


ASTR 4800 - Space Science: Practice & Policy
 Today: *The Juno Mission to Jupiter* – Guest lecture by Dr. Fran Bagenal

- Exam #2 on Wednesday.
 - Includes all readings & lectures Oct. 12 – Nov. 14.
 - See PowerPoint class notes on class website
 - Also allowed to bring one page (front & back) with notes
- Homework #3 due today by 5 pm.



Astronomy 4800 – Space Science: Practice & Policy

1

Scientists are Working on an Official ‘alien contact protocol’ for when ET phones Earth
 By Isobel Whitcomb at Space.com

- University of St. Andrews, Scotland – new SETI Detection Hub
- Only protocol from 1989 by SETI Institute
- Focuses on receiving/response – not sharing knowledge
- To include interdisciplinary sciences and humanities




Question: Who should be involved with creating this protocol? Governments? Science Academies? And do you think it is a good use of time?

Meggan Amos

2

Juno Fran Bagenal, LASP





Orbiting Jupiter since 4th July 2016

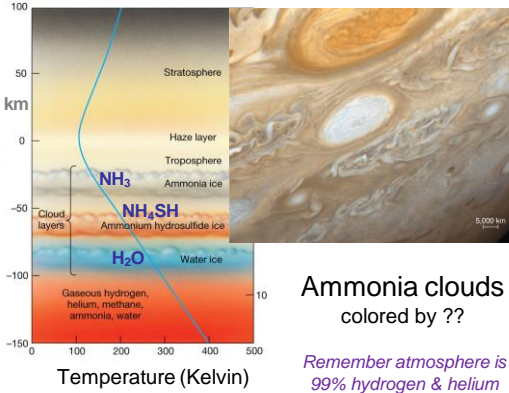
3

Jupiter

J_{Year} 12 Years
 Orbit 5.2 AU
 Mass 318 M_{Earth}
 Radius 11 R_{Earth}



4



Ammonia clouds colored by ??

Remember atmosphere is 99% hydrogen & helium

5

Jupiter

pressure (bars) | temperature (K) | density (g/cm³)

1 | 125 | 0.0002
 500,000 | 2,000 | 0.5
 2,000,000 | 5,000 | 1.0

gaseous hydrogen
 liquid hydrogen
 metallic hydrogen

~4

~25

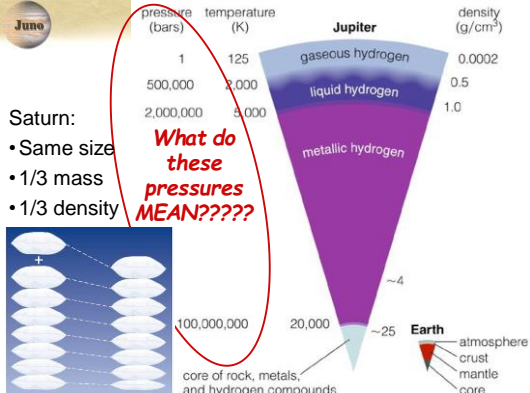
Earth: atmosphere, crust, mantle, core

core of rock, metals, and hydrogen compounds

100,000,000 | 20,000

Saturn:
 • Same size
 • 1/3 mass
 • 1/3 density

What do these pressures MEAN?????



6


Atmospheric Pressure at the Surface of Earth

1 bar
 = 14.7 pounds/sq. inch x g
 = 10,000 kg / m² x g

Air pressure in this room = pressure through your feet with 4 people standing on your shoulders

Check my math!


Pressure you need to multiply by g=10 m/s²
 – this will give you proper MKS units of Pascal



7

Juno P_{jupiter} ~50 Mbars

That's 1000 elephants standing on top of each other, with the bottom elephant standing on one leg, balancing on a stiletto heel

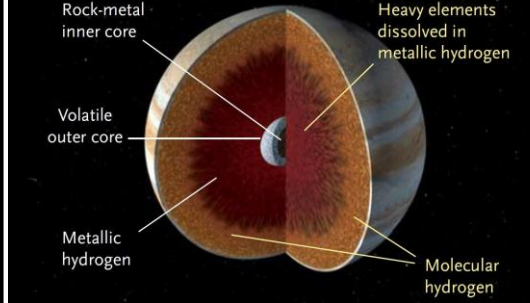


8

BIG Q: What's inside?

Core?
 Rock-metal inner core
 Volatile outer core
 Metallic hydrogen

No Core?
 Heavy elements dissolved in metallic hydrogen
 Molecular hydrogen



9

Gas giant planets formed beyond the frost line where hydrogen gas captured onto ice core

Juno's Goals:
 Where's the water?
 How did the gas giant planets form?
 And, since we are flying over the poles...
 How does the aurora work?

