



Section 1

Microgravity Science Division & Microgravity Environment Program Overview

Dave Francisco

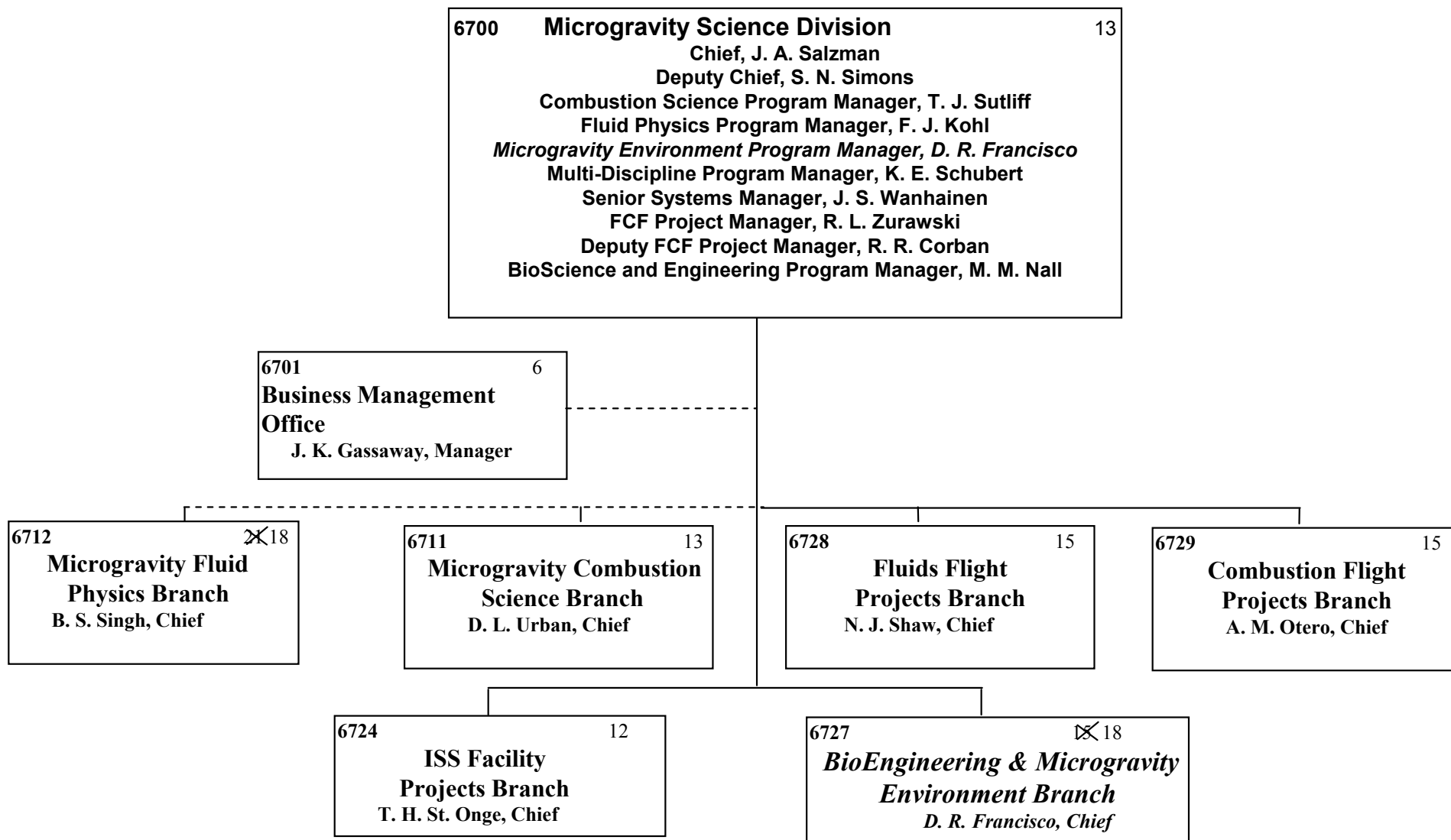
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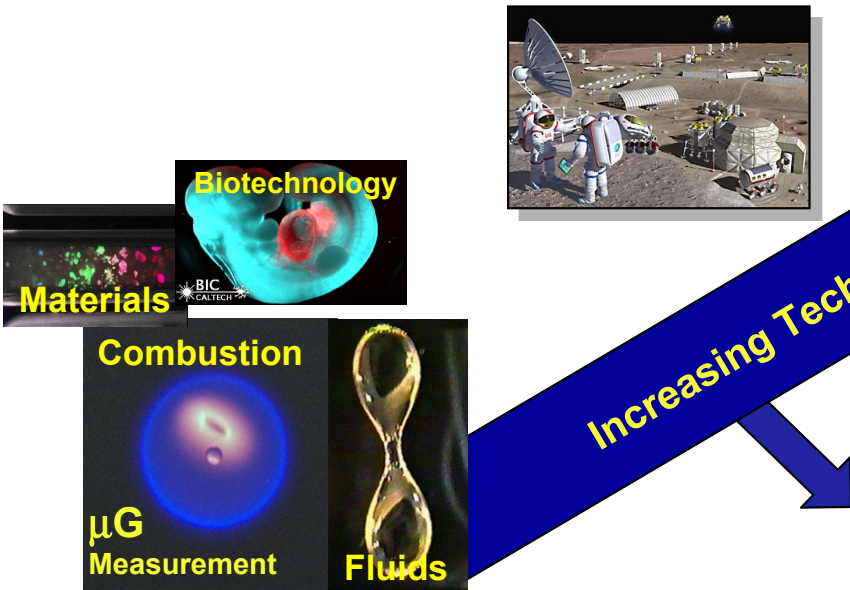


