The Deep Space Network

A Science Instrument Linking Ground & Space

Joseph Lazio

Jet Propulsion Laboratory
California Institute of Technology

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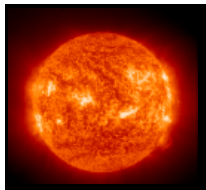
National Aeronautics and Space Administration

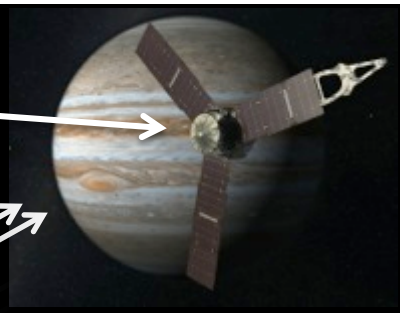
Juno

www.nasa.gov

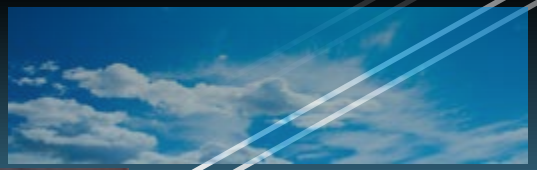
The Deep Space Network View

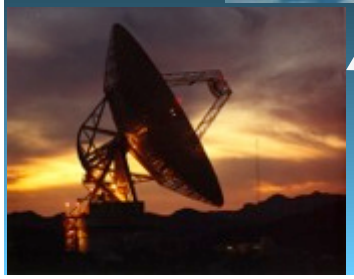


Flight Systems
- RF communications technology
- laser communications technology
- science instruments



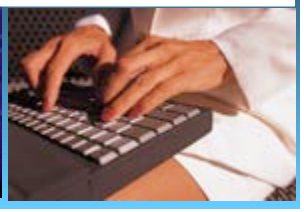
Radio Science
- interiors, atmospheres, rings
- solar wind
- gravitational waves





Ground Systems
- RF stations
- laser terminals
- radar
- astronomy

Multi-mission Systems
- mission design
- navigation (RF, laser)
- control systems
- planning, sequencing
- Planetary Data System



Future is bright – and crowded

- **We enable dozens of operating missions: in deep space and Earth orbit**
- **We will send astronauts beyond low Earth orbit**
- **We will do ground-breaking direct science using our unique faculties**

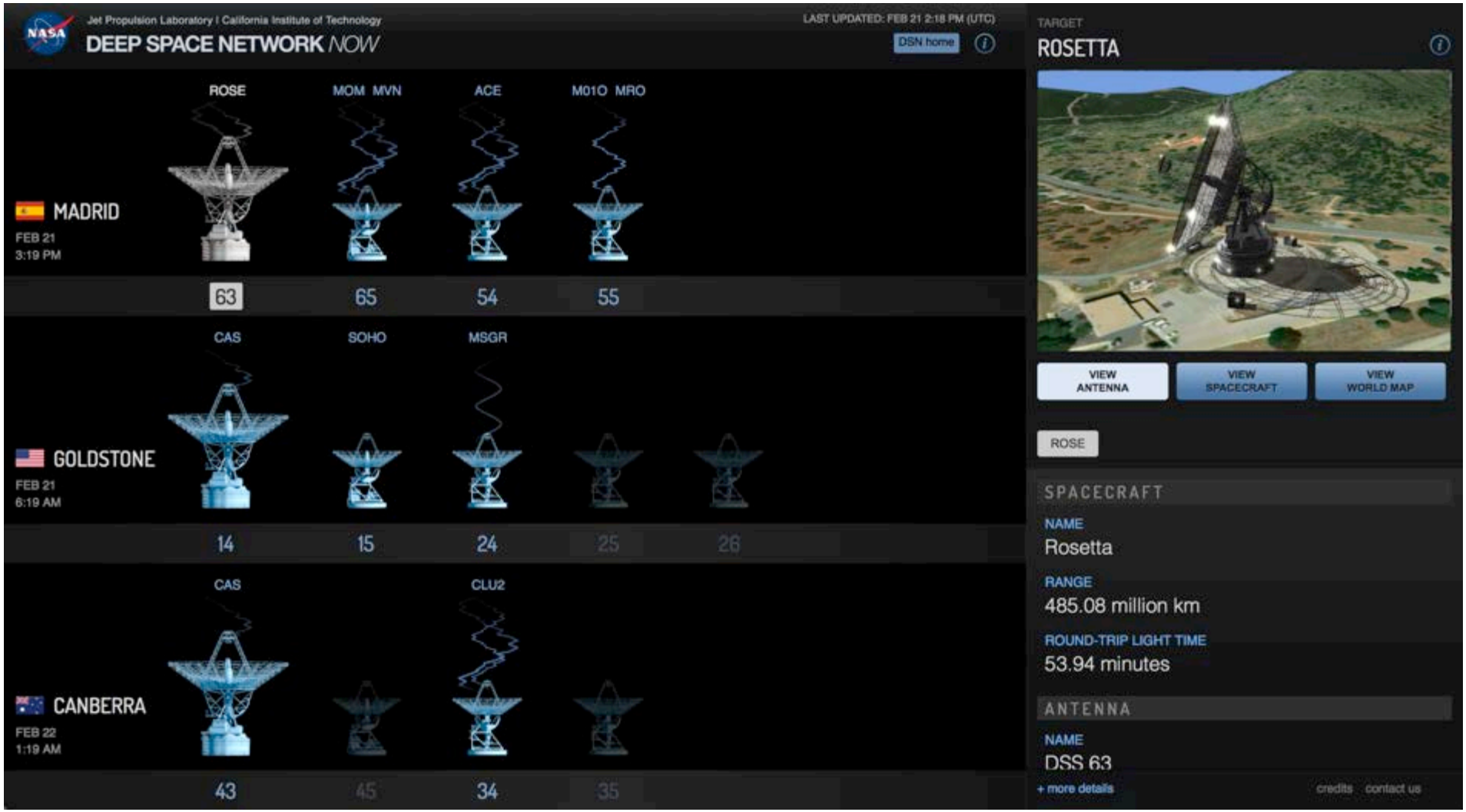
Don’t leave Earth without us!

