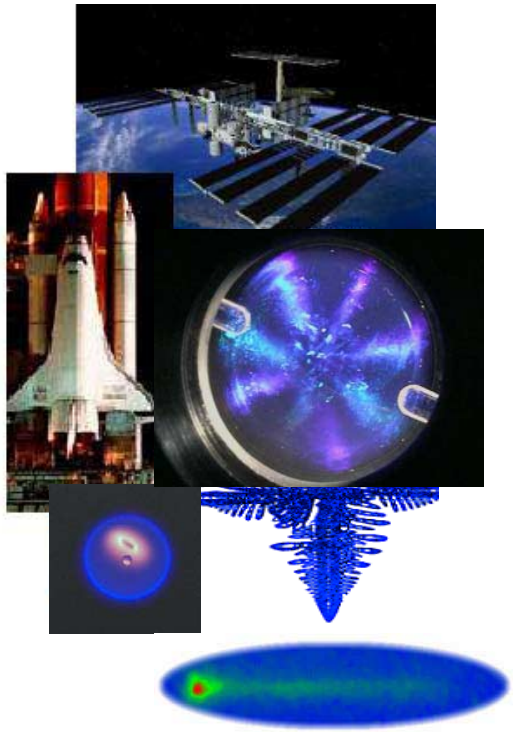
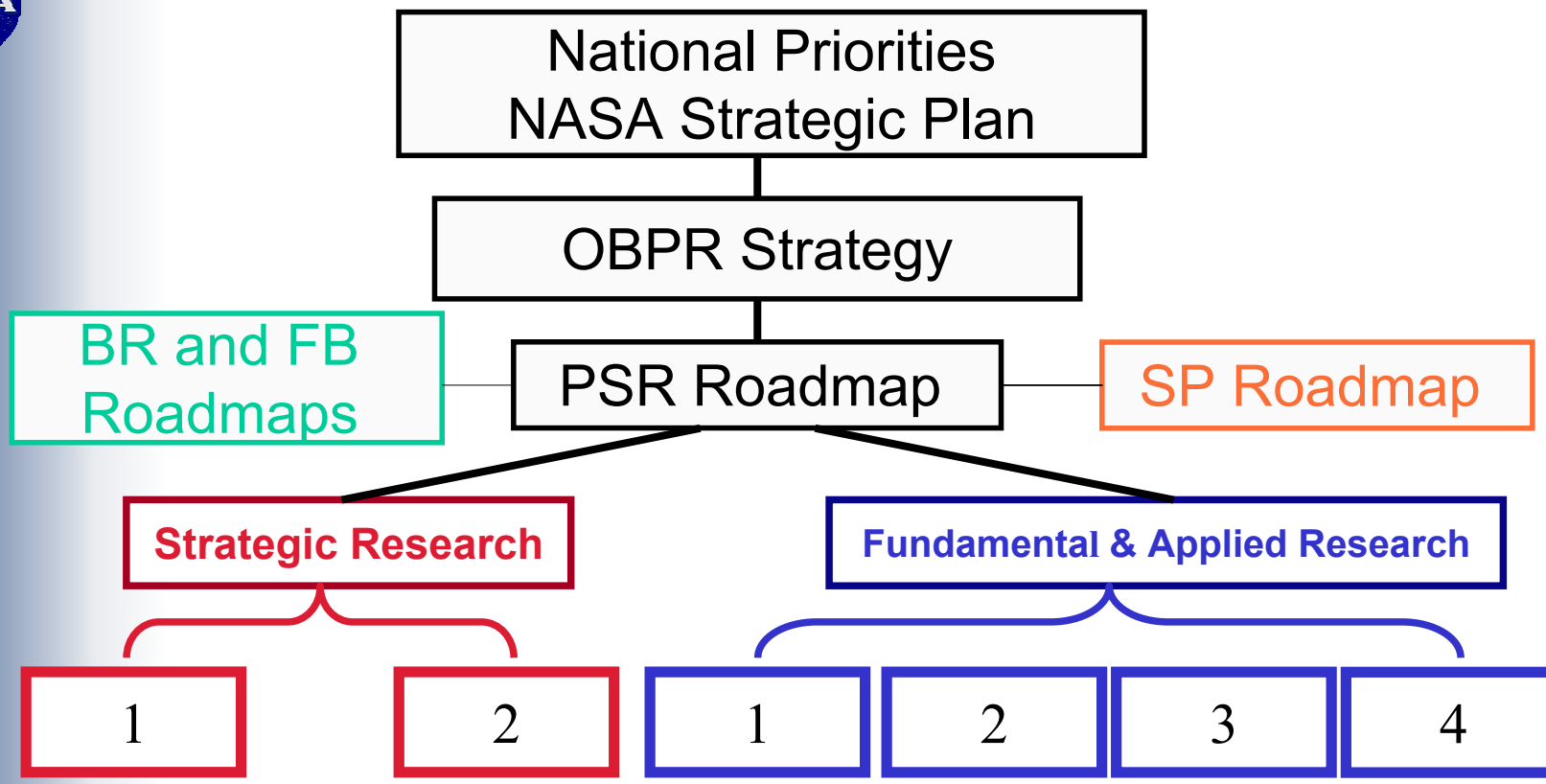
OBPR

