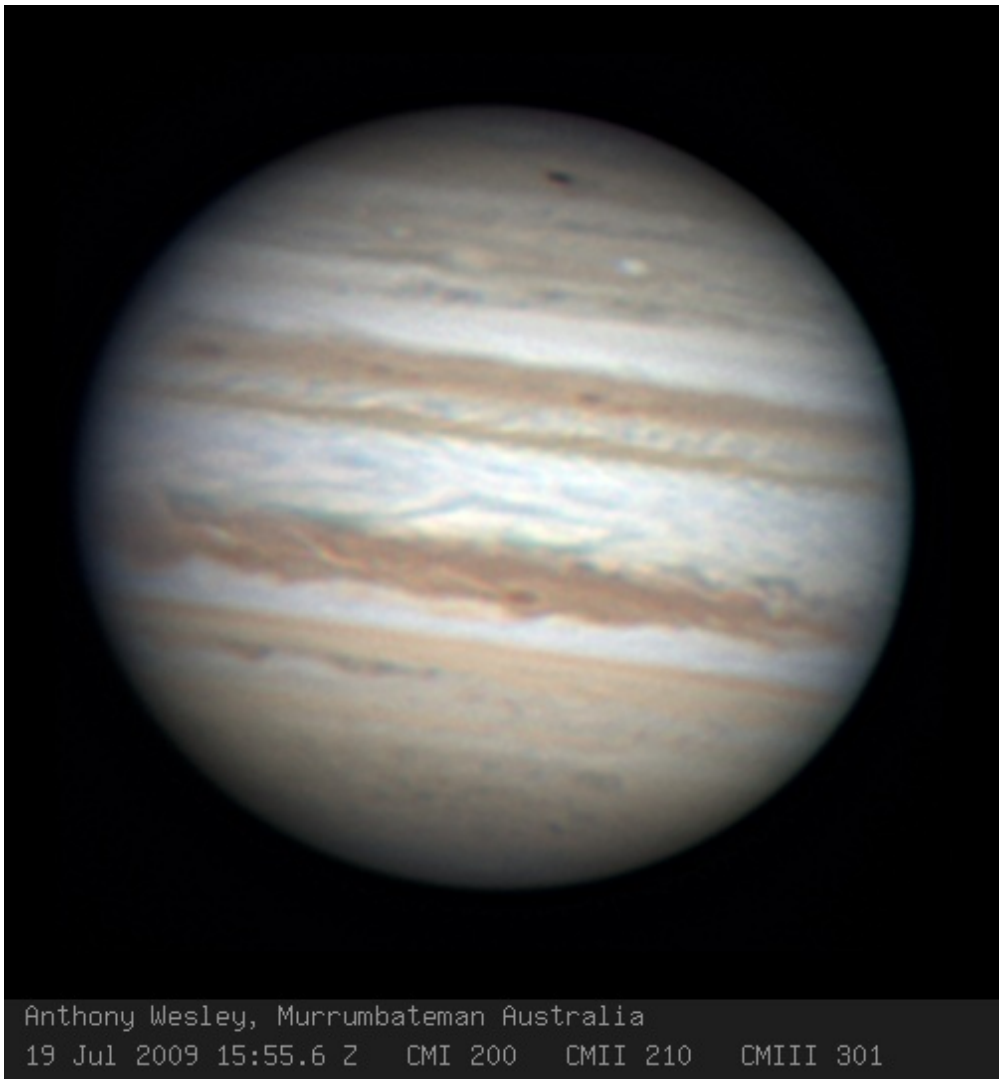
Jupiter at opposition - today



A question for the scholarly assembly:

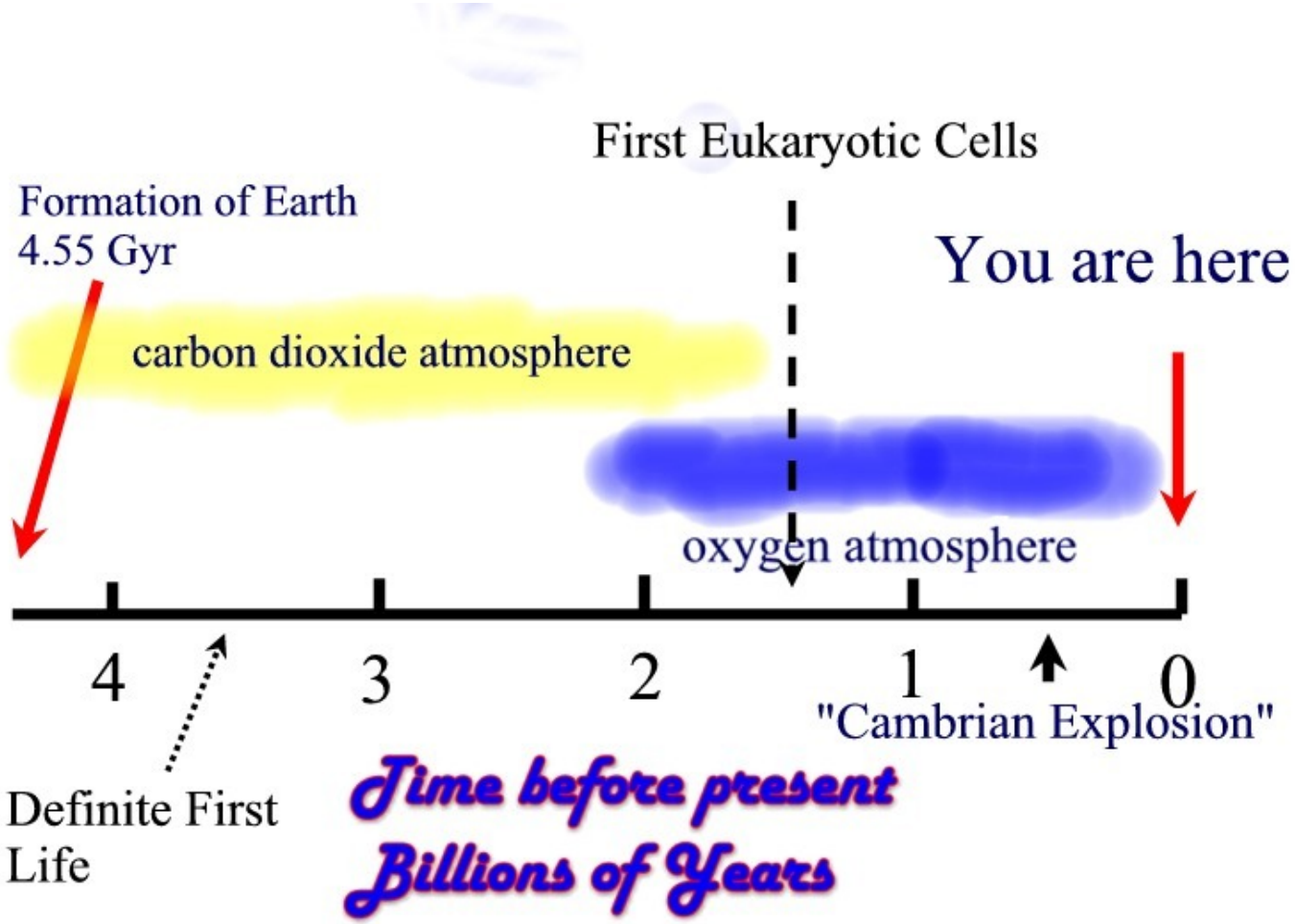
- Last time, said that the surface conditions of Mars did not allow liquid water
- Now we see what are claimed to be water flow channels, like dry river beds in the southwest
- What's up?