Strata at Base of Mt Sharp

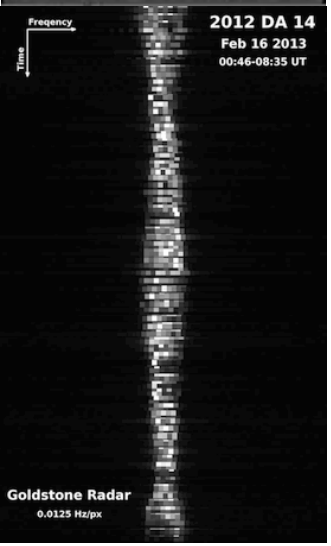
Indicates the flow of water before the mountain formed

DSN Now

http://eyes.nasa.gov/dsn/dsn.html



DSN as a Ground(-Space) Observatory



Solar System Radar

Unique solar system science; provides support to most planetary missions, Exploration, NEO Program

Radio Science

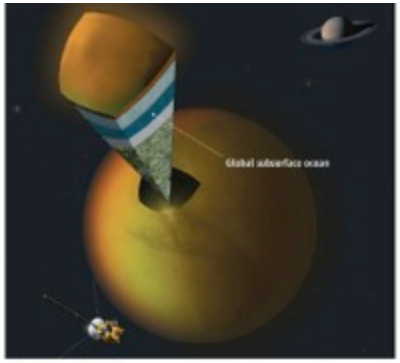
Science measurements on most planetary missions

Astronomy

Radio telescopes for mission science enhancement and international peer-reviewed proposals

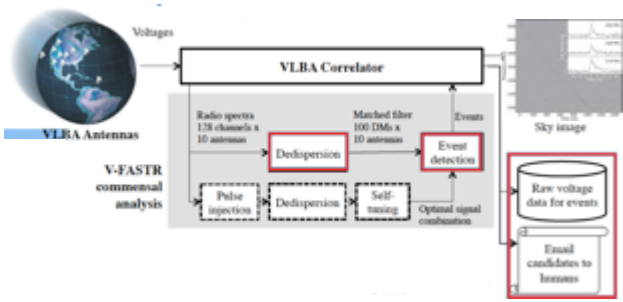
Education and Outreach

Scientists engaging with students and public



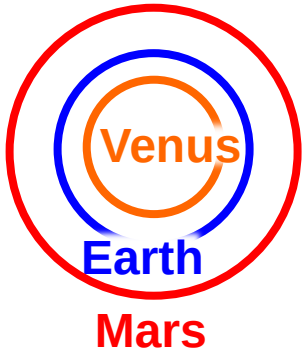
PLANETARY SCIENCE

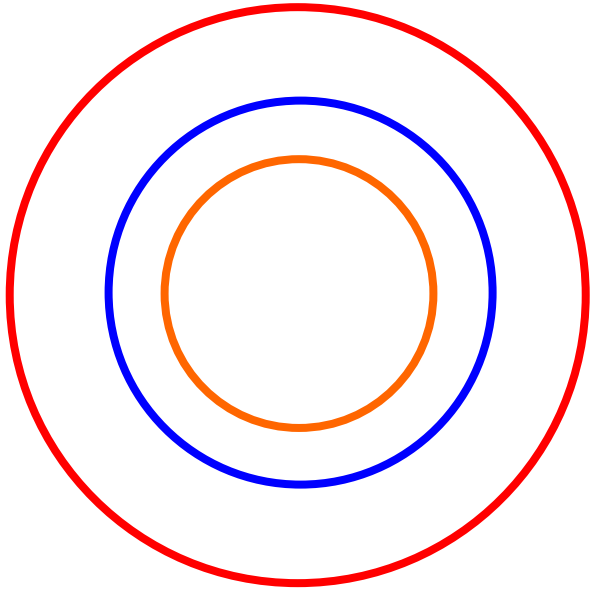
Cassini Spies an Ocean Inside Saturn's Icy, Gassy Moon Titan