# Path to a Research Plan



May 15, 2003
Fran Chiaramonte
(E. Trinh)
Code UG
NASA HQ



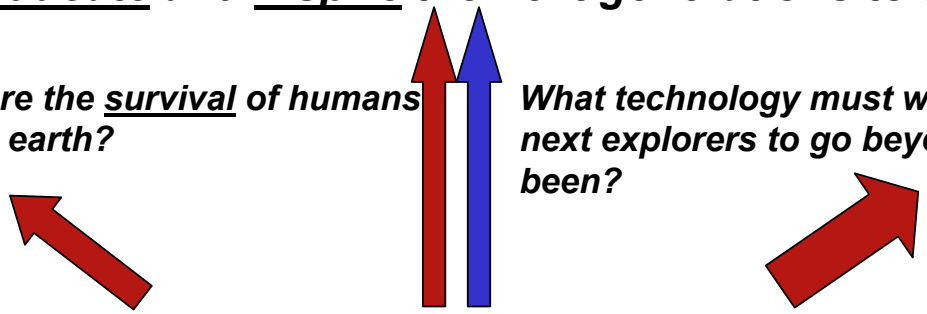

Cell Biotech, Macromolecular Biotech, Fluid Physics and Transport, Combustion and Chemical Reactions, Fundamental Physics, Materials Science and Engineering, Bioscience and Engineering, Biomolecular Systems

# Physical Sciences Dual Thrust and the OBPR Organizing Questions

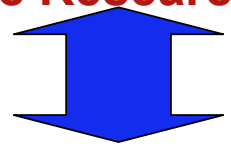
***How can we <u>educate</u> and <u>inspire</u> the next generations to take the journey?***

***How can we assure the <u>survival</u> of humans traveling far from earth?***

***What technology must we create to <u>enable</u> the next explorers to go beyond where we have been?***



**PSR Strategic Research for Exploration**



**PSR Fundamental and Applied Research**

***What must we know about how space changes life forms, so that humankind will <u>flourish</u>?***

***What new opportunities can our research bring to <u>expand</u> understanding of the laws of nature and <u>enrich</u> lives on Earth ?***

# OBPR Physical Sciences Research Goals and Thrusts

**Technology Roadmap**

**Research Plan**

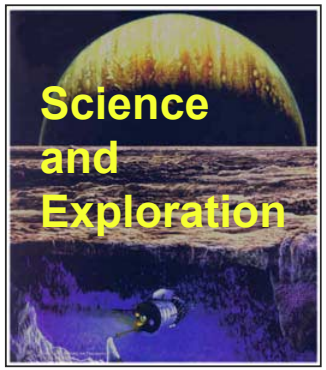
- Bioengineering
  Biotechnology
  Biomolecular
- Combustion
  Fluids
  Materials
- Low Temp
  Atomic
  Gravitational

