The United States Microgravity Science Program

Presentation to

the 39th AIAA Aerospace Sciences Meeting and Exhibit

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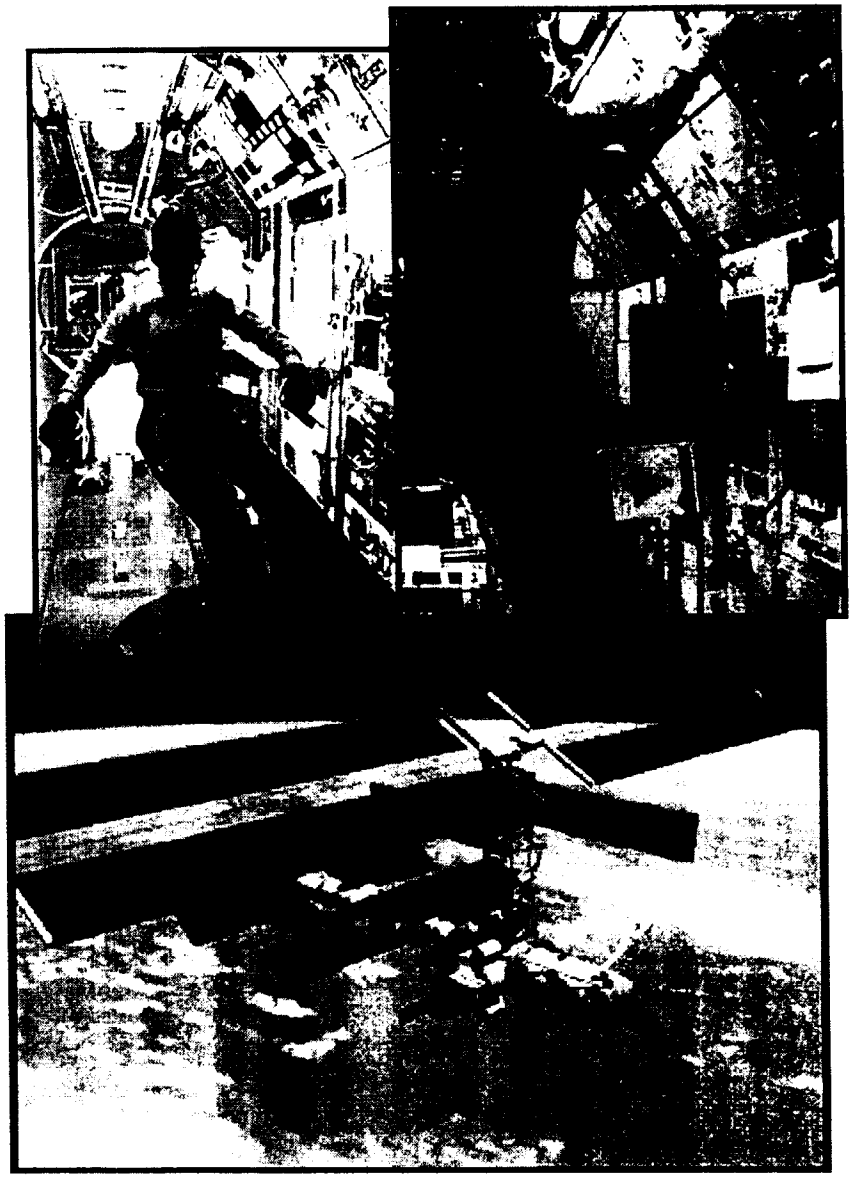
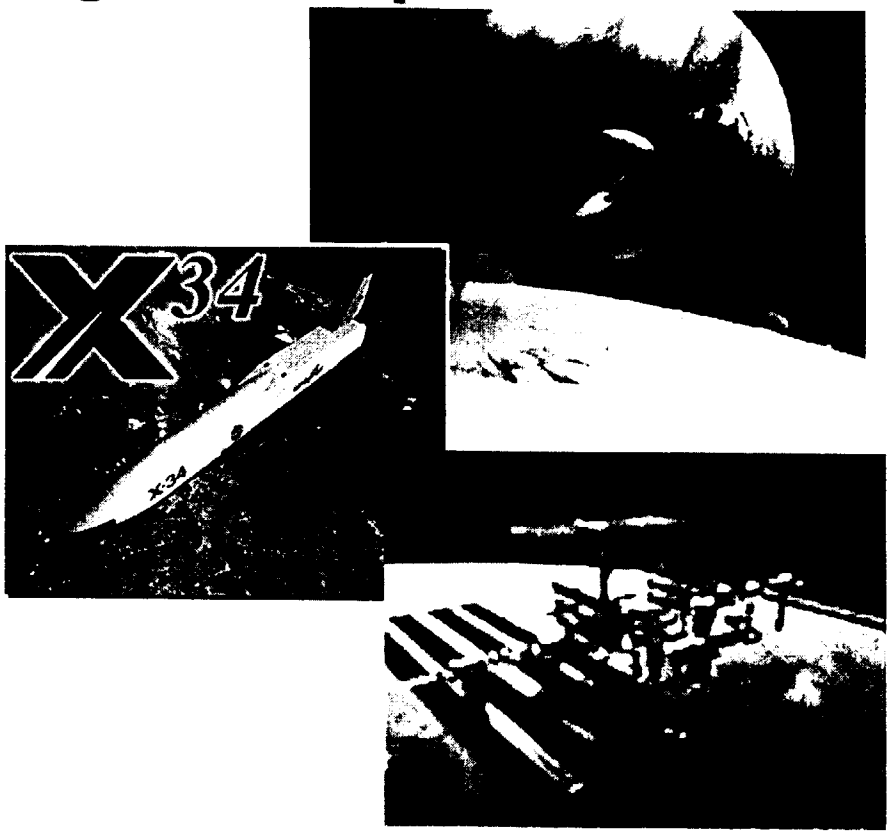


