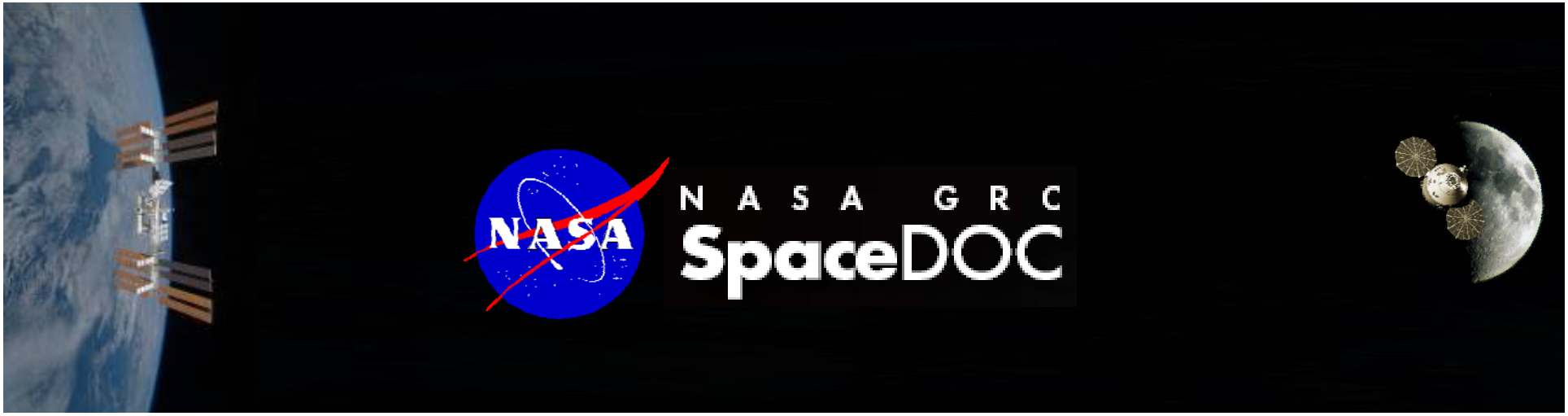
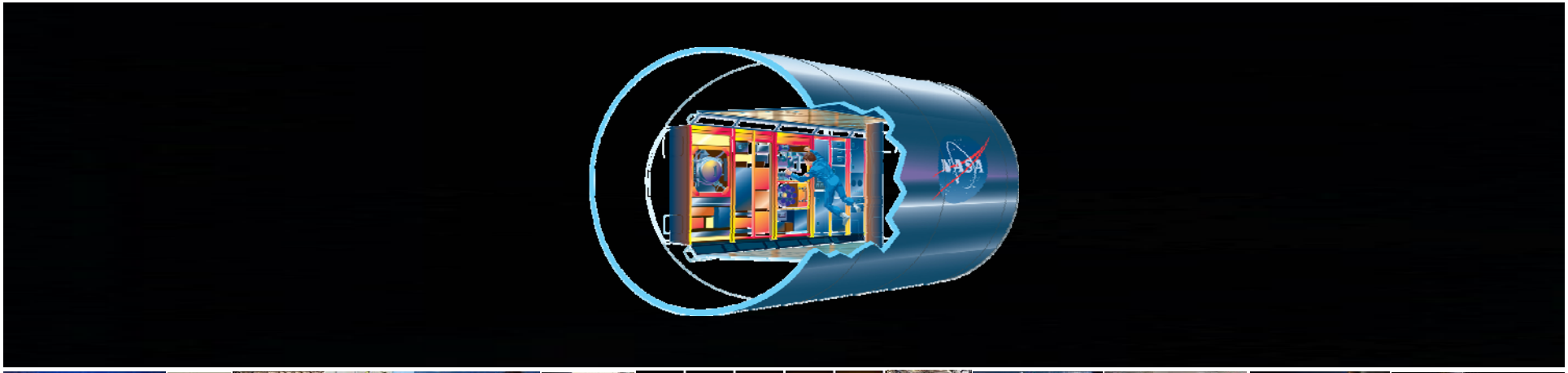