Microgravity Science Division Organization



BioScience and BioEngineering

Goal 9 *Extend the duration & boundaries of human space flight to create new opportunities for exploration & discovery*

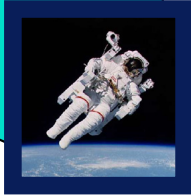


- ✓ Fluid Modeling of Physiological, Vehicle & Cell Culturing Systems
- ✓ Low gravity effects on fluid to cell environment
- ✓ Fluids & combustion sensor technology for biomedical & advanced life support
- ✓ 1g g-jitter measurement of bioreactors

NASA BioScience & Engineering Institute

- ✓ BioMEMS
- ✓ Bio materials
- ✓ Transport phenomena in biology & devices
- ✓ Lab-on-chip
- ✓ Molecular Nanosystems
- ✓ Tissue BioScience and Engineering

✓ Miniature, low power, reliable Vehicle & Human Space Systems
 ✓ Biomedical diagnostics & environmental sensors
 ✓ Radiation, bone loss countermeasures
 ✓ Medical applications



The John Glenn Biomedical Engineering Consortium

- ✓ Biomedical Issues
 - Medical diagnostics
 - Medical Treatment
 - Countermeasures

Microgravity Science Division Human Exploration Program(s)

GRC is supporting the human exploration initiative in the following areas:

BioScience and BioEngineering Program

- Medical Systems – development of technology in line with Critical Path Roadmap
- Bone and Muscle – methods/processes/countermeasures to understand and mitigate bone loss and muscle atrophy in low gravity
- Environmental Control and Monitoring – development of technology in support of the crew and vehicle systems
- Digital Human – computational modeling of the human body with effects of low gravity – aid in the development of countermeasures

Fluid and Combustion Programs

- Fire Research, Detection and Suppression – applying microgravity combustion expertise
- Life Support Systems – applying microgravity fluids expertise
- Advanced Propulsion Systems & Space Power - applying microgravity fluids expertise
- In-Situ Fabrication & Repair - applying microgravity combustion expertise
- ISRU - applying microgravity combustion expertise



Microgravity Science Division BioScience and BioEngineering Program

We are implementing the program via intramural strategic research and obtaining extramural strategic research partnering via the following:

NASA John Glenn Biomedical Engineering Consortium – 10 projects

Projects funded to address risks identified in the Bioastronautics Critical Path Roadmap - Partnership with local medical institutions

