2011: a “commercial” space odyssey

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ITA’s Three Decades of Space Processing Hardware Development and Commercial Microgravity Research Missions

- 2 ISS Missions
- 1 Shuttle/Mir Mission
- 11 Space Shuttle Missions
- 8 Sounding Rocket Flights
- 4 Low-g Aircraft Flights

Timeline:
- Early 1980’s
- 2012
A Little History

• 1<sup>st</sup> flight since the ill fated STS-107 in 2003
• Events following the loss of Columbia crippled ITA
  • NASA mishandled recovered ITA payload causing loss of data
  • NASA refused to reimburse ITA for losses from flight
  • ITA sued NASA and DOJ
  • Suit resolved shortly before STS-134 launch
• Formed BSE as the marketing and customer interface for ITA
  • ITA will now just develop and manufacture hardware
• We are back and flying again
  • We plan to fly on Dragon in 2013
Commercial BSE Payload Part of Historic Back-to-Back STS-134 & STS-135 Shuttle Program Conclusion

9 weeks
2 missions
2 integration cycles
3 payload processing cycles
9 Professional experiments
35 Student STEM experiments
29 Days in Space

STS-134 docks to ISS

LMA experiment package transferred to ISS

Two LMA Trays
ITA Cancer exp
Fingland exp
Schenker exp

Large Urokinase crystal grown on ISS in LMA

ISS LMA Trays transferred back to Shuttle Mid-deck

MDA Mid-deck activation anomaly causes minor loss of data

Mission extended 1 day

BSE HW labels

Mid-deck experiments

16 Day Mission

May 16, 2011

Final Flight of Endeavour

13 Day Mission

June 1, 2011

STS-134

STS-135

APU problems Postponed from April 19. then May 8th

Final Flight of Atlantis

July 8, 2011

July 21, 2011

Shuttle Program Termination

35 Days
NanoRacks Modules may be configured as follows:

- 1 CU: 2W
- 2 CU: 4W
- 3 CU: 6W
- 4 CU: 8W
- 2x2 CU: 8W
- 3x2 CU: 12W
- 4x2 CU: 16W

The 1st Space “Plug and Play”!

Nanoracks is a ISS National Laboratories Payload
Two Nanoracks-CubeLab Frames were installed on 19A and ULF4 Modules can be flown on any ISS transportation vehicle

Payloads can fly on any launch vehicle
NanoRack Modules can work in or out of the frame

Nanoracks Frame
NanoRacks NanoLab Modules
Nanoracks-CubeLab Frame In ISS Locker
ISS ExPRESS Rack 4, Lockers 3 and 7
Processed Payloads at the Space Life Sciences Lab (SLSL):

- Outstanding facility
- Processed our STS-134 & STS-135 payloads
- 25 labs
- Conference rooms
- Primary gateway for payloads bound for ISS
- Operated by Space Florida
- Recently flooded
The STS-134 Payload

- 1 MDA in one 4U NanoRacks vessel
  - CL-8 (The mission tech jargon)
- 4 trays (16 vials) of LMAs in one 2U Nanoracks vessel
  - CL-7
  - 2 trays to ISS for 9 weeks
  - Returned large urokinase crystal
- 5 professional experimenters
- 20 Academic Institutions
  - 16 SSEP experimenters
  - 3 University experiments
  - 1 High school experiment
The STS-135 Payload

• 1 MDA in one 4U NanoRacks vessel
• 4 trays (16 vials) of LMAs in two 2U Nanoracks vessels
  • Recovered 2 trays from STS-134
  • 3 professional experiments to ISS
• 4 professional experimenters
• 15 Academic Institutions
  • 11 SSEP experimenters
  • 3 University experiments
  • 1 High school experiment
A New National STEM Education Initiative: The Student Space Experiment Program (SSEP)

• SSEP designed to empower students as scientists
  • Student teams design real experiments, propose for a real flight opportunity, go thru formal proposal review process, go thru a flight safety review and have their own science conference.
• Lead org NCESSE in partnership with NanoRacks and ITA
• National announcement of opportunity by NCESSE June 2010
• Experiment design competition in participating communities involved over 20,000 students
  • 447 proposals submitted by student teams
  • 293 put forward to preliminary review boards
  • 43 finalists put forward to a National SSEP Review Board which met in Washington, D.C in November
• Selected 16 grade 5-12 student experiments for flight as part of NanoRack’s Experiment using ITA hardware
• SSEP vision is to provide routine student access to space via commercial payload opportunities
  • Which ITA has been doing for years!
ITA Has Flown 93 Student/School Experiments and Positively Touched the Lives of Thousands of Students

"...some students have changed their career plans developing a strong interest in the biological sciences..."

"...ITA donates to schools any unused wells for science experiments free of Charge..."
“Everyone has to get an Official Flight Authentication Certificate!”

CERTIFICATE OF FLIGHT AUTHENTICATION

BioSpace Experiments, Inc.™ congratulates

Annie Fisher STEM Magnet School, Hartford, Connecticut

on the successful space flight of their experiment

“Microgravity’s Effect on Tomato Growth”

aboard the Space Shuttle Mission STS-135

from 8 July 2011 11:29:03 EDT to 21 July 2011 05:57:54 EDT.

