

**STS-107 Whole Payload % Science Gained: Code U, ISS RME, SPACEHAB commercial, ESA, FREESTAR**  
**John Charles, Ph.D., Code U Mission Scientist, and David Liskowsky, Ph.D., Code U Program Scientist**  
**30 May 2003**

SUMMARY: Current\* estimates are: 42 experiments retrieved 0% data; 7, between 1-50%; 16, between 51-75%; and 13, between 76-100%, and 12 TBD%. Overall, about 30% of the total data expected was collected on the mission. \*May be revised following analysis of recovered hardware.

PROJECT	% SCIENCE GAINED	COMMENTS	INPUT FROM	DATE RECEIVED
<b>Fundamental Biology</b>				
FRESH-02 (3 experiments)	0%	AEM hardware performed flawlessly, proving again the ability of AEM HW to successfully fly animals for research. Even with RDM temp issues experienced during the mission, full science return was expected. Although no flight data was gained, Dr. Gabrion did collect tissues from the vivarium controls (maintained at 75F) and elevated temp vivarium controls (exposed to 85F) to determine the impact of temperature variations on production of cerebral spinal fluid. This data will be useful for planning future flight experiments.	Rudy Aquilina, FBP Project Manager	2/10/2003
BRIC-14	TBD%	100% operational success. This test of flight hardware established BRIC as viable facility for experiment operation. The internal and external temperature environment was perfect for moss growth throughout the mission, and the investigators expected good science return. <b>4/28: Fixed (preserved on orbit) moss colonies found in every container recovered from Columbia hardware; analysis pending.</b>	Rudy Aquilina, FBP Project Manager; Guy Etheridge/KSC	02/10/2003; 05/28/2003
BRIC-60/c. elegans	TBD%	100% operational success. This test of flight hardware established BRIC as viable facility for experiment operation. The internal and external temperature environment was perfect for roundworm growth throughout the mission, and the investigators expected good science return. <b>4/28: c. elegans retrieved from recovered hardware--descendants of flown specimens. All 3 HOB0 temperature recorders recovered and successfully downloaded as well.</b>	Guy Etheridge/KSC	5/28/2003
Biotube/MFA	10%	100% operational success. No postflight microscopic data was obtained, but macroscopic data derived from the downlinked images will provide information about root growth in a magnetic field in absence of gravity.	Rudy Aquilina, FBP Project Manager	2/10/2003
Bacter	0%	Biopack did not operate ideally, having incubator and centrifuge problems, but the principal investigator still expected a 50% science return. Although no flight data was gained, Dr. Pyle did collect ground control samples to evaluate the impact of the unique temperatures the bacteria experienced during the mission. This will be valuable information for future missions.	Rudy Aquilina, FBP Project Manager	2/10/2003
Biopack-FBP	50% (but see comment)	Dr. Millie Hughes-Fulford, FB PI, and a co-investigator on ESA Biopack, is completing her ground based gene chip analysis. This gene chip information, though not compared to flight samples, will still yield 50% of the science she intended to accomplish.	Rudy Aquilina, FBP Project Manager	2/10/2003
<b>Human Life Sciences</b>				
PhAB-4 (4 experiments)	0%	All the inflight operations were successfully performed, including both oral ingestion and IV infusions of tracers coupled with multiple blood, urine and saliva collections. The EOR/F and TEHM operated flawlessly over the duration of the flight.	Jacob Bloomberg, HLS Project Scientist	2/7/2003
MPFE (2 experiments)	0%	The Automated Microbial System (AMS) successfully incubated and analyzed the growth of yeast and bacterial samples, clearly demonstrating the utility of the AMS technology in a microgravity environment.	Jacob Bloomberg, HLS Project Scientist	2/7/2003
Sleep 3	0%	No useful results in the absence of in-flight data retrieval.	Jacob Bloomberg, HLS Project Scientist	2/7/2003
DSO 635	0%	Spatial reorientation following spaceflight: no useful results in the absence of post-flight crewmember testing.	Jacob Bloomberg, HLS Project Scientist	2/7/2003
DSO 632B	0%	Pharmacokinetics and contributing physiologic changes during spaceflight: no useful results in the absence of post-flight crewmember testing.	Jacob Bloomberg, HLS Project Scientist	2/7/2003
<b>Microgravity Research</b>				
BDS-05	25%	Photos and video down-link, while striking, are not scientifically conclusive. As the team processes the duplicate ground experiments the science return may be increased.	Tom Goodwin, BDS Project Scientist	2/11/2003
