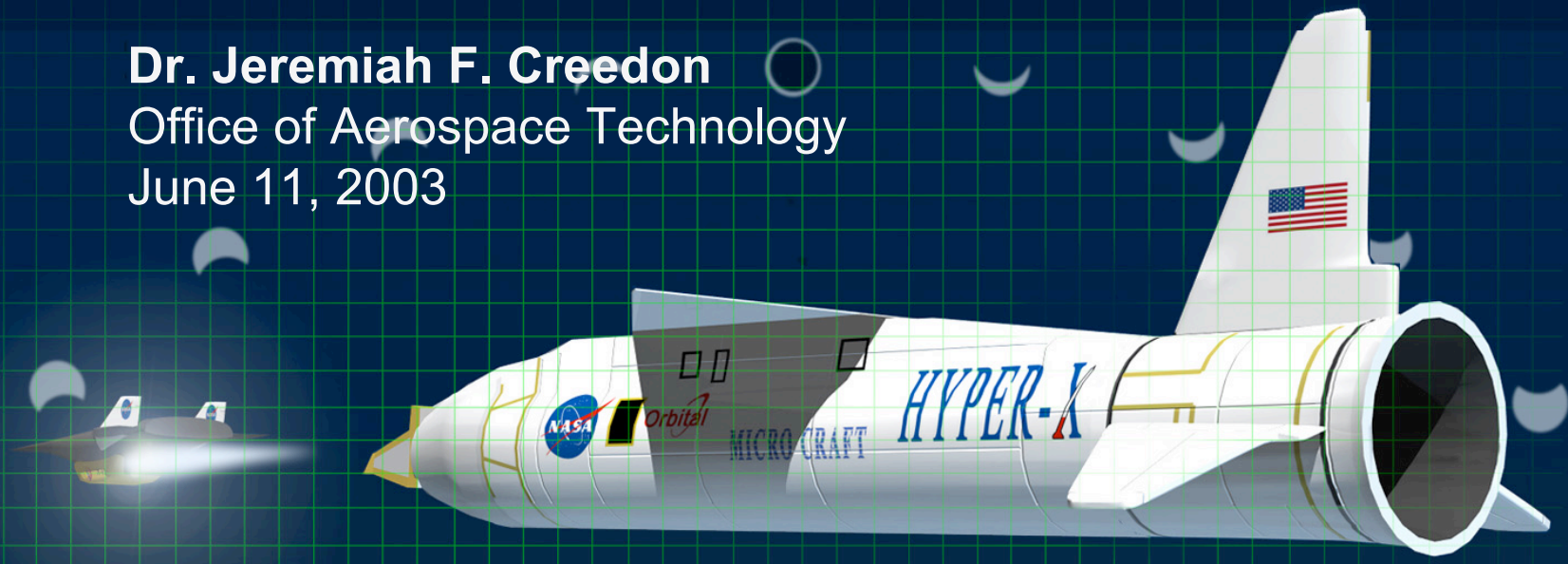
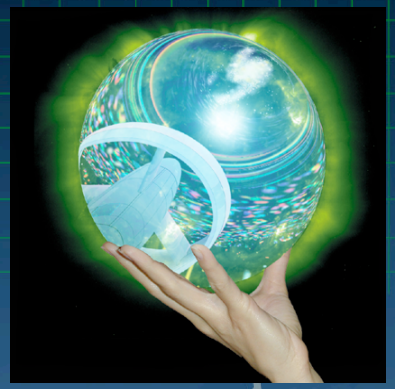
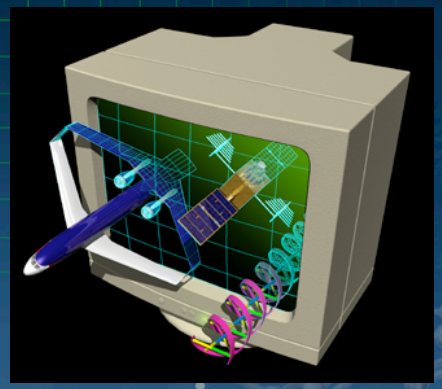
Turning Goals Into Reality

Celebrating our Accomplishments

Dr. Jeremiah F. Creedon
Office of Aerospace Technology
June 11, 2003



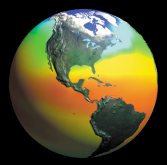




Space Launch Initiative
Aeronautics
Mission Science Measurement
Technology Transfer Partnerships

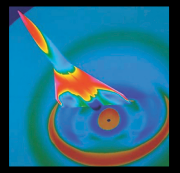
6 Strategic Enterprises
One NASA


Space Science


Earth Science


Biological & Physical Research


Space Flight


Aerospace Technology


Education

NASA's Vision

- To improve life here
- To extend life to there
- To find life beyond

NASA's Mission

- To understand and protect our home planet
- To explore the universe and search for life
- To inspire the next generation of explorers

…as only NASA can

NASA's 10 Strategic & Enabling Goals

Understand and protect our home planet	Understand Earth's system and apply Earth system-science to improve the prediction of climate, weather, and natural hazards
	Enable a safer, more secure, efficient, and environmentally friendly air transportation system.
	Create a more secure world & improve the quality of life by investing in technologies & collaborating with other agencies, industry, & academia.
Explore the Universe and search for life	Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.
	Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.
Inspire the next generation of explorers	Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.
	Engage the public in shaping and sharing the experience of exploration and discovery.
Enabling	Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.
	Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.
	Enable revolutionary capabilities through new technology.

Aerospace Technology Enterprise

Mission Statement:

To pioneer and validate high-payoff technologies

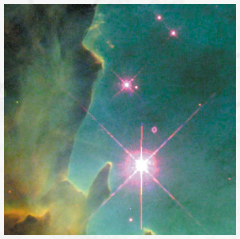
To improve the quality of life
To enable exploration and discovery
To extend the benefits of our innovation throughout our society.

Our success is measured by the extent to which our results improve the quality of life and enable exploration and scientific knowledge

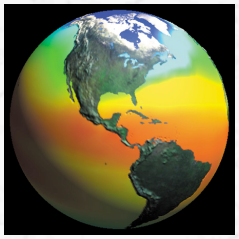
The Aerospace Technology Enterprise

Our success is measured by . . .

OGA & Industry Partners



Space Science



Earth Science

Biological and Physical Research

Non Aerospace Industry

Space Flight

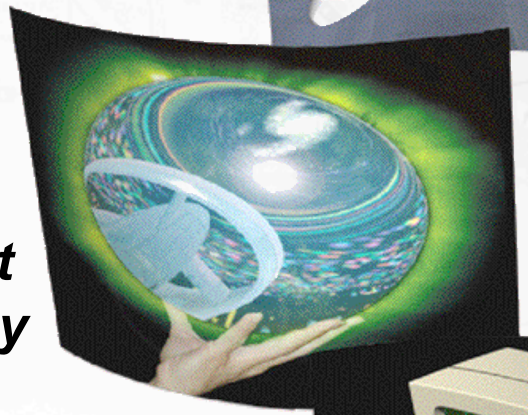
Aerospace Technology Enterprise

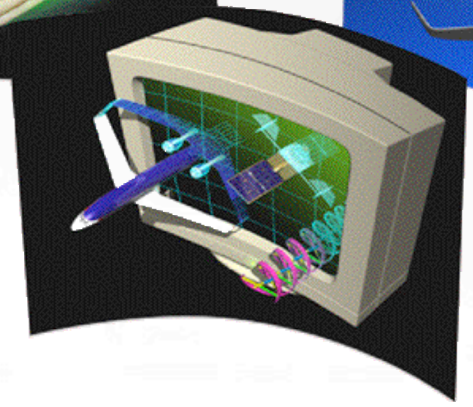
Strategic Themes

Aeronautics Technology

Space Launch Initiative

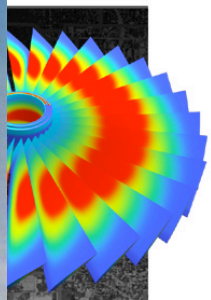
Mission and Science Measurement Technology

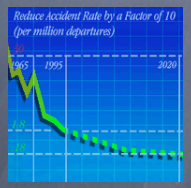




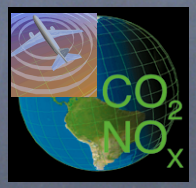
Innovative Technology Transfer Partnerships

Aeronautics Technology Theme

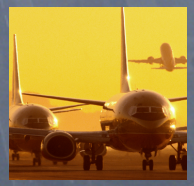




Protect Air Travelers and the Public

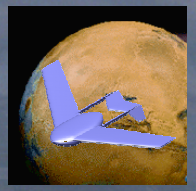


Protect the Environment



Increase Mobility

Protect the Nation



Explore New Aeronautical Missions

Agency Goal 2

Objective 2.1 Protect Air Travelers and the Public

Challenge:

Improve aircraft safety & performance in icy weather

Accomplishment:

Improved the computer modeling of ice formation

Thermal ice protection subroutines added to LEWICE

Impact:

Manufacturers use the NASA LEWICE tool in design and certification of aircraft

TGIR Accomplishment:

Glace Ice formation from the icing research tunnel at the NASA Glenn Research Center.

