Farewell to Earth: Planets and other things

Galileo leaves Earth: NASA

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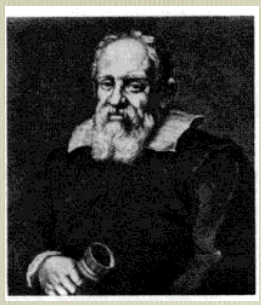
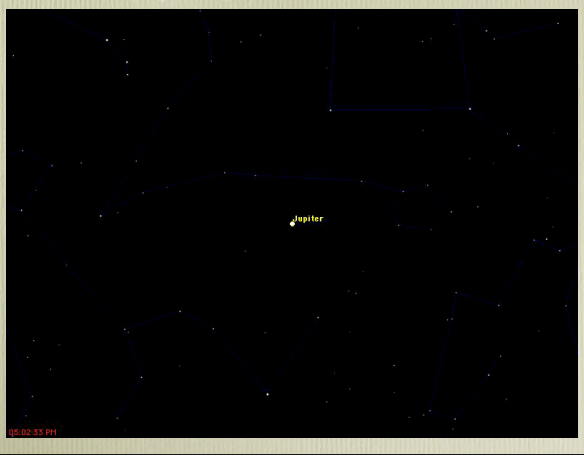
Farewell to Earth

- *Galileo to* Galileo
- *Person* to Satellite

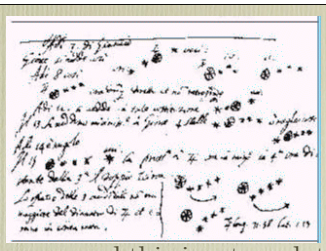


GALILEO (1564-1642)

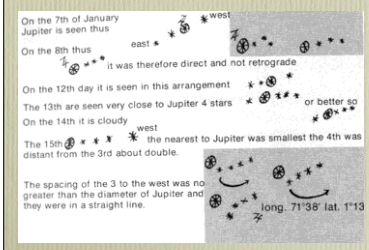
- Moons of Jupiter: Jan 8th 1608



- This is his original notebook



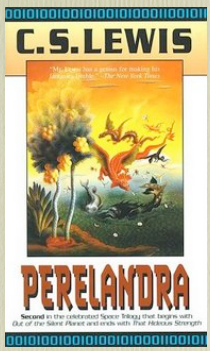
- and this is a translation.



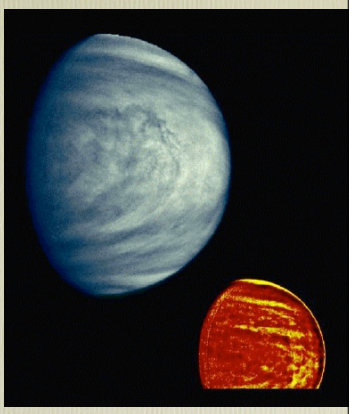
- moons also discovered by a German astronomer, Marius (or Mayr). He gave them their names Io, Europa, Ganymede and Callisto.

Venus

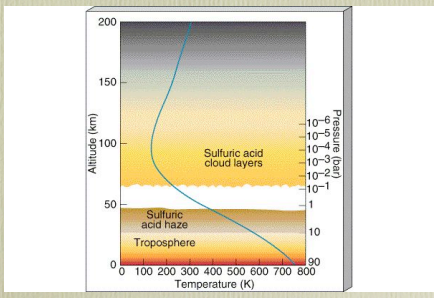
- Popular with writers: e.g C. S Lewis
- So does it look like this?



