Overview
FY01 Focus Areas

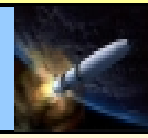
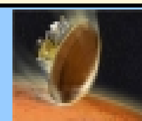
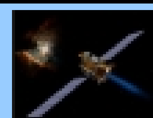
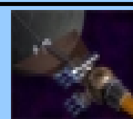
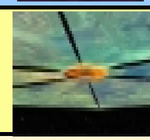
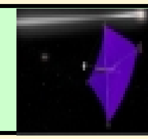
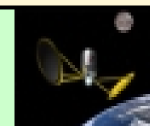
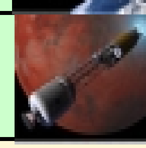
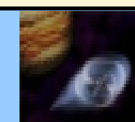
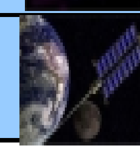
- **Prioritize investments to achieve Agency goals**
  - In-Space propulsion, nuclear power/propulsion and radiation mitigation
- **Improve understanding of the Earth's Neighborhood**
  - Refine concepts and science needs
- **Improve definition of the robotic/human partnership in space**
  - Capture 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

Agency Investments

Prioritized In-Space Propulsion Technologies

Process

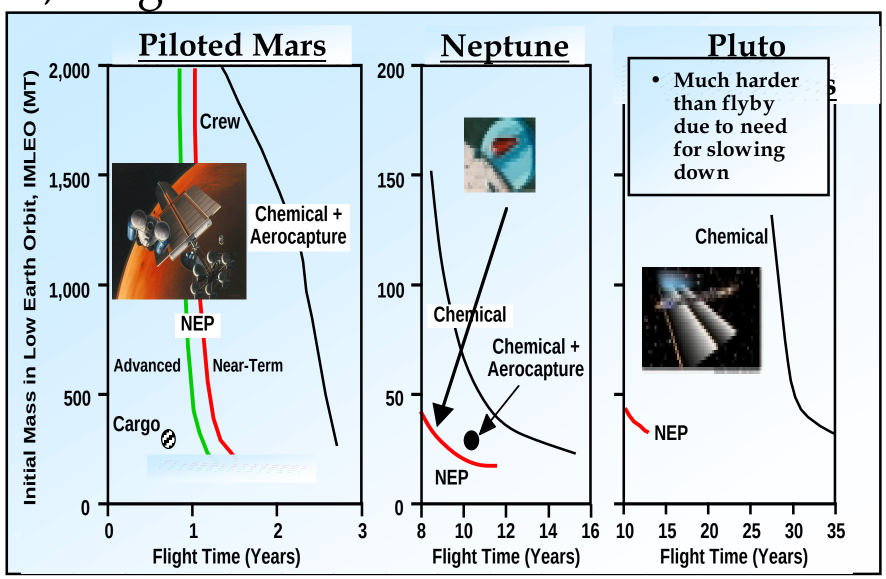
- Requirements/Goals Established by NASA Enterprises
- Technology options identified
- Systems concepts developed
- Systems Concepts Compared
- Technologies Prioritized

In-Space Propulsion Technology	High Priority	Medium Priority	Low Priority	High Payoff/ High Risk
Advanced Chemical				
Aerocapture				
Solar Electric Propulsion (SEP)				
Nuclear Electric Propulsion (NEP)				
Solar Sails				
Solar Thermal				
Nuclear Thermal Propulsion (Bimodal)				
Plasma Sails				
Momentum Exchange Tethers (MXER)				

- Code S Priority (yellow)
- Code M Priority (green)
- Code M and S (blue)

Agency Investments
Nuclear Power and Propulsion

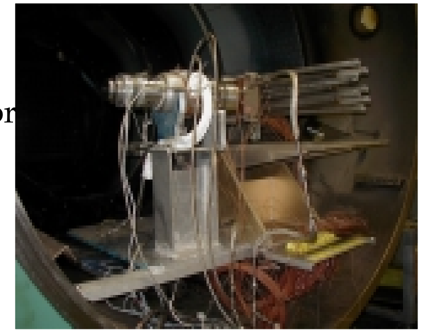
- NEP identified as high-priority in space propulsion technology for human and robotic exploration
  - Enables very high delta-V missions
  - Offers abundant power at destination
- Evolutionary approach to fission propulsion proposed (3 phases)
  – 10-500 kW NEP and surface
  – Up to 10 MW NEP, solid-core NTR
  – Up to 100 MW NEP
- Enables non-Keplerian orbits that can avoid hazardous regions (e.g. ring particles)
- Enables complex, long duration missions



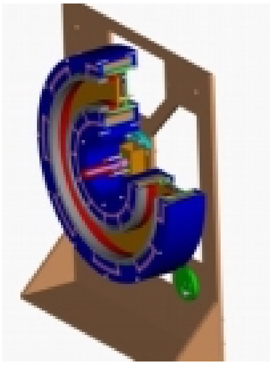
Agency Investments
Nuclear Power and Propulsion