Scale of the Solar System

Relative sizes of planetary orbits known for centuries





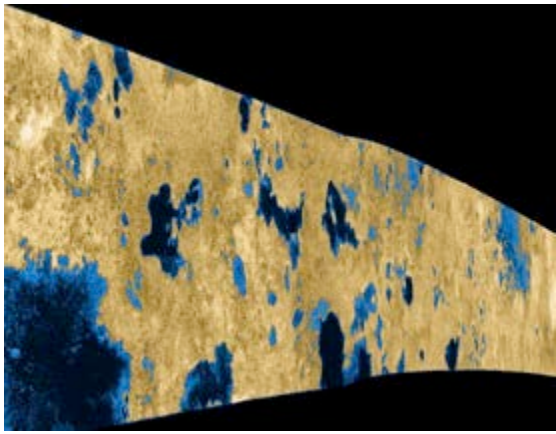
Absolute sizes of planetary orbits unknown until 1962

- Needed for spacecraft navigation
- Precision measurements from DSIF [DSN] radar measurements

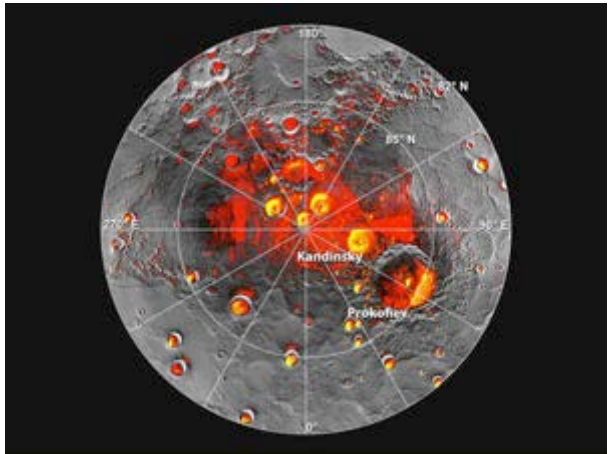
DSN Radar Accomplishments

- First indications of Venus retrograde rotation (1962)
- Probing the surfaces of asteroids (1976)
- First radar returns from Titan (1989-1993), suggestive of icy surface but with potential liquids
- Anomalous reflections from Mercury (1991), indicative of polar ice

Magellan **radar image of Venus (NASA/Caltech/JPL)**



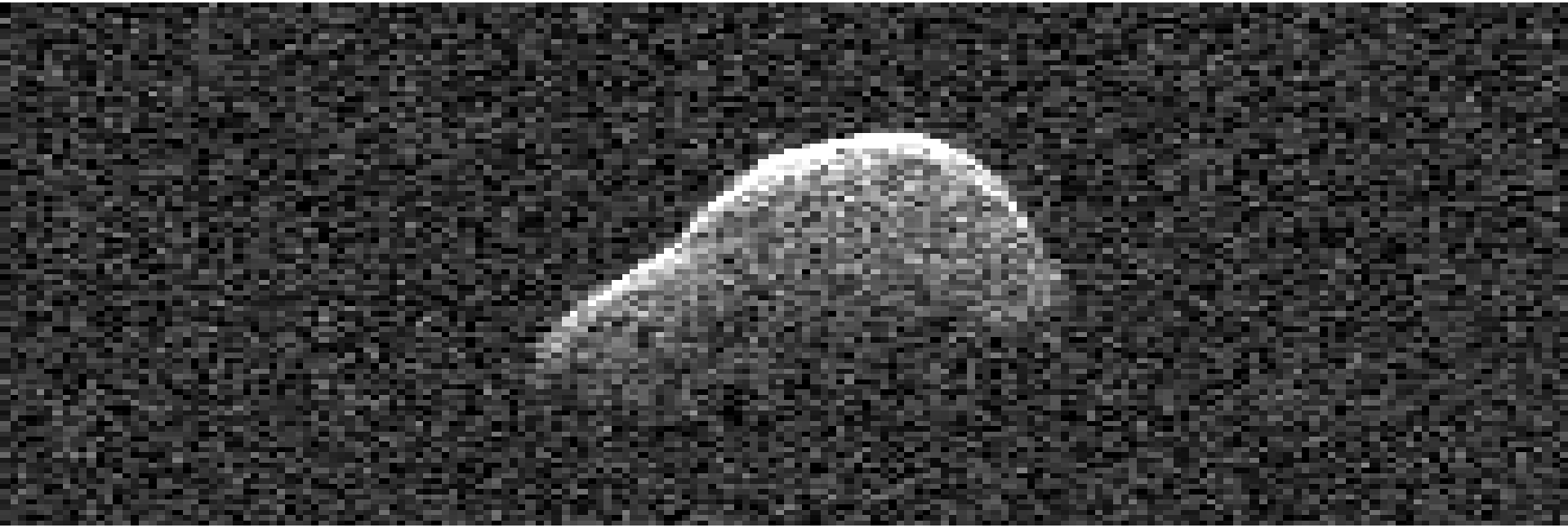
Cassini **radar image of Titan (NASA/JPL/USGS)**