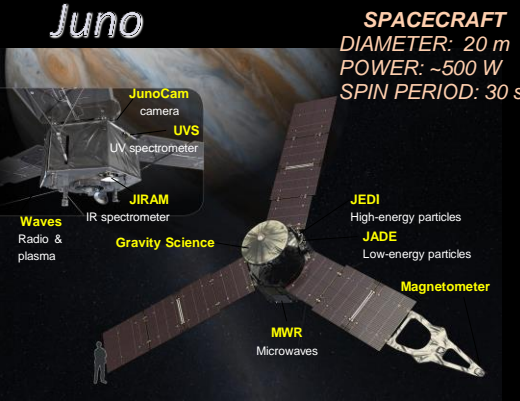


10

Juno

SPACECRAFT
 DIAMETER: 20 m
 POWER: ~500 W
 SPIN PERIOD: 30 s

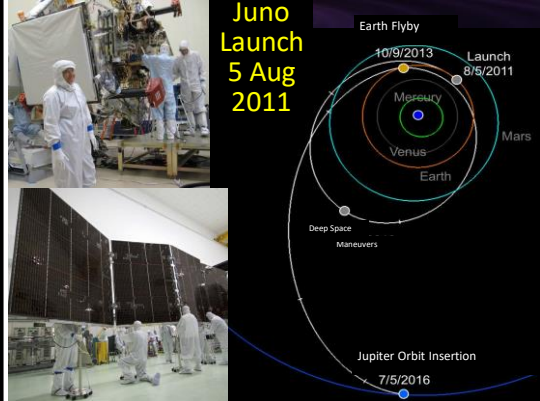
JunoCam camera
 UVS UV spectrometer
 JIRAM IR spectrometer
 Gravity Science
 Waves Radio & plasma
 JEDI High-energy particles
 JADE Low-energy particles
 Magnetometer
 MWR Microwaves



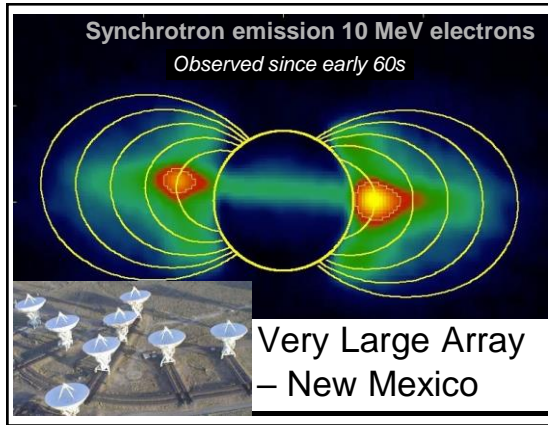
11

Juno Launch 5 Aug 2011

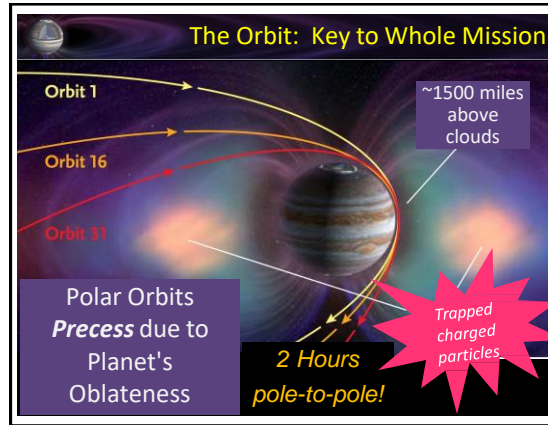
Earth Flyby 10/9/2013
 Launch 8/5/2011
 Mercury
 Venus
 Earth
 Mars
 Deep Space Maneuvers
 Jupiter Orbit Insertion 7/5/2016



