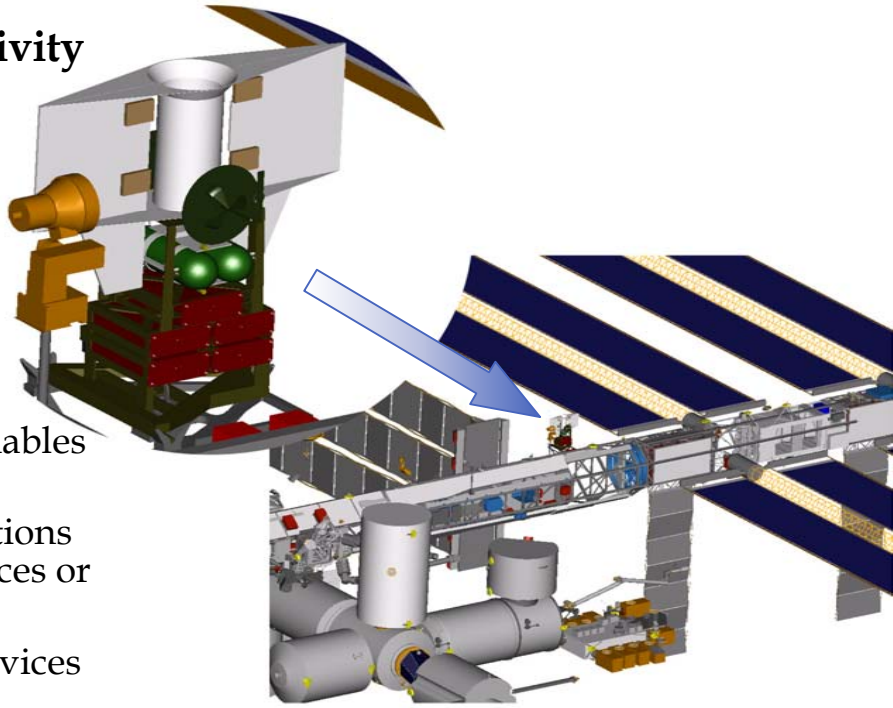
THREADS
Potential Value to ISS

Technology applications can:

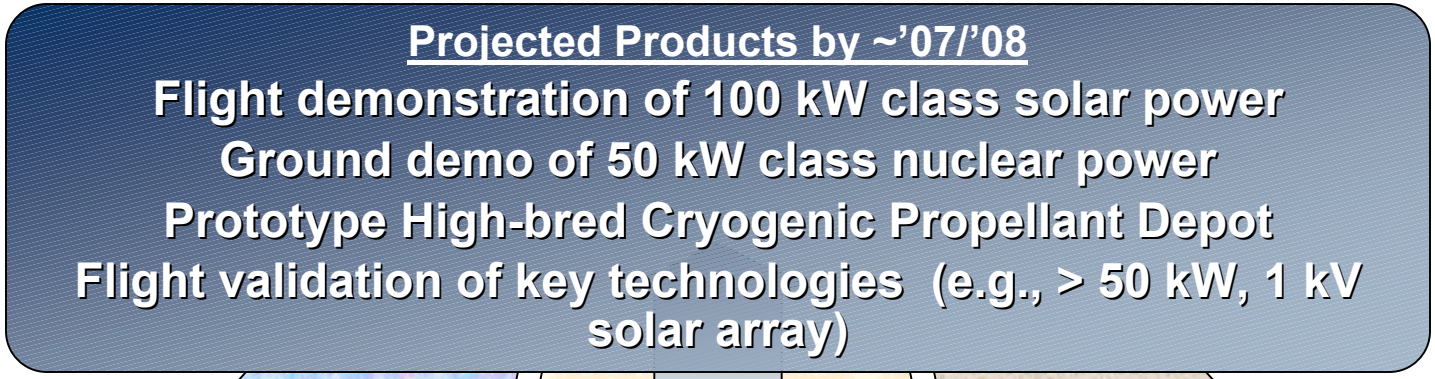
- **Improve performance and crew productivity**
  - Automation of systems, payloads, health monitoring, intelligent agent technologies
  - Advanced crew interfaces enhance crew effectiveness
- **Reduce resupply and logistics**
  - Plasma engines can perform reboost with existing waste H_2
  - Closed loop life support minimizes consumables use
  - MEMS/wireless technologies provide functions with reduced drain or impact on ISS resources or infrastructure
  - Miniature sensors, processors, and other devices have minimal impact on sparing