MGM	50-60%	Two factors allow MGM to claim important results from the mission. First, a significant amount of data from most of the flight experiments was downlinked and stored on the ground during the mission, and preliminary analysis indicates that high-quality data were obtained from experiments 2, 3, 4, 5, 6, and 10. The downlinked data are identical to the data stored on board except that they were sampled at a much lower rate. Second, several of the originally-planned 9 flight experiments were enhanced to provide greater return, and a new 10th experiment was added during the mission. A preliminary look at the data indicates that several very important results were captured.	Stein Sture, MGM Principal Investigator	2/4/2003
CM2-SOFBALL	65%	The CM-2/SOFBALL Experiment obtained 15 of 15 planned initial burns, 15 of 15 planned reburns (resparked same mixture), and 7 extra reburns on-orbit. Hardware and operations were complete success. SOFBALL data return is due to the successful downlink of all sensor data and Gas Chromatograph files, and many image files. The data percentage is increased from 50% given earlier due to the PI Team's detailed assessment of flame ball positions vs. time from the downlinked digital video frames. Less than 50% of the video frames were downlinked, but more combustion tests (37) were accomplished than planned (30 including reburns) because of multiple reburn test points (a "data feeding frenzy!"). Some video frames were acquired from every mixture tested. However, almost no downlinked video was received from the 3rd camera (narrow field of view) intended for higher resolution images of the flame balls. Given the results evaluated thus far, new discoveries and new space flight records for lean burning combustion have already been documented by PI. CM-2/SOFBALL-2 GC data quality exceeded those of previous flights due to the elimination of residual gases and the addition of a new sensor.	Paul Ronney, Principal Investigator	2/27/2003
CM2-LSP	50+%	CM-2/LSP Experiment Team obtained important science results from STS-107. Following experiment data and control problems due to Ku issues, extra crew time recouped lost test runs and LSP completed 14 out of 15 planned runs. Experiment was deemed completely successful. Although data downlink was difficult, the team managed to downlink sensor and image data from 7 of the 14 tests (thus the 50% score), along with partial data from another 7. PI indicated that quality of each of these flames equalled the best quality flames from STS-94, in which only two flames met the science criteria for a perfect "paradigm flames" which have identical physical properties at the same distance along any of the streamlines in the flame, allowing the PI to extend the mathematical models to the more practical, turbulent flames found on Earth. Future experiments similar to LSP planned for ISS have gained valuable insight and experience from this success. <b>May 29: Team to examine recovered hardware attempt retrieval of soot samplers.</b>	Ann Over, CM-2 Project Manager	02/07/2003; 05/28/2003
SAMS-FF	mandatory data: 60-90%; non-critical data: ~2%	SAMS presently has approximately 60% of the data from the mandatory CM-2 sensor, and another 25-30% (of the CM-2 data) may be available on a laptop presently stored at JSC. Most (98%) of the non critical SAMS data was lost, including data to: support MGM, characterize the SDM, and compare the roll rate sensor against the OARE to facilitate the development of a next generation quasi-steady low frequency acceleration measurement system.	Ron Sicker, SAMS-FF & OARE Project Manager	2/12/2003

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OARE	~90%	OARE collected and down linked approximately 90% of the mandatory data to support SOFBALL and MIST. The OARE data analysis will be impacted by the loss of bias data stored on the main unit. This will affect the accuracy of the OARE data below 10 micro-g. Also significant is the loss of the unique OARE sensor that was the flight spare for the MAMS system on ISS.	Ron Sicker, SAMS-FF & OARE Project Manager	2/12/2003
<b>Space Products Development</b>				
CPCG	0%	100% operational success. The CPCG-PCF payload hardware performed nominally throughout the mission. However, all of the scientific knowledge to be gained from this experiment were lost. The PCF was a very passive experiment. No on-orbit data was obtained for this experiment, all science data collection was planned once the sample returned from flight.	Dan Connor, CPCG Project Manager	2/6/2003
CIBX-2 (10 experiments)	TBD%	The CIBX2 payload has no means of contact while in orbit. There is no science information available until the payload is analyzed upon return after the flight. <b>5/8: some recovered experiment hardware may be found to contain useful results.</b>	Michael Bem, CIBX Project Manager; John Cassanto, ITA	02/06/2003; 05/08/2003
CIBX-2/Bence-Jones Protein Crystallization	TBD%	No useful results in the absence of in-flight data retrieval.		
