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California Institute of Technology
Pasadena, California

Commercializing Rocket Science: Tech Transfer at JPL

Dan Broderick
Office of Technology Transfer at JPL
NASA Jet Propulsion Laboratory

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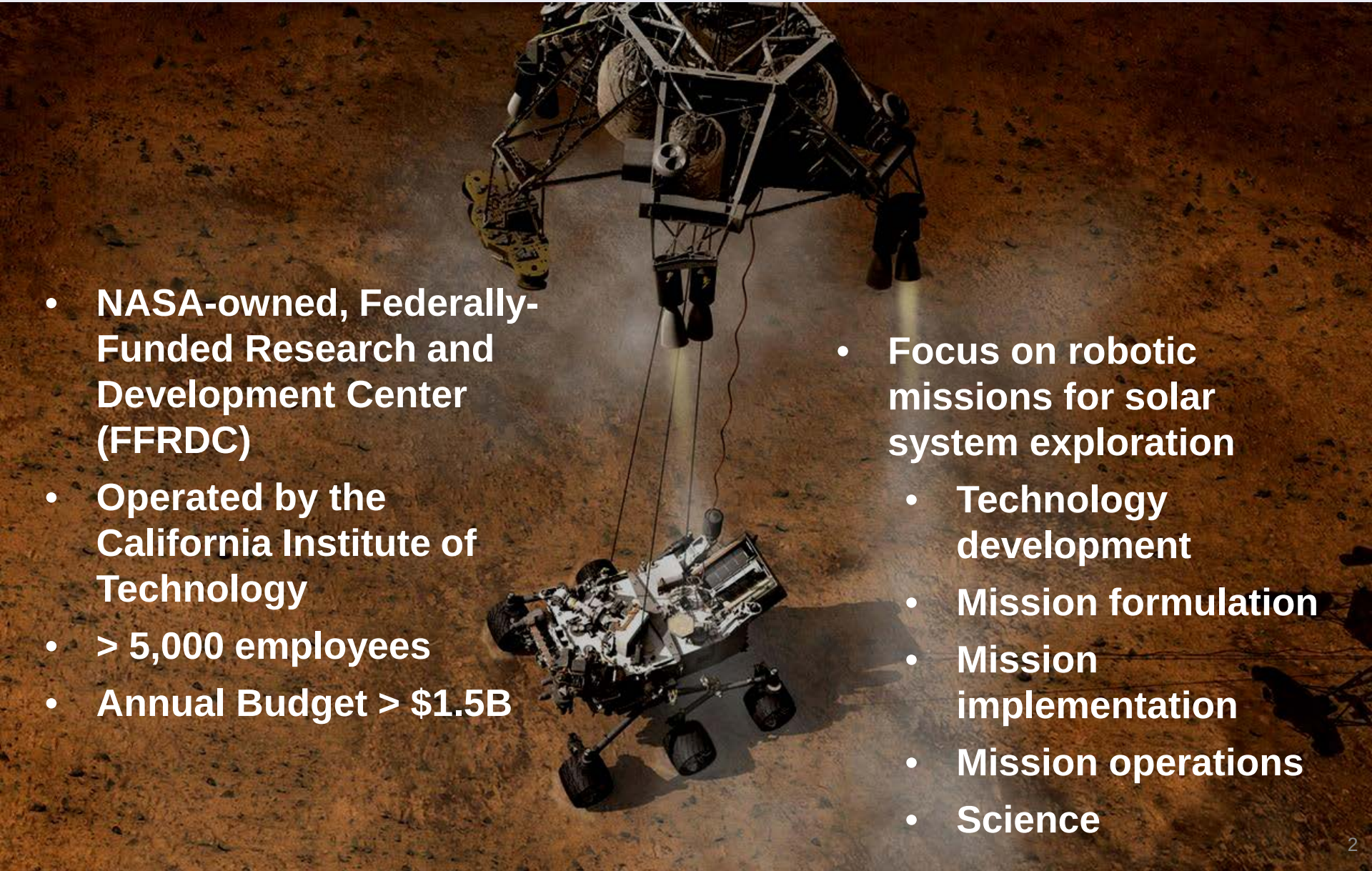

- NASA-owned, Federally-Funded Research and Development Center (FFRDC)
- Operated by the California Institute of Technology
- > 5,000 employees
- Annual Budget > $1.5B

- Focus on robotic missions for solar system exploration
  - Technology development
  - Mission formulation
  - Mission implementation
  - Mission operations
  - Science

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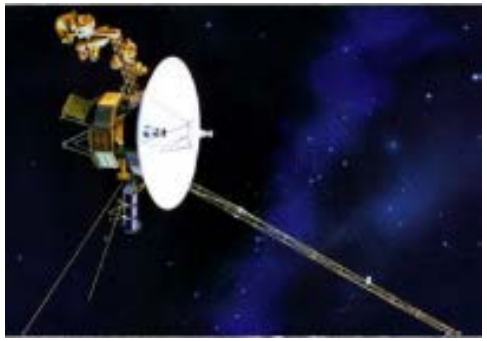
Voyager



