

# **In Space Propulsion Overview**

## **14-17 January 2003**



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# In-Space Propulsion Program Overview



## ◆ Objective

- Develop in-space propulsion technologies that can enable and/or benefit near and mid-term NASA science missions by significantly reducing cost, mass, and/or travel times.

Technology areas include:

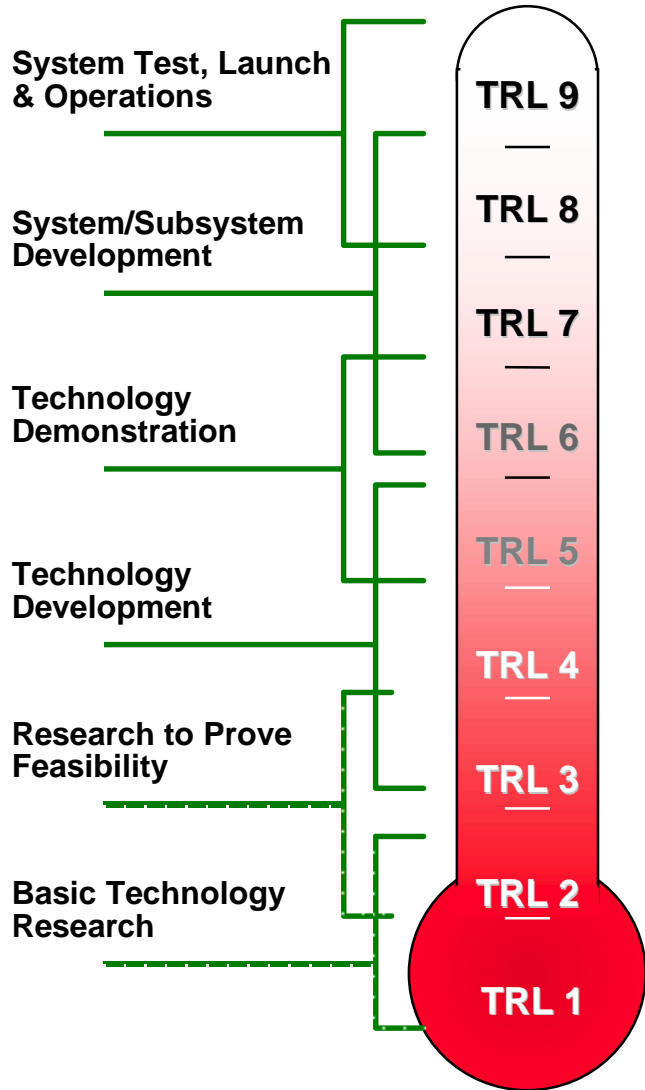
- Solar Electric Propulsion (nuclear electric is now part of Nuclear Systems Initiative)
- Propellantless Propulsion (aerocapture, solar sails, tethers, etc.)
- Advanced Chemical Propulsion

## ◆ Approach:

- Identify and prioritize the most promising technologies using systems analysis and peer review.
- Develop mid-TRL technologies to TRL 6 for incorporation into mission planning within 3-5 years of initiation.
  - Maximize use of open competition to seek best solutions