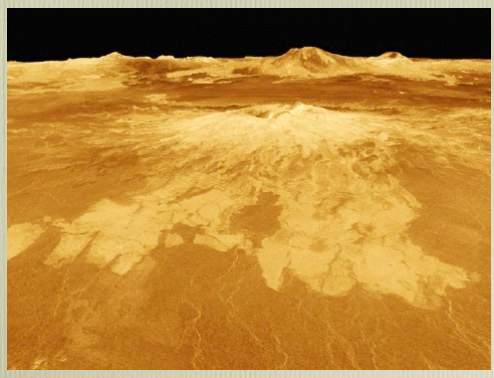
- Almost featureless in optical. Usual picture is UV (upper) or infrared (lower) and only shows cloudtops.
- Venera, pioneer and radar showed surface for first time
- Year = 225 days.
- Rotation (i.e. 1 venus day = 243 days Retrograde (so sun "rises" in the west: unknown till 1961)
- Atmosphere very dense (pressure ~ 100 x earth at surface). Mainly CO_2



- Upper clouds rotate in 4 days (~360 km hr^{-1})
- At surface, gentle winds, but temperature ~ 900 °C
- Surface rocks basaltic, appear to be young

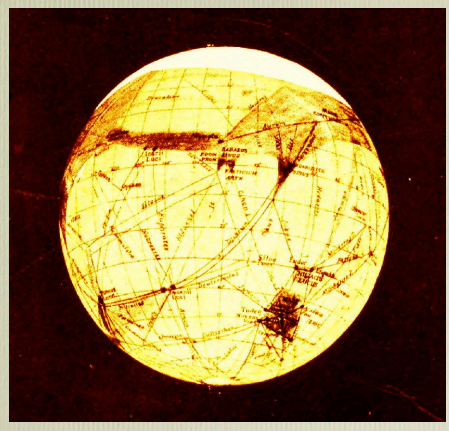


- Sapas Mons, a volcano 400 km across and 1.5 km high. Note the lava flows extend for hundreds of km.

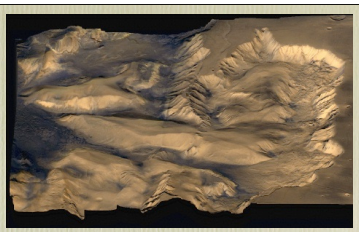


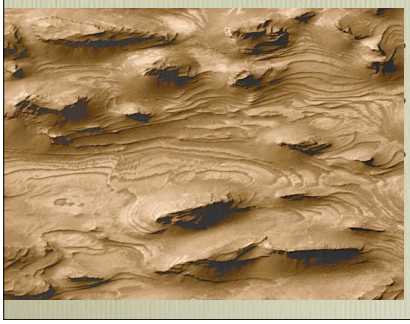
Mars

- Very popular with writers:
- Bradbury did it best ("Sands of Mars")
- Lowell observed canals



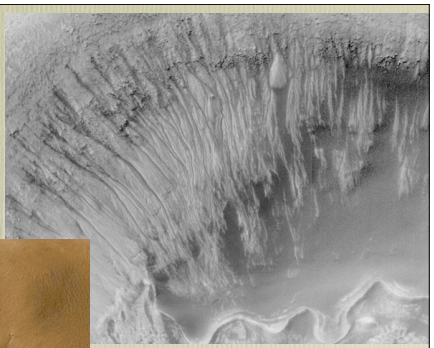
- Candor Chasma: Massive rift valley.





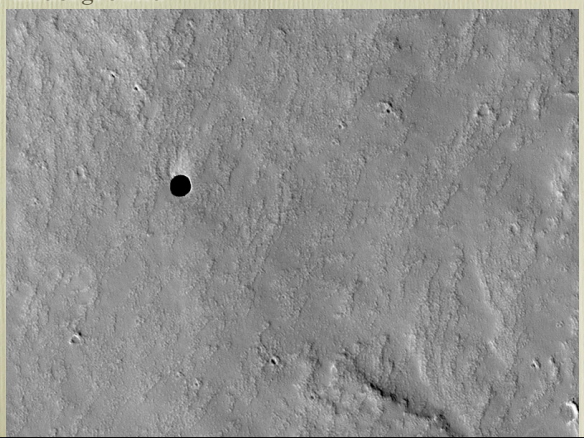
- The interesting problem:
- Does Mars have water?
- Sometimes it looks just as though it once did