CIBX-2/Urokinase Cancer Research	TBD%	<b>5/9: 7 crystal samples recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
CIBX-2/Micro-encapsulation of Drugs	TBD%	<b>5/9: 14 microcapsules recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
CIBX-2/Food Products in Space	TBD%	<b>5/9: 15 samples recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
CIBX-2/Growth of Bacterial Biofilm on Surfaces During Spaceflight (GOBBSS) "Peace in Space Experiment"	TBD%	<b>5/9: 5 samples recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
CIBX-2/Inorganic Crystal Growth in Microgravity	TBD%	<b>5/9: 5 samples recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
CIBX-2/Tin Crystal Formation	TBD%	<b>5/9: 2 samples recovered; analysis pending.</b>	John Cassanto, ITA; Barry Perlman	05/09/2003 press release; 05/26/2003
CIBX-2/Bacteria with Expression of Antibiotic Resistance	TBD%	<b>5/9: 6 samples recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
CIBX-2/Biofilm Formation	TBD%	<b>5/9: 4 samples recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
CIBX-2/Regeneration of Nerve Cell Growth Factor	TBD%	<b>5/9: 1 samples recovered; analysis pending.</b>	John Cassanto, ITA	05/09/2003 press release
ZCG	30%	All functional objectives were met during the mission (except for data downlink capability, due to un-resolved anomaly at MCC). The payload performed nominally throughout the mission. <b>5/30: Based on analysis of crystals recovered, PI believes they will recover approximately 30% of the science planned, and hope to get one paper out or at least include the results in an up coming publication.</b>	Al Sacco, PI, ZCG	5/30/2003
CM2-MIST	90%	Water Mist experiment operated nominally after the initial leak problem was repaired by the astronauts. The team was able to perform 94% of the runs that they had originally planned and approximately 90% of the data were downlinked to the MCC, making it a highly successful experiment. Important scientific results were obtained on mist behavior characterization and on suppression and extinguishment of lean, stoichiometric, and rich flames, as well as on exploratory suppression tests of near lean-limit flames.	Angel Abbud-Madrid, Mist Co-Investigator & Suleyman Gokoglu, Mist Project Scientist	2/28/2003
Astroculture (2 experiments)	0%	Sufficient data and video of hardware operation status and plant health status to be described as engineering return. Both the glovebox and growth chambers performed nominally throughout the mission.	John West, SPD Project Manager	2/6/2003
<b>European Space Agency (Commercial and ESA/NASA Barter)</b>				
ARMS (8 experiments)	60-80%	All preflight baseline data are available; all post-flight recovery data lost, estimated at 20-30% by M. Le Gouic and K. Prisk. If in-flight data stored at White Sands are complete (what was received at POCC was not complete due to some computer crashes) then science return may be 70-80%; if they are not complete then probably 60-70%; so as a summary, ARMS science gain is 60 to 80%.	Marine Le Gouic, ESA ARMS project scientist; P. Di Palermo, ESA Project Manager	02/26/2003; 02/27/2003
Biopack (8 experiments)	0%	No data returned from processed in-flight experiment samples from all eight experiments.	P. Di Palermo, ESA Project Manager	2/27/2003
Biobox (4 experiments)	0%	Facilities telemetry indicated perfect performance; no data from processed in-flight experiment samples from all four experiments.	P. Di Palermo, ESA Project Manager	2/27/2003
ERISTO	0%	No data returned from processed in-flight experiment samples from all two experiments on 12 human bone cell cultures.	P. Di Palermo, ESA Project Manager	2/27/2003
APCF (7 experiments)	0%	Data from all 38 experiment containers recorded onboard on digital tape; results based on post-flight analysis of processed samples.	P. Di Palermo, ESA Project Manager	2/27/2003
FAST (3 experiments)	90% or better	All telemetry and video data from all three experiments was downlinked, but some data was corrupted by ground computer problems (potentially recoverable)	P. Di Palermo, ESA Project Manager	2/27/2003
