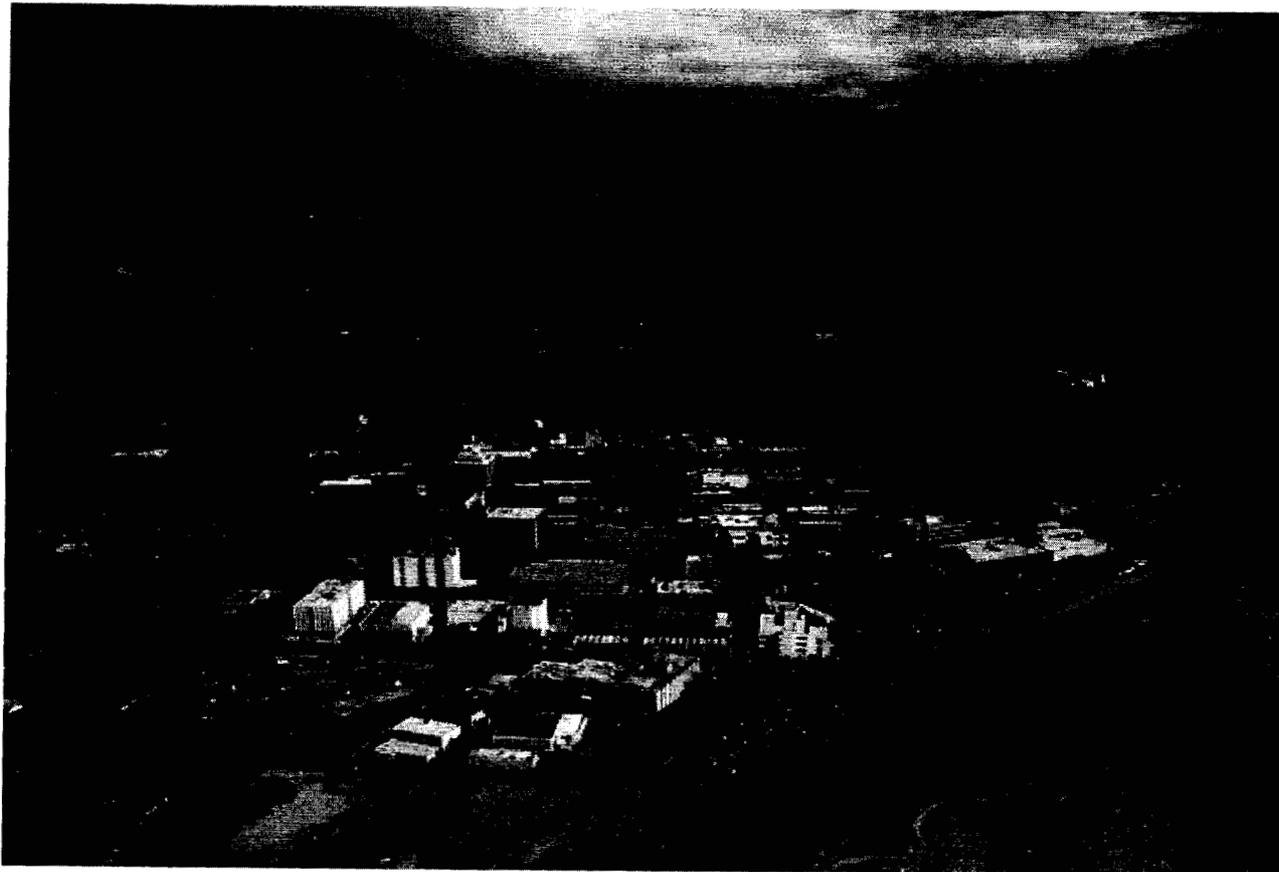




Jet Propulsion Laboratory



National Aeronautics and Space
Administration
Jet Propulsion Laboratory
California Institute of Technology