Mars and water

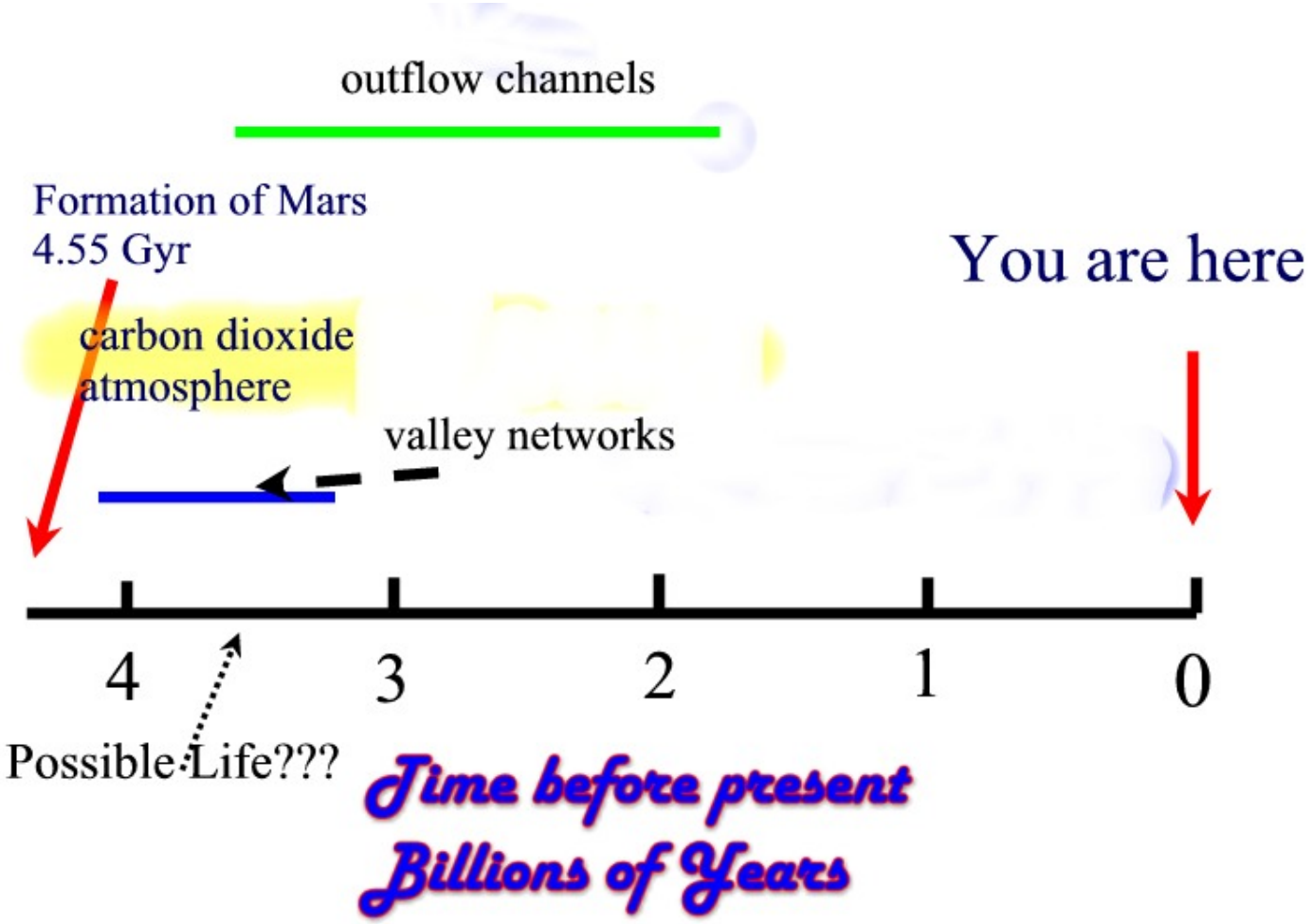
- Liquid water cannot be present on the surface of Mars at the present time
- Nonetheless, pictures from orbit show water channels going through ancient landscapes on Mars (2 types of channels)
- Perhaps the climate of Mars 3-4 billion years ago was conducive to the presence of bodies of standing water

To see what people have in mind, let's compare the (relatively) well-known geological history of Earth with a speculative history of Mars

A sketchy history of the planet Earth



An even sketchier history of the planet Mars



To determine if their were stable bodies of water on ancient Mars requires geological measurements, studies of minerals in Martian rocks

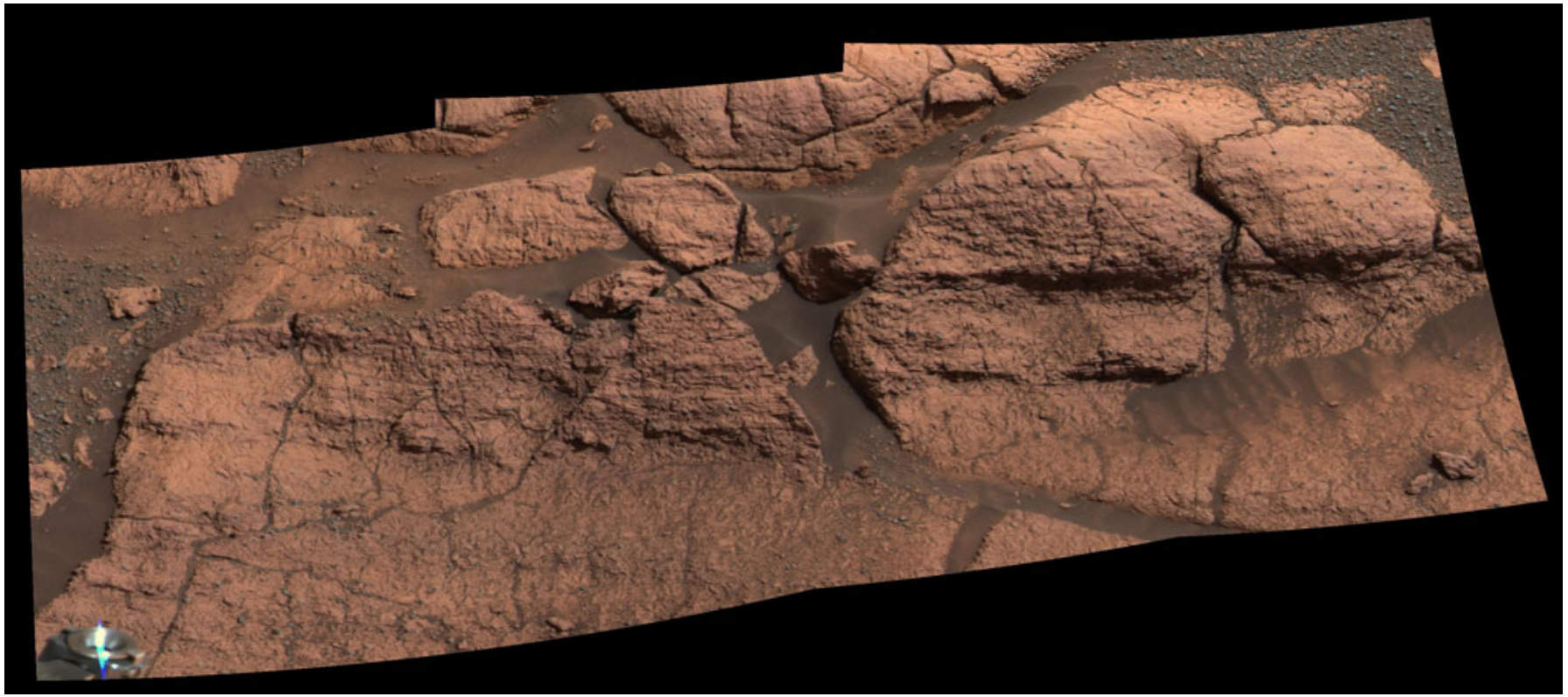
Some minerals (hematite) form in presence of standing water. Others, (olivine) are destroyed by water.