Mars rovers

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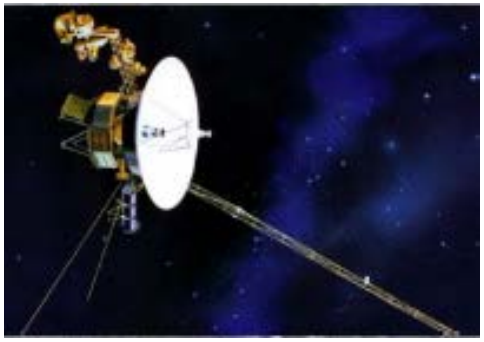
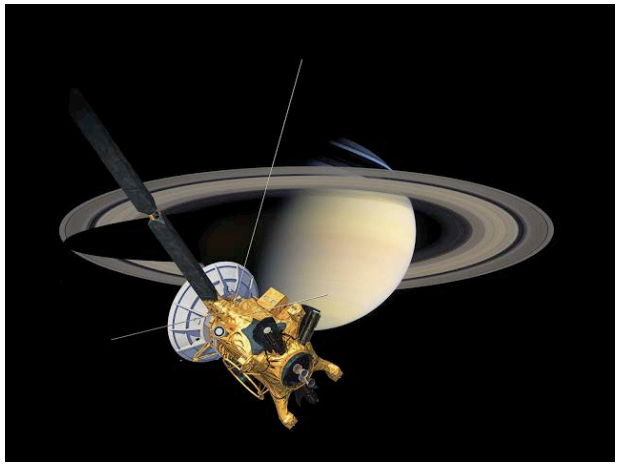
Voyager



Cassini at Saturn



Mars rovers

JPL is NASA's lead center for robotic exploration of the solar system

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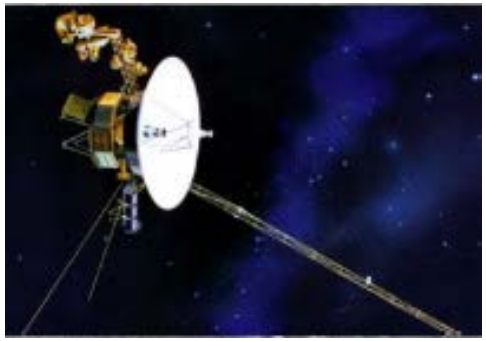

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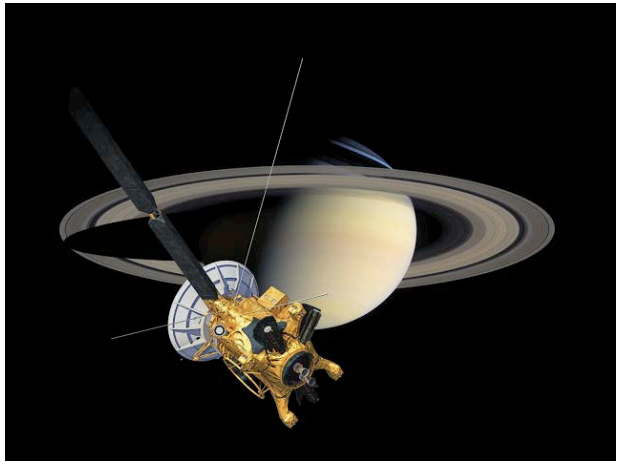