Area: 177 acres

**Employs: ~ 5,400
employees and on-site
contractors**

**Annual budget is
approximately
1.4 billion dollars.**

**JPL's facilities are
NASA owned, and
operated by the
California Institute of
Technology**

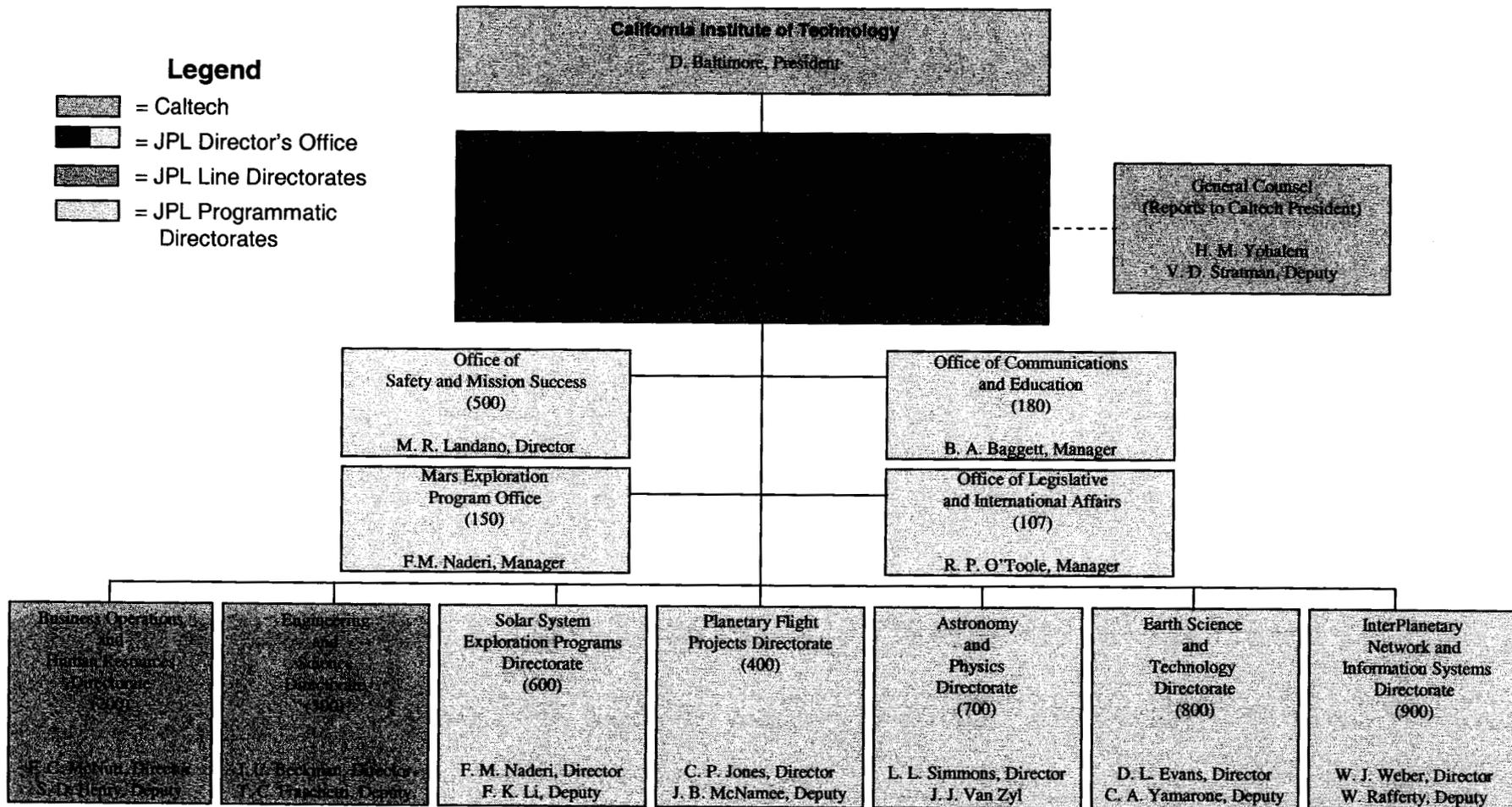
JPL Organization



National Aeronautics and Space Administration
 Jet Propulsion Laboratory
 California Institute of Technology

Legend

-  = Caltech
-  = JPL Director's Office
-  = JPL Line Directorates
-  = JPL Programmatic Directorates



National Space Technology Applications



National Aeronautics and Space Administration
 Jet Propulsion Laboratory
 California Institute of Technology

