

PIMS Interaction with Principal Investigator Teams

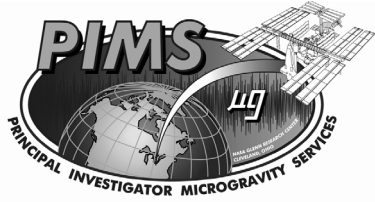


SECTION 3

PIMS Interaction with Principal Investigator Teams

Kenol Jules
PIMS Project Scientist
NASA Glenn Research Center

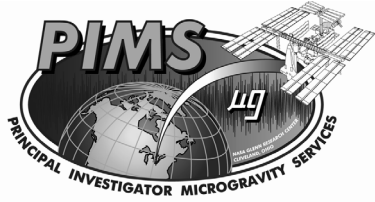
March 4th, 2003



PIMS Interaction with Principal Investigator Teams



- **PIMS performs the project scientist role for the accelerometer instruments**
 - **PIMS works with the science experiment principal investigators, project scientists, and other program participants to assist in the understanding and utilization of the acceleration data**
 - **PIMS products include general and specific analyses, vehicle characterization, and mission summary reports**
 - **PIMS conducts the Microgravity Measurements Group (MGMG) meetings to foster interchange of data and information within the microgravity environment community and to the microgravity science community**
 - **PIMS conducts the Microgravity Environment & Interpretation Tutorial (MEIT) to convey significant features of the reduced gravity environment to the microgravity Principal Investigator teams and other interested parties**

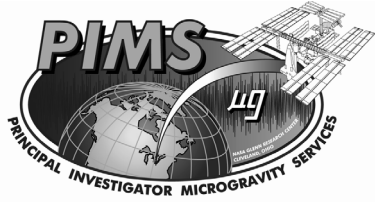


PIMS Interaction with Principal Investigator Teams



PIMS' Missions are:

- **To assist PI teams in understanding different aspects of measuring and interpreting the reduced gravity environment of various platforms and ground-based facilities.**
- **To provide interpretation of the reduced gravity environment and perform detailed analyses for general and specialized characterization.**
- **To educate PIs, Project scientists and associates about the reduced gravity environment through the annual gatherings:**
 - **Microgravity Environment Interpretation Tutorial (MEIT)**
 - **MicroGravity Measurements Group (MGMG)**



PIMS Interaction with Principal Investigator Teams



- **Microgravity Environment Interpretation Tutorial (MEIT)**

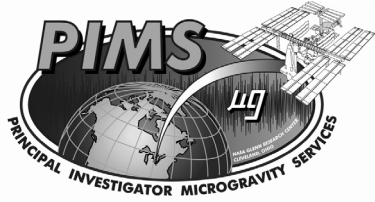
A yearly educational opportunity for PI teams and other interested parties to understand the reduced gravity environment.

- **Purpose**

Present to PI teams information about the reduced gravity environment regarding the:

- effect of acceleration on experiments
- nature of the reduced gravity acceleration environment
- methods of measuring the accelerations
- methods of processing the acceleration data
- methods of presenting/displaying the acceleration data
- examples of the reduced gravity environment and experiment effects

<http://www.grc.nasa.gov/WWW/MMAP/PIMS/MEIT/meitmain.html>



PIMS Interaction with Principal Investigator Teams



•Microgravity Measurements Group Meeting (MGMG)

Participation from investigators in all areas of microgravity research, including science experiment principal investigators and project scientist, numerical modelers, instrumentation developers, vibration isolation developers and acceleration data analysts

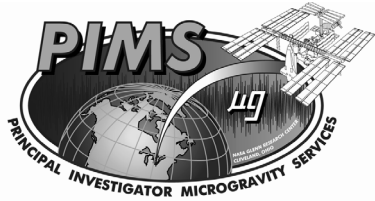
•Purpose

A forum for exchange of information and ideas about various aspects of microgravity acceleration research in the NASA Microgravity Research Program.

