ZERO ROBOTICS
HS TOURNAMENT 2014

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Championship Tournament
January 16, 2015

Version 1.1

NASA CASIS esa MIT SSL Aurora FLIGHT SCIENCES

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Welcome

Dear Zero Robotics Teams,

Congrats on making it to the finals and Welcome to Boston! We are thrilled that you are here with us for the 2014 Zero Robotics championship event! We hope this trip will be exciting and educational.

During this event, you will have the opportunity to tour the various facilities at MIT and participate in a live test session with cosmonaut **Elena Olegovna Serova,** astronaut **Samantha Cristoforetti** and astronaut **Barry E. "Butch" Wilmore** as they run your algorithms on the SPHERES test bed on the ISS. You will also get to meet astronaut **Catherine "Cady" Coleman** (MIT alum) in person at MIT. Finally, you will join us in a few special presentations by **Dante Lauretta** of Osiris Rex and **Matt Taylor,** a principle scientist of Rosetta. To ensure that the entire trip runs smoothly, we ask that you adhere to the following code of conduct.

Code of Conduct

- Borrowing from the excellent credo of *FIRST* Robotics, please exhibit "Gracious Professionalism™" at all times.
- In that spirit, refrain from the use of profane, insulting, harassing or otherwise offensive language, especially during the competition.
- Students should make sure their chaperones and/or advisors know where they are, who is with them and when they will return when leaving the general area of the event.

Contact Information

This event is being organized by the Zero Robotics team. Please don't hesitate to contact the following members of the ZR team if you have any questions or comments during your stay here.

Wendy Feenstra	wfeenstra@aurora.aero	(617) 835-6719
Kelly O'Brien	kelly16@mit.edu	(484) 706-3835
Mizanul Chowdhury	mizanul@mit.edu	(469) 734-1058

Once again, we hope you enjoy your visit.

The SPHERES Zero Robotics Team

Schedule

All times are Eastern Time (MIT Local time).

Thursday, 2015-Jan-15

Time	Event	Location
Any	Teams arrive, no events planned	Cambridge, MA

Friday, 2015-Jan-16

Time	Event	Location
06:30-07:15	Arrival	32-123
07:15-9:10	Welcome to ZR Finals by MIT, ESTEC and special guests	32-123
09:10-12:15	ISS Finals live from station*	32-123
12:15-12:30	MIT and ESTEC Closing Remarks	32-123
12:30-13:30	Luncheon	(Outside of 32-123)
13:30-15:00	Team interviews (optional)	32-123
14:00-15:00	Coaches Meeting: Open sourcing ZR	36-112
15:00-18:00	Break 15:00-17:00 MIT Museum free admission with pass	N51
18:00-20:00	Awards Ceremony and Dessert Reception	MIT Museum

NOTES:
* Times for activities aboard the ISS are approximate.

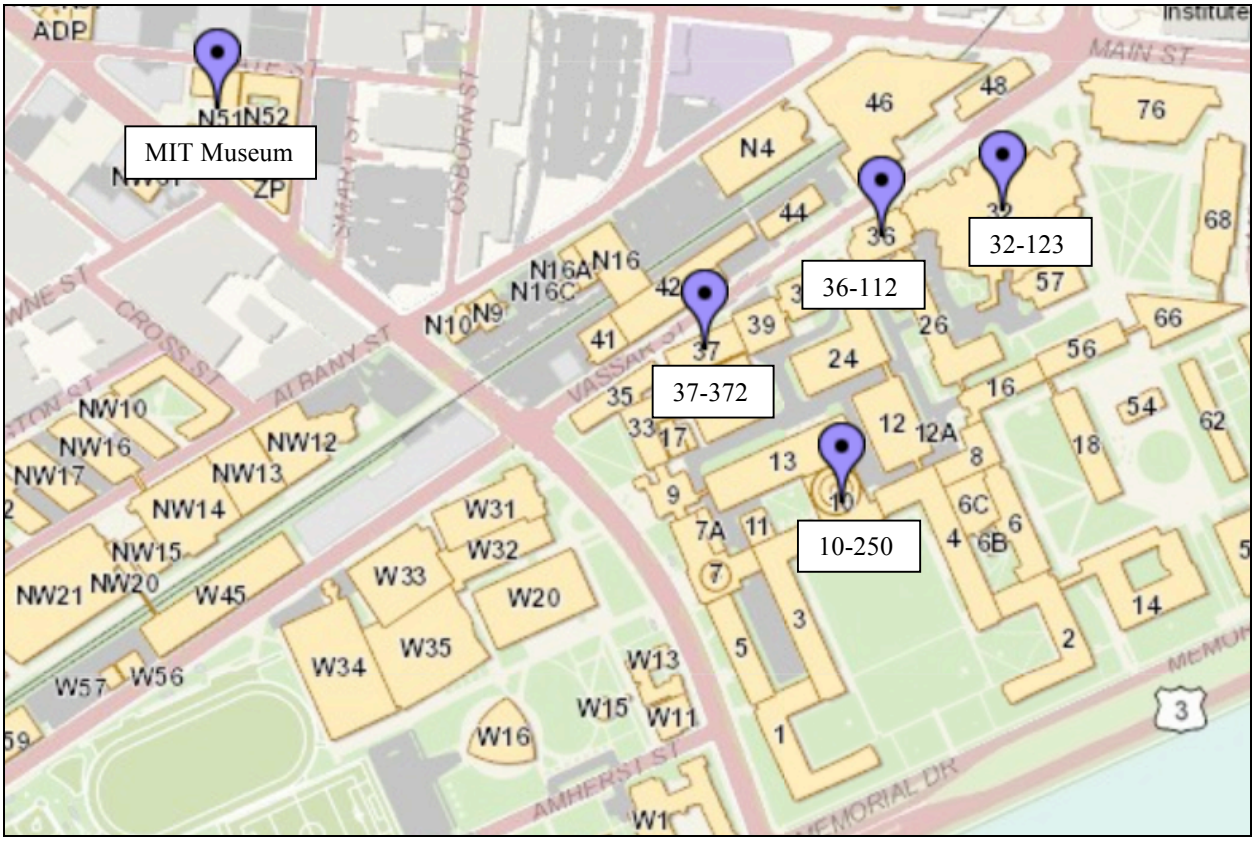
Saturday, 2015-Jan-17

Time	Event	Location
10:00-11:00	MIT Admissions Info-Session	10-250
11:00-12:30	MIT Official Tour	10-250
12:30-13:30	Lunch (on your own)	
13:30-14:30	SSL Tour	37-372

MIT MAP

32- 123	: http://whereis.mit.edu/?go=32-123
36-112	: http://whereis.mit.edu/?go=36-112
10-250	: http://whereis.mit.edu/?go=10
MIT Museum	: http://whereis.mit.edu/?go=N51
37-372	: http://whereis.mit.edu/?go=37-372

Note: All rooms in MIT are numbered in the format Building-FloorRoom. For example, 10-250 corresponds to Building 10, Floor 2, Room 250.