**Dr. Don
 National Space Technology Applications
 Program Director**

Defense & Intelligence Space Programs

Civil & Commercial Space Programs

Defense

Intel

Civil

Partnerships/ITTP

Air Force

USA

USN

MDA

DARPA

NRO

NIMA

AGA

DOE

NOAA

HLS

NIH & NSF

Industry Alliances

SBIR

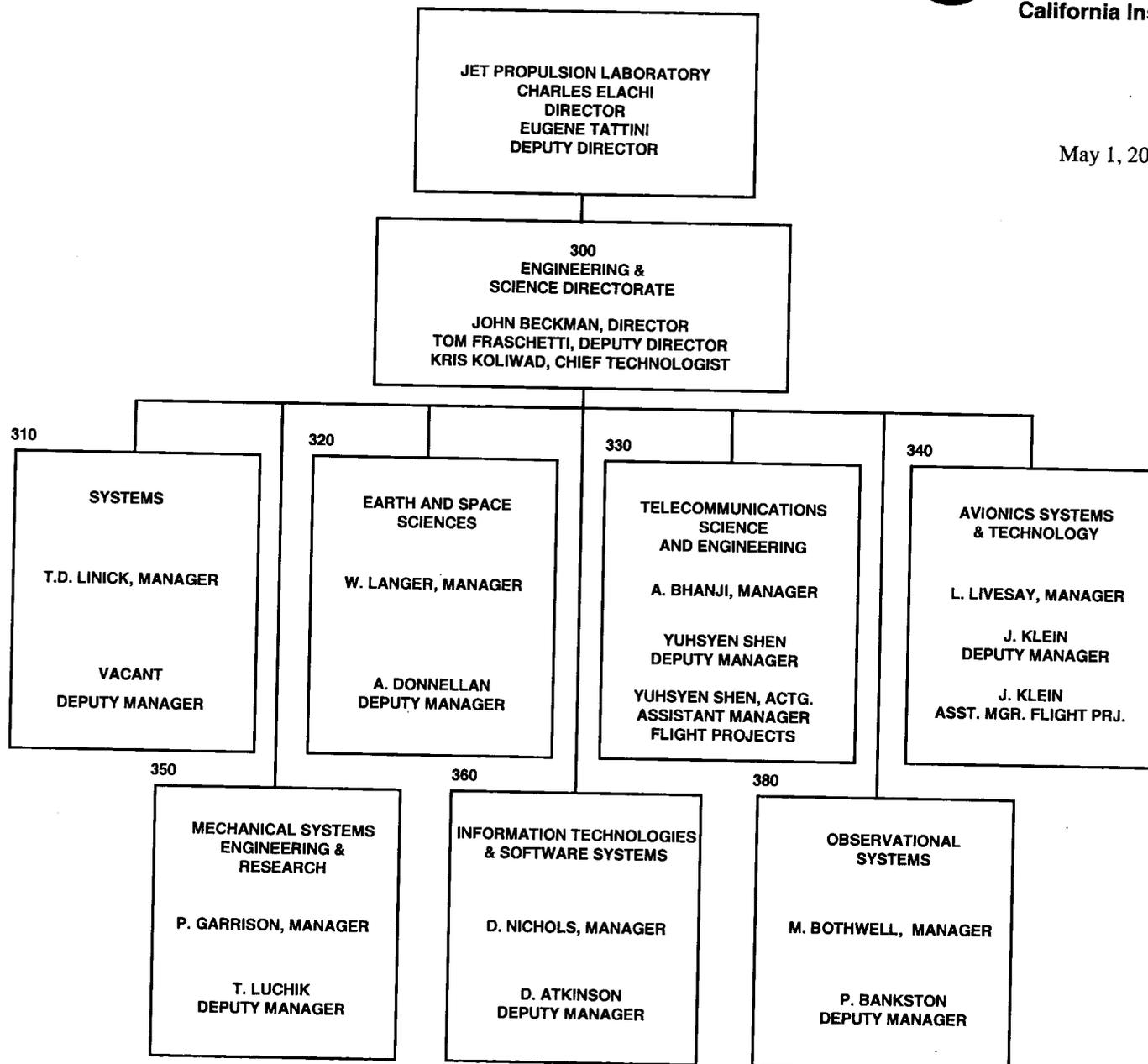
SIAM

Engineering & Science Directorate



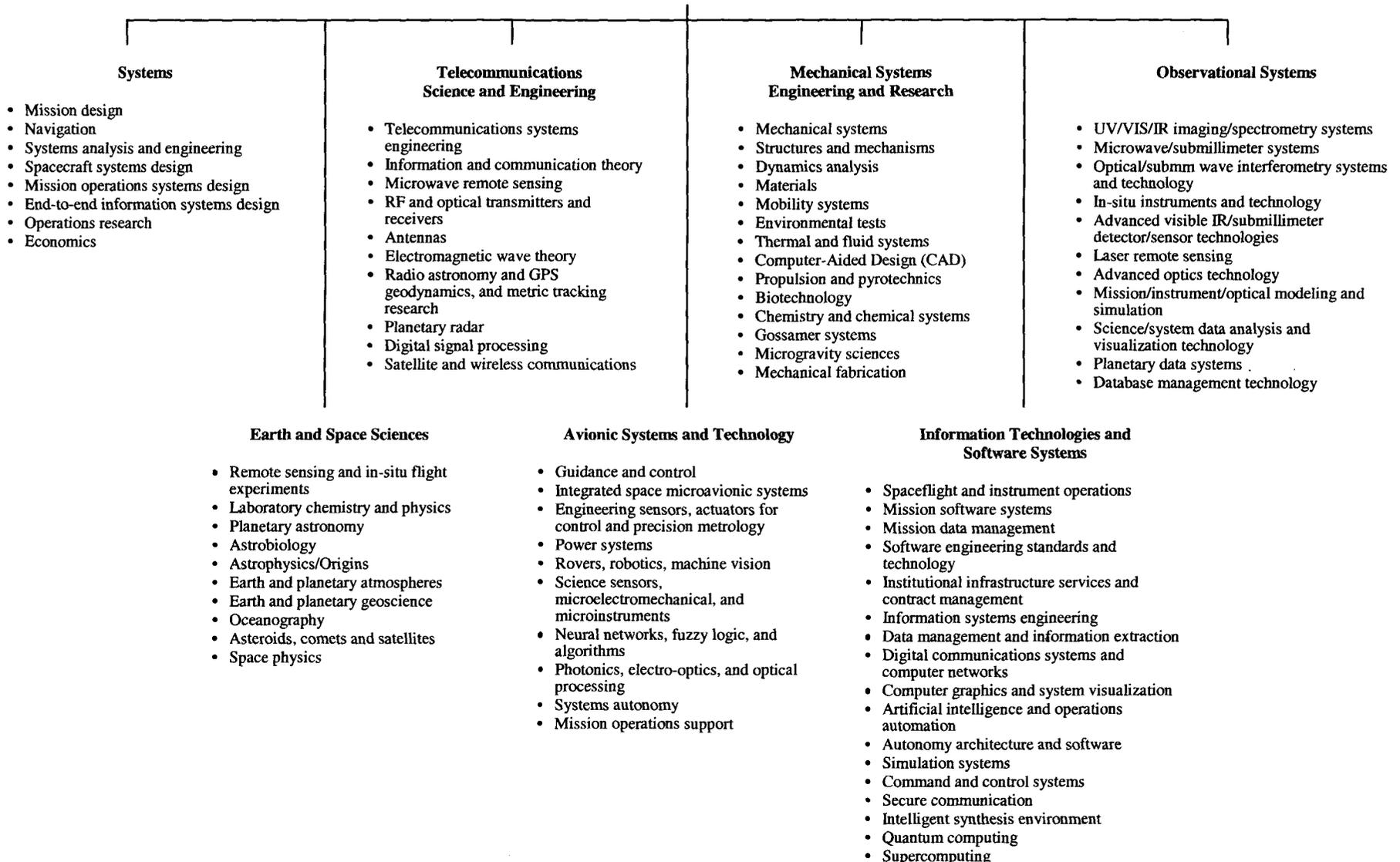
National Aeronautics and Space
Administration
Jet Propulsion Laboratory
California Institute of Technology

May 1, 2003





Technical Division Competencies





National Aeronautics and Space
Administration
Jet Propulsion Laboratory
California Institute of Technology

Technology and Engineering

JPL is a world leader in key areas critical to deep space exploration



**End-to-end system engineering
and project management**



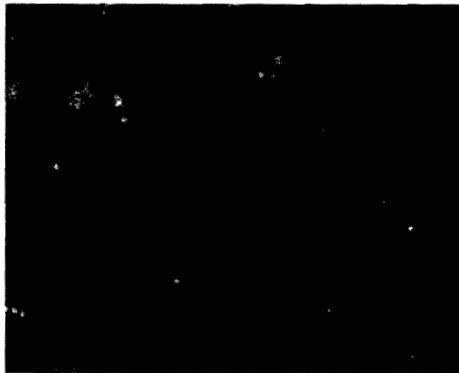
Autonomous mobility



**Deep space
communications**



**Deep space navigation and highly stable
clocks**



**Extreme precision formation
flying for science and
rendezvous**



**High precision spaceborne systems in
optical to sub-millimeter, including
interferometry**



**Active sensors for mapping and positioning
(SAR, altimeters, GPS)**

JPL Leadership Technologies



National Aeronautics and Space Administration
 Jet Propulsion Laboratory
 California Institute of Technology

<i>Technologies to enable:</i>	<i>Solar System & Mars</i>	<i>Astronomy & Physics</i>	<i>Earth Science</i>
• <i>Autonomous regional mobility (surface and atmosphere) and safe landing</i>	●		
• <i>Deep space communications and interplanetary network</i>	●	●	
• <i>Deep space navigation and highly stable clocks</i>	●	●	
• <i>Extreme precision formation flying for science observations and rendezvous</i>	●	●	●
• <i>High precision space-borne systems in optical to sub millimeter domain including interferometry</i>		●	●
• <i>Specialized active sensors for mapping and positioning (SAR, altimeters, GPS, ...)</i>	●		●