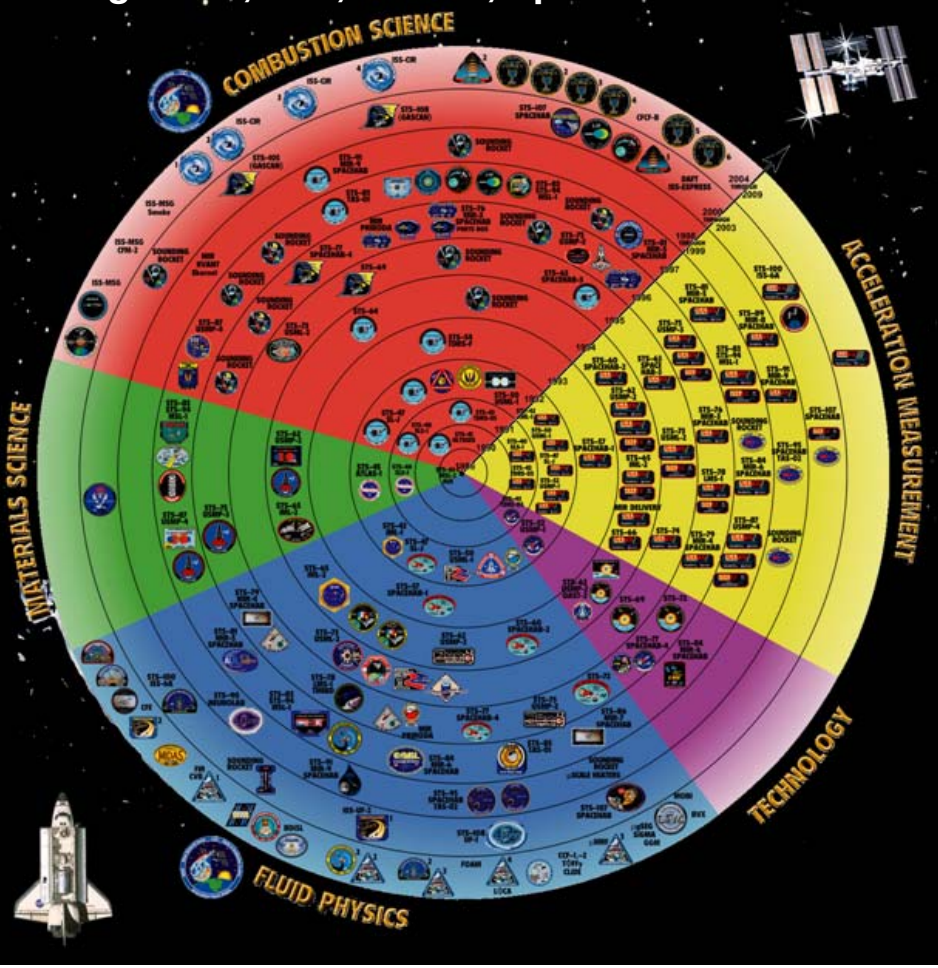
ZIN Technologies



Heritage of Science Mission Success

ZIN Technologies

For over 20 years, the ZIN engineering team has partnered with NASA GRC management, scientific experts and industry to manage and develop space flight systems, from concept definition, design, development, and fabrication to system assembly, integration, test, launch, operations and return.



- Spanning engineering and science, ZIN has collaborated in the development of nearly 100 successful NASA GRC space flight payloads, performing all formulation and implementation phases.
- Space Flight Payload development is a multifaceted operation involving the knowledge of and coordination between many different organizations: government, science/technologists, commercial and other hardware developers.
- We are experienced in the program and project management process requirements as they relate to a wide variety of spacecraft, launch vehicles, in-space facilities, communications networks, instruments, and supporting ground systems.

ZIN Technologies

http://www.zin-tech.com

ZIN Technologies Inc. (ZIN) a minority owned small business (SB) has provided advanced aerospace / biomedical engineering services and products for NASA, DoD, centers for scientific research and aerospace corporations.

With over five decades of experience, our capabilities are continually being improved to stay on the leading edge of rapidly evolving technologies that meet the needs of our customers.

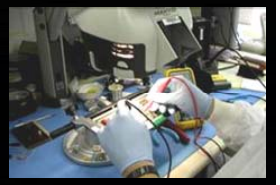
ZIN specializes in the seamless and transparent progression between concept, detailed design, engineering, manufacturing, integration, testing, verification, certification, maintenance and ground and space operations.

- 150+ person organization consists of scientists, engineers, designers, and technicians experienced in managing complex programs and technical requirements.
- ISO 9001-2000 certified and is actively pursuing AS9100 Quality certification.
- Robust/Certified Government support systems and DCAA approved forward pricing
- DISC Central Verification Activity can provide information regarding our current DOD facility clearance status to the appropriately requesting parties at (888)282-7682
- We have received numerous quality and performance awards including recognition as a 2003 and 2004 NASA George M. Low Quality Award Finalist

Admin & Engineering

Laboratories

Manufacturing



Integration & Test

Engineering Services

ZIN Technologies

ZIN has the technical core competencies and technical resources to accomplish complex engineering tasks that extend through requirements development, design, manufacture, integration, test, certification and operations.

We are experienced in the program and project management process requirements as they relate to a wide variety of spacecraft, launch vehicles, in-space facilities, communications networks, instruments, and supporting ground systems.

ZIN can provide in-house engineering, analysis, manufacturing and test as well as on-site dedicated support in the following disciplines:

- Systems Engineering
- Project Management
- Product Assurance
- Mechanical Engineering
- Thermal Engineering
- Electrical Engineering
- Electro-Optics Engineering
- Software Engineering
- Hardware Assembly
- Environmental Testing

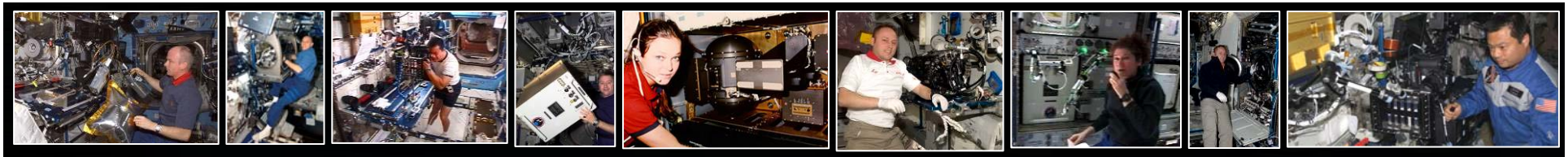
Design, Development, and Operations in Low Earth Orbit require specialized design analysis experience to provide proper design margin and verifications for ground, launch & on orbit environmental conditions experienced by the scientific hardware:

- Static And Dynamic Stress/Deflection
- Thermal Analysis
- Acoustic Emissions
- Interaction Simulations
- Radiation Effects
- Probabilistic Risk Modeling
- Microgravity Environment Modeling
- Composite Sizing

Spaceflight Hardware and Software

NASA GRC SpaceDOC

ZIN Technologies



Spaceflight Hardware & Software

- **Hardware & Software Development, Integration, Test and Certification**
- **Crew and Ground Support Personnel Training & Real Time Operations**
- **Low Earth Orbit, Deep Space, Pressurized, Unpressurized**
- **Space Shuttle, MIR, International Space Station, Progress, Soyuz, ATV, HTV, and future Constellation (ARES, ORION), Commercial**
- **Microgravity Science, Human Health, Exploration Technology**

Our expertise covers the full spectrum of spaceflight hardware development, from concept to design, development, on-orbit operations and disposal

- **Requirements Definition**
- **Analysis and Design**
- **Software Development**
- **High Fidelity Mockups**
- **Simulators**
- **Engineering Models**
- **Prototypes**
- **Crew Trainers**
- **Flight Qualification**
- **Production**
- **Spacecraft Integration**
- **Mission Operations**

