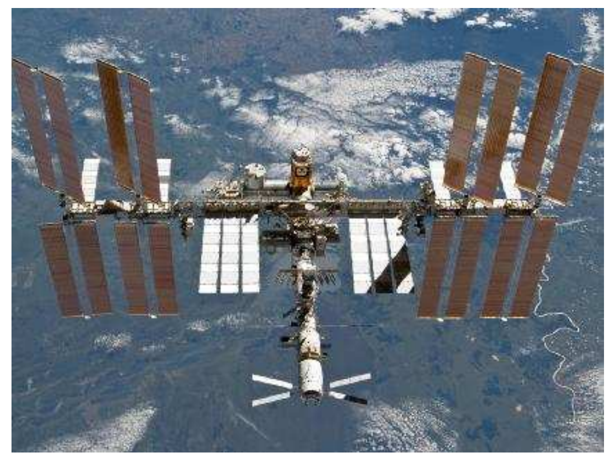
Synopsis of Mission and Experiments

26 Soyuz/Expedition 27 Launch

NASA

Celebrating 50 years of human spaceflight

Expedition 27 Crew



April 2011

26 Soyuz/Expedition 27 Launch
April – May 2011

Vehicle: 26 Soyuz, TMA-21

Launch: April 4, 2011

Docking: April 6, 2011

Undock/Landing: September 16, 2011

26 Soyuz Crew

Andrey Borisenko
Commander Soyuz and Expedition 28

Ron Garan
ISS Flight Engineer

Alexander Samokutyaev
ISS Flight Engineer

Expedition 27 crew will join Expedition 26 crew already on-orbit

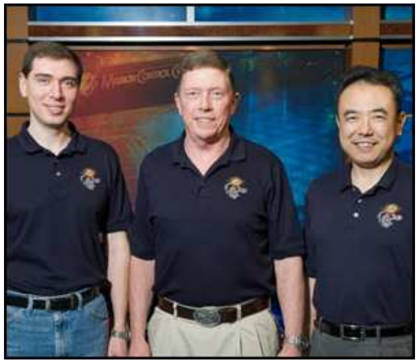
Dmitri Kondratyev Expedition 27 Commander

Catherine Coleman ISS Flight Engineer

Paolo Nespoli (ESA) ISS Flight Engineer

Expedition 26 crew will undock and land on May 16, 2011

27 Soyuz/Expedition 28 Launch
May – September 2011



Vehicle: 27 Soyuz

Launch: May 30, 2011

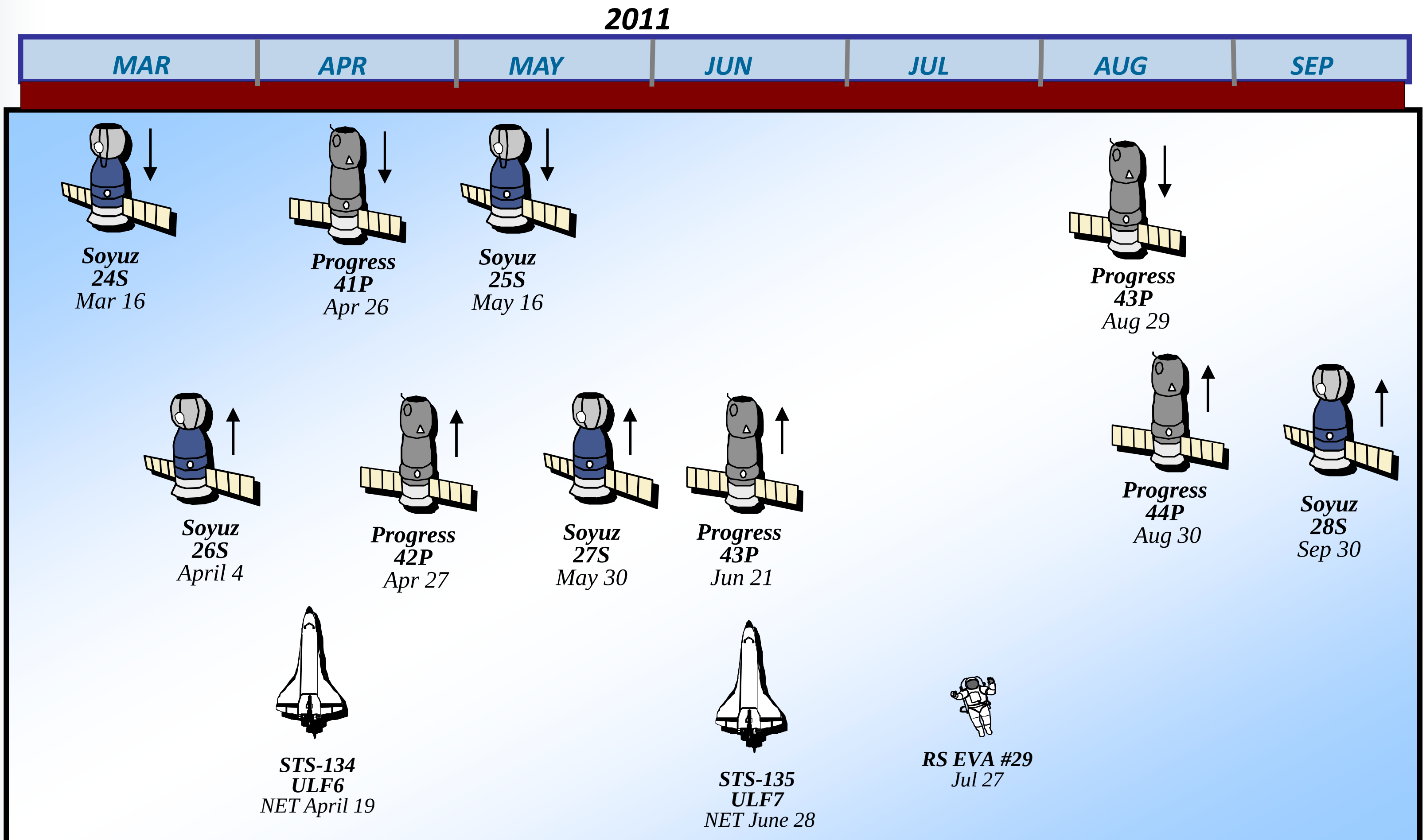
Docking: June 1, 2011

Undock/Landing: November 16, 2011

27 Soyuz Crew
Mike Fossum Expedition 28 Flight Engineer and Expedition 29 Commander
Sergei Volkov ISS Flight Engineer
Satoshi Furukawa (JAXA) ISS Flight Engineer

Expedition 28 Crew
Andrey Borisenko Expedition 28 Commander
Alexander Samokutyaev ISS Flight Engineer
Mike Fossum ISS Flight Engineer
Satoshi Furukawa (JAXA) Flight Engineer
Ron Garan Flight Engineer
Sergei Volkov Flight Engineer

ISS Expedition 27/28 Summary



S - Soyuz (crew rotation, cargo)
P - Progress (cargo and fuel)
EVA - Extravehicular Activity (EVA)
STS - Space Shuttle

ISS Expedition 27/28 Mission Objectives April - Sept, 2011

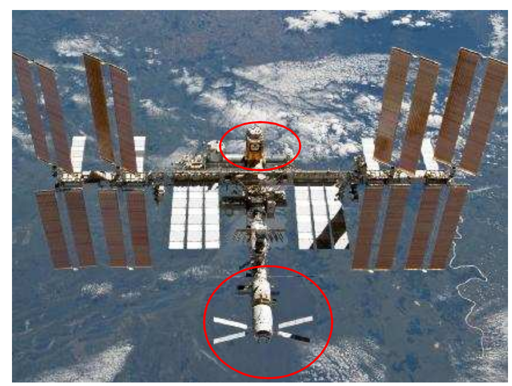
NASA

- Conduct complex vehicle operations with two Shuttle docking and undockings; two Soyuz docking and undockings; Progress dockings and undockings; ATV undocking; and SpaceX fly-by
- Perform crew handover between Expeditions
- Complete reconfiguration of the permanent multipurpose module (PMM) for on-orbit operations
- Perform check out and preparation tasks for STS 134/ULF-6 delivery of the Alpha Magnetic Spectrometer (AMS-2) and the final Express Logistics Carrier (ELC)
- Prepare for departure of Europe's ATV2 resupply vehicle, June 2011
- Perform check out and preparation tasks for STS 135/MPLM delivery of supplies, logistics, spare parts and research equipment
- Prepare for SpaceX fly-by and demonstration

PMM

AMS-2

ATV2



ISS with HTV2 and ATV2 attached, February and March 2011

STS 134/ULF-6 Delivery of the Alpha Magnetic Spectrometer

AMS is a state-of-the-art particle physics detector developed by an international team of 59 institutes from 16 countries; sponsored by the U.S. Department of Energy. The AMS will use the unique environment of space to advance knowledge of the universe and lead to the understanding of the universe's origin by searching for antimatter, dark matter and measuring cosmic rays.