NASA BioScience and Engineering Institute – University of Michigan

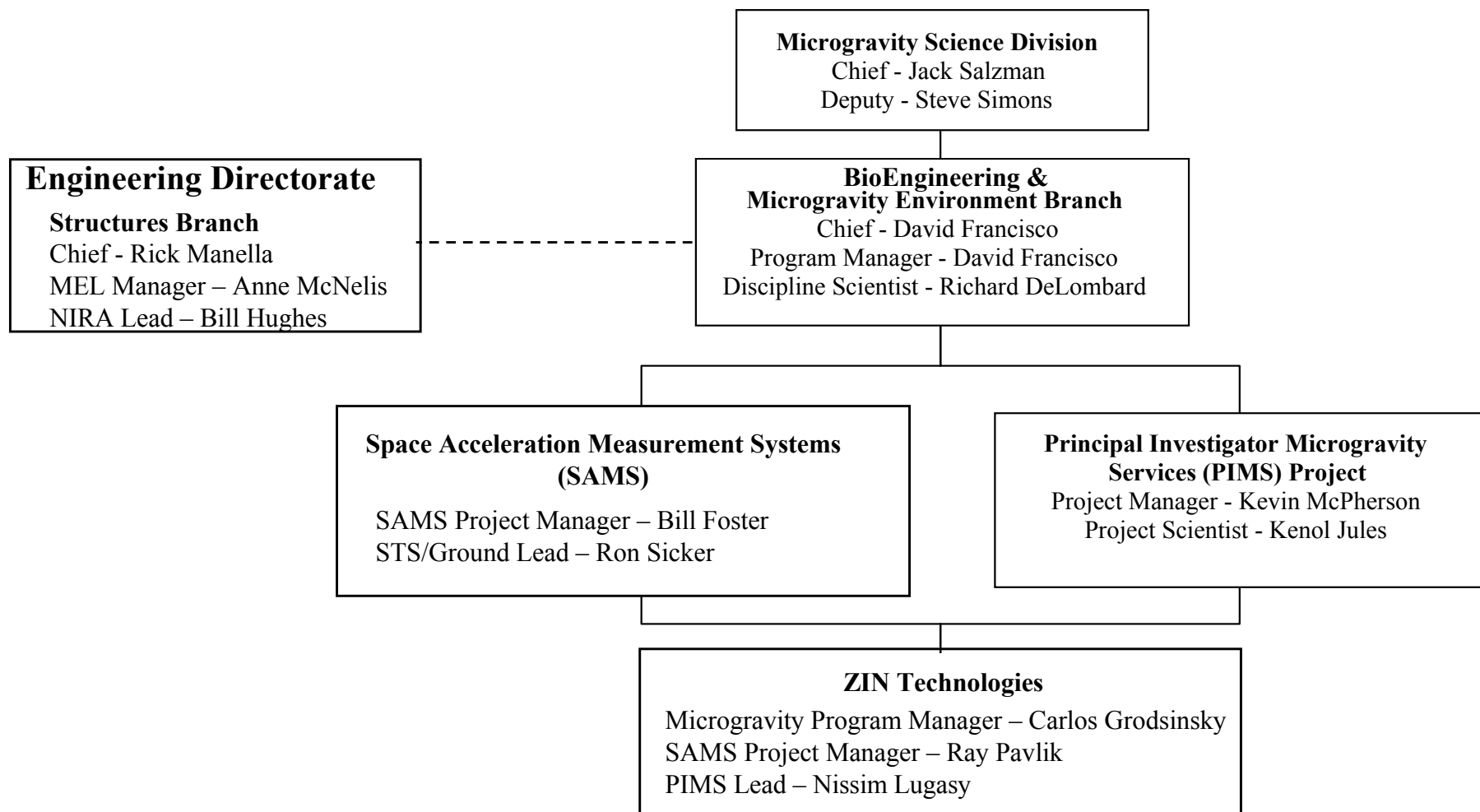
To enable world-class research, development, U.S. technology transfer, and education in BioScience and Engineering related to NASA's Human Exploration mission(s) –

Areas of emphasis are:

- Transport Phenomena in Biology and Devices**
- Tissue BioScience and Engineering**
- BioMEMS and Biomaterials**
- Molecular Biophysics and Bioengineering**

Interagency agreements with NIH and NEI

GRC Microgravity Environment Program Organization



Microgravity Environment Program

What is the Microgravity Environment Program (MEP) charter?