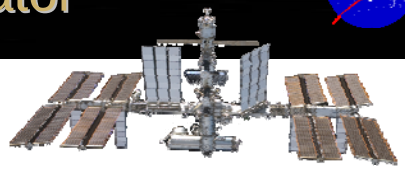
Fluids & Combustion Facility

ISS Glovebox Science Experiment
Smoke and Measurement Experiment

Experienced Multi-Carrier Integrator

NASA GRC SpaceDOC

ZIN Technologies



Payload	Flight Number	Mission	Launch Date	Launch Vehicle	Carrier
BCAT-3	13P	ISS Resupply	Jan 04	Progress	MWA
BCAT-4	STS-123	1J/A	Mar 08	Middeck	MWA
CFE	13P	ISS Resupply	Jan 04	Progress	MWA
	STS-121	ULF1.1	Jul 06	Shuttle MPLM	MWA
CIR	181	ISS Resupply	Mar 08	ATV-1	CIR Support Hardware
	30P	ISS Resupply	Sep 08	Progress	CIR Support Hardware
	STS-126	ULF-2	Nov 08	Shuttle MPLM	CIR RACK
CSLM2	STS-113	11A	Nov 02		MSG
	STS-118	13A.1	Aug 07	Middeck	MSG
	STS-123	1J/A	Mar 08	Shuttle Middeck	MSG
CVX2	STS-107	Science	Jan 03	Shuttle	Hitchhiker
DAFT-1	15P	ISS Resupply	Jul 04	Progress	Express Rack
DAFT-2	16P	ISS Resupply	Dec 04	Progress	Express Rack
DAFT 3 & 4	STS-121	ULF1.1	Jul 06	Shuttle MPLM	Express Rack
ERE-1	N/A	Science	Jul 01	Sounding Rocket	Sounding Rocket
FIR	STS-128	17A	Jul 09	Shuttle MPLM	FIR Rack
InSPACE	STS-111	UF-2	Jun 02		MSG
	STS-113	11A	Nov 02		MSG
InSPACE-2	STS-120	10A	Oct 07	Shuttle Middeck	
MAMS	STS-100	6A	Apr 01	Shuttle MPLM	Express Rack
PaRIS	181	ISS Resupply	Mar 08	ATV-1	CIR
PCS	STS-100	6A	Apr 01	Shuttle MPLM	Express Rack
SAL-6	N/A	Science	Feb 00	Sounding Rocket	Sounding Rocket
SAME	STS-118	13A.1	Aug 07	Shuttle MPLM	MSG
SAMS	STS-100	6A	Apr 01	Shuttle MPLM	Express Rack
	STS-111	UF-2	Jun 02	Shuttle Middeck	MSG
	STS-121	ULF1.1	Jul 06	Shuttle Middeck	Express Rack
	STS-124	1J	May 08	Shuttle Middeck	Express Rack
SAMS-FF	N/A	SAL-6	Feb 00	Sounding Rocket	Sounding Rocket
	STS-107	Science	Jan 03	Shuttle	SPACEHAB
SHERE	STS-120	10A	Oct 07	Shuttle Node 2	MSG
	STS-123	1J/A	Mar 08	Shuttle Middeck	MSG
Sofball	STS-107	Science	Jan 03	Shuttle	SPACEHAB
SoRGE	STS-115	12A	Sep 06	Shuttle Middeck	
SPICE	STS-126	ULF-2	Nov 08	Shuttle MPLM	MSG

ZIN is experienced in the flexible utilization of many different launch and on-orbit carriers for integration of space flight payloads.

- **Launch Vehicles with differing launch and handling environments include shuttle, ATV, Soyuz, Progress, and future commercial.**
- **On-Orbit carrier options today include sounding rockets, Microgravity Science Glovebox (MSG), EXPRESS racks, FCF, and other ISS internal and external pallet locations.**
- **These differing carriers offer widely varying utilities and diagnostics (electrical, telemetry, video recorders), operating conditions (restricted volumes, variable stowage, autonomous vs. operator-assisted), thermal environments (passive, fan to cabin air, air and water active cooling), and turnaround times.**
- **The goal is to select the carrier that provides the requisite experiment interfaces and requirements at the lowest cost, minimum development and time to launch without compromising the science**