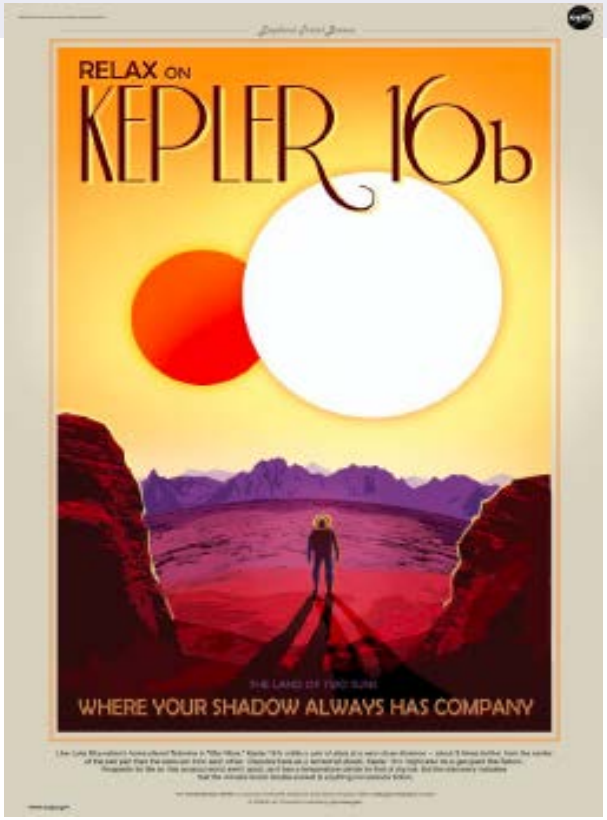

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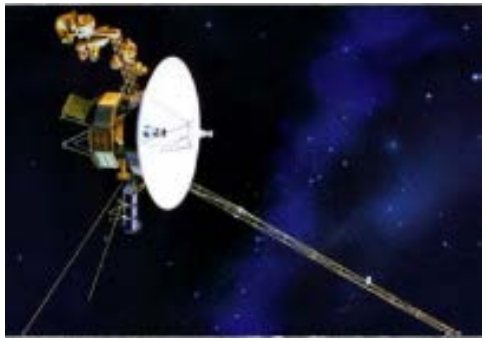

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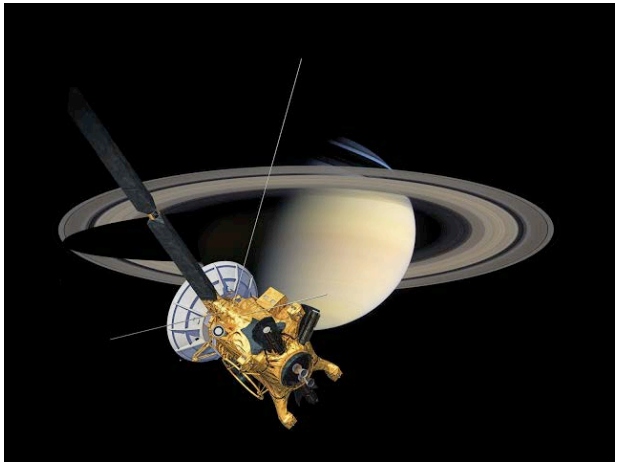

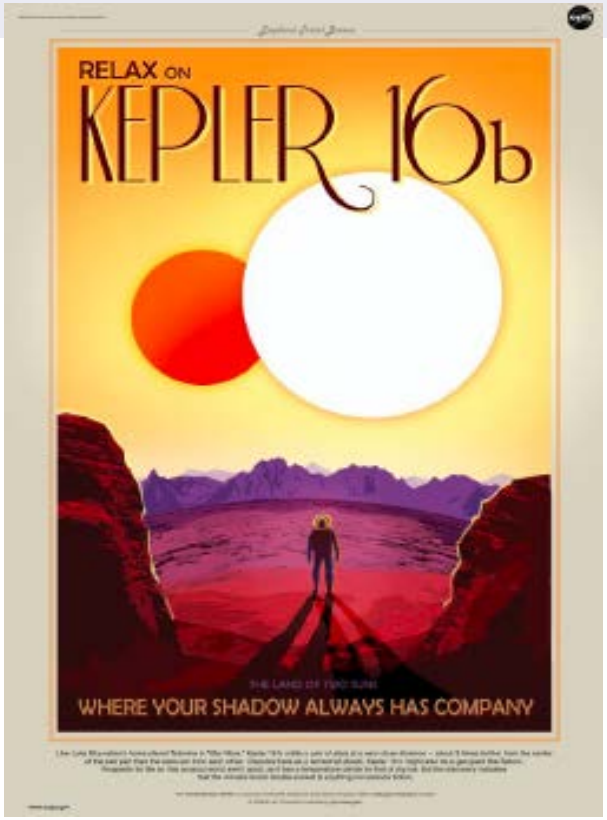

Mars rovers

JPL is NASA's lead center for robotic exploration of the solar system.

