Building Stronger Ties to the University community:

Perspectives from University Research and Affairs Office

Kamlesh (Kam) Lulla, Ph.D.
Helen W. Lane, Ph.D.
University Research and Affairs Office

In Memory of Columbia Astronauts…

They will always live in our hearts


BROWN
CLARK
CHAWLA
ANDERSON
RAMON
HUSBAND
MCCOOL
STS 107
NASA
CENTER

Chicago at night from International Space Station

ISS006E36391

Purpose

PART ONE:

To Provide an overview of Johnson Space Center programs and technology development areas

PART TWO:

To initiate a discussion on the theme of "NASA-University Interactions" (or how to collaborate with Johnson Space Center?)

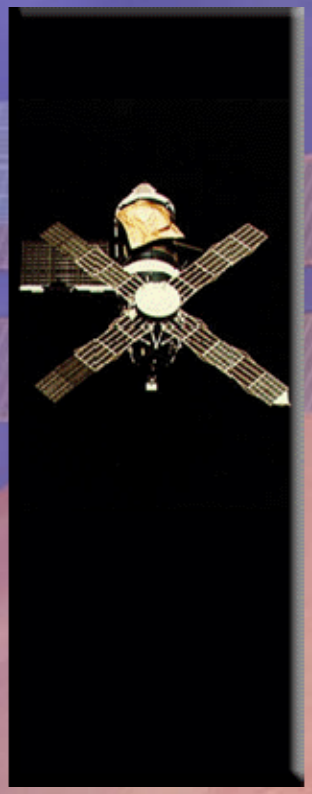
To explore ways to strengthen ties between JSC/NASA and the Space Grant community and university partners.

Johnson Space Center
Leadership in Human Spaceflight Missions

Mercury

Gemini

Apollo



Skylab

Shuttle

Station

2020 & Beyond

Shuttle Program

Return to Flight Examples of Work

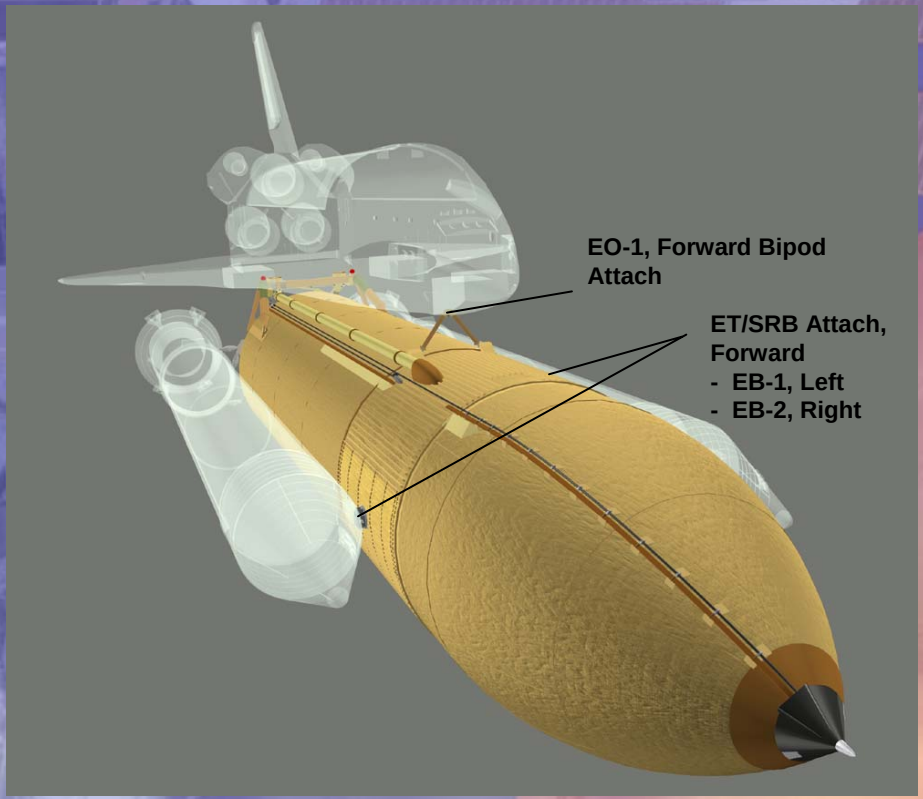
- Ascent orbital debris impact testing and analysis
- Camera development for wing observation
- Sensors for wing
- Rudder speed brake actuators
- RCC and tile repair activities

Shuttle- Review of some of the Return to Flight issues

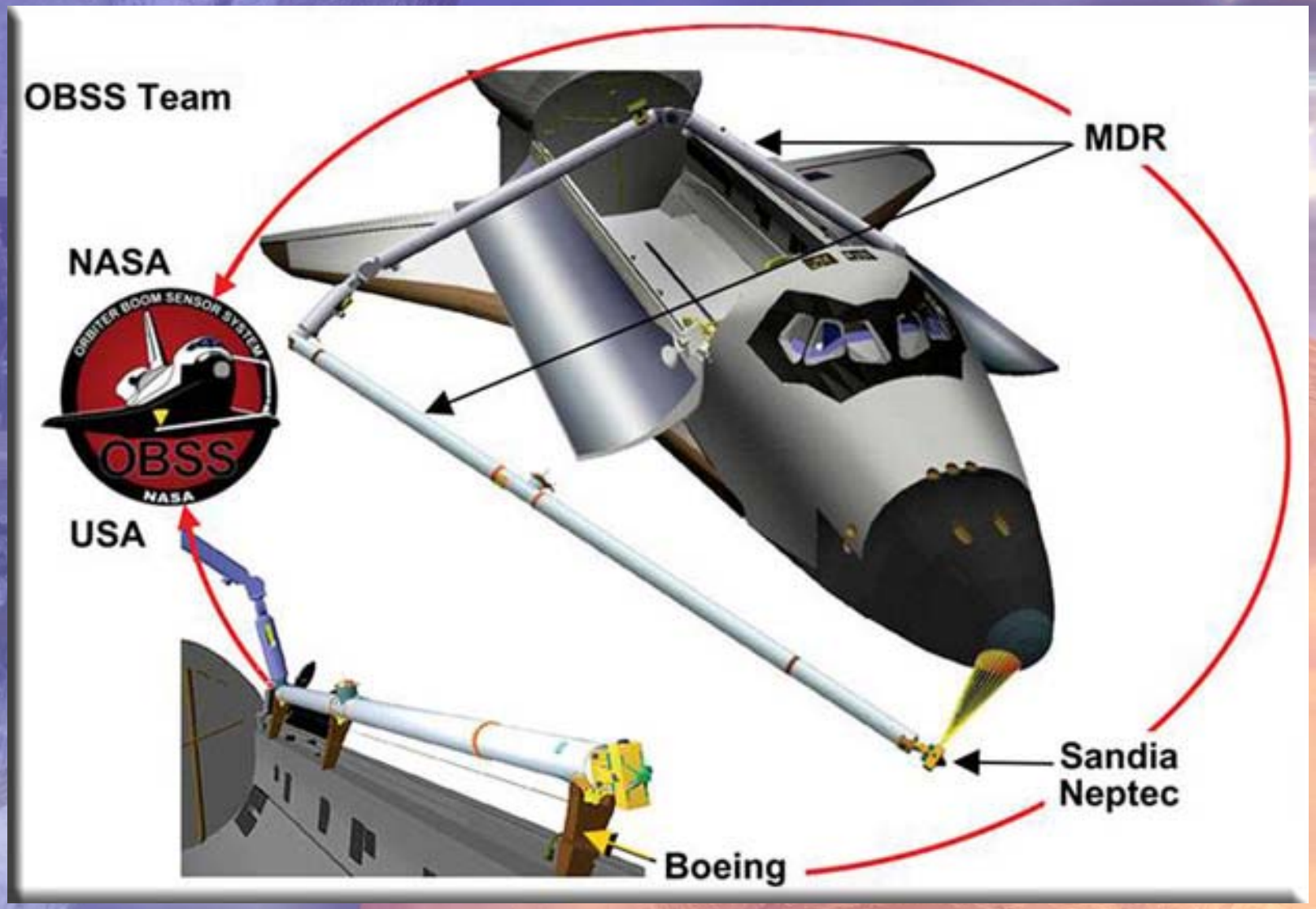
Columbia Accident Investigation Report required changes to inspection of the wing and the external tank