Payload Planning and Integration Expertise

NASA GRC SpaceDOC

ZIN Technologies

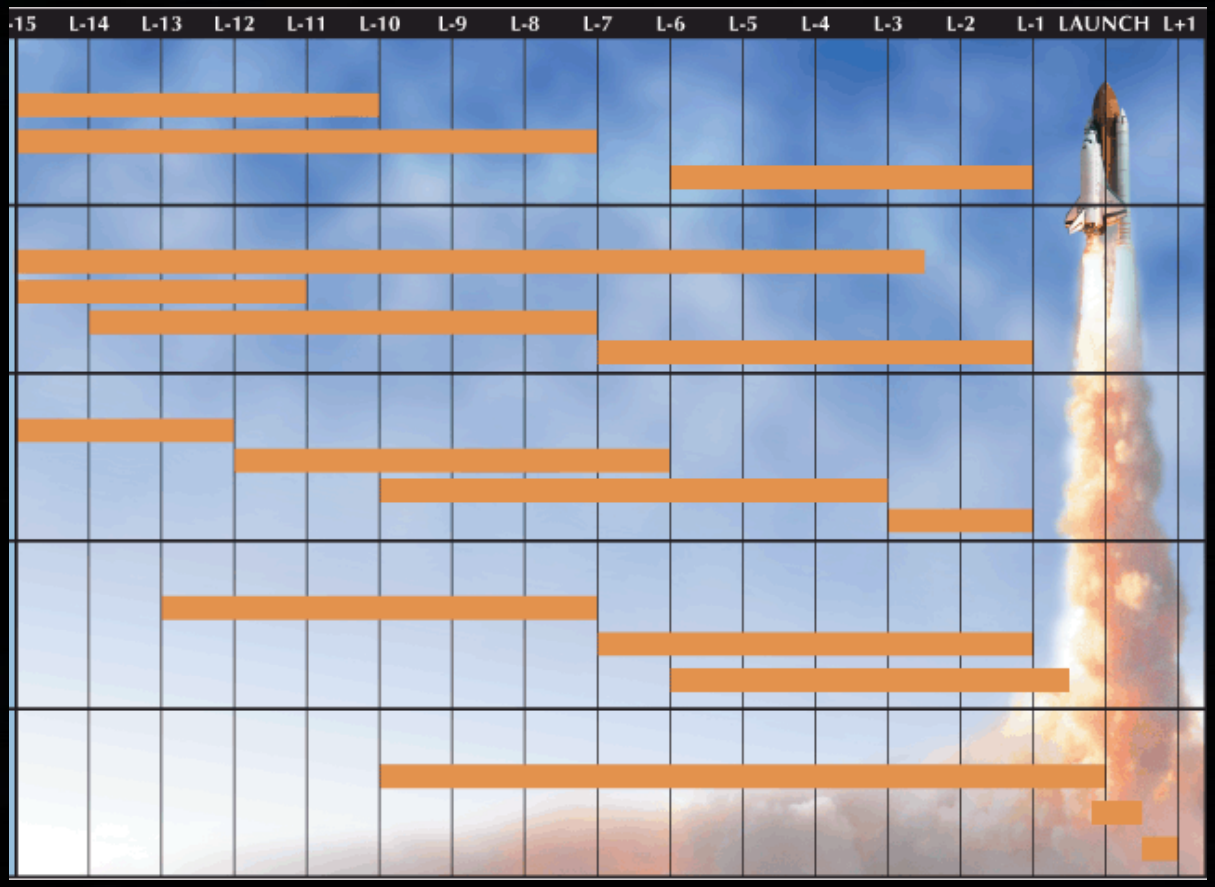
Payload Analytical Integration
- Requirements Definition
- Manifesting
- ICD Development
- Payload Verification

Mission Analytical Integration
- Safety Certification
- Mission Requirements Definition
- Mission Design
- Mission Design Verification

Mission Training
- Ground and Flight Personnel
- Mission Training Plan
- Familiarization Training
- Hands-on Training
- Joint Integrated Simulations

Hardware Physical Integration
- Requirements Development
- Carrier Integration and Test
- Payload Integration and Test

Mission Operations
- Procedure Development
- Real-Time Flight Operations
- Daily Planning
- Mission/Post-Flight Analysis



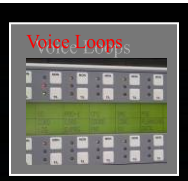
The ZIN Team has ISS Payload Integration facilitates support expertise from concept through on-orbit operations

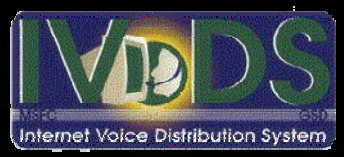
ZIN Technologies

- **Payload Planning**
  - Perform initial planning and evaluate mission criteria unique to the payload
    - Launch Vehicle Opportunities, On-Orbit Carrier
- **Mission Integration**
  - Planning and ISS Data Set and Documentation Preparation and Submittals
    - Payload unique to launch vehicle and on-orbit carrier
- **Payload Engineering Integration**
  - Assist in requirement identification, verification and verification submittal
    - Requirements unique to the payload
- **Operations Integration Products**
  - Crew and Ground Support Personnel Training
  - Submit request for ISS Resource requirements necessary for payload operations
- **Pre Operation Planning**
  - Define requirements
  - Develop Ground software using TReK workstations
  - Develop Crew Procedures ready for iPV
  - Develop Crew and Ground Support Personnel Training Plans
  - Develop Crew and Ground Support Personnel Training Packages
  - Implement Crew & GSP Training Plans
  - Provide payload increment requirements to the ISS program

Telescience Ground Operations

ZIN Technologies





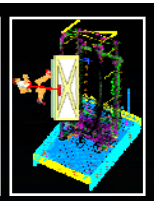
Since 2001, ZIN personnel have developed, operated and maintained the NASA Glenn TSC for Shuttle and ISS payload operations. Premium Wide Area Network connectivity for data and voice as well as ISS video channels are resources available to TSC users.

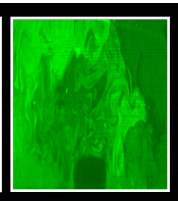
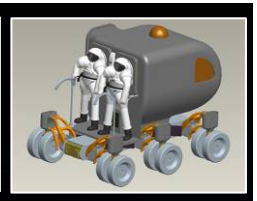
Telescience Support Console Operations

- Help to develop realistic operational scenarios and define the resources required to operate payloads from the ground.
- Facilitate payload operational scenarios by providing data, voice, and video resources to carry out the payload's mission
  - Bandwidth, data storage, video recording, etc.
- Provide experienced operations personnel
- Provide training in the proper use of TSC resources
- Provide real-time support for payload operations

ZIN software engineers are experts with the interfaces required to command on-orbit payloads as well as receive and process payload telemetry. Using TReK software, engineers can efficiently provide custom solutions for each payload.

ZIN Technologies



ZIN works to develop technologies to solve the medical and physiological problems of spaceflight and lunar exploration requiring novel, small, low power, non-invasive and versatile instrumentation and hardware.

The technologies developed are intended to meet NASA needs and also have a clear overlap into clinical medicine and/or commercial application.

