Horizons

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# Project Aether

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American Institute of Aeronautics and Astronautics

*Horizons is a quarterly publication of the Houston section of the American Institute of Aeronautics and Astronautics.*

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**Cover: Project Aether, led by Dr. Benjamin Longmier**

## The AIAA Houston Section Year in Review

From the Chair

SARAH SHULL

As I write this I am now in my final month as your Houston Section Chair. It has been a very busy year so I am looking forward to having a bit more free time this summer but I am also a bit sad to hand over the reins just when I feel like I am getting the hang of being at the top of the org chart. I will, of course, remain involved as past-chair and in other roles for, I hope, many, many years to come.

Since the publication of our last issue we have held several very successful AIAA events, including our Annual Technical Symposium (ATS) and first ever Engineers as Educators Workshop. ATS this year attracted approximately 150 presenters and attendees and discussed a variety of topics ranging from future commercial involvement in human spaceflight to newly agreed to international docking standards to space journalism. Keynote talks were given by Mark Erminger of the NASA JSC Commercial Cargo and Crew Office and Brewster Shaw Vice President & General Manager of Space Exploration at The Boeing Company. As a service to you, our members, copies of all ATS presentations cleared for public release will soon be available on our section website at http://www.aiaa-houston.org/Conferences.aspx.

In conjunction with ATS we also held two sessions of the Engineers as Educators Workshop. This two hour workshops, developed and run by the K-12 STEM Education Committee at AIAA National, strives to teach engineers effective ways to inspire K-12 students to pursue careers in math, science and engineering. All who participated seemed to really enjoy the workshop and are eager to reach out to students in the area. We have had several request to offer this workshop again for those unable to attend the recent sessions and are working to offer it again in the fall, so keep an eye on your e-mail.

As always, if you are interested in getting more involved with AIAA Houston Section, don't hesitate to contact me at chair@aiaa-houston.org. We often have openings on our section executive council that we are looking to fill. It has been a pleasure to serve as your Houston Section Chair this past year. I'd like to extend a special thanks to all of the council members this year, many of whom put in numerous volunteer hours month after month to ensure that AIAA continues to be of service to the Houston aerospace community.

From the Editor

# Journalism in Aeronautics and Astronautics

**DOUGLAS YAZELL, EDITOR**

Horizons is a big job for our team every issue. Long-time editors since I started volunteering with our section in 1999 are John Keener, Jon Berndt (15 issues) and Dr. Steven E. Everett (7 issues). Bob Beremand and Don Kulba are two of our regular Horizons staff who might have time to fill in that role if needed in a pinch now and then. Steve and Jon are also potential backups when I am unavailable.

Following Jon's innovations, we use Microsoft Publisher for typesetting. It's like using PowerPoint, but Publisher has some features that make it worthwhile.

As a non-profit group (part of the non-profit AIAA national group), we can buy Publisher and other software at very affordable prices at techsoup.org.

I put a Windows 7 partition on our Apple MacBook Pro (15" screen, purchased when we bought our iPad 1, as soon as the Apple iPad was on the market) at home in order to typeset Horizons starting last issue. Publisher does not work with the Mac OS.

While preparing my purchase at techsoup.org, I downloaded a free 60-day trial copy of MS Office Professional 10 (includes Publisher) from Microsoft.

I used my own money to buy some of this software, but we get more out of AIAA volunteering than we put into it. I purchased Windows 7 at a Best Buy store. The web site www.techsoup.org makes software available for non-profit groups. Donations for administrative costs are required for each software application or suite of apps obtained in this manner. I now have, on our Apple MacBook Pro, Microsoft Office Pro 2010 for Windows and Adobe Acrobat Pro X for the Mac OS, both from this source. About one eighth of my expenses will be reimbursed by our section. At least one other person from our editing team will be obtaining similar apps from this web site at his own expense. For example, it was only $31 for the Office suite of apps. But each order for Microsoft software products requires a minimum of five Microsoft products on the order.