NASA's Five Strategic Enterprises



Space Science

Earth Science

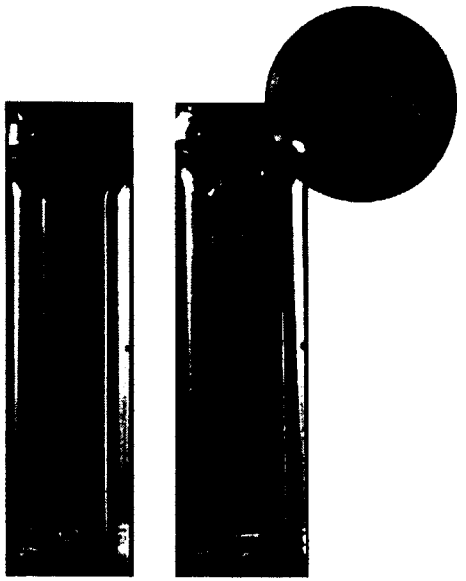
Human Exploration and Development of Space

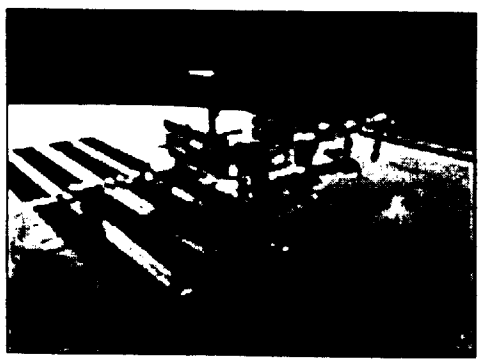
Aerospace Technology

Biological & Physical Research

Biological and Physical Research

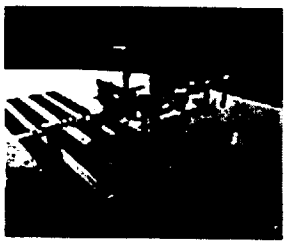
NASA has the capability to create a unique cross-disciplinary research program bringing the basic sciences of Biology, Physics, and Chemistry together with a wide range of Engineering disciplines and Information Technologies.

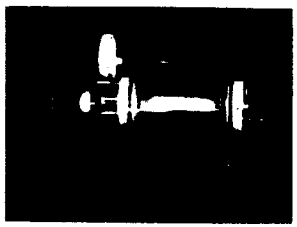




The resulting synergy and the access to Space will ensure that the Agency's objectives are addressed with the most effective tools available, and that the resulting impact on Biology and Biomedical research will be significant and long lasting.