SPACE EXPLORATION AND TERRESTRIAL APPLICATIONS

Exercise Countermeasure

Iv Water

Biometric Monitoring

Health And Human Performance

- **Technology to influence and monitor the physiologic adaptation to weightlessness.**
- **Technology to support medical care in space and on planetary surfaces.**
- **Technology to provide remote IV water purification capability**
  - **Monitoring and preventing bone and muscle loss through daily load stimulus measurement and dosage assessment**
  - **Detecting changes in physiological parameters including cardiovascular status**
  - **Assessing/preventing human health and performance risks through probabilistic risk assessments against mission tasks and adaptation**
  - **Providing emergency room capability through remote monitoring and assessments**
  - **Developing training systems to maintain proficiency**
  - **Develop Human performance, locomotion and mission task analogue facilities to assess partial and no-gravity environmental effects**
  - **Developing IV water purification hardware to provide IV water for emergency procedures on ISS and Lunar outpost**

ISS FCF Fluids Integrated Rack (FIR)

ZIN Technologies

Launch Aug 2009)

Fluids and Combustion Facility
FIR

Flexible, Multi-use Facility That Provides Core Diagnostics And Data Acquisition & Control Capabilities That Support A Broad Range Of Research In Support Of Space Exploration

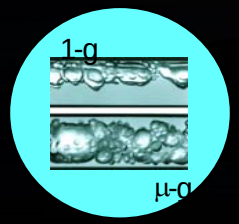
Objective:

FIR provides the largest, contiguous volume for experimental hardware of any ISS facility, easily reconfigurable diagnostics, customizable software, active rack-level vibration isolation, and other subsystems that are required to support a wide range of Exploration Systems Investigations.

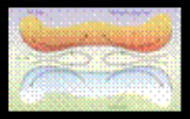
Relevance/Impact:

The FIR will support strategic research to enable:

- Storage/transfer of two-phase fluids
- Characterize two-phase heat transfer
- Support development of multi-phase environmental controls for life support systems
- Support human health in physiological/medical systems research to enable long term missions.



Human Health



Manufacturing Processes

Space Systems Fluids Management

ISS FIR/LMM/CVB Integrated Payload

ZIN Technologies

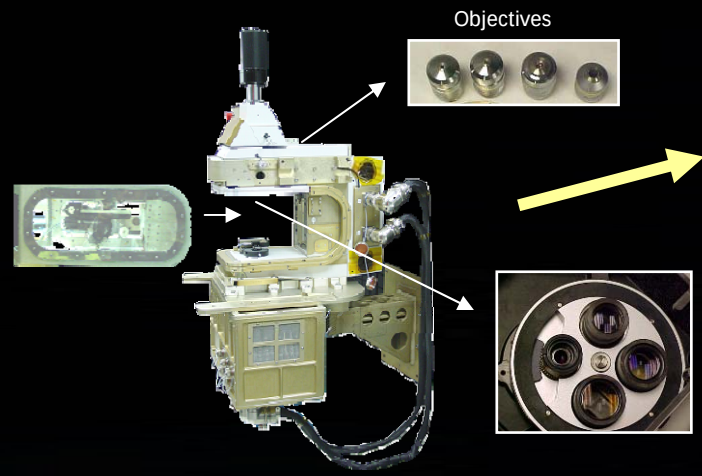
Launch Aug 2009)

Light Microscopy Module (LMM)

The LMM is a state of the art research instrument featuring an imaging light microscope capable of conducting cutting edge fluids research. The LMM is capable of being upgraded to support additional research in the future.

PI-specific and multi-user hardware customizes the FIR in a unique laboratory configuration to perform fluids research effectively.

Critical Vapor Bubble (CVB) Sample Cell Shown



PI Specific Hardware (Fluids, Biological or other discipline)

- PI Sample Cell with universal Sample Tray
- Specific Diagnostics
- Specific Imaging
- Fluid Containment

Multi-Use Payload Apparatus

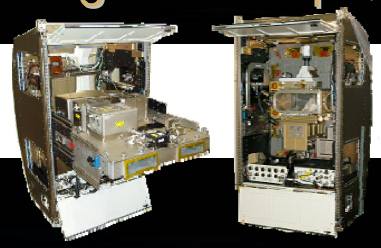
- Test Specific Module
- Infrastructure that uniquely meets the needs of PI experiments
- Unique Diagnostics
- Specialized Imaging
- Fluid Containment

FCF Fluids Integrated Rack

- Power Supply
- Avionics/Control
- Common Illumination
- PI Integration Optics Bench
- Imaging and Frame Capture
- Diagnostics
- Environmental Control
- Data Processing/Storage
- Light Containment

ISS FIR/LMM Integrated Capabilities

ZIN Technologies



FIR Capabilities

- FIR's large configurable volume, 0.49m3, provides a flexible platform required for Fluid Physics-Based Exploration Investigations.
- FIR's optics bench allows for precise alignment of coupled (optical, mechanical) hardware.
- FIR's efficient power system can provides sufficient power required by Fluid Physics-Based Exploration Investigations (nominally provides over 2.1 kW of power up to 3 kW max).
- FIR provides a thermally controlled environment via 3kW of water cooling and 1.3 kW of air cooling.
- FIR provides experiments with an advanced state-of-the-art data acquisition and control system (analog & digital I/O's, motion control, RS-422, Ethernet, Analog video, IEEE 1394 FireWire, 860 GB of data storage).
- Real time downlink available for image analysis and decision
- FIR provides diagnostics required by Fluid Physics-Based and Biological Exploration Investigations (cameras & light sources).

LMM Capabilities

- Laboratory grade high resolution digital cameras (8-bit and 12-bit) – Color and B&W
- Auxiliary Fluids Container: 1 level of containment; working volume = 1.9 ft3 ~ 1 MLE
- Can perform colormetric measurements
- LMM is scripted to run and can be adjusted to comply with specific measurement protocols
- White Light Microscope (Leica DM-RXA), autofocus capabilities
- Thin-film interferometry
- Imaging modalities: Reflected Bright field
  - Dark field, Differential Interference Contrast (DIC) and Phase Contrast upgradeable
- Imaging with or without cover slips possible
- Objectives: 0.5x (Bertrand Lens), 10x, 20x, 40x, 50x (LWD), 63x (oil), & 100x (oil) (Other Lenses can be used)
  - Upgradeable for biological applications:
    - **Confocal fluorescence microscopy capable with a 532 nm and a 488 laser upgrade**
    - **Wide-field fluorescence microscopy upgradeable**