- Test Damage to Leading Edge Wing
- External Tank Connection
- Inspection of the Wing On-Orbit

External Tank and Connection to Shuttle



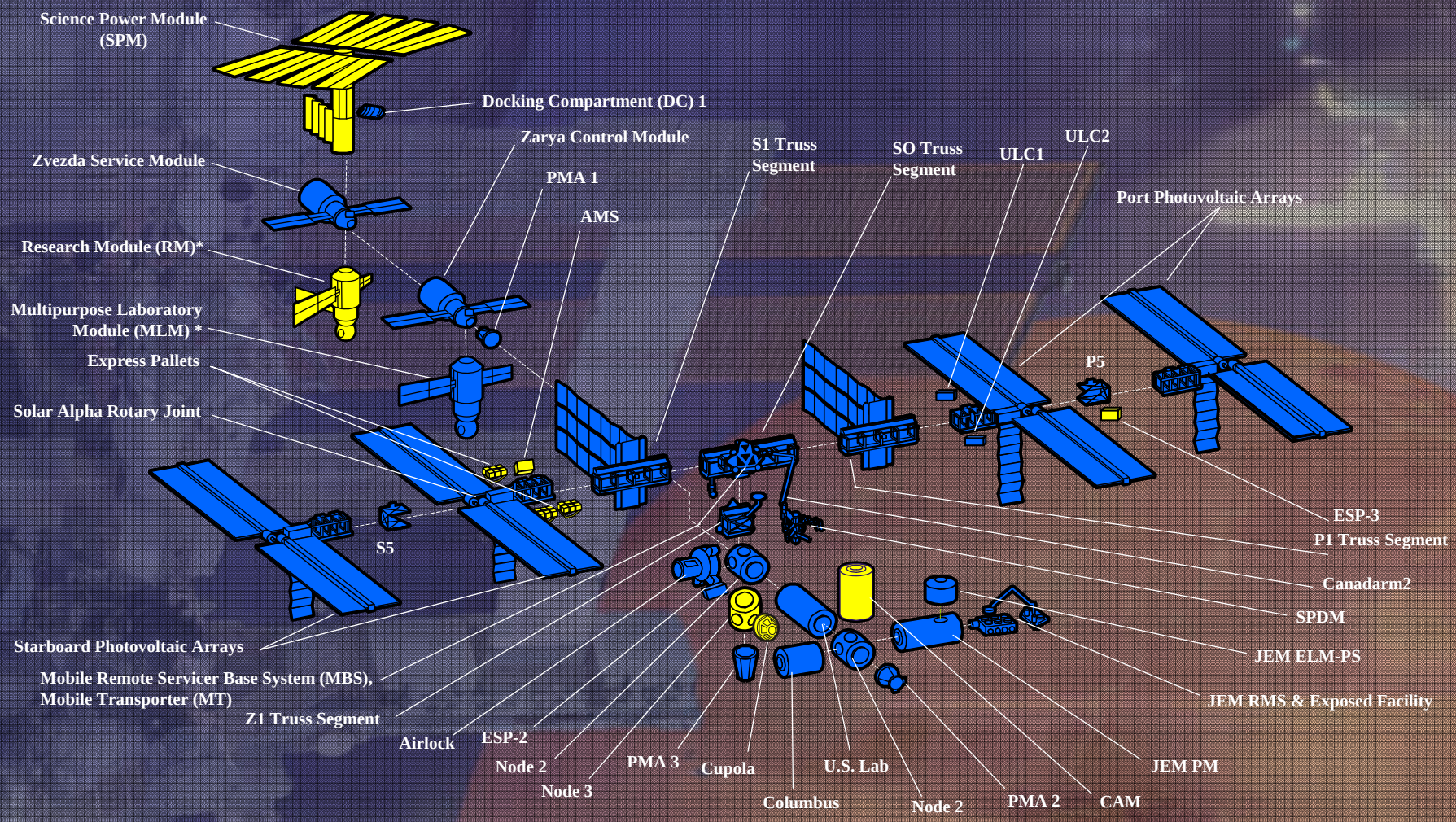
Orbiter Boom Sensor System
Boom Assembly




Assembly Complete
(Baseline)

Bringing Nations Together

International Space Station Assembly Complete



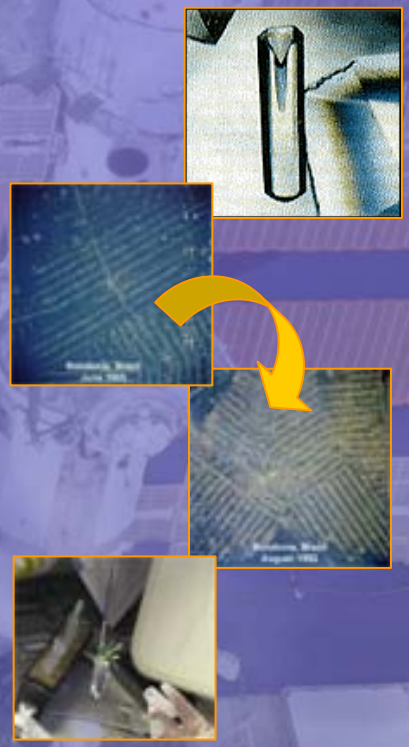
* RM and MLM are launched by Russian vehicles.

• *Lighter colored modules are under consideration.*

Astronaut Leroy Chiao, Commander, and NASA ISS science officer

Cosmonaut Salizhan S. Sharipov, Flight Engineer

For the Benefit of Life on Earth...

