

Planetary Atmospheres

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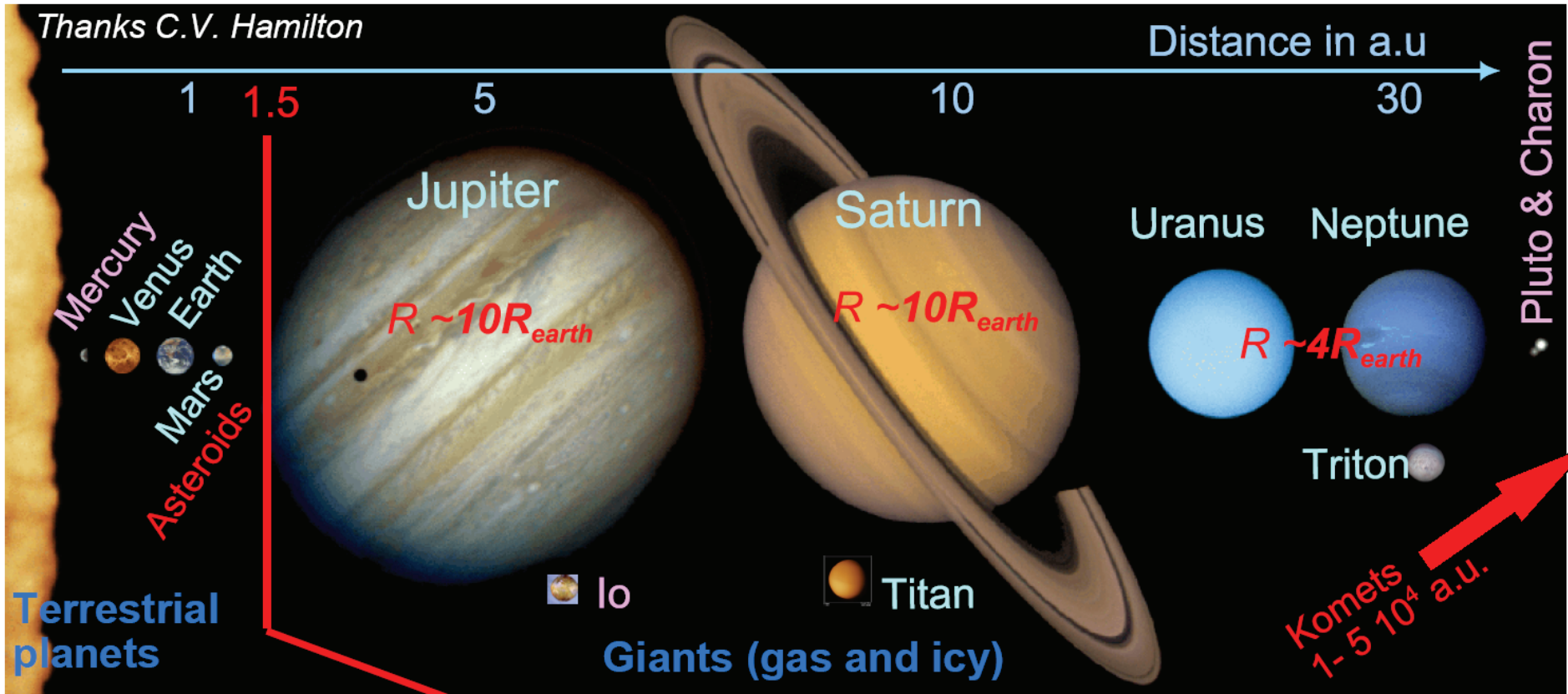
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Content of the course

- ✚ 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

Thanks C.V. Hamilton



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

- $M > 20M_{\text{earth}}$
- $\rho \sim 1.5 \text{ g/cm}^3$
- Gas balls with heavy core
- Solar composition (H, He) and H_2O , NH_3 , CH_4 ices
- $T \sim 8$ hours
- Interior flux \sim 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 atmospheres**
 - ▶ 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 aphelium*
 - ★ *Similar processes on icy satellites*
 - ▶ **Io**
 - ★ *SO_2 at $\sim 10^{-8}$ bar*
 - ★ *Volcanic activity*