- This is the Newton crater



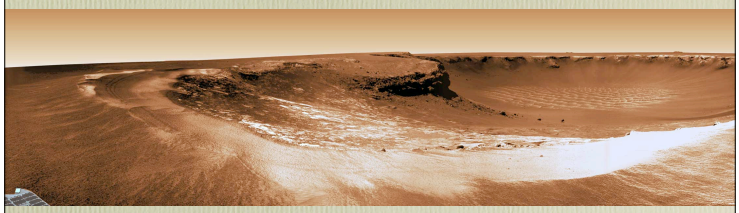
- and what really look like arroyos in New Mexico

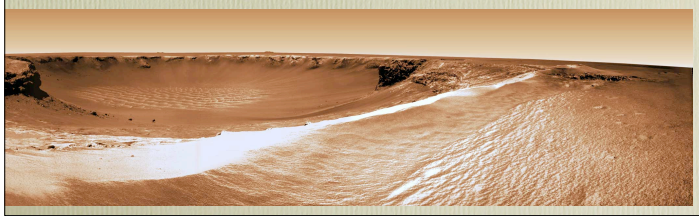
• and "holes":deep caves where water could still exist. So probably there was a lot of water: could still be some underground



• Note the quality of pictures now: Victoria crater.

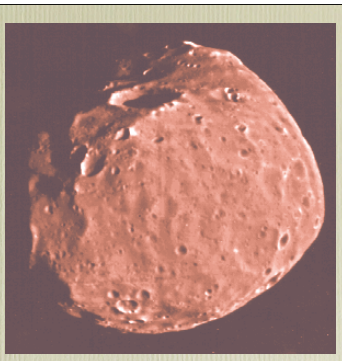
• Frost is frozen CO_2

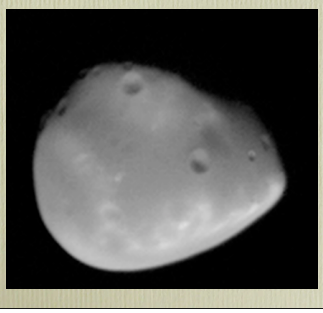




• Two small, close, irregularly shaped moons.

• Phobos has very large impact crater.





Deimos
Moons are probably captured asteroids.

Jupiter and Moons

• Largest planet by far.

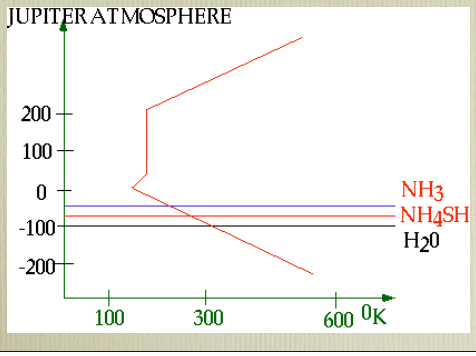
• Strongly banded appearance, corresponding to convective regions in atmosphere.

• Dark areas (bands) lie lower in atmosphere than light areas (zones).

• Colours due to complex organic molecules: detected so far are:

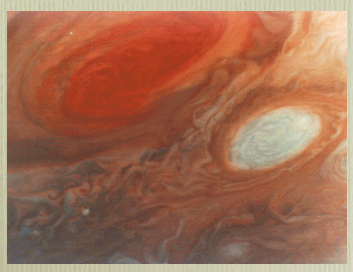
• Methane,ammonia), hydrogen, acetylene, phosphine, carbon monoxide, hydrogen cyanide hydrogen sulphide

• No surface in usual sense.

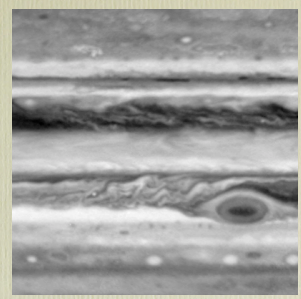


• Great Red Spot, noted since 1600's: 20,000 km x 50,000 km.