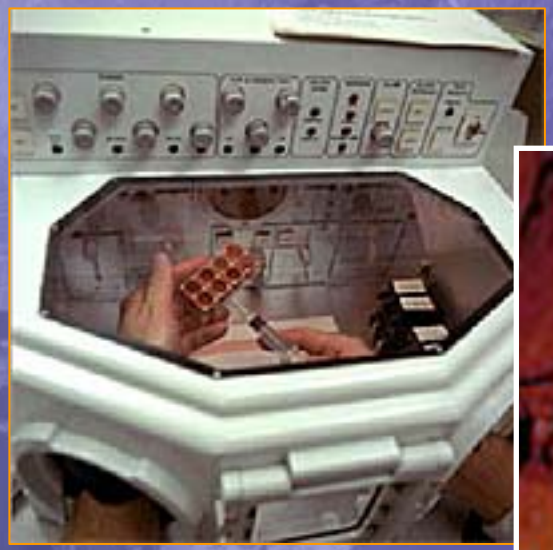


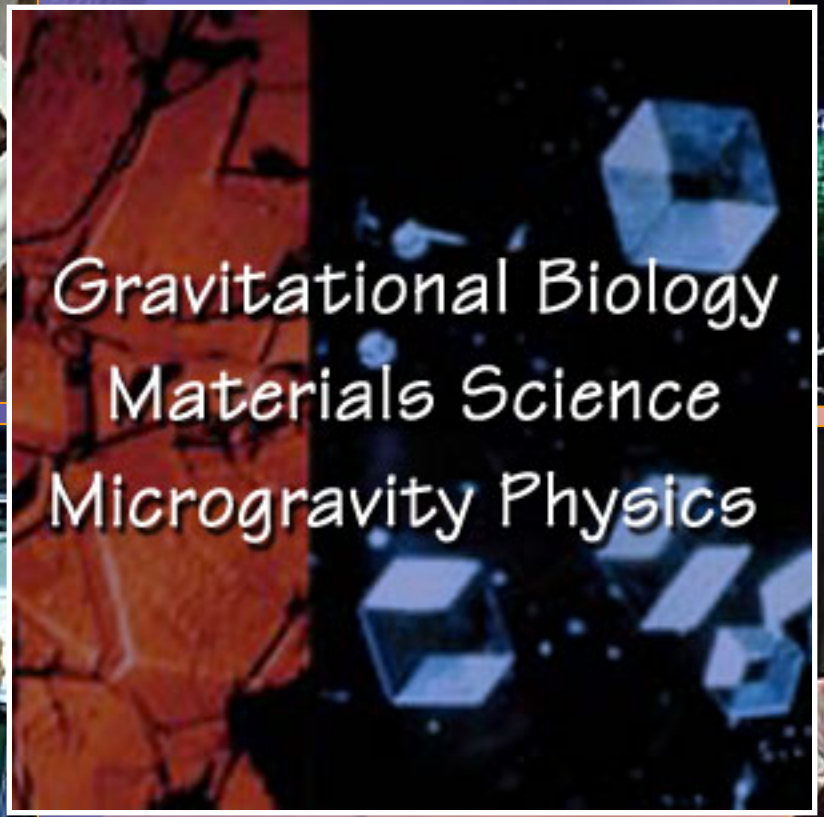
Research

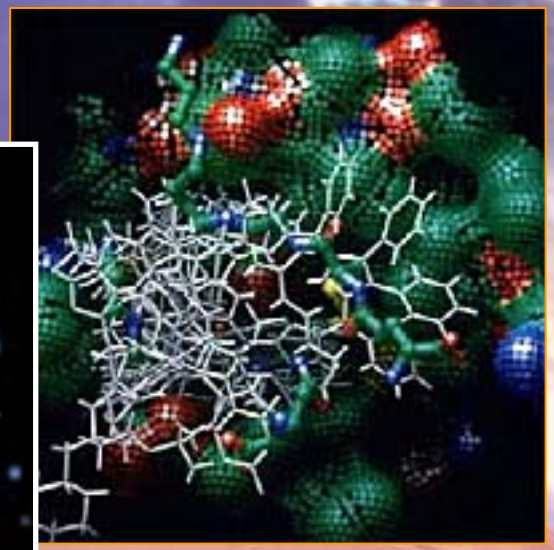
Education

Business

Life and Microgravity Science







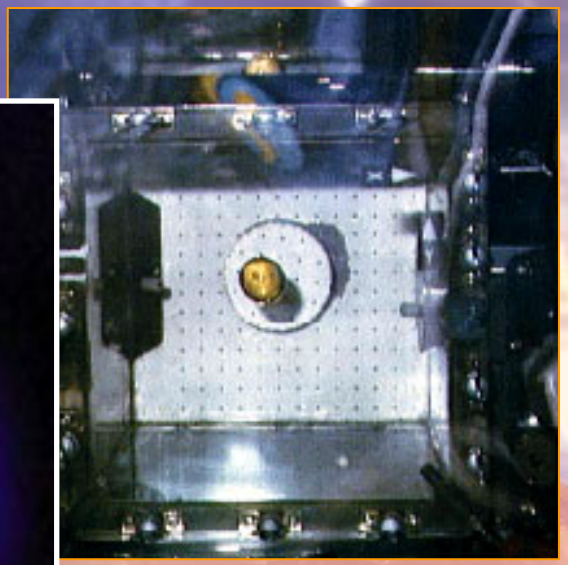
Life and Microgravity Science

Biomedical Science

Biotechnology

Fluid Physics

Combustion Science



Potentially Debilitating Effects of Microgravity

- Bone Demineralization – Osteoporosis
- Impaired Fracture Healing – Non-Union
- Renal Stone Formation & Soft Tissue Calcification
- Orthostatic Intolerance (on return to gravity)
- Cardiac Arrhythmias
- Dehydration (on return to gravity)
- Decreased Aerobic Capacity
- Impaired Coordination
- Muscle Atrophy (Loss of Strength)
- Radiation Sickness
- Increased Cancer Risk
- Impaired Immune Function
- Behavioral Changes & Performance Decrements
- Medical Treatments at Risk


TENNESSE

Research in Artificial Gravity – Human Centrifuge

The Cellular Biotechnology Program

Bio-Nanotechnology Objective:

To use nanotechnology tools to study the affects of the space environment at the sub-cellular level and to develop relevant assays and countermeasures

Guava Flow Cytometer

Current Bio-Nanotechnology Projects:

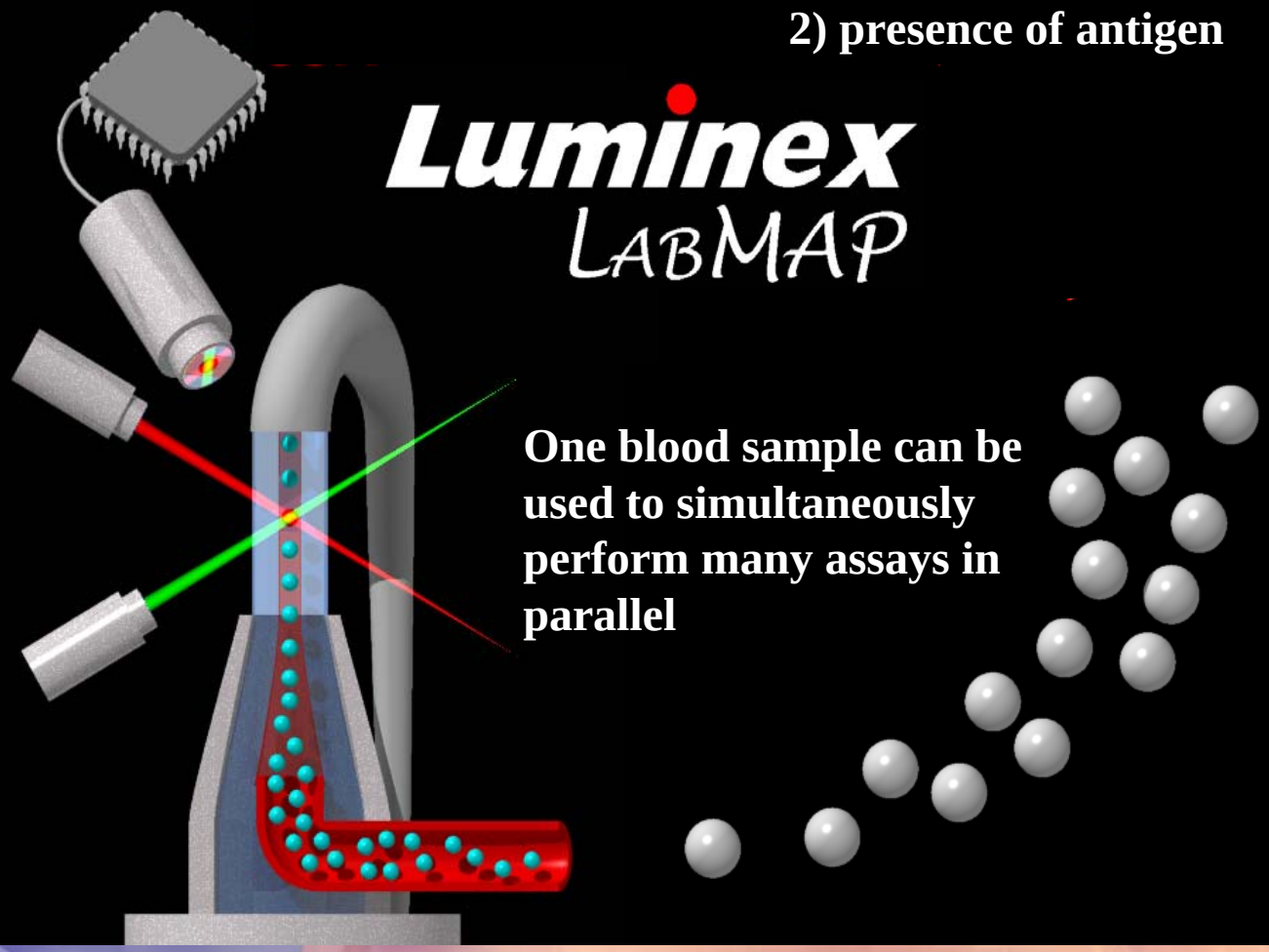
- Multiple simultaneous bio-assays using a flow cytometer and microbeads with 'bar codes' made from quantum dots.
- Mechanical properties of live cells and affects on signaling pathways
- Role of apatite nanoparticles – nanobacteria – in calcification