Research at ISS can benefit ISS as well as future programs:

- **Improve knowledge base on space environmental effects on humans contributes to better health and safety for crews,**
  - Zero G and radiation
  - Human performance over long mission durations
- **Systems exposure to operational and space environment**
  - Contributes to long term reliability
  - Contributes to evolution of simpler designs and better control of functions

Projected Products and Benefits -- Examples



Science

Mid-Term
High-Power Spacecraft and Stages
Large, Space-assembled Structures for Astronomy

Far-Term
Wireless Power for Global Exploration and Outposts

Very Far-Term
Oort Cloud Probes

Infrastructure

Mid-Term
Evolutionary ISS Power Systems

Mid- to Far-Term
Gateway Deployment at Earth-Moon L_1
Lunar Power Grid

Very far-Term
Power, Propellants, Vehicles for Interplanetary Exploration Missions

Commerce

Mid-Term
"Mega-Sat" Class GEO Systems
"Power plug" in space

Far-Term
Commercial Propellant Depots
Low-Cost Power for Commercial LEO Platforms

Very-Far Term
Power Utilities in Space

Commercial Development of Space

Space Resources Development
- √ Lunar Resources
- √ Asteroid Resources

Space Utilities & Power
- √ Space Solar Power
- √ Cryogenic Propellant Depots

Habitation & Bioastronautics
- √ Habitable Volume
- √ Extravehicular Activity

Space Assembly, Inspection & Servicing
- √ Platform Assembly
- √ In-Space Servicing

√Exploration & Expeditions
- √ Virtual Exploration
- √ Surface Systems

Space Transportation
- √ ETO
- √ Affordable In-Space
- √ Excursion Transport

On Earth (US Industry)
Information and Communications
Agriculture
Energy and Natural Resources
Health Care and Medicine
Transportation and Automotive

In Earth Orbit
Commercial Ventures on ISS
Space Business Parks in LEO
Mega-CommSats in GEO
Public Space Travel

Earth's Neighborhood
Lunar Virtual Exploration
Space Transportation Services
Space Power Utilities
Spacecraft and Platform Servicing
Lunar Resources Development

Beyond Earth's Neighborhood
Mars Virtual Exploration
Government Mission support (e.g., Mars Campaign Launch, Communications, etc.)

Assessment of THREADS Applicability

- **Assessment of potential applications of the technologies included in THREADS to a wide range of potential areas, including**
  - Space Science
  - Commercial Space Development
  - Human Space Flight
- **An approach for pursuing this action has been developed, including:**
  - A consistent forecast of mission/market developments in these three areas during the 10-25+ Years (reaching out to the very far term in some cases)
  - Identification of potential architectures and systems concepts that represent good candidate approaches to achieving the projected missions / markets
  - Creation of a simple scoring methodology to identify the possible applicability and/or benefits of THREADS to the forecast
  - Development of a spread sheet tool embodying the forecast and scoring
- **An initial analysis has been completed**
  - Three timeframes:Near-to-mid, Mid-to-far, Far and beyond
  - For each timeframe: No applicability = 0; Applicable, but not critical = 0.5; Critical = 1.0

Percentage of Overlap	
Human Space Flight	100%
Space Science	69%
Commercial	95%

Assessing FY'03 Resources

Assumptions/Ground rules

- **Opportunity for decisions anticipated to be mid-to-late in this decade**
- **General strategy: make investments to support future decisions**
  - Emphasis on investments that enable leveraging of existing NASA (or other Agency, etc.) programs
  - Emphasis on investments that support dual-purpose applications (e.g., nearer term NASA space science, commercial space, etc.)
  - Down-select to higher-priority R&D investments
- **Defer substantial investments in full-scale human-rated space demonstrations (e.g., habitation systems) of systems-technologies, pending future decisions**
- **The Space Launch Initiative (SLI) R&T results are anticipated, but resources for SLI are not included in gap analysis details**