ISS Finalists (in seeding order)

Alliance name	School/Organization	State	Country
(1) BACON Zanneio BRRobotics			
BACON	Charlottesville High School	VA	United States
Zanneio Stardust	Zanneio Model Experimental Lyceum	-	Greece
Big Red Robotics	The Lawrenceville School	NJ	United States
(2) y0b0ticsCode::AGHS			
y0b0tics!	Montclair Community Team	NJ	United States
Code::Space	National College of Computers Science	-	Romania
AGHS	Albert Gallatin High School	PA	United States
(3) The Illuminati			
DevilTech	West Lafayette Jr/Sr High School	IN	United States
ZRighi	ITI "Augusto Righi"	-	Italy
SuperMajo Bros.	ITI Ettore Majorana	-	Italy
(4) RobodogsCallistoTrISS			
Robodogs	Sweeny High School	TX	United States
Callisto	Nicolae Balcescu High School	-	Romania
TrISS	Tri-County RVTHS	MA	United States
(5) Zapopan254Zagle			
Zapopan Zero	Instituto Tecnológico Superior de Zapopan	-	Mexico
Team 254	Bellarmine College Prep	CA	United States
Zagle	Zagle School	-	Poland
(6) ProximaQuarkHerder			
Proxima Centauri	Liceo Cecioni	-	Italy
The Quark Charm	Storming Robots	NJ	United States
Herder-Berlin	Herder-Gymnasium Berlin	-	Germany
(7) CrabTachyonsMontaVista			
Crab Nebula	Liceo Cecioni	-	Italy
Tachyons	Saratoga High School	CA	United States
Monta Vista Zero	Monta Vista High School	CA	United States
(8) LakeElevenVADARS			
Team Lake	Clear Lake High School	TX	United States
Corà's Eleven	Liceo G.B.Brocchi	-	Italy
VADARS	South Charleston High School	WV	United States
(9) WhiteHolePlasma			
White Hole	Moscow Gimnasia 1567	-	Russia
Plasma Robotics	Red Mountain High School	AZ	United States
(10) GruWall-EAppreciate			
The Gru Crew	Lubbock High School	TX	United States
Wall-E 2.0	I.T.T. Verona Trento	-	Italy
2468 Team Appreciate	Westlake High School	TX	United States

(11) SunspotsNarwhalsEagles			
Sunspots	ITI G. Galilei	-	Italy
Flying Narwhals	Thomas Sprigg Wootton High School	MD	United States
SpaceEagles	El Segundo High School	CA	United States
(12) Juggler Lightning Elia			
Juggler	I.I.S.G.B.Vaccarini Catania	-	Italy
Force Lightning	Cypress Bay High School	FL	United States
Elia Boys	ITI R. Elia	-	Italy
(13) KuhlschrankKätheGreenHope			
Team Kuhlschrank	Pope John XXIII H.S., Sparta H.S., Newton H.S.	NJ	United States
Käthe in Space	Käthe Kollwitz Gymnasium	-	Germany
Green Hope Zero Robotics	Green Hope High School	NC	United States
(14) NullPointerO.L.E.Ohms			
NullPointerException	Wissahickon High School	PA	United States
O.L.E.	Colegio Retamar	-	Spain
The Ohms	Rockdale Magnet School for Science and Technology	GA	United States

Virtual Finalists (in seeding order)

Alliance name	School/Organization	State	Country
(1) KepplerianWestwoodROBOVALL			
The Mach Kepplerians	Mark Keppel High School	CA	United States
Westwood Robotics	Westwood High School	AZ	United States
ROBOVALL	IIS G. Vallauri		Italy
(2) RocketRoboNattaNoray			
Team Rocket	River Hill High School	MD	United States
USS RoboNatta Enterprise	I.I.S. Giulio Natta		Italy
Noray	Colegio Retamar		Spain
(3) StuyZirconiumCadets			
Stuy-Naught	Stuyvesant High School	NY	United States
ZiRconiuM	IIS Pacinotti-Archimede		Italy
Cadets of Space	National College of Computers Science		Romania
(4) FerrarisusaKnightsPrinceWilliam			
Ferrarisusa_ZRC	Ferrari di Susa (To)		Italy
Northern Knights	West Windsor Plainsboro HS North	NJ	United States
Prince William County Schools	Prince William County Schools	VA	United States
(5) LSA Robotics Team			
LSA Robotics Team	Liceo Scientifico Avogadro		Italy
(6) AGNELLITRONICS			
AGNELLITRONICS	Istituto Internazionale E. Agnelli		Italy

CoronaSPHERES Game Parameters

Conducting Optical Research on Nearby Asteroids (CORONA)

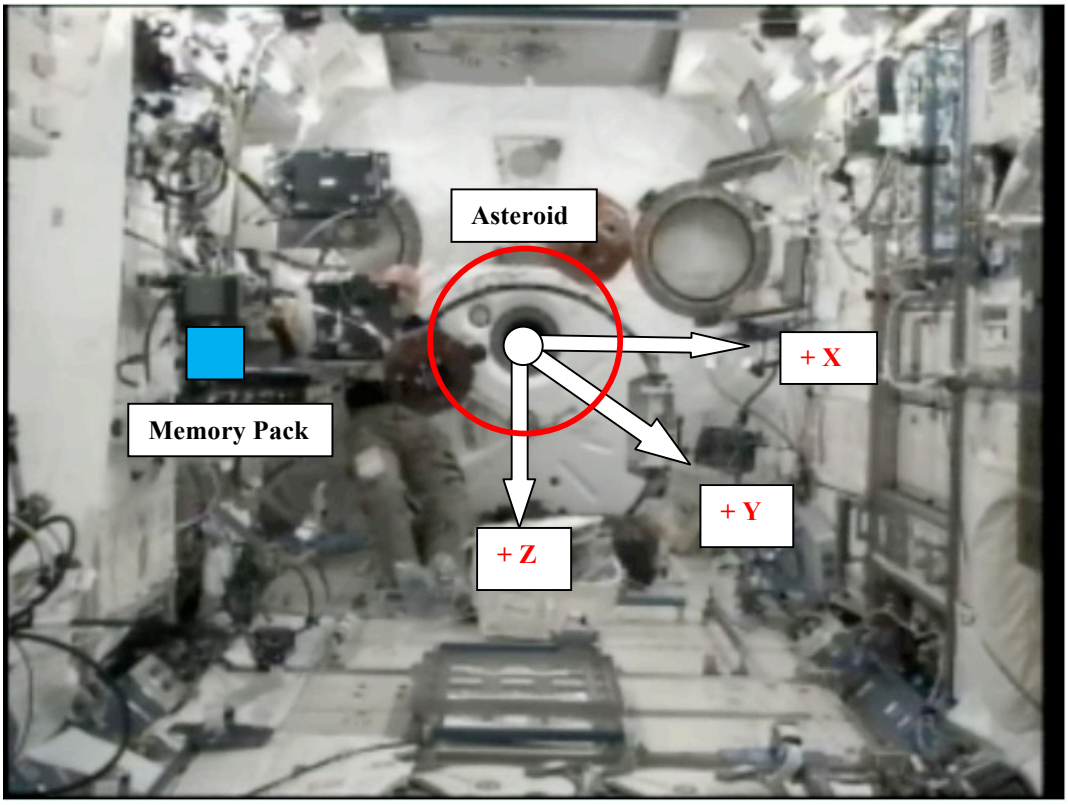
This year's challenge called CORONASPHERES is inspired by current research missions to asteroids. To achieve game objectives students programmed their satellites to take (virtual) pictures of points of interest on a (virtual) asteroid. The pictures are taken "near" or "far" from the asteroid for different points. Points are earned only after (virtually) uploading valid pictures back to Earth. Throughout the game, there are (virtual) solar flares that erase the pictures in memory, and if precautions are not taken, can also damage the satellite. Satellites are completely safe only in the shadow zone, which is behind the asteroid.