The Mars Exploration Rovers (MER) are mobile, geological laboratories sent to see if Martian rocks are lava flows (e.g. basalts) or minerals formed in the presence of water.

Spirit and Opportunity on the Surface of Mars

On a hill in Gusev crater

Sedimentary rocks on Mars



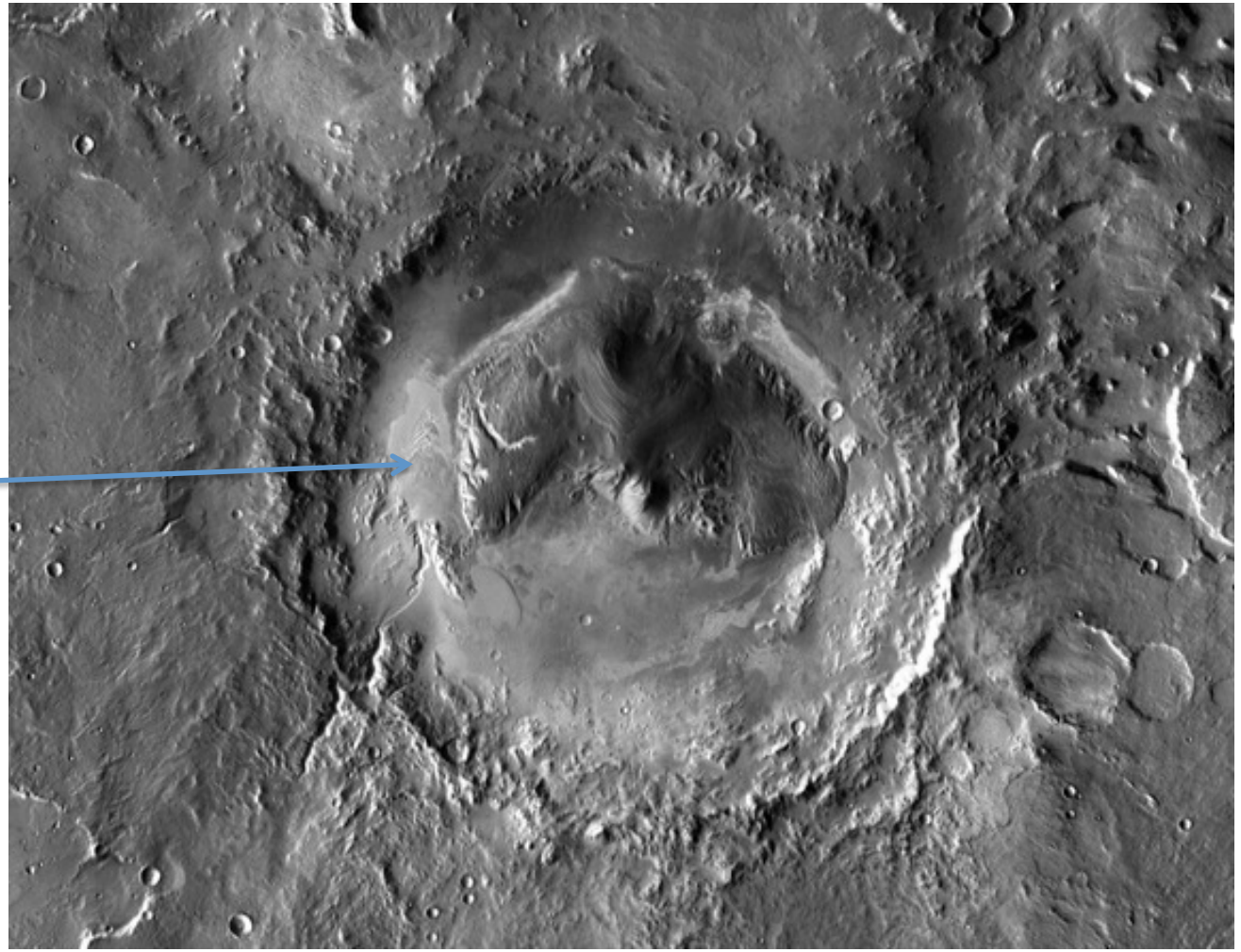
Opportunity finds hematite spheres…minerals that condensed from water

What have we learned from the MERs and "Mars Phoenix"

- It now seems clear that there were standing bodies of water for long periods of time early in Martian history
- Evidence is presence of hematite, jarosite, and other minerals that form in lakes or oceans
- Relative absence of carbonate rocks is due to alternative chemistry in acidic water
- **But,** apparently oldest rock strata do contain carbonate rocks and clay (montmorillonite)

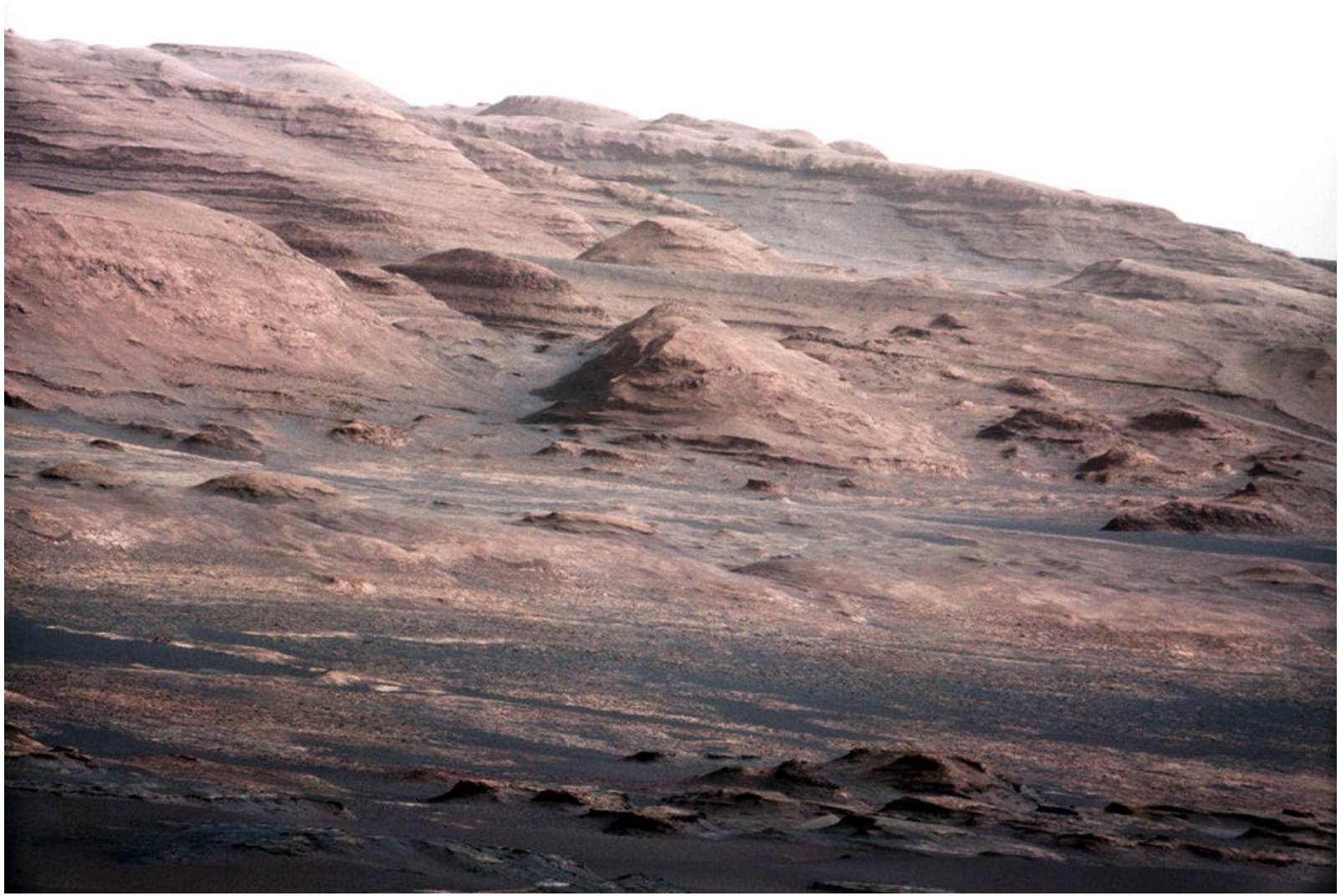
The Mars Science Laboratory and Gale Crater