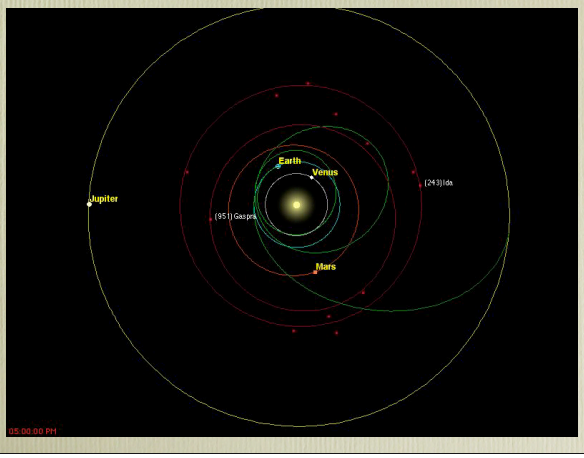
• Top of spot extends well above surrounding cloud tops.



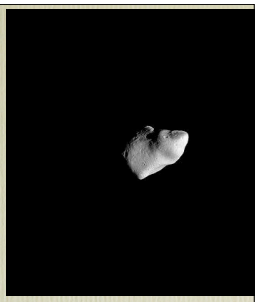
- Now clearly seen to be "hurricane"
- Speeds of rotation ~ 500 km/hr
- Lifetime not too surprising:
- 1000 x bigger than terrestial hurricanes, so lifetime could well be 1000 x longer!

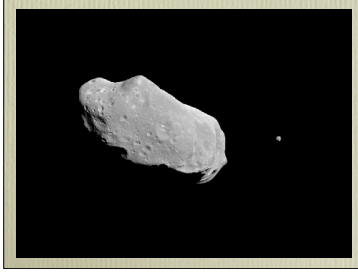


Galileo, the space probe



- Took a quick look at 2 asteroids on the way out
- Gaspara



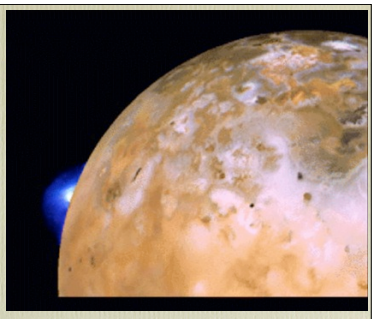


- And Ida and its moon, Dactyl.

Moons of Jupiter: Io

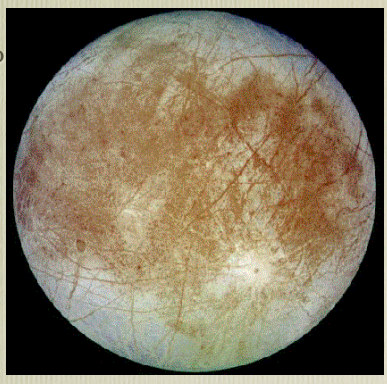
- Jupiter has some of the oddest moons in the solar system.
- Four large easily visible with binoculars
- Can watch Io rotating

- Io is in a state of continuous volcanic eruption.
- Volcanic plumes to 250 km
- Vulcanism caused by "tidal pumping" by other moons.



Moons of Jupiter: Europa

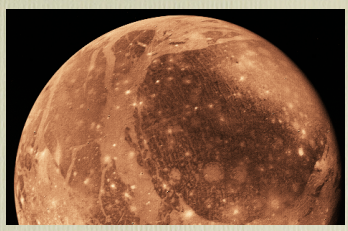
- Rock covered with ice, probably slushy since no impact craters.