Item Locations

Item	X position(m)	Y position(m)	Z position(m)
Asteroid	0	0	0.0
Memory Pack	-0.50	0.60	0.0

Coordinate System

This view shows the Japanese Experiment Module (JEM) looking along the +Y axis of the game. The +X, +Y, +Z axis , and the locations of the virtual Asteroid and virtual Memory Pack are shown in the image.



ISS Test Session & Rules

Running a live competition with robots in space presents a number of real-world challenges that factor into the rules of the competition. Among many items, the satellites use battery packs and CO_2 tanks that can be exhausted in the middle of a match and the competition must fit in the allocated time. This section establishes several guidelines the Zero Robotics team intends to follow during the competition. Keep in mind, as in any refereed competition, additional real-time judgments may be required. Please respect these decisions and consider them final.

Above all, the final competition is a demonstration all the hard work teams have put forward to make it to the ISS. The ZR staff's highest priority will be making sure every alliance has a chance to run on the satellites. It is also expected that the competition will have several "Loss of Signal" (LOS) periods where the live feed will be unavailable. We will attempt to make sure all teams get to see a live match of their player, but finishing the competition will take priority.

To summarize, time priority will be allocated to:

1) Running all submissions aboard the ISS at least once
2) Completing the tournament bracket
3) Running all submissions during live video

We also hope to complete the tournament using only results from matches run aboard the ISS, but situations may arise that will force us to rely on other measures such as simulated matches.

Competition Format

The alliances will be divided into 2 conferences for the ISS competition. Matches have been seeded based on the ranking from the final alliance competition. All teams ranked with odd numbers will participate in Conference A; all teams ranked with even numbers will participate in Conference B, as shown in Figure 1.

Conference A Alliance ranks	Conference B Alliance ranks
1,3,5,7,9,11,13	2,4,6,8,10,12,14

Figure 1: Division of Teams between Conferences

Each conference will include one "bye" team (alliances ranked #1 and #2 automatically advance to the conference semi-finals) and 2 brackets of 3 alliances each (as shown in Figure 2). Each bracket will play 3 matches in round-robin style: alliance A vs. B, B vs. C, and C vs. A.

After the round-robins are complete, there will be a winner of each bracket (shown as A-1, A-2 , B-1, B-2 in Figure 2.) The following rules determine the winner:

1. The alliance with the most wins advances
2. If alliances are tied for wins, the alliance with the highest total score advances
3. If scores are tied, simulation results will be used to break the tie

The semi-final match between the top 2 bracket winners and the "bye" team will also be played in round-robin style. The winner of this match is determined in the same way as the bracket winners:

1. The top 2 alliances with the most wins in their bracket, advance
2. If there is a tie for wins, the alliance(s) with the highest total score in their bracket advance
3. If scores are tied, simulation results will be used to break the tie

The winning alliance from each conference will play a single match to determine the Zero Robotics ISS Champion. The losing alliance will be awarded 2nd place.

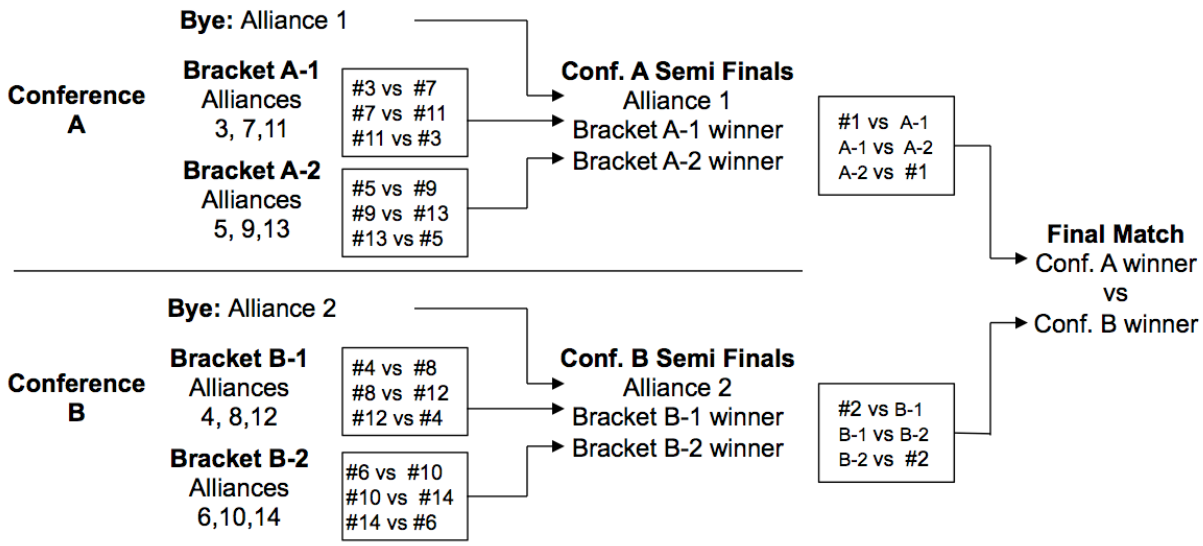


Figure 2: ISS Competition Bracket

Definition: *Successful Match*

- Both satellites move correctly to initial positions
- Both satellites have normal motion throughout the test
- Both satellites return a valid score
- Neither satellite expends its CO_2 tank during a test run

Definition: *Simulated Match*

In advance of the competition, the ZR Team will run a simulated round robin competition between all participating teams. The results from matches in this competition will be used in place of ISS tests if necessary (see below.) The results of a simulated match will only be announced if they are used in the live competition.

Scoring Matches

Scores in the scoring matches will be determined according to these rules:

Case 1: Successful Match, Both Satellites Return Unique Score (e.g. 130, 151)

- The scores will be recorded as the official score for the match

Case 2: Either Satellite Returns an Invalid Score (e.g. 255)

- If the first run of a match is not successful, the match will be re-run (time permitting)
- If the second run of a match is not successful, the results from a simulated match will be used

Test Result Guide and Brackets

Each satellite will return a test result number at the completion of each test. As in the simulation, these numbers will indicate the result of each race. The crew will use the communications loops to call down these values during the session.

Test Result #	Test Outcome	Action
11-239	Valid score values	
254	Second Player not selected	Rerun race
255	Satellite reset	Rerun race

When a score of a match is read from the ISS the score encodes the team number as well as the score for the match.

Team number = (Test Result Number % 10)

Score = (Test Result Number / 10)

(i.e if the score read from the ISS is 123 then Team number is =3 and the Score is = 12)

Winning team of each match is awarded an extra point. All scores less than 1 will be recorded as 1 and all scores greater than 22 will be recorded as 22 except when the team earns an extra point for winning a match. For example if a team earns a score greater than 22 and is also the match winner the score read from ISS will be 23.

A blank bracket listing has been provided in the pages below to fill in during the event. You may also view the bracket on one of the projector screens in the auditorium.