Clay deposits at bottom of central mountain



Mars Science Laboratory “Curiosity” in Gale Crater on Mars

The destination for “Curiosity”

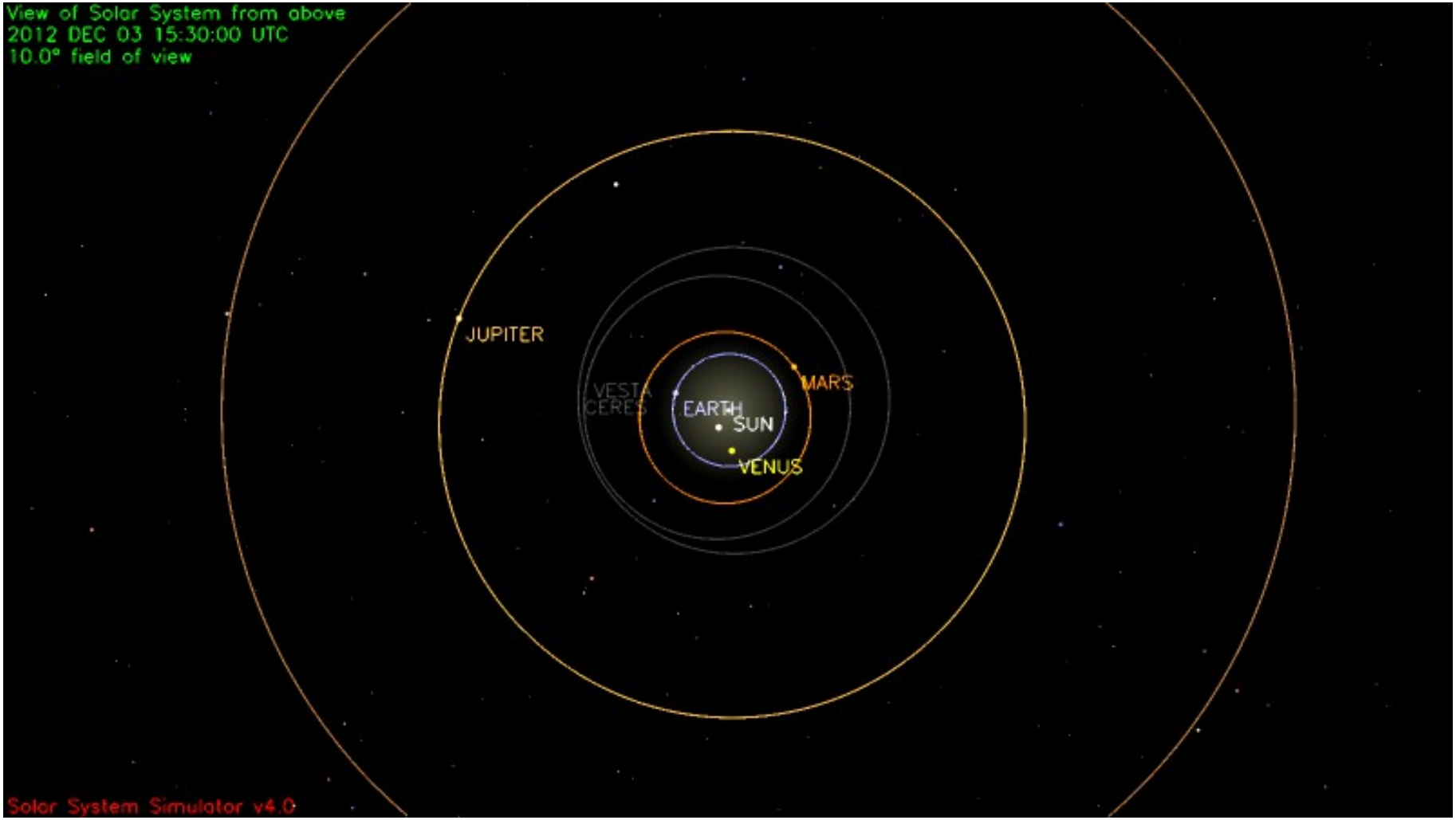


What can we expect (and hope for) from Curiosity?

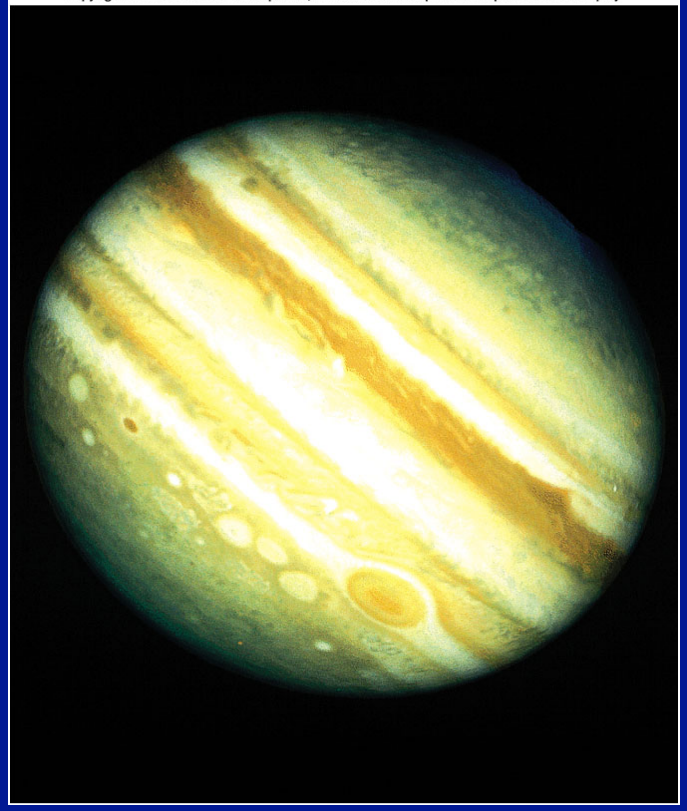
- Can it confirm existence of clays in lowest, oldest Martian strata (formed in non-saline waters)?
- Can this confirm (or reject) the possibility of a prolonged “warm, wet” period on Mars?
- Something else?
- Stay tuned