But we also do Astrophysics and Earth Science

Orbiting Carbon Observatory

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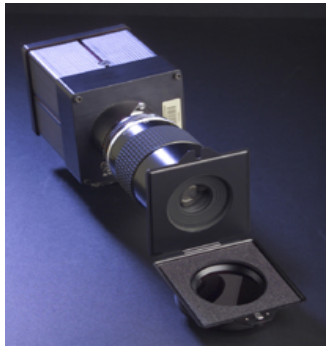
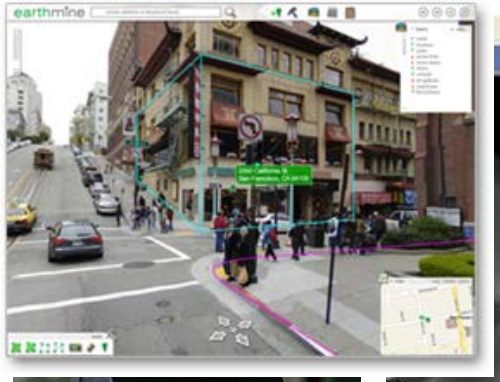
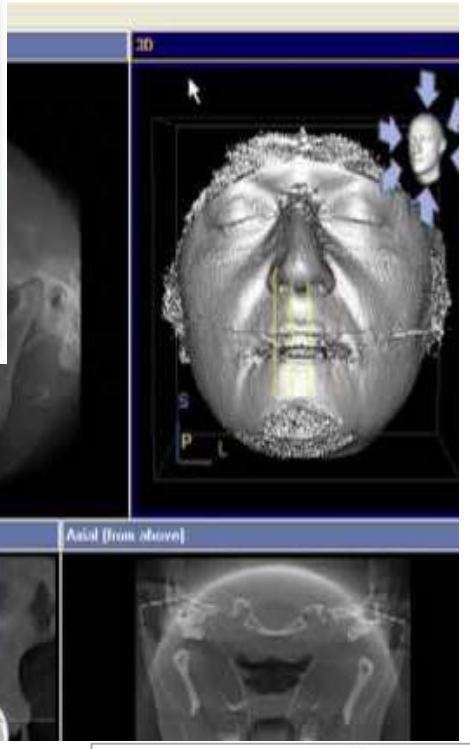
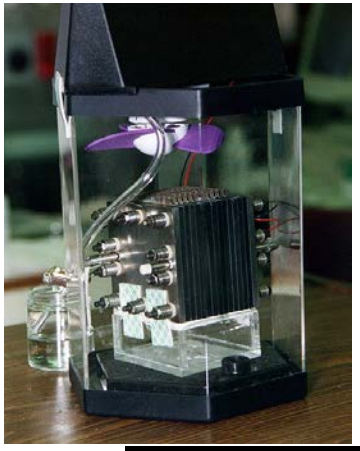
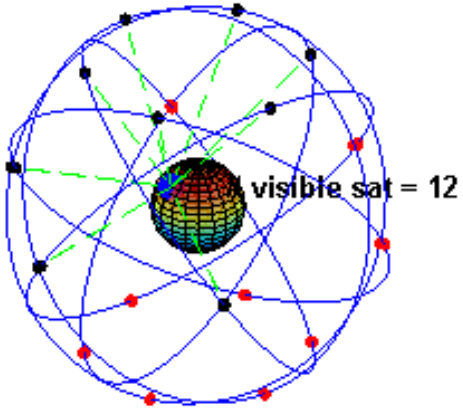
JPL Creates Innovations that Improve Life

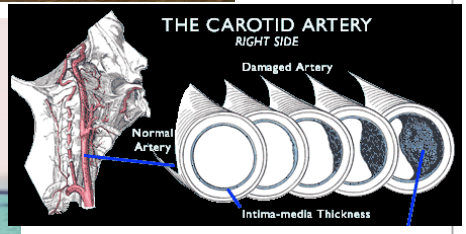












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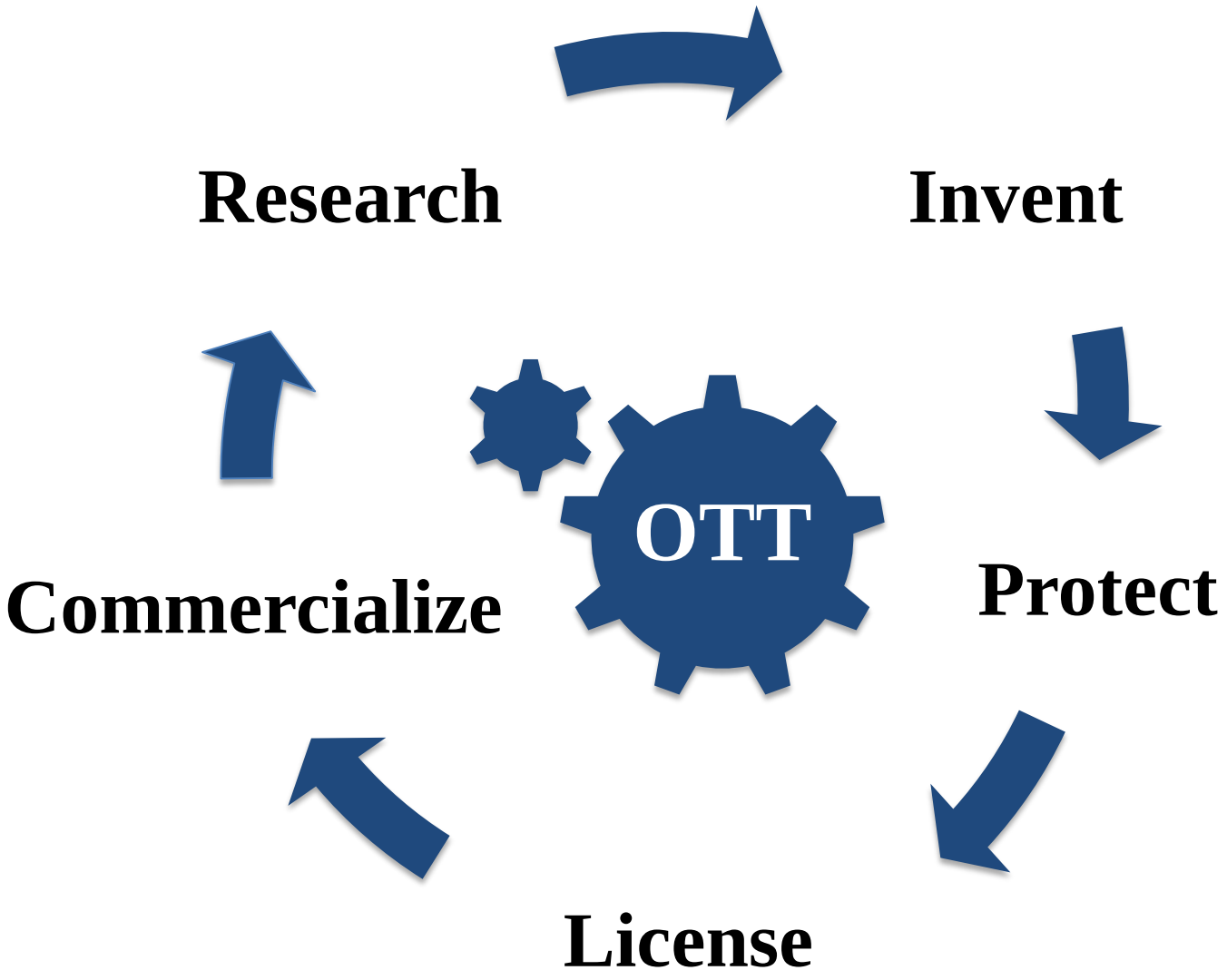
The Virtuous Cycle