ISS Finals Brackets

Conference A

Bye: BACON Zanneio BRRobotics

Bracket A-1

Team 1	Team 2	Team 1 Points	Team 2 Points
The Illuminati	CrabTachyonsMontaVista		
CrabTachyonsMontaVista	SunspotsNarwhalsEagles		
SunspotsNarwhalsEagles	The Illuminati		

Winner of Bracket A-1: _____

Bracket A-2

Team 1	Team 2	Team 1 Points	Team 2 Points
Zapopan254Zagle	WhiteHolePlasma		
WhiteHolePlasma	KuhlschrankKätheGreenHope		
KuhlschrankKätheGreenHope	Zapopan254Zagle		

Winner of Bracket A-2: _____

Conference A Semi Finals

Team 1	Team 2	Team 1 Points	Team 2 Points
BACON Zanneio BRRobotics	(A-1)		
(A-1)	(A-2)		
(A-2)	BACON Zanneio BRRobotics		

Winner of Conference A Semi Finals: _____

Conference B

Bye: (2) y0b0ticsCode::AGHS

Bracket B-1

Team 1	Team 2	Team 1 Points	Team 2 Points
RobodogsCallistoTrISS	LakeElevenVADARS		
LakeElevenVADARS	Juggler Lightning Elia		
Juggler Lightning Elia	RobodogsCallistoTrISS		

Winner of Bracket B-1: _____

Bracket B-2

Team 1	Team 2	Team 1 Points	Team 2 Points
ProximaQuarkHerder	GruWall-EAppreciate		
GruWall-EAppreciate	NullPointerO.L.E.Ohms		
NullPointerO.L.E.Ohms	ProximaQuarkHerder		

Winner of Bracket B-2: _____

Conference B Semi Finals

Team 1	Team 2	Team 1 Points	Team 2 Points
y0b0ticsCode::AGHS	(B-1)		
(B-1)	(B-2)		
(B-2)	y0b0ticsCode::AGHS		

Winner of Conference B Semi Finals: _____

Championship Match

Team 1	Team 2	Team 1 Points	Team 2 Points
A	B		

Champion: _____

Virtual Finalists Brackets

Bracket 1

Team 1	Team 2	Team 1 Points	Team 2 Points
KepplerianWestwoodROBOVALL	StuyZirconiumCadets		
StuyZirconiumCadets	LSA Robotics Team		
LSA Robotics Team	KepplerianWestwoodROBOVALL		

Winner of Bracket 1 : _____

Bracket 2

Team 1	Team 2	Team 1 Points	Team 2 Points
RocketRoboNattaNoray	FerrarisusaKnightsPrinceWilliam		
FerrarisusaKnightsPrinceWilliam	AGNELLITRONICS		
AGNELLITRONICS	RocketRoboNattaNoray		

Winner of Bracket 2 : _____

Championship Match

Team 1	Team 2	Team 1 Points	Team 2 Points

Champion : _____

Cosmonaut Bio: Elena Olegovna Serova[1]

PERSONAL DATA: Born April 22, 1976, in Vozdvizhenka, Ussurijsk Region of Primorsky Area, Russia.

EDUCATION: In March 2001 graduated from aerospace department of the Moscow Aviation Institute as a test engineer.

In 2003 graduated from the Moscow State Academy of instrument-making and information as an economist.
EXPERIENCE: Prior to selection to the Cosmonaut Corps Serova worked as a 2nd category engineer at the Energia Rocket Space Corporation and the MCC-Moscow.

COSMONAUT SELECTION DATE AND CLASS: On October 11, 2006, the Interdepartmental Board recommended that she be assigned to the Energia Rocket/Space Corporation Cosmonaut Corps as a cosmonaut candidate.

In February 2007 she started a two-year course of basic training for spaceflight.

In December 2006 by the order of the Ministry of Defense she was assigned to the GCTC Cosmonaut Corps as a test cosmonaut candidate.

On June 9, 2009, the Interdepartmental Board certified her as a test cosmonaut of the Energia Rocker and Space Corporation.

SCIENCE ACTIVITIES: Completed a postgraduate course at the Energia Rocket Space Corporation (extramural training).

CURRENT STATUS: Since 2011 Serova is a test cosmonaut of the Roscosmos Cosmonaut Corps.

[1] NASA http://www.jsc.nasa.gov/Bios/htmlbios/serova.html

Astronaut Bio: Samantha Cristoforetti[2]

Personal data

Born in Milan, Italy, on 26 April 1977, Samantha Cristoforetti enjoys hiking, scuba diving, yoga, reading and travelling. Other interests include technology, nutrition and the Chinese language.

Education

Samantha completed her secondary education at the Liceo Scientifico in Trento, Italy, in 1996 after having spent a year as an exchange student in the United States.

In 2001, she graduated from the Technische Universität Munich, Germany, with a master's degree in mechanical engineering with specialisations in aerospace propulsion and lightweight structures. As part of her studies, she spent four months at the Ecole Nationale Supérieure de l'Aéronautique et de l'Espace in Toulouse, France, working on an experimental project in aerodynamics. She wrote her master's thesis in solid rocket propellants during a 10-month research stay at the Mendeleev University of Chemical Technologies in Moscow, Russia.

As part of her training at the Italian Air Force Academy, she also completed a bachelor's degree in aeronautical sciences at the University of Naples Federico II, Italy, in 2005.

Experience

In 2001 Samantha joined the Italian Air Force Academy in Pozzuoli, Italy, graduating in 2005. She served as class leader and was awarded the Honour Sword for best academic achievement. From 2005 to 2006, she was based at Sheppard Air Force Base in Texas, USA. After completing the Euro-NATO Joint Jet Pilot Training, she became a fighter pilot and was assigned to the 132nd Squadron, 51st Bomber Wing, based in Istrana, Italy.

In 2007, Samantha completed Introduction to Fighter Fundamentals training. From 2007 to 2008, she flew the MB-339 and served in the Plan and Operations Section for the 51st Bomber Wing in Istrana, Italy.

In 2008, she joined the 101st Squadron, 32nd Bomber Wing, based at Foggia, Italy, where she completed operational conversion training for the AM-X ground attack fighter.

Samantha is a Captain in the Italian Air Force. She has logged over 500 hours flying six types of military aircraft: SF-260, T-37, T-38, MB-339A, MB-339CD and AM-X.

Samantha was selected as an ESA astronaut in May 2009. She joined ESA in September 2009 and completed basic astronaut training in November 2010. In July 2012 she was assigned to an Italian Space Agency ASI mission aboard the International Space Station. She was launched on a Soyuz spacecraft from Baikonur Cosmodrome in Kazakhstan on 23 November 2014 on the second long-duration ASI mission and the eighth long-duration mission for an ESA astronaut.

Samantha is now working and living on the International Space Station as part of her Futura mission and enjoys interacting with space enthusiasts on Twitter as @AstroSamantha.

[2] ESA http://www.esa.int/Our_Activities/Human_Spaceflight/Astronauts/Samantha_Cristoforetti

Astronaut Bio: Barry E. "Butch" Wilmore[3]

PERSONAL DATA: He is married to the former Miss Deanna Newport of Helenwood, Tennessee and they have two daughters. He was raised in Mt. Juliet, Tennessee where his parents Eugene and Faye Wilmore still reside. His brother Jack and family reside in Franklin, Tennessee.

EDUCATION: Bachelor of Science and Master of Science in Electrical Engineering, Tennessee Technological University. Master of Science in Aviation Systems, University of Tennessee. Mount Juliet High School, Mount Juliet, Tennesee.