We provide the following services:

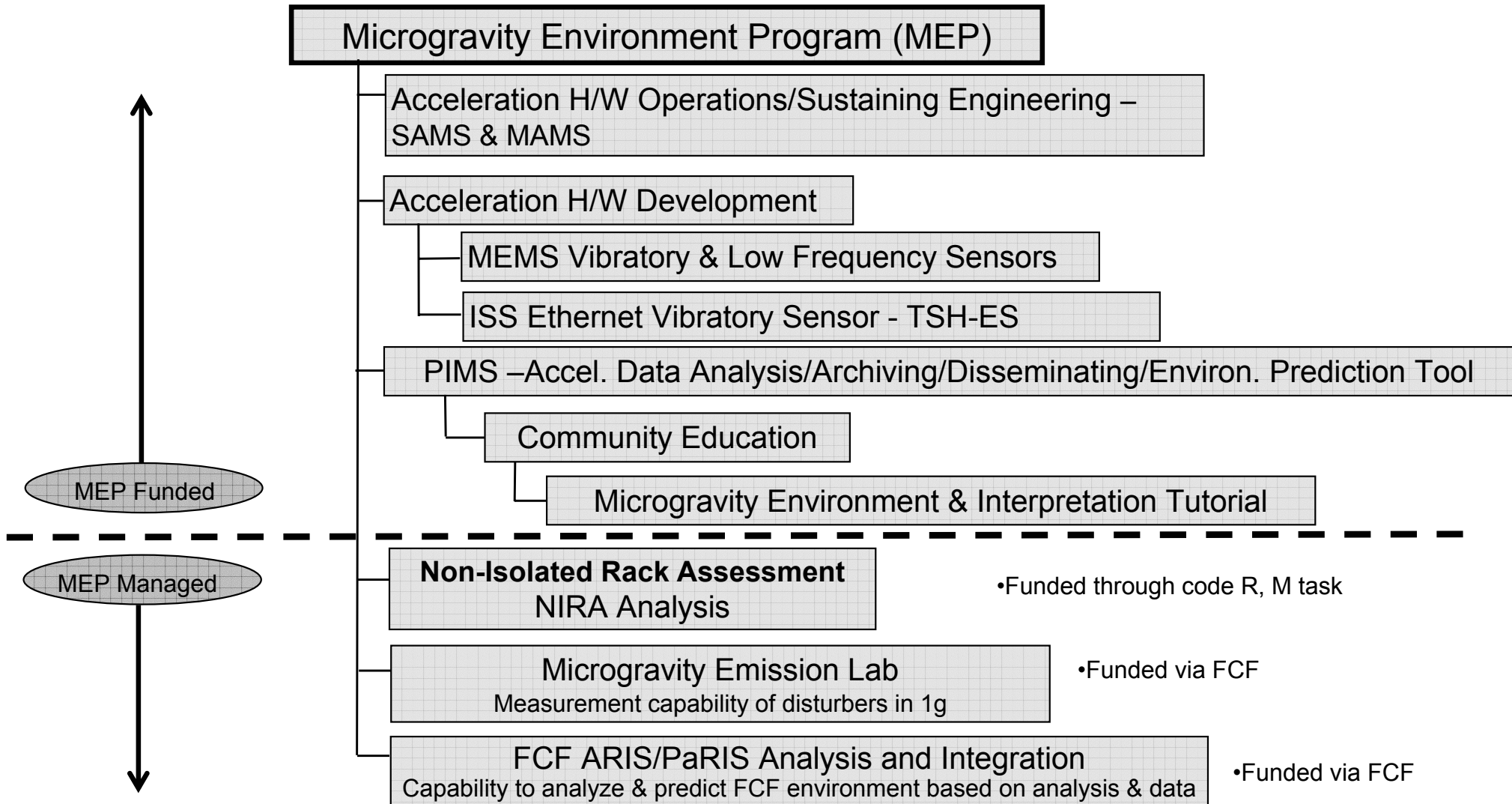
- Acceleration Measurement Instruments for space and ground applications
- Detailed acceleration data analysis
- Platform Environment Characterization (identification of disturbers)
- Environment education
- Support for ISS microgravity requirements verification with dynamics emissions characterization testing and payload analysis techniques/processes.
- ARIS/PaRIS integration and analysis
- ISS Microgravity Environment Prediction capability
- Non-Isolated Rack Assessment - NIRA

Our customers include:

- Principal Investigators
- Technology Developers
- Crew Members
- Payload Developers
- Vehicle Developers

We are sponsored by NASA's Code U program.