The AMS is a 15,000 lbs payload that will sit on the S3 Truss upper inboard payload attach site. It will run continuously for at least 3 years using 8 detectors and a large superconducting magnet.

AMS – side view

AMS on S3 Truss

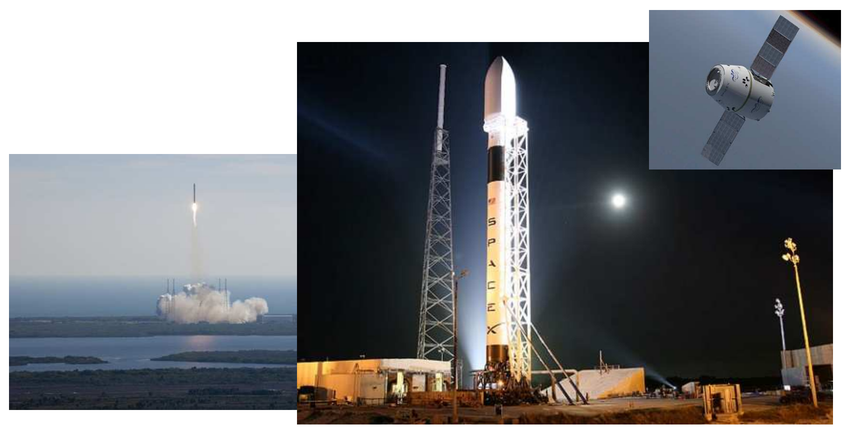
N A S A

ISS Expedition 27/28 Mission Milestones

Final flight of Space Shuttle Endeavour delivering the Alpha Magnetic Spectrometer (AMS-2) and the final Express Logistics Carrier (ELC).

Final flight of Space Shuttle Atlantis delivering supplies, logistics, spare parts and research equipment to the ISS.

SpaceX Falcon 9 launch and Dragon spacecraft flyby of the ISS, approaching within 20km to demonstrate radio telemetry and command capability.



Recent Events

The ISS crew members unpacked and welcomed Robonaut 2 on board the ISS on March 15, 2011. The humanoid robot will teach engineers how dexterous robots behave in space and help us understand the interface between humans and robots during operational testing.

Robonaut meets the public during NASA Technology Day on Capital Hill.

Expedition 26 crewmembers returned to snowy Kazakhstan on March 16, 2011, after spending almost 6 months on ISS.

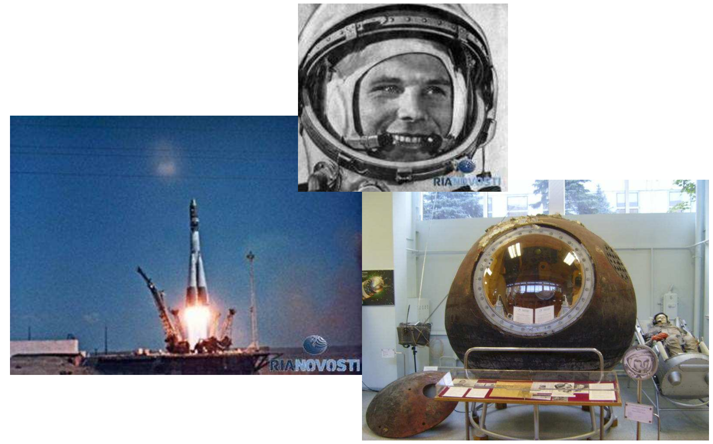
This photograph taken aboard the ISS following the earthquake and tsunami off the coast of Japan on March 14, 2011.

JAXA's HTV2 cargo vehicle undocked and burned up in the Earth's atmosphere during reentry on March 29 2011, after spending 8 weeks attached to the ISS.

Celebrating Human Spaceflight

NASA

50th anniversary of Vostok-1, Russia's first human in space and the first person to orbit the Earth on April 12, 1961. Russian cosmonaut Yuri Gagarin's flight lasted 108 minutes completing one orbit of the earth reaching 203 nautical miles.



Vostok I capsule used by Yuri Gagarin in first space flight now on display at the RKK Energiya Museum outside of Moscow.

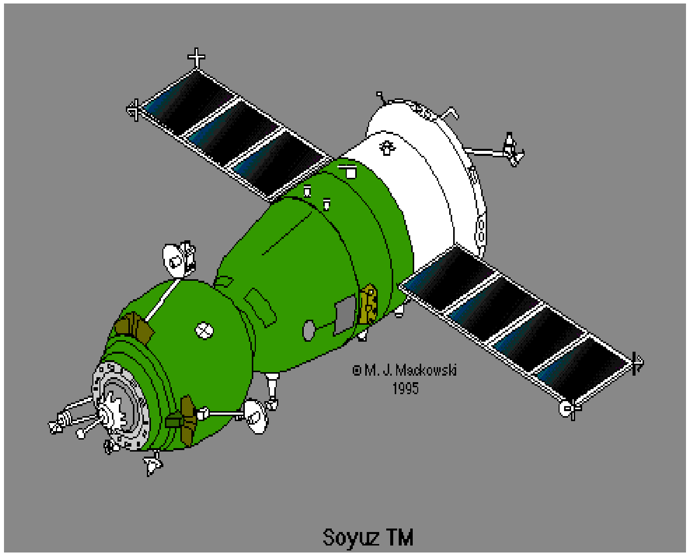
30th anniversary of STS-1 Space Shuttle Columbia's first flight of a reusable spacecraft on April 12, 1981. NASA astronauts John Young and Robert Crippen orbited the Earth 37 times in 54.5-hours covering 1,074,567 miles.

Soyuz

NASA

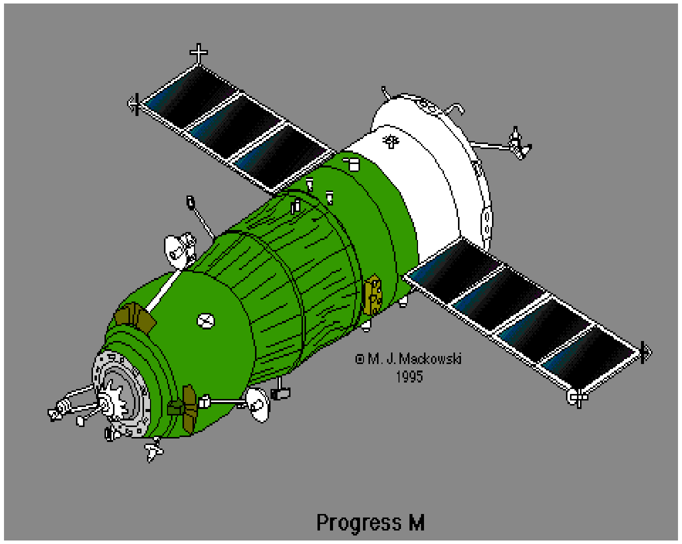
The Soyuz spacecraft is launched to the ISS from the Baikonur Cosmodrome in Kazakhstan aboard a Soyuz rocket. It consists of an Orbital Module, a Descent Module and an Instrumentation/ Propulsion Module.

Soyuz and Progress Vehicles



SOYUZ

- Soyuz serves as the ISS crew rotation and return vehicle, acting as a lifeboat in the event an emergency would require the crew to leave the ISS.
- Two new Soyuz vehicles rotate crew to the ISS every 6 months.



PROGRESS

- Several Progress vehicles bring cargo and propellant supplies to the ISS each year.
- Although similar to the Soyuz, the Progress is an uncrewed, automated, cargo vehicle.
- Once docked to the ISS, the Progress vehicle has the ability to raise the Station's altitude and control the orientation of the Station using the vehicle's thrusters.
- A Progress can deliver on average 1,700 kg (approx. 3,700 lbs.) of pressurized cargo.