Physical Sciences Research Goals

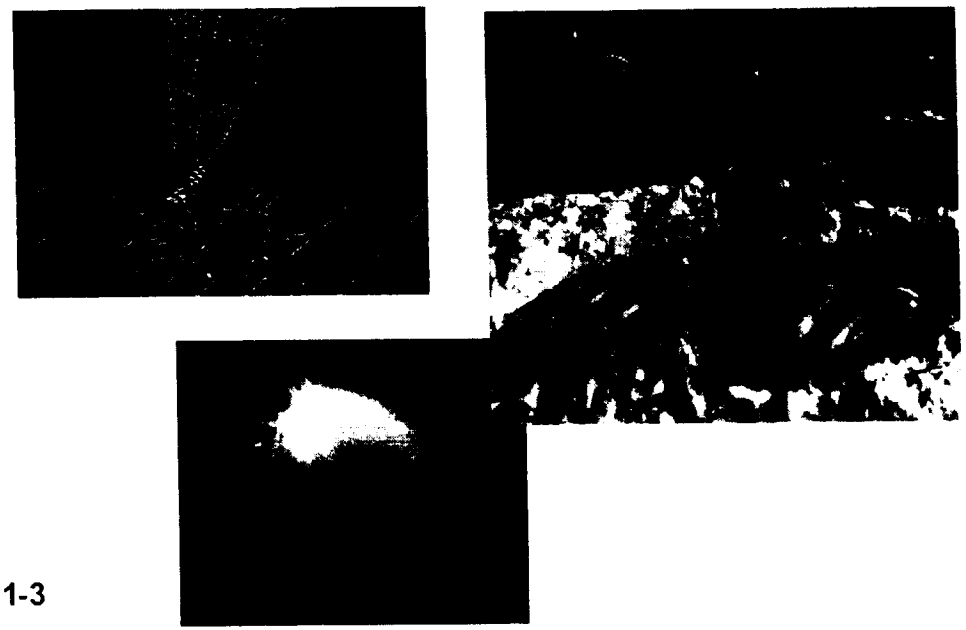




- To carry out cutting–edge, peer–reviewed, and multi–disciplinary basic research enabled by the space environment to address NASA's goal of advancing and communicating knowledge.
- To develop a rigorous cross–disciplinary scientific capability, bridging physical sciences and biology to address NASA's human and robotic space exploration goals.
- To establish the ISS facilities as unique on–orbit science laboratories addressing targeted scientific and technological issues of high significance.
- To enhance the knowledge base impacting Earth–based technological and industrial applications.

Physical Sciences Research* Organization

- **Fundamental Microgravity Research**
  - Fundamental Physics
  - Materials Science
  - Fluid Physics
  - Combustion Science
  - Exploration Research
- **Biomolecular Physics**
  - Atomics and molecular processes in biosystems
  - Biological sensing phenomena
  - Cellular components assembling mechanisms
- **Biotechnology & Earth-based Application**
  - Cellular biotechnology
  - Macromolecular biotechnology
  - Earth-based applications



*** Research and technology development from TRL 1-3**

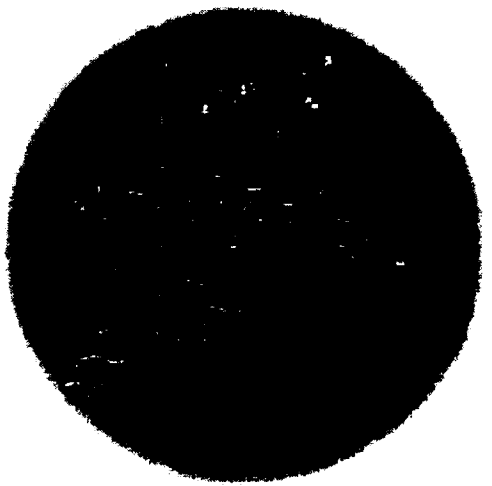
Physical Sciences Research Enhancements

The Physical Sciences Research Division restructured to promote cross-disciplinary physical, chemical, biological, and theoretical research

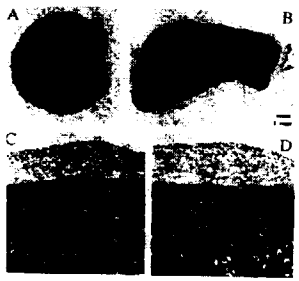
- **Basic research program to understand the effects of gravity on physico-chemical properties (microgravity research)**