Bioscope AFM

Flow Cytometer

Bar-coded beads are 'scanned' one at a time

Each bead provides:
1) type of antigen
2) presence of antigen



One blood sample can be used to simultaneously perform many assays in parallel

Cadmium-Zinc-Telluride Research

Earth-grown

"Twins"
(Lattice defect causing mirror image of structure on opposite sides)

Dislocations
(800,000 cm^{-2})
(In best commercial product = 30,000cm^{-2})

Space-grown

"Twins" virtually eliminated

Dislocations
= 800 cm^{-2}

Ref. Dr. David J. Larson, Jr., State University of New York, Stony Brook

Hurricane Frances 9/2/04 as imaged by ISS Astronaut Mike Fincke

Astromaterials Acquisition and Curation

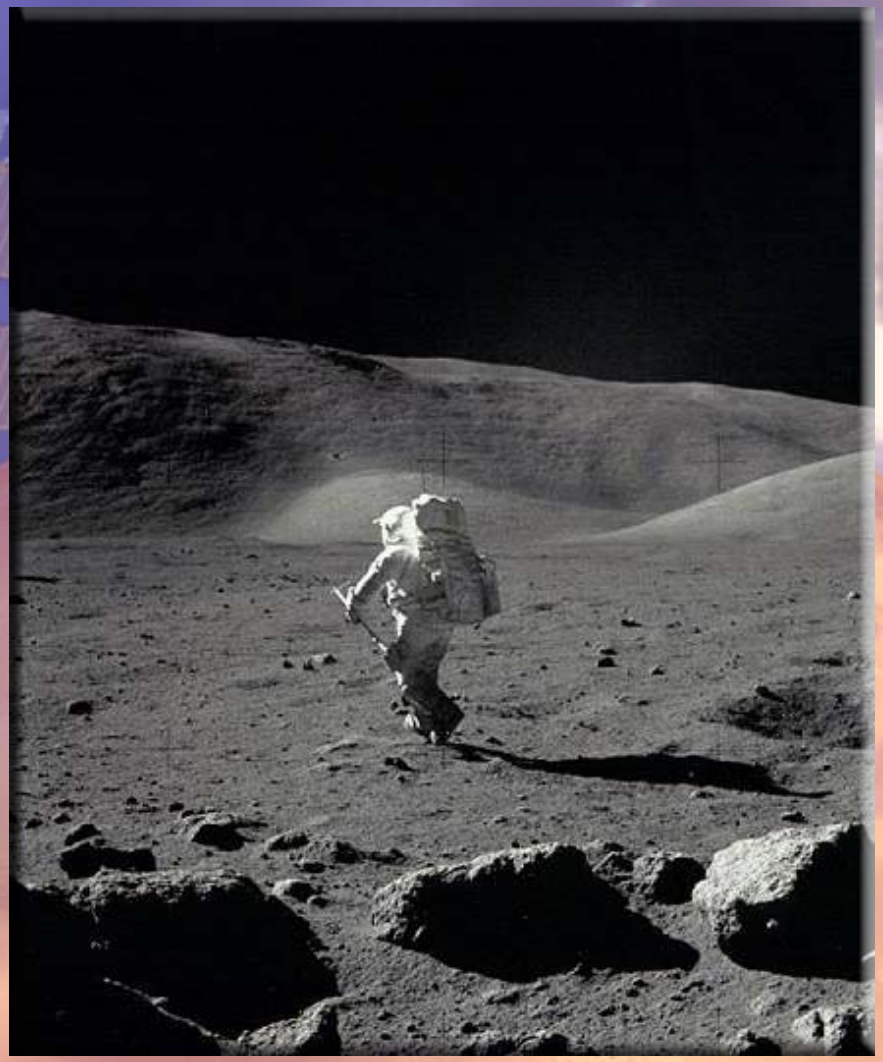
- Current Collections
  - Apollo Lunar Samples
  - Antarctic Meteorites
  - Cosmic Dust
  - Space Exposed Hardware
- Acquisition / Future Curation
  - Stardust
  - Genesis
  - Muses-C
  - New mission proposals
- Advanced Curation Research
  - Robotic sample handling
  - Cold curation
  - Planetary protection

Curation

- Protect, preserve, document, and distribute samples
  - Protect and preserve samples
    - Class 10 storage and processing
    - Clean, N_2 purgeable containers (storage and transport)
  - Document
    - Provide sample information to science community
    - Document and track all sample transactions
  - Distribute allocated samples to approved PIs
    - Clean collector surfaces, if necessary
    - Subdivide samples for allocation
  - Provide all of the above for space exposed hardware

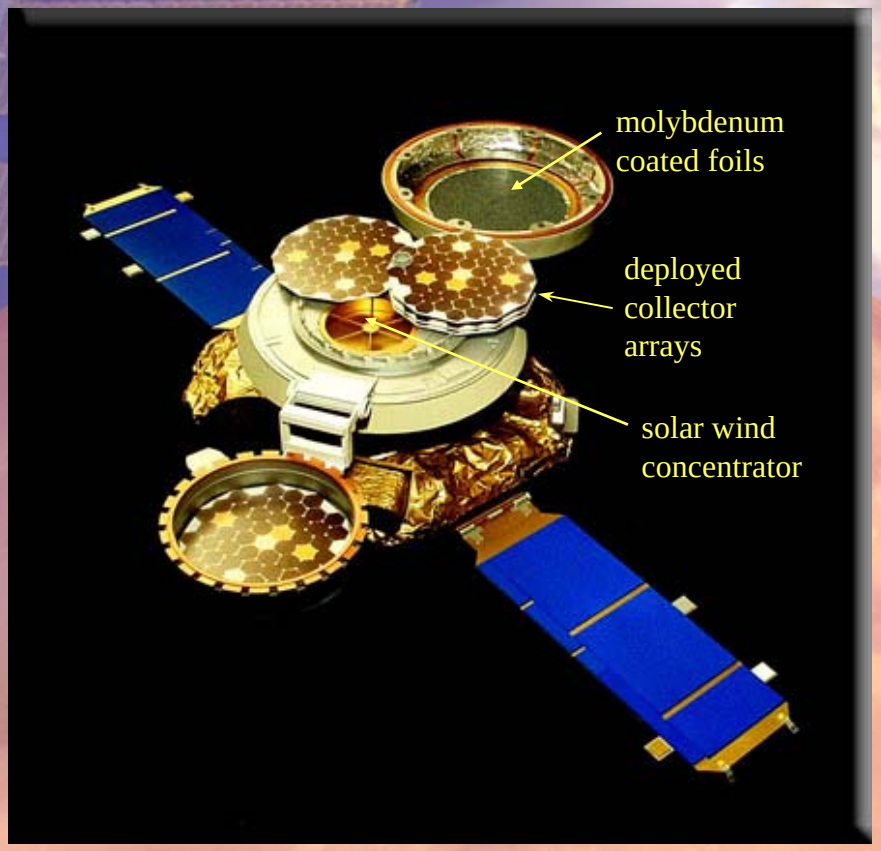
The Importance of Sample Return Missions

- Science is done on the ground
- Instrumentation is state-of-the-art and more
- Ultimate in precision & sensitivity
- Not limited by mass, power, cost or reliability
- Results can be confirmed by several methods
- Instruments can be calibrated
- Analysis is iterative not limited by pre-conceived ideas
- Samples - a resource for present and future study