SPECIAL HONORS: Navy Meritorious Service Medal, five Air Medals, three with Combat 'V' designation. Six Navy Commendation Medal, three of which also hold the Combat 'V' designation. Two Navy Achievement Medal and numerous unit decorations. Aviation Officer Candidate School (AOCS) "Distinguished Naval Graduate." Initial Naval Flight Training "Commodores List with Distinction." United States Atlantic Fleet "Light Attack Wing One - Pilot of the Year" (1991). U.S. Atlantic Fleet "Strike Fighter Aviator of the Year" (1999). Recipient of the Strike Fighter Wing Atlantic "Scott Speicher Award" for Weapons Employment Excellence (1998). Tennessee Technological University "Sports Hall of Fame" Inductee for football (2003). Tennessee Technological University Outstanding Alumus and Engineer of Distinction (2010). Honorary Doctorate, Tennessee Technological University (2012).

EXPERIENCE: Wilmore has accumulated more than 6800 flight hours and 663 carrier landings, all in tactical jet aircraft, and is a graduate of the United States Naval Test Pilot School (USNTPS).

During his tenure as a fleet Naval officer and pilot, Wilmore completed four operational deployments, flying the A-7E and FA 18 aircraft from the decks of the USS Forrestal, USS Kennedy, USS Enterprise and the USS Eisenhower aircraft carriers. He has flown missions in support of Operations Desert Storm, Desert Shield and Southern Watch over the skies of Iraq, as well as missions over Bosnia in support of United States and NATO interests. Wilmore successfully completed 21 combat missions during Operation Desert Storm while operating from the flight deck of the USS Kennedy. His most recent operational deployment was aboard the USS Eisenhower with the "Blue Blasters" of Strike Fighter Squadron 34 (VFA-34), an F/A-18 squadron based at Naval Air Station Oceana, Virginia.

As a Navy test pilot, Wilmore participated in all aspects of the initial development of the T-45 jet trainer to include initial carrier landing certification and high angle of attack flight tests. His test tour also included a stint at USNTPS as a systems and fixed wing Flight Test Instructor. Prior to his selection to NASA, Wilmore was on exchange to the United States Air Force as a Flight Test Instructor at the Air Force Test Pilot School at Edwards Air Force Base, California.

NASA EXPERIENCE: Selected as an astronaut by NASA in July 2000, Wilmore reported for training in August 2000. Following the completion of two years of training and evaluation, he was assigned technical duties representing the Astronaut Office on all propulsion systems issues including the space shuttle main engines, solid rocket motor, external tank, and also led the astronaut support team that traveled to NASA's Kennedy Space Center, Florida, in support of launch and landing operations. He completed his first flight as pilot on STS-129 and has logged more than 259 hours in space.

SPACE FLIGHT EXPERIENCE: STS-129 (November 16 - 29, 2009) was the 31st shuttle flight to the International Space Station. During the mission, the crew delivered two Express Logistics Carrier (ELC racks) and about 30,000 pounds of replacement parts to maintain the station's proper orientation in space. The mission also featured three spacewalks. The STS-129 mission was completed in 10 days, 19 hours, 16 minutes and 13 seconds, traveling 4.5 million miles in 171 orbits, and returned to Earth bringing back with them NASA astronaut, Nicole Stott, following her tour of duty aboard the station. In September of 2014, Wilmore is scheduled to launch from the Baikonur on Cosmodrome, Kazakstan Soyuz 40S to the International Space Station. Wilmore is scheduled to assume command of the station in November 2014.

[3] NASA http://www.jsc.nasa.gov/Bios/htmlbios/wilmore-be.html

Astronaut Bio: Catherine "Cady" Coleman[4]

PERSONAL DATA: Born December 14, 1960, in Charleston, South Carolina. Married to glass artist Josh Simpson. She enjoys flying, scuba diving, sports and music. As an undergraduate, she competed in intercollegiate athletics on MIT's crew team. Her mother, Ann L. Doty, resides in Dayton, Ohio. Her father's family resides in Vancouver, Washington.

EDUCATION: Graduated from W.T. Woodson High School, Fairfax, Virginia, in 1978; received a bachelor of science degree in chemistry from the Massachusetts Institute of Technology in 1983 and a doctorate in polymer science and engineering from the University of Massachusetts in 1991.

EXPERIENCE: Coleman was commissioned as a second lieutenant in the U.S. Air Force in 1983 and began graduate work at the University of Massachusetts. Her research focused on polymer synthesis using the olefin metathesis reaction and polymer surface modification. In 1988, Coleman entered active duty and was assigned to Wright-Patterson Air Force Base. As a research chemist at the Materials Directorate of the Wright Laboratory, she synthesized model compounds for optical applications, such as advanced computers and data storage. Coleman also acted as a surface analysis consultant for the Long Duration Exposure Facility (launched from STS-41C in 1984 and retrieved during STS-32 in 1990). In addition to assigned duties, Coleman was a volunteer test subject for the centrifuge program at the Crew Systems Directorate of the Armstrong Aeromedical Laboratory. She set several endurance and tolerance records during her participation in physiological and new equipment studies. Coleman retired from the Air Force in November 2009.

NASA EXPERIENCE: Coleman was selected by NASA in March 1992 and reported to the Johnson Space Center in August 1992. Initially assigned to the Astronaut Office Mission Support Branch and detailed to flight software verification in the Shuttle Avionics Integration Laboratory, Coleman subsequently served as the special assistant to the Center Director, Johnson Space Center. She served in the Astronaut Office Payloads and Habitability Branch, working with experiment designers to ensure that payloads can be operated successfully in the microgravity environment of low Earth orbit. As the lead astronaut for long-term habitability issues, she led the effort to label the Russian segments of the International Space Station in English and also tracked issues, such as acoustics and living accommodations aboard the station. She served as a CAPCOM in mission control for both the space shuttle and space station for a number of years. She represented the astronaut office on the Tile Repair Team for NASA's Return to Flight after the Columbia accident. Coleman also served as the Chief of Robotics for the Astronaut Office, tasked with overseeing astronaut robotics training and the integration of crew interfaces into new robotics systems.

Space Shuttle Training: Coleman served as a mission specialist on STS-73, trained as a backup mission specialist for an injured crewmember on STS-83, and was the lead mission specialist on STS-93 for the deployment of the Chandra X-Ray Observatory.

Space Station Training: Coleman acted as the backup U.S. crewmember for Expeditions 19, 20 and 21 and served as a backup crewmember for Expeditions 24 and 25 as part of her training for Expeditions 26 and 27.

SPACE FLIGHT EXPERIENCE: Coleman has logged more than 4,330 hours in space aboard the Space Shuttle Columbia and the International Space Station.

STS-73 Columbia (October 20 to November 5, 1995) was the second United States Microgravity Laboratory mission. The mission focused on materials science, biotechnology, combustion science, the physics of fluids, and numerous scientific experiments housed in the pressurized Spacelab module. In completing her first space flight,

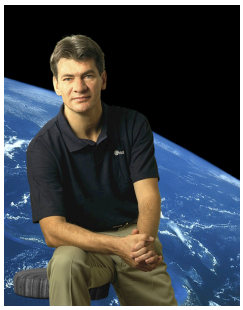
[4] NASA http://www.jsc.nasa.gov/Bios/htmlbios/coleman.html

Coleman orbited the Earth 256 times, traveled more than 6 million miles and logged a total of 15 days, 21 hours, 52 minutes and 21 seconds in space.

STS-93 Columbia (July 22-27, 1999) was a 5-day mission during which Coleman was the lead mission specialist for the deployment of the Chandra X-Ray Observatory. Designed to conduct comprehensive studies of the universe, the telescope has enabled scientists to study exotic phenomena such as exploding stars, quasars and black holes. Mission duration was 118 hours and 50 minutes.