JPL Technology Expertise



National Aeronautics and Space
Administration
Jet Propulsion Laboratory
California Institute of Technology

<i>Technologies to enable:</i>	<i>Solar System & Mars</i>	<i>Astronomy & Physics</i>	<i>Earth Science</i>
• <i>Advanced coolers and thermal design</i>		●	
• <i>Advanced in-space propulsion & aerocapture</i>	●		●
• <i>Advanced remote sensing instruments</i>	●		
• <i>Advanced tools for mission design</i>	●	●	●
• <i>Autonomy</i>	●	●	●
• <i>Electronics for extreme environments</i>	●		
• <i>Fault tolerant computing and sensing for extreme environment</i>	●		
• <i>High performance on-board computing</i>		●	
• <i>Low mass advanced spacecraft systems including nano systems</i>	●		
• <i>Low temperature batteries</i>	●		
• <i>Miniaturized in-situ laboratories</i>	●		

JPL Technology Expertise



National Aeronautics and Space Administration
 Jet Propulsion Laboratory
 California Institute of Technology

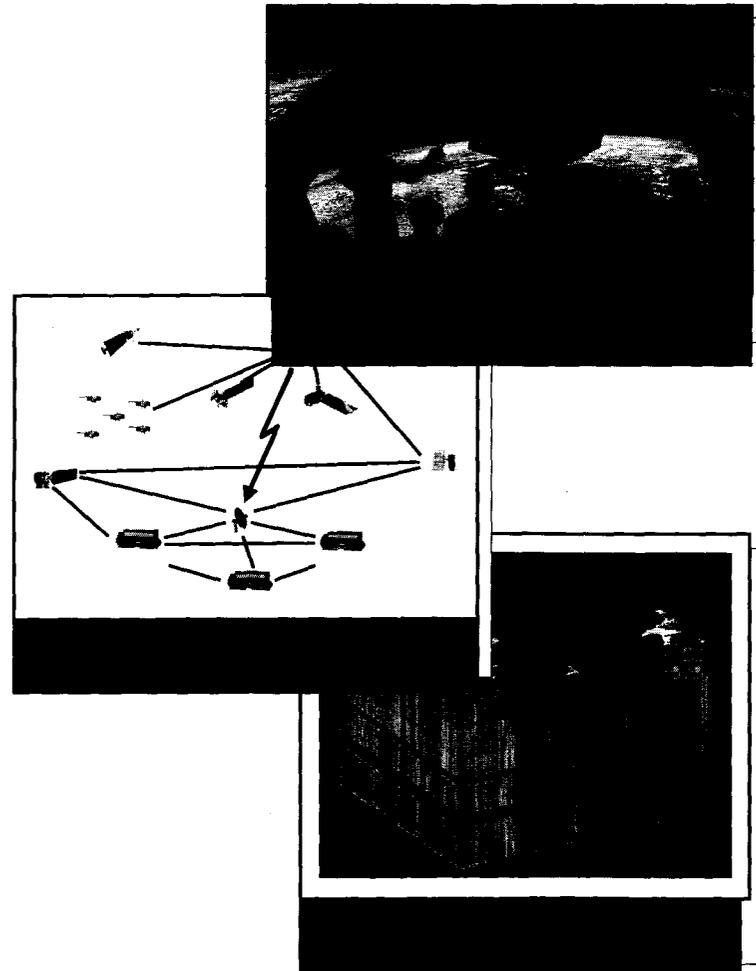
<i>Technologies to enable:</i>	<i>Solar System & Mars</i>	<i>Astronomy & Physics</i>	<i>Earth Science</i>
• <i>Non-Earth centric life detection</i>	●		
• <i>Ocean and solid Earth modeling</i>			●
• <i>Planetary protection</i>	●		
• <i>Quantum- and background-limited detectors and sensors</i>		●	●
• <i>Rendezvous and sample capture</i>	●		
• <i>Reusable fault tolerant, object-oriented flight/ground software</i>	●	●	●
• <i>Spacecraft system modeling</i>		●	●
• <i>Sub-millimeter, thermal infrared, and THz sensors</i>		●	●
• <i>Subsurface access</i>	●		
• <i>Virtual presence</i>	●		●



Earth Science Technology Emphasis Areas

Earth System Science in the future will leverage three ongoing technology revolutions:

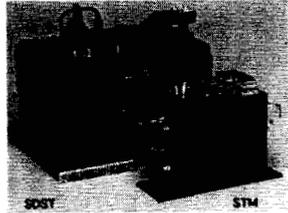
- **Technologies enabling Earth System Science:**
 - Active microwave
 - Submillimeter/thermal IR
 - Interferometry
 - Large aperture precision deployables
 - 4 deg K coolers, sensors and detectors
 - Precision formation flying
 - Laser/LIDAR remote sensing
 - GPS technologies
 - Sensor web integration and sensor networks
 - Evolvable systems
 - Synthetic aperture radar
 - Quantum gravity radiometer and quantum sensors
 - Miniature in situ sensor package
 - Subsurface exploration techniques
 - High fidelity simulation and modeling



RF Communications



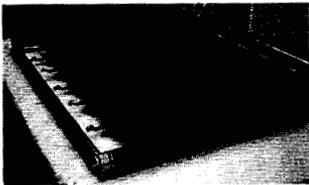
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Administration
Jet Propulsion Laboratory
California Institute of Technology



- *Small Deep Space Transponder (SDST) exists today*
- *Space Transponding Modem (STM) by FY07*



- *3m X/Ka-Band Inflatable Lens Antenna by FY10*



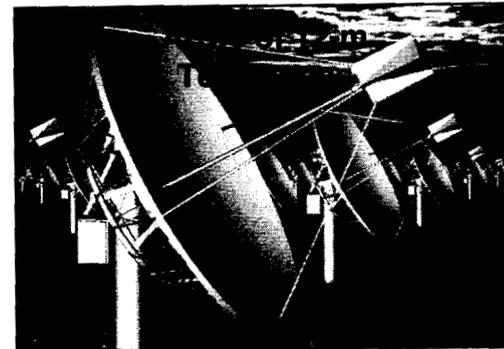
- *3.5m X/Ka-Band Reflect-Array Membrane design by FY08*
- *5-7m design by FY12*