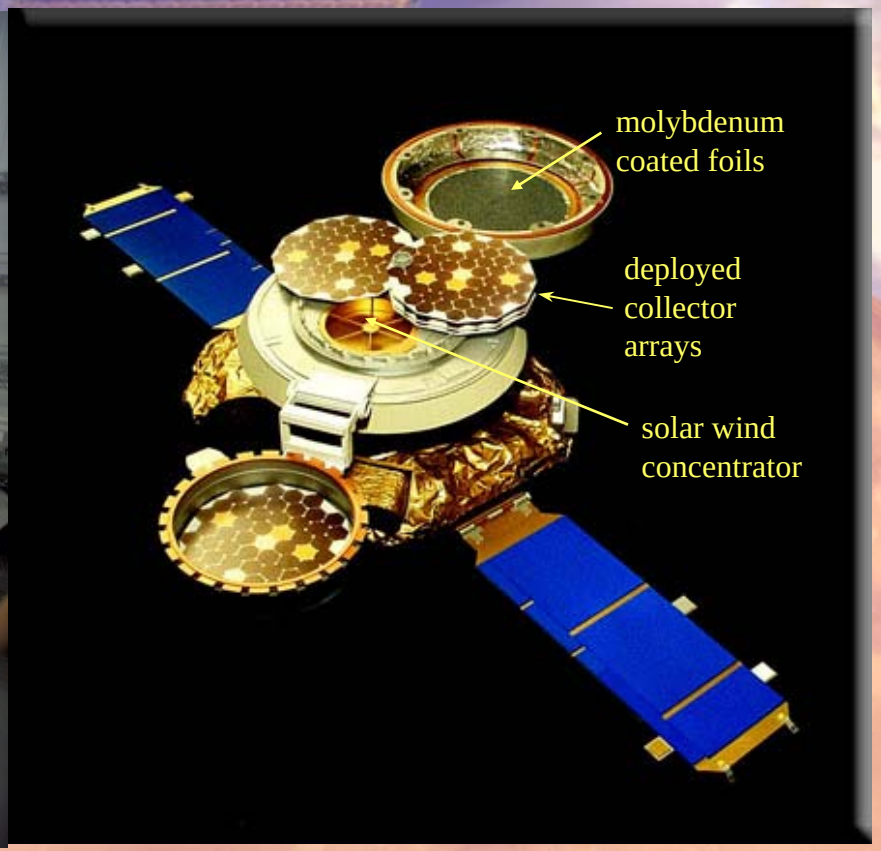


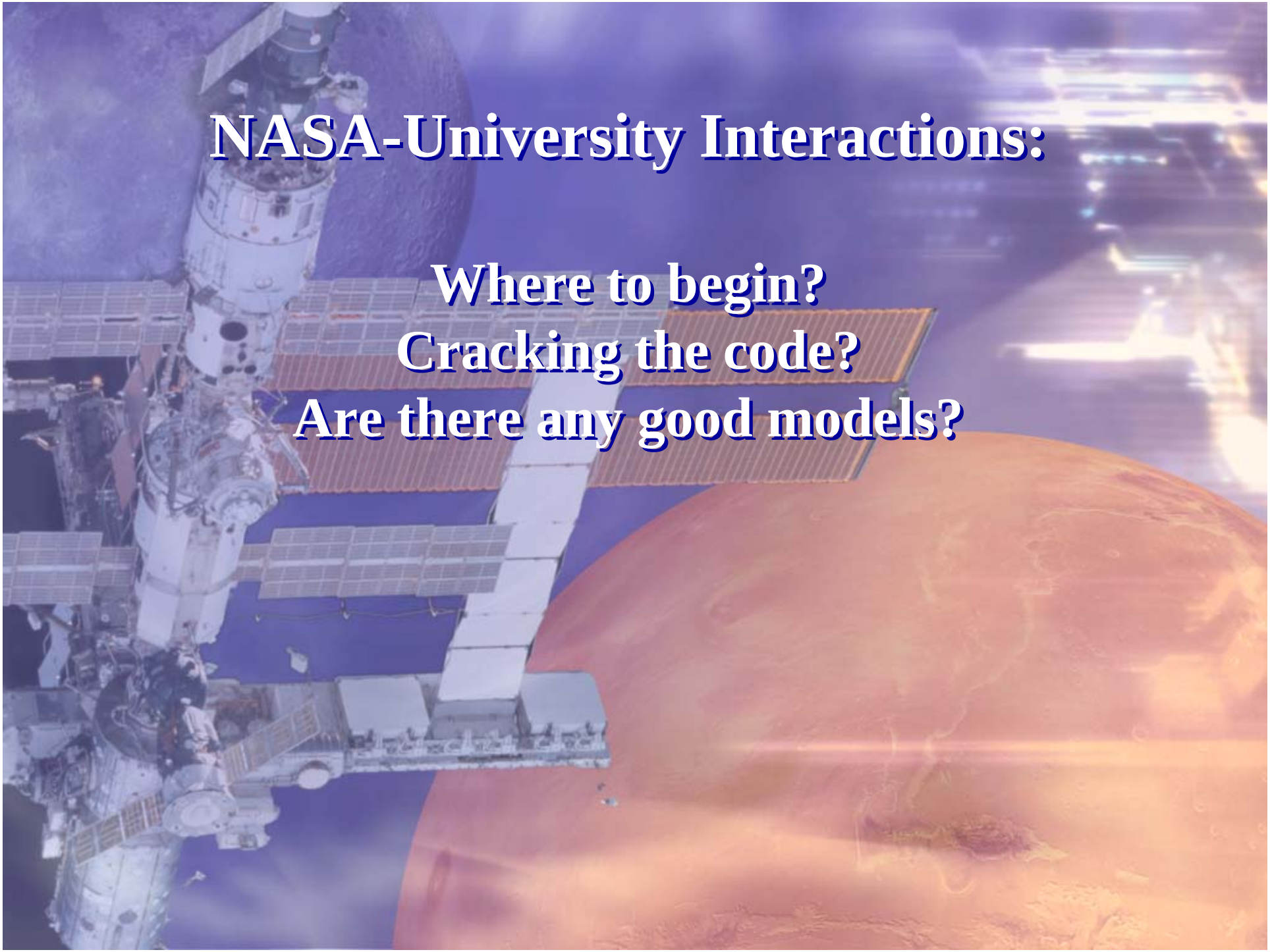
The Genesis Mission: Samples now at JSC

- **Place a Spacecraft Outside the Earth's Magnetosphere**
- **Expose Ultra-Pure Materials**
- **Return Imbedded Solar Wind Samples to Earth**
- **First NASA Extraterrestrial Samples Returned Since Apollo**