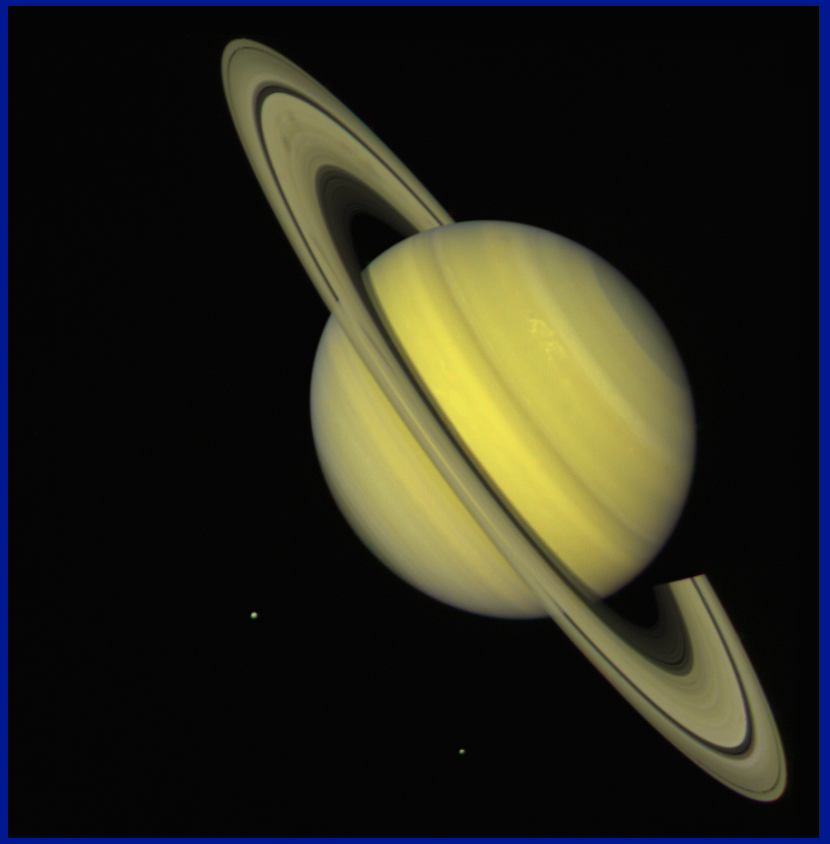
The El Dorado of future missions: Mars Sample Return

Moving out in the solar system… the Jovian planets



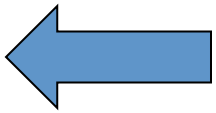
Jupiter and Saturn





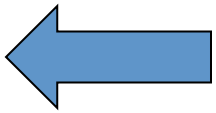
Jupiter and Saturn in the night sky

- Jupiter is almost always larger in angular size than Venus and Mars
- Right now, Venus and Mars have angular diameters of about 12 and 4 arcseconds, respectively. Jupiter is 48 arcseconds
- Saturn is about 16
- What does it mean?



Basic properties of Jupiter and Saturn

- Jupiter: 11.2 X diameter of Earth and 318 X mass
- Saturn: 9.5 X diameter of Earth and 95 X the mass
- Jupiter and Saturn: the "giant planets"
- Question: how do we know the masses of Jupiter and Saturn?



A visual comparison of Earth, Jupiter, and Saturn

Jupiter and Saturn are rapid rotators: 9.9 and 10.7 hours

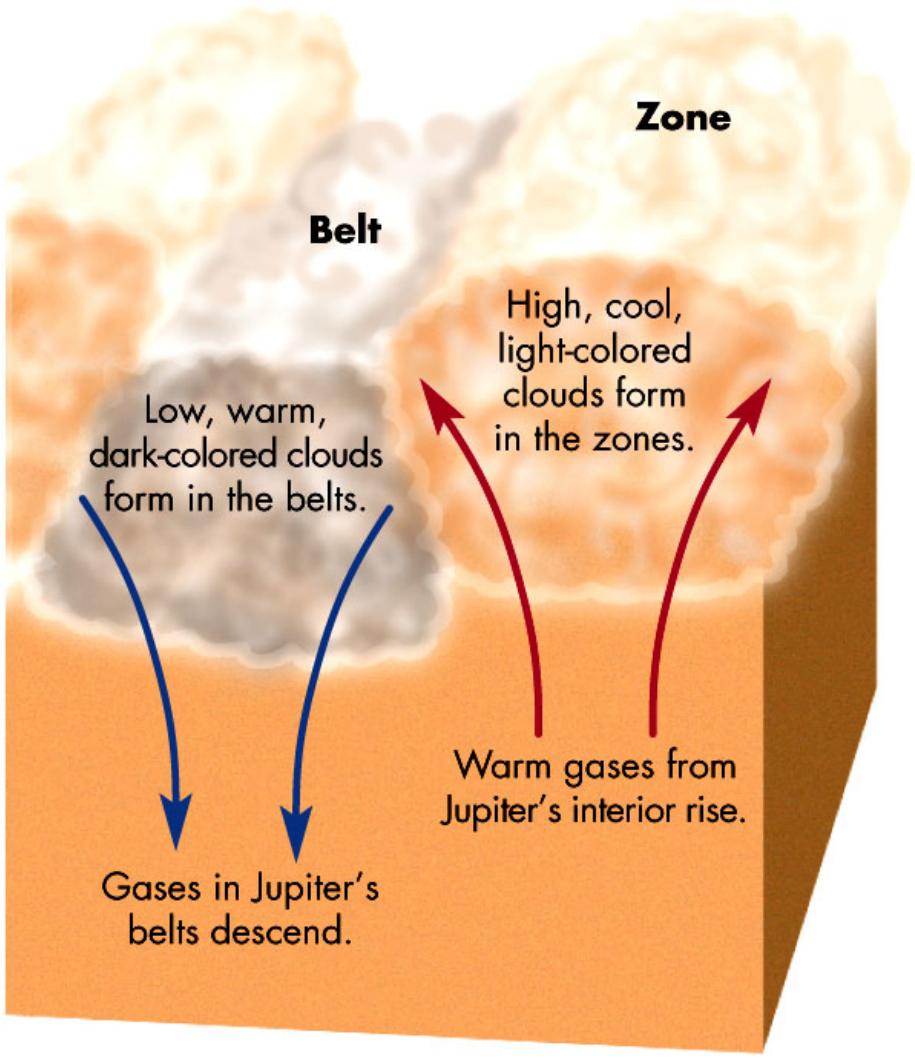
The Chemical Composition of Jupiter and Saturn

The densities of Jupiter and Saturn are about that of water (Jupiter is 1.33 grams/cc, Saturn is 0.69 grams/cc). Basic physics shows that objects with the mass, size, and density of Jupiter and Saturn must be made of very light elements. Specifically, they must be composed nearly completely of hydrogen and helium.

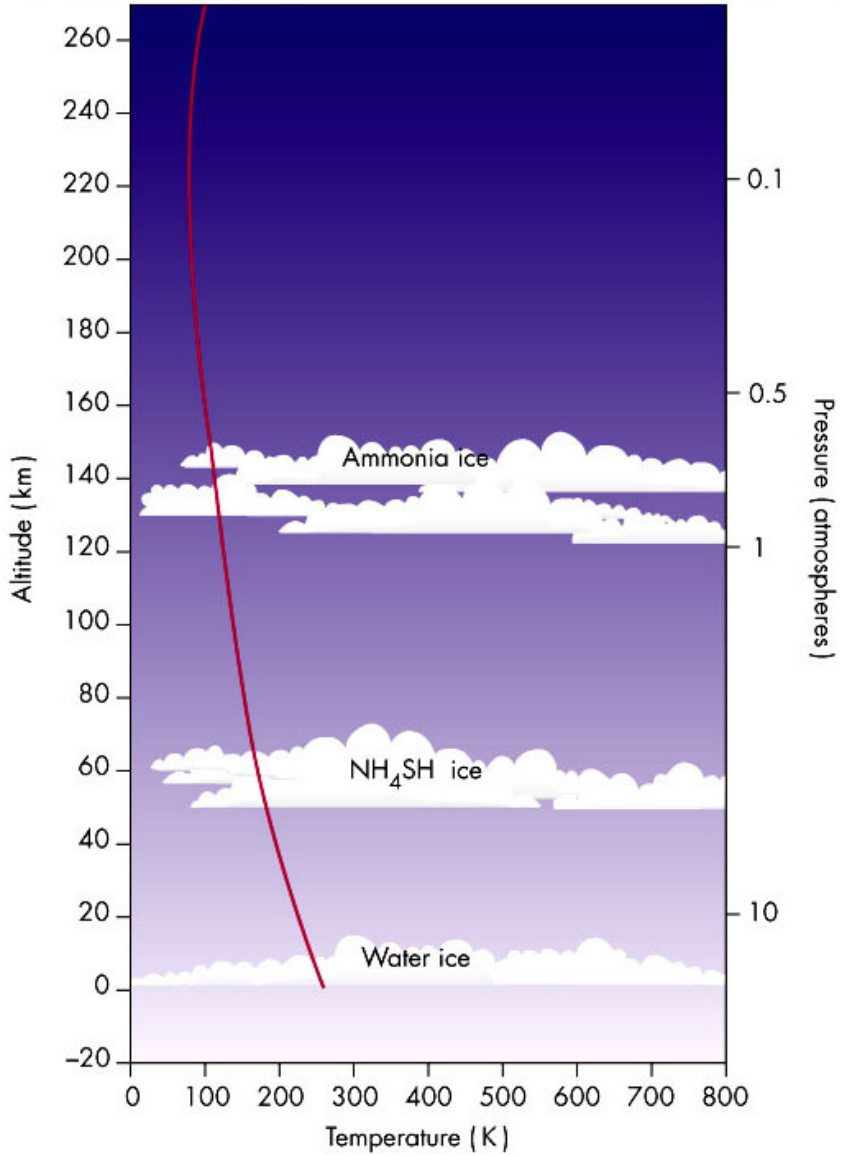
Although we reach this conclusion on the basis of theoretical physics, this conclusion is borne out by all observations. The spectrum of Jupiter shows absorption lines due to hydrogen-rich molecules such as ammonia (NH3), methane (CH4), and water, as well as others hydrocarbons such as acetylene, ethane, and propane. This chemical composition was also verified by the Galileo spacecraft probe, which descended into the atmosphere of Jupiter.