THREADS
An Agency-Wide Approach

THREADS

NASA Strategic Enterprises	1.0 Systems Integration, Analysis, Concepts, Modeling	2.0 Enabling Advanced Research and Technology	3.0 Technology Flight Demonstrations
Human Exploration and Development of Space	• HEDS Technology & Commercialization Initiative	• HEDS Technology & Commercialization Initiative • SOMO R&T	• HEDS Technology & Commercialization Initiative • Space Shuttle Upgrades Program
Space Science Enterprise	• Advanced Mission Studies • Decade Planning Team	• Mars Exploration Technology • ASTEP Program(s) • New Millennium Program • Gossamer S/C; ISTP, etc. • Mid-TRL NRAs	• New Millennium Program • Data from Robotic Mars Missions/Experiments • In-Space Transportation Technology Program (ISTP)
Biological and Physical Research Enterprise		• Advanced Human Support Technology • Biomedical Research and Countermeasures • Physical Sciences Research	
Aero-Space Technology Enterprise	• Revolutionary Aerospace Systems Concepts (RASC) • NASA Institute for Aerospace Concepts (NIAC) • Engineering / Costing Tools	• Space R&T Base (incl. NRAs) • Intelligent Systems • Space Launch Initiative • SBIR (THREADS-Supporting Topics)	• Space Launch Initiative (SLI--coordination)
Earth Science Enterprise	• ES Vision Technologies • Advanced Mission Concepts	• Instrument Incubator Program (IIP) • Advanced Technology Initiative (ATI) • Advanced Information Systems Technology (AIST)	• New Millennium Program (EO-X)

AND ... Opportunities from investments in studies and technology from outside NASA, including other US Agencies, US Industry and International Organizations

FY01 Focus Areas

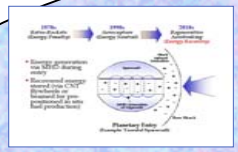
- **Prioritize investments to achieve Agency goals**
- **Improve understanding of the Earth's Neighborhood**
  - Refine concepts and science needs
- **Improve definition of the robotic/human partnership in space**
  - Capture the state-of-the-art for future robotics
  - Quantify and compare robotic/human performance in projected operations
  - Increase understanding of critical Bioastronautics issues
- **Advance Technology for Human/Robotic Exploration and Development of Space (THREADS)**
  - Discover innovative concepts and technology
  - Show progress in key technology areas
- **Expand leveraging activities**
  - Active investments from; NIAC, RASC, SBIR, SSP
  - DoD - opportunities through Technology Area Review and Assessment (TARA), Advanced Concept Technology Demonstrations (ACTD), etc.
  - Education; Steckler Trust

Leveraging
Revolutionary Concepts

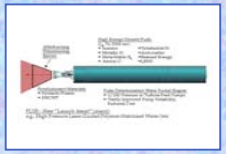
Searching for Transformational Ideas for NEXT Across The Agency

Revolutionary Technologies → **Advanced System Concepts** → **New Missions and Markets**

NEXT

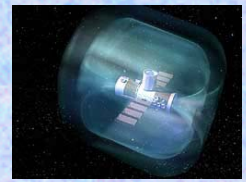


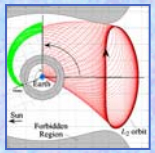
Regenerative Aerobraking



Revolutionary Rockets

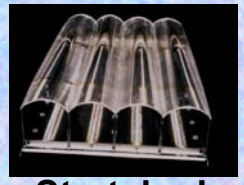
M2P2





Invariant Manifolds

L_1 Gateway

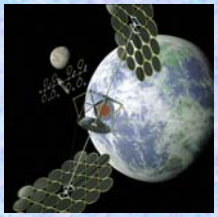


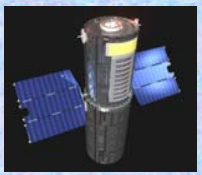
Stretched Lens Array

Enterprise Advanced Concepts

Power Beaming Infrastructures

Space Solar Power



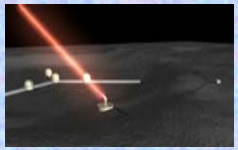


Hybrid Propellant Module

Human & Robotic Exploration

Exobiological Existence of Life in Europa

Agency Advanced Concepts RASC and NIAC



Comet-Asteroid Protection System

X-ray Interferometer

Transformers

In-Space Remote Sensing

Humans to the Moons of the Outer Planets

Leveraging Government-Wide Opportunities

THREADS

Other Government Agencies	1.0 Systems Integration, Analysis, Concepts, Modeling	2.0 Enabling Advanced Research and Technology	3.0 Technology Flight Demonstrations
DOD	• USAF / Aerospace Corp	• DARPA • BMDO • USAF / AFRL • Others	• DARPA • BMDO • USAF / AFRL • Others
DOE		• Space Nuclear (Reactor) Power R&D • NREL • BNL	• Advanced RTG Development and Demonstration
NIH		• Adaptation and Countermeasures Research • Radiation countermeasures research • Others	
NSF	• Advanced Concepts Workshops/Studies	• Human-Machine systems research • Others	