Expedition 26/27 to the International Space Station: On Coleman's third space mission, she served as a flight engineer aboard the Russian Soyuz TMA-20 spacecraft for launch and landing and spent 159 days in space aboard the International Space Station. In addition to performing science experiments and space station system maintenance operations, she acted as the lead robotics and science officer during her tenure aboard the ISS. Exp 26/27 hosted a record number of visiting vehicles to the ISS: A total of two space shuttle missions (STS-133 and STS-134), three Russian Progress supply ships, the second Automated Transfer Vehicle from the European Space agency “Johannes Keppler” and the second Japanese supply ship “Kounatori.” Notably, Coleman was the lead robotic arm operator for the capture of Kounatori, performing the second-ever free flyer robotic capture aboard the ISS. Expedition 26 launched from Baikonur, Russia, on December 16, 2010, and Expedition 27 landed near Dzhezgazhan, Kazakhstan, on May 24, 2011, after traveling 63,345,600 miles in 2,544 orbits during 159 days in space.

Astronaut Bio: Paolo Nespoli[5]



Personal data

Born on 6 April 1957 in Milan, Italy, Paolo Nespoli's hometown is Verano Brianza, Milan, Italy. He enjoys scuba diving, piloting aircraft, assembling computer hardware, electronic equipment and computer software.

Education

Paolo received a Bachelor of Science in Aerospace Engineering in 1988 and a Master of Science in Aeronautics and Astronautics in 1989 from the Polytechnic University of New York. He was awarded the Laurea in Ingegneria Meccanica by the Università degli Studi di Firenze, Italy, in 1990.

Qualifications and licences

Civilian: professional engineer, private pilot, advanced scuba diver and nitrox diver.

Military: master parachutist, parachute instructor, jump master, high-altitude low opening, Special Forces operator.

Special honours

Team achievement awards for space mission Mir-97 (DLR German Aerospace Center), space mission EuroMir-95 (ESA), NASA–Mir programme (NASA), space mission EuroMir-94 (ESA), Bedrest Experiment (ESA–CNES), Columbus Utilisation Simulation (ESA).

Experience

Paolo was drafted by the Italian army in 1977 and became a non-commissioned officer working as a parachute instructor at the Scuola Militare di Paracadutismo of Pisa. In 1980 he joined the 9° Btg d'Assalto "Col Moschin" of Livorno, where he became a Special Forces operator. From 1982 to 1984, he was assigned to the Italian contingent of the Multinational Peacekeeping Force in Beirut, Lebanon. Following his return to Italy he was appointed an officer and continued working as a Special Forces operator.

Paolo resumed his university studies in 1985. He left active army duty in 1987. Upon completing his MSc in 1989, he returned to Italy to work as a design engineer for Proel Tecnologie in Florence, where he conducted mechanical analysis and supported the qualification of the flight units of the Electron Gun Assembly, one of the main parts of the Italian space agency's Tethered Satellite System.

In 1991 he worked for ESA's European Astronaut Centre in Cologne, Germany. As an astronaut training engineer, he contributed to basic training for the European astronauts. Paolo was responsible for the preparation and management of astronaut proficiency maintenance as well as the Astronaut Training Database, a system used for astronaut training.

In 1995, he worked on the EuroMir project at ESA's ESTEC establishment in Noordwijk, the Netherlands, where he was responsible for the team that prepared, integrated and supported the Payload and Crew Support Computer used on Russia's Mir space station.

In 1996, Paolo went to NASA's Johnson Space Center in Houston, USA, where he worked in the Spaceflight Training Division on training crew for the International Space Station.

In July 1998, Paolo was selected as an astronaut by Italy's ASI space agency, and a month later, joined ESA's European Astronaut Corps, based at the European Astronaut Centre.

[5] ESA http://www.esa.int/Our_Activities/Human_Spaceflight/Astronauts/Paolo_Nespoli

In August 1998, he relocated to NASA's Johnson Space Center in Houston, Texas, and was assigned to the 17th NASA astronaut class. In 2000 he qualified for a mission on the US Space Shuttle and to fly on the International Space Station. In July 2001, he completed the Space Shuttle robotics arm course and, in September 2003, completed advanced skills training for spacewalks.

In August 2004, he was assigned to the Gagarin Cosmonaut Training Centre in Star City, near Moscow, Russia, where he followed the initial training for the Soyuz spacecraft.

Paolo returned to NASA's astronaut office in Houston, where he maintained his qualifications and attended further courses. He also carried out technical duties for NASA, ESA and ASI.

In June 2006, Paolo was assigned to Space Shuttle mission STS-120.

Spaceflight experience

From 23 October to 7 November 2007, Paolo flew as a Mission Specialist on Space Shuttle *Discovery*for the STS-120 flight to the International Space Station. This mission delivered and installed Node-2, a major building block essential for further expansion of the Station. Another important task was to relocate one of the four solar arrays that provide power to the Station. Paolo played a key role inside the Station for the mission's spacewalks, including the installation of Node-2. During his Esperia mission, Paolo performed a number of experiments for the European scientific community in human physiology and biology. Paolo also took part in educational activities.
In November 2008, Paolo Nespoli was assigned to his second spaceflight, Expedition 26/27. The long-duration mission to the International Space Station was launched on 15 December 2010. Paolo's duties as a flight engineer during his MagISStra mission included scientific experiments and technology demonstrations, as well as performing educational activities. After having spent 159 days in space, he returned to Earth on 24 May 2011.

Astronaut Bio: Jeffrey A. Hoffman (Ph.D.)[6]

NASA ASTRONAUT (FORMER)

PERSONAL DATA: Born November 2, 1944, in Brooklyn, New York, but considers Scarsdale, New York, to be his hometown. Married to the former Barbara Catherine Attridge of Greenwich, London, England. They have two sons, Sam and Orin. Dr. Hoffman enjoys skiing, mountaineering, hiking, bicycling, roller skating, swimming, sailing, and music. His parents, Dr. and Mrs. Burton P. Hoffman, are residents of White Plains, New York.

EDUCATION: Graduated from Scarsdale High School, Scarsdale, New York, in 1962; received a bachelor of arts degree in astronomy (graduated summa cum laude) from Amherst College in 1966, a doctor of philosophy in astrophysics from Harvard University in 1971, and a masters degree in materials science from Rice University in 1988.

ORGANIZATIONS: Member of the International Academy of Astronautics; the International Astronomical Union; the American Institute of Aeronautics and Astronautics; the American Astronomical Society; the Spanish Academy of Engineering; Phi Beta Kappa; and Sigma Xi.