Agency Goal 2

Objective 2.1 Protect Air Travelers and the Public

Challenge:

Turbulence has been identified by the FAA, NTSB, and airline sources as the leading cause of in-flight injuries

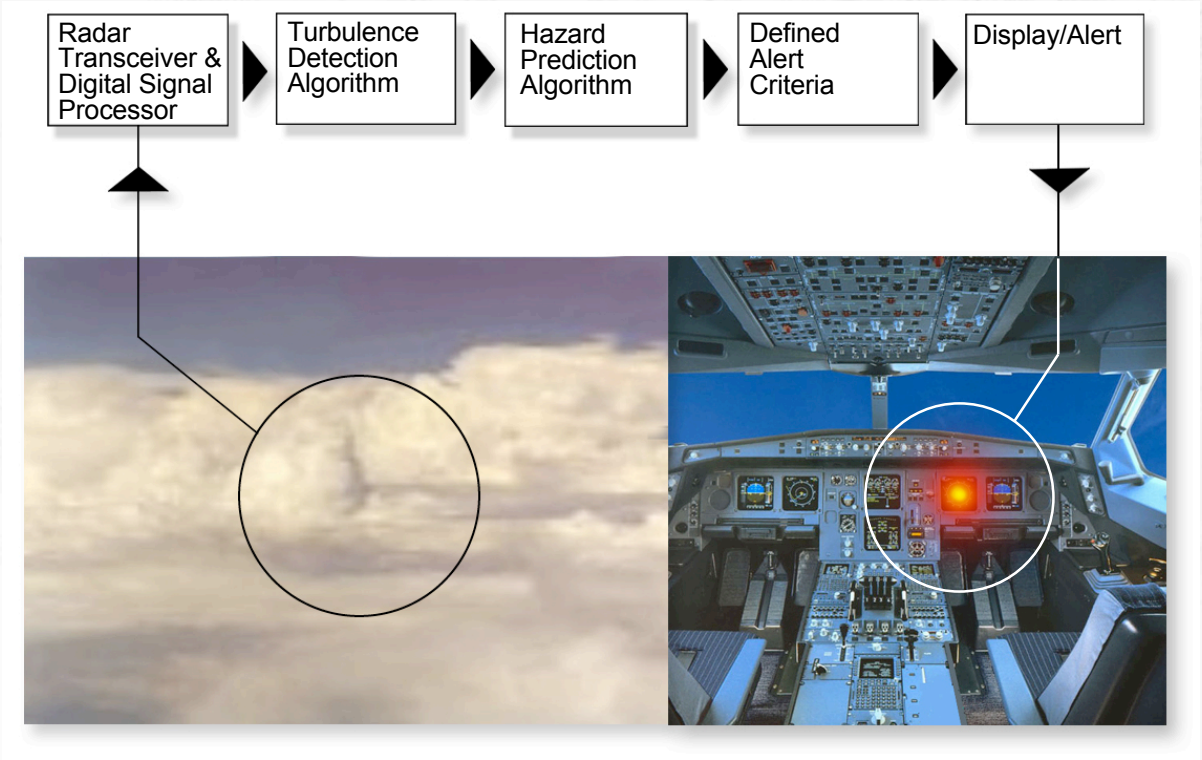
Accomplishment:

Developed a real-time turbulence prediction and detection/ warning system and developed an aircraft-independent turbulence intensity index

Impact:

Severe turbulence was detected with 30 to 120 second advanced warning

TGIR Accomplishment:



TPAWS end-to-end system concept

Agency Goal 2

Objective 2.2 Protect the Environment

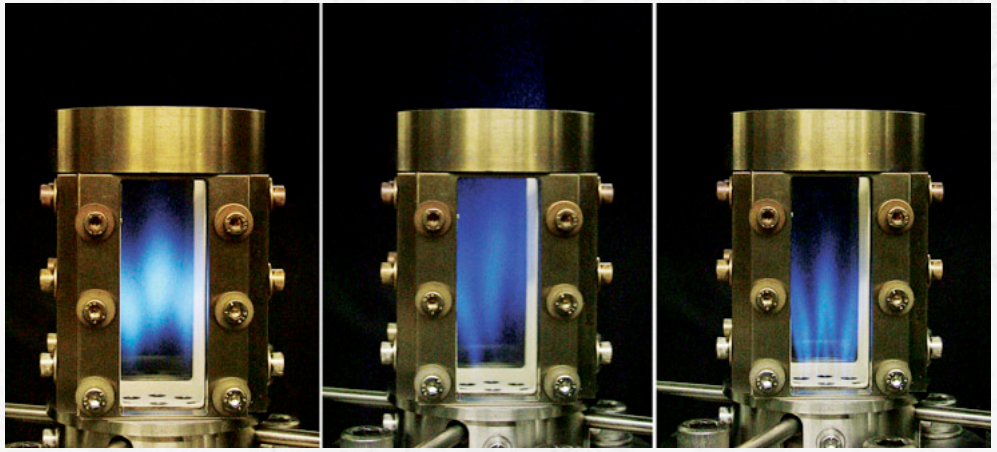
Challenge:

Determine if CO_2 can be eliminated as a product of combustion

Accomplishment:

- Low NOx hydrogen fuel injector developed
- Light weight tanks of fiber reinforced polymer/clay nanocomposites were developed

***TGIR** Accomplishment:*



NASA hydrogen air combustion experiment, demonstrates a cleaner burning fuel option (by eliminating CO_2)

Impact:

- Hydrogen-based fuel jet engine and zero CO_2 emissions can be a reality
- Lightweight tanks can provide 20% weight reduction; 40% increase in strength, and 50% greater fracture toughness making fuel cell technology much more practical

Agency Goal 2

Objective 2.3 Increase Mobility

Challenge:

Reduce delays and increase capacity in the NAS

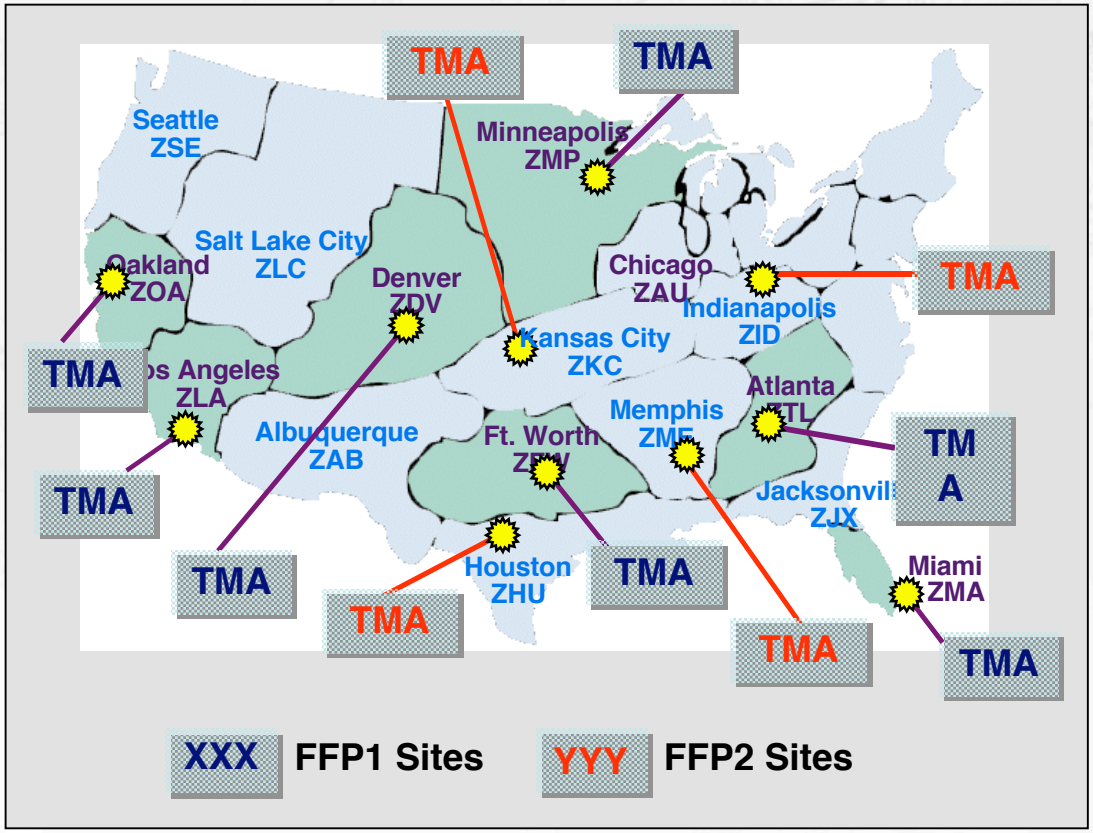
Accomplishment:

Traffic Management Advisor (TMA) has been deployed throughout the whole NAS.