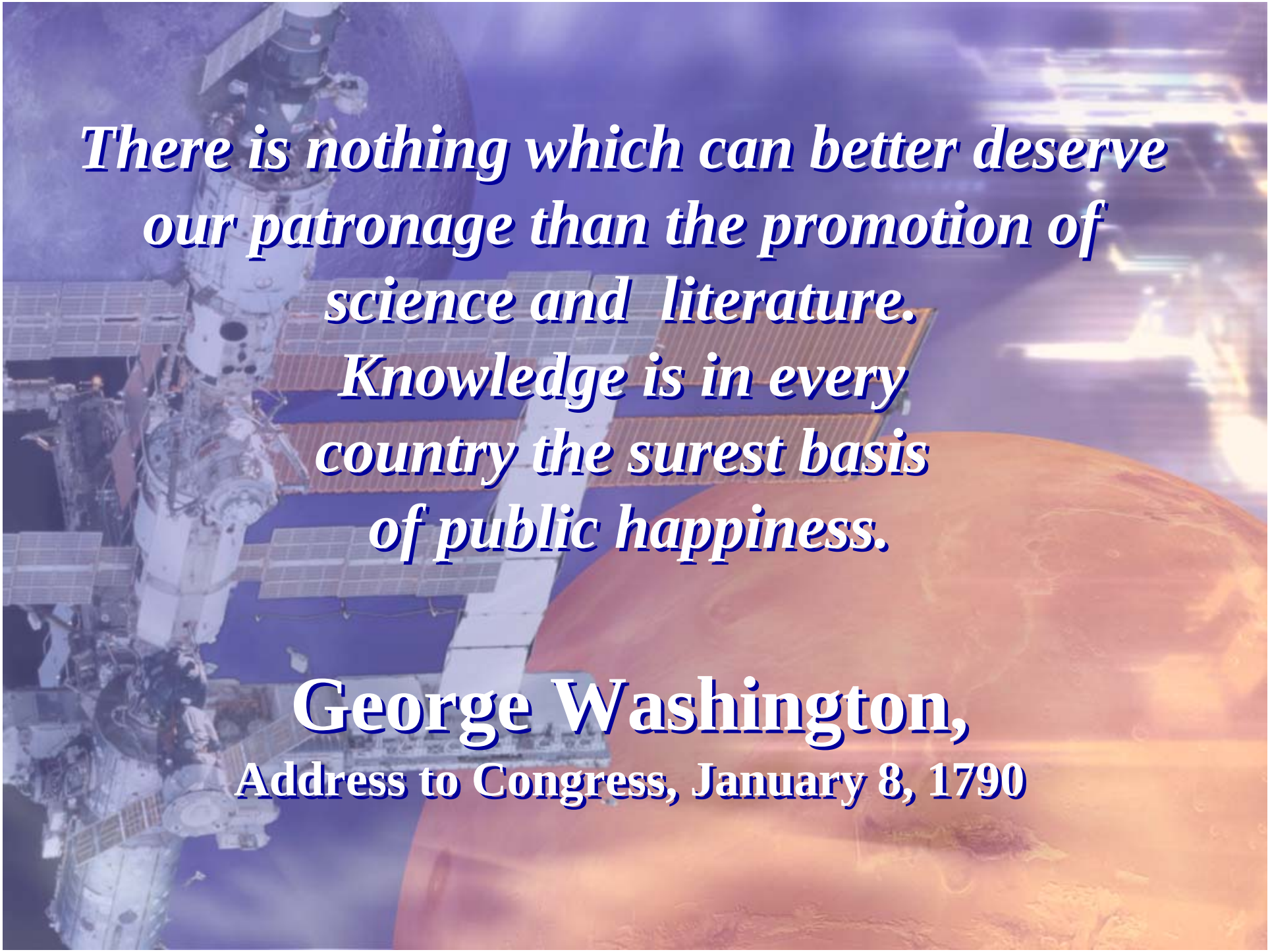
The Genesis Mission: Samples now at JSC





NASA-University Interactions:

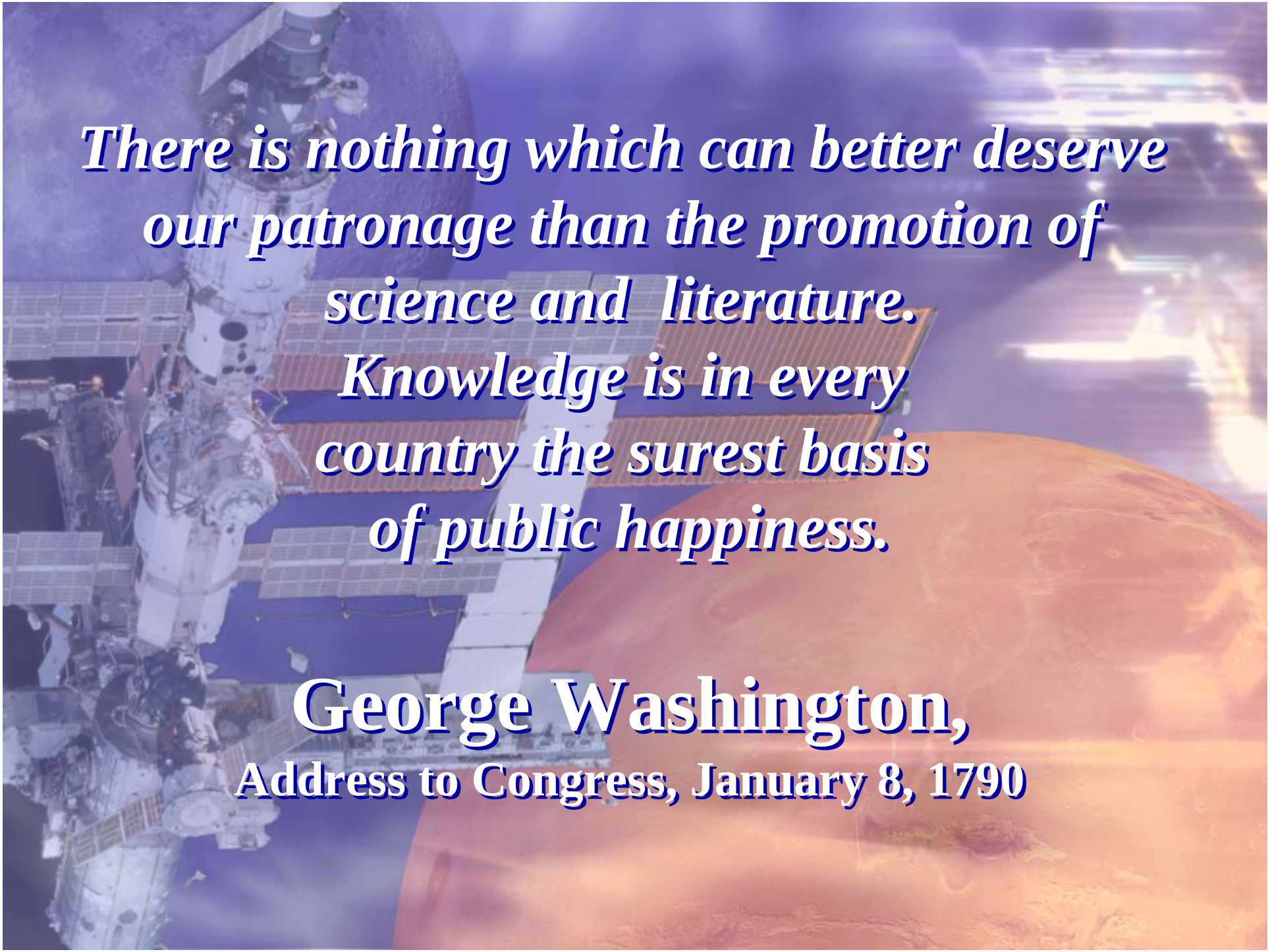
Where to begin?
Cracking the code?
Are there any good models?



There is nothing which can better deserve our patronage than the promotion of science and literature. Knowledge is in every country the surest basis of public happiness.

George Washington,

Address to Congress, January 8, 1790



There is nothing which can better deserve our patronage than the promotion of science and literature. Knowledge is in every country the surest basis of public happiness.

George Washington,

Address to Congress, January 8, 1790

Space Grant consortia: NASA's Representatives in the States

- Benefits of long-term relationship between NASA and the states
- Makes contributions to NASA's workforce and pipeline priorities and the agency initiatives in Education

(from NASA HQ website)

NASA Centers are different and have their unique cultures that have evolved over the years.

Understanding the cultural traits of your center is vital for successful interactions.

NASA/JSC Culture

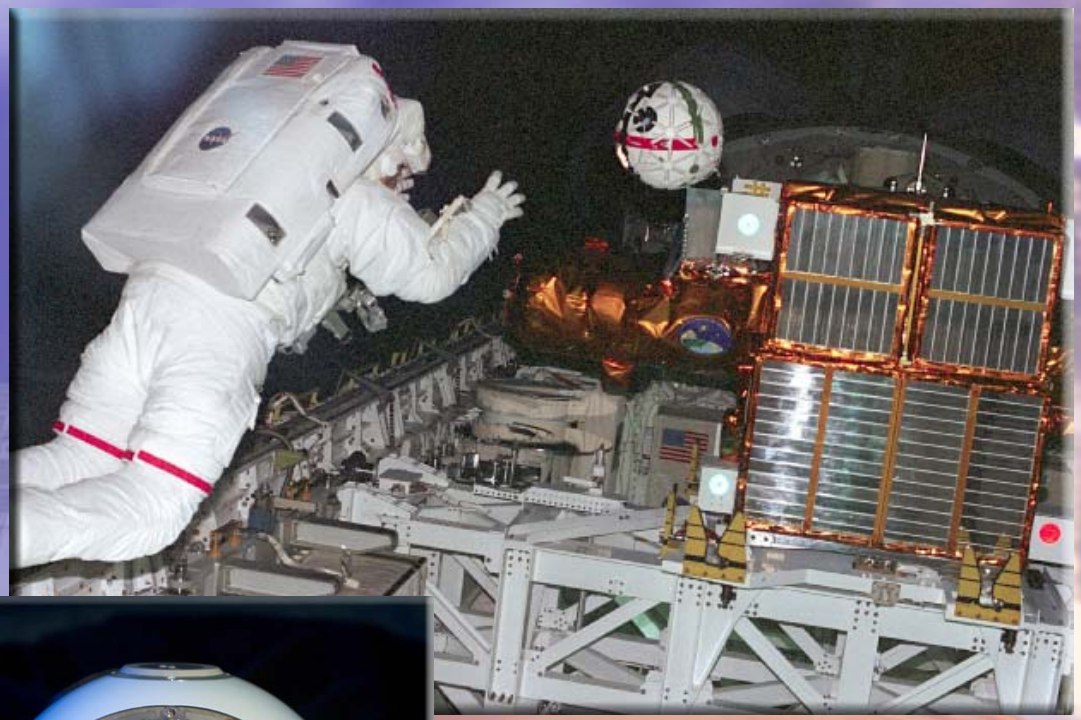
- Advisory/participatory management style
- Emphasis on hands-on engineering
- Demand technical accuracy
- Development of sophisticated testing facilities
- Emphasis on systems engineering