SPECIAL HONORS: Awarded the Amherst College 1963 Porter Prize in Astronomy, 1964 Second Walker Prize in Mathematics, 1965 John Summer Runnells Scholarship Prize, and 1966 Stanley V. and Charles B. Travis Prize and Woods Prize for Scholarship. Elected to Phi Beta Kappa in 1965 and Sigma Xi in 1966. Received a Woodrow Wilson Foundation Pre-Doctoral Fellowship, 1966-67; a National Science Foundation Pre-Doctoral Fellowship, 1966-71; a National Academy of Sciences Post-Doctoral Visiting Fellowship, 1971-72; a Harvard University Sheldon International Fellowship, 1972-73; and a NATO Post-Doctoral Fellowship, 1973-74. Dr. Hoffman was awarded NASA Space Flight Medals in 1985, 1991, 1992, 1994 and 1996, NASA Exceptional Service Medals in 1988 and 1992, and NASA Distinguished Service Medals in 1994 and 1997. He was awarded the V. M. Komarov and the Sergei P. Korolyov Diplomas by the International Aeronautical Federation in 1991 and 1994. As part of the Hubble Space Telescope Rescue Team, he was awarded the National Aeronautic Association Collier Trophy in 1993, the Aviation Week and Space Technology Laurels for Achievements in Space in 1993, the American Astronautical Society Victor A. Prather Award in 1994, the Freedom Forum Free Spirit Award in 1994, and the American Institute of Aeronautics and Astronautics Support Systems Award in 1995.

SCIENTIFIC EXPERIENCE: Dr. Hoffman's original research interests were in high-energy astrophysics, specifically cosmic gamma ray and x-ray astronomy. His doctoral work at Harvard was the design, construction, testing, and flight of a balloon-borne, low-energy, gamma ray telescope.

From 1972 to 1975, during post-doctoral work at Leicester University, he worked on several x-ray astronomy rocket payloads. He also designed and supervised the construction and testing of the test equipment for use in an x-ray beam facility which he used to measure the scattering and reflectivity properties of x-ray concentrating mirrors. During his last year at Leicester, he was project scientist for the medium-energy x-ray experiment on the European Space Agency's EXOSAT satellite and played a leading role in the proposal and design studies for this project.

He worked in the Center for Space Research at the Massachusetts Institute of Technology (MIT) from 1975 to 1978 as project scientist in charge of the orbiting HEAO-1 A4 hard x-ray and gamma ray experiment, launched in August 1977. His involvement included pre-launch design of the data analysis system, supervising its operation post-launch, and directing the MIT team undertaking the scientific analysis of flight data being returned. He was also involved extensively in analysis of x-ray data from the SAS-3 satellite being operated by MIT. His principal research was the study of x-ray bursts, about which he authored or co-authored more than 20 papers.

[6] NASA http://www.jsc.nasa.gov/Bios/htmlbios/hoffman.html

NASA EXPERIENCE: Selected by NASA in January 1978, Dr. Hoffman became an astronaut in August 1979. During preparations for the Shuttle Orbital Flight Tests, Dr. Hoffman worked in the Flight Simulation Laboratory at Downey, California, testing guidance, navigation and flight control systems. He worked with the orbital maneuvering and reaction control systems, with Shuttle navigation, with crew training, and with the development of satellite deployment procedures. Dr. Hoffman served as a support crewmember for STS-5 and as a CAPCOM (spacecraft communicator) for the STS-8 and STS-82 missions. Dr. Hoffman has been the Astronaut Office Payload Safety Representative. He also worked on EVA, including the development of a high-pressure spacesuit, and preparations for the assembly of the Space Station. Dr. Hoffman was a co-founder of the Astronaut Office Science Support Group. During 1996 he led the Payload and Habitability Branch of the Astronaut Office.

Dr. Hoffman left the astronaut program in July 1997 to become NASA's European Representative in Paris, where he served until August 2001. His principle duties were to keep NASA and NASAs European partners informed about each others activities, try to resolve problems in US-European cooperative space projects, search for new areas of US-European space cooperation, and represent NASA in European media. In August 2001, Dr. Hoffman was seconded by NASA to the Massachusetts Institute of Technology, where he is a Professor in the Department of Aeronautics and Astronautics. He is engaged in several research projects using the International Space Station and teaches courses on space operations and design.

SPACE FLIGHT EXPERIENCE: Dr. Hoffman made his first space flight as a mission specialist on STS 51-D, April 12-19, 1985, on the Shuttle *Discovery*. On this mission, he made the first STS contingency space walk, in an attempted rescue of a malfunctioning satellite.

Dr. Hoffman made his second space flight as a mission specialist on STS-35, December 2-10, 1990, on the Shuttle *Columbia*. This Spacelab mission featured the ASTRO-1 ultraviolet astronomy laboratory, a project on which Dr. Hoffman had worked since 1982.

Dr. Hoffman made his third space flight as payload commander and mission specialist on STS-46, July 31-August 8, 1992, on the Shuttle *Atlantis*. On this mission, the crew deployed the European Retrievable Carrier (EURECA), an ESA-sponsored free-flying science platform, and carried out the first test flight of the Tethered Satellite System (TSS), a joint project between NASA and the Italian Space Agency. Dr. Hoffman had worked on the Tethered Satellite project since 1987.

Dr. Hoffman made his fourth flight as an EVA crewmember on STS-61, December 2-13, 1993, on the Shuttle *Endeavour*. During this flight, the Hubble Space Telescope (HST) was captured, serviced, and restored to full capacity through a record five space walks by four astronauts.

Dr. Hoffman last flew on STS-75 (February 22 to March 9, 1996) on the Shuttle *Columbia*. This was a 16-day mission whose principal payloads were the reflight of the Tethered Satellite System (TSS) and the third flight of the United States Microgravity Payload (USMP-3). The TSS successfully demonstrated the ability of tethers to produce electricity. The TSS experiment produced a wealth of new information on the electrodynamics of tethers and plasma physics before the tether broke at 19.7 km, just shy of the 20.7 km goal. The crew also worked around the clock performing combustion experiments and research related to USMP-3 microgravity investigations. During this mission, Dr. Hoffman became the first astronaut to log 1000 hours aboard the Space Shuttle.

With the completion of his fifth space flight, Dr. Hoffman has logged more than 1,211 hours and 21.5 million miles in space.

Guest Speaker: Dante Lauretta[7]

Principal Investigator, OSIRIS-Rex

Dante Lauretta is a Professor of Planetary Science and Cosmochemistry at the University of Arizona's Lunar and Planetary Laboratory.

He received a B.S. in Physics and Mathematics from the University of Arizona in 1993 and a Ph.D. in Earth and Planetary Sciences from Washington University in St. Louis in 1997. He was a postdoctoral research associate in the Department of Geological Sciences at Arizona State University from 1997 through 1999. He was an Associate Research Scientist in the Department of Chemistry and Biochemistry at Arizona State University from 1999 through 2001. He was hired on to the faculty at the University of Arizona in 2001.

His research interests focus on the chemistry and mineralogy of asteroids and comets as determined by in situ laboratory analysis and spacecraft observations. This work is important for constraining the chemistry of the solar nebula, understanding the origin of complex organic molecules in the early Solar System, and constraining the initial chemical inventories of the terrestrial planets. He is an expert in the analysis of extraterrestrial materials. In particular, he uses inductively coupled plasma-mass spectrometry (ICP-MS), scanning electron microscopy (SEM), transmission electron microscopy (TEM), electron microprobe analysis (EPMA), and X-ray diffraction (XRD) to study meteorites, lunar samples, and particles returned by Stardust. Dr. Lauretta is known for his experimental work on the formation of iron-bearing sulfides in the solar nebula. He also worked on the cosmochemical behavior of various elements, such as mercury,boron and beryllium in meteorites. Asteroid 5819 Lauretta was named in his honor. He is currently serving as the Principal investigator on NASA's OSIRIS-REx mission to return 60 g of carbonaceous asteroid regolith from asteroid 101955 Bennu.