- Close-ups show odd crustal structures, almost like pack-ice

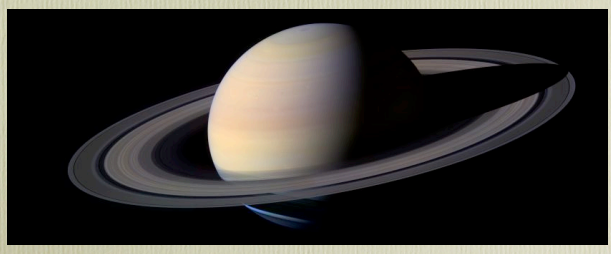
Moons of Jupiter: Ganymede

- Largest moon in the solar system: Ice on rock. Many craters, but with central pits, not peaks. Huge transverse faults

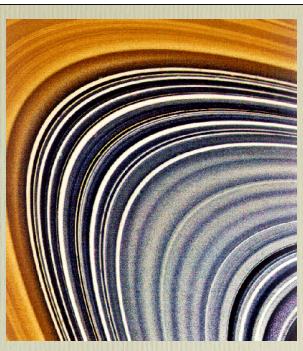


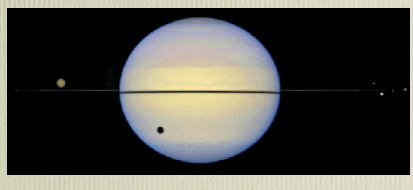
Saturn

- Atmosphere similar to Jupiter, but less heating (internal & sun) so weather better!

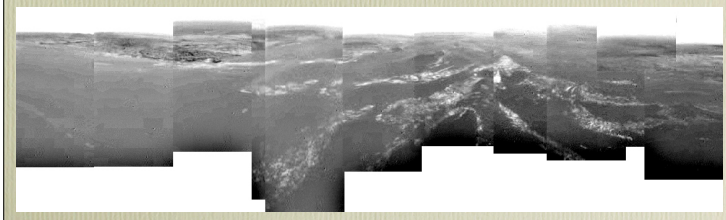


- First seen by Galileo as "Handles"
- Made of small ice pellets and dust (moonlets)
- many thousands of ringlets, some braided
- rings very thin (< 2 km) kept from dispersing by "shepherd" moons

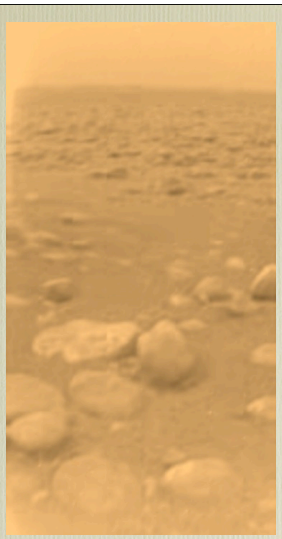




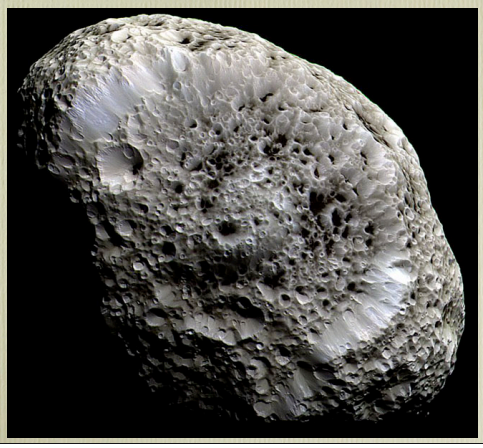
- Titan, larger than earth's moon, has yellow atmosphere methane & ammonia, surface invisible
- Touchdown of probe 14 January 2005,
- The white streaks seen near this boundary are ground 'fog' of methane or ethane vapour, Wind speed at 6-7 m/s.



- Touch down at 4.5 m/s
- probe penetrated 15 cm.
- Surface consistency of wet sand or clay.

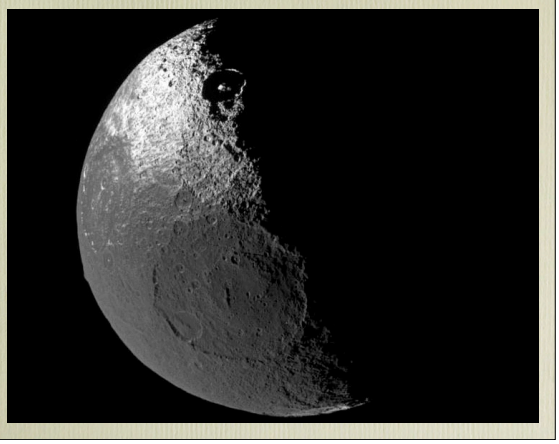


- Hyperion
- Density about 1/2 water (!) suggests spongy texture!