Preliminary Advanced Colloids Experiment

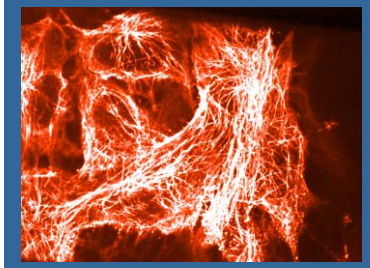
ZIN Technologies

In-Development

PACE

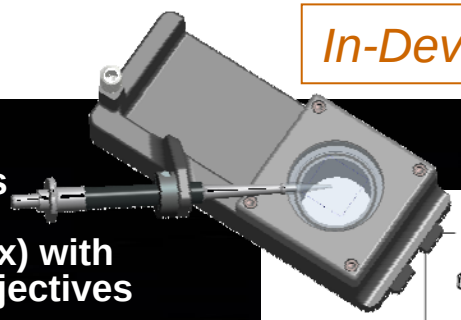
Sample containment vessel that allows for high magnification of biological sample

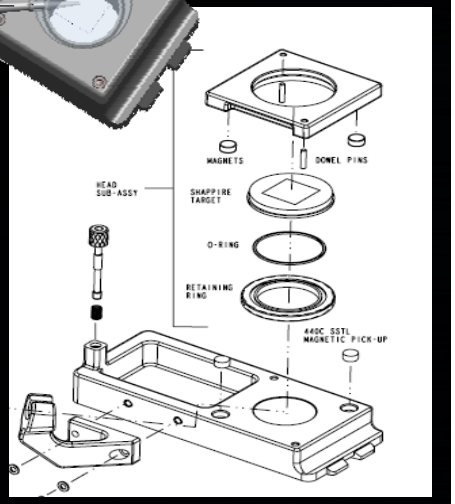
FCF FIR LMM

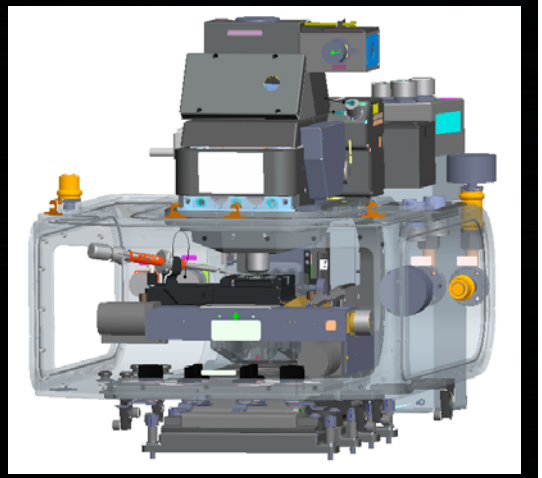


Microtubles from Rat

Biological images taken with LMM Microscope







Objective:

Risk mitigation for future Advanced Colloids Experiments (ACE). Determine what magnifications are possible (50x, 63x, 100x) with both air and oil immersion microscope objectives in an ISS vibration environment.

Hardware Description:

- **Light Microscopy Module (LMM) is a remotely controllable, automated microscope, that allows flexible scheduling, and control of physical and biological science experiments within the Fluids Integrated Rack on the International Space Station.**
- **PACE allows the user to mount a sample onto the LMM X-Y stage to support microscopic observations. PACE-1 sample is a USAF test target. The target can be removed by the crew and replaced with any object desired.**

Biology Opportunity:

- **The FIR/LMM provides white light illumination for bright field & trans illumination as well as a filter bank, high resolution CCD imaging, and automation of all microscope functions.**
- **PACE target mount provides a mechanism to support oil immersion objectives. Target head containing USAF target can be removed and replaced with a sample cell.**
- **The extensive FIR and LMM Data Acquisition & Control System will support automated control, via software, of motion, thermal control, and optical (imaging) systems required to perform user objectives.**

Coarsening in Solid-Liquid Mixtures

NASA GRC SpaceDOC

ZIN Technologies

Flight Hardware

CSLM

Control unit that allows measurement of temperature, pressure and humidity. Ability to quickly cool samples.

Ground-Based Sample.

CSLM-1: Sample from MSL-1 mission.

Objective:

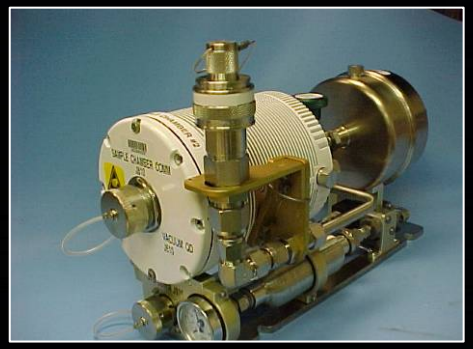
- **Support the development and improve the accuracy of theoretical models of the Ostwald Ripening (coarsening) process using a Lead/Tin sample of various volume fractions.**

Hardware Description:

- STD based Electronics Control Unit (ECU) containing A/D, DIO, Precision Temperature Controller, & Hard Drive Storage. Front panel LCD display provides feedback and status to the crew.
- Hermetically sealed Sample Processing Unit (SPU) with thermally isolated furnace (sample holder) holding 4 lead/tin samples.

Biology Opportunity:

- ECU is flight ready and capable of providing experimenters with a compact Data Acquisition System for use in the MSG with or without the SPU. There are 2 flight qualified ECU units. The ECU is user programmable and can interface via serial link to the MSG laptop.
- The SPU can provide a level of containment, interfaces to the ISS Vacuum Exhaust System (VES), and contains a reservoir of water to quickly quench (cool down) the samples when processing is complete.
- Ancillary hardware including MSG mounting plate, cables, and vacuum hose are currently on-orbit.



Smoke Point in Co-Flow Experiment

ZIN Technologies

Flight Hardware

SPICE

Provides a small containment vessel that can provide gas flow through different nozzles. It can record via analog and discrete digital images.

