

Inventory of ISS Research Facilities and Capabilities Available to Support National Laboratory Operations

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At Assembly complete in 2010, the ISS will have a variety of multidisciplinary laboratory facilities and equipment available to support the National Laboratory operations. These capabilities have been built by NASA and its International Partners and can be made available on a time-shared basis to other US government agencies and private entities to pursue their own mission driven research and applications on the ISS. Shared utilization of these capabilities will be detailed in negotiated agreements with NASA and/or the sponsoring International Partner agency.

This facilities and capabilities list is organized by research discipline, including human research, physical sciences research, and multipurpose research. The list identifies the sponsoring agency and whether the capability is already on orbit or planned for future launch. Additional information on the ISS National Laboratory program can be found at http://www.nasa.gov/mission_pages/station/science/nlab/index.html. Additional information on current ISS program can be found at http://www.nasa.gov/mission_pages/station/science/ and <http://exploration.nasa.gov/programs/station/>

Sponsoring agency and whether **on orbit or **planned for future launch** is indicated Facilities and Capabilities Listed by Discipline Emphasis**

- ❖ Human Research:
 - HRF-1 (Human Research Facility-1), on orbit
 - Ultrasound (diagnostic)
 - SLAMMD (Space Linear Acceleration Mass Measurement Device) for measuring crewmember mass
 - HRF-2 (Human Research Facility-2), on orbit
 - CBPD (Continuous Blood Pressure Device)
 - Pulmonary Function System (Includes GASMAP (Gas Analyzer System for Metabolic Analysis Physiology) and PFM/PAM [Photo-acoustic Analyzer Module/Pulmonary Function Module]), determines the concentration of respired gases, when combined with GASMAP allows a wide range of tests of lung and cardiac function
 - Refrigerated Centrifuge, spins sample tubes from 1000-5000 rpm, at temperatures from ambient to +4°C
 - HRF (Human Research Facility) common hardware
 - ActiWatches (measure light exposure and activity when worn by crewmembers, data downlinked to ground through HRF data system)
 - Holter Monitor (electrocardiograms)
 - PMDIS/TRAC (Perceptual Motor Deficits in Space/ Test of Reaction and Adaptation Capabilities) push-button and joystick interfaces for software-driven tests of hand-eye coordination
 - International human research hardware, on orbit

- Percutaneous Electrical Muscle Stimulator (PEMS), ESA, on orbit
 - Hand Grip Dynamometer/Pinch Force Dynamometer (HGD/PFD), ESA, on orbit
 - Eye Tracking Device (ETD), DLR, on orbit
 - EPM (European Physiology Module), ESA, planned
 - Cardiolab
 - Multi-Electrode Electroencephalogram Mapping Module (MEEM), EEG and EMG measurement
 - Bone Analysis Module (BAM)
 - Handgrip Dynamometer/Pinch Force Dynamometer
 - MARES (Muscle Atrophy Research Exercise System), NASA, planned
 - Measures the strength of isolated muscle groups in arms and legs
- ❖ **Biological Research (Incubators, Refrigerators, Freezers, and Centrifuges):**
- BSTC (Biotechnology Specimen Temperature Controller), NASA, on orbit in ExpRESS Rack
 - Incubator: +4 to 50 °C for up to 32 stationary tissue culture modules (TCMs)
 - CGBA (Commercial Generic Bioprocessing Apparatus), NASA, on orbit in ExpRESS Rack
 - Refrigerator/Incubator from +4°C to 37°C
 - EMCS (European Modular Cultivation System), ESA/NASA, on orbit in ExpRESS Rack
 - Centrifuges: two centrifuges for 0-2x gravity experiments in a controlled environment
 - MELFI (Minus Eighty Laboratory Freezer for ISS), NASA, on orbit
 - Refrigerator/Freezer at +4°C, -26°C, and -80°C
 - BioLab (Biological Experiment Laboratory in Columbus), ESA, planned
 - Bioglovebox providing two levels of containment and ozone sterilization
 - Centrifuges: two centrifuges from 0.001 to 2 x gravity
 - Incubator: 18 to 40°C
 - Microscope: bright field, phase contrast and dark field
 - Spectrophotometer: 220-900 nm
 - Refrigerator/Freezer: -20 to +10°C
 - GLACIER (General Laboratory Active Cryogenic ISS Equipment), NASA, planned in ExPRESS Rack
 - Refrigerator/Freezer from +4°C to as low as -185°C
 - MERLIN-II (Microgravity Experiment Research Locker/Incubator II), NASA, planned in ExPRESS Rack
 - Refrigerator/Freezer/Incubator from -20°C to +48.5°C
 - Saibo (Life Science experiment facilities, Cell Biology Experiment Facility), JAXA, planned
 - Clean Bench (glovebox) providing 2 levels of containment and UV sterilization
 - Centrifuge: 0.05 to 2 x gravity
 - Incubator: 15 to 40°C, with controlled humidity and CO₂
 - Microscope: Bright field, phase contrast and fluorescence microscope with 4x, 10x, 20x and 40 x objectives
- ❖ **Physical Science Research**