Impact:

TMA increases peak arrival/departure capacity while minimizing delay at inefficient altitudes.

TGIR *Accomplishment:*



"There's no question that Traffic Management Advisor is a cost-beneficial investment. We're seeing capacity increases of 3 to 5 percent . . . "

Marion Blakey
December 4, 2002

Agency Goal 3

Objective 3.2 Support National Security (Aeronautics)

Challenge:

The Air Force needs a High-performance, un-crewed vehicle

Accomplishment:

Designed autonomous taxi control laws, collision avoidance, and airspace operation strategies for the X-45A.

Impact:

Tests were very successful and Autonomous UCAV is much closer to reality.

TGIR Accomplishment:

DARPA, U.S. Airforce, Boeing X-45A UCAV at NASA Dryden.

Space Launch Initiative Theme

Assure Access to Return from ISS

Improve Space Transportation Safety, Reliability, Affordability

Enhance Security

Next Generation Launch Technology

X-37

Demonstration of Autonomous Rendezvous Technologies

Progress on 2nd Generation Designs

June 2001
ATP

March 2002
IATR

November 2002
SRR

2003/2004
Phase II ATP

Mid-Decade
Decision

Hundreds of
Concepts

15 Concepts

3 Concepts

2 Concepts

Full-Scale
Development

Requirements Challenged and Changed
Includes All Aspects of the Complete System

- Reusable Launch Vehicle
- Ground & Flight Operations
- Ground-Based & On-Orbit Support Infrastructure

New Integrated Space Transportation Plan

02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21

International Space Station

- US Core Complete
- IP Core Complete
- ISS Extend?
- Future Exploration beyond LEO?

Space Shuttle

- Competition Decisions
- Operate Thru Mid Next Decade
- Extend?
- Extend Until 2020+
- Further Extend as Crew and/or Cargo Vehicle?

Orbital Space Plane

- Design
- FSD Decision
- Orbital Tech Demo
- Development
- ISS Crew Return Capable
- Crew Transfer on Human-Rated EELV
- OSP Primary Crew Vehicle?
- Operations

Next Generation Launch Technology

- Tech
- Long-Term Technology Program
- Launch System Decision (Based on Reqt, $, DoD)
- Risk Reduction
- FSD Decision
- 1st Flight
- OSP Bridge To New Launcher
- Hypersonic FSD?
- Development
- Operations

OSP Requirements Summary and Concept of Operations

Level 1 Requirements Summary:

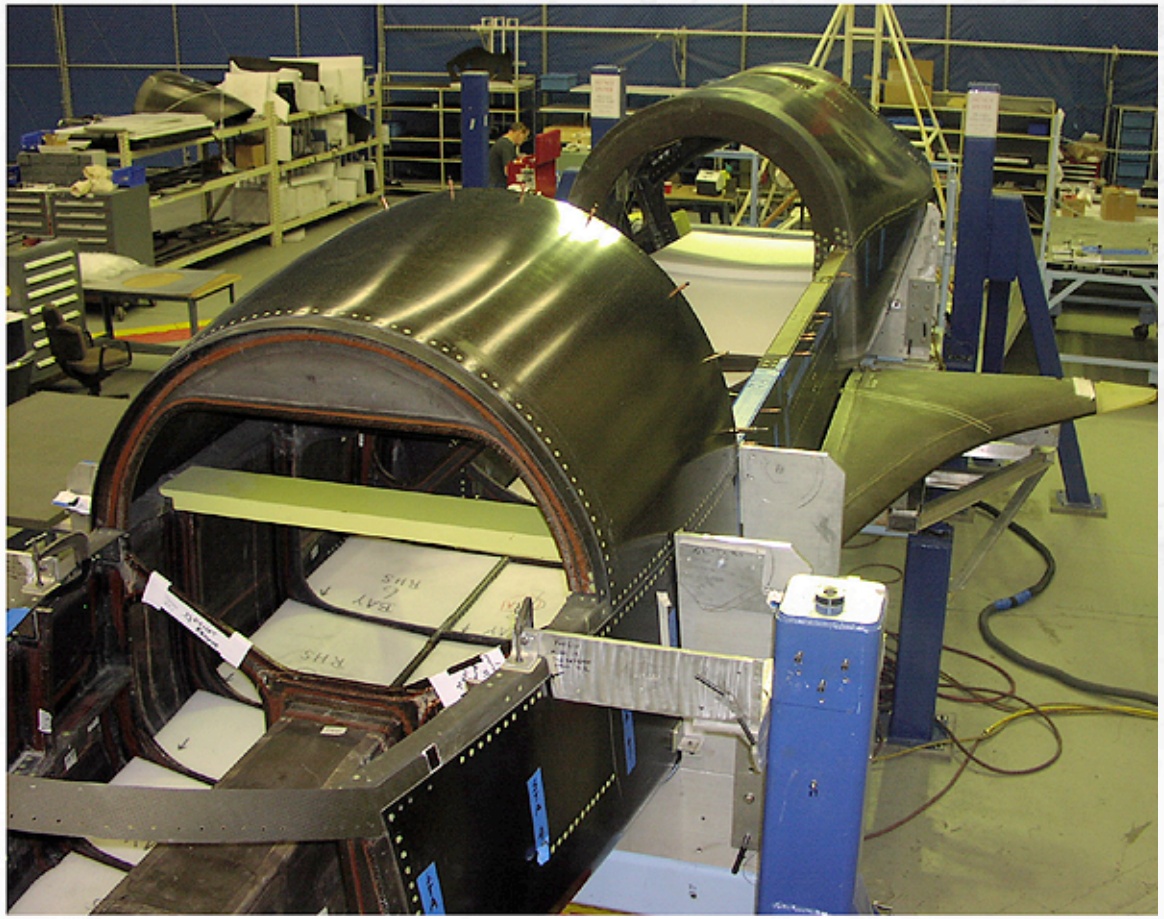
- Rescue for four ISS crew no later than 2010; Crew Transport to/from ISS no later than 2012
- Rapid separation from ISS; 24 hours to definitive medical care
- Risk of loss shall be lower than the Soyuz for rescue mission
- Increased on-orbit maneuverability; Designed for minimum life cycle cost

OSP Requirements Summary and Concept of Operations

Concept of Operations

- The vehicle(s) shall initially launch on an ELV.
- The system shall be operated through 2020. However, the system should be designed for longer.
- The systems for crew rescue and crew transport could be different versions of the same vehicle.
- The system shall provide contingency capability for cargo delivery to support a minimal level of science.
- The system shall support a nominal ISS crew rotation period of 4–6 months.