MESSENGER+radar image of Mercury (NASA/HU APL/CIW/NAIC)

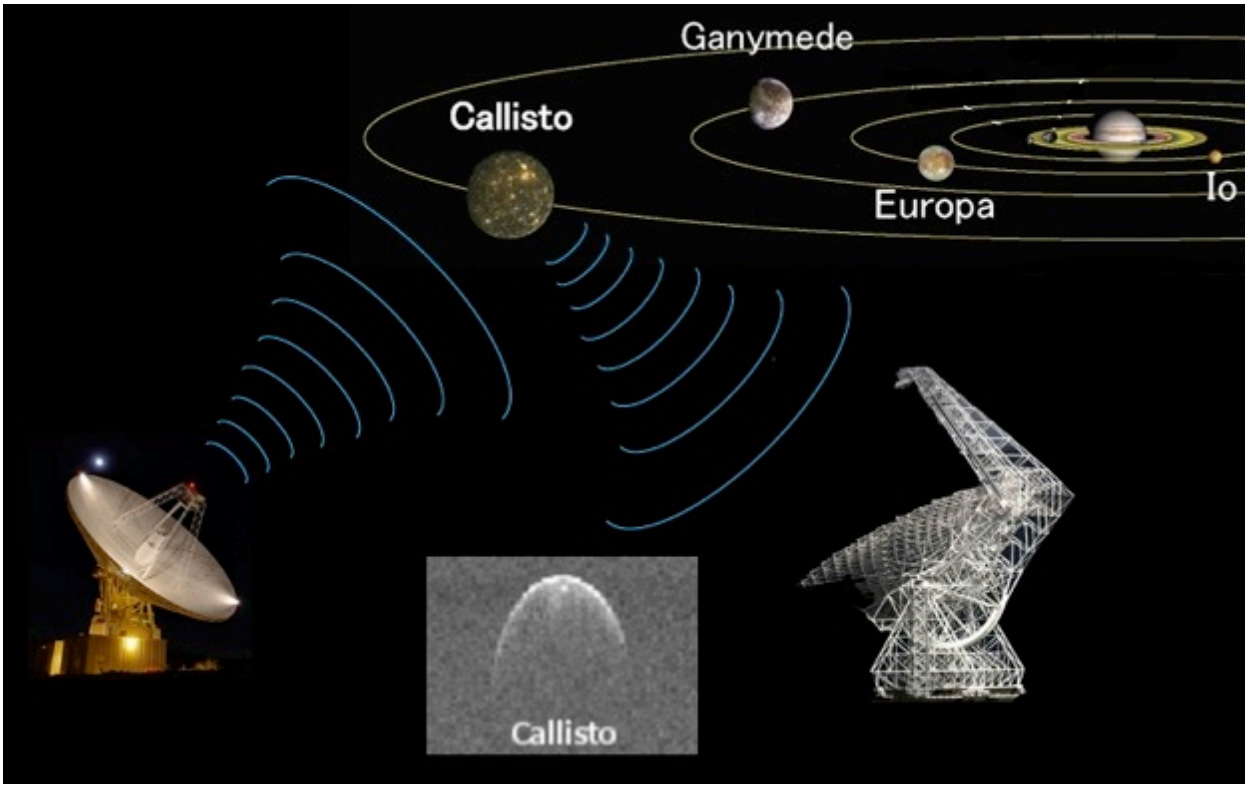
Comet P/2016 BA14

Goldstone Solar System Radar



Observations: 2016 March 17--20
Only 19th comet ever detected by radar
Resolution ~ 250 m pixels

Ranging to the Galilean Satellites



Jupiter's tidal dissipation constrains interior structure

- **GSSR, Arecibo, GBT ranging to Galilean satellites**
  - **Aiming for 2 km uncertainties in orbits (5× improvement)**
- **Detect secular acceleration of Galilean satellites from Jovian tides**
  - **Determine tidal dissipation parameter k_2/Q**
  - **Juno measures k_2**