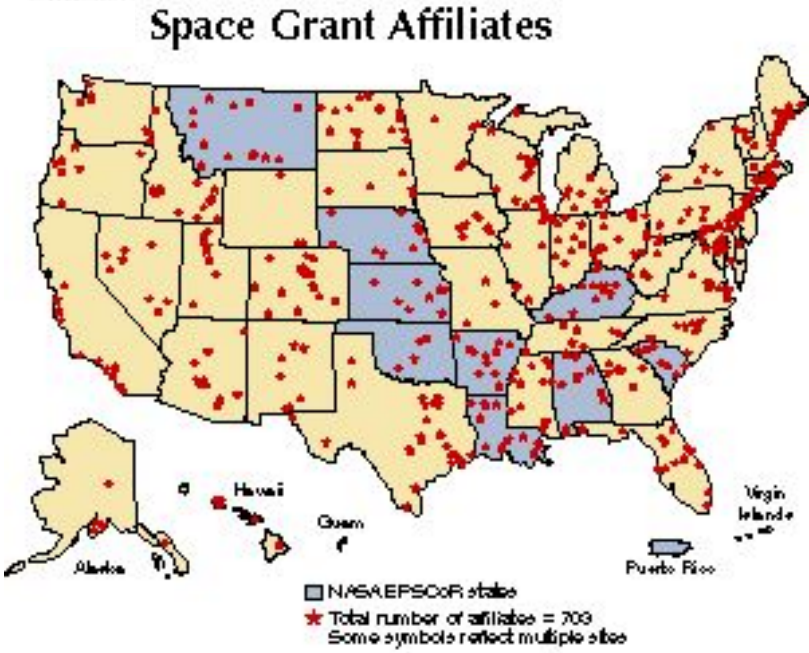
AND ... Opportunities from investments in studies and technology with other US Agencies, US Industry and International Organizations

Leveraging Coordination With Other Agencies

Initiatives under Review:

- Engage with DoD Director of Research & Engineering for NASA participation in DoD Technology Area Review & Assessment (TARA) process
- Get NEXT oriented membership on Defense Science Board
- Coordinate to meet NEXT technological objectives with :
  - OSD - Special Asst. for civil space
  - NRO - S&T Coord.
  - U.S. SPACOM - Ops Coord.
  - AFRL - Sr. Scientist/Technologist
  - SMC - Requirements Coord.
  - BMDO/NMD - S&T Coord.
- Map and coordinate NEXT and DoD technology plans and investments
- Develop NEXT-DoD Technology Initiatives Exercise
- Align JPL's Project Development Center with TARA for periodic NEXT S&T maturity assessment
- Engage with BMDO Chief Scientist on technology pursuit and investment and on SBIR coordinated management
- Develop mission rationales and functional interfaces for DoD and NEXT technologists
- Partner with DoD organizations developing NEXT ACTDs and ATDs for submission to DoD
- Build broad agency involvement in NEXT related developments, operations and applications (USGS, NOAA, EPA, NRO, SBA, et. al.)

Leveraging
Educational Opportunity



- **Ralph Steckler/Space Grant Space Colonization Research and Technology Opportunity**
  - Mr. Steckler selected NASA as the beneficiary of his estate so that students can creatively address the challenges of space colonization.
  - Matching DPT funds plus Codes M and U contributions provide ~$1M/year for the next three years
  - Program announcement released March 22, 2001
  - Received 29 proposals addressing topics as diverse as artificial gravity, terraforming, and extraterrestrial crop production
  - Awards to be made in FY02 for one to three year research grants

NEXT Goals for FY02

Continue the process of integrating the Agency's exploration activities and technology investments to realize the NEXT Exploration Strategy

- **Pursue robotic/human partnership**
- **Proceed with Technology for Human/Robotic Exploration and Development of Space (THREADS)**
- **Expand leveraging activities with other government, private, and international coalitions**

Where NEXT?

- Difficult environment - credibility
- Loss of key personnel
- Loss of team momentum
- Uncertain customer base
- HTCI terminated in FY01
- DPT funding terminated after FY02

NASA loses its think tank for an integrated future vision


"As for the future, your task is not to foresee it, but to enable it"
Antoine de Saint-Exupery