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Avenues of Technology Commercialization

Expertise Transfer

- JPL personnel often develop unique and advanced skills in a technical area through their work at the Laboratory
- Apply those skills to revolutionary commercial products and services
- Commercial products and services may often be based on specific JPL technologies that have been published, presented at conferences, and placed in the public domain

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Avenues of Technology Commercialization

Technology Licensing

- Partially or fully developed NASA technology, usually protected by Patent or Copyright, is licensed to a commercial company
- Company then further develops a NASA JPL technology and eventually introduces a commercial product or service
- That company may continue to return to JPL to license future advances and even fund commercial partnerships to further the technology

Avenues of Technology Commercialization

Commercial Partnerships

- Companies come to JPL to fund research and development work that requires JPL capabilities not otherwise available in the private sector
- JPL develops a technology specifically for a commercial sponsor's need, in accordance with the Laboratory's mission
- Commercial Partnerships can lead to licensing agreements for the new technology (via the Technology Transfer Mechanism)

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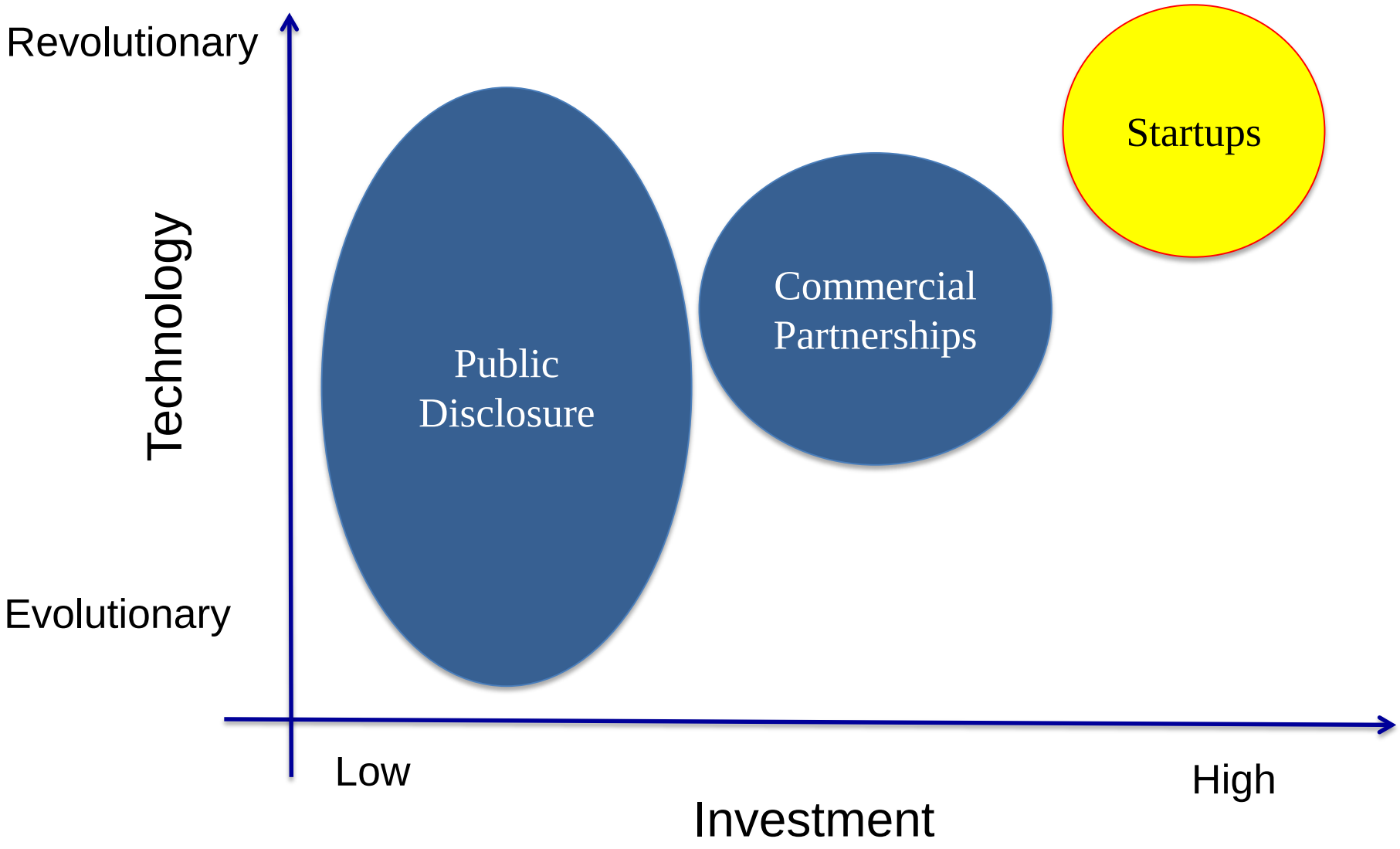
Technology Transfer Mechanisms