(*A History of Johnson Space Center, 1993*)

JSC is an Engineering and Operational Center

Mission Operations are a very "High Priority"

JSC initiatives require a systems approach with integrated solutions and assessments



JSC Values
Applied Research and Technology Development

What is unique about JSC?

JSC is an engineering and operational center.

Mission Operations are a “high priority”.

JSC values applied research and technology development.

JSC initiatives require a systems approach with integrated solutions and assessments.

What does JSC want from the University Community?

Two-way Technical Interchange:

JSC Engineers need state of the art technological innovations and information from universities for applications in mission operations

JSC Engineers would like to communicate their technical developments to the universities (e.g. inspection days)

JSC endorses the concept of "Capstone courses" in engineering that emphasize systems approaches

What does JSC want from the University community?

Workforce development:

JSC strongly supports the diversity in workforce and would like universities to enhance minority engineering education

University Research and Affairs Office Interfaces at JSC

NASA Management

NASA HQ

University Research and Affairs Office

AH Education Program

AJ Minority Program

Colleges and Universities

Universities and NASA/JSC

University research and technology

- Basic and applied research, test facilities, prototype development, low to mid range Technology Readiness levels
- Trained work force
  - Undergraduate
  - Continuing education
  - Advanced degrees

NASA/JSC provides

- Expertise, mentoring, and inspiration
- Collaboration
- Teaching at Universities
- Facilities

NASA/JSC needs

- Employees
- Research and technology

JSC education programs:

University/College: Engineering /Science

160+ Coops in 2003-2004

25+ Summer Interns

15 NRC Postdoctoral Associates

25 Postdocs in life sciences/engineering

22 Faculty in NFFP and dozens in various JSC science/engineering Labs.

Over 120 High school students in Various JSC programs

Spending a sabbatical at JSC

Conduct collaborative research on-site at JSC

"There is a tremendous <u>infusion</u> of faculty and students at JSC. The numbers may not show it. The statistics do not capture this vital interaction…."

Dr. Helen Lane, URAO

Some recent examples faculty collaborations with JSC (not a complete list):

National Biomedical Research Institute's

Consortium (Baylor College of Medicine and others)

Rice University/JSC collaboration in

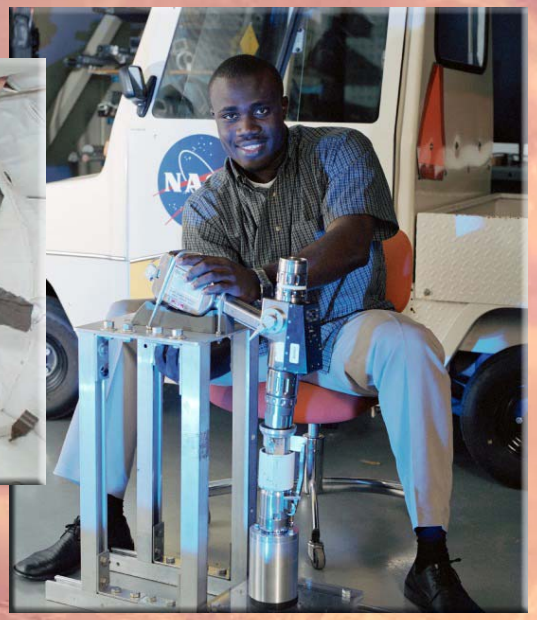
Nanotechnology/Space Physics

Lunar Planetary Institute

Minority University Research Centers (e.g. Texas Southern University, Prairie View A and M University)

Opportunities at JSC

- Undergraduate education programs
- Community College Aerospace Scholars (CCAS)
- KC-135 student flight opportunities
- Lunar and Planetary Institute Summer Intern Program in Planetary Science



NASA Johnson Space Center (JSC) Student Sponsorship Program

Program Objectives:

- Build a strong relationship between universities, students, and NASA JSC
- Provide hands-on career exploration opportunities for students
- Provide student work exposure to the aerospace industry
- Encourage student interest in science, technology, engineering, and mathematics fields
- Train and develop students for future employment in the aerospace industry

Applicant Requirements:

- Enrolled in an accredited college or university pursuing a bachelor's degree in Engineering, Science, or Business
- US Citizen
- Available to work at NASA JSC a minimum of 15 weeks (duration must be acceptable to the organization) during Spring or Fall semester

Cost to Your College/ University:

The cost to sponsor a student at NASA Johnson Space Center for a 15-week semester session is approximately $8300. For your investment, you will receive

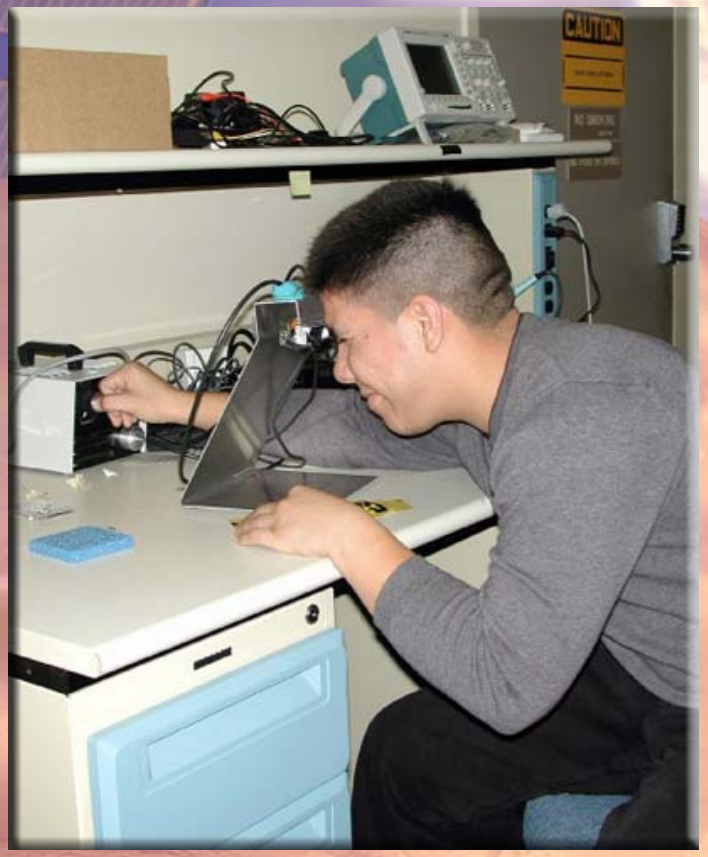
- The opportunity for your student to work directly with NASA engineers and scientists on human space flight projects
- Career development and financial stipends to deserving students
- Strengthen affiliation between university and NASA

For more information, please contact
Bob Musgrove at robert.p.musgrove@nasa.gov
or 281-483-3065
Classification: Higher Education
Collaboration: JSC/Space Grant