Read the quotation in the text about the fact that Jupiter and Saturn are nearly completely composed of hydrogen and helium. *In this, they have the same*

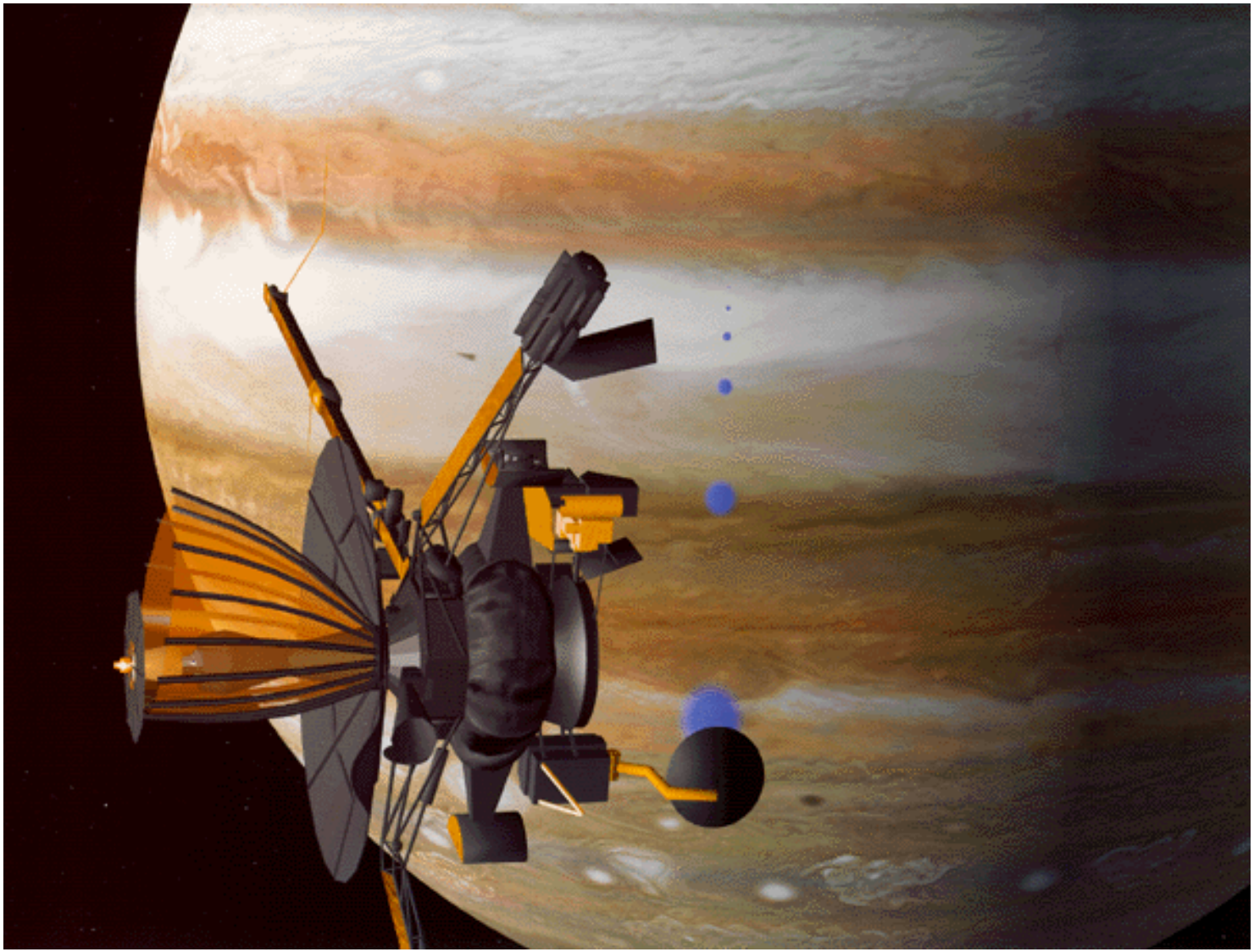
The cloud bands of Jupiter



The atmospheric structure of Jupiter

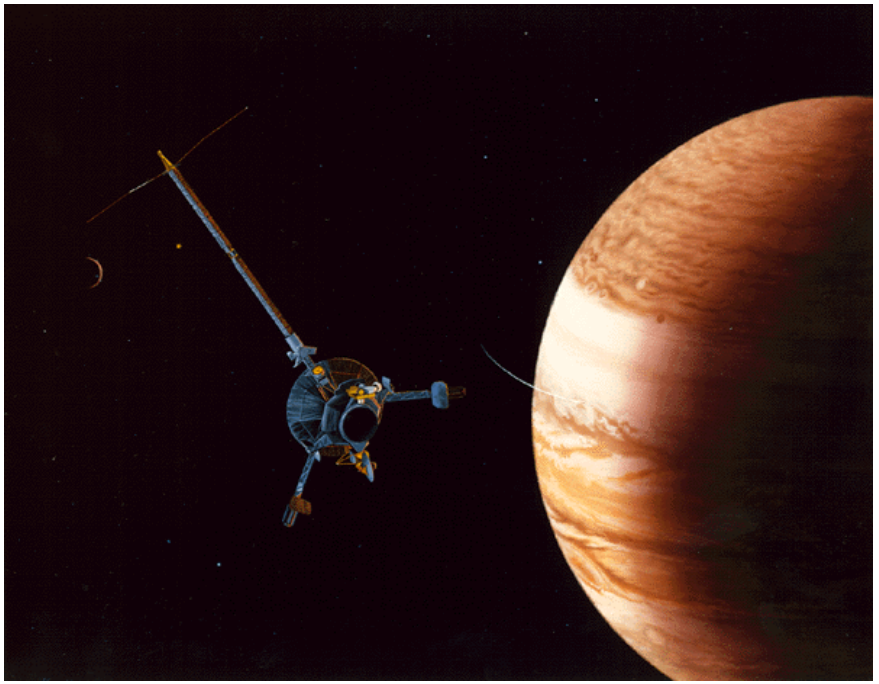


Exploration of Jupiter



The Galileo spacecraft mission

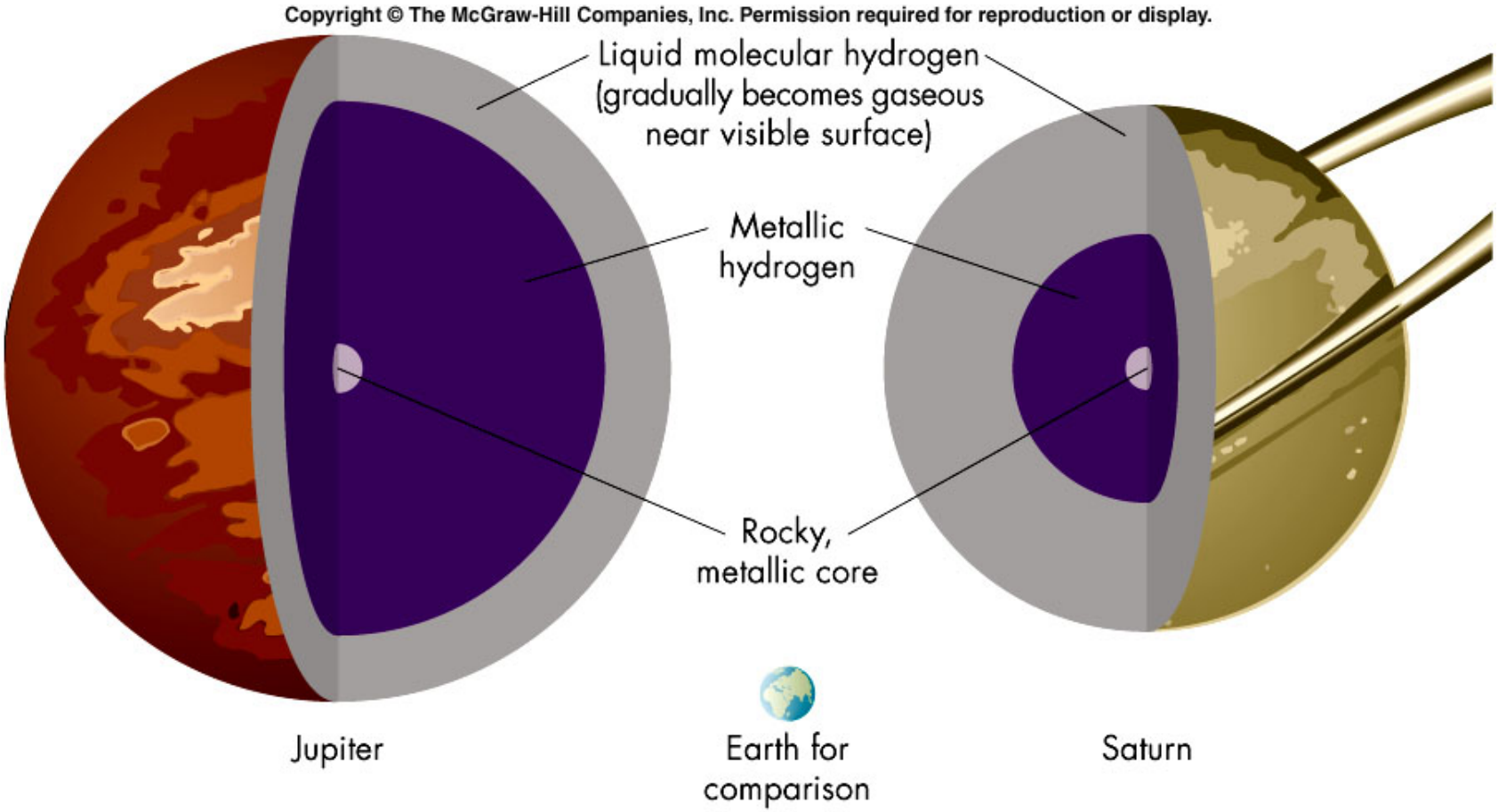
- Launch: October 1989
- Arrival at Jupiter: December 1995
- End of mission (dive into Jupiter): September 2003