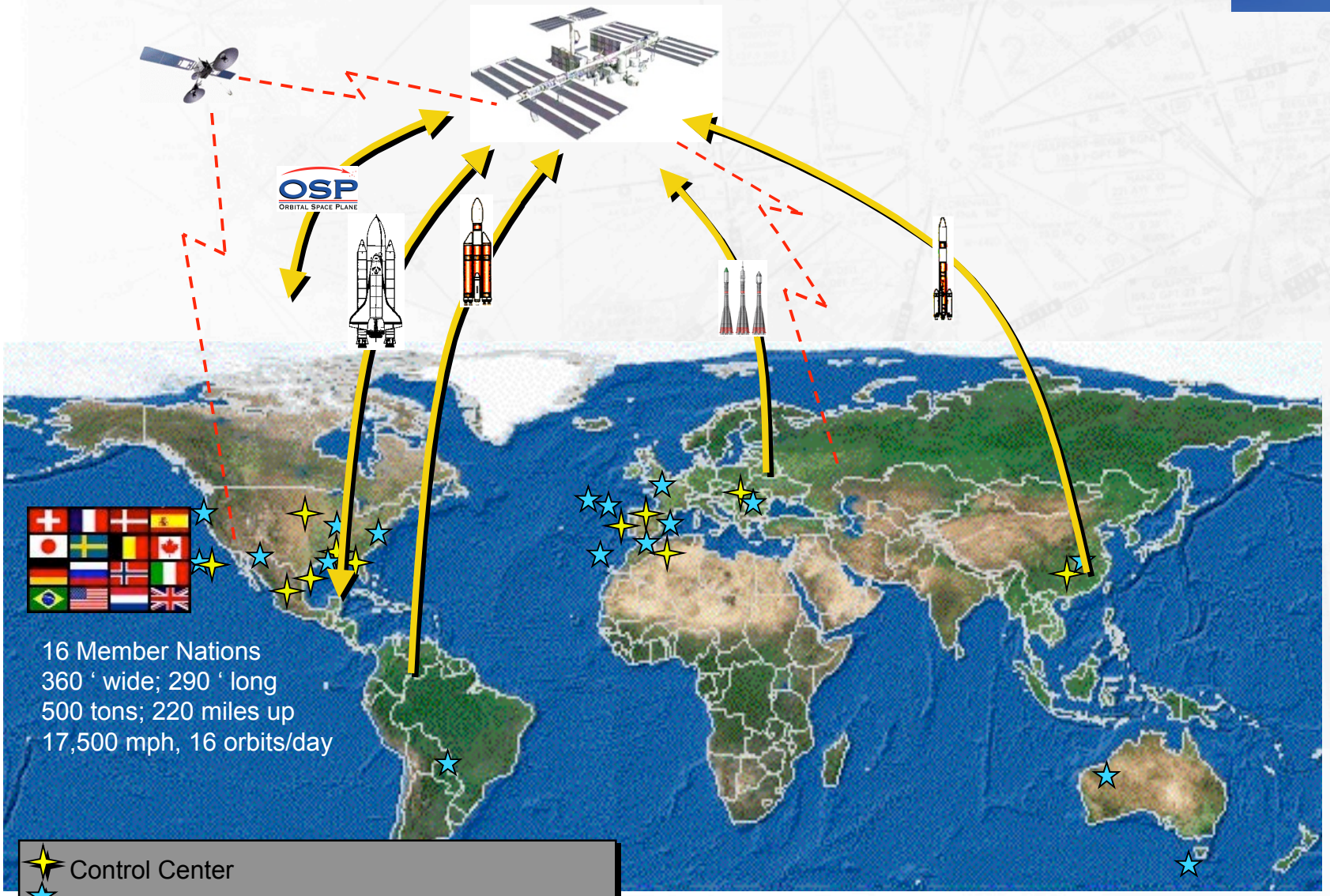
TGIR *Accomplishment:*



Assembly of X-37

Agency Goal 8

Objective 8.1 Assured ISS Access



ISS Traffic Flow Management Study

Agency Goal 8

Objective 8.2 Mission Safety and Affordability

Challenge:

A highly reliable main engine is needed.

Accomplishment:

The Co-Optimized Booster for Reusable Application (COBRA) Engine was developed. The key enabling technology is a single liquid oxygen and liquid hydrogen pre-burner, which was successfully tested.

Impact:

- Fabrication time can be reduced (from 4 to 1 yr.)
- Channel wall nozzle eliminates leakage and the need for a heat exchanger
- 100's of parts and a catastrophic failure mode are eliminated

***TGIR** Accomplishment:*

The COBRA team accomplishments include design of a liquid-liquid pre-burner, a key enabling technology

Agency Goal 8

Objective 8.2 Mission Safety and Affordability

Challenge:

To reduce risk of explosion and improve safety, NASA needs a space qualified leak detection capability

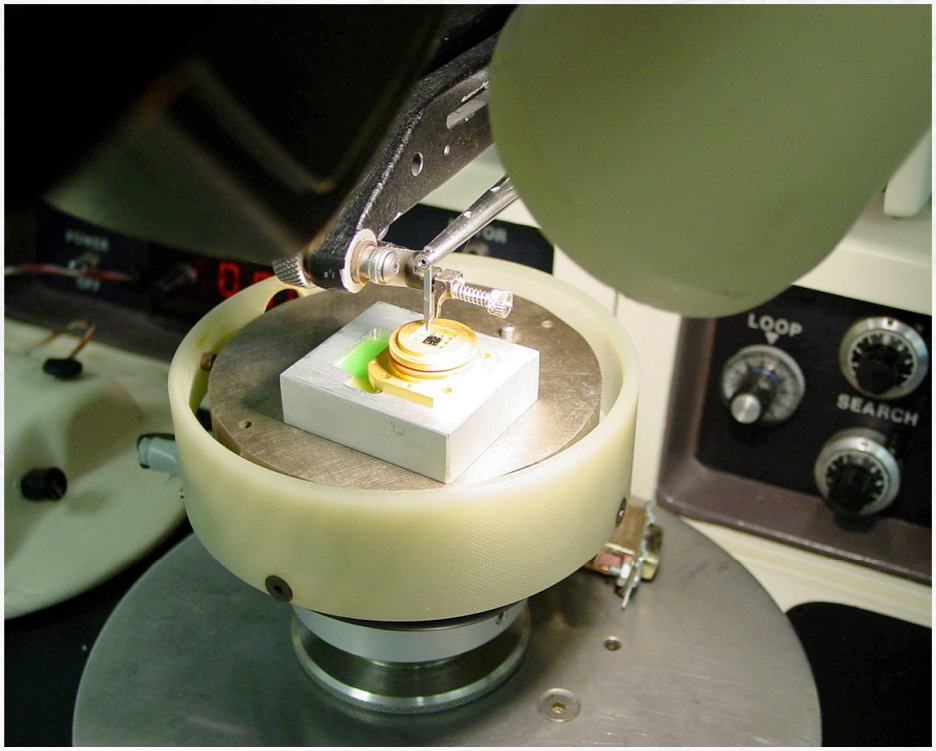
Accomplishment:

NASA developed a postage stamp size hydrogen leak detector consisting of a Microsystems-based hydrogen sensor combined supporting electronics.

Impact:

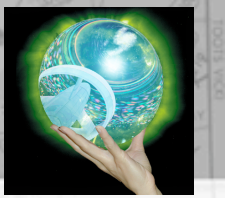
Current large systems with high power needs have been replaced by a space-qualified system that is available for all NASA and industry needs.

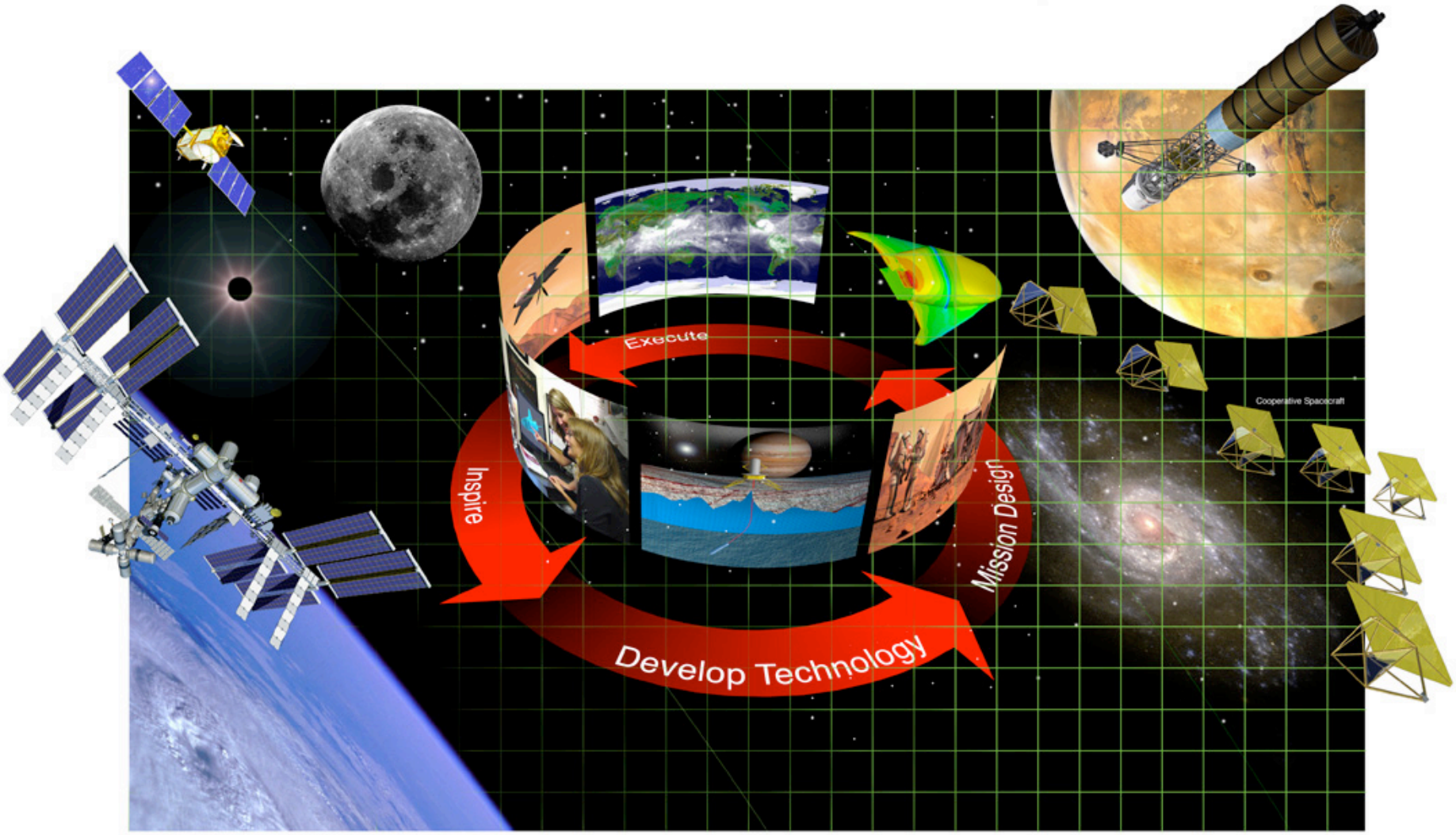
TGIR Accomplishment:



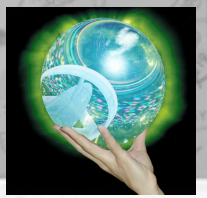
Miniature Smart Leak Detection System invented by GRC Team.

Mission and Science Measurement Technology Theme

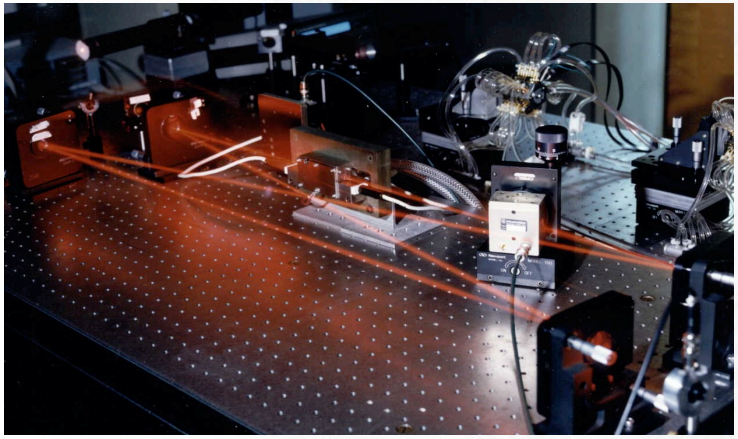




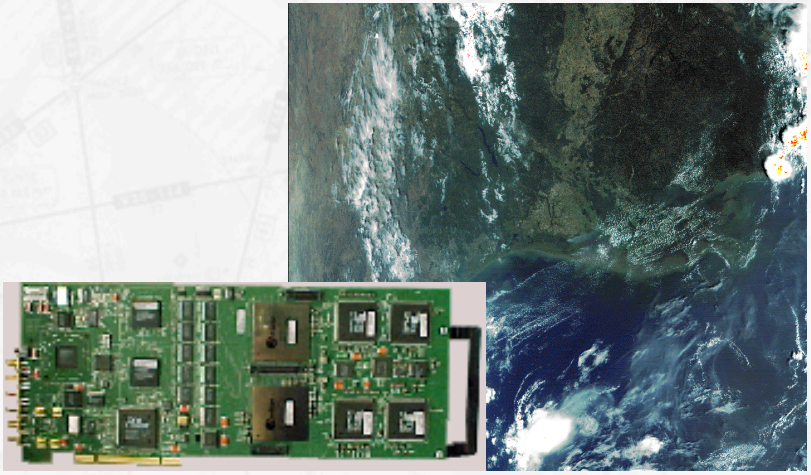
Mission and Science Measurement Technology Accomplishments



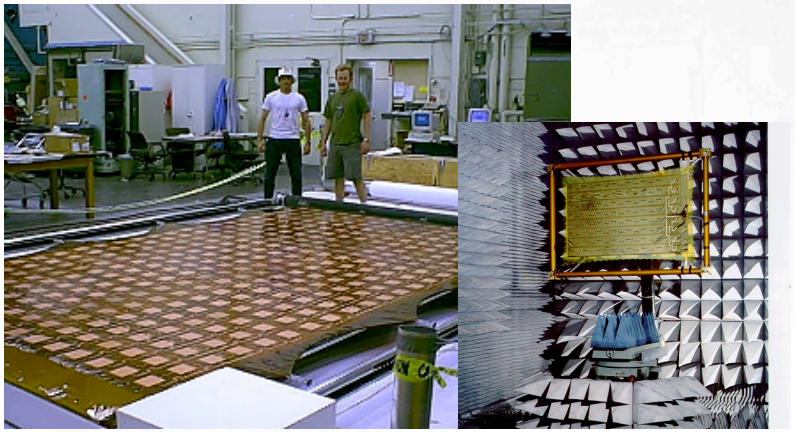
For Earth Science:



Demonstrated proof-of-concept 2-micron tunable laser transmitter for future Lidar missions

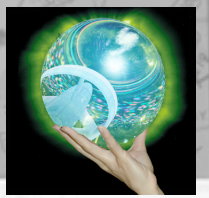


Demonstrated 622 Mbps transceiver for receiving live pass images from Terra spacecraft



Demonstrated membrane antennas for SAR and microwave radiometers

Advanced Lidar Instrument Technology Initiative



2 Lasers, 4 Techniques, 6 Priority Measurements

Pulsed Laser Development

2 MICRON

Key Technologies in Common

Laser Diodes
Laser Induced Damage
Frequency Control
Electrical Efficiency
Heat Removal
Ruggedness
Lifetime
Contamination Tolerance

1 MICRON

Jointly funded by Codes R & Y

2.05 micron

DIAL: CO_2

Backscatter Lidar: Aerosols/Clouds

2.05 micron

Doppler Lidar: Wind

Atmosphere: Lower Upper

Coherent

Direct

X3

0.355 micron

1.06 micron

X2

Altimetry: Oceanography

X2

0.532 micron

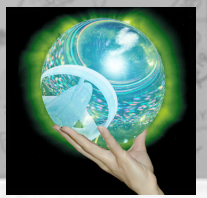
OPO

0.30-0.32 micron

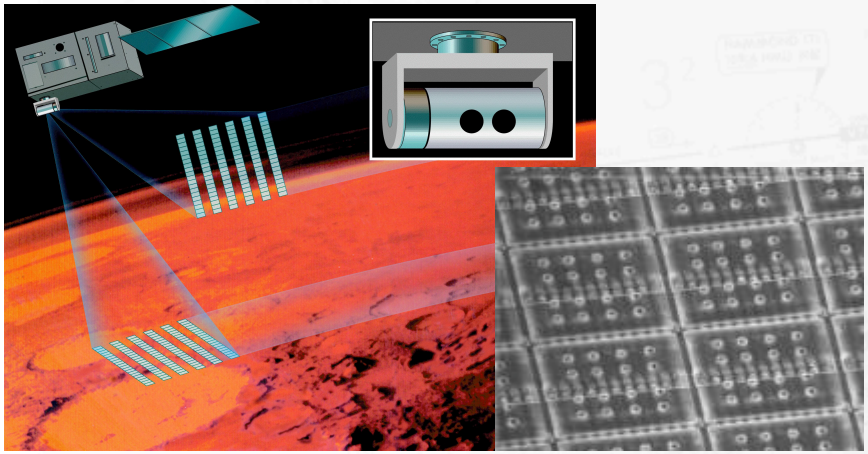
DIAL: Ozone

Backscatter Lidar: Aerosols/Clouds

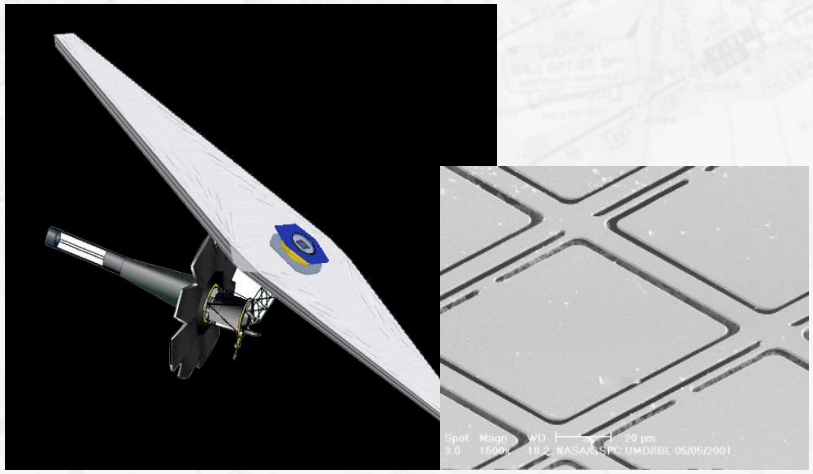
Mission and Science Measurement Technology Accomplishments