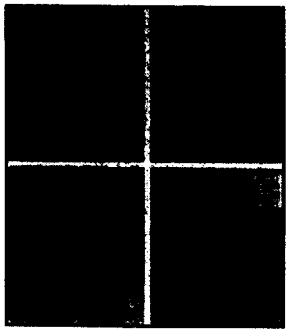
- **Introduction of Biomolecular Physics Program to develop atomic and molecular-scale tools**

- **Redesigned Biotechnology Program utilizes and enables the space environment and exploration**



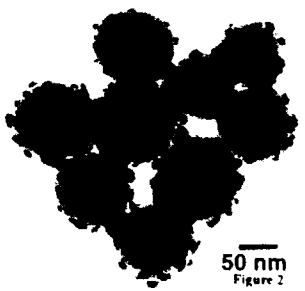
Microgravity Research Strategic Directions

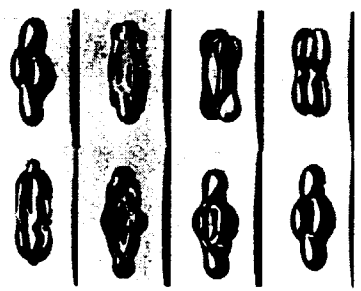




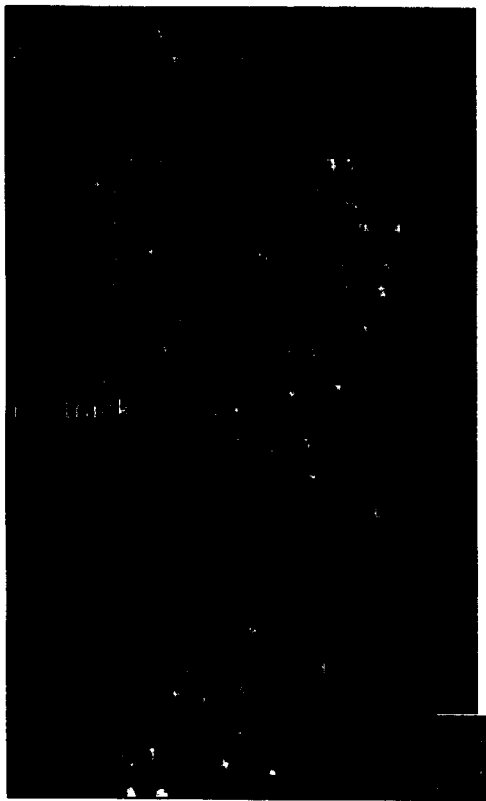
Goal-oriented basic and applied research

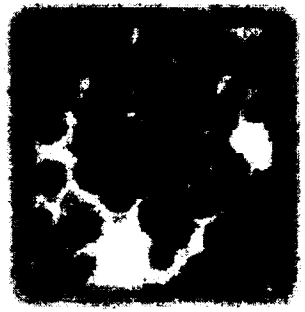
- Fundamental research enabled by the microgravity environment
- Basic research targeting human space exploration goals
- Microgravity research in support of Earth-based applications





Additional Program Enhancements





- New NRA approach
- Synergy between other disciplines/ outside areas
- 50 - 50 split between fundamental research and applied research

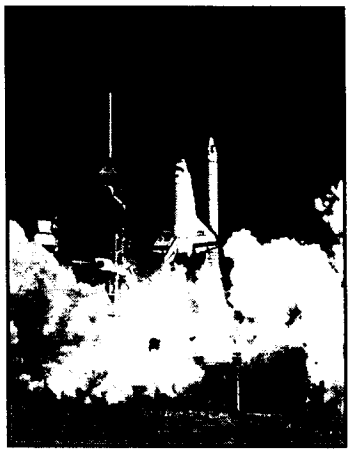
Upcoming Missions

	FY2000	FY2001	FY2002	FY2003
KC-135 Parabolic Aircraft	6 Flight Campaigns 6 Month Depot Maintenance	11 Flight Campaigns	14 Flight Campaigns	14 Flight Campaigns
Suborbital Rockets	Terrier-Orion ERE-1	SAL-6	SAL-7	
Space Shuttle	STS-101 PCG-BAG STS-106 PCG-EGN	STS-105 GAS-MSCRE STS-107 Research Mission	STS-108 GAS-COLLIDE STS-112 Research Mission-2	STS-121 Research Mission-3 (Tentative)
ISS Assembly Sequence		ISS 4A ISS 5A ISS 5A.1 ISS 6A ISS 7A ISS 7A.1	ISS UF1 ISS 8A ISS UF2 ISS 9A	ISS 11A ISS 9A.1 ISS 12A ISS 12A.1 ISS 13A ISS 13A.1