Expedition 27/28 Research Synopsis

Information provided by:
ISS Program Scientist Office and ISS Payload Office (NASA)
Canadian Space Agency (CSA)
European Space Agency (ESA)
Japan Aerospace and Exploration Agency (JAXA)

For more details on the research and facilities described please see:
http://www.nasa.gov/mission_pages/station/science/index.html

Prepared by the
Office of the ISS Program Scientist
April 2011

N A S A

Expedition 27/28 Research Program

- Expedition 27/28 will include operation of 115 integrated experiments in biology and biotechnology, Earth and space science, educational activities, human research, physical and materials sciences and technology
  - Three are planned for operation by the Canadian Space Agency (CSA)
  - Fifteen are planned for operation by the European Space Agency (ESA)
  - Eighteen are planned for operation by the Japan Aerospace and Exploration Agency (JAXA)
  - Twenty-one are Sortie experiments to be conducted by Space Shuttle crewmembers during missions to the ISS

- Integrated experiments on this Expedition will support the work of approximately 350 scientists world-wide

- ISS Research Facilities include:
  - Advanced Biological Research System (ABRS); Biological Experiment Laboratory; European Modular Cultivation System (EMCS); European Drawer Rack; European Physiology Module (EPM); Muscle Atrophy Research and Exercise System (MARES)
  - Combustion Integrated Rack (CIR); Fluids Integrated Rack (FIR); Microgravity Sciences Glovebox (MSG); Materials Science Research Rack-1 (MSRR); Fluid Science Laboratory (FSL)
  - 2 Human Research Facility Racks (include ultrasound, refrigerated centrifuge, portable computer, pulmonary function system, etc.)
  - 8 EXPRESS Racks (provide power and communications for experiments housed inside, two also provide vibration isolation)
  - 3 Minus Eighty Degree Laboratory Freezer for the ISS (MELFI)
  - Sun Monitoring on the External Payload Facility of Columbus (Solar); Ryutai Experiment Rack (Ryutai); Saibo Experiment Rack (Saibo)
  - Window Observational Research Facility (WORF)
  - European Transportation Carrier (ETC)

NASA-Integrated Experiments

NASA

Biology and Biotechnology
- BIOKIS[S]
- NanoRacks-CubeLabs-LMA[I]
- NanoRacks-CubeLabs-MDA[I]
- Night Vision[I]
- NLP-Cells-6[I]
- NLP-Cells-7[S]
- NLP-Vaccine[S]
- Plant Signaling[I]
- STL[S]
- SyNRGE[S]
- VIABLE ISS[I]

Earth and Space Science
- AMS-02[E]
- CEO[I]
- HREP-HICO[E]
- ISSAC[I]

Educational Activities
- CSI-05[I]
- EarthKAM[I]
- EPO-Demos[I]
- ISS Ham Radio[I]
- Kids in Micro-g 2[I]
- Lego Bricks[I]
- NanoRacks-CubeLabs-MDA-Education[S]
- NLO-Education-1

Human Research
- Bisphosphonates[I]
- CBTM-3[S]
- Functional Task Test[PP]
- Integrated Cardiovascular[I]
- Integrated Immune[I]
- Integrated Immune-SDBI[s]
- Nutrition[I]

Human Research
- Pro K[I]
- Reaction Self Test[I]
- Integrated Immune[I]
- Integrated Immune-SDBI[s]
- Nutrition[I]
- Pro K[I]
- Reaction Self Test[I]
- Repository[I]
- Sleep-Short[S]
- Spinal Elongation[S]
- Sprint[I]
- Treadmill Kinematics[I]
- VO2max[I]

Physical and Materials Science
- BCAT-3[I]
- BCAT-4[I]
- BCAT-5[I]
- BCAT-6[I]

Physical and Materials Science
- Bio[I]
- CCF[I]
- CFE-2[I]
- CVB[I]
- DECLIC-ALI[I]
- FLEX-2[I]
- InSPACE-3[I]
- MISSE-7[E]
- MISSE-8[E]
- MSL-CETSOL and MICAST[I]
- PACE-2[I]
- Shape Memory Foam[I]
- SHERE-II[I]
- SLICE[I]
- SpaceDRUMS[I]

Technology
- APE[S]
- DTN[I]

Technology
- ENOS[I]
- FOB[S]
- HREP-RAIDS[I]
- MAUI[D]
- PSSC[I]
- RAMBO-2[D]
- REBR[D]
- Robonaut[I]
- Robotic Refueling[I]
- SEITE[I]
- SIMPLEX[D]
- SNFM[I]
- SPHERES[I]
- STORRM[I]
- STP-H3-Canary[E]
- STP-H3-DISC[E]
- STP-H3-MHTEX[E]
- STP-H3-VADER[E]
- VCAM[I]

I=ISS Inflight *E=ISS External* *S=Space Shuttle* *D=Descent Only* *PP=Pre/Postflight*

ESA-Integrated Experiments

Biology and Biotechnology
Gravi-2[I]
TripleLux-A[I]
Earth and Space Science
SOLACES[E]
SOLSPEC[E]
Educational Activities
ESA-EPO[I]
Human Research
3D-Space[I]
Card[I]
EKE[I]

Human Research
Immuno[I]
Passages[I]
SOLO[I]
Thermolab[I]
Vessel Imaging[I]
Physical and Materials Science
Geoflow-2[I]
Technology
DOSIS-DOBIES[I]
TriTel
Vessel ID System[E]

JAXA-Integrated Experiments

Biology and Biotechnology
Aquatic Habitat[I]
CsPINs[I]
Microbe[I]
Myco[I]
Nano Step[I]
Earth and Space Science
SEDA-AP[E]
SMILES[E]
Educational Activities
JAXA EPO 7[I]
Human Research
Biological Rhythms[I]

Human Research
Hair[I]
Onboard Diagnostic Kit[I]
Physical Science
Hicari[I]
Marangoni[I]
Alloy Semiconductor[I]
JAXA PCG[I]
Technology
TEM[I]
JAXA-Commercial[I]
MAXI[E]
PADLES[I]

CSA-Integrated Experiments

Educational Activities
CSA Comm and Outreach[PP]
Tomatossphere-III[I]

Human Research
Vascular[I]

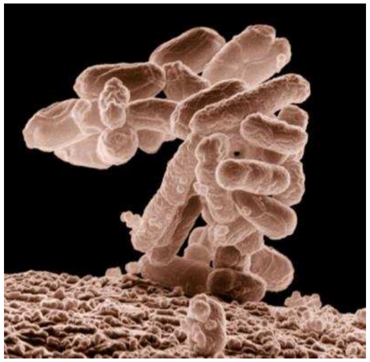
I=ISS Inflight *E=ISS External* *PP=Pre/Postflight*

Biology and Biotechnology

N A S A

- **BIOKon In Space (BIOKIS)** evaluates genetic distinctions of various biological species following short-duration space flight to give scientists greater insight into genetic mutations resulting from microgravity exposure. Pier Luigi Ganga, Kayser Italia s.r.l., Livorno, Italy
- **Dynamism of Auxin Efflux Facilitators, CsPINs, Responsible for Gravity-regulated Growth and Development in Cucumber (CsPINs)** uses cucumber seedlings to analyze the effect of gravity on gravimorphogenesis (peg formation) in cucumber plants. Hideyuki Takahashi, Ph.D., Tohoku University, Sendai, Miyagi, Japan
- **Threshold Acceleration for Gravisensing – 2 (Gravi-2)** grows lentil seedling roots under various gravity conditions on board the ISS to determine the amount of acceleration force sufficient to stimulate the direction of root growth. Dominique Driss-Ecole, Ph.D., University Pierre-et-Marie Curie, Paris, France
- **Japan Aerospace Exploration Agency Protein Crystal Growth (JAXA PCG)** grows crystals of biological macromolecules by the counter-diffusion technique in microgravity for use in applied structural biology and pharmaceutical activity. Masaru Sato, Japan Aerospace and Exploration Agency, Tsukuba, Japan
- **Microbial Dynamics in ISS – I (Microbe-I)** monitors microbes on board the ISS which may affect the health of crewmembers. Koichi Makimura, M.D., Ph.D., Teikyo University, Otsuka, Hachioji, Japan
- **Mycological Evaluation of Crew Exposure to ISS Ambient Air (Myco)** evaluates the risk of microorganisms via inhalation and adhesion to the skin to determine which fungi act as allergens on the ISS. Chiaki Mukai, M.D., Ph.D., Japan Aerospace Exploration Agency, Tsukuba, Japan
- **NanoRacks-CubeLabs Module-7** mixes samples of liquids in microgravity. The science goals for NanoRacks-CubeLabs Module-7 are proprietary with an international client base. Jeffrey Manber, NanoRacks, LLC, Laguna Woods, CA

Astronaut Williams works with the Gravi experiment in the US Lab.



Electron micrograph image of the E coli pathogenic microbe magnified 10,000 times.

Biology and Biotechnology

Astronaut Behnken works with the NLP-vaccine experiment.