- MAMS (Microgravity Acceleration Measurement System), NASA, on orbit in ExPRESS Rack
 - Measures accelerations caused by the aerodynamic drag created as the International Space Station (ISS) moves through space, rotates and vents water, in the frequency range from 0.01 Hz to 100 Hz
- SAMS-II (Space Acceleration Measurement System-II), NASA, on orbit in ExPRESS Rack
 - Measures vibratory/transient accelerations caused by vehicle, crew and equipment disturbances in the frequency range from 0.01 to 300 Hertz
- CIR (Combustion Integrated Rack), NASA, planned
 - Fuel management, combustion chamber, cameras
- FIR (Fluids Integration Rack), NASA, planned
 - Optics bench, cameras
 - Microscope: Light Microscopy Module (LMM) with 0.5x, 10x, 40x, 63x (oil) and 100x (oil) objectives, with laboratory grade high resolution digital cameras
 - Designed for optional Neodymium:Yttrium Aregon Garnet (YAG) laser, gas chromatograph, and confocal fluorescence microscopy options
- FSL (Fluid Science Laboratory), ESA, planned
 - White light and monogromatic lasers
 - Camera systems: still, high speed video, high-resolution, and infrared
 - Laser Doppler anemometer
- Kobairo, JAXA, Planned
 - Gradient Heating Furnace (500 to 1600°C) for materials processing
- MSRR-1 (Materials Science Research Rack-1), NASA, planned
 - Microgravity Science Lab Furnace
- Ryutai (fluid physics and crystal growth facility), JAXA, planned
 - Fluid Physics Experiment Facility with temperature sensor and control, infrared imager, nitrogen gas laser
 - Solution Crystallization Observation Facility with Mach-Zender interference microscope, amplitude modulation, polarizing, and bright-field microscopes
 - Protein Crystallization Research Facility allowing vapor diffusion, batch, membrane and liquid-liquid diffusion methods of growing protein crystals
- SpaceDRUMS (Space Dynamically Responding Ultrasonic Matrix System), NASA, planned in ExPRESS Rack

❖ Earth Observation Research:

- WOLF (Window Observational Research Facility), NASA, planned, provides bracket, power and data interfaces for remote sensing instruments in the optical-quality window of the *Destiny* laboratory
- AgCAM (Agricultural Camera), multispectral imaging system, NASA, planned for WOLF

❖ Radiation measurement and dosimetry

- ALTEA (Anomalous Long Term Effects in Astronauts' Central Nervous System), ASI, on orbit

- Helmet for measuring incident high-energy radiation particles striking the central nervous system
 - Can also be used as a passive dosimeter
 - ALTCRISS (ALTEINO Long Term monitoring of Cosmic Rays on the ISS), ESA, on orbit radiation detector package
 - ISS Radiation Area Monitors (RAMs) and TEPCs (Tissue Equivalent Proportional Counters), NASA, on orbit, used for operational monitoring of the ISS radiation environment,
 - LAZIO (Low Altitude Zone Ionization Observatory), ESA, on orbit radiation detector instrumentation
 - Matroshka, ESA, on orbit
 - human shaped phantom torso with active and passive dosimeters that can be used to quantify human radiation exposure, has been mounted both inside and outside ISS
- ❖ Multi-purpose:
- EarthKAM camera system, NASA, on-orbit, can be used with general purpose on-orbit digital cameras to take automatically take photographs at times as programmed from the ground
 - ExPRESS Racks (EXpedite the PROcessing of Experiments to Space Station), NASA, on orbit, additional racks planned
 - Supports interchangeable small payloads and stowage
 - MSG (Microgravity Science Glovebox), NASA, on orbit, 2 levels of containment (non-biological), image processing
 - MWA (Maintenance Work Area) glovebox, NASA, on orbit, 1 level of containment
 - Portable Glovebox (PGB), ESA, on orbit, 2 levels of containment
 - EDR (European Drawer Rack), ESA, planned
 - Supports interchangeable small payloads and stowage
 - ETC (European Transport Carrier), ESA, planned
 - Stowage and transportation for experiments
- ❖ External Facilities
- ExPRESS Logistics Carriers, NASA, planned, allows mounting of external payloads on the P3 and S3 trusses of ISS
 - EuTEF (European Technology Exposure Facility), ESA, planned outside Columbus, provides an external platform on the Columbus Module for mounting equipment
 - SOLAR, ESA, planned outside Columbus, a platform with coarse pointing capability for three science instruments to monitor solar flux in three different wavelengths
 - JEM Exposed Facility (JEM-EF), JAXA, planned outside Kibo, provides data and power at up to 10 external mounting sites

Index of Related Capabilities

Gloveboxes:

- MSG (Microgravity Science Glovebox), NASA, on orbit, 2 levels of containment
- MWA (Maintenance Work Area) glovebox, NASA, on orbit, 1 level of containment

Portable Glovebox (PGB), ESA, on orbit, 2 levels of containment

Biolab Glovebox, ESA, planned, 2 levels of containment with sterilization

Saibo Rack Glovebox, JAXA, planned, 2 levels of containment with sterilization

Centrifuges

HRF 2 Refrigerated Centrifuge for samples

European Modular Cultivation System (EMCS) for small organisms

Biolab Centrifuge for small organisms

Saibo Rack Centrifuge for small organisms

Incubators

BSTC (Biotechnology Specimen Temperature Controller)

Commercial Generic Bioprocessing Apparatus (CGBA)

European Modular Cultivation System (EMCS)

Microgravity Experiment Research Locker/Incubator II (MERLIN II)

Biolab Incubator

Saibo Rack Incubator

Microscopes

Biolab Microscope

FIR Light Microscopy Module (LMM)

Saibo Rack Microscope

Ryutai Rack Microscope