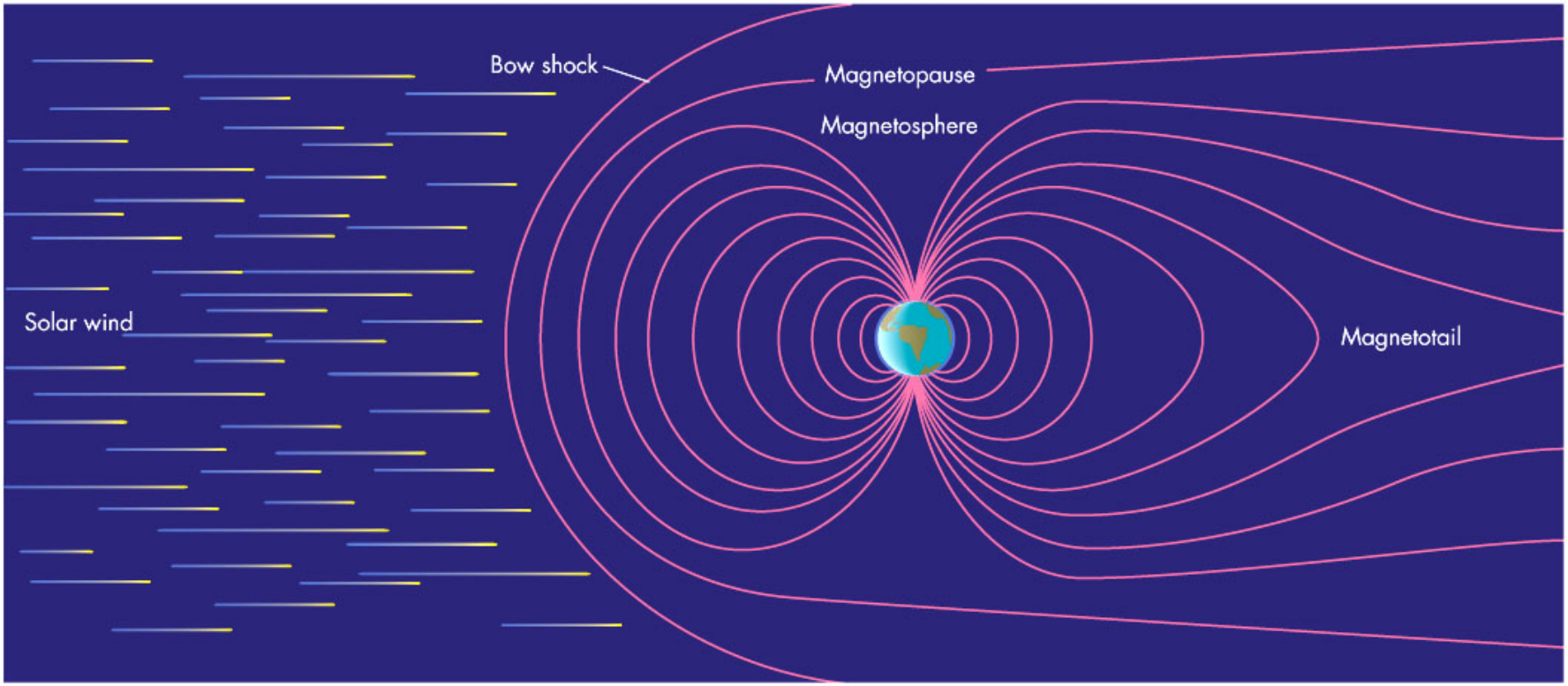
The Galileo Probe

The Galileo Probe

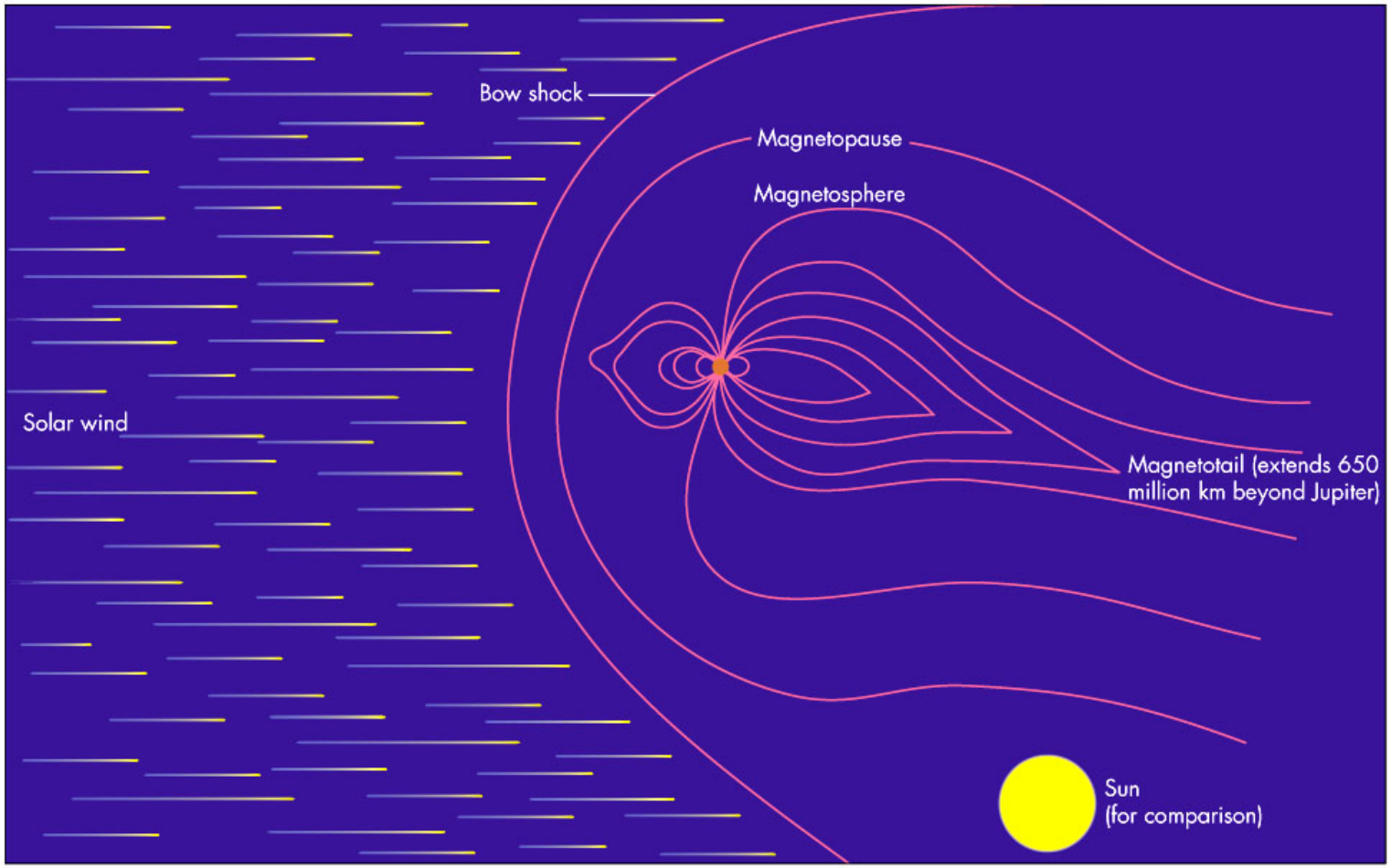
The interior structure of Jupiter (and Saturn)



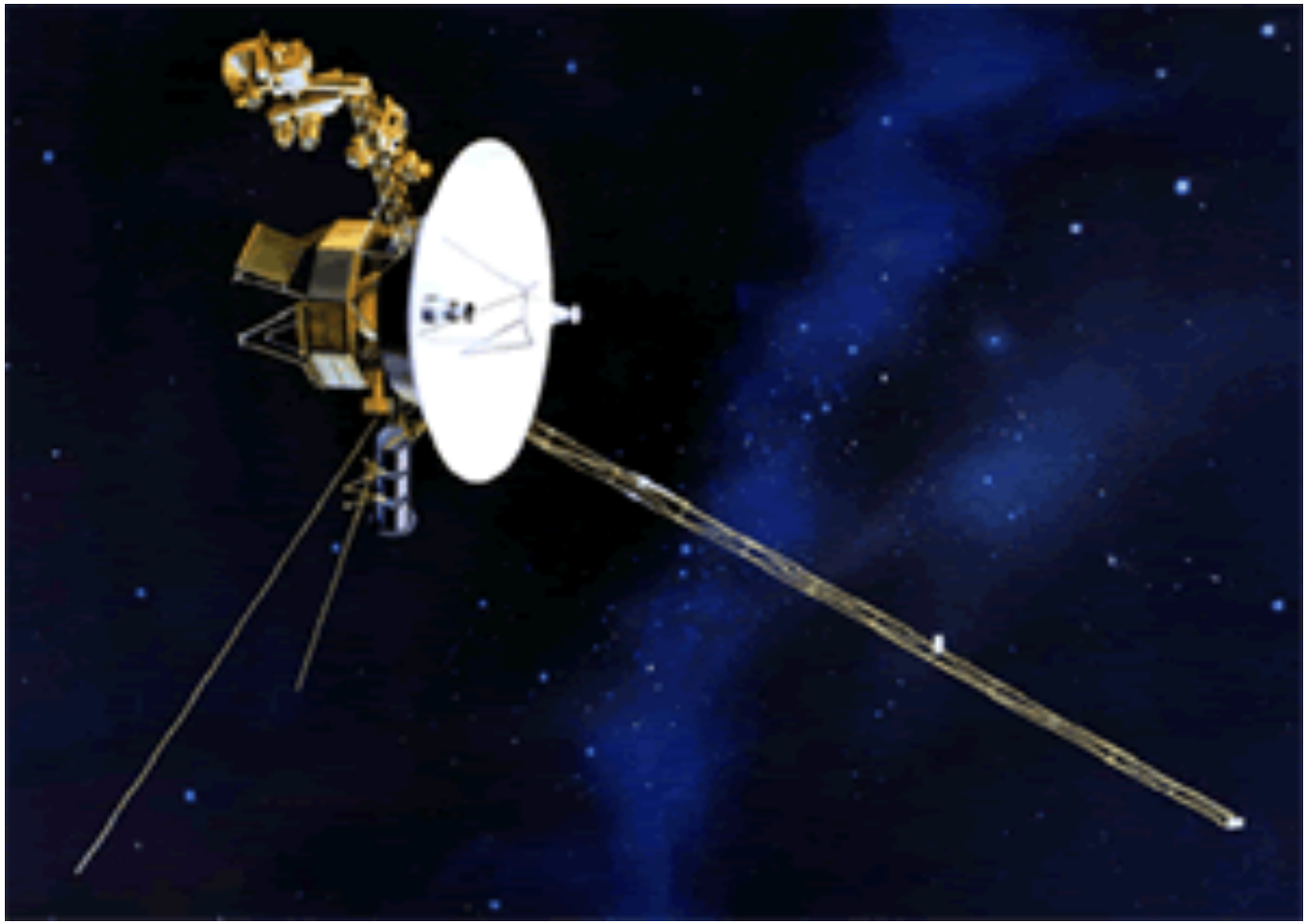
Magnetospheres 1: the Earth and the Van Allen Belts



Magnetospheres 2: the magnetosphere of Jupiter



University of Iowa connection…plasma waves and radio waves with the Voyager spacecraft



Sounds from the Voyager encounter with the Jovian bow shock

University of Iowa space plasma waves