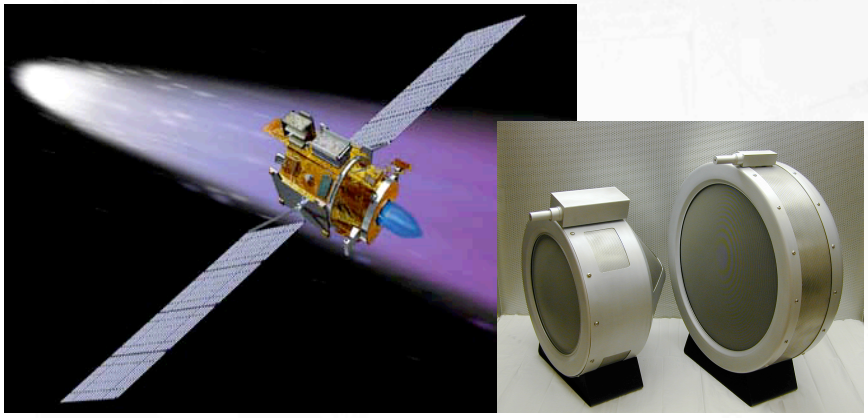
For Space Science:



Thermopile IR detectors selected for Mars Reconnaissance Orbiter atmospheric sounder

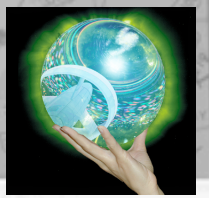


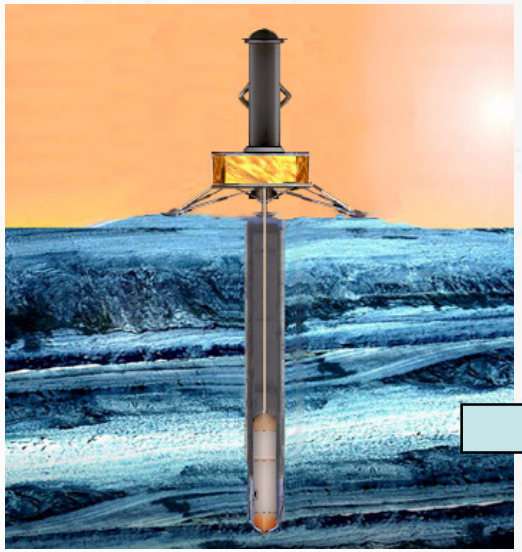
MEMS-based Micro-Shutter Array selected for Next Gen. Space Telescope

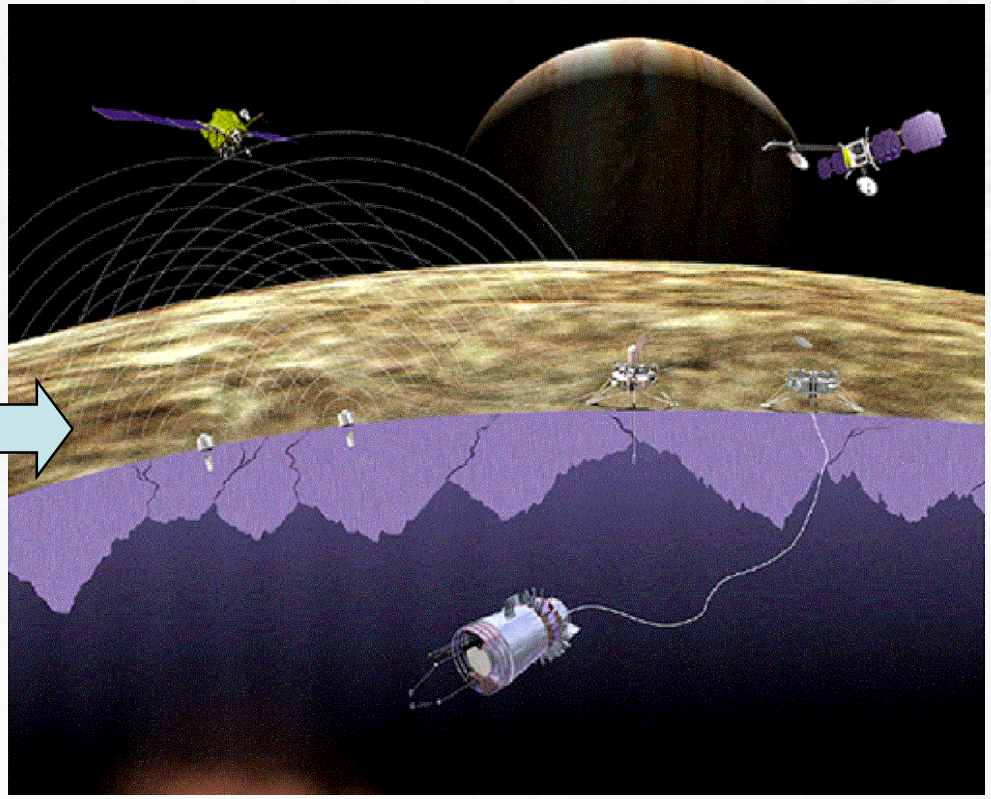


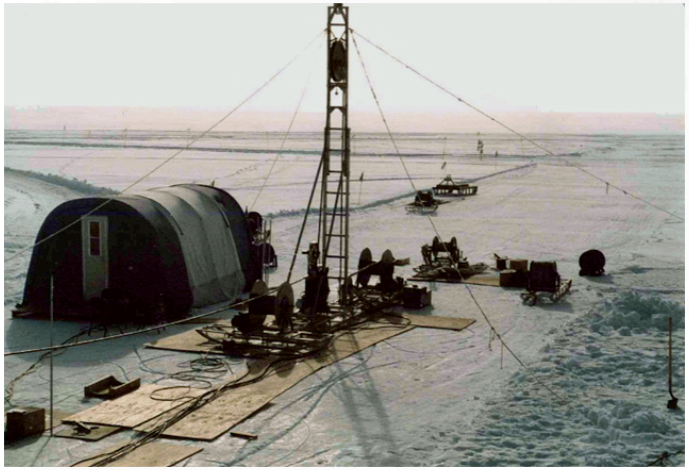
10kW Next Generation Ion Engine selected for further development by In-Space Propulsion Technology Program.

Cryobot Ice Explorer



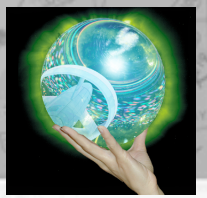






Agency Goal 10

Objective 10.2 Science Driven Architecture and Technology



Challenge:

Increase quantity of scientific measurements of Martian atmosphere

Accomplishment:

NASA developed an uncooled thermopile linear array at 1/8th the original weight and using 1/4 of the power specification for the Mars Climate Sounder

Impact:

Mars Reconnaissance Orbiter instrument will sample the atmosphere at 20 altitudes simultaneously measuring pressure, temperature, and gas composition.

***TGIR** Accomplishment:*

The Mars Reconnaissance Orbiter will use high-power microwaves to analyze the planet's surface for signs of water.

Agency Goal 9

Objective 9.5 Support for Space Exploration

Challenge:

Reduced travel times and acquire long duration propulsion system for extended space science missions