**Strategic Research for Exploration**

- Research Theme 1
- Research Theme 2

**Fundamental & Applied Research**

- Research Theme 1
- Research Theme 2
- Research Theme 3
- Research Theme 4

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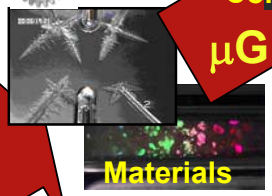
# Strategic Research for Exploration

*Enable the Next Explorers*

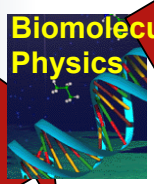
*Materials for in-space Propulsion*

*Materials for space systems*

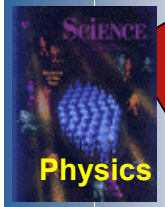
*In-space Fabrication*



Materials



Biomolecular Physics




Physics

*Molecular-level Health and environment monitors*

*Spacecraft fire safety*

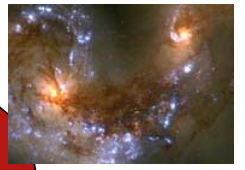
Combustion

μG

Fluids

Bioengineering

Biotechnology



*Life Support sub-systems*

*Astronaut Crew health*

*Spacecraft thermal/power sub-systems*

*Planetary environment research*

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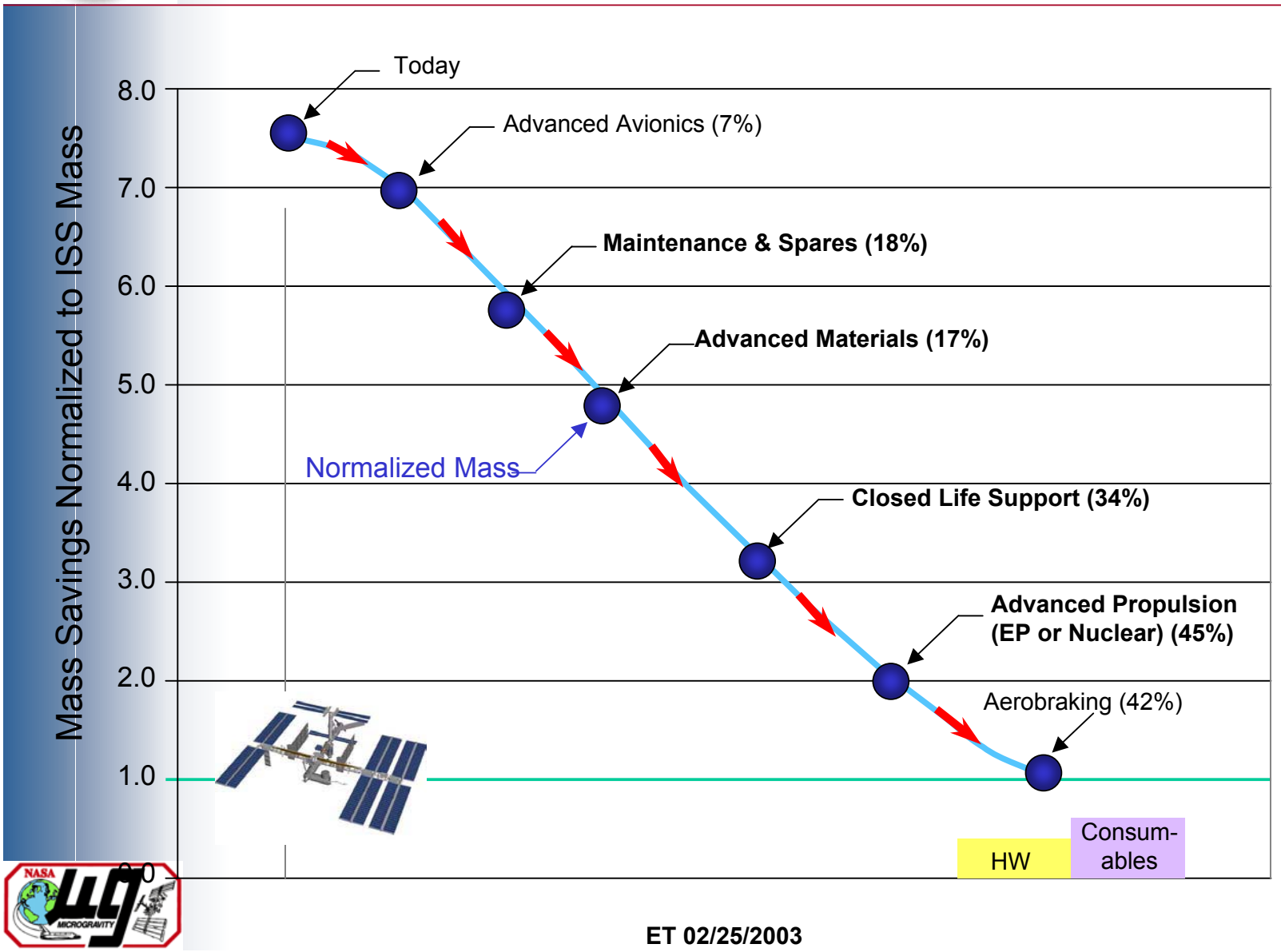
# Evaluating Technology Investments
## Example: Mars Human Mission