•Topics (some past topics):

- Disturbances by microgravity science experiments
- Microgravity constraints on payloads
- Operational performance of SAMS and MAMS instruments
- Impact of crew exercise and other activities on environment
- ARIS-ICE and ARIS performance
- NASDA and Russian accelerometer systems discussion

<http://www.grc.nasa.gov/WWW/MMAP/PIMS/MGMG/mgmgmain.html>



PIMS Interaction with Principal Investigator Teams



Principal Investigator Microgravity Services (PIMS)

Support NASA's Microgravity Research Program Principal Investigators (PIs) by providing acceleration data processing, analysis, and interpretation for a variety of reduced gravity carriers and ground-based facilities, such as:

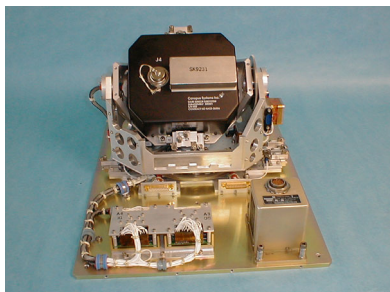
- Space Shuttle
- ISS
- Sounding Rockets
- Parabolic Flight-Path Aircraft (KC-135)
- Drop Towers
- Ground Testing
- Microgravity Emission Lab (MEL)

Principal Investigator Microgravity Services (PIMS)

Analyze acceleration data from a number of acceleration measurement systems, such as:

- Space Acceleration Measurement System (SAMS-RTS): [0.01-400 Hz]
- Space Acceleration Measurement System (SAMS-TSH): [0.01-200 Hz]
- Orbital Acceleration Research Experiment (OARE): [≤ 0.01 Hz]
- Microgravity Acceleration Measurement System (MAMS):
 - MAMS-OSS: [≤ 0.01 Hz]
 - MAMS-HiRAP: [up to 100 Hz]

MAMS-OSS/HiRAP



March 4th, 2003

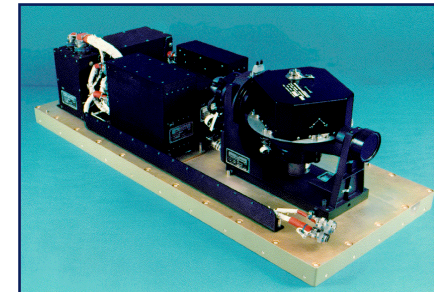
SAMS-RTS

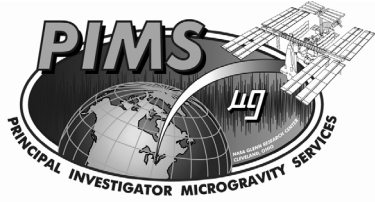


SAMS-TSH



OARE





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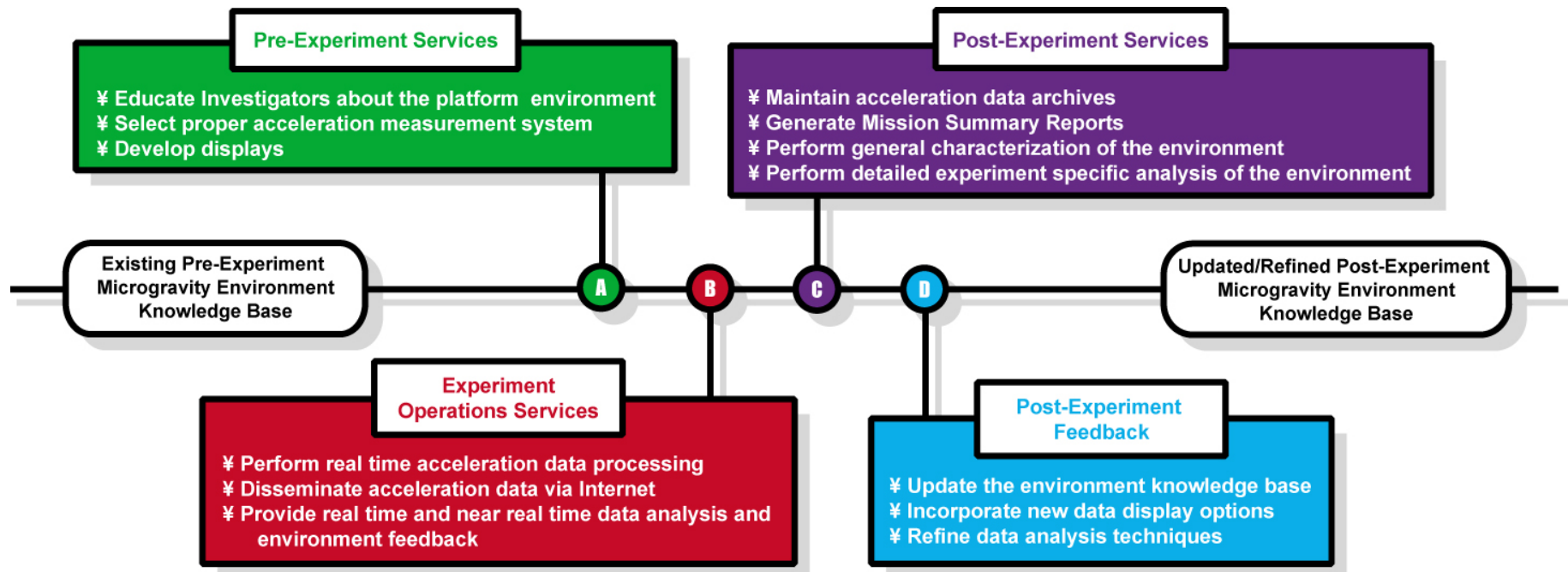