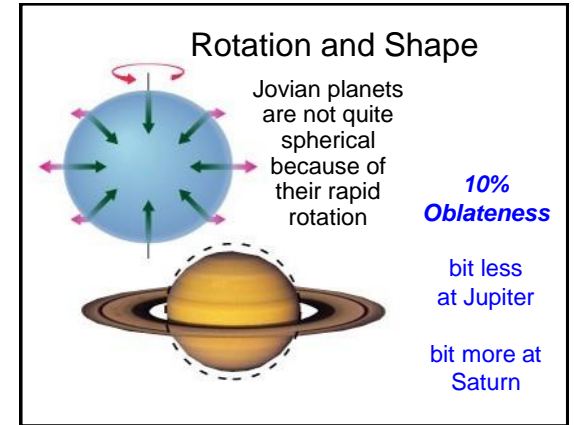
12



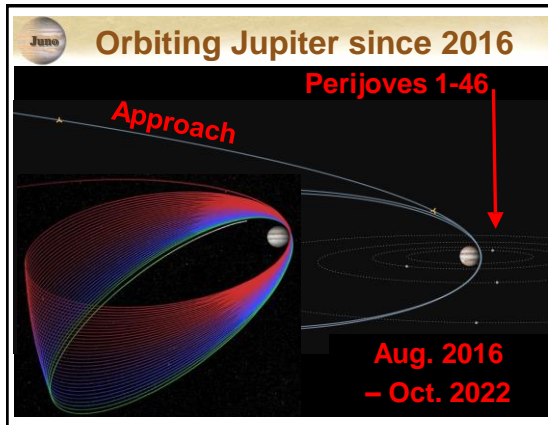
13



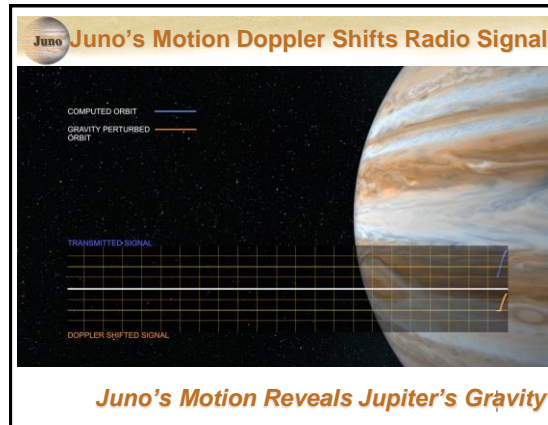
14



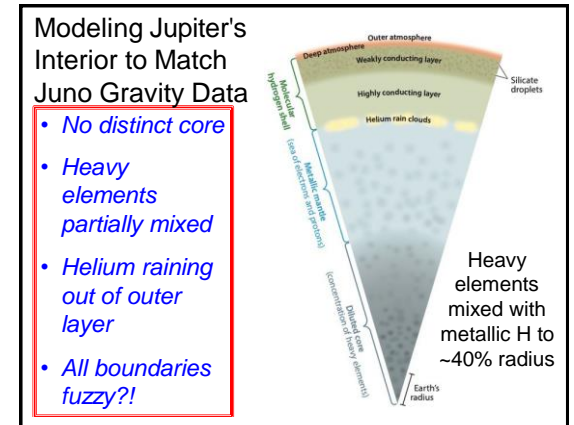
15



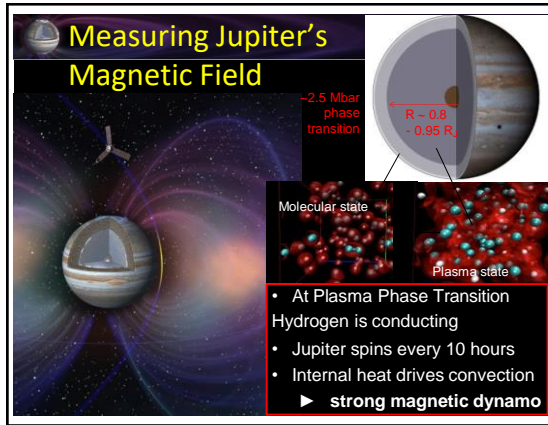
16



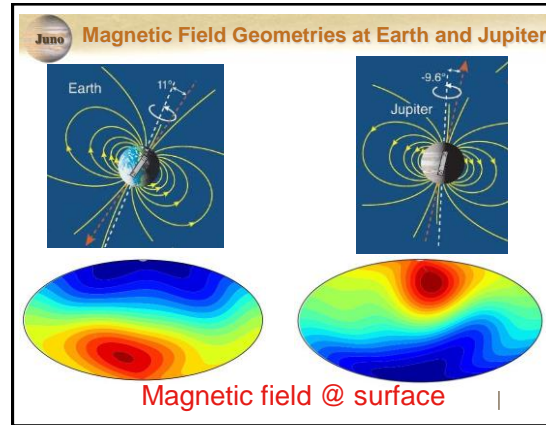
17