Jatropha fruit used in NPL-Cells-6 experiment*.*

- **NanoRacks-CubeLabs Module-8** processes biological samples in microgravity. The science goals for NanoRacks-CubeLabs Module-8 are proprietary. Jeffrey Manber, NanoRacks, LLC, Laguna Woods, CA
- **Eyespots and Macular Pigments Extracted from Algal Organisms Immobilized in Organic Matrix with the Purpose to Protect Astronaut's Retina (Night Vision)** studies the response of microalgae strains (that contain eye spots similar to the human retina) to space radiation with results applicable to future nutrition programs for astronauts during long-duration space exploration missions. Maria Teresa Giardi, Ph.D., Institute of Crystallography, Rome, Italy
- **National Lab Pathfinder – Cells – 6: Jatropha – 3 (NLP-Cells-6)** assesses the effects of microgravity on formation, establishment and multiplication of undifferentiated cells of the *Jatropha curcas*, a biofuel plant. The experiment will evaluate changes in cell structure, growth and development, genetic changes, and differential gene expression as they relate to accelerating the breeding process for the development of new cultivars of this biofuel plant. Wagner Vendrame, Ph.D., Tropical Research and Education Center, Gainesville, FL
- **National Lab Pathfinder - Cells - 7 (NLP-Cells-7**) contains several different experiments that examine cellular replication and differentiation of cells. This research is investigating the use of space flight to enhance or improve cellular growth processes utilized in ground based research. Louis Stodieck, Ph.D., BioServe Space Technologies, University of Colorado
- **National Laboratory Pathfinder – Vaccine (NLP-Vaccine)** contains pathogenic (disease causing) organisms, which use space flight to develop a potential vaccine for the prevention of infection on Earth and in microgravity. Timothy Hammond, M.B.B.S., Durham Veterans Affairs Medical Center, Durham, NC

Biology and Biotechnology

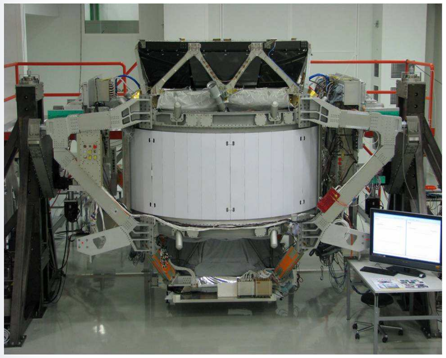
N A S A

- **Plant Signaling** experiment studies the effects of microgravity on the growth of plants. Samples of the plants are harvested and returned to Earth for scientific analysis which will aid in food production during future long-duration space missions, as well as data to enhance crop production on Earth. Imara Perera, Ph.D., North Carolina State University, Raleigh, North Carolina
- **Tissue Loss (STL)** uses cell cultures to examine the response of human immune cells in microgravity and target intervention strategies. Cheryl Nickerson, Ph.D. Arizona State University, Tempe, AZ
  Symbiotic Nodulation in a Reduced Gravity Environment (SyNRGE) investigates microgravity effects associated with microbe-host interactions and cell-cell communication using a plant-bacteria model system. *Medicago truncatula* (barrel medic) seedlings are grown on-orbit in the presence of genetically marked strains of nitrogen fixing bacteria capable of forming a mutualistic symbiosis with plants. Gary Stutte, Kennedy Space Center, Cape Canaveral, FL
- **Gene, Immune and Cellular Responses to Single and Combined Space Flight Conditions - A (TripleLux-A)** studies the effects of space flight and radiation on the immune function of vertebrate cells in microgravity. Bertold Hock, Ph.D., Technical University of Munich at Weihenstephan, Freising, Germany
- **eValuatIon And monitoring of microBiaL biofilms insidE ISS (VIABLE ISS)** evaluates microbial biofilm development on space materials. Both metallic and textile space materials, either conventional or innovative, will be located inside and on the cover of Nomex pouches that will be placed inside the ISS. Francesco Canganella, Department of Agrobiology and Agrochemistry, University of Tuscia, Viterbo, Italy

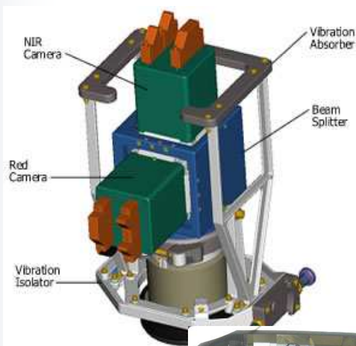
Medicago truncatula (barrel medic) seedlings used in the SyNRGE investigation.

Image of *Arabidopsis thaliana* plant used in several plant investigations on board the ISS.

Earth and Space Science



AMS-02 integration activities in Geneva, Switzerland.



AgCam in the window facility during online testing at KSC.

- **Alpha Magnetic Spectrometer – 02 (AMS-02)** is a state-of-the-art particle physics detector constructed, tested and operated by an international team. The AMS-02 uses the unique environment of space to advance knowledge of the universe and lead to the understanding of the universe's origin by searching for antimatter, dark matter and measuring cosmic rays. Samuel Ting, Ph.D., Massachusetts Institute of Technology, Cambridge, MA
- **Crew Earth Observations (CEO)** takes advantage of the crew in space to observe and photograph natural and human-made changes on Earth. The photographs record the Earth's surface changes over time, along with dynamic events such as storms, floods, fires and volcanic eruptions. These images provide researchers on Earth with key data to better understand the planet. Susan Runco, Johnson Space Center, Houston, TX
- **HICO and RAIDS Experiment Payload - Hyperspectral Imager for the Coastal Ocean (HREP-HICO)** operates a specialized visible and near-infrared camera to detect, identify and quantify coastal features from the ISS. The experiment analyzes the water clarity, water depth, and sea floor composition for maritime purposes. Photographs from HICO are important for maritime vessels in describing the oceans where they are traveling. Mike Corson, Naval Research Laboratory, Washington, D.C.
- **ISS Agricultural Camera (ISSAC)** takes frequent images, in visible and infrared light, of vegetated areas on the Earth, principally of growing crops, rangeland, grasslands, forests, and wetlands in the northern Great Plains and Rocky Mountain regions of the United States. Images will be delivered directly to requesting farmers, ranchers, foresters, natural resource managers and tribal officials to help improve their environmental stewardship of the land. Images will also be shared with educators for classroom use. George A. Seielstad, Ph.D., University of North Dakota, Grand Forks, ND
- **Space Environment Data Acquisition Equipment - Attached Payload (SEDA-AP)** measures the effect of the space environment in ISS orbit on materials and electronic devices. Tateo Goka, Japan Aerospace Exploration Agency, Tokyo, Japan

Earth and Space Science

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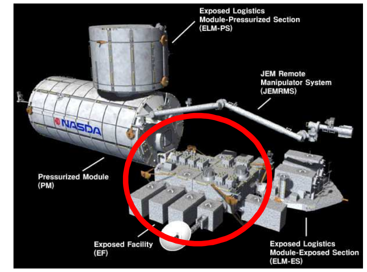
- **Superconduction Submillimeter-wave Limb-emission Sounder (SMILES)** creates global mappings of stratospheric trace gases by a sensitive submillimeter receiver. Masato Shiotani, Kyoto University, Kyoto, Japan
- **SOLar Auto-Calibrating EUV/UV Spectrophotometers (SOLACES) and SOLar SPECtral Irradiance Measurements (SOLSPEC)** measures the solar spectral irradiance from the sun. G. Schmidtke, Fraunhofer-Institut for Physikalische Messtechnik, Freiburg, Germany; M. G. Thuillier, Centre National de la Recherche Scientifique, Verrieres le Buisson, France; Claus Froehlich, Ph.D.



JAXA's SMILES experiment is mounted on the JEM exposed facility.

Educational Activities

- **Canadian Space Agency Communications and Outreach (CSA Comm and Outreach)** activity captures communications scripted images and video for CSA investigations onboard the ISS. RuthAnn Chicoine, Candian Space Agency, Saint-Hubert, Quebec, Canada
- **Commercial Generic Bioprocessing Apparatus Science Insert – 05 (CSI-05)** provides the K-12 community opportunities to utilize the unique microgravity environment of the ISS as part of the regular classroom to encourage learning and interest in science, technology, engineering and math. Louis Stodieck, Ph.D., University of Colorado - Boulder, BioServe Space Technologies, Boulder, CO
- **Earth Knowledge Acquired by Middle School Students (EarthKAM)** allows middle school students to program a digital camera on board the ISS to photograph a variety of geographical targets for study in the classroom. Photos are made available on the world wide web for viewing and study by participating schools around the world. Educators use the images for projects involving Earth Science, geography, physics, and social science. Sally Ride, Ph.D., University of California - San Diego, San Diego, CA

Seventh graders use a map and the Internet to determine the latitude and longitude of their next picture during and EarthKAM session.

