This presentation is an overview of the spacecraft that have visited Jupiter and some of the discoveries made.
Outline

Jupiter Spacecraft Outline

• Pioneer 10 and 11
• Voyager 1 and 2
• Ulysses
• Galileo
• Cassini
• New Horizons
• Future Missions
• Juno, JUICE, etc.
The spacecraft launch and encounter dates.
The Pioneers had a lot of “firsts” in their missions.
Pioneer 10/11
1973/74

- Scientists identified plasma in Jupiter's magnetic field
- First close-up images of the planet
- Charted Jupiter's intense radiation belts
- Located the planet's magnetic field
- Discovered that Jupiter is predominantly a liquid planet.

- Studied magnetic fields, energetic particle radiation and dust populations in interplanetary space.
- Pioneer 11 obtained dramatic images of the Great Red Spot, made the first observation of the immense polar regions, and determined the mass of Jupiter's moon, Callisto.

Pioneer 11 allowed a first look at the Jupiter polar regions.
Without a doubt, the Voyagers are the greatest space missions of discovery in history.
An overview of the Voyager spacecraft.
A few details about some of the radio experiments on Voyager.

**Voyager 1 & 2**

**Radio Science (RSS)**

**Principal Investigator:** Prof. G. Leonard Tyler

The science objectives at Jupiter

- Measure physical properties of planetary and satellite ionospheres and atmospheres by examining the propagation effects on a dual-frequency radio signal

- Determine planetary and satellite masses, gravity fields, and densities by precise tracking of a dual-frequency radio signal
A few details about some of the radio experiments on Voyager.
Voyager showed some incredible radio spectra of Jupiter’s decameter, hectometer, and kilometer radio emissions.
Voyager found that Jupiter’s magnetotail extends at least 5 A.U. from Jupiter.
An overview of the Ulysses mission. Too bad the radio instrument peaked at 940 kHz.
A few good discoveries at Jupiter by Ulysses.
A Ulysses radio spectrum at Jupiter.
The Galileo mission launch and orbital trajectory.
Highlights of the Galileo mission.

Launch: Oct. 18, 1989 from Kennedy Space Center, Fla., on space shuttle Atlantis on mission STS-34
Primary Mission: October 1989 to December 1997
Extended Missions: Three, from 1997 to 2003
Number of Jupiter orbits during entire mission: 34
Number of flybys of Jupiter moons: Io 7, Callisto 8, Ganymede 8, Europa 11, Amalthea 1

Major scientific results of the Galileo mission include:

- First observation of ammonia clouds in another planet’s atmosphere
- Confirmation of extensive volcanic activity on Io
- Evidence supporting the theory that liquid oceans exist under Europa’s icy surface
- First detection of a substantial magnetic field around a satellite (Ganymede);
- Magnetic data evidence suggesting that Europa, Ganymede and Callisto have a subsurface liquid-saltwater layer
- Formation of the rings of Jupiter (by dust kicked up as interplanetary meteoroids)
- Observation of two outer rings
- Global structure and dynamics of the magnetosphere
Galileo discovers the moon Ganymede has its own magnetosphere.
Jovian low-frequency radio emissions detected on 3 December 2000 by the RPWS experiment onboard Cassini approaching Jupiter. Frequency range is 3.5 kHz to 16.1 MHz. The Io-DAM emission appears here down to about 2 MHz, while weaker Io-independent (non-Io-DAM) arcs merge with the hectometer component (HOM) detected down to ~400 kHz. The auroral broadband kilometer component (bKOM) is detected down to ~40 kHz. The narrowband emission (nKOM) about 100 kHz is generated at or near the plasma frequency $f_{pe}$ in Io's torus. The quasi-periodic (QP) bursts, spaced by 5 to >15 min, are detected in the ~5 to 20 kHz range. Distance to Jupiter was $383 \, R_J \, (2.7 \times 10^7 \, \text{km})$ at the time of this observation.
New Horizons
2007

This image of Io eclipsed by Jupiter’s shadow, Feb. 27, 2007
Credit: NASA/JHU/APL/SWRI

Studies of Jupiter’s
1) Atmospheric structure and storm behavior.
2) Major satellites and search for new moons
3) Ring composition
4) Magnetosphere

New Horizons very quickly flew by Jupiter in 2007. On to Pluto!
The Juno mission launch and orbital trajectory.
A summary of the Juno spacecraft.
The major science questions to be addressed by the Juno mission.

- How did Jupiter form?
- How much water or oxygen is in Jupiter?
- What is the structure inside Jupiter?
- Does Jupiter rotate as a solid body, or is the rotating interior made up of concentric cylinders?
- Is there a solid core, and if so, how large is it?
- How is its vast magnetic field generated?
- How are atmospheric features related to the movement of the deep interior?
- What are the physical processes that power the auroras?
- What do the poles look like?
A summary of the proposed JUICE mission.