- Refurbished 2 kWe Brayton testbed and began high power Brayton system design studies with industry
- Conducted Heat Pipe reactor-to-Stirling power conversion integrated test
- Conducted Stirling engine-to-Hall thruster integrated test
- Fabricated and tested plasma injector for compact toroid high power plasma thruster
- Completed design and initial fabrication stages of 50kWe Hall thruster
- Conducted mission/trajectory design and analysis for high and low thrust nuclear propulsion systems
- Prepared conceptual designs of NEP and NEP/NTR vehicles for human and robotic science missions

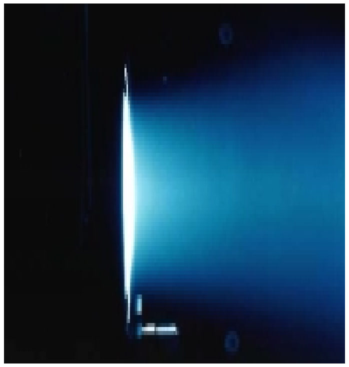
NEP
End-to-End
Demonstrator



50 kW
Hall thruster

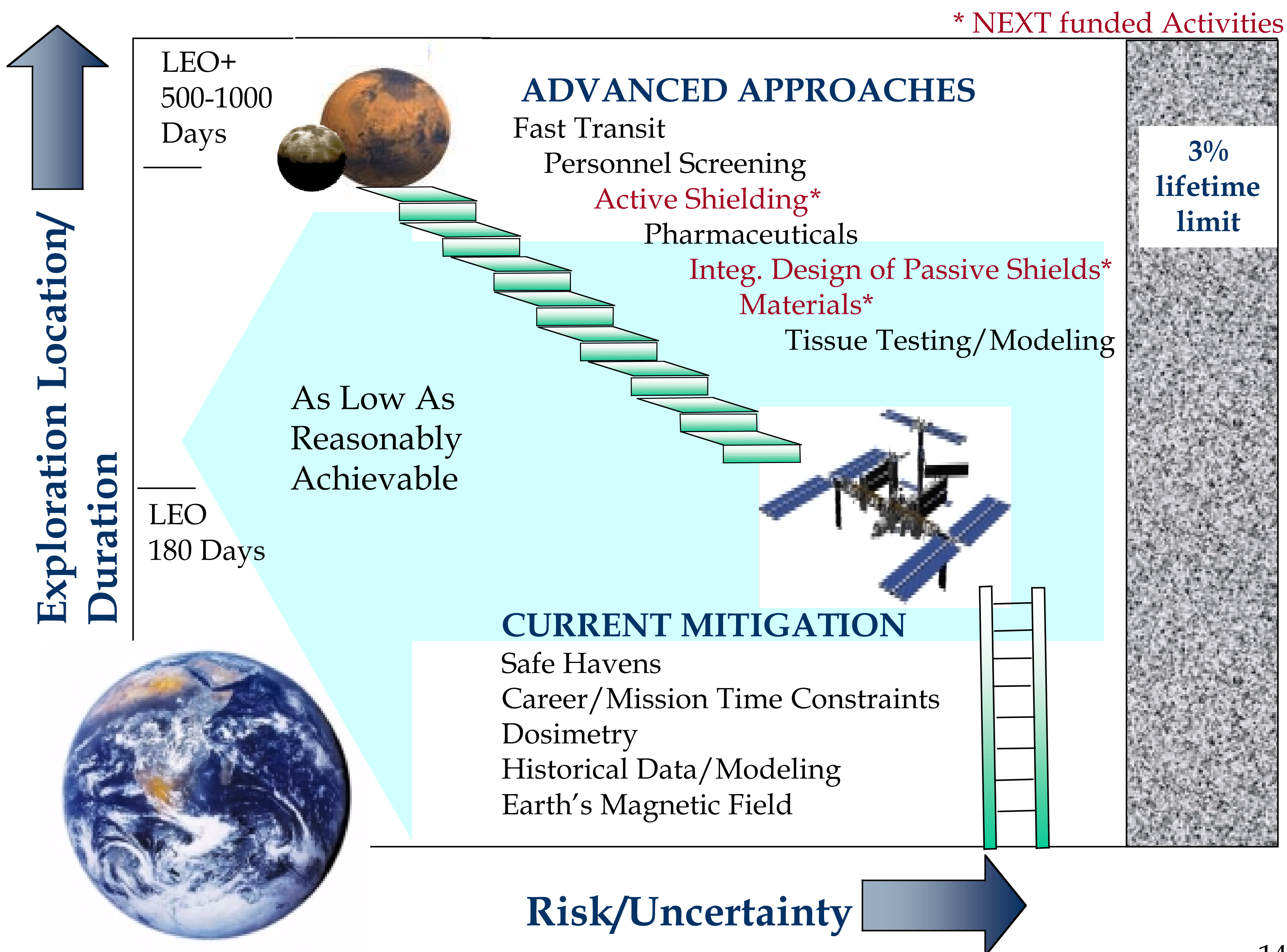


Ion
thruster



Agency Investments

Attacking the Radiation Challenge



Agency Investments
NEXT Radiation Research

Recommendations for effective dose limits (Sv*) for 3% excess cancer fatality for 10 year careers