- *35W Ka-band TWTA enables 4x improvement over X-band by FY03*
- *100W X-band TWTA by FY04*
- *100W Ka TWTA by FY07*
- *High power amp by FY09*



- *Grid amplifier by FY11*



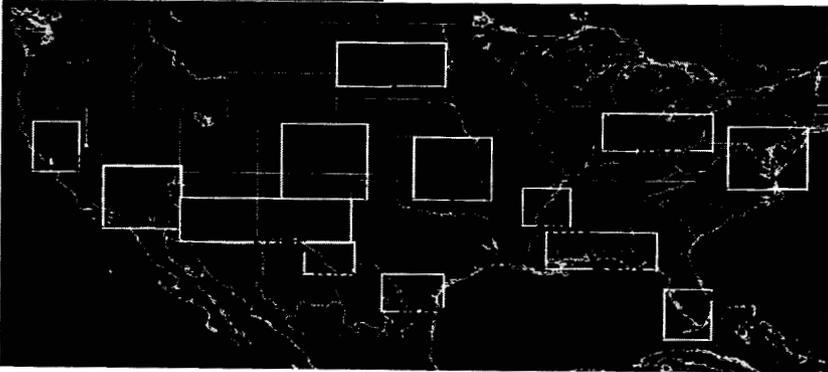
Optical Communications



National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology



Measuring atmospheric visibility & cloud cover statistics from space



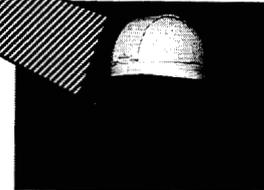
Near-Earth & deep-space optical receiving stations



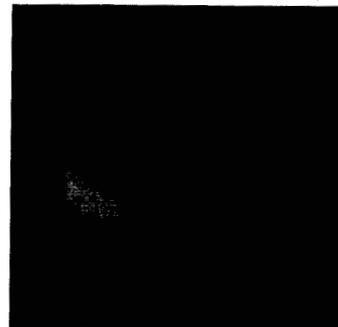
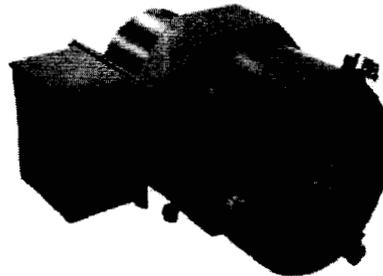
High bandwidth air-to-ground links

Beacon laser from ground

Communications Laser



Low-mass, low-complexity optical terminal



Multi-beam scintillation mitigation strategies

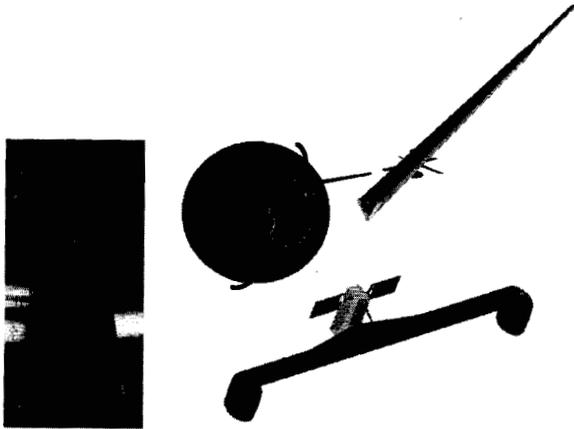


Multi-Gbps WDM link

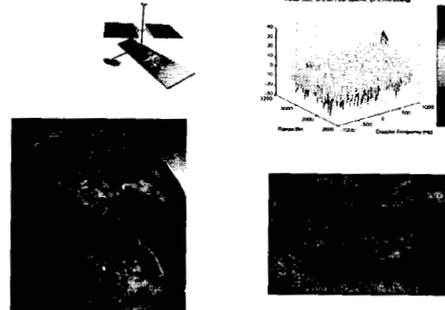
Examples of JPL's Technologies



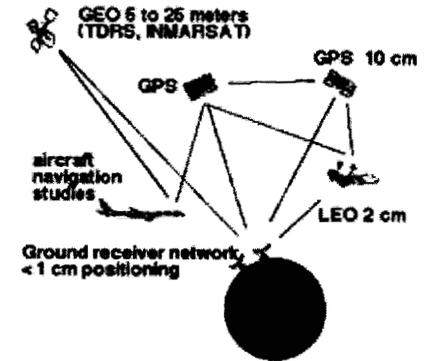
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 California Institute of Technology



Inflatable Antennas



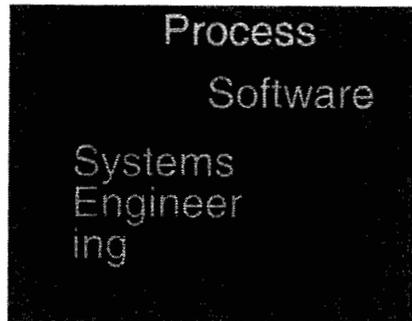
SBR



GOA II



Instruments



Mission Data System

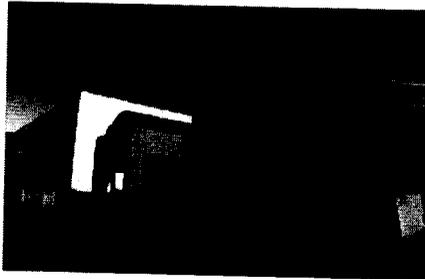


Hyperspectral & Image Processing

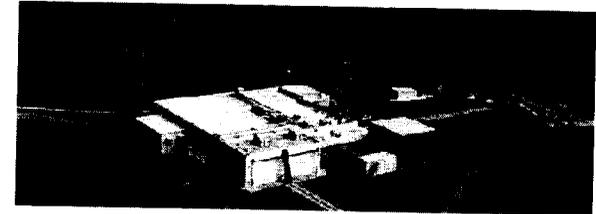
JPL's Technology Facilities



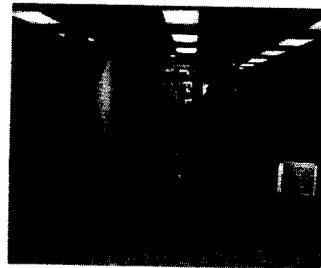
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Administration
Jet Propulsion Laboratory
California Institute of Technology