SPICE Experiment Assembly

Objective:

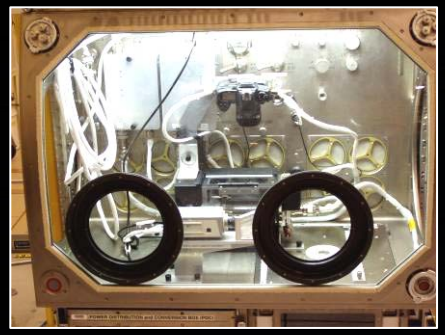
- **Provide an improved understanding of soot emission from jet flames in a co-flow environment as a function of nozzle diameter, co-flow velocity, fuel velocity and fuel composition.**

Hardware Description:

- Hardware is designed to operate in the MSG glovebox.
- Experiment Assembly provides the co-flow environment. Gas is introduced, using one of the 12 gas bottles, at specific flow rates through various size nozzles and ignited. Flame is video taped using the MSG recorder and high resolution still images acquired with a Nikon D100 camera.
- Crew using an external control box adjust air flow and fuel flow rate as well as the Nikon shutter.

Biology Opportunity:

- The Nikon D100 Camera is flight ready and capable of 3k x 2k resolution images. High res images are stored on removable microdrives.
- The Panasonic CP654 S-video is routed to the MSG recorder for real-time observation via the Power/Video unit.
- Power /Video unit converts composite signal to s-video to allow the still & video signals to be routed to video monitors for crew observation during runs and to the MSG video recorders.



Capillary Flow Experiment

NASA GRC SpaceDOC

ZIN Technologies

Flight Hardware

CFE

System for passive gas-liquid separations. Improved design knowledge in the storage and transport of liquids in space

Objective:

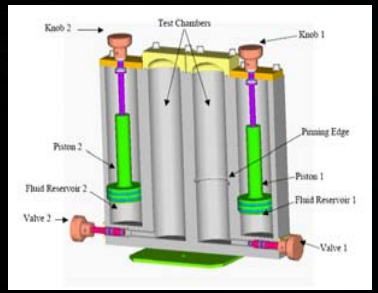
- **Investigate capillary flow in the management of fluid systems in space.**
- **Improved design knowledge in the storage and transport of liquids in space**

Hardware Description:

- CFE provides improved design knowledge in the storage and transport of liquids in space thereby increasing system reliability, decreasing system mass, and reducing overall system complexity.
- Each test unit provides relevant capillary resulting phenomena, critical wetting in discontinuous structures, large length scale contact line damping, and capillary flow in complex containers.
- Each test represents passive fluid transport and control common in critical phase separation

Biology Opportunity:

- System for passive gas-liquid separations
- Technology in space uses capillary forces to position and transport fluid.
- Currently being used to study bubble mitigation in the ISS Urine Processing Facility.



Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions

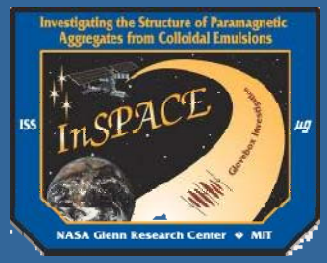
NASA GRC SpaceDOC

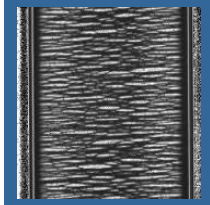
ZIN Technologies

Flight Hardware

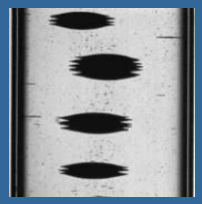
InSPACE

Allows a magnetic field to be applied to a sample. Provides orthogonal imaging capability





MR fluids in a continuous magnetic field on orbit develops a cross-linked network structure.



MR fluid in a pulsed field on orbit undergoes a novel structural alignment.

Objective:

- **To visually study the gelation transition in magneto-rheological fluids (MR) under steady and pulsed magnetic fields, and to determine the lowest energy configurations of the three dimensional structures of a magneto-rheological fluid in a pulsed magnetic field.**

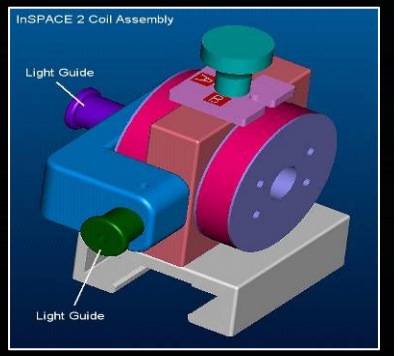
Hardware Description:

- Provide data on the dynamics and internal particle structure for an assessment of the viscous-elastic properties.
- Precise control of the visco-elastic properties and states enables MR fluid characterization for futuristic robotic interfaces.

Biology Opportunity:

- Allows a magnetic field to be applied to a sample (2mm cube)
- Provides orthogonal imaging capability with or without a magnetic field
- MR fluids are useful in first aid space safety by providing encapsulation pressure and stints around bone fractures and sprains.

Vial Assembly



Coil Assembly

Binary Colloidal Alloy Test

ZIN Technologies

Flight Hardware

BCAT

Sealed sample vessel that allows macroscopic imaging from two sides. Determine phase separation rates and properties of model critical fluid system

NASA Image: ISS013E26396 - Critical fluid sample 2 phase separating aboard Expedition 13.