"Real soon now" I will install UNIX on a partition on this home computer in order to keep up to date with the related computer skills. Open Office is software comparable to Microsoft Office and similar products from Apple, so that is worth investigating for journalists and engineers.

Jon and I agree that Horizons should be bimonthly. Others recommend staying with our traditional quarterly schedule. But our Horizons team is finding good contributors and our Horizons calendar will be more useful if we follow a bimonthly schedule.

It's amazing how good Horizons looks on our Apple iPad at home using the bundled app iBooks. Jon gets credit for creating the professional and colorful look found in Horizons in recent years, but it looks and feels much better on the iPad than on a laptop or desktop computer. Each Horizons page in iBooks fills the screen in portrait orientation. A swipe across the screen with a finger takes the reader to the next page. Each page snaps into place easily and quickly. When we pinch our fingers to zoom on text, it is crystal clear immediately at any size.

Links to web sites in Horizons work automatically when "www" or "http" is part of the address. With Adobe Acrobat, we can probably add links to our table of contents.

I keep an eye on the new formats for space journalism. Creating a PDF document for our Horizons newsletter is not new, but it still works well for now. A new book format, an iPad app, is demonstrated in a video presentation at www.TED.com. Search for Al Gore's new book, Our Choices, a follow-up to his film, An Inconvenient Truth.

As I mentioned last issue, space collectables are often a bad fit for museums and a

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good fit for private collections. I recently completed a five-medallion collection which is now very affordable at thespacestore.com. These medallions are 1.75" in diameter and they are two-sided. They are pewter-colored (gray) and made in China, but I don't know how many of each were made. They are not numbered. One side of each medallion contains the Apollo 40th anniversary logo and the words, "CELEBRATE APOLLO" and "EXPLORING THE MOON, DISCOVERING THE EARTH." On the other side are quite a few words, "OFFICIAL COMMEMORATIVE", "APOLLO (11, 12, 13, or 17, etc.) 40TH ANNIVERSARY", and "THIS MEDALLION CONTAINS METAL FLOWN TO THE MOON ON APOLLO MISSIONS."

Since our section conducted quite a few Apollo 40th anniversary events (thanks to Dr. Albert A. Jackson IV and others), I decided to complete that collection. In fact, I bought quite a few duplicates as gifts for friends and relatives. The medallion with the NASA logo on one side was the first one I purchased. It was available for sale in a space souvenir store at NASA/JSC. I was not yet aware of other medallions in this series. Then my wife and I each obtained one Apollo 13 medallion at an Apollo 13 40th anniversary event at NASA/JSC. Later I found the other three medallions in this series on sale individually at the souvenir stores in Space Center Houston, the visitor center next door to NASA/JSC. Months later the five-medallion set was available at www.thespacestore.com.

Daniel Adamo's article reminds me of past conversations with him introducing me to the open source astronomy software Celestia. A few years ago I installed that on our older Mac, the PowerBook G4 with a 17" screen. It is an excellent astronomy app.

During my years of engineering teamwork on NASA's Constellation program (Orion Crew Exploration Vehicle entry mode team flight control system), I concluded that our human space exploration beyond Earth orbit (with settlements in mind?) was a smart choice in light of the danger of new impacts on Earth from meteors, comets, and asteroids. Daniel Adamo's article on the Red Baron Scenario guides readers to some of those relevant science results, quantifying some of the danger and discussing new spacecraft missions for surveying potentially hazardous Near Earth Objects (NEOs).

This June 2011 issue of Horizons is targeted to be published online by June 30, 2011. We aim for the August issue to be published online by August 31, 2011. If our bimonthly schedule goes as planned, readers will be able to find a new issue of Horizons online at www.aiaa-houston.org at the end of every even-numbered month.

Keep in touch. Send feedback and comments to our contributors or e-mail me using *editor "at" aiaa-houston.org*.