Educational Activities

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- **Education Payload Operation - Demonstrations (EPO-Demos)** records video education demonstrations performed on the ISS by crewmembers using hardware already onboard the ISS. EPO-Demos enhance existing NASA education resources and programs for educators and students in grades K-12 and support the NASA mission to inspire the next generation of explorers. Matthew Keil, Johnson Space Center, Houston, TX
- **European Space Agency – Education Payload Operation (ESA-EPO)** films simple curriculum relevant demonstrations proposed by European educators to give students an appreciation of the free fall environment. Recordings will be used during educational events and on the ESA education website. ESA
- **ISS Ham Radio (ISS Ham Radio)** allows students to talk directly with the crews living and working aboard the ISS. Kenneth Ransom, Johnson Space Center, Houston, TX
- **Japan Aerospace Exploration Agency Education Payload Observation 7 (JAXA EPO 7)** documents educational events and artistic activities on board the ISS to enlighten the general public about microgravity research and human space flight. Naoko Matsuo, Japan Aerospace Exploration Agency, Tsukuba, Japan
- **Kids In Micro-gravity - 2 (Kids in Micro-g-2)** provides students in grades 5 - 8 a hands-on opportunity to design an experiment or simple demonstration that could be performed both in the classroom and aboard the ISS. Deborah Biggs, Johnson Space Center, Houston, TX
- **Lego Bricks** is a series of toy Lego kits that are assembled on orbit and used to demonstrate scientific concepts. Some of these models include satellites, a space shuttle orbiter, and a scale model of the ISS. The Lego Group, Billund, Denmark

School children build LEGO space vehicles at Kennedy Space Center.

Crewmember activates the NanoRacks-CubeLabs on board the ISS.

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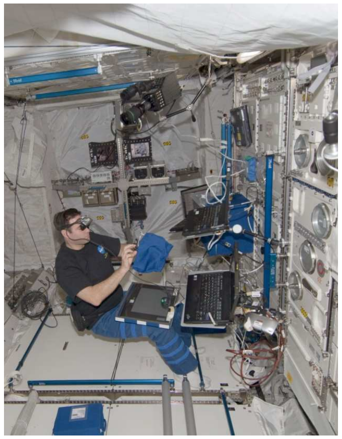
Educational Activities

Students study the growth of their tomato plants during the Tomatosphere program.

- **NanoRacks-CubeLabs Module-8** processes biological samples in microgravity. The science goals for NanoRacks-CubeLabs Module-8 are proprietary. Jeffrey Manber, NanoRacks, LLC., Laguna Woods, CA
- **National Laboratory Office – Education – 1 (NLO-Education-1)** promotes Science, Technology, Engineering, and Math (STEM) education in the United States through activities on-board the ISS. Mark Severance, Johnson Space Center, Houston, TX
- **Tomatosphere-III** will send thousands of tomato seeds to the ISS for exposure to the space environment. The seeds will be returned to Earth for use in 10,000 classrooms throughout Canada as a learning resource. Students will measure the germination rates, growth patterns and vigor of growth of the seeds. Marilyn Steinberg, Canadian Space Agency, Saint-Hubert, Quebec, Canada

Human Research



Astronaut Chamitoff works with 3D-Space experiment in the JAXA lab.

- **Mental Representation of Spatial Cues During Space Flight (3D-Space)** investigates the effects of microgravity on the mental representation of spatial cues by astronauts during and after space flight. The absence of the gravitational frame of reference during space flight could be responsible for disturbances in the mental representation of spatial cues, such as the perception of horizontal and vertical lines, the perception of an object's depth, and the perception of a target's distance. Gilles Clement, Ph.D., Centre National de la Recherche Scientifique, Toulouse, France

Human Research

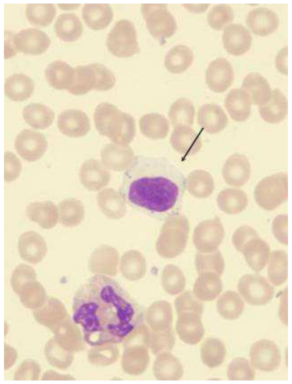
- **Effect of Long-term Microgravity Exposure on Cardiac Autonomic Function by Analyzing 24-hours Electrocardiogram (Biological Rhythms)** examines the effect of long-term microgravity exposure on cardiac autonomic function by analyzing 24-hour electrocardiogram of long-duration ISS crewmembers. Chiaki Mukai, M.D Ph.D., Japan Aerospace Exploration Agency, Tsukuba, Japan
- **Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss (Bisphosphonates)** determines whether antiresorptive agents (help reduce bone loss), in conjunction with the routine inflight exercise program, will protect ISS crewmembers from the regional decreases in bone mineral density documented on previous ISS missions. Adrian LeBlanc, Ph.D., Division of Space Life Sciences, Universities Space Research Association, Houston TX; Toshio Matsumoto, M.D., Ph.D., University of Tokushima, Kuramoto, Japan
- **Long Term Microgravity: A Model for Investigating Mechanisms of Heart Disease with New Portable Equipment (Card)** experiment studies blood pressure decreases in the human body exposed to microgravity on board the ISS. Peter Norsk, M.D. University of Copenhagen, Copenhagen, Denmark
- **Commercial Biomedical Test Module - 3 (CBTM-3)** uses a validated mouse model to examine the effectiveness of an experimental therapeutic as a possible countermeasure for muscle atrophy. Combined with exercise, this experimental therapeutic developed by Amgen could one day form the basis for a treatment that will help maintain a high level of physical fitness in future flight crews. Louis Stodieck, Ph.D., BioServe Space Technologies, University of Colorado - Boulder, Boulder, CO
- **Assessment of Endurance Capacity by Gas Exchange and Heart Rate Kinetics during Physical Training (EKE)** targets the development of a diagnostic tool for the assessment of endurance capacity from respiratory and cardiovascular kinetics in response to changes in exercise intensity of long duration space explorers. U. Hoffman, ESA

Astronaut Coleman performing a remotely guided echocardiogram on a test subject.

JAXA astronaut Wakata works with the ESA Card experiment.

Human Research

- **Physiological Factors Contributing to Changes in Postflight Functional Performance (Functional Task Test)** tests astronauts on an integrated suite of functional and physiological tests before and after short and long-duration space flight to identify critical mission tasks that may be impacted, map physiological changes to alterations in physical performance and aid in the design of countermeasures that specifically target the physiological systems responsible for impaired functional performance. Jacob Bloomberg, Ph.D., Johnson Space Center, Houston, TX
- **Neuroendocrine and Immune Responses in Humans During and After Long Term Stay at ISS (Immuno)** provides an understanding for the development of pharmacological tools to counter unwanted immunological side-effects during long-duration missions in space. Alexander Chouker, M.D., Un of Munich, Germany
- **Cardiac Atrophy and Diastolic Dysfunction During and After Long Duration Spaceflight: Functional Consequences for Orthostatic Intolerance, Exercise Capability and Risk for Cardiac Arrhythmias (Integrated Cardiovascular)** quantifies the extent, time course and clinical significance of cardiac atrophy (decrease in the size of the heart muscle) associated with long-duration space flight. This experiment identifies the mechanisms of this atrophy and the functional consequences for crewmembers who will spend extended periods of time in space. Benjamin D. Levine, M.D., Presbyterian Hospital and University of Texas Southwestern Medical Center at Dallas, Dallas, TX; Michael W. Bungo, M.D., University of Texas Medical School, Houston, TX
- **Validation of Procedures for Monitoring Crew Member Immune Function (Integrated Immune)** assesses the clinical risks resulting from the adverse effects of space flight on the human immune system and will validate a flight-compatible immune monitoring strategy. Clarence Sams, Johnson Space Center, Houston, TX
- **Validation of Procedures for Monitoring Crew Member Immune Function - Short Duration Biological Investigation (Integrated Immune-SDBI)** assesses the clinical risks resulting from the adverse effects of space flight on the human immune system and validates a flight-compatible immune monitoring strategy. Immune system changes will be monitored by collecting and analyzing blood, urine and saliva samples from crewmembers before, during and after space flight. Clarence Sams, PhD, Johnson Space Center, Houston, TX



Blood sample showing white blood cells.

Canadian astronaut Thirsk inserts experiment samples into the MELFI freezer.

Human Research

NASA flight surgeon works with the Reaction Self Test inside the undersea habitat during the 12th NASA Extreme Environment Mission Operations (NEEMO) mission.

Canadian astronaut Thirsk inserts a urine sample into the MELFI freezer as part of the Nutrition study.