Microdevices Laboratory



Mesa Antenna Range



Supercomputers



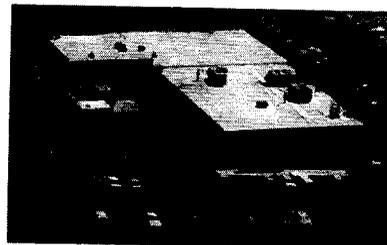
Project Design Center



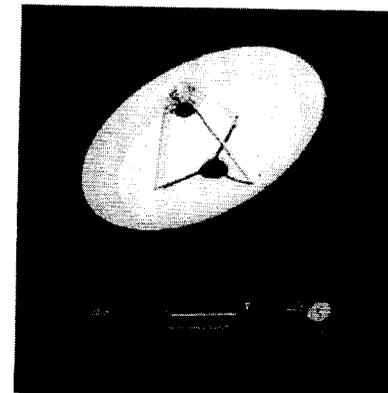
**FIDO Rover Testbed
in Mars Yard**



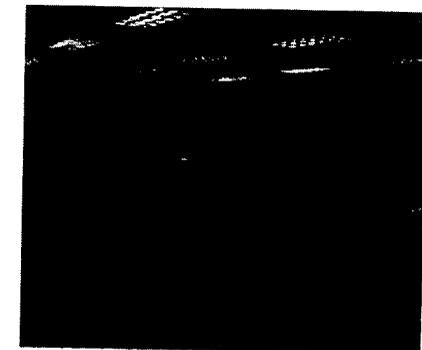
Space Simulators



Frequency Systems Lab



Deep Space Station 13



**Center for Integrated
Space Microsystems**



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- **Additional Depth**



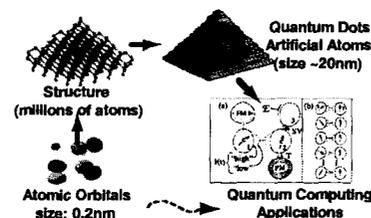
JPL Technology Areas



Create revolutionary sensor technologies to enable new areas of scientific observations

Microdevices and Compact Instruments

- ◆ Micro and nano devices for transducers, information processors and actuators
- ◆ Sensors based on micro/nano structures (electromechanical, biogeochemical, field and particle)
- ◆ Actuators for micro and nano scale manipulation and mechanical control
- ◆ Integrated micro/nano systems for spacecraft and information systems
- ◆ Micro and nano devices for computing and memory



JPL Technology Areas

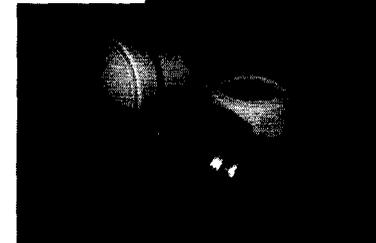


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Space Robotic Systems

Develop robotics technologies that will enable new revolutionary NASA missions. Increase science return by orders of magnitude while increasing system reliability and safety

- ◆ Intelligent, self reconfiguring and cooperating robots
- ◆ Autonomous space, aerial, surface and subsurface vehicles for in-situ exploration
- ◆ Planetary and deep space spacecraft systems
- ◆ On-board information processing, self diagnosing and fault tolerant spacecraft
- ◆ Safe descent, landing, ascent and rendezvous at planetary and deep space bodies
- ◆ End to end space science mission systems analysis