COM2PLEX	90% or better	All telemetry and video data from all three experiments was downlinked, but some data was corrupted by ground computer problems (potentially recoverable)	P. Di Palermo, ESA Project Manager	2/27/2003

**SPACEHAB Commercial**

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<b>SPACEHAB Commercial</b>				
MSTRS	30%	A majority of the science data was collected on an on-board storage device intended for post mission analysis.	Code U	2/14/2003
CEBAS	0%	Unfortunately the CEBAS project has 100 % science loss for the space experiment. There was no housekeeping or science data transmission during the mission. Normally the recorded video documentation of the fish behavior and the retrieved living animals, plants and snails would have been analyzed and investigated postflight.	Code U	2/14/2003
CMPCG	0%	100% operational success. All hardware operations on-orbit went great. Unfortunately all science data collection was planned for post-flight.	Dan Connor, CPCG Project Manager	2/6/2003
OSTEO-2	0%	No data returned from processed experiment samples.	inferred from ERISTO	2/24/2003
STAR'S- Bootes (6 experiments: see Ant Colony, Chemical Garden, Spiders, Carpenter Bees, Medaka Fish and Silkworms)	70%	SPACEHAB's Space Media commercial payload, STARS, saw many amazing results on this mission. As part of an education program with experiments designed by students, the STARS payload received daily downlink of video, photos, and humidity and temperature readings. These six experiments, designed by students from Australia, China, Israel, Japan, Liechtenstein, and the United States, were able to achieve approximately 70% of their scientific objectives, providing unique insight into the low gravity impact on the behavior and development of ants, bees, silkworms, and fish eggs, the random crystal growth of cobalt and calcium, and the web spinning ability of spiders.	Kimberly Campbell SPACEHAB	2/12/2003
Ant Colony (Fowler H.S., Syracuse NY)	95%	These students developed a Harvester Ant experiment to study on orbit tunnelling behavior. From downlinked video and photos, most of the objectives were met. The students had hoped to carefully analyze the space and ground tunnels post flight. This final analysis will not be possible.	Code U	2/14/2003
Chemical Garden (Technion U., Israel)	95%	The students have flown cobalt and calcium to study the growth and structure of crystalline fibers. The students established two hypotheses for the space experiment, both validated through downlink video and photos. The students had hoped to analyze the experiment contents post mission in more detail to determine if crystal development in space differed from the ground control. This final analysis will not be possible.	Code U	2/14/2003
Spiders (Glenn Waverly School, Melbourne Australia)	50%	The students from Melbourne, Australia designed an orb spider experiment. In part, the students and teachers developed this experiment to determine if the spider will build a different web in space. This was observed in the down-linked video imagery. They had also planned to study the physical properties of the web silk to see if the metabolic make-up is different. Due to the loss of the samples, this part of the experiment can not be completed.	Code U	2/14/2003
Carpenter Bees (Liechtenstein Gymnasium School)	50%	Half of the investigation involved analyzing the way the bees burrowed through wood in microgravity. This was observed in the down-linked video imagery. The other half of the investigation included analyzing the wood block and adjustment to gravity post-flight. This half of the investigation is a complete loss.	Code U	2/14/2003
Medaka Fish	25%	The experiment observed hatching Medaka fish eggs to determine if development was faster in low gravity environment possibly due to a lower expenditure of energy. It is believed that all 4 eggs hatched on the ground and one in space.	Code M	3/3/2003
Silkworms (Beijing China)	95%	Students from China developed a silkworm experiment. The downlinked on orbit video and photos showed the metamorphosis process thereby completing most experiment objectives. The students had hoped to analyze the experiment contents post mission in more detail to determine if insect development in space differed from the ground control. This final analysis will not be possible.	Code U	2/14/2003