Microgravity Environment Program at NASA Glenn Research Center

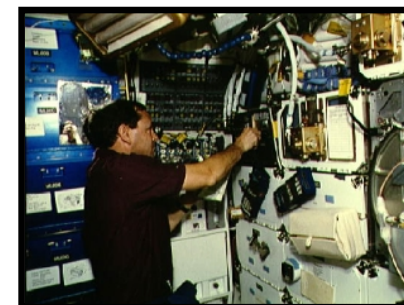


Microgravity Environment Program History

Space Acceleration Measurement System (SAMS) – 15+ yrs

Missions supported on Sounding Rockets, STS, Mir

- SAMS has characterized 20+ flights on STS & 3+ years on Mir
 - Flown on sounding rockets
- OARE - Low frequency measurement system flown 12 times on STS



SAMS on STS

International Space Station (ISS)

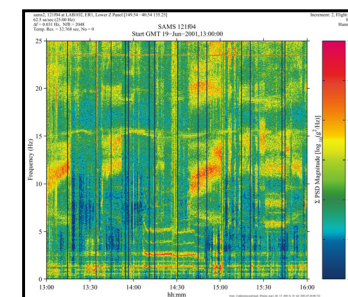
- SAMS- II - The Vibratory Acceleration Measurement System for ISS
 - Launched on 6A
 - Operational since June 2001 – 20,000+ hours operations
- MAMS - Microgravity Acceleration Measurement System –
- Low frequency measurement system for ISS plus vibratory to 100 Hz
 - Launched on 6A
 - Operational since May 2001 – 20,000+ hours of operation



SAMS II - ISS

PIMS- Principal Investigator Microgravity Services

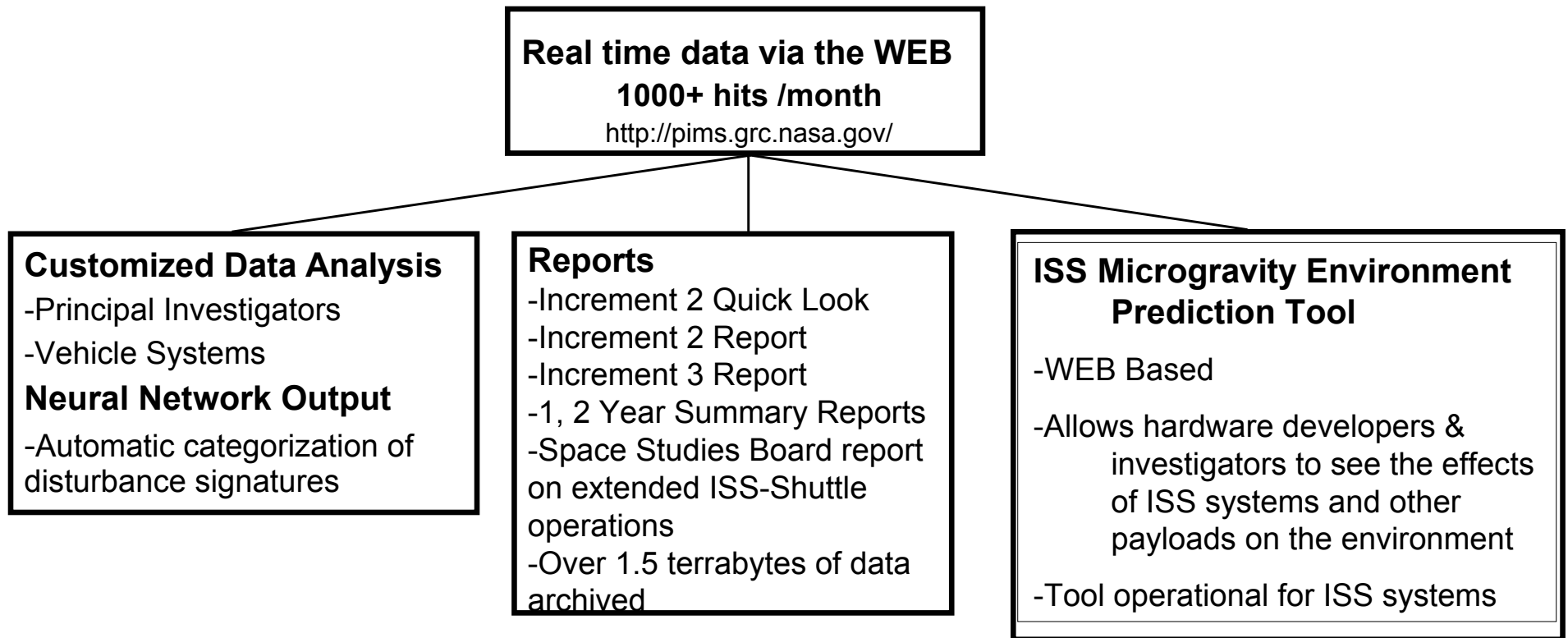
- – Processed over 1900 user requests and documented over 20 flights,
- 5 flight platforms, and multiple ground based platforms
- Near real time ISS data on WEB, Increment reports complete
- ISS Microgravity Environment Prediction Tool
- 7th MEIT, 22 MGMGs



