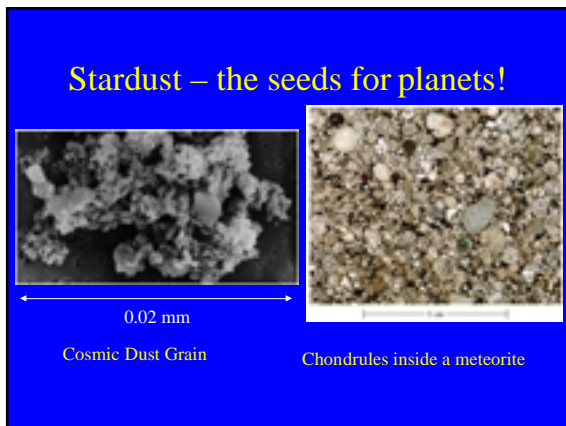
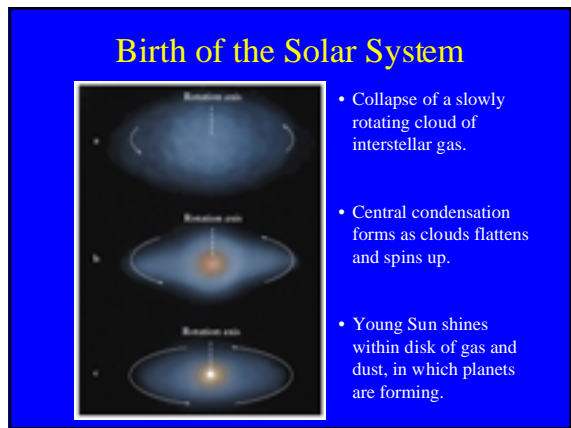
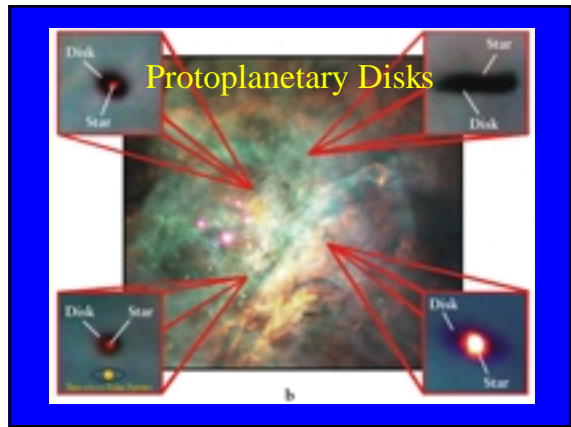
Nucleus just ~10 kilometres across, Tail millions of km long

## Star Formation in the Eagle Nebula

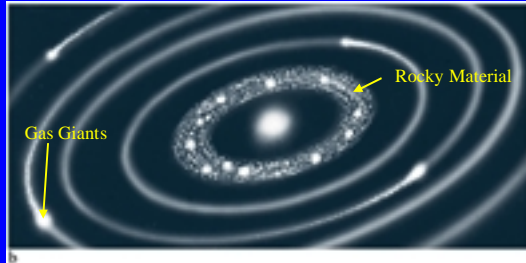


## The Orion Nebula





## Formation of the Planets – II: Planetesimals (50 million yrs)



## Formation of the Planets – III: Planets (100 million years)



## Numerical simulation of the Birth of the Solar System



## Extra-solar Planets