- **Nutritional Status Assessment (Nutrition)** is a comprehensive in-flight study to understand changes in human physiology during long-duration space flight. This study includes measures of bone metabolism, oxidative damage, and chemistry and hormonal changes, as well as assessments of the nutritional status of the astronauts participating in the study. Scott M. Smith, Ph.D., Johnson Space Center, Houston, TX
- **Onboard Diagnostic Kit** is a total telemedicine system including a stethoscope and electroencephalography capable of measuring, storing and analyzing crew's medical data. In addition, the medical data will be downlinked in real-time to doctors on the ground. JAXA
- **Scaling Body-Related Actions in the Absence of Gravity (Passages)** tests how astronauts interpret visual information in microgravity. M. Luyat, ESA.
- **Dietary Intake Can Predict and Protect Against Changes in Bone Metabolism during Spaceflight and Recovery (Pro K)** is NASA's first evaluation of a dietary countermeasure to lessen bone loss of astronauts. Pro K proposes that a flight diet with a decreased ratio of animal protein to potassium will lead to decreased loss of bone mineral. Scott M. Smith, Ph.D., Johnson Space Center, Houston, TX
- **Psychomotor Vigilance Self Test on the ISS (Reaction Self Test)** is a portable 5-minute reaction time task that allows the crewmembers to monitor the daily effects of fatigue on performance while on board the ISS. David F. Dinges, Ph.D., University of Pennsylvania School of Medicine, Philadelphia, PA

Human Research

- **National Aeronautics and Space Administration Biological Specimen Repository (Repository)** is a storage bank used to maintain biological specimens over extended periods of time and under well-controlled conditions. Biological samples from the ISS including blood and urine are collected, processed and archived during the preflight, inflight and postflight phases of ISS missions. Kathleen A. McMonigal, M.D., Johnson Space Center, Houston, TX
- **Sleep-Wake Actigraphy and Light Exposure During Spaceflight - Short (Sleep-Short)** examines the effects of space flight on the sleep of the astronauts during Space Shuttle missions. Advancing state-of-the-art technology for monitoring, diagnosing and assessing treatment of sleep patterns is vital to treating insomnia on Earth and in space. Charles A. Czeisler, M.D., Ph.D., Brigham and Women's Hospital, Harvard Medical School, Boston, MA; Laura K. Barger, Ph.D., Brigham and Women's Hospital, Harvard Medical School, Boston, MA
- **SOdium LOading in Microgravity (SOLO)** studies the mechanisms of fluid and salt retention in the body during space flight. Martina Heer, Ph.D., Institute of Aerospace Medicine, Cologne, Germany
- **Spinal Elongation and its Effects on Seated Height in a Microgravity Environment (Spinal Elongation)** measures the change that occurs in the astronaut’s seated height due to spinal elongation in microgravity. Sudhakar Rajulu, Ph.D., Johnson Space Center, Houston, TX
- **Integrated Resistance and Aerobic Training Study (Sprint)** evaluates the use of high intensity, low volume exercise training to minimize loss of muscle, bone, and cardiovascular function in ISS crewmembers during long-duration missions. Lori Ploutz-Snyder, Ph.D., Universities Space Research Association, Houston, TX
- **Thermoregulation in Humans During Long-Term Spaceflight (Thermolab)** investigates the thermoregulatory and cardiovascular adaptations during rest and exercise during a long-duration microgravity exposure. H. C. Gunga, ESA

Astronaut Williams enters data at a computer workstation for the Sleep experiment in the US lab.

JAXA astronaut Wakata pictured with fresh tomatoes and apples on the ISS.

Human Research

NASA

Astronaut Stott performs exercise for the Treadmill Kinematics experiment.

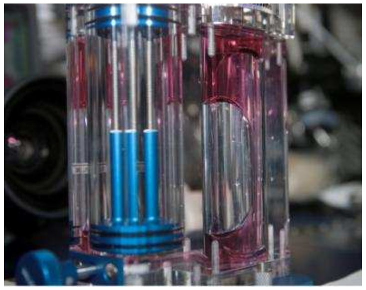
Astronaut Williams performing the protocol used to measure VO_2max.

- **Biomechanical Analysis of Treadmill Exercise on the ISS (Treadmill Kinematics)** is the first rigorous investigation to quantify the biomechanics of treadmill exercise conditions during long duration spaceflight on the ISS. Understanding these mechanisms will allow the development of appropriate exercise prescriptions to increase exercise benefits to crew health and well-being. John De Witt, Ph.D., Wyle, Houston TX
- **Vascular Health Consequences of Long-Duration Space Flight (Vascular)** evaluates the impact of long-duration space flight on the blood vessels of astronauts. Richard Lee Hughson, Ph.D., University of Waterloo, Waterloo, Ontario, Canada
- **Vascular Echography (Vessel Imaging)** evaluates the changes in central and peripheral blood vessel wall properties (thickness and compliance) and cross sectional areas of long-duration ISS crewmembers during and after long-term exposure to microgravity. Phillippe Arbeille, M.D., Ph.D., University of Tours, Tours, France
- **Evaluation of Maximal Oxygen Uptake and Submaximal Estimates of VO2max Before, During, and After Long Duration ISS Missions (VO2max)** documents changes in maximum oxygen uptake for crewmembers onboard the ISS on long-duration missions. Alan D. Moore, Jr., Ph.D., Johnson Space Center, Houston, TX

Physical and Materials Science

- **Crystal Growth of Alloy Semiconductor Under Microgravity (Alloy Semiconductor)** clarifies crystal growth factors of high-quality bulk alloy semiconductors by investigating solute transport in liquid and surface orientation dependence of growth kinetics under microgravity and terrestrial conditions. Yuko Inatomi, Japan Aerospace and Exploration Agency, Tokyo, Japan
- **Binary Colloidal Alloy Test – 3, -4, -5 and -6 (BCAT-3, -4,-5 and -6)** is a suite of investigations which photograph randomized colloidal samples in microgravity to determine their resulting structure over time. Results will help scientists develop fundamental physics concepts previously hindered by the effects of gravity. Data may lead to improvements in supercritical fluids used in rocket propellants biotechnology applications, and advancements in fiber-optics technology. David A. Weitz, Ph.D., Harvard University, Cambridge, MA
- **Capillary Channel Flow (CCF)** studies a critical variety of inertial-capillary dominated flows key to spacecraft systems that cannot be studied on Earth. CCF results are useful for the design, testing, and instrumentation for verification and validation of liquid management systems of current orbiting, design stage, and advanced spacecraft envisioned for future exploration missions. Michael Dreyer, Ph.D., University of Bremen, Bremen, Germany
- **Capillary Flow Experiment - 2 (CFE-2)** is a suite of fluid physics experiments that investigate capillary flows and flows of fluids in containers with complex geometries. Results will improve current computer models that are used by designers of low gravity fluid systems and may improve fluid transfer systems on future spacecraft. Mark M. Weislogel, Ph.D., Portland State University, Portland, OR

Astronaut Tani photographing the BCAT sample.



Fluid flow demonstrated during the CFE experiment.

Physical and Materials Science

NASA

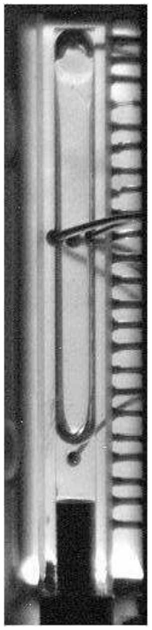
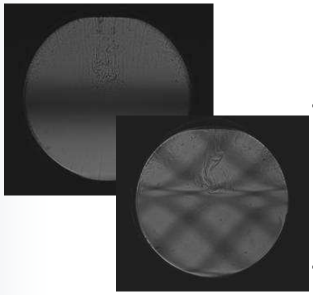


Image taken by the surveillance camera in the Light Microscopy Module during initial operations of the CVB experiment.

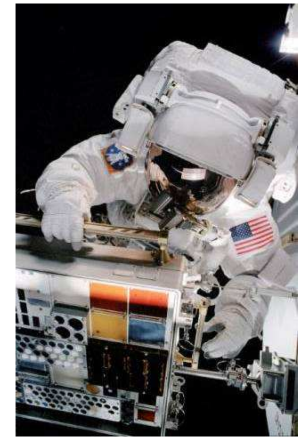


Pure water above the critical point observed in wide field transmission during ground tests of the DECLI experiment.