Opportunities at JSC

National Space Grant College and Fellowship Program

Summer temporary program leading to college training



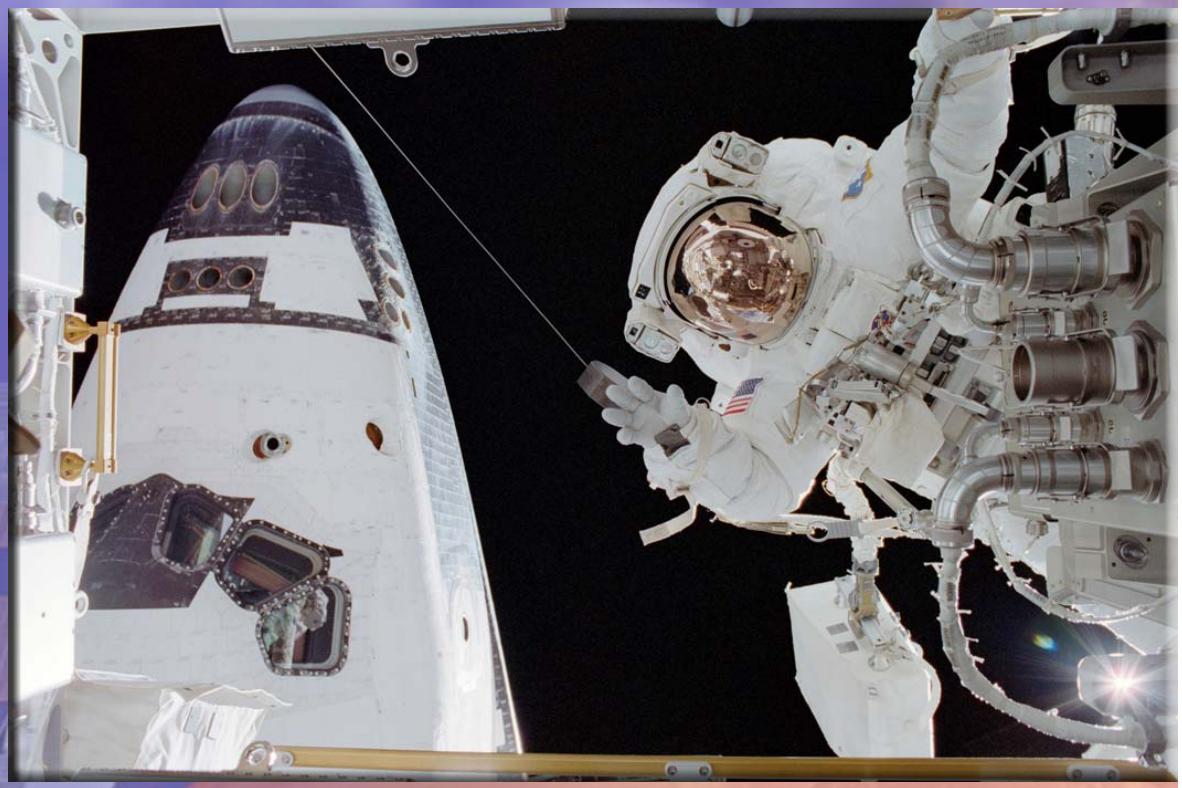
Undergraduate Student Researcher Program

Space Science Outreach and Research Minority Serving Universities

Challenges:

Communications

Changes in NASA staff and changes in NASA missions, focus



Culture at NASA Centers:
Space Grant not considered a NASA program at Centers

Competition instead of cooperation with NASA centers

Role/s of UAO at NASA Centers

Summary

- NASA Johnson Space Center will benefit from universities in:
  - Basic research for next generation of exploration initiatives
  - Accelerated development of critical technologies
    - Power
    - Computing, communications, networking
    - Nanotechnology
    - Robotics
    - Advanced Materials
- Requires collaborative work across NASA Centers, universities, and industry

Johnson Space Center
Biannual Research and
Technology Development

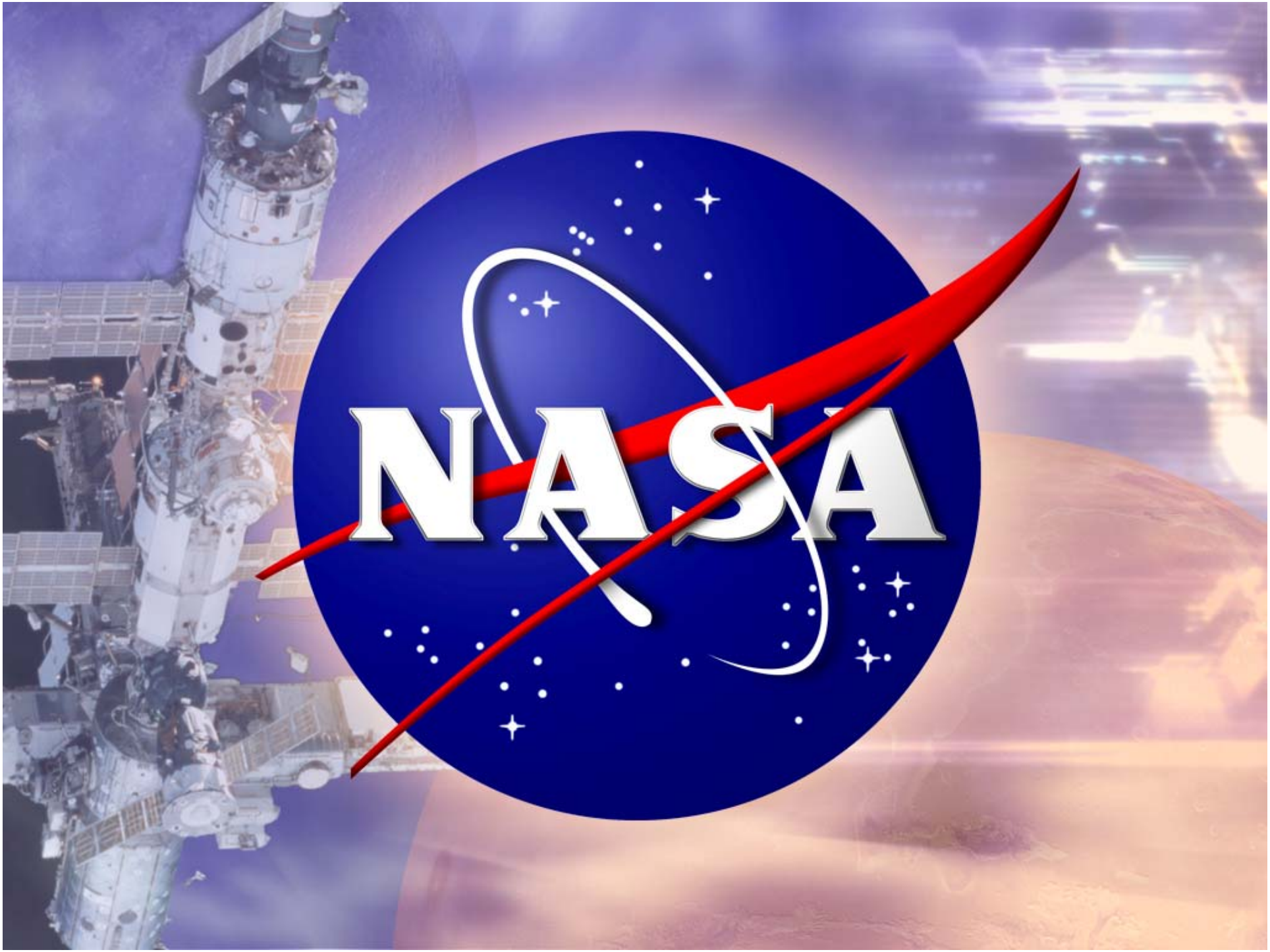
WEB PAGE

http://research.jsc.nasa.gov

http://research.jsc.nasa.gov

Dr. Helen Lane
University Research and Affairs Office
helen.w.lane@nasa.gov
Dr. Kamlesh (Kam) Lulla
kamlesh.p.lulla@nasa.gov

(281) 244-7542 or (281) 483-7165


NASA