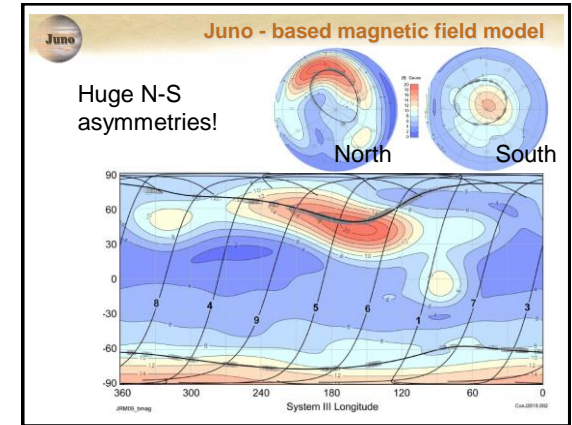
18



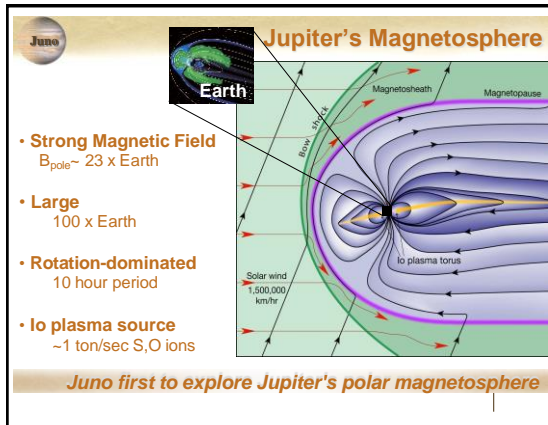
19



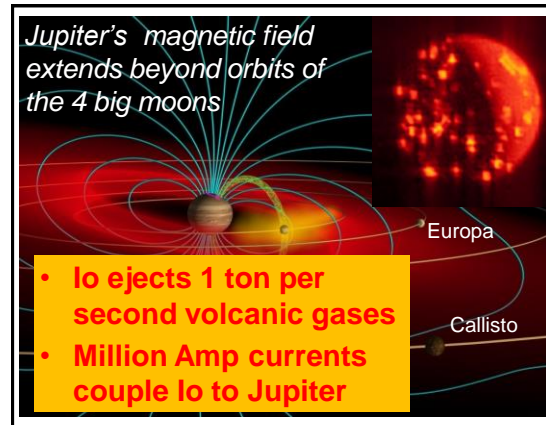
20



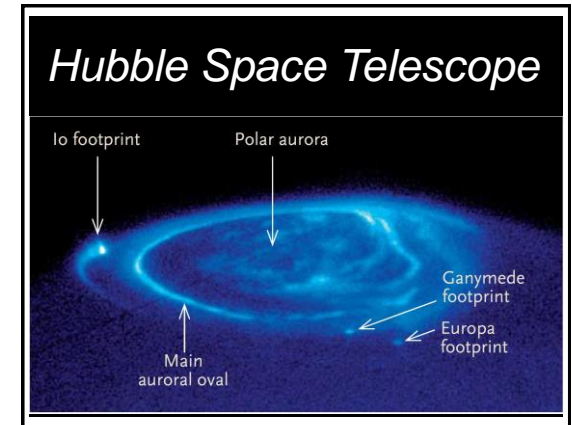
21



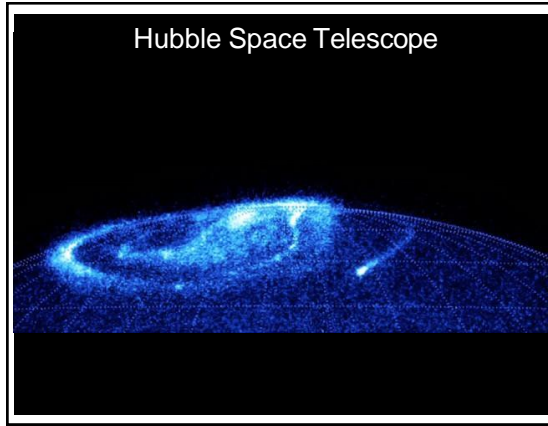
22



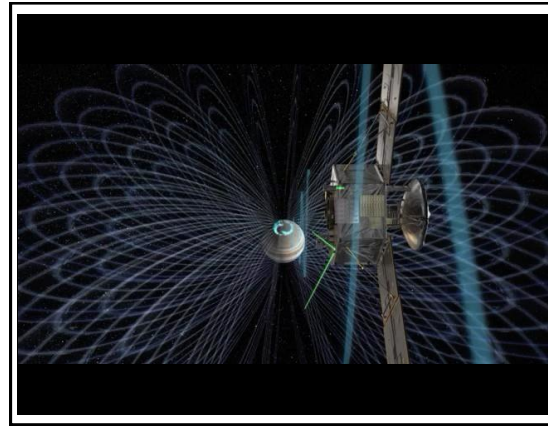
23



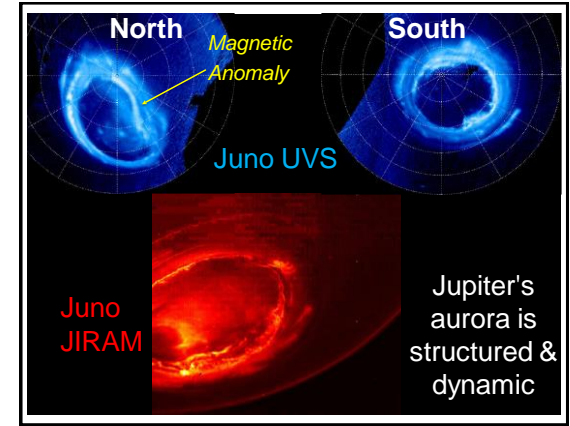