Microgravity Research Space Shuttle Flight Operations

STS-107

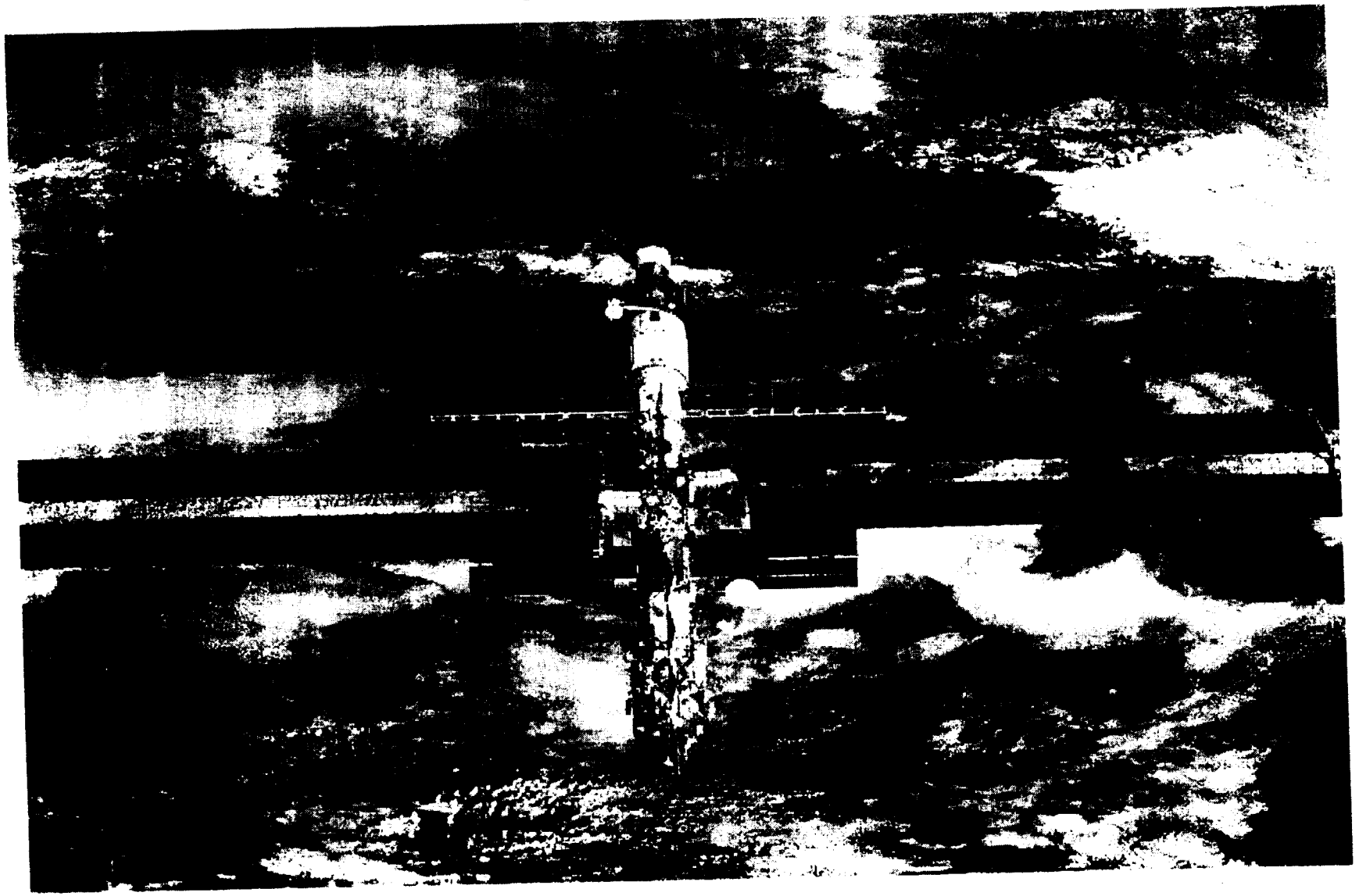
- Combustion Module-2 (CM-2)
  - Structures of Flame Balls at Low Lewis-number Experiment (SOFBALL)
  - Laminar Soot Processes Experiment (LSP)
- Space Acceleration Measurement System-Free Flyer (SAMS-FF)
- Orbital Acceleration Research Experiment (OARE)
- Bioreactor Demonstration System-05 (BDS-05)
- Mechanics of Granular Materials-III (MGM-III)