StarNav	95%	All the available images taken during the flight were downloaded so they received all the data. However, there would have been some additional value to have the hardware returned and investigated post-flight, so science lost is estimated at about 5%.	Code U	2/14/2003
VCD FE	62%	VCD FE was operated successfully on-orbit. Downlink data and voiced-down crew comments and observations helped achieve the science. All water samples, remainder of recorded data on orbit, all manually recorded data and hardware loss reduced the science achieved significantly.	Cindy Hutchens, VCD FE Principal Investigator	2/11/2003
<b>FREESTAR</b>				
CVX-2 (Code U)	100+%	Critical Viscosity of Xenon (CVX-2) lost approximately 10% of in-orbit data, but the recorded data exceeded minimum goals, allowing CVX-2 to be judged a complete success. The object of the experiment was to measure the viscosity of Xenon, one of nature's simplest fluids, very near its liquid-vapor critical point (Tc=-16.7 deg. C) more accurately than possible on Earth, and to compare data with theoretical calculations to improve mathematical models.	FREESTAR Final Report <a href="http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf">http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf</a>	3/20/2003
LPT	100+%	These experiments demonstrated Low Power Transmitter's ability to do simultaneous communications and on-board navigation, as well as multi-mode communications, reconfiguration and Internet Protocol (IP) in space. All of the data from this experiment was captured which could provide more cost-effective space operations in future satellite missions.	FREESTAR Final Report <a href="http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf">http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf</a>	3/20/2003
SEM	> 50%	Space Experiment Module (SEM) was an educational initiative that allowed students to fly simple experiments for space flight research. These experiments were lost and no data was collected, but success was gained from achieving the goal of stimulating and inspiring the students through the pre-flight payload development and integration activities (estimated to provide at least 50% of maximum benefit to students).	FREESTAR Final Report <a href="http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf">http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf</a>	3/20/2003
SOLCON	100+%	The Solar Constant Experiment (SOLCON) was managed by the Royal Meteorological Institute of Belgium and sponsored by NASA. This instrument was designed to measure the solar constant and identify variations in the value during a solar cycle. The data will ensure continuity of the solar constant level obtained by instruments mounted on free flyers, over climate time scale duration.	FREESTAR Final Report <a href="http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf">http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf</a>	3/20/2003
SOLSE	~80%	Shuttle Ozone Limb Sounding Experiment (SOLSE) and Limb Ozone Retrieval Experiment (LORE) met all objectives in demonstrating the technique of using light scattered from the Earth's atmosphere to measure ozone. This was a test of an improved vertical resolution for routine ozone monitoring capability in the next generation of weather satellites. SOLSE lost 88% of its data, and LORE lost 30%, but the data returned are adequate for assessing it as ~80% successful.	FREESTAR Final Report <a href="http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf">http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf</a>	3/20/2003
MEIDEX	> 50%	MEIDEX recorded much less dust in the atmosphere than anticipated, but this is strictly due to climatic conditions. MEIDEX met all objectives in observing sprites and performing calibrations. Playback of impounded data will probably increase estimate of success.	FREESTAR Final Report <a href="http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf">http://spaceflight.nasa.gov/shuttle/science/freestar_report.pdf</a>	3/20/2003