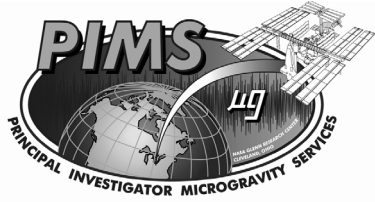
Principal Investigator Microgravity Services (PIMS)

Support the following disciplines and Groups:

- **Biotechnology**
- **Combustion Science**
- **Fluid Physics**
- **Materials Science**
- **Fundamental Physics**
- **Astronaut Office**
- **International Partners**
- **Vehicle Dynamics**

PIMS Functions During Experiment Life Cycle





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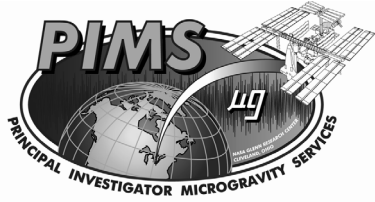


PIMS' support to PIs includes the following:

- **Receive, Process, Analyze, and Interpret Accelerometer Data to Characterize the Reduced Gravity Environment of Various Platforms for the Investigative Teams.**

ANALYSIS SUPPORT:

- **Monitor the Reduced Gravity Environment in Real Time to Support PIs Operation (when needed)**
- **Provide Real Time Displays**
- **Provide Near Real Time Support**
- **Provide Post Mission Support**
- **Provide a Near Real Time ISS Reduced Gravity Environment Monitoring System (ISS MEMS) Via the PIMS' web site (Future Capability)**



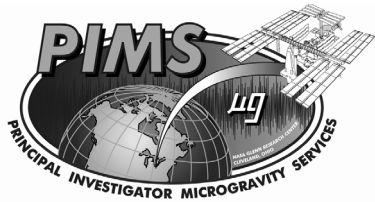
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PIMS' support to PIs includes the following:

DATA SUPPORT:

- **Provide easy access to plots of acceleration data from the PIMS' web site**
- **Provide easy access to archive acceleration data via the PIMS' ftp site**
- **Provide customized format plots to PI teams based on pre-mission inputs**
- **Publish Summary Report of Mission Acceleration Measurements (ISS and Space Shuttle)**