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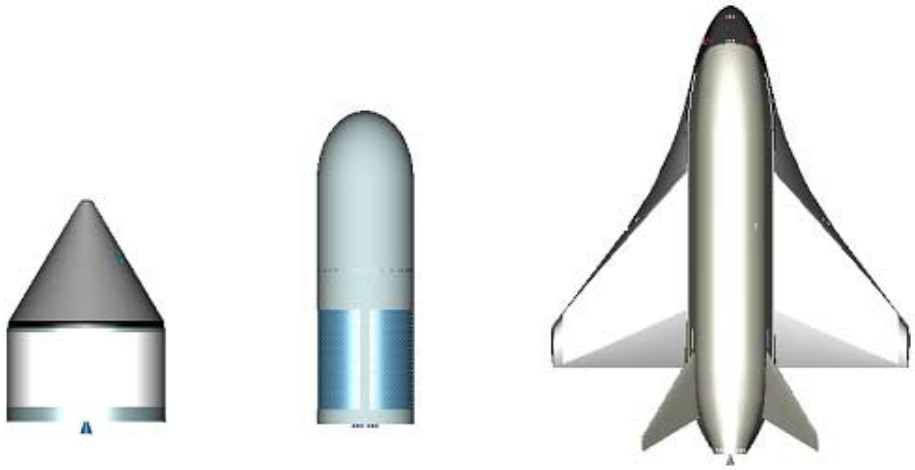
# Orbital Space Plane Concepts

There is no preferred vehicle shape. Capsule; Lifting Body and Winged Vehicle are all being considered at this time. Must be able to launch on an Expendable Launch Vehicle.



Crew Transfer Vehicle (CTV) version will operate for about 5 days for a typical mission to ISS and back to Earth.

The Crew Rescue Vehicle (CRV) version could stay docked to ISS for up to 180 days, nominally, before returning to Earth.

# Orbital Space Plane Overview

The Orbital Space Plane (OSP) is intended to provide crew and limited cargo access to and from the International Space Station (ISS).

Initially, NASA intends for development of the OSP to result in a crew rescue vehicle for the ISS, enabling a larger permanent crew to occupy the orbiting research facility and depart safely in the event of an emergency. This early version of the plane, expected to enter service within the decade, would be launched on top of an expendable rocket.

By 2012, the OSP will be used to ferry crew and light cargo to the ISS. In time, the project could become the foundation for a crew transfer vehicle routinely flown to space on a new launch vehicle.

Based largely on existing technologies, the OSP would provide safe, affordable access to the ISS.

