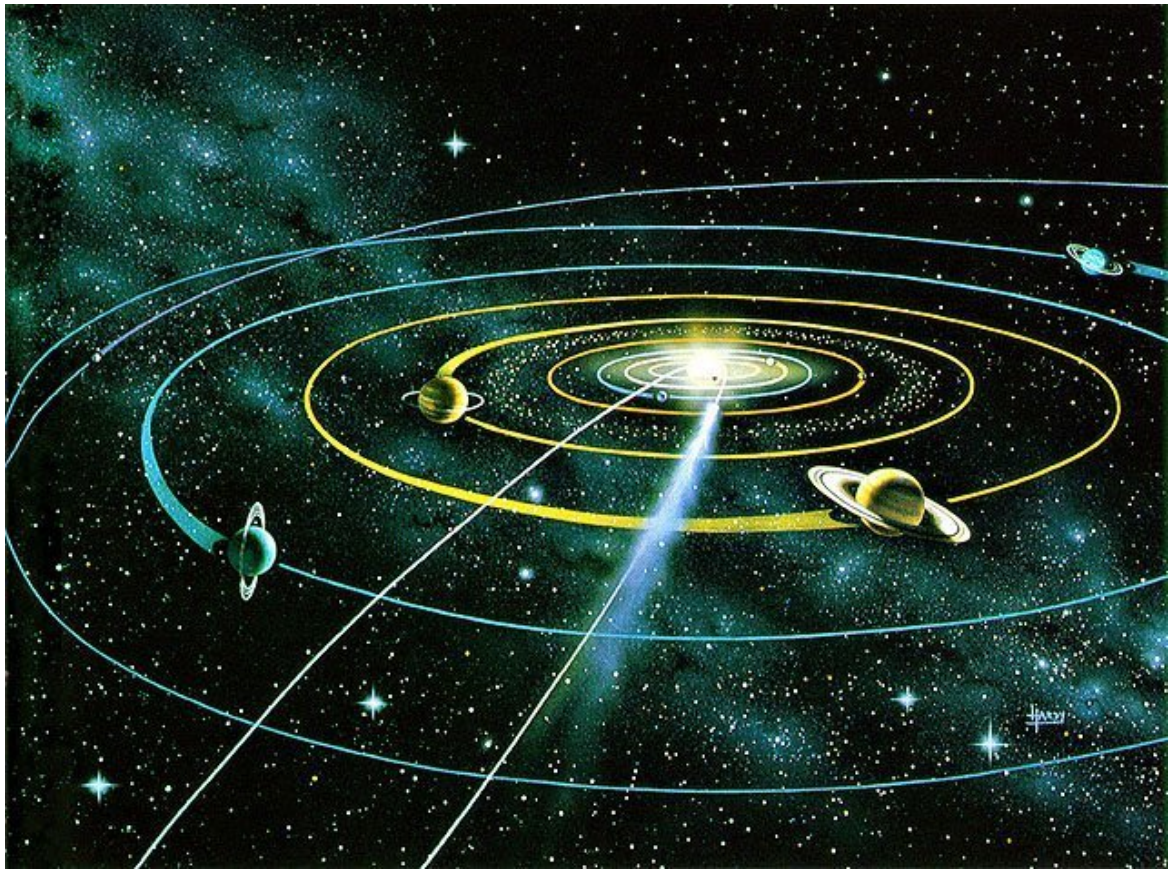
Astrophysical Dynamics

Introduction by Hans Rickman

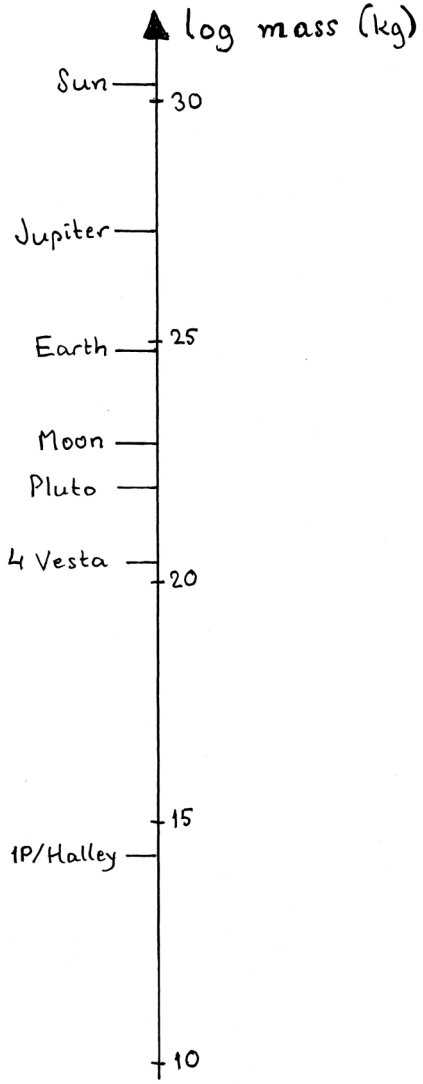
N-body Problems

- 2-body problem: Easy to solve in closed form (analytical formulae)
- 3-body problem: Practically impossible to solve by analytic means; perturbation theory + numerical integrations
- few-body problem: Like 3-body problem but slightly more complicated
- many-body problem: *N* is very large; we use a statistical approach and study the distribution function of orbits in the system