PIMS Data Processing

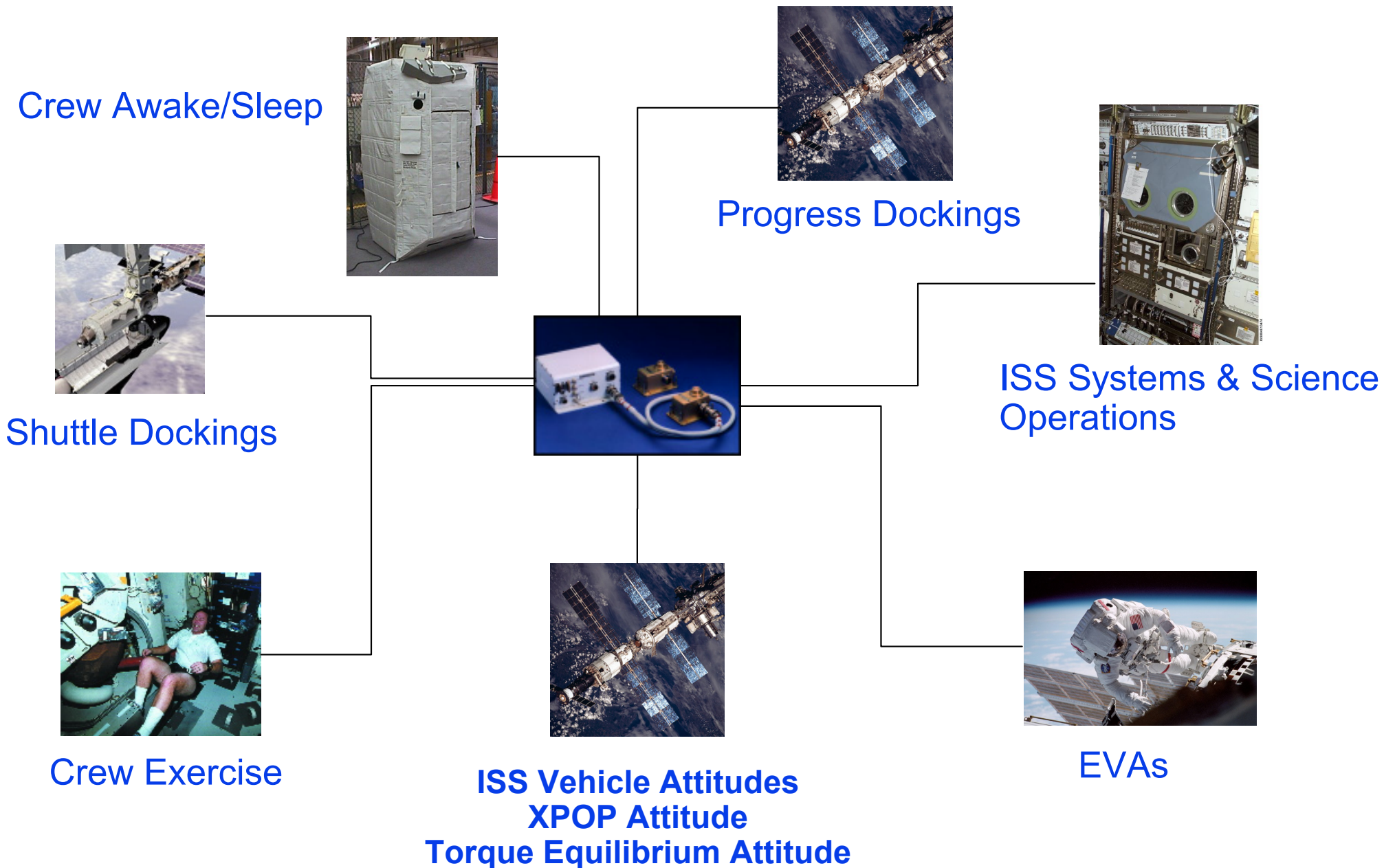
PIMS- Principal Investigator Microgravity Services