24



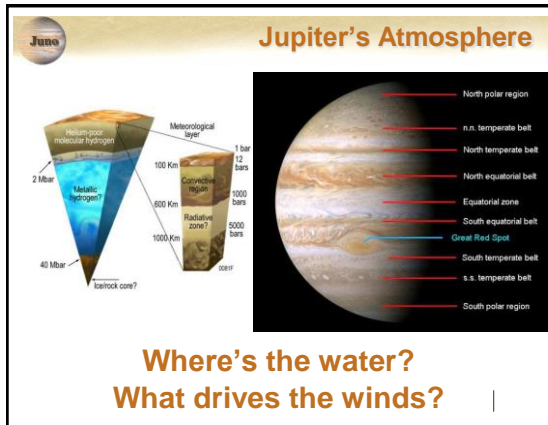
25



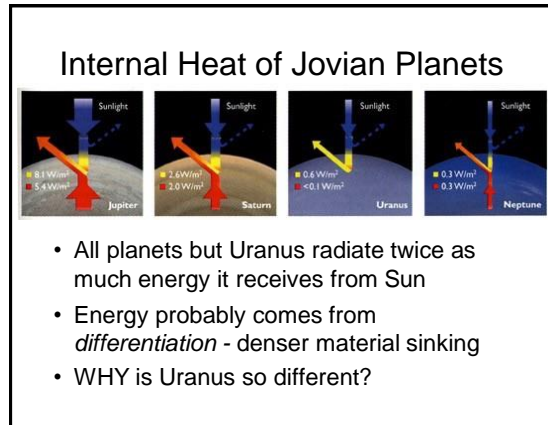
26



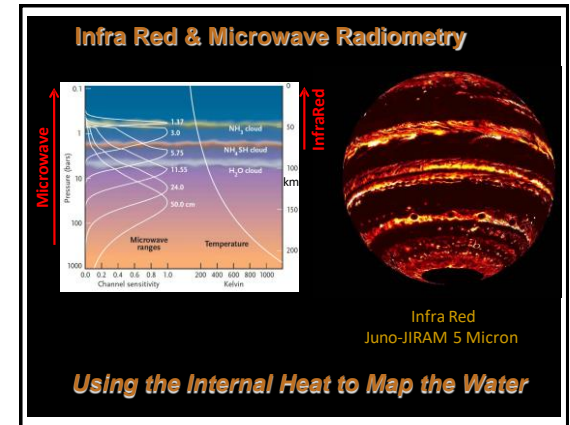
27



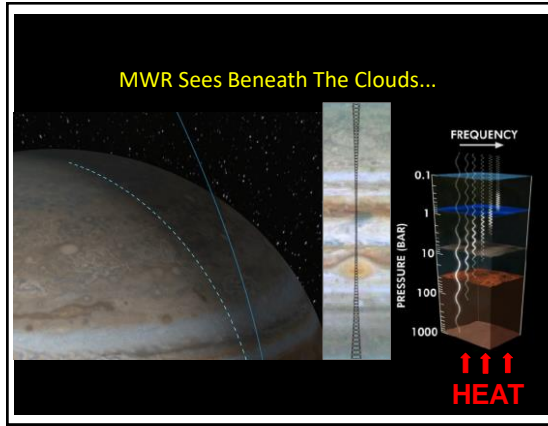
28



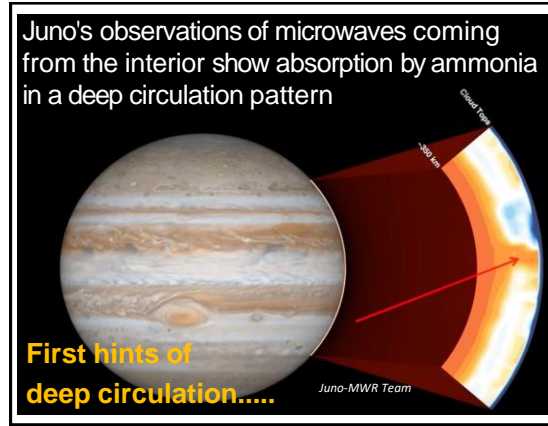
29



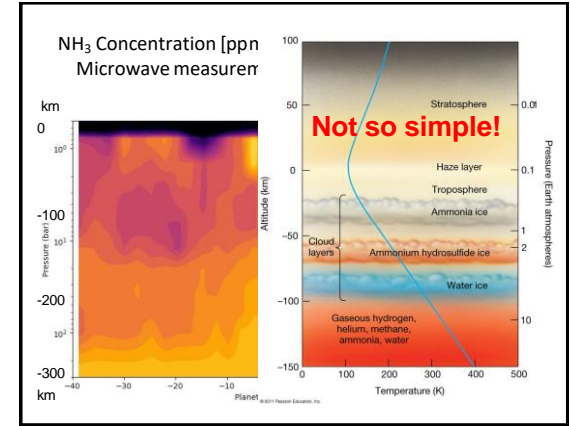
30