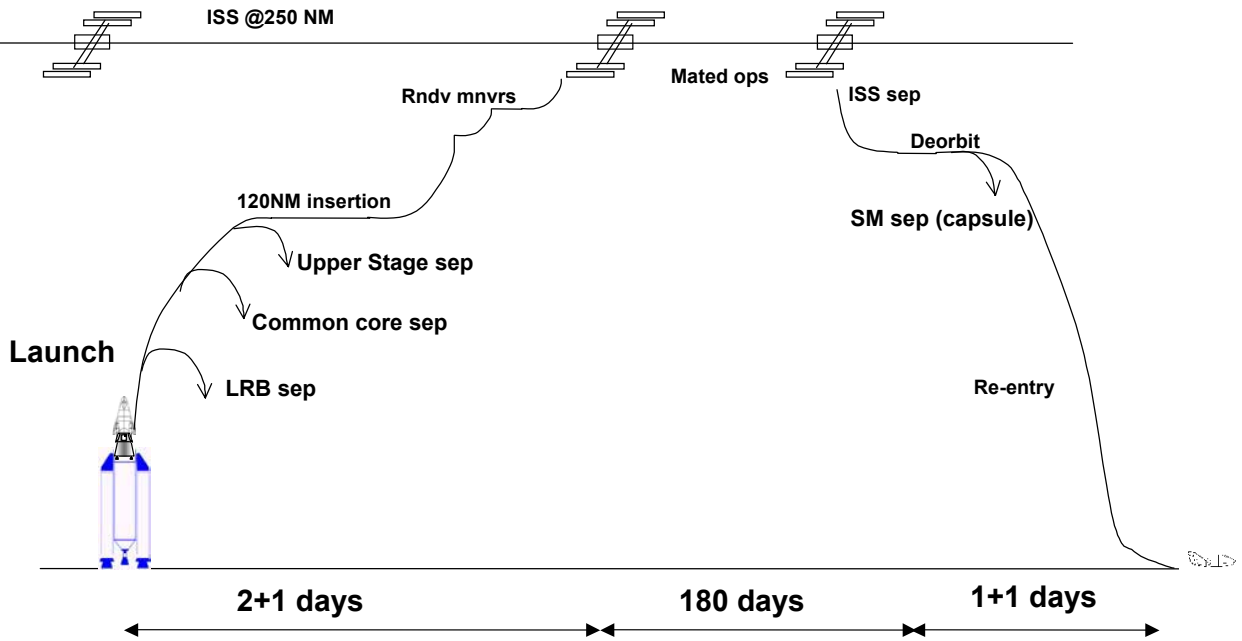
The OSP Program is more than a spacecraft. The program will take an integrated systems approach to design the entire space transportation system — including ground operations, space vehicle and all supporting technologies needed to conduct a mission to and from the ISS.