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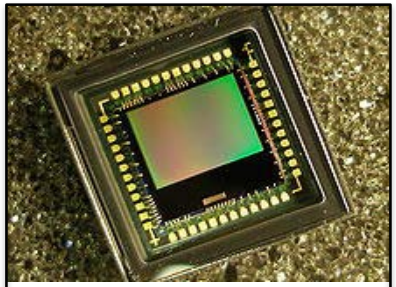
Commercial applications for JPL derived technology



Digital Cameras

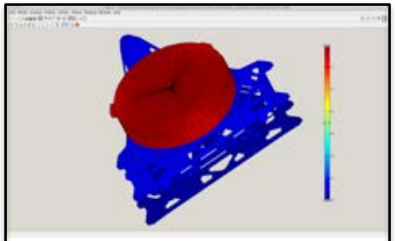
Database Software

Sunglasses

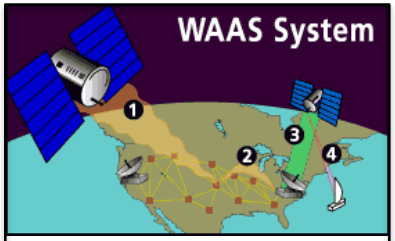
Cardiac Health

IR Thermometer

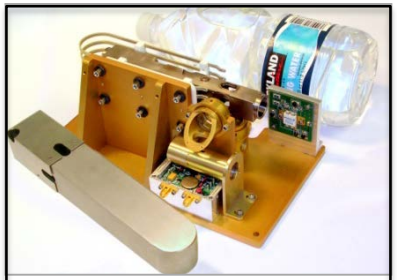
Fire Detection



Engineering Design Software

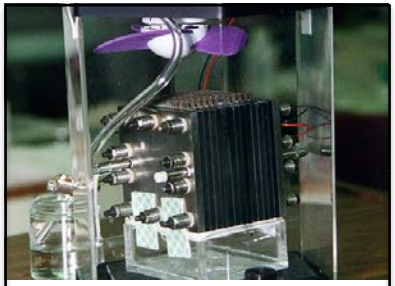


Global Positioning



Precision Clocks

Robotic Surgery



Clean Energy

Mobile Robotics

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JPL Technologies in Medical Applications

Cancer Detection

Advanced BioPhotonics

Highly sensitive Quantum Well Infrared Photodetector (QWIP) Technology developed at JPL is being used to detect increased heat due to changes in blood flow in tumors

BioScan is now an FDA Approved system to monitor breast cancer therapy

Infrared Thermometer

Diatek / Welch Allyn

IR Astronomy technology used to measure the heat emitted by eardrum without contact

JPL technologists worked with Diatek to develop first IR thermometer

Diatek acquired by Welch Allyn, now marketed as “Sure Temp”