– Process, analyzes, documents and disseminates real time data via the WEB and Annual Reports.



PIMS Software received 2003 R&D 100 Award

ISS Environment Measurement and Characterization



SAMS New Sensor Developments

Three new sensors under development

MEMS - Vibratory Sensor

- Reduces volume by 33%.
- Cost < \$2500, 85% reduction.
- Reduces power by 50%.
- Sensor selected, tested, engineering model designed & assembled

MEMS- Low Freq Sensor

- Fabrication techniques identified
- Grant in process to determine feasibility
- Could reduce volume drastically

Triaxial Sensor Head -ES

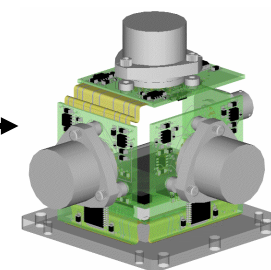
- Ethernet standalone sensor.
- Replaces EE and SE with one unit.
- Reduces two boxes to one
- Volume savings of 6 to 1.
- Flight units built and tested, ready for implementation



NASA
C-2002-1881
National Aeronautics and Space Administration
John H. Glenn Research Center at Lewis Field



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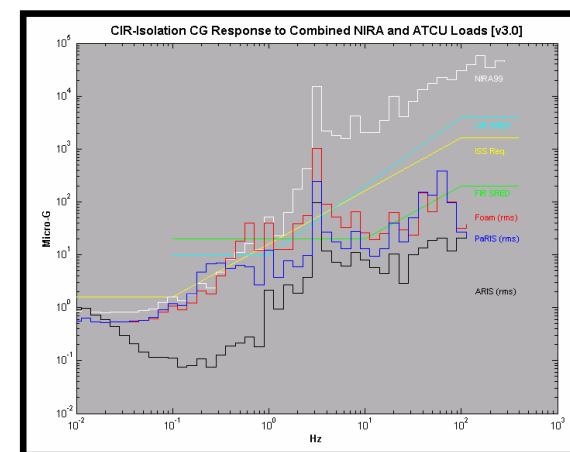


Microgravity Environment Program

- Support for ISS microgravity requirements verification by testing and analysis.
- Testing
 - Dynamics Emissions Characterization by utilizing the Microgravity Emissions Laboratory (MEL). The MEL utilizes a 6 DOF inertial measurement system, capable of characterizing disturbances (down to $0.1 \mu\text{g}'\text{s}$) of the space-flight hardware.
- Analysis
 - Payload analysis techniques/processes for ISS microgravity verifications which includes:
 - PIRN 110H and ARIS Rack level allocations
 - Microgravity isolation approaches and integration processes
 - ARIS, Passive vs Hardmount comparisons
 - Verification/validation approaches and model requirements