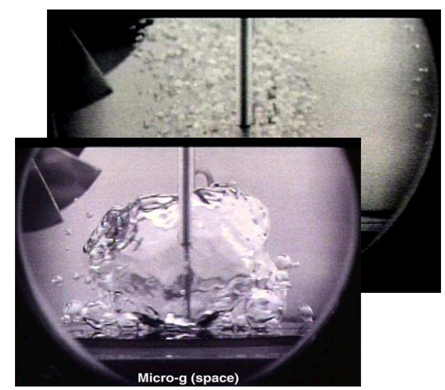
- **Constrained Vapor Bubble (CVB)** operates a miniature wickless heat pipe (heat exchanger) to understand the physics of evaporation and condensation as they affect heat transfer processes in microgravity. Peter C. Wayner, Jr., Ph.D., Rensselaer Polytechnic Institute, Troy, New York; Joel Plawsky, Sc.D., Rensselaer Polytechnic Institute, Troy, NY
- **DEvice for the study of Critical LIquids and Crystallization – Alice Like Insert (DECLIC-ALI)** studies the dynamics of near-ambient temperature critical fluids of sulfur hexafluoride, a colorless, odorless, non-toxic and non-flammable gas known and carbon dioxide. Yves Garrabos, Ph.D., Institut de Chimie de la Matière Condensée de Bordeaux, Bordeaux, France; Daniel Beysen, Ph.D., Physique et Mecanique des Milieux Heterogenes, Paris, France
- **Flame Extinguishment Experiment - 2 (FLEX-2)** assesses the effectiveness of fire suppressants in microgravity to quantify the effect of different possible crew exploration atmospheres on fire suppression. Forman A. Williams, University of California, San Diego, San Diego, CA
- **Simulation of Geophysical Fluid Flow under Microgravity - 2 (Geoflow-2)** studies thermal convection in the gap between two concentric rotating spheres to model Earth's liquid core. Christoph Egbers, Ph.D., Brandenburg University of Technology, Cottbus, Germany
- **Growth of Homogeneous SiGe Crystals in Microgravity by the TLZ Method (Hicari)** experiment evaluates the crystal-growth theory to produce high-quality crystals of silicon-germanium semiconductor. Kyoichi Kinoshita, NTT Basic Research Laboratories, Atsugi-shi, Japan
- **Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions - 3 (InSPACE-3)** studies magnetorheological fluids (fluids that change properties in response to magnetic fields) to improve or develop new brake systems and robotics. Eric M. Furst, Ph.D., University of Delaware, Newark, DE

Physical and Materials Science

- **Microheater Array Boiling Experiment (MABE)** studies the process involved with boiling in gravity and microgravity to enable the development of efficient cooling systems on future spacecraft and on Earth. Jungho Kim, Ph.D., University of Maryland, College Park, MD
- **Chaos, Turbulence and its Transition Process in Marangoni Convection (Marangoni)** analyzes the behavior of a surface-tension-driven flow in microgravity. Hiroshi Kawamura, Ph.D., Faculty of Science and Technology, Tokyo University of Science, Chiba, Japan
- **Materials ISS Experiment 7 and 8 (MISSE-7, -8)** are testbeds for materials and coatings attached to the outside of the ISS which are being evaluated for the effects of atomic oxygen, ultraviolet, direct sunlight, radiation, and extremes of heat and cold. These experiments allows the development and testing of new materials to better withstand the rigors of space environments. Robert Walters, Ph.D., Naval Research Laboratory, Washington, DC; Phillip Jenkins, Naval Research Laboratory, Washington, DC
- **Materials Science Laboratory - Columnar-to-Equiaxed Transition in Solidification Processing and Microstructure Formation in Casting of Technical Alloys under Diffusive and Magnetically Controlled Convective Conditions (MSL-CETSOL and MICAST)** are two investigations that support research into metallurgical solidification, semiconductor crystal growth (Bridgman and zone melting), and measurement of thermo-physical properties of materials. Charles-Andre Gandin, Ph.D., Ecole de Mines de Paris, ARMINES-CEMEF, Sophia Antipolis, France (CETSOL), Lorenz Ratke, Prof., German Aerospace Center, Cologne, Germany (MICAST)
- **Nucleate Pool Boiling eXperiment (NPBX)** studies heat transfer and vapor removal processes that take place during nucleate boiling from a well characterized surface in microgravity. Such an understanding is needed for optimum design and safe operation of heat exchange equipment employing phase change for transfer of heat in microgravity. Vijay Dhir, Ph.D., University of California - Los Angeles, Los Angeles, CA



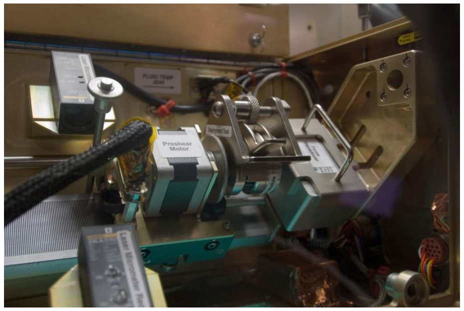
Astronaut Forrester performing an EVA to remove MISSE hardware from the outside of the ISS.



In Earth's gravity, buoyancy allows bubbles to overcome surface tension forces and rise upward. In microgravity force is very weak and bubbles remain attached to the heater.

Physical and Materials Science

- **Shape Memory Foam** evaluates the recovery of shape memory epoxy foam in microgravity. This investigation will study the shape memory properties required to manufacture a new concept actuator (a device that transforms energy to other forms of energy). Professor Loredana Santo, University of Rome Tor Vergata, Rome, Italy
- **Shear History Extensional Rheology Experiment - II (SHERE-II)** investigates the effect of preshearing rotation on the stress and strain response of a polymer fluid — a complex fluid containing long chains of polymer molecules — being stretched in microgravity. Understanding and measurement of these complex fluids is important for containerless processing, a key operation for fabrication of parts on future exploration missions. Gareth McKinley, Ph.D., Massachusetts Institute of Technology, Cambridge, MA
- **Space Dynamically Responding Ultrasonic Matrix System (SpaceDRUMS)** is a suite of hardware that enables containerless processing in microgravity. SpaceDRUMS can completely suspend a baseball-sized solid or liquid sample during combustion or heat-based synthesis to assist with development of advanced materials of a commercial quantity and quality. Jacques Guigne, Ph.D.,Guigne Space Systems, Incorporated, Paradise, Newfoundland, Canada



The Laser Micrometer, deployment tool, preshear motor, and force transducer on the SHERE experiment in the Microgravity Science Glovebox .

Hardware used for the SHERE fluid physics experiment.

Technology

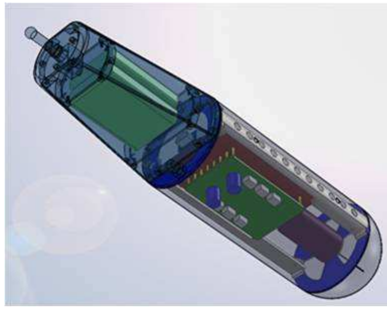


Illustration of the APE hardware which has a cylindrical shape with a spherical radome located on the front.

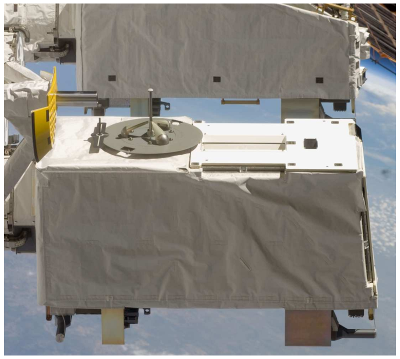
Image of a radiation detector (gold cylinder) and spectrometer (gold box) as part of the DOSIS-DBOBIES experiment in the US Lab.

- **Astronaut Personal Eye (APE)** tests the use of an autonomous microvehicle to support ISS crew Intra-Vehicular Activity (IVA) and Extra-Vehicular Activity (EVA) operations. Giorgia Pontetti , G & A Engineering s.r.l., Oricola (AQ) Italy
- **Biology (Bio)** will determine the magnifications that are possible with a microscope in an ISS vibration environment. Bio will image three-dimensional biological sample particles, tissue samples and live organisms. William Meyer, Glenn Research Center, Cleveland, OH
- **Dose Distribution Inside ISS - Dosimetry for Biological Experiments in Space (DOSIS-DOBIES)** documents the actual nature and distribution of the radiation field inside the ISS and develops a standard method to measure the absorbed doses in biological samples onboard the ISS. Guenther Reitz, Ph.D., German Aerospace Center, Cologne, Germany and Filip Vanhavere, Ph.D., Belgian Nuclear Research Centre (SCK-CEN), Brussells, Belgium
- **Delay Tolerant Networking (DTN)** tests communication protocols onboard the ISS to rapidly mature the DTN technology for use in NASA's exploration missions and space communications architecture. Kevin Gifford, Ph.D., University of Colorado, Boulder, CO
- **Electronic NOse for Space exploration (ENOS)** studies air quality monitoring searching for possible anomalies in the internal on-orbit atmosphere. Monitoring ISS air quality provides the opportunity to improve cabin air conditions, and identify potential real-time anomalies that may occur in the ISS air quality. Eugenio Martinelli, Arnaldo D'Amico, and Corrado Di Natale, University of Rome Tor Vergata, Rome, Italy