Legend - Technology Transfer - Commercial Partnership - Expertise Transfer

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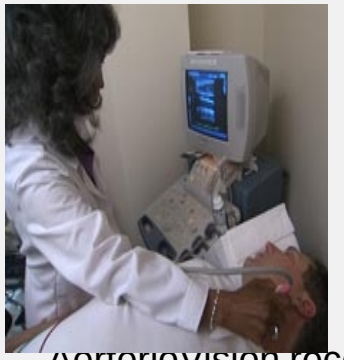
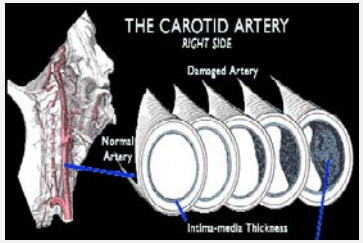
JPL Technology in Surgical Applications

Heart Disease Detection

MTI

JPL image analysis software, combined with ultrasounds to measure carotid artery thickness for early heart disease detection





Aerteriovision received FDA approval in 2001, and systems now in growing demand

Robotic Surgery

Intuitive Surgical

Prototype technologies first developed at JPL for hazardous environments robotics

Incorporated into DaVinci System, which dominates emerging Robotic Assisted Surgery field

Robotic Surgery now a fast growing $1B+ industry

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JPL Technology in Public Safety Applications

Hazardous Operations

iRobot

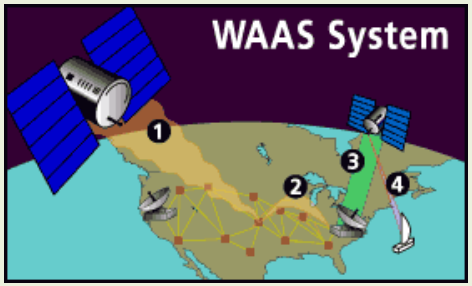
iRobot Packbot incorporates many technologies developed for Mars Rovers

Among other missions, Packbot took radioactivity readings in the damaged Fukushima Daiichi Nuclear Power Plant just after the March 2011 Tsunami in Japan

GPS Positioning

Hundreds of Licenses

Best in class satellite orbit determination software



Now in prominent use in a number of commercial applications that enhance public safety, including:

– E-911 Systems

–Commercial Aviation (WAAS)

– Marine Navigation

Legend - Technology Transfer - Commercial Partnership - Expertise Transfer

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JPL Technology in Environmental Applications

Agriculture

John Deere/NAVCOM

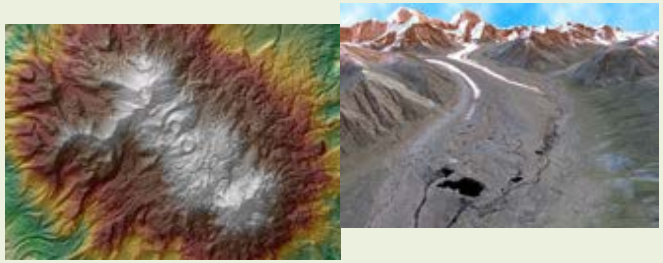
JPL partnered with John Deere subsidiary NAVCOM to incorporate JPL GPS software into precision agriculture systems

Such systems increase harvest yields and allow for farming operations at night or during reduced visibility

Airborne Mapping

Fugro EarthData

GeoSAR radar mapping instrument developed at JPL being used by Fugro to develop digital elevation models of rugged or inaccessible areas



Applications include National Security, Oil and Gas Exploration, Agriculture, Forestry and Water Resources Management

Legend - Technology Transfer - Commercial Partnership - Expertise Transfer

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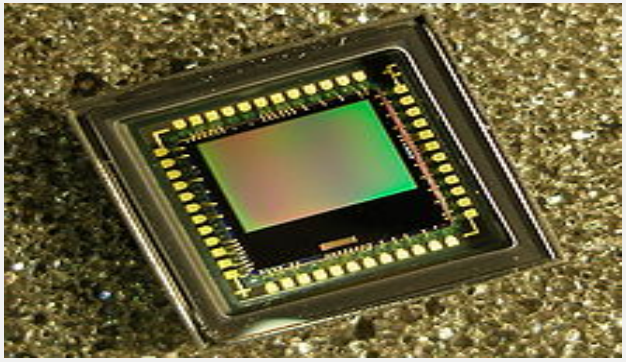
JPL Technology in Consumer Products

Cameras

Photobit Startup, now Licensed Widely

Active Pixel Sensor, a Low Power, Compact Imaging Technology was developed at JPL for space observations

JPL technologists form startup



Technology now a standard for cell phone cameras, estimated at $2B in sales

NASA Global Differential GPS

Multiple Partners

GDGPS Network crucial to NASA science, satellite communications and ability to correct for atmospheric effects

Network is also supported by several partnerships which use GPS data for commercial offerings

Legend - Technology Transfer - Commercial Partnership - Expertise Transfer

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New Startup - Verrix

Sterility assurance for medical devices

Resulted from JPL astrobiology research

JPL Researcher on SAB

- ***Passionate determination on the part of researcher***
- ***Significant efforts in fundraising and business plan***
- ***Startup would not have launched without intense researcher efforts***