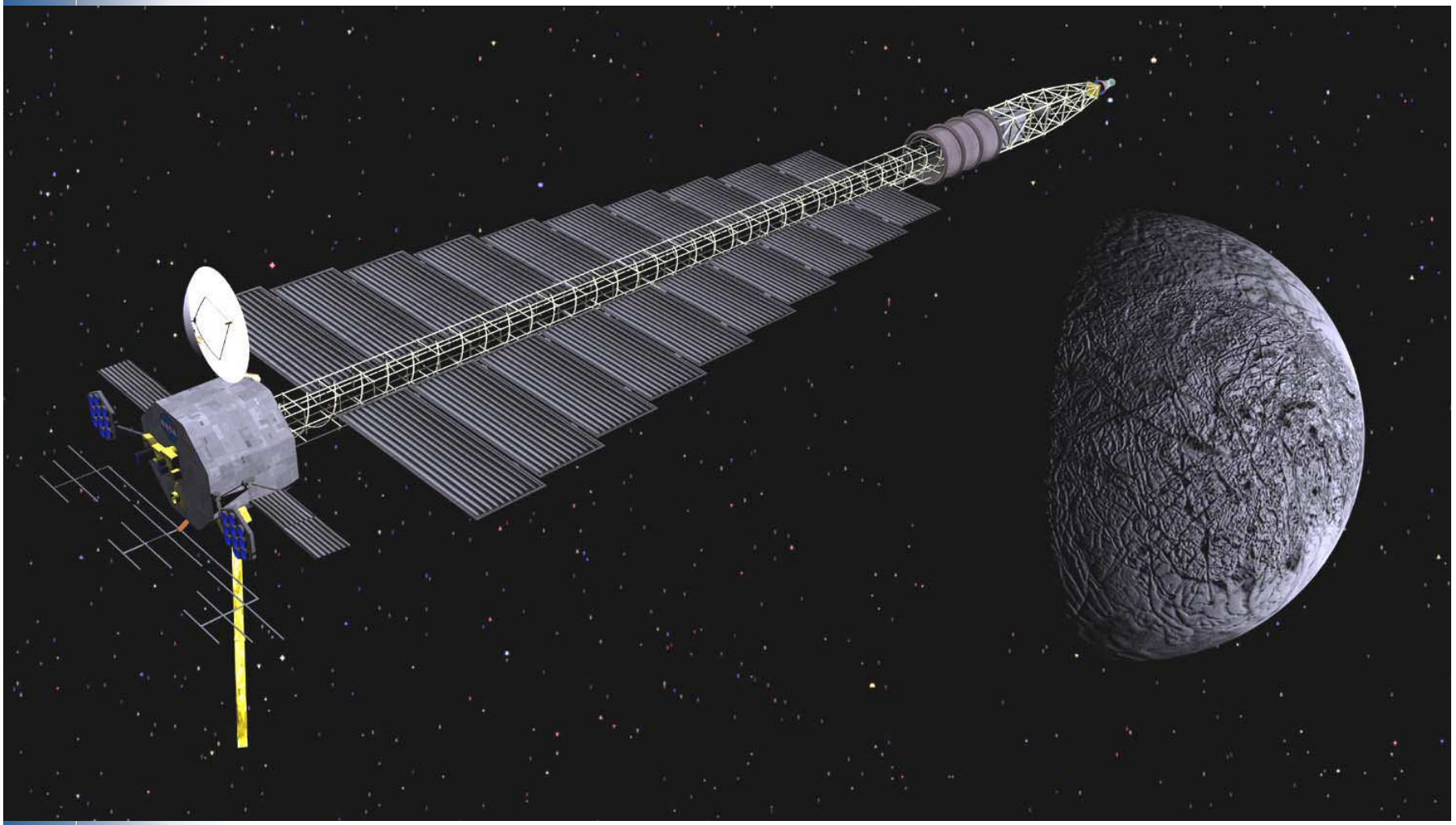
In addition, flight demonstrators such as the X-37 vehicle will flight test advancing technologies to reduce the risk of future reusable launch vehicle systems including the OSP.

# Priority List of Fluids Issues for OSP

1. ECLSS needs refrigeration that is reliable and uses less power than a thermoelectric device.
2. ECLSS needs to reject heat using a very small radiator space that is subjected to the launch pad environment (salt spray) and aerodynamic loads of ascent.
3. ECLSS needs a way to take dissolved gas out of Proton Exchange Membrane (PEM) fuel cell water to use for ECLSS reasons.