Mission Name

Osiris was formed from pieces scattered across ancient Egypt, where he awoke as the bringer of life and ruler of the underworld," says Lauretta. "Our spacecraft has a similar story — it will be consisted of components fabricated in locations around the world, that once together, will allow us to connect with a Near-Earth Object that is an accessible remnant from the formation of our Solar System.

[7] Wikipedia http://en.wikipedia.org/wiki/Dante_Lauretta and http://www.asteroidmission.org/--accessed 1/2015

Guest Speaker: Matt Taylor[8]

Rosetta Project Scientist, European Space Agency

Matt Taylor was born in London, gained his undergraduate Physics degree at the University of Liverpool, and a PhD from Imperial College London. His career has focused on the space plasma measurements, working in Europe and the US on the four spacecraft ESA Cluster mission, leading to a post at ESA which started in 2005 working as the project scientist for Cluster and the ESA-China Double star mission. His studies have focused on energetic particle dynamics in near-Earth space and in the interaction of the Sun's solar wind with the Earths magnetic field, particularly focusing on how boundary layer interactions evolve, leading to 70 first or co-authored papers. Most recently he was appointed the Project Scientist on the Rosetta mission.

"Since early on in my career I have enjoyed working with groups or teams of scientists towards a common goal, encouraging them to work with one another and to support their activities. This really fits with my project science activities at ESA, which focus on getting the most science out of our missions, by supporting and liasing with the instrument scientists and their teams, along with the mission and science operations teams at ESA and other agencies such as NASA."

"The opportunity to work on Rosetta was huge and I cannot begin to describe the excitement associated with this mission. It really is just so cool. Previous missions have only flown past comets. For the first time we will fly with the comet and actually land on it! The Rosetta mission is a breakthrough in space science and exploration and really demonstrates what international collaboration can achieve."

Primary Mission Goals

- Catch comet 67P/Churyumov-Gerasimenko in 2014 and accompany it into the interior solar system.
- Observe the comet's nucleus and coma from close range.
- Deploy Philae to make first controlled landing on a comet.
- Measure the increase in cometary activity during perihelion (position closest to the Sun).
- Observe the changes associated with the change in season as the comet leaves the inner solar system on its outbound leg. At that time a different pole will be exposed to the sun.

Other Goals En Route to Comet C-G

- Assist in observation of Deep Impact Mission (Comet Tempel-1) (2005)
- Observe Mars during Mars Gravity Assist maneuver (2007)
- Observe two asteroids: Steins (2008) and Lutetia (2010)

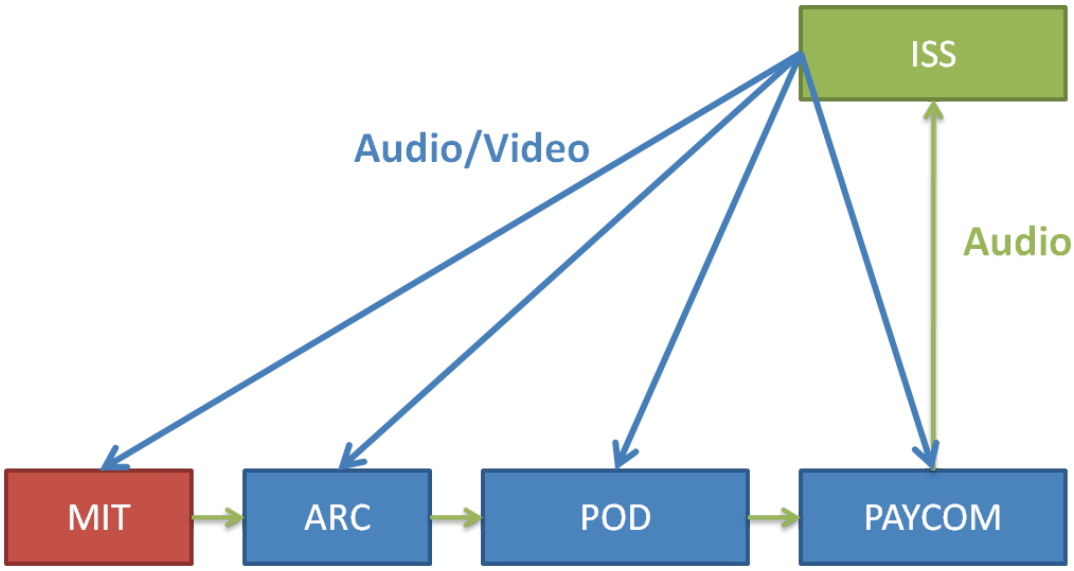
Mission Name

Rosetta is named after the Rosetta Stone, an incomplete stela of black basalt incised with the same priestly decree in three scripts (Egyptian Hieroglyphs, Egyptian Demotic and Greek) concerning Ptolemy V. The great significance of the Stone is that it provided the key to deciphering Egyptian hieroglyphs. The Rosetta Space Mission seeks to see if comet C-G can provide a key to deciphering the origins of the solar system and/or life on Earth.

[8] http://rosetta.jpl.nasa.gov/mission-facts/mission-goals and http://rosetta.jpl.nasa.gov/matt-taylor

MIT/NASA Communications During Test Sessions

The communications flow during a SPHERES test session involves several NASA-affiliated groups all over the country. Each can see and hear the crew through audio and video downlink. PAYCOM at NASA Marshall Space Flight Center in Huntsville, AL speaks directly to the crew. PAYCOM is managed by the Payload Operations Director (POD), also at Marshall. POD approves everything before it is relayed to the crew. MIT's connection to POD is through NASA Ames Research Center (ARC) in Moffett Field, CA. MIT speaks to ARC, who speaks to POD and PAYCOM, and PAYCOM speaks to the crew. Sound confusing? It is sometimes, but the chain of communications is a filter to make sure only the most concise and important information from the MIT team reaches the crew.



Acronym & Common Phrases Guide

POD	Payload Operations Director
PAYCOM	Payload Communications Officer
"SPHERES"	Call sign of the SPHERES research team at Ames
"MIT"	Call sign of the SPHERES research team at MIT
GUI	Graphical User Interface
Huntsville	Location of Payload Operations, at NASA Marshall Space Flight Center
Space to Ground	Communication loop that NASA uses to talk to ISS
SSC	Standard Station Computer (laptop)
LOS	Loss of Signal
AOS	Acquisition of Signal
JEM	Japanese Experiment Module, a.k.a Kibo

Things to see in Boston/Cambridge

Tours

Historic Freedom Trail	http://www.thefreedomtrail.org/
Boston Trolley Tours	http://www.trolleytours.com/boston/

Museums

MIT Museum	http://web.mit.edu/museum/
Museum of Science	http://www.mos.org/
Museum of Fine Arts	http://www.mfa.org
Skywalk Observatory	http://skywalkboston.com/
Isabella Steward Gardner Museum	http://www.gardnermuseum.org/
New England Aquarium	http://www.neaq.org/

Areas

Harvard Square	Red Line, Harvard Sq T-stop
Boston Commons	Red Line, Park Street T-stop
Newbury Street	Green Line, Hynes ICA T-stop
Faneuil Hall Market Place	Red/Orange Line, Downtown Crossing

Universities (other than MIT)

Harvard University	http://www.harvard.edu
Boston University	http://www.bu.edu/
Berkley College of Music	http://www.berklee.edu/
Tufts University	http://www.tufts.edu
Wellesley College	http://www.wellesley.edu
Northeastern University	http://www.neu.edu