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New Startup - Neural Eye

- **Arose from Tuan Dong's work in computer vision**
- **Bio-Inspired visual data processing – mimics neural path**
- **Unique facial/object recognition software**
- **Company planning to develop applications to several markets (financial services, retail, healthcare…)**

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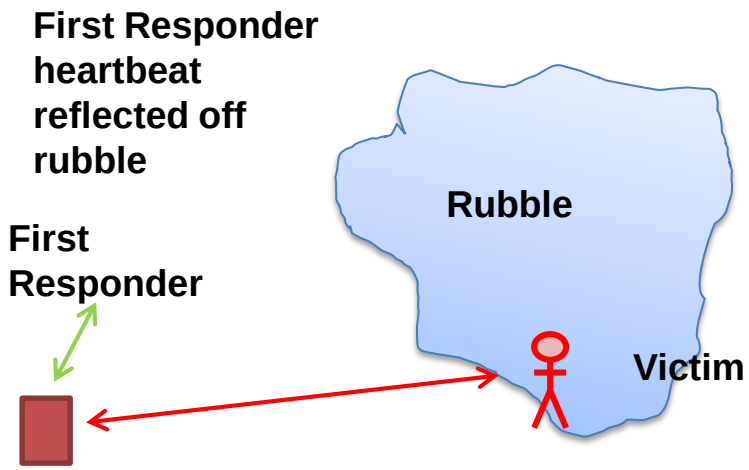
"FINDER" Radar Technology to Find Humans

Search and Rescue

- *Finds victims trapped in rubble*

Additional uses

- *Defense (licensed)*
- *Police (possible startup)*
- *Medical (possible startup)*



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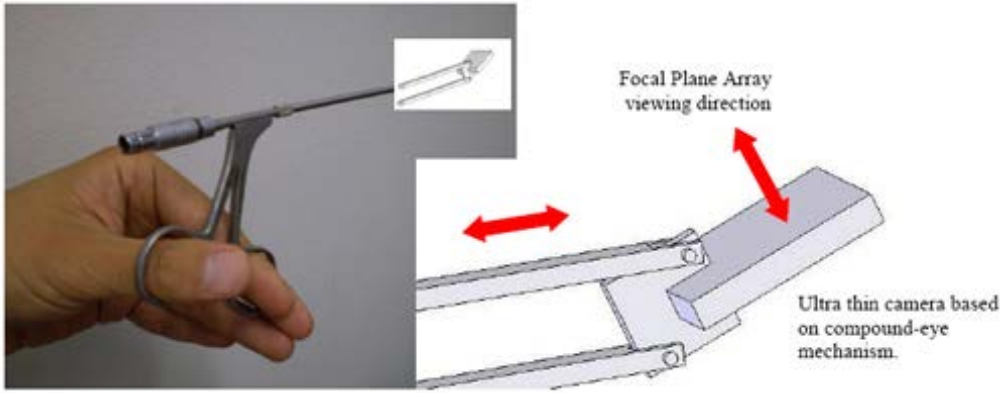
Skull Base Institute / Marvel

Space Act Agreement – exercised Option to Patents and Know-How

3D endoscopy, miniaturized optics

Enables minimally invasive brain surgery

Applications include brain tumor removal



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On the Horizon
Amorphous Metal Gears

Outperforms crystal alloys

- ***Wear resistance***
- ***Fracture toughness***
- ***Manufacturing ease***
- ***Net shape fabrication***
- ***Lower cost or no lubricants***

JPL researcher consulting

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JPL Strategic Technology Directions

Deep Space Communications

Detectors and Instruments Systems

Advanced Propulsion and Power

In Situ Planetary Exploration Systems

Survivable Systems for Extreme Environments

Lifecycle Integrated Modeling and Simulation

Large Aperture Systems

Deep Space Navigation

Precision Formation Flying

Mission System Software and Avionics

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JPL Strategic Technology Directions - Commercial Partnership Areas

Deep Space **Communications**

Detectors and Instruments Systems

Advanced Propulsion and **Power**

In Situ Planetary **Exploration** Systems

Survivable Systems for **Extreme Environments**

Lifecycle Integrated **Modeling and Simulation**

Large Aperture Systems

Deep Space Navigation

Precision Formation Flying

Mission System **Software** and Avionics

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Encouraging Entrepreneurism: Revision of New Venture Rules

- **Recognition that technology commercialization often requires startups and the active involvement of JPL researchers**
- **We want to keep innovative scientists that we have made investments in**
- **More entrepreneur friendly**
- **Encourage commercialization**
- **More OTT involvement in the process**
- **Entrepreneurism rewarded**

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Spectrum of Partnerships

Various drivers for partnerships served with a one process….

Infusion	Collaboration	Commercialization
Transfer NASA technology to new suppliers for NASA needs	Leverage joint interests to develop NASA technology	Transfer NASA technology to create commercial offerings