# Typical Mission Profile





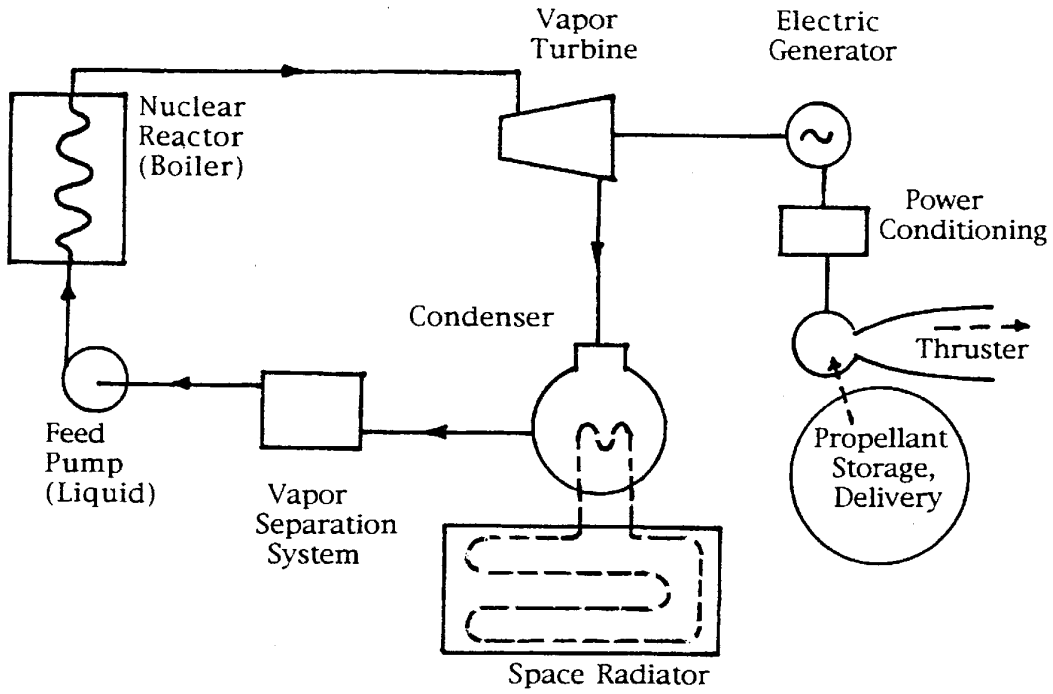



FIGURE III.B.3 Schematic showing major elements of a nuclear electric propulsion system.

# Physical Sciences Research (PSR) Program Status

- The OBPR Physical Sciences Research program has been comprehensively reviewed and endorsed by National Research Council. The value and need for the research have been re-affirmed
- The research program has been prioritized and resource re-allocations have been carried out through an OBPR-wide process. An increasing emphasis on strategic, mission-oriented research is planned. The program will strive to maintain a balance between strategic and fundamental research
- A feasible ISS flight research program fitting within the budgetary and ISS resource envelopes has been formulated for the near term (2003-2007). The current ISS research program will be significantly strengthened starting 2005 by using discipline dedicated research facility racks.
- A research re-planning effort has been initiated and will include active participation from the research community in the next few months.

  The research re-planning effort will poise PSR to increase ISS research utilization for a potential enhancement beyond ISS IP Core Complete
- The Physical Sciences research program readily integrates the cross-disciplinary requirements of the NASA and OBPR strategic objectives

# Physical Sciences Research and Technology Plan Development Process *(cont.)*

- Each fundamental research thrust will develop a roadmap through technical workshops and Discipline Working Groups (DWGs)
- Most fundamental research thrusts will involve cross-disciplinary efforts
- A Technology Roadmap will guide the Strategic Research for Exploration thrust
- The Research Plan will integrate and coordinate fundamental Research Thrusts Roadmaps with the Technology Roadmap
- The Technology Roadmap will be developed in coordination with other OBPR programs as well as other Enterprise (R,S,M,N)
- International Partners will contribute to the roadmaps and through research coordination
- The research plan will be vetted with the discipline working groups, the BPRAC subcommittees, and with the BPRAC
- Recommendations from NRC past and current committees will be implemented whenever appropriate

# Physical Sciences Research and Technology Plan Development Process

• Proposed theme element content will be "missionized" around planned content and potential new projects (facilities, modules, initiatives) on approximately a five-year horizon, with the approval of PSRD management. Center/science working group teams will develop descriptions of "mission" objectives, value, and requirements. Purpose is to create a competitive environment for concept development and to stimulate community ownership/advocacy.

• Proposed theme elements reviewed and approved by PSRD management. Strawman roadmaps for themes developed. Program budget and technology requirements verified.

•Theme elements are prioritized with the input of advisory groups. Integration into program themes (questions) and required technology investments are defined by science and technology roadmaps. Review and assessment by OBPR management.

***The effort this year will be a learning experience, and will produce a best-effort product as the precursor to the second-generation effort to begin next year.***