# In-Space Propulsion Program Will Advance Mid-TRL Technologies to Support NASA Mission Applications



## NASA Implementation: (Deep Space One Ion Engine Example)

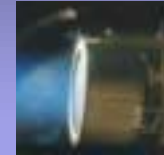


## In-Space Propulsion Technologies

Aeroassist



Adv. Electric Propulsion



Solar Thermal



Adv. Chemical



Tethers



Solar Sails



Plasma Sails



## Low-TRL Technologies For the Future



External Pulsed Plasma



Fusion & Antimatter



Beamed Energy



# In-Space Propulsion Program Status

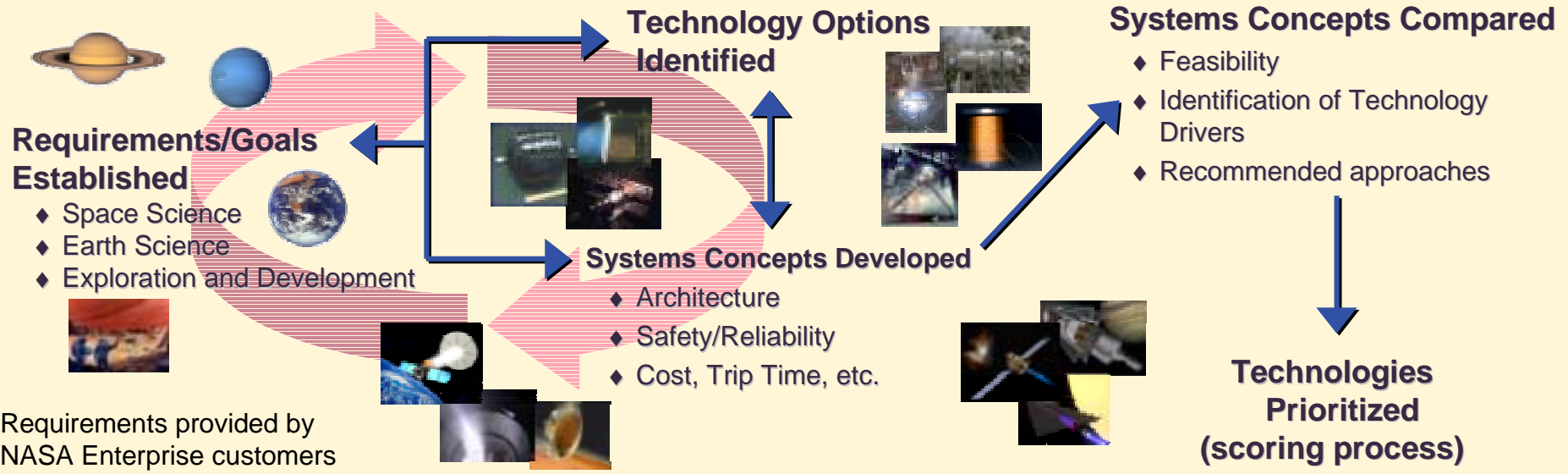


## ◆ Status

- In Space Propulsion is a HQ, Space Science, managed program
  - Dr. Colleen Hartman, Program Manager
  - MSFC is the implementing organization for ISP
- Competed efforts
  - Two awards made under an NRA specific to the Next Generation of Ion Electric Propulsion technologies.
  - Released In Space Propulsion Technologies, Cycle 1 solicitation (Aerocapture, Solar Sails, Electric Propulsion for NEP and Power Conversion) under the Research Opportunities in Space Sciences (ROSS) NRA. Selections announced in late August, 2002.
  - In Space Propulsion Technologies NRA, Cycle 2 (Aerocapture, Advanced Chemical, kW Solar Electric Propulsion, Momentum Exchange Tethers, Plasma Sails and Solar Sails) amendment to the ROSS NRA currently open - [http://research.hq.nasa.gov/code\\_s/nra/current/NRA-02-OSS-01/appendA4\\_4.html](http://research.hq.nasa.gov/code_s/nra/current/NRA-02-OSS-01/appendA4_4.html).
- Directed efforts
  - FY02 directed tasks included Systems Analysis and continuation of NSTAR life test.
  - Eight directed tasks underway for FY03.
- All Nuclear technologies moved under the Nuclear Systems Initiative



# FY02 In Space Propulsion Technology Prioritization Process



High Priority	Medium Priority	Low Priority	High Payoff/High Risk
Aerocapture	Advanced Chemical	Solar Thermal	Solar Sails 1 g/m <sup>2</sup>
NGI (5/10 kW)	Solar Electric		Momentum Exchange Tethers
Solar Sails	SEP Hall (100 kw)		Plasma Sails

**Cross-Enterprise  
In-Space  
Propulsion  
Priorities**



# In-Space Transportation Technology Products

## High Priority Technologies



### ◆ Aerocapture

- Low-mass aeroshell with integrated TPS
- Aerocapture flight-like instrumentation
- Advanced Aerodynamic Decelerators (trailing ballutes, attached ballutes and inflatable aeroshells)

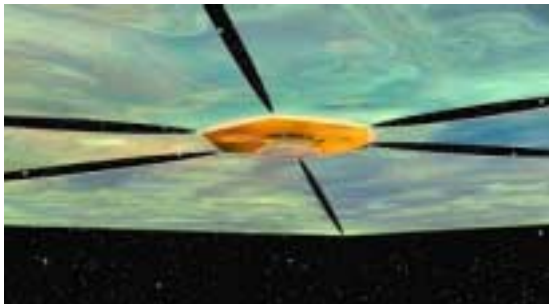
### ◆ Next Generation Ion Thruster

- Next generation integrated ion engine thruster technology
  - NASA's Evolutionary Xenon Thruster
  - Carbon Based Ion Optics



### ◆ Solar Sails

- Sail subsystem design and fabrication and ground demonstration
- Structural testing of sail booms
- Long term environmental evaluation of ultra-thin sail material





# In-Space Transportation Technology Products Medium / Low Priority Technologies



## ◆ Advanced Chemical

- Fuels development
- Cryogenic Fluid Management
- Lightweight components

## ◆ kW Solar Electric Propulsion

- Laboratory demonstration of 50kW Hall thrusters
- Competitively select thruster technology advancement based on application

## ◆ Solar Thermal Propulsion

- Technology investments under further study
- Directed tasks focused toward fundamental performance questions



# In-Space Transportation Technology Products High Risk/High Payoff & Lower Priority Technologies



## ◆ Plasma Sails

- Thrust measurement and validation
- Compare analytical model results vs. Laboratory test data



## ◆ Momentum Exchange Tethers

- Model development and evaluation
- Catch Mechanism concept
- High strength tether



## ◆ Solar Sails < 1g/m<sup>2</sup>

- Ultra-lightweight sail materials
- Large area lightweight structures and mechanisms