## From the Editor

*Below: My set of five medallions with a duplicate turned around to show the Apollo 40th logo. My Apollo 40th anniversary lapel pin is also shown.*
*Image credits: Douglas Yazell*

*Apollo patch image credits: NASA (http://history.nasa.gov/apollo_patches.html)*

*NASA logo: public domain*

## From the Assistant Editor

# NASA Photo: Worth a Thousand Words

**ROBERT BEREMAND**

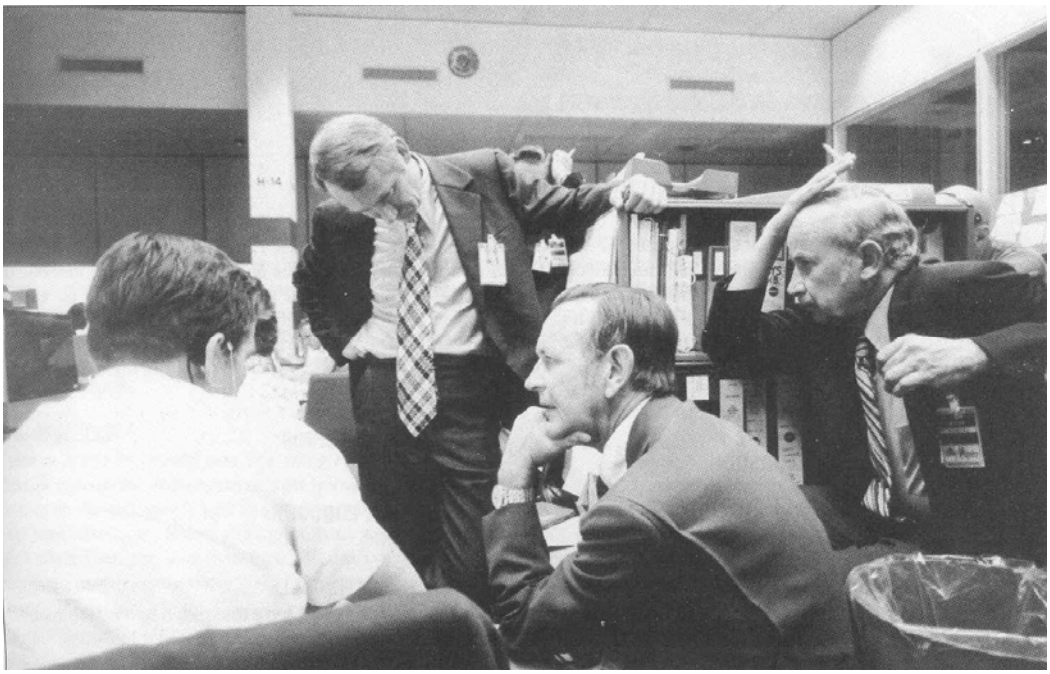
*ISS027-E-036801 (23 May 2011) --- This image of the International Space Station and the docked space shuttle Endeavour, flying at an altitude of approximately 220 miles, was taken by Expedition 27 crew member Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23, 2011 (USA time). The pictures are the first taken of a shuttle docked to the International Space Station from the perspective of a Russian Soyuz spacecraft. Onboard the Soyuz were Russian cosmonaut and Expedition 27 commander Dmitry Kondratyev; Nespoli, a European Space Agency astronaut; and NASA astronaut Cady Coleman. Coleman and Nespoli were both flight engineers. The three landed in Kazakhstan later that day, completing 159 days in space. Image credit: NASA*

*http://spaceflight.nasa.gov, space station, Expedition 27*

# The Lone Man in the McCall Mural at NASA/JSC



DOUGLAS YAZELL



*Left: Howard W Tindall, Jr., second from right, and, left to right, Bill Schneider, Chris Kraft, and Sig Sjoberg monitor a problem with the Command Service Module used to transport the Skylab 3 crew to the orbiting Skylab space station cluster. (NASA Photo S-73-31875.)*

We can now update our cover story from last issue, "Who's Who in the McCall Mural at JSC". The man in the McCall mural at left (in an image cropped from an image of the entire mural) appears to be Sig Sjoberg, the man in the striped tie at right in the above photograph. Someone e-mailed me (I lost her note.) on about Monday, May 23, 2011, to explain her conclusion that it is Mr. Sjoberg in the mural. I found the photograph by searching the internet.