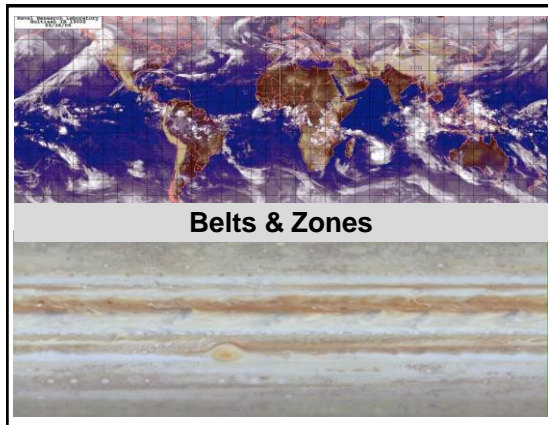
31



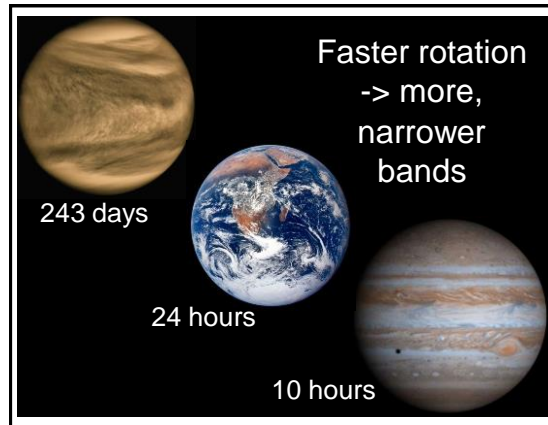
32



33



34



35

Jupiter's Belts & Zones Similar to Earth

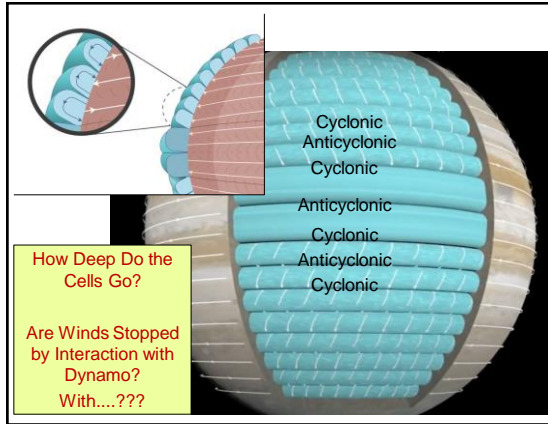
- Rotation dominated – Jupiter spins faster
- Many more cells
- More round than flat
- No oceans, no land