PIMS Interaction with Principal Investigator Teams



Quasi-steady Plot Types

Display Format	Notes
Acceleration versus Time	<ul style="list-style-type: none"> precise accounting of measured data with respect to time; best temporal resolution
Interval Min/Max Acceleration versus Time	<ul style="list-style-type: none"> displays upper and lower bounds of peak-to-peak excursions of measured data good display approximation for time histories on output devices with resolution insufficient to display all data in time frame of interest
Interval Average Acceleration versus Time	<ul style="list-style-type: none"> provides a measure of net acceleration of duration greater than or equal to interval parameter
Trimmed Mean Filtered Acceleration versus Time	<ul style="list-style-type: none"> removes infrequent, large amplitude outlier data
Quasi-Steady Mapped Acceleration versus Time	<ul style="list-style-type: none"> use rigid body assumption and vehicle rates and angles to compute acceleration at any point in the vehicle
Quasi-Steady Three-Dimensional Histogram (QTH)	<ul style="list-style-type: none"> summarize acceleration magnitude and direction for a long period of time indication of acceleration "center-of-time" via projections onto three orthogonal planes

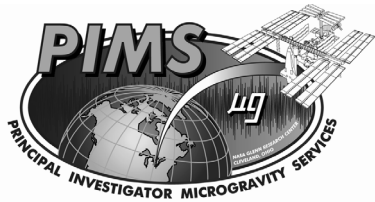


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Time Domain Summary Table

DISPLAY	NOTES
Acceleration vs. Time	<ul style="list-style-type: none"> • most precise accounting of measured data with respect to time • display device constrains resolution for long time spans or high sample rates
Interval Minimum/Maximum Acceleration vs. Time	<ul style="list-style-type: none"> • displays upper and lower bounds of peak-to-peak excursions • good display approximation for time histories on output devices with resolution insufficient to display all data in time frame of interest (see notes below though)
Interval Average Acceleration vs. Time	<ul style="list-style-type: none"> • descriptive statistics • not fully descriptive (“lossy compression”)
Interval Root-Mean-Square (RMS) Acceleration vs. Time	

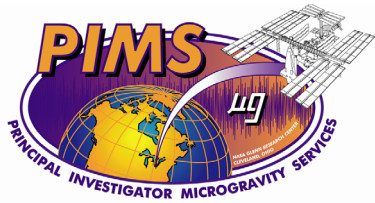


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Frequency Domain Summary Table

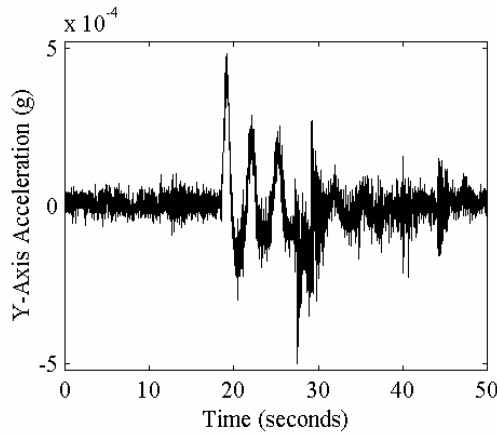
DISPLAY	NOTES
Power Spectral Density (PSD) vs. Frequency	<ul style="list-style-type: none"> • quantifies distribution of power with respect to frequency • windowing (tapering) to suppress spectral leakage • spectral averaging to reduce spectral variance (degraded Δf)
Cumulative RMS Acceleration vs. Frequency	<ul style="list-style-type: none"> • quantifies RMS contribution at and below a given frequency • quantitatively highlights key spectral contributors
RMS Acceleration vs. One Third Octave Frequency Bands	<ul style="list-style-type: none"> • quantify RMS contribution over proportional frequency bands • compare measured data to ISS vibratory requirements
Spectrogram (PSD vs. Frequency vs. Time)	<ul style="list-style-type: none"> • displays power spectral density variations with time • good <i>qualitative</i> tool for characterizing long periods • identify structure and boundaries in time and frequency
Principal Component Spectral Analysis (PCSA)	<ul style="list-style-type: none"> • summarize magnitude and frequency excursions for key spectral contributors over a long period of time • results typically have finer frequency resolution and high PSD magnitude resolution relative to a spectrogram at the expense of terrible temporal resolution