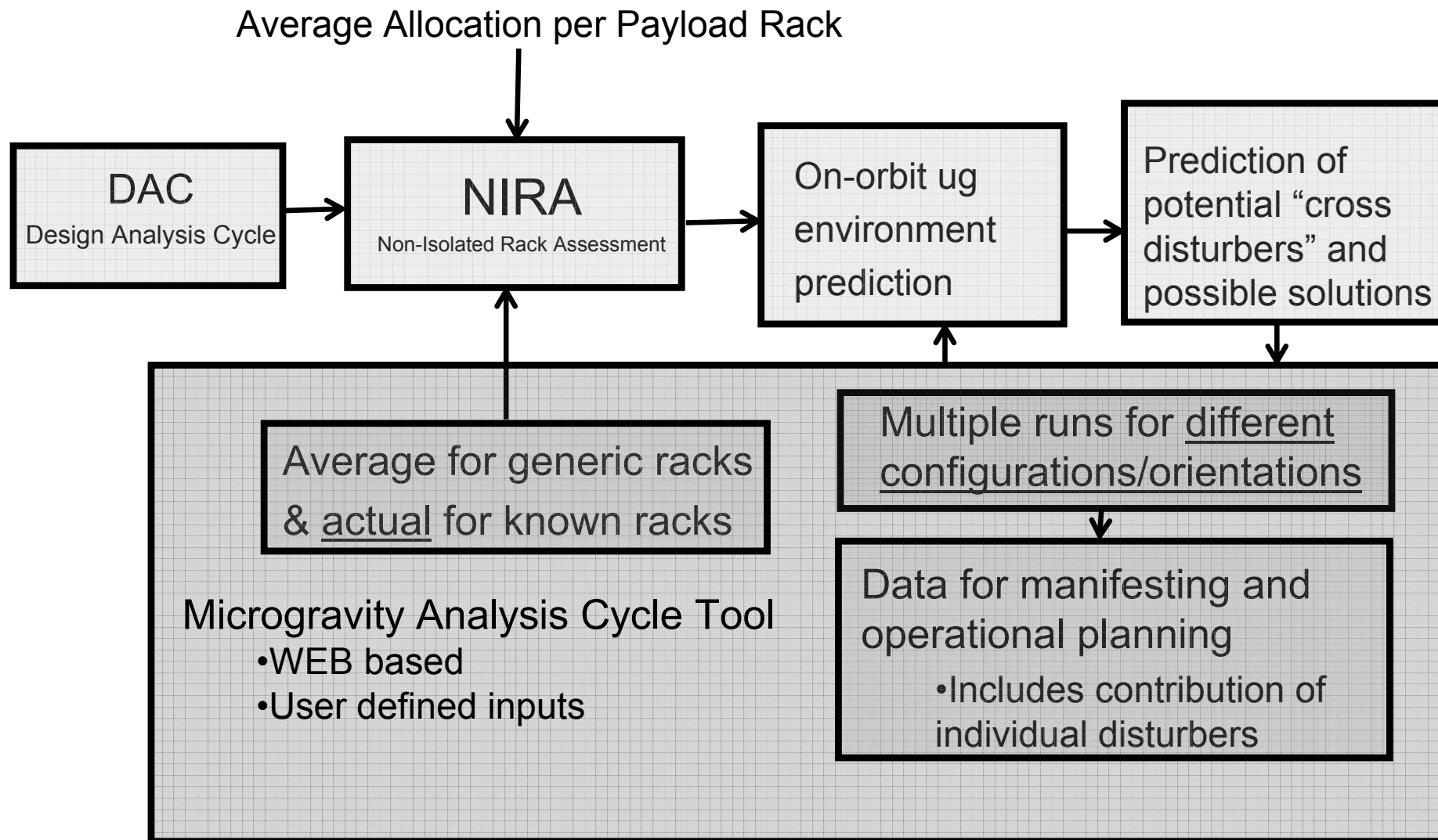


Middeck locker suspended in the MEL



Comparison of Isolation techniques for FCF CIR

Microgravity Environment Assessment Tool





Microgravity Environment Program

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