Gravity data indicates cells ~1000 km deep

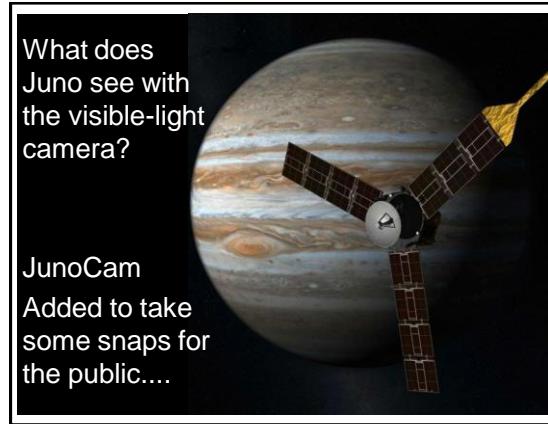
Earth

Jupiter

36



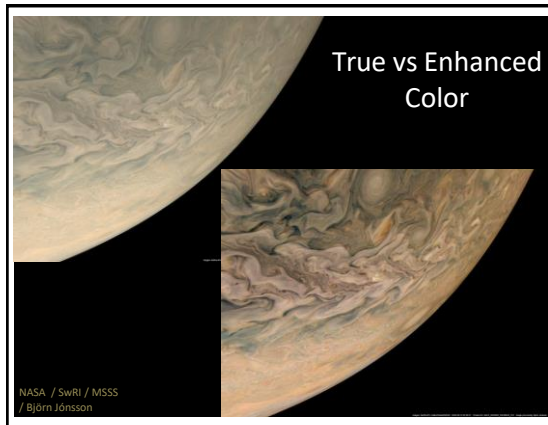
37



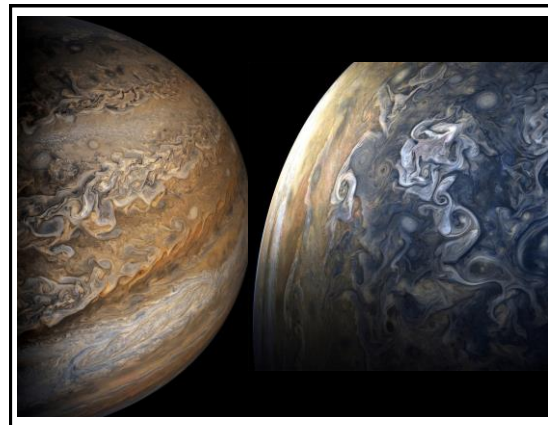
38



39



40



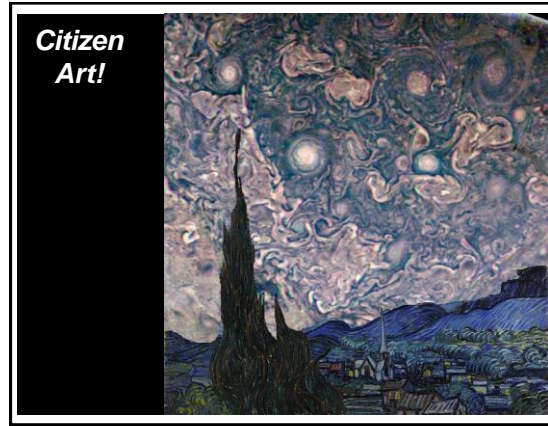
41



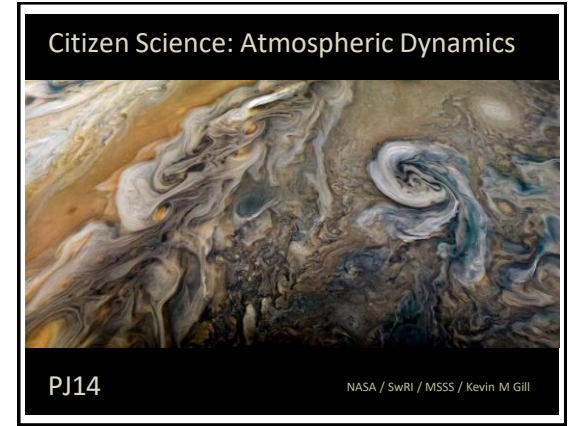
42



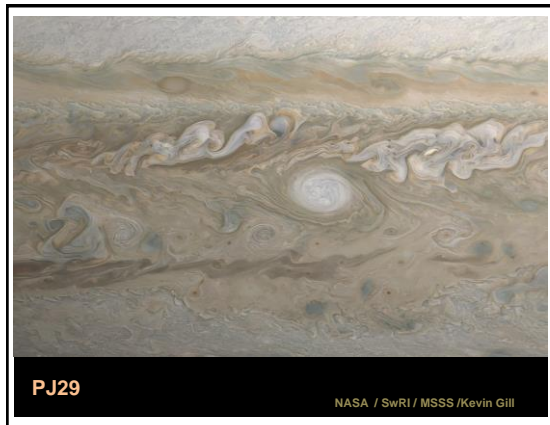
43



44



45



46



47



48



Looking out of an airplane window

49



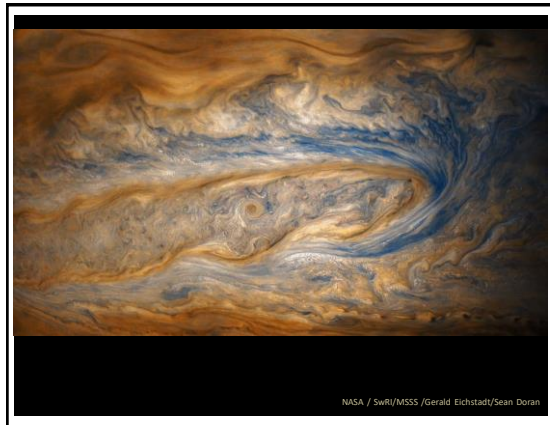
PJ13

NASA / SwRI / MSSS
/Gerald Eichstadt
/Sean Doran

50



51



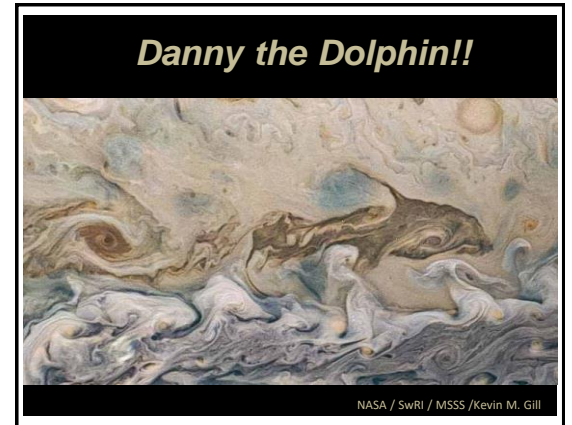
NASA / SwRI/MSSS /Gerald Eichstadt/Sean Doran

52



NASA / JPL / MSSS / Gerald Eichstadt / Sean Doran

53



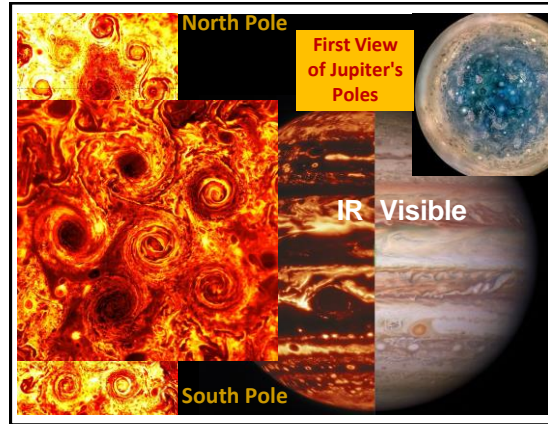
Danny the Dolphin!!