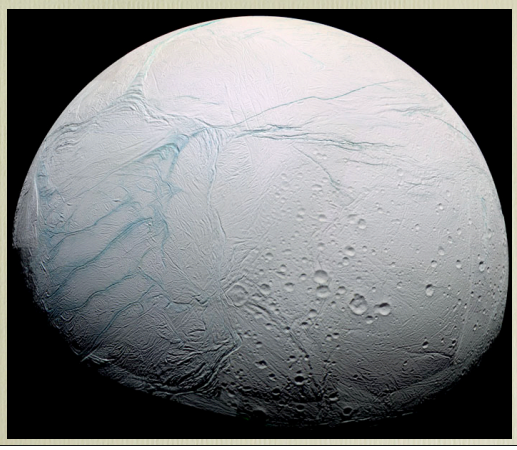
Iapetus

- Half of moon is covered in material as black as coal!

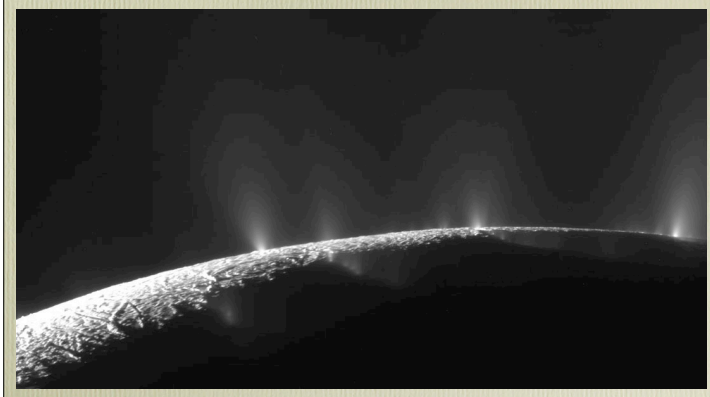


Enceladus

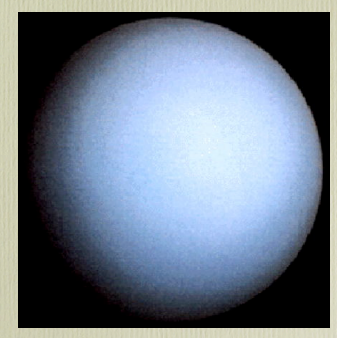
Giant striped snowball?



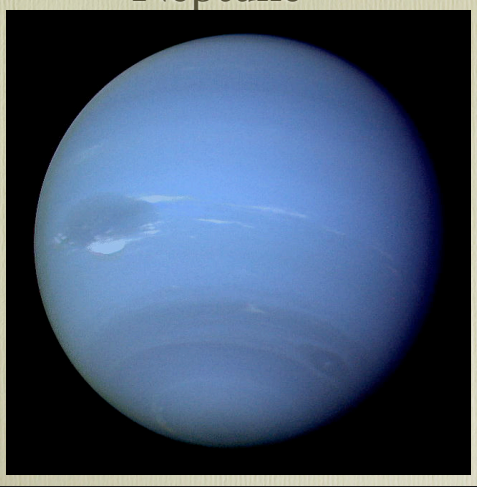
- With ice volcanoes!



Uranus



Neptune

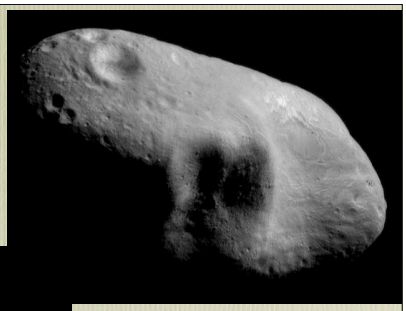


Pluto-Charon

- So what else is there?