	Female		Male	
Age	1990	2000	1990	2000
25	1.0	0.4	1.5	0.7
35	1.8	0.6	2.5	1.0
45	2.5	0.9	3.2	1.5
55	3.0	1.7	4.0	3.0

Age at First Mission	No. of 180-day LEO missions**	
	Female	Male
25	0	1
35	1	1
45	1	2
55	2	3

Considerations

- Costs of training
- Costs of crew replacement
- Career corps vs one-mission astronauts

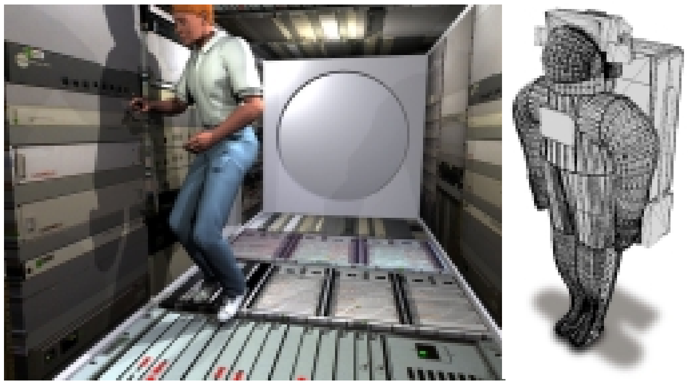
* 1 SV = 100 REM. 1 REM = measure of effective biological damage as determined by absorbed dose x quality factor

** Administrative limits: 1% risk excess cancer risk; 0.2 Sv/mission; no uncertainty assumed.

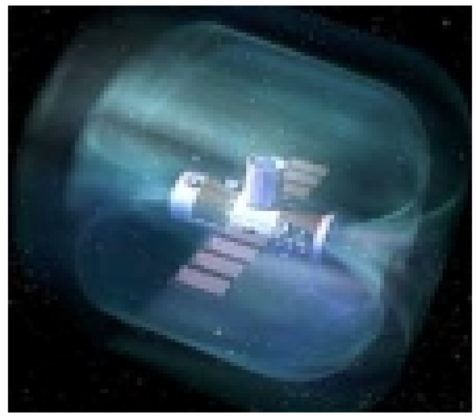
Report Available - Space Radiation Cancer Risk Projections

Agency Investments
Shielding Materials

Multidiscipline Networked Immersive 3D Simulation and Optimization

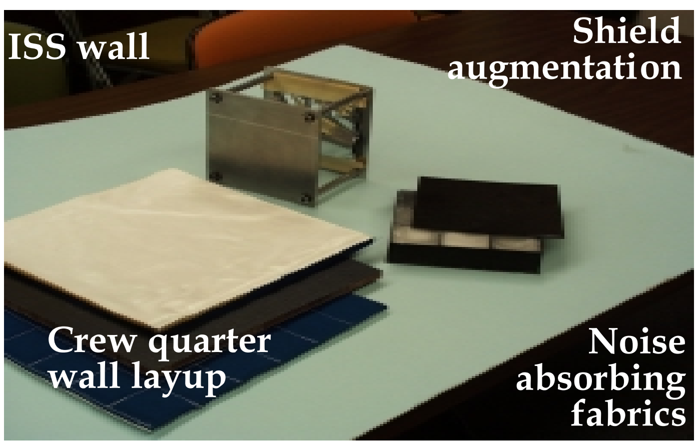


Mini Magnetospheric Plasma Propulsion



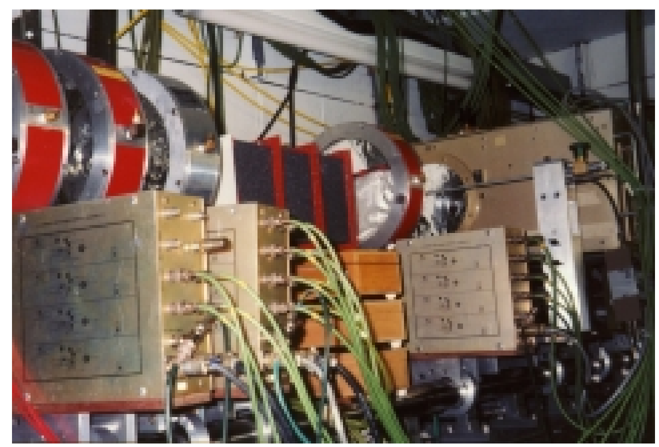
Brookhaven National Lab (BNL)

Polyethylene Augmentation for ISS



Radiation Absorbing Materials

Habitat and EVA Garment Material Testing



Reports Available - “Optimization of Multifunctional Material for Radiation Protection” and numerous papers