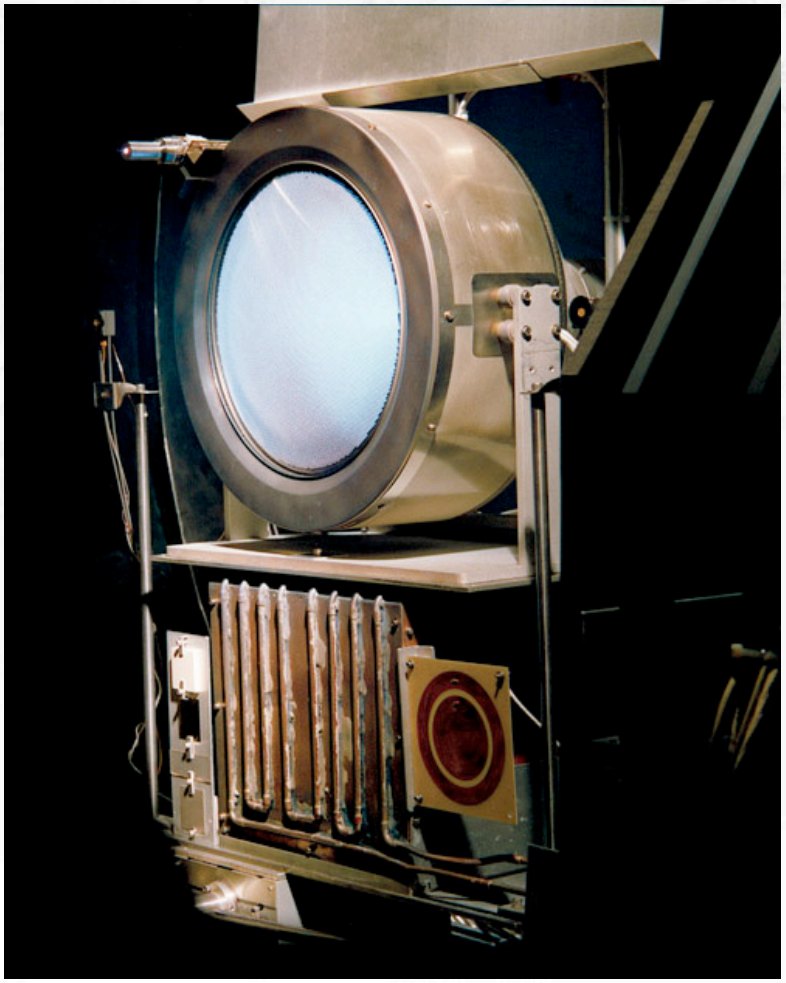
Accomplishment:

NASA developed and tested a 10Kw ion engine design for use in nuclear-electric propulsion.

Impact:

Engine produces 4x the power and 60% greater specific impulse than the current state-of-the-art ion engine.

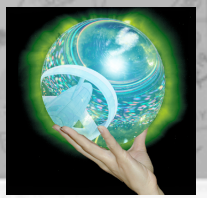
TGIR Accomplishment:



Ion engine mounted in a JPL testbed

Agency Goal 10

Objective 10.1 Mission Risk Analysis



Challenge:

Reduce the time and increase the quality of vehicle design

Accomplishment:

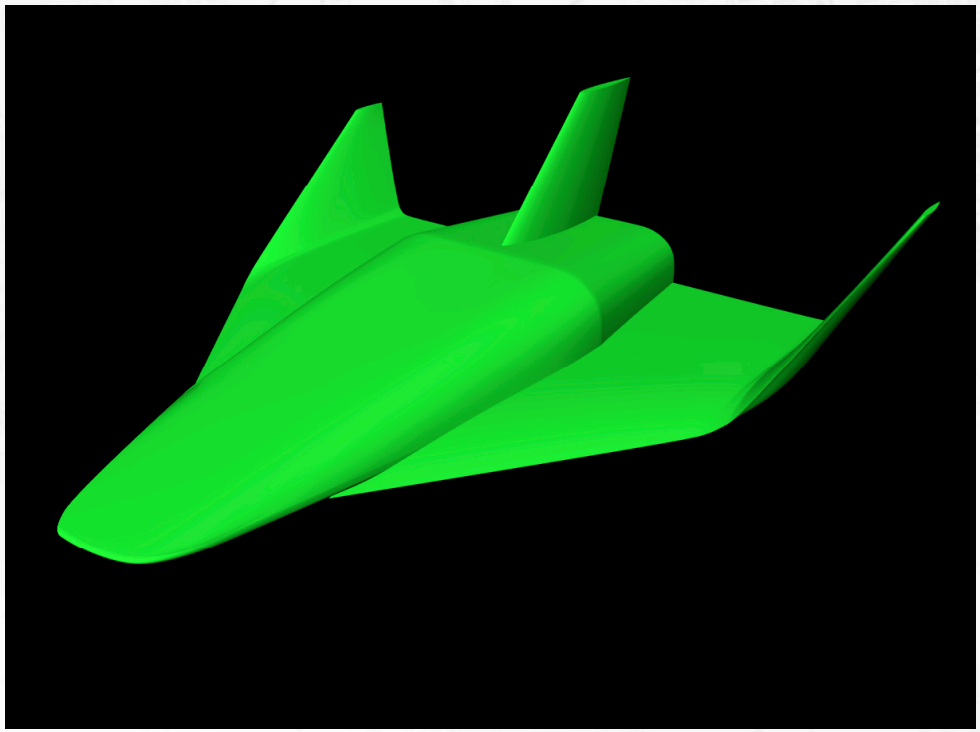
CFD, wind tunnel, and flight test data were all integrated into a real-time piloted simulation.

Impact:

Real-time evaluations of the handling qualities of RLVs were performed by while designs were still under development.

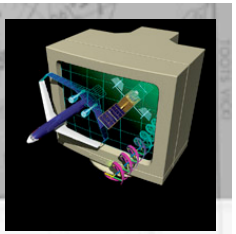
A virtual lab is now available for collaborative design groups.

TGIR Accomplishment:



Example of Crew Transfer Vehicle (CTV)

Innovative Technology Transfer Partnerships Theme

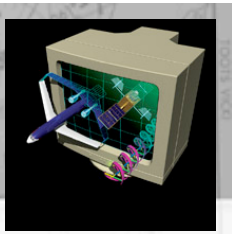


in NASA Technology Development

Economic Strength

Agency Goal 3

Objective 3.3 Extending Benefits to Society



Challenge:

There is a medical need for a easy to use fetal heart monitor for non-medical environments.

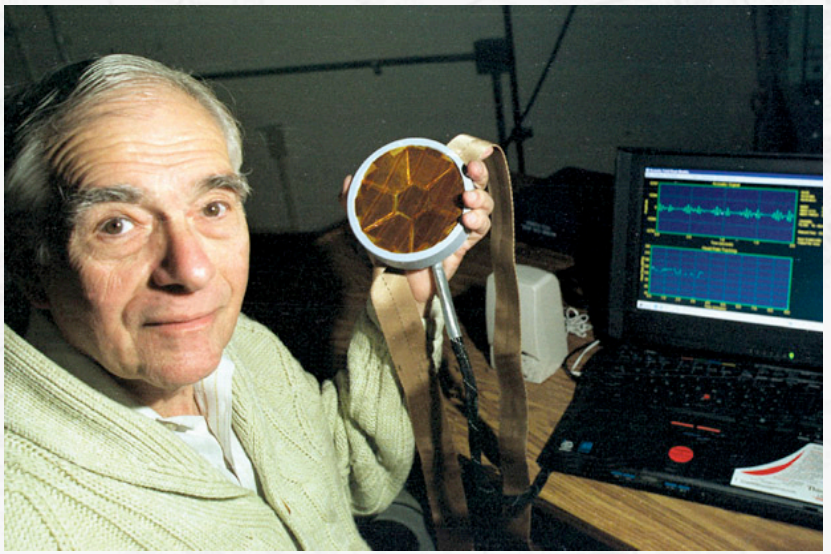
Accomplishment:

NASA thin electro-active film technology used to measure pressure associated with airflow in wind tunnel modified for use in fetal heart monitoring.

Impact:

Transferred and licensed technology to Baby Beats Inc. to develop prototype heart monitoring system.

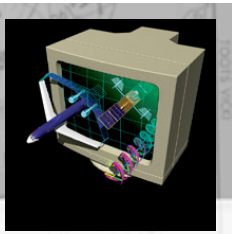
TGIR Accomplishment:



Material used for wing surface measurements is flexible and is ideally suited for fetal testing.

Agency Goal 3

Objective 3.3 Extending Benefits to Society



Challenge:

There is a commercial demand for faster CFD simulation – a technology that NASA has