Asteroids

Never part of a single object which exploded: must have formed separately

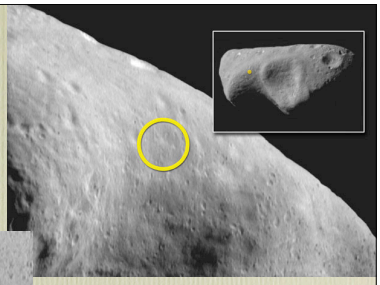


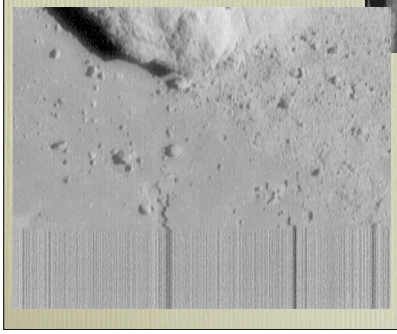
Eros (like all the asteroids) is a lump of rock

We can even watch it rotate

- And we even landed on it

4th object (after the Moon, Mars and Venus) in the universe!



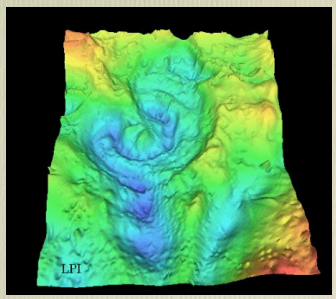


- but a bit too hard!

Comets

What killed the dinosaurs?

- Alan Hildebrand found a 65 million year old, 112 mile wide ring structure (the Chicxulub crater) off Yucatan
- Crater is consistent with the impact of an object of sufficient size (6 - 12 miles) to cause the global disruptions.



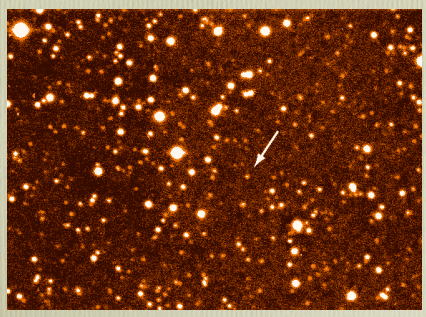
Much more important: can it happen again?

Yes, so we need to keep an eye on near-earth asteroids

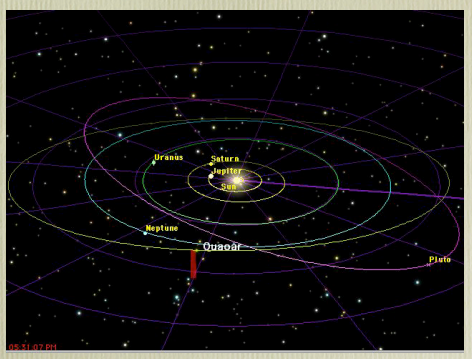
- Manicougan crater in Northern Quebec: so large that it can only be seen from space. ~ 200 Million years old.

How big is the solar system?

- For a long time Pluto set the bounds, but now Quaoar

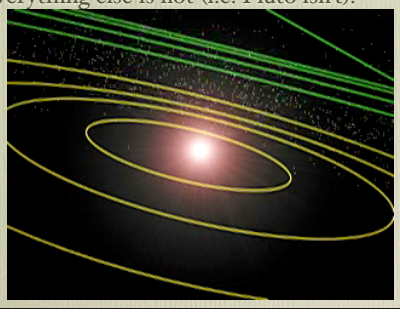


- And it's really far out



And Sedna

- Sedna is almost at its closest; 10,000-year orbit takes it into the Oort cloud which is the origin of comets.
- What exactly is a planet? (Sedna and Quaoar are "objects")
- No easy answer: conventionally we take original 8 as planets, and say everything else is not (i.e. Pluto isn't).



Acknowledgements

- Astronomy Picture of the Day (APOD)
- NASA
- ESA
- Next lecture:

1. Life and Death amongst the Stars
2. Physics as a creation Myth