Technology

- **Forward Osmosis Bag (FOB)** is designed to convert dirty water into a liquid that is safe to drink using a semi-permeable membrane and a concentrated sugar solution. FOB examines how fast water moves across the membrane in microgravity using blue dye to evaluate the effects of hand kneading the FOB bags. Howard G. Levine, Kennedy Space Center, Cape Canaveral, FL
- **HICO and RAIDS Experiment Payload - Remote Atmospheric and Ionospheric Detection System (HREP-RAIDS)** provides atmospheric scientists with a complete description of the major constituents of the thermosphere (layer of the Earth's atmosphere) and ionosphere (uppermost layer of the Earth's atmosphere), as well as global electron density profiles at altitudes between 100 - 350 kilometers. Scott Budzien, Naval Research Laboratory, Washington, D.C.
- **Japan Aerospace Exploration Agency - Commercial Payload Program (JAXA-Commercial Payload Program)** studies commercial items brought to the ISS by JAXA to experience the microgravity environment. JAXA.
- **Maui Analysis of Upper Atmospheric Injections (MAUI)** observes the Space Shuttle engine exhaust plumes from the Maui Space Surveillance Site in Hawaii. The observations occur when the Space Shuttle fires its engines at night or twilight. The images are analyzed to better understand the interaction between the spacecraft plume and the upper atmosphere of Earth. Rainer A. Dressler, Ph.D., Hanscom Air Force Base, Lexington, MA
- **Monitor of All-sky X-ray Image (MAXI)** is a highly sensitive X-ray slit camera monitoring more than 1000 X-ray sources in space over an energy band range of 0.5 to 30 keV. Masaru Matsuoka, Ph.D., Japan Aerospace Exploration Agency, Tsukuba, Japan
- **Passive Dosimeter for Lifescience Experiment in Space (PADLES)** measures radiation exposure levels onboard the ISS using passive and integrating dosimeters. Aiko Nagamatsu, Ph.D., Japan Aerospace Exploration Agency, Tsukuba, Japan

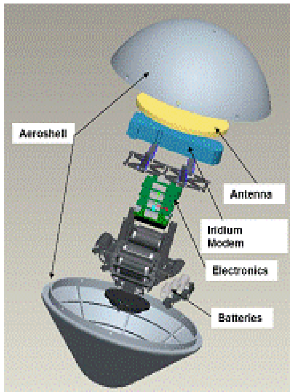
Injection of Osmotic Concentrate into inner partition of FOB.



MAXI experiment attached outside the ISS on the JAXA lab.

Technology

- **Pico-Satellite Solar Cell Experiment (PSSC)** is a picosatellite designed to test the space environment by providing a testbed to gather data on new solar cell technologies. Henry Yoo, Ph.D., Air Force Research Laboratory, Kirtland Air Force Base, Albuquerque, NM
- **Ram Burn Observations - 2 (RAMBO-2)** uses a satellite to observe Space Shuttle orbital maneuvering system engine burns to improve plume models, as the Shuttle maneuvers on orbit. Understanding the direction in which the spacecraft engine plume, or exhaust flows could be significant to the safe arrival and departure of spacecraft on current and future exploration missions. William L. Dimpfl, Ph.D., Aerospace Corporation, Los Angeles, CA
- **Reentry Breakup Recorder (REBR)** will test a cost-effective system that can ride a reentering vehicle, record data during the reentry and breakup of the vehicle, and return data for analysis. William Ailor, Ph.D., The Aerospace Corporation, El Segundo, CA
- **Robonaut** will demonstrate that a dexterous robot can operate for extended duration within the space environment, assist with ISS tasks, and interact with the crewmembers. Myron A. Diftler, Ph.D., Johnson Space Center, Houston, TX
- **Robotic Refueling Mission (RRM)** will demonstrate and test the tools, technologies and techniques needed to robotically refuel satellites in space, even satellites not designed to be serviced. This would be the first on-orbit attempt to test robotic refueling techniques for spacecraft not built with on-orbit servicing in mind, and is expected to reduce risks and lay the foundation for future robotic servicing missions. Frank Cepollina, Goddard Space Flight Center, Greenbelt, Maryland
- **Shuttle Exhaust Ion Turbulence Experiments (SEITE)** uses space-based sensors to detect the ionospheric turbulence inferred from the radar observations from a previous Space Shuttle Orbital Maneuvering System (OMS) burn experiment using ground-based radar. Paul A. Bernhardt, Ph.D., Naval Research Laboratory, Washington D.C.

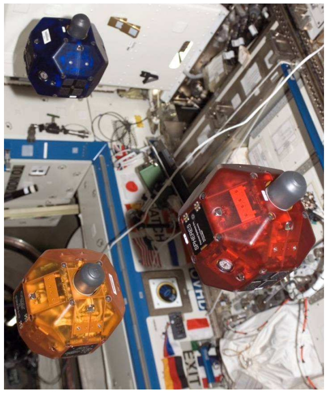


Data collected by the REBR investigation will improve the understanding of vehicle breakup during reentry,

Robonaut was developed through a Space Act Agreement between NASA and General Motors.

Technology

- **Shuttle Ionospheric Modification with Pulsed Localized Exhaust Experiments (SIMPLEX)** investigates plasma turbulence driven by rocket exhaust in the ionosphere using ground-based radars. Paul A. Bernhardt, Ph.D., Naval Research Lab, Washington D.C.
- **Serial Network Flow Monitor (SNFM)** uses commercial software to monitor the payload local area network (LAN) to analyze and troubleshoot LAN data traffic. Validating LAN traffic models may allow for faster and more reliable computer networks to sustain systems and science on future space missions. Carl Konkel, Boeing, Houston, TX
- **Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES)** uses bowling-ball sized spherical satellites inside the ISS to test a set of well-defined instructions for spacecraft performing autonomous rendezvous and docking maneuvers. Three free-flying satellites are self-contained with power, propulsion, computers and navigation equipment. The results are important for satellite servicing, vehicle assembly and formation flying spacecraft configurations. David W. Miller, Ph.D., Massachusetts Institute of Technology, Cambridge, MA
- **Sensor Test for Orion Relative Navigation Risk Mitigation - DTO 703 (STORRM)** tests the vision navigation sensor, star tracker, and docking camera planned for the Orion spacecraft during Shuttle approach to and departure from the ISS. This test determines how well the navigation system performs during the mission. Heather Hinkel, Johnson Space Center, Houston, TX
- **Space Test Program - Houston 3 - Canary (STP-H3-Canary)** investigates the interaction of ions with the background plasma environment around the ISS. Geoff Mcharg, Ph.D., United States Air Force Academy, Colorado Springs, CO
- **Space Test Program - Houston 3 - Digital Imaging Star Camera (STP-H3-DISC)** is a low size, weight, and power sensor used for pointing knowledge of 0.02 degree or greater. Andrew Williams, Air Force Research Laboratory, Wright-Patterson Air Force Base, OH; Andrew Nicholas, Naval Research Laboratory, Washington, DC; Geoff Mcharg, Ph.D., US Air Force Academy, CO



Three satellites fly in formation as part of the SPHERES investigation in the US lab.

The Space Shuttle will be used for sortie investigations.

Technology

Two Phase Flow precursor to MHTEX experiment.

Image of VCKAM cabin air monitor during testing at KSC.

- **Space Test Program - Houston 3 - Massive Heat Transfer Experiment (STP-H3-MHTEX)** will flight qualify an advanced capillary pumped loop system. Andrew Williams, Air Force Research Laboratory, Wright-Patterson Air Force Base, OH; Andrew Nicholas, Naval Research Laboratory, Washington, DC; Geoff Mcharg, Ph.D., US Air Force Academy, CO
- **Space Test Program - Houston 3 - Variable Emissivity Radiator Aerogel Insulation Blanket Dual zone thermal control Experiment suite for Responsive space (STP-H3-VADER)** tests a new form of thermal insulation protection using Aerogel material as the thermal isolator. Andrew Williams, Air Force Research Laboratory, Wright-Patterson Air Force Base, OH; Andrew Nicholas, Naval Research Laboratory, Washington, DC; Geoff Mcharg, Ph.D., US Air Force Academy, CO
- **Transport Environment Monitor Packages (TEM)** measures the temperature data aboard the ATV2. M.Masukawa, JAXA
- **3D Silicon Detector Telescope (TriTel)** characterizes the radiation environment of the ISS and estimates the absorbed dose and dose equivalent burden on ISS crewmembers. A. Hirn, ESA

Vehicle Cabin Atmosphere Monitor (VCAM) identifies gases that are present in minute quantities in the ISS breathing air that could harm the crews health. Ara Chutjian, Ph.D., California Institute of Technology, Pasadena, CA and Jet Propulsion Laboratory, Pasadena, CA

Vessel ID System demonstrates the capability of a simple EVA compatible mechanism to accommodate small passive equipment and payloads on the ISS modules and demonstrate the space-based identification capability of maritime vessels. ESA

NASA

The Payload Operations Center (POIC) at Marshall Space Flight Center in Huntsville, AL, celebrated its 10th anniversary of round-the-clock support to the ISS on March 8, 2011. As the science command post for the ISS, it links Earth-bound researchers with their experiments and payloads on orbit. During the past 10 years, the POIC has supported more than 6,000 hours of science experiments conducted by 41 space station crew members; and coordinated more than 1,100 experiments supporting more than 1,600 scientists world-wide.

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