NASA / SwRI / MSSS /Kevin M. Gill

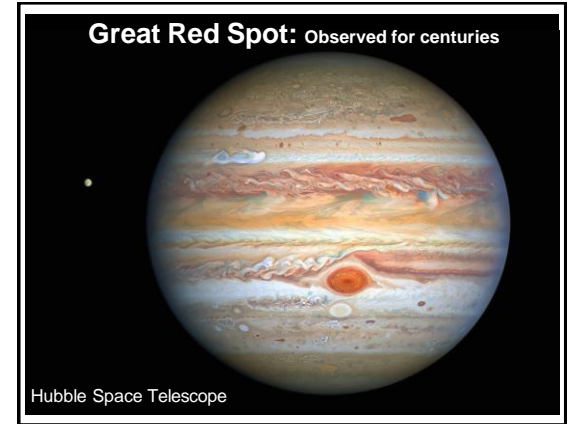
54



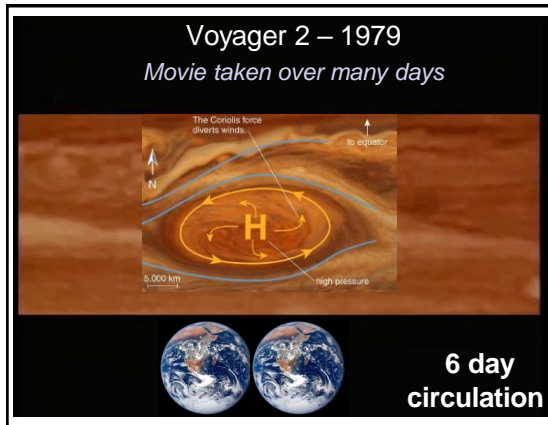
55



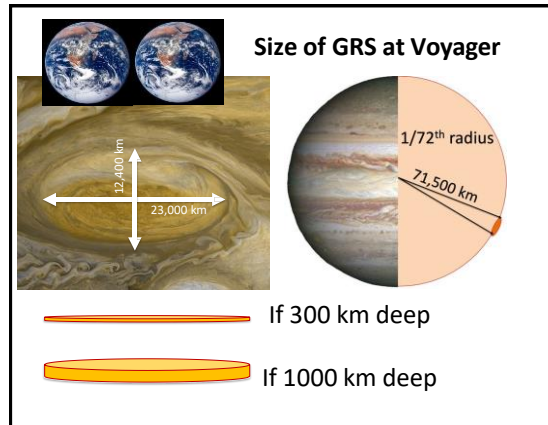
56



57



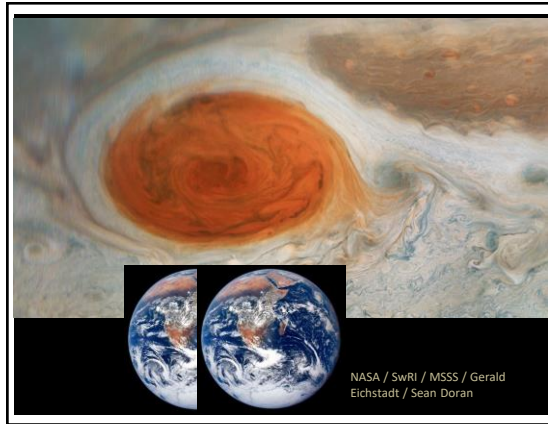
58



59



60



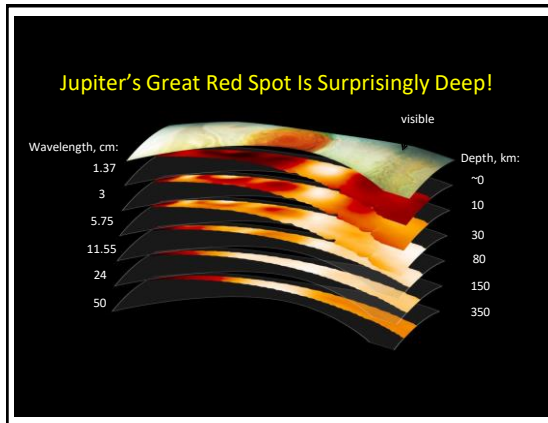
61



62



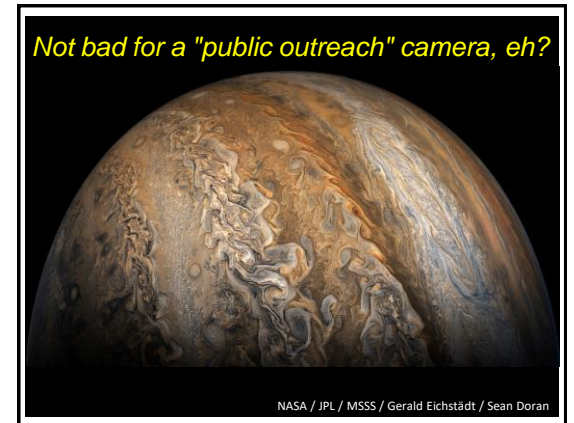
63



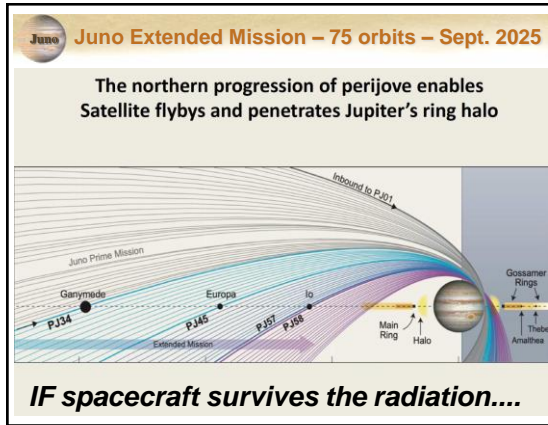
64



65



66



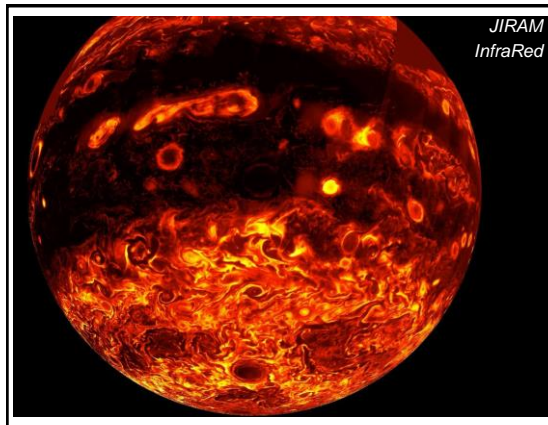
67



68



69



70



71



72