Planetary Atmospheres

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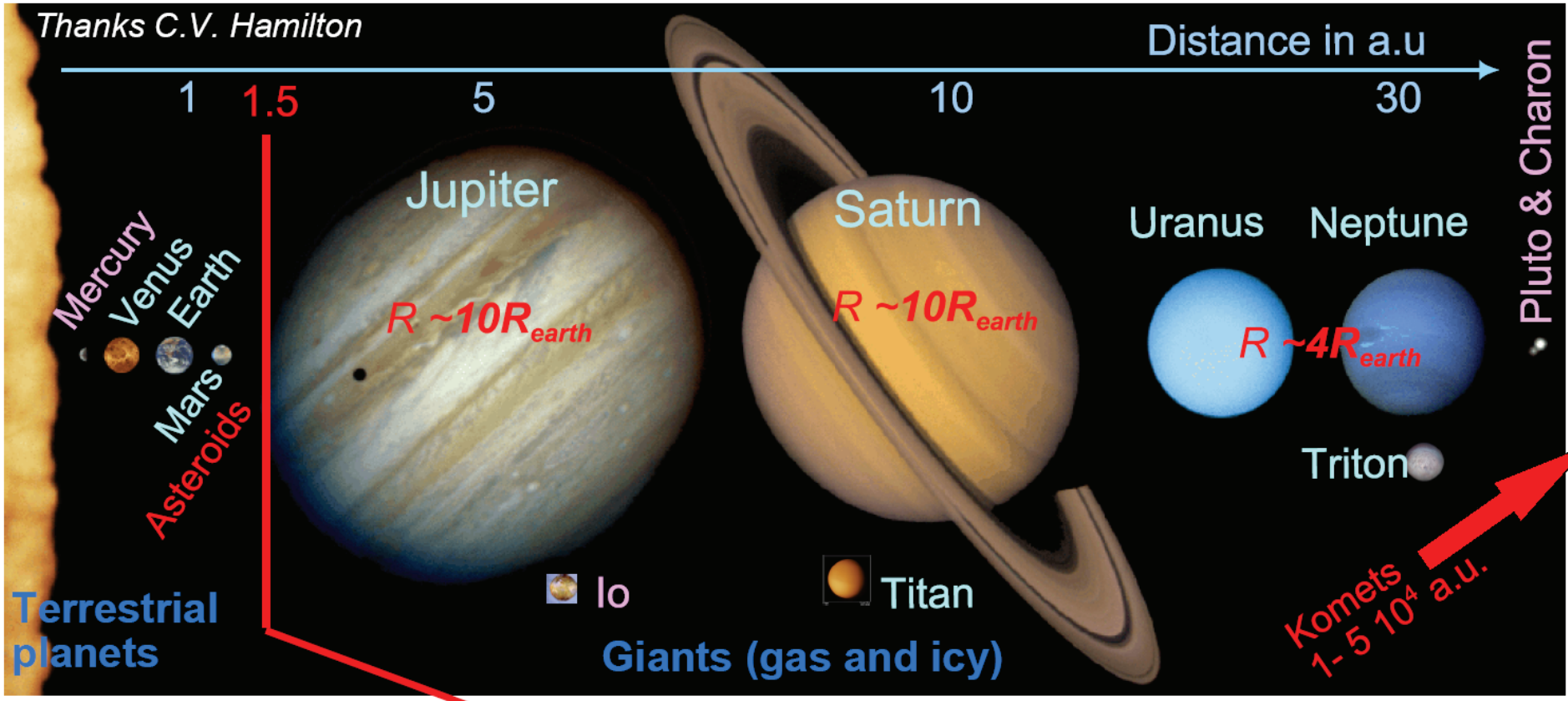
Content of the course

- Introduction
- Structure of a planetary atmosphere
- Composition, chemistry and clouds
- Atmospheric dynamics
- Basics of radiative transfer
- Methods of investigation
- Origin and evolution of planetary atmospheres
- Radiative energy balance
- Atmospheres of planets
  - *Venus*
  - *Mars*
  - *Giant planets*

Family of the Sun



- $M \sim M_{earth}$
- $\rho \sim 5$ g/cm^3
- Solid bodies, heavy elements
- T > 1 day
- Interior flux << Solar flux

- $M > 20M_{earth}$
- $\rho \sim 1.5$ g/cm^3
- Gas balls with heavy core
- Solar composition (H, He) and H_2O, NH_3, CH_4 ices
- T ~ 8 hours
- Interior flux ~ Solar flux

Diversity of the Solar system bodies

- 8 Planets
- 67 moons
- 100s of comets
- 10,000 asteroids
- 10,000 Kuiper Belt Objects

Types of atmospheres

- **Fully developed atmosphers**
  - **Venus, Earth, Mars, Titan**
  - **Jupiter, Saturn, Uranus, Neptune**
- **Tenuous atmospheres (exospheres)**
  - **Mercury**
    - *O, Na, He, K, Ca at $p < 10^{-12}$ bar*
    - *Sputtering and capture of solar wind*
  - **Pluto & Triton**
    - *N_2, CO, CH_4 at $p \sim 10^{-5}$ bar*
    - *Sublimation of ices, freezing out in apohelium*
    - *Similar processes on icy satellites*
  - **Io**
    - *SO_2 at $\sim 10^{-8}$ bar*
    - *Volcanic activity*