STS-112 Preliminary Code

- Middeck Glovebox Facility (MGBX)
  - Candle Flames in Microgravity (CFM-2)
  - Front Interface with Vortex Experiment (FIVE)
  - Fiber Supported Droplet Combustion (FSDC-3)
  - Shear History Extensional Rheology Experiment (SHERE)
  - Smoke Points in Coflow Experiment (SPICE)
- Bioreactor Demonstration System (BDS-7,8)
- Biotechnology Payload #1 (New SBT)
- Biotechnology Payload #2 (New SBT)

International Space Station Preparation



What Are Increments?

Increments unify integration, research, and crews under a single theme

- Increments average about 4 months and are determined by crew rotations and flights to/from International Space Station
- Each increment has a theme that focuses on the primary science or activities performed
  - Increment 1: Bringing space to the public
  - Increment 2: Radiation
  - Increment 3: Bone and muscle research
  - Increment 4: Plants and PROCESS
  - Increment 5: Crystals for the future

Increment 1 is here!

As of 11/2/2000

Increment 1 on orbit now!

- November 2000-February 2001
- 4 Modules on-orbit
  - Unity (Node)
  - Zarya (Functional Cargo Block)
  - Zvezda (Service Module)
  - Destiny (U.S. Lab 02/01)
- 5 assembly and resupply flights
- Expedition 1 Crew arrived November 2, 2000 on *Soyuz*

ISS at end of Increment 1

Yuri Pavlovich Gidzenko

William (Bill) Shepherd
Commander

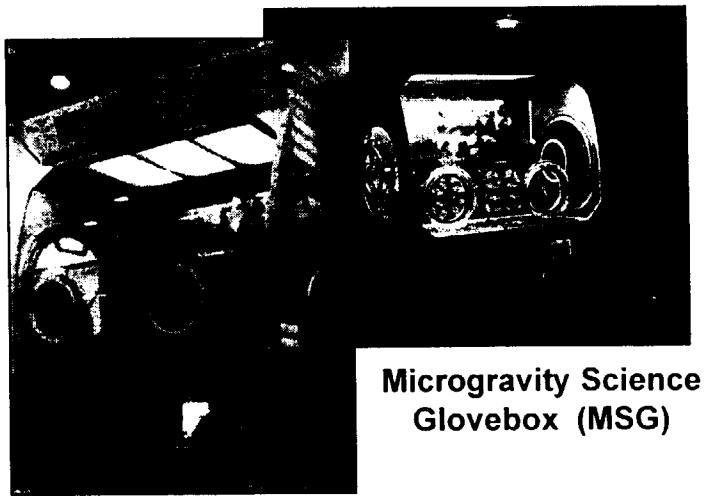
Sergei K. Krikalev

Research Plan Summary

- **Experiments for increments 1-5 are manifested**
- **Existing experiment queues are being assessed for flight increments 6-17**
- **Increment 6-12 themes will be available 01/01**
- **Increment 13-17 themes are targeted for 6/01 following interactions with ISS Program Office to determine resources allocated**
- **Increments schedules are subject to Shuttle performance**

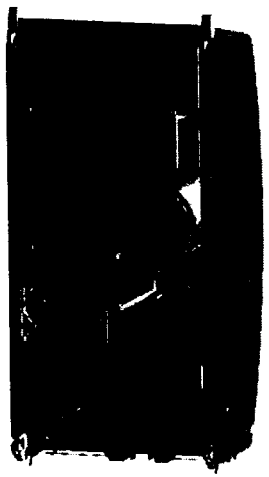
Microgravity Research on the International Space Station