Solar System Dynamics

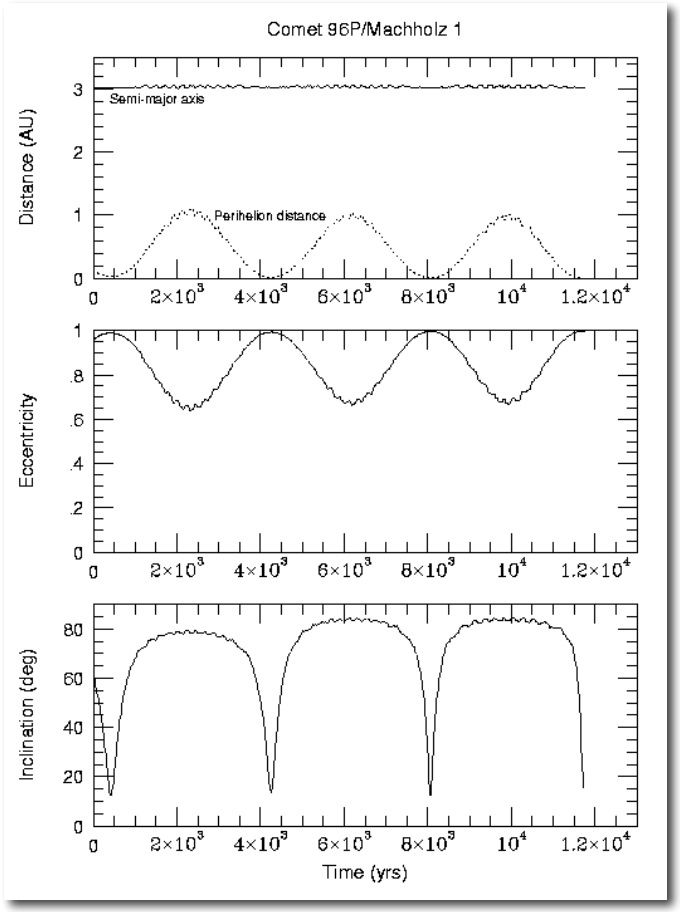


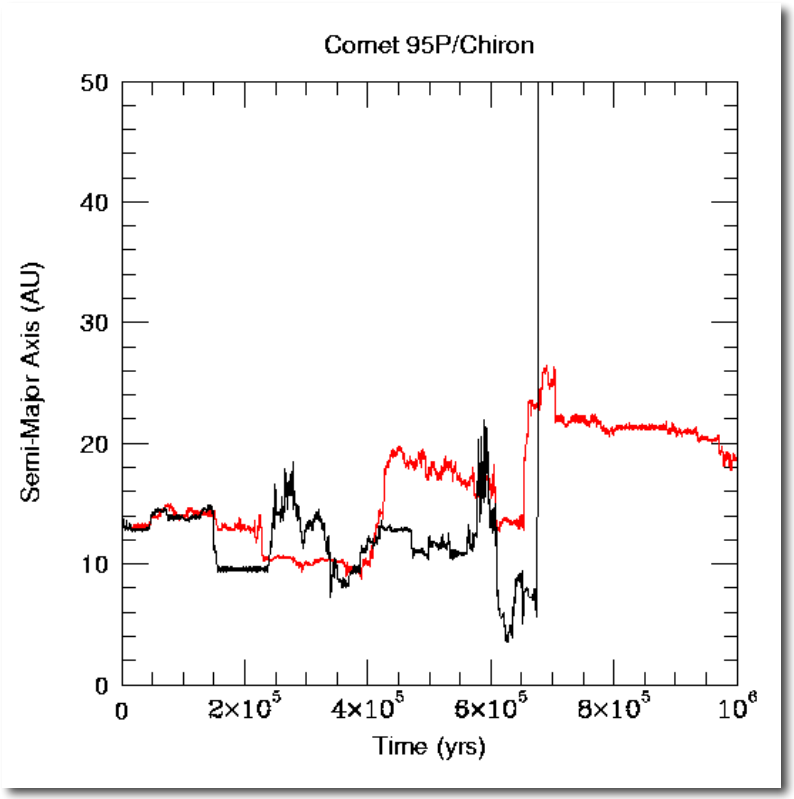
Solar System inventory



- The Sun is >1000 times as massive as any other object
- The planets span a range of ~6000 in mass
- Dwarf planets are (so far) >10 times less massive
- Small bodies are even less massive

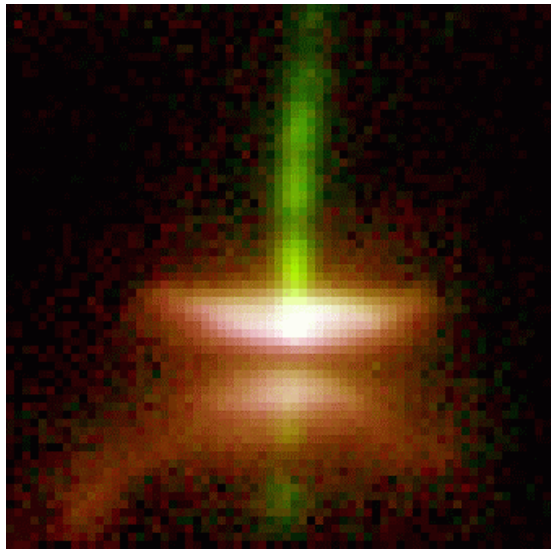
Orbital evolutions



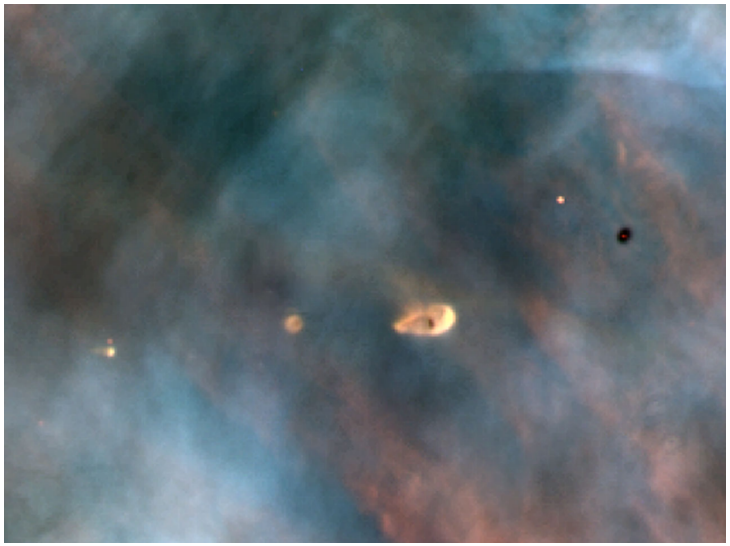


Numerical integration results for comets

Protoplanetary disks



HH 30
“Herbig-Haro object”



“proplyds”
(Orion nebula)

General radii ~ 100 AU

HST pictures

Many-body systems

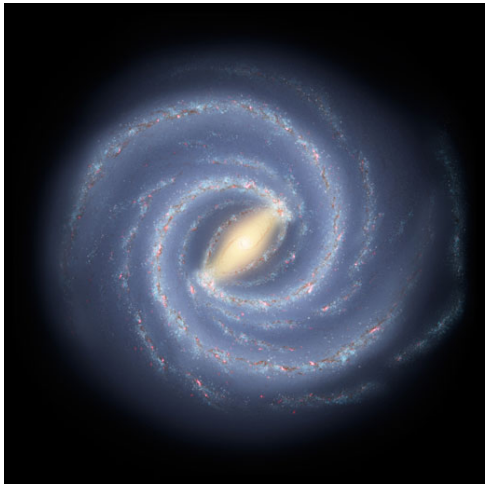
Oort cloud

M13, globular cluster

Not self-gravitating

Self-gravitating

Galactic Dynamics



- The study of our Galaxy as a self-gravitating system; stellar orbits in the Galactic potential; the rotation curve; epicyclic and vertical oscillation frequencies

Tidal interactions and mergers