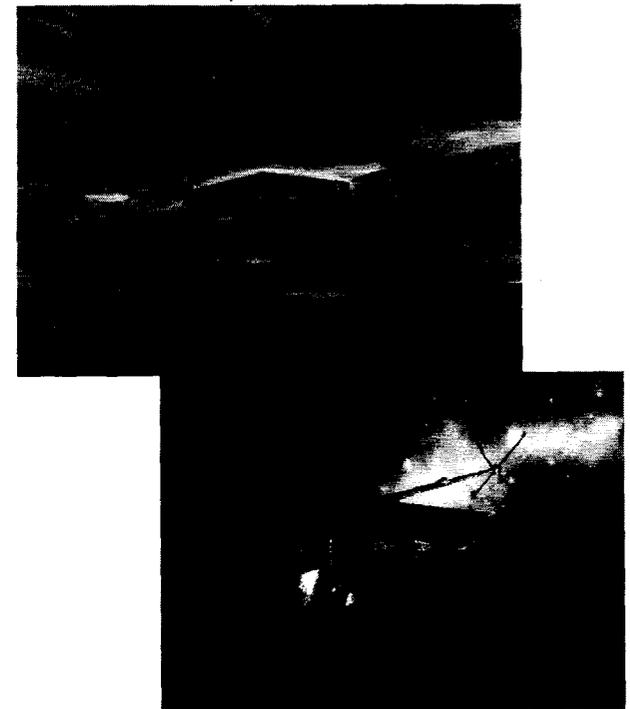
JPL Technology Areas



**Interferometry and
Large Aperture
Wavefront Sensing &
Control**

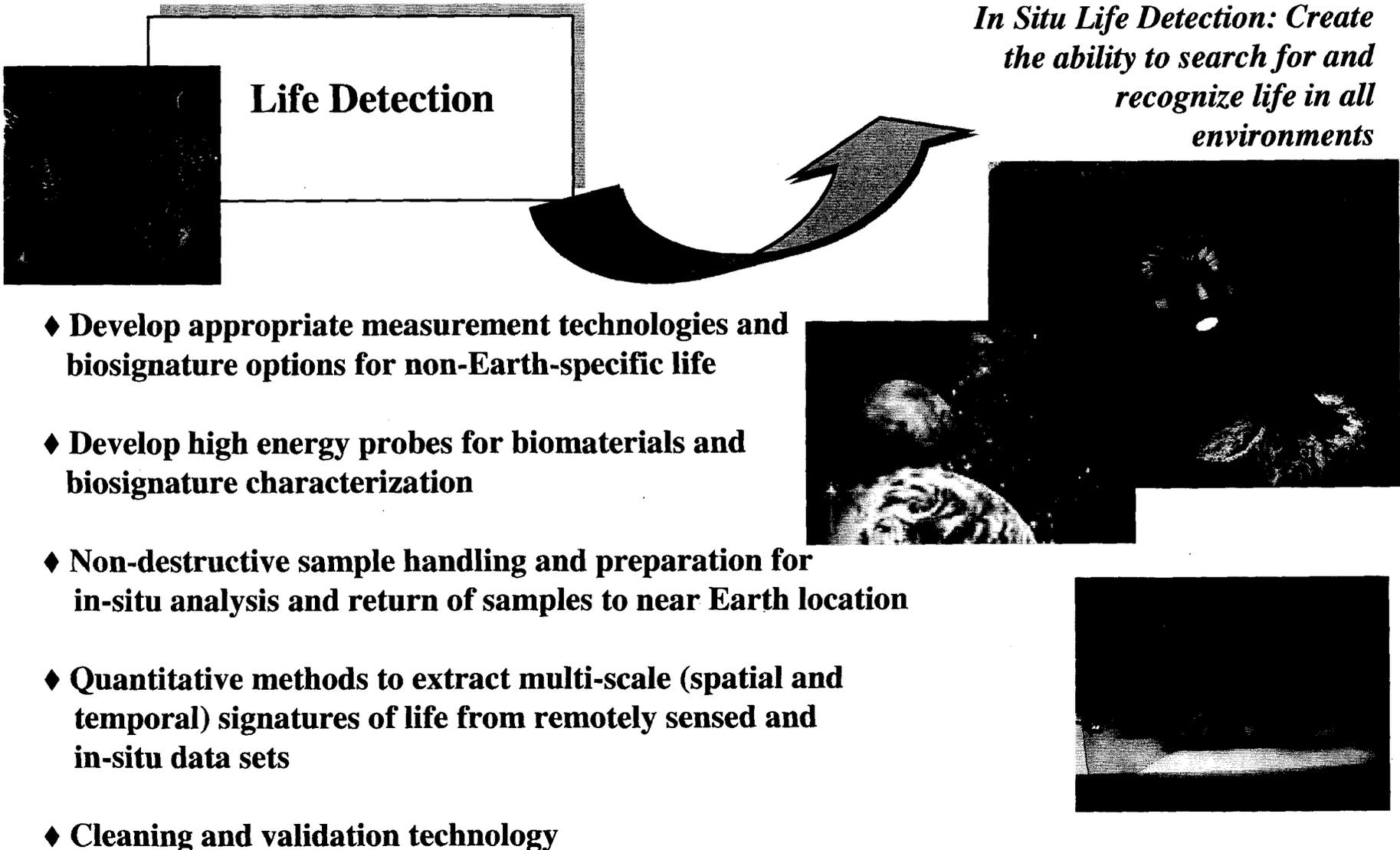
*Enable large, lightweight, low
cost optical systems and
structures for future missions*

- ◆ Point to point metrology and control technology
- ◆ Optical surface metrology and control technology
- ◆ Cryogenic optical systems technology
- ◆ Separated aperture interferometry technology
- ◆ Lightweight optics and in-space assembly technology
- ◆ Integrated modeling and simulation of precision optical systems





JPL Technology Areas



Life Detection

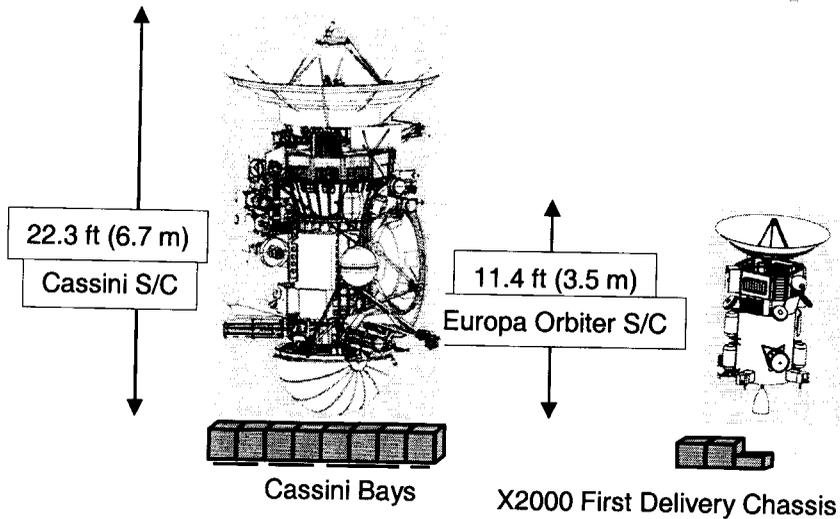
*In Situ Life Detection: Create
the ability to search for and
recognize life in all
environments*

- ◆ Develop appropriate measurement technologies and biosignature options for non-Earth-specific life
- ◆ Develop high energy probes for biomaterials and biosignature characterization
- ◆ Non-destructive sample handling and preparation for in-situ analysis and return of samples to near Earth location
- ◆ Quantitative methods to extract multi-scale (spatial and temporal) signatures of life from remotely sensed and in-situ data sets
- ◆ Cleaning and validation technology

Key Technology Developments for Solar System Exploration

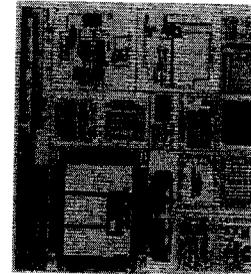


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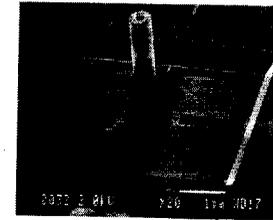


X2000 Avionics:

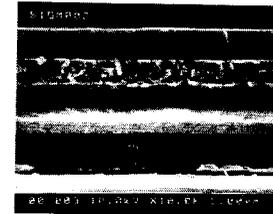
Low mass, rad hard, high performance



System on a chip

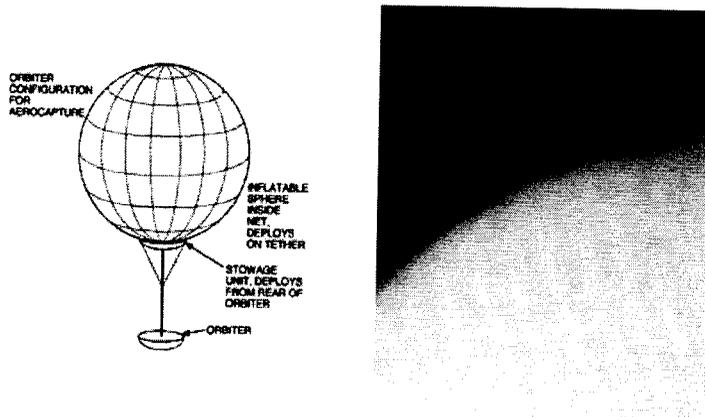


Microgyroscope



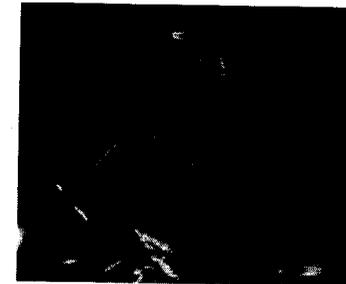
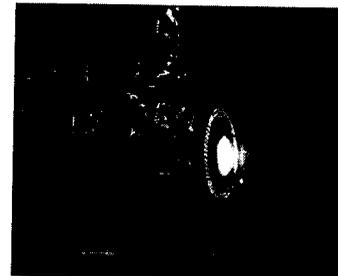
Magnetic On-Chip Microinductors

Highly integrated, survivable microsystems:



Aerocapture:

Low-mass orbit insertion



Advanced power sources

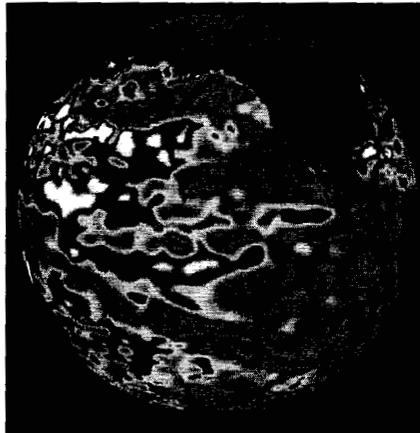
Advanced Propulsion:

Shorter flight times and smaller launch vehicles

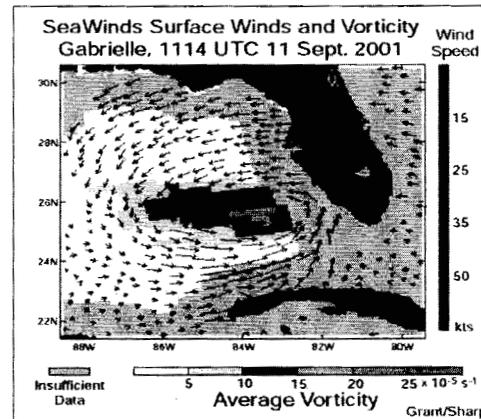


Earth Science

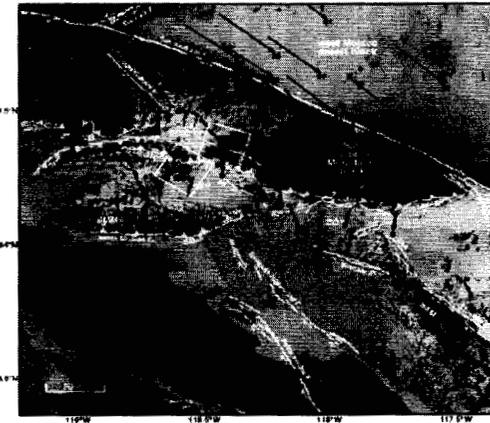
Applying our capabilities to our own planet



TOPEX/Poseidon



Quikscat



InSAR and GPS



Shuttle Radar Topography Mission

NASA and NOAA are using data to improve El Nino and hurricane forecasts

NASA, NSF and USGS are using data to better assess seismic risks

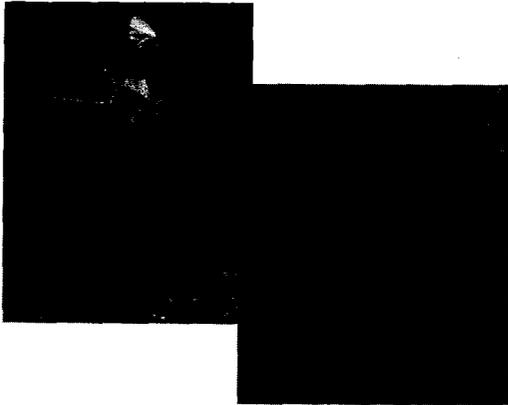
Savings for NIMA: JPL's SRTM mission reduced topographic maps cost 14 times over conventional methods

JPL's Vision by 2020



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Established a continuous presence around and on the surface of Mars



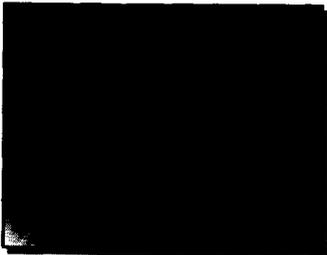
Explored the Jovian and Saturnian satellites in detail and probed their surfaces and interiors for possible pre-biotic and life-favorable environments.



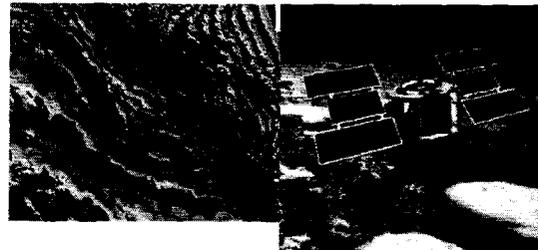
Returned first samples from other solar system bodies beyond the moon.



Began exploring neighboring solar systems.



Established operational capability to monitor dynamics of solid Earth and its oceans and atmosphere.



Established the Interplanetary Network, which is being commonly used by students.