Objective:

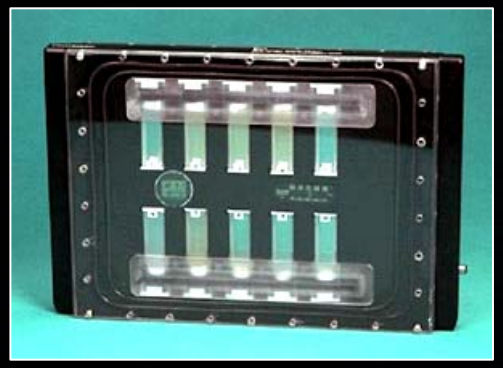
- **On Earth gravity causes colloid particles to settle. Settling prevents the formation of large scale crystallites and obscures the observation of the more finely controlled behavior.**
- **BCAT modules can support 10 fluid samples for study in microgravity.**

Hardware Description:

- **Samples can be homogenized with a stirring magnet.**
- **Crystals and other features are located by shifting light and camera angles.**
- **Photos of artifacts are taken and angles are measured via the tape measure.**
- **When the masking effects of gravity are removed, the rate that BCAT critical point samples separate into two phases show an unexpected (exponential scaling law) behavior, which seems to deviate from expected (power law scaling) behavior.**
- **The crystallization of aspherical particles in microgravity will enable tests of recent predictions and bring new understandings (e.g. CDOT showed that hard spheres do not have a glass phase).**

Biology Opportunity:

- **BCAT uses the Earthcam camera and a laptop already on orbit to record data.**



Sample Holder

NASA Image: ISS013E08004 - Expedition 13 Science Officer Jeff Williams.

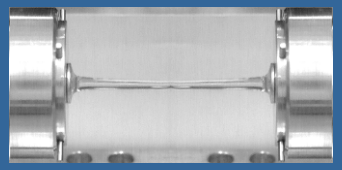
Shear History Extensional Rheology Experiment

ZIN Technologies

Flight Hardware

SHERE

On-orbit Rheometer that has the ability to measure film thickness and can image a fluid during stretching.



Polymeric Liquid Bridge In Microgravity

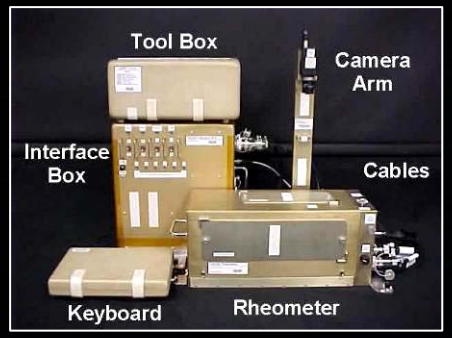
Objective:

- **To perform rotational shearing and axial stretching of a viscous fluid sample at different rates.**

Hardware Description:

- Rheometer creates stretched 194-mm long fluid fiber and rotationally shears one end up to 500 rpm.
- Instrumentation can measure axial force to 10 kdyne, midpoint diameter from 0.1 to 10 mm, stretch position to ± .05 mm, and fluid temperature to within ± 0.5 °C. Overhead video silhouette can be obtained for half of the column.
- Each Fluid Module contains 5.3 x 10 Ø mm fluid sample. Multiple interchangeable samples.

- ***Biology Opportunity:***
- Stowage Tray can fit into on-orbit CGBA thermal carrier for temperature control of samples.
- Spider silk and other biologically derived materials can be studied for their properties.
- The effects of fluids interfaces on properties for surfactants, amphiphilic polymers, proteins, and phospholipid monolayers/bilayers can be explored, including the effect of colloidal particles on the interfaces.



NASA GRC ISS Research Content On-Line

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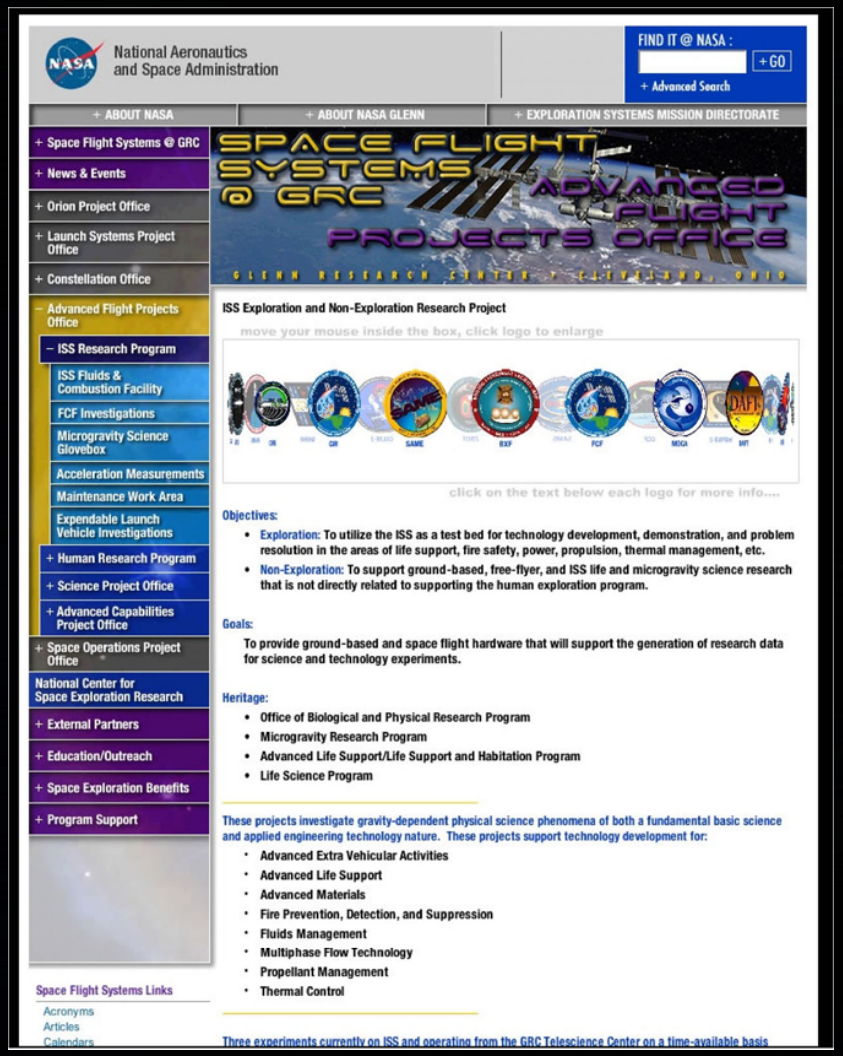
GRC ISS Research Project Homepage



http://SpaceFlightSystems.grc.nasa.gov/Advanced/ISSResearch/

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