EXPRESS Rack

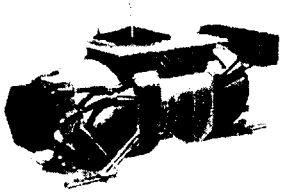


Microgravity Science Glovebox (MSG)

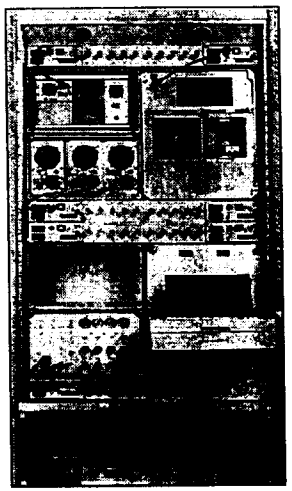
Fluids and Combustion Facility (FCF)



Materials Science Research Facility (MSRF) Research Rack (MSRR-1)



Low Temperature Microgravity Physics Facility (LTMPF)



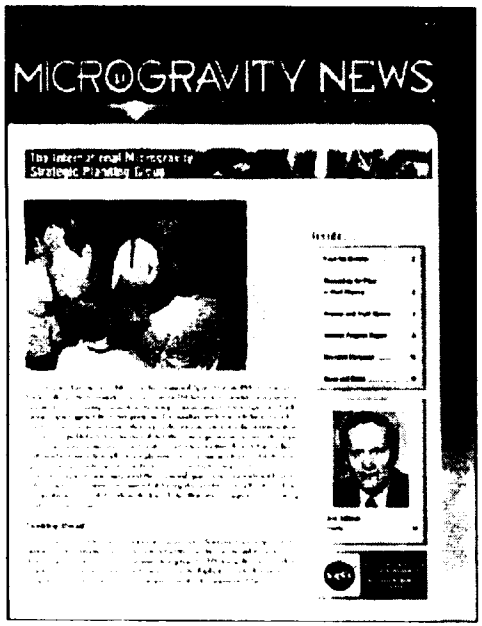
BioTechnology Facility (BTF)

Microgravity Research International Space Station Status

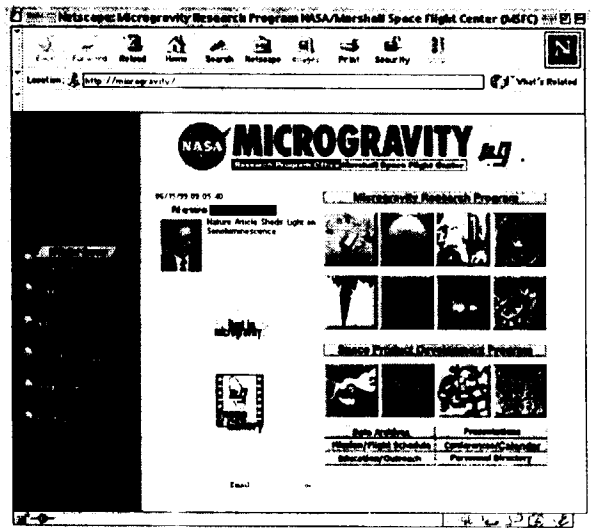
- First Microgravity payload flew on ISS Flight 2A-2B in September 2000
  - Protein Crystal Growth - Enhanced Gaseous Nitrogen (PCG-EGN)
- Significant Microgravity Express Rack activity starts in 2001 with Flights 6A, 7A, 7A-1, and UF-1
- ISS Flight 6A (April 2001)
  - Space Acceleration Measurement System-II (SAMS II)
  - Microgravity Acceleration Measurement Systems (MAMS)
  - Physics of Colloids in Space (PCS)
  - Protein Crystal Growth - Single Thermal Enclosure System (PCG-STES)
- Microgravity ISS Flight UF-2 (February 2002)
  - Microgravity Science Glovebox (MSG)
- Fluids, Combustion, and Materials Facilities
  - Initial Hardware launch planed for UF-3 in August 2004

For Program Updates See . . . .

Microgravity Quarterly Newsletter



http://microgravity.nasa.gov



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