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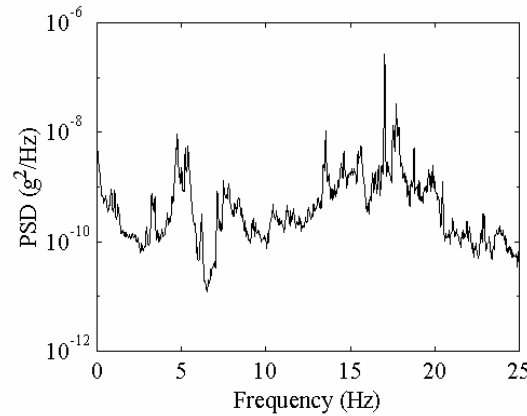


acceleration vs. time

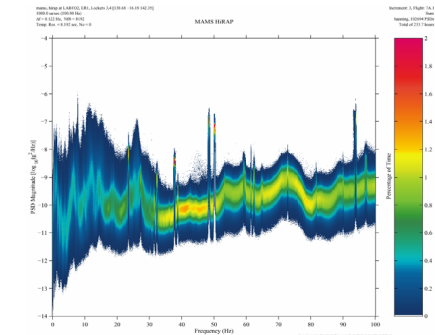
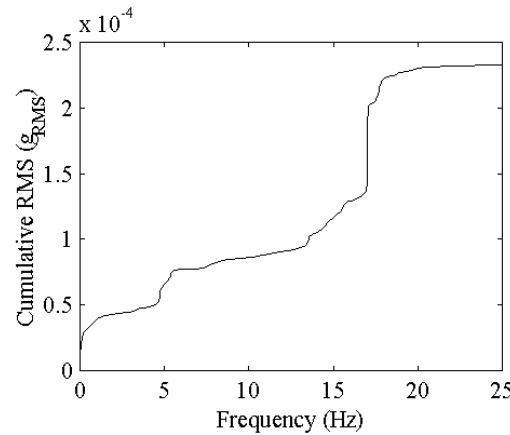
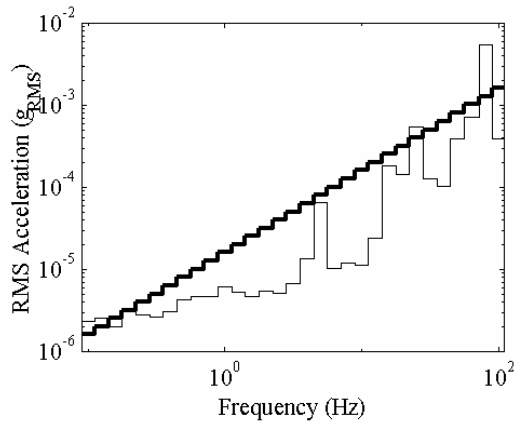
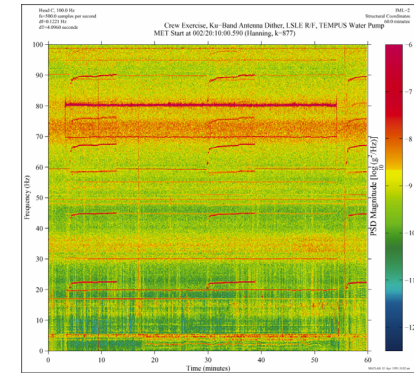


power spectral density vs. frequency

• displays distribution of power with respect to frequency



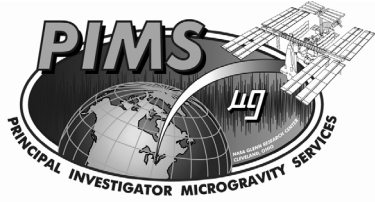
**spectrogram
(power spectral density (3D)
vs. frequency vs. time)**



g_{RMS} vs. 1/3 octave frequency bands
quantify RMS contribution over proportional frequency bands

cumulative g_{RMS} vs. frequency
quantifies RMS contribution at and below a given frequency

Principal Component Spectral Analysis (PCSA)
(% time (3D) vs. power spectral density vs. frequency)



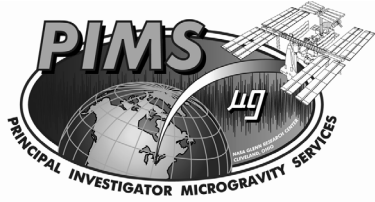
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PIMS' support to PIs includes the following:

EDUCATIONAL:

- **Annual Microgravity Environment Interpretation Tutorial (MEIT)**
- **Annual MicroGravity Measurements Group (MGMG)**
- **Astronaut Class Training (ASCAN)**
- **ISS Increment Specific Astronaut Training**
- **One on One seating with PI teams**

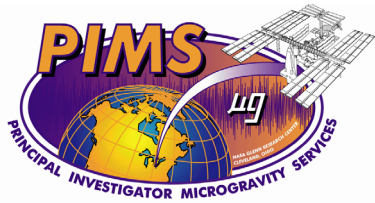


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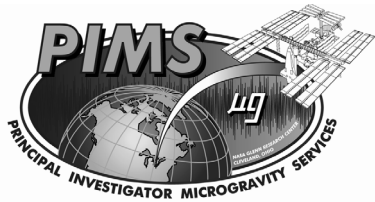
How to Request Data and Science Support From PIMS:

- ❑ <http://pims.grc.nasa.gov/html/RequestDataPlots.html>



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Note: If you have filled this form within the last three months and your data needs and experiment are the same, except for different time periods, Please fill in your name and email address, then go to section 4

** designates required fields*

FirstName:*

LastName:*

Title:

Microgravity Dicipline:
(e.g., Biotech, Materials Science, etc.)
OR Other:

Address:

Email:*

Phone:*

Experiment Name:

Ascent Flight/Descent Flight:

Affiliation (e.g. GRC, MSFC, ESA):
OR Other:

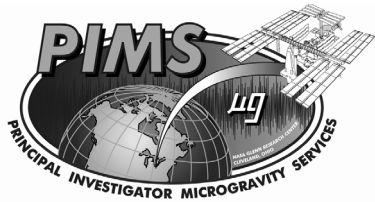
Type:

Have you participated in:

MGMG

MEIT

INTERNATIONAL



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1. Experiment Information

1. Please briefly describe the scientific objective of your experiment (include specific scientific discipline, key principle under investigation, etc.)

2. Does your experiment or supporting equipment have any frequency sensitivities?

If yes, please elaborate.

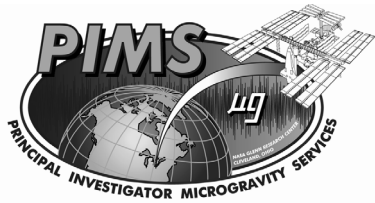
3. Does your experiment or supporting equipment have any directional sensitivity?

If yes, please elaborate.

4. Does your experiment or supporting equipment contain rotating equipment that may disturb the microgravity environment?

If so, please state them.

1 Hierarchical Menu Trees Created



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5. Please describe the typical operating scenario for your experiment. For example, multiple "experiment runs" lasting 20 minutes per run, a few "runs" per day, or "experiment runs" requiring 3 weeks for processing a single test sample. Please provide as much detail as possible, describing your weekly activities.

6. Can you suspend/pause your experiment operation to avoid acceleration disturbances?

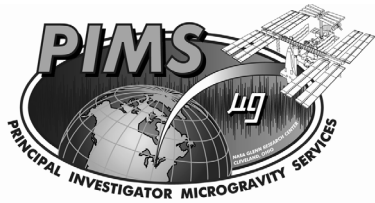
7. Can you modify your operation in response to real-time observation of acceleration data?

8. Do you desire acceleration data collection throughout your experiment operations?

Are there critical experiment operations for which acceleration data collection is highly desired or required?

If so, elaborate.

9. Briefly describe the operating scenario of your experiment (i.e., 24x7, 2 days per week and so forth)



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2. Accelerometers

1. Do you require

Quasi-Steady and Vibratory acceleration data
Quasi-Steady acceleration data (i.e., below 0.01 Hz)
Vibratory acceleration data (i.e., 0.01 - 300 Hz)
Quasi-Steady and Vibratory acceleration data

3. Acceleration Data Support

1. Is near real time acceleration data support required?

YES

Is post-experiment (offline) acceleration data support required?