This certificate verifies that this science experiment was flown in the middeck of the Space Shuttle Atlantis, utilizing the ITA Materials Dispersion Apparatus carried by the NanoRacks CubeLab Module-6 and operated by Mission Specialist Rex Walheim.

John M. Cassanto
President, BioSpace Experiments, Inc.™
Payload Processing Challenges

- First mission in 8 years for “old guard” ITA launch crew
  - Lost some key players, some couldn’t make it
- Relied heavily on Interns
  - Kept end-to-end price low (for users/experimenters)
  - Benefit for students: provides them with hands-on experience that would take a decade in the aerospace business to get
  - But, they start at the low end of learning curve and must come up FAST in a pressure packed environment
- The manpower mix for both flight included 4-5 seasoned veterans (~25 years of space experiment experience) and 4-5 Interns
  - We also enlist the assistance of PI’s
- The timeline to load and harvest samples is non forgiving

John Cassanto  Dr. Dennis Morrison
Valerie Cassanto  Jane Farrington
Al Alvarado  Don Alberts

STS-134 Interns Will, Mike, Bob, Dr. Morrison, Ron
Processing Logistics, Loading and Other Mission Challenges

- Logistics – Incoming to Deployment
  - SSEP and other student experiments included many biological organisms, with their own special handling requirements
  - Each experiment sample needs to be appropriately cared for and coordinated with other experiments for loading into the unit
    - Temperature
    - Early and late arrivals at the facility coordinated
      - From arrival via UPS/delivery to loading the samples into the instrument
    - Don’t put a particular bacteria culture next to culture known to feed on that particular bacteria culture

- Late loading and Early Harvesting Challenges
  - Biological organisms
  - Coordinating loading and harvesting sequences: Great intern job

- Mission Activities Coordination
  - We had an LMA deactivation that need to happen during docking day close to docking
  - Had to identify holes in astronaut timeline and coordinate with PI for fix
Other Challenges

- No guarantee, even after you think you did everything right, that the astronaut up stairs will!
- One STS-134, Astronaut Chamitoff mistakenly lost count of rod crank turns while manually activating the MDA, impacting ~15% of experiments in minilab.
- Corrective action minimized loss of data.
The Launch Team Experience is the Ultimate Team Building Experience

- Grueling
- Long hours, sometimes around the clock
- On constant call
- Must be able to take direction
- Demands competence and First Time Quality in all assigned tasks
- Total team effort
- Very rewarding experience
- Greater reward and emotional experience when you see the launch vehicle take off!
- For an Intern, invaluable opportunity, priceless experience and memories
BSE’s Summer 2011 Interns Had the Experience of a Lifetime

- 7 interns
  - Embry-Riddle Aeronautical University
  - University of Central Florida
- Hands-on experience with actual flight hardware
  - Experiences only awarded to senior personnel in established aerospace corporations
- The guidance of experienced professionals
- Grueling work schedule, No pay
  - Place to stay, an occasional meal
  - Boot Camp for “real” space
- Memories to last a lifetime
The Experiments

• Flew a broad range of experiments
  • 44 in total
• Professional/Industry/and Student
• Biomedical Research, Cell Biology, Crystal Growth, Fluid Physics, Manufacturing Process Research
• The effect of microgravity on….
  • Squid Gene Expression
  • PPAR Gama Protein Crystals
  • Urokinase Crystal Growth
  • Planetary Society LIFE
  • Tin Crystal Growth
  • Max Cell Size of Tardigrades
  • Goldfish Embryo Development
  • Honey as a Preservative in Space
  • Talapia/ Zebra Fish Embryos
  • *Lactobacillus acidophilus* spores Development
  • Brine Shrimp Development
  • Biofilm Formation
  • Osteoblast Specialization and Bone Growth
  • Lysozyme Protein Crystal Growth
  • Radiation Exposure/Seed germination
  • Nextgen Cosmetics Chemistry
  • Growth Rate of Murine Myoblasts
  • Various seeds
  • Many Many More….
Then We Needed a Mission Patch!

- Famed space artist Don Davis just happened to be one of our “official” dignitaries on the launch team
- We put him to work as official artist and photographer
- He was inspired to create an BSE STS-135 patch,
  - From midnight to 4:35am on STS-135 harvesting night
  - From Black & White to Color, freehand, while roaming from lab to lab in an inspired state.
Concluding Remarks

• Being a member of payload launch crew is a unique experience
  • First flight after Columbia comeback
• The process is educational, long and tiring, arduous, but rewarding
• Particularly so if in 9 weeks you can:
  • Fly two missions
  • Go through 3 integration cycles
  • Fly 9 professional experimenters
  • Fly 35 academic institutions
• We flew 5 commercial/industrial experiments
  • Dr. Sygusch’s Urokinase cancer experiment
  • Dr. Morrison’s microencapsulation experiments
  • Dr. Schenker’s Expression of MMP-1 Gene, Footsteps of Creation 16S RNA and the Origin of Life experiments
  • Dr. Betts Shuttle Living Interplanetary Flight experiment (LIFE)
  • Dr. Fingland’s Gene Expression experiment
• Come fly with us in 2013