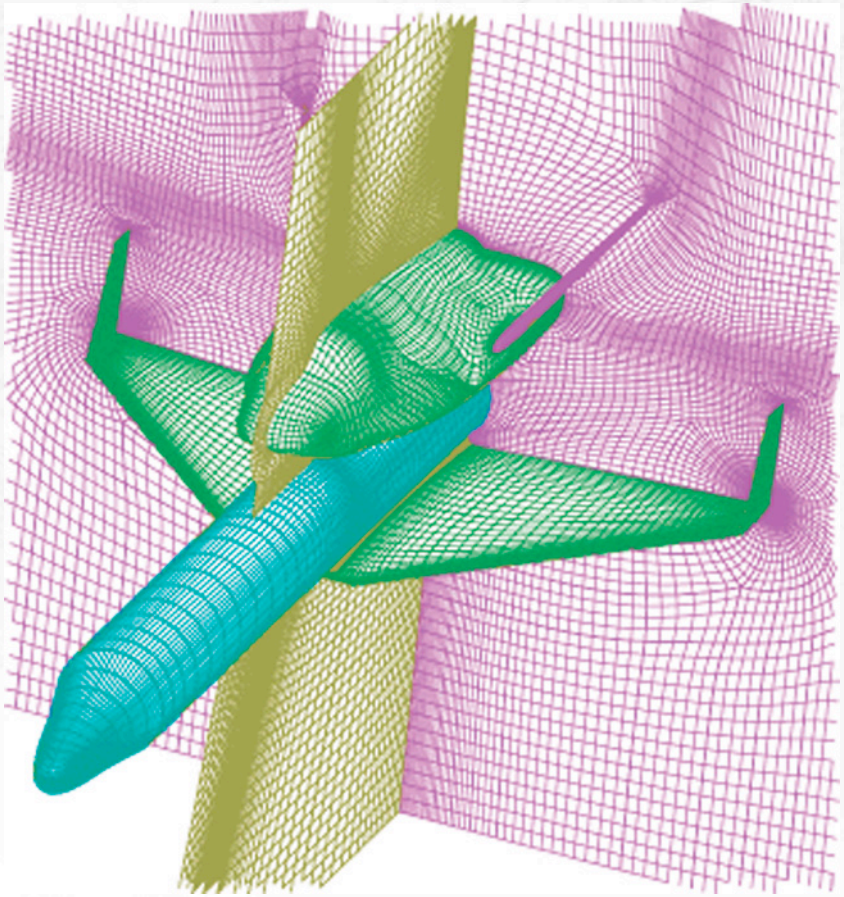
Accomplishment:

Developed CART 3D, an aerodynamic simulation tool, jointly with NYU. Tool has been licensed to industry for uses beyond aerospace applications.

Impact:

CART 3D will revolutionize CFD simulations. Enables complex geometries to be modeled 100 times faster than current state-of-the-art.

TGIR Accomplishment:

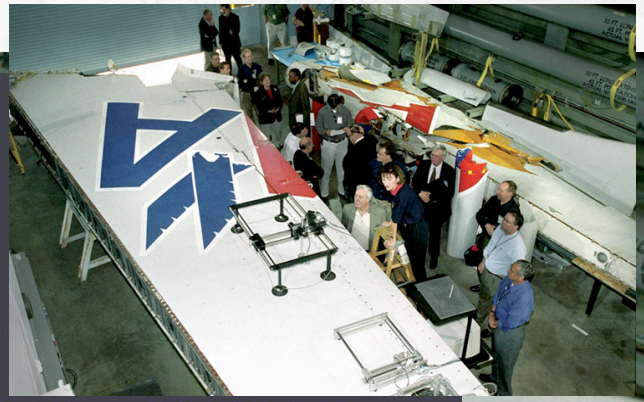


Program Development Company's GridPro technology used for conceptual design of a two-stage-to-orbit launcher.

Aerospace Technology Expertise

A Resource to the Nation

NASA support for Flight 587 accident investigation.



NASA Technologies assists in V-22 Osprey accident investigation

New NASA Technology assists in Columbia accident investigation

Virtual Reconstruction of C
Scanned Left Wing Le

Enterprise Highlights

Agency Budget:

- NASA's new Mission and Vision is the lens through which we view all Aerospace Technology activities - implemented through themes
- "As only NASA can" - pursue activities unique to our mission
- Defining and implementing Full-Cost management and Headquarters program lead

Enterprise Highlights

Enterprise Initiatives:

- FY ’04 initiatives were funded within existing budget to ensure a Credible, Responsible and Compelling program
- Implemented Independent External Reviews: MSM - completed; Aeronautics Technology is ongoing; SLI next year
- Realigned our organizational structure to strengthen our Theme Program Management Capabilities
- The FY’02 Performance and Accountability Report has 12 GPRA performance goals for OAT, all of which are rated green or better.

Theme Highlights

Aeronautics Technology:

- Funded four of key initiatives -- Aviation Security, QAT, UAV in the NAS, and Airspace Systems
- Reflects strengthened working relationship with DoD, FAA, and DOT

Space Launch Initiative:

- Reformulated SLI Program consistent with Agency program and budget priorities

Mission & Science Measurement Technology:

- Greater coordination with and support of the NASA Science Enterprises
- Independent External Review (by the NRC) validated our customer orientation and research priorities

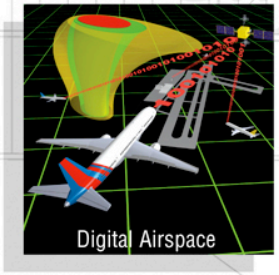
Integrated Technology Transfer Partnership:

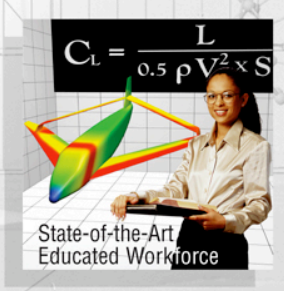
- Refocuses overall effort by reducing our commercialization (spin-off) efforts to place greater emphasis on “Spin-in” Technology Transfer

Opportunities

Aeronautics Blueprint

The NASA Aeronautics Blueprint– Toward a Bold New Era of Aviation





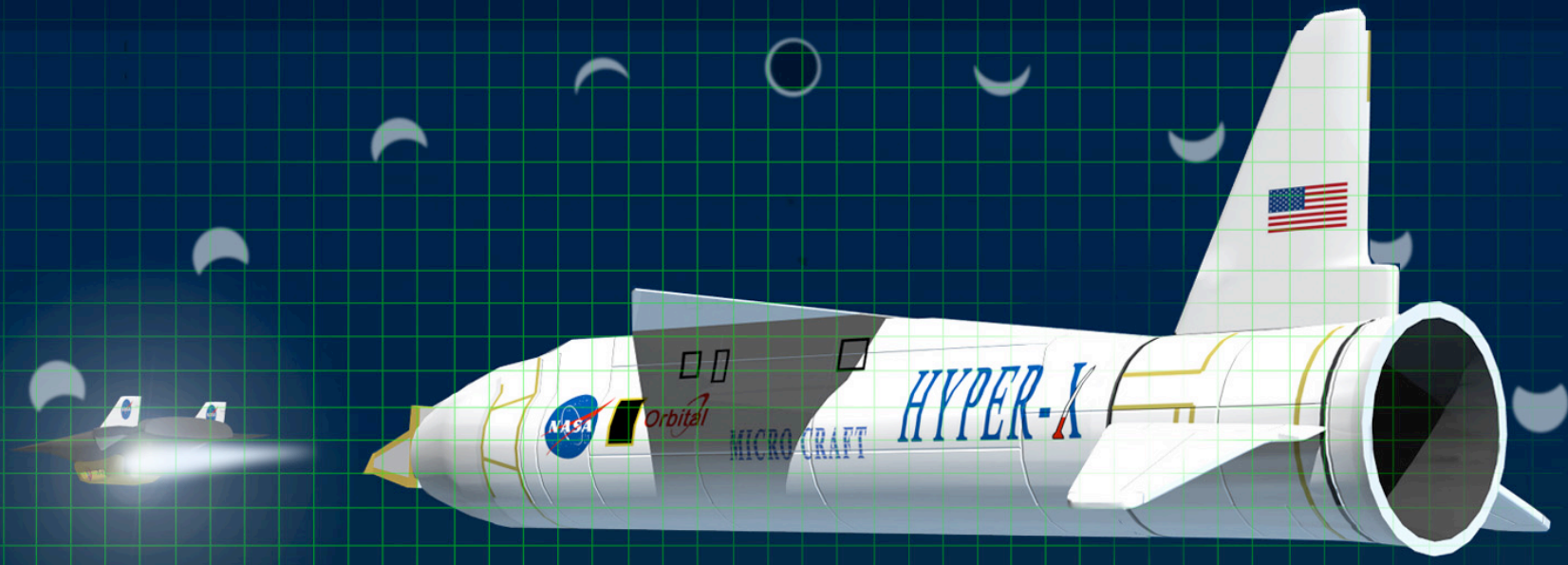
Aerospace Leadership

Support for Aerospace Research has been Growing on a National Level

- **Strong Recommendations from the Commission:**
  - ". . . transformation of the U.S. air transportation system . . ."
  - ". . . create a space imperative."
  - ". . . invigorates and sustains the aerospace industrial base."
  - ". . . promote the growth of, a scientifically and technologically trained U.S. aerospace workforce. . ."
  - ". . . significantly increase its investment in basic aerospace research, . . ."
- **Strong Congressional Support:**
  - Dodd - Allen S 309: Aeronautics Research and Development Revitalization Act of 2003
  - Larson Forbes HR 586: Aeronautics Research and Development Revitalization Act of 2003

Turning Goals Into Reality

Celebrating our Accomplishments



Our success is measured by the extent to which our results improve the quality of life and enable exploration and scientific knowledge

Space Launch Initiative

Aeronautics

Mission Science Measurement

Technology Transfer Partnerships