YES

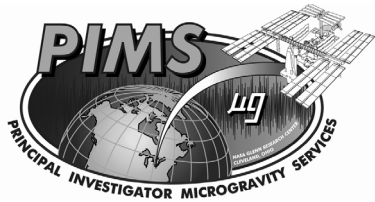
Are both required?

YES

2. For near real time support, how quickly is access to the data required (seconds, minutes)?

In what format is the acceleration data required (data files, data plots, etc.)?

1 Hierarchical Menu Trees Created



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In what format is the acceleration data required (data files, data plots, etc.)?

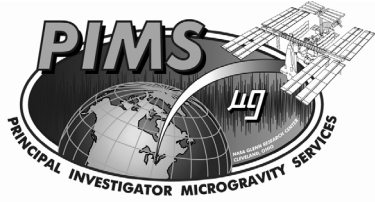
3. For offline support, how quickly is access to the data required (while still on orbit, post experiment operations, post increment operations)?

In what format is the acceleration data required (data files, data plots, etc.)?

4. Data Requests

Please provide below any additional information regarding your specific data needs, which may have not been captured above (e.g. type, plot format, time span for plots, data format, if actual values are needed and so on).

If you encounter any errors after submitting, please email the form to kend.rules@grc.nasa.gov



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PIMS' Point of Contacts:

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PIMS Project Scientist

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Kenol.jules@grc.nasa.gov

Kevin McPherson

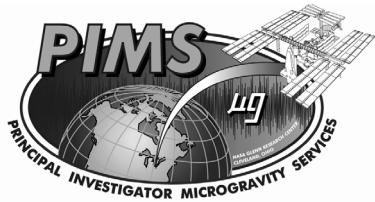
PIMS Project Manager

216-433-6182

kevin.mcpherson@grc.nasa.gov

OR:

pimsops@grc.nasa.gov



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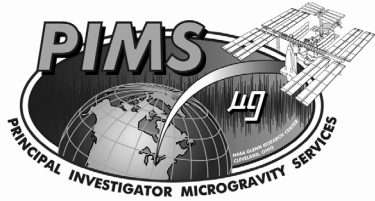
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Acceleration Measurement WWW links

- **Microgravity Science Division at NASA Glenn Research Center**
 - <http://microgravity.grc.nasa.gov>
- **NASA Glenn Acceleration Measurement Program**
 - http://microgravity.grc.nasa.gov/MSD/MSD_htmls/acceleration.html
- **Principal Investigator Microgravity Services Home Page**
 - http://microgravity.grc.nasa.gov/MSD/MSD_htmls/PIMS.html

Microgravity Environment References

- **Microgravity Environment Description Handbook TM**
 - Compilation of major microgravity environment disturbances, their sources, and their effects as measured on the Shuttle Orbiters and the Mir Space Station
 - NASA TM-107486 July 1997
 - <http://www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/Micro-descpt.html>
- **Acceleration Data Analysis and Presentation Techniques TM**
 - Detailed description of acceleration data analysis techniques
 - [http:// www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/adapt.html](http://www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/adapt.html)
- **Mission Summary Reports**
 - Mission specific characterizations for various Shuttle and Mir missions
 - [http:// www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/reportlist.html](http://www.grc.nasa.gov/WWW/MMAP/PIMS/HTMLS/reportlist.html)



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Principal Investigator Microgravity Services

Acceleration Measurement WWW links

- **MAMS and SAMS**
 - <http://pims.grc.nasa.gov>
- **PIs on-line acceleration data request form for MAMS and SAMS**
 - <http://pims.grc.nasa.gov/html/RequestDataPlots.html>
- **Microgravity Environment Interpretation Tutorial (MEIT)**
 - <http://www.grc.nasa.gov/WWW/MMAP/PIMS/MEIT/meitmain.html>

- **Microgravity Meeting Group (MGMG)**
 - http://www.grc.nasa.gov/WWW/MMAP/PIMS/MGMG/MGMG_main.html
- **ISS Increment Mission Summary Reports**
 - http://pims.grc.nasa.gov/html/ISS_Reports.html