*Left and below: Parts of the NASA/JSC mural by Robert McCall. Image credits: NASA*

My copy of Kraft's book Flight, My Life in Mission Control, was moved to our attic (impossible to find for now) about a week ago while we did some home renovation. I seem to recall that Sig Sjoberg was the man who lured Mr. Kraft into a lifelong love/hate relationship with golf. At the end of the book, Mr. Kraft thanks him for that, I think. That book may have more photos of Mr. Sjoberg.

Feature

# Project Aether: Inspiring the Next Generation of Explorers

ELDON SUMMERSON, BENJAMIN LONGMIER

Project Aether
Principal Investigator: Benjamin Longmier, Ph.D.
Undergraduate Mentors: Eldon Summerson, Charlie Powell
Sponsors: AIAA, Dr. Barry Lefer's University of Houston balloon group, AIAA-Houston, GoPro, Praxair, Dr. Edgar Bering of UH, undergraduate volunteers, Christine Haman and Darrell Anderson of the University of Houston.

Forty years ago when today's aerospace scientists and engineers were children, men were walking on the moon and becoming an astronaut was every child's dream. It wasn't difficult to understand the impact of the space program a generation ago, but for today's students, events like landing on the moon are history lessons and the space program has taken a backseat in national attention. How then do we expect today's students to want to become tomorrow's aerospace scientists and engineers? In a word - opportunities. The rigors of a well rounded undergraduate curriculum leave little room for the pursuits of the imagination so that the availability of first hand experiences is often key to cultivating interests among students. This is what we tried to provide through Project Aether in allowing local students from Booker T. Washington High School to participate in the construction and release of an aeronautical experiment. Providing this opportunity to students from a school that is generally underprivileged and low performing turned out to be a special opportunity for everybody involved.

The purpose of the project was to launch rugged HD cameras, provided by GoPro, on a weather balloon that would reach 100,000 feet while recording video and still footage of the ascent and descent. The cameras and a GPS unit were attached to a square frame, suspended from a parachute that was subsequently suspended from the weather balloon. When the students arrived and introductions were made, Ben explained the premise of the project and how it would be useful for the students to know some of the details of the equipment for their upcoming rocket launches. Initial interest varied across the group, some students seemed indifferent while others were busy taking notes. In an unfamiliar environment the students were reserved and timid but once they were able to start physically interacting with the experiment they became active and eager to be involved. They based their work off of visual observations but occasionally an energetic leader would come ask us questions to make sure their design was just right. It wasn't long before everyone was involved in some way, and soon we were preparing for

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Project Aether is a program designed to inspire the next generation of scientists, engineers, explorers, and dreamers. We are composed of a small number of professional rocket scientist mentors and space physicist mentors and a group of Houston graduate, undergraduate, and high school students. We want to share our experiences with the world. Performed with off the shelf hardware, the inaugural flights of Project Aether document how space exploration can be accessible to the individual. The picture and video data from the flights is shared online where any student with internet access can share in the emotional experiences of viewing the world from the edge of space. Videos from Project Aether flights have reached ~11 Million students on Youtube (as of mid-2011), and viewership continues to grow at a non-linear rate. Interested high school, undergraduate, and graduate students and teachers in the greater Houston area are encouraged to contact Ben Longmier at provdev@aiaa-houston.org for more information on participation. For teachers and student outside the Houston area, "Fly-it-yourself" kits are offered for sale at www.ProjectAether.org.

Feature

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launch. Everyone had an active role in the launch, and after we let go expressions of awe and elation were spread across the students' faces as they squinted up at bright sky, watching the balloon soar into the clouds. Congratulations were shared all around and then the whole group got back to work preparing the second payload for launch. We added two small gyroscopes to the second platform to help stabilize angular rotation and then strung the whole assembly up as we had for the first balloon. The second launch went seamlessly now that the whole group had some experience in the procedure. You could tell that these students were proud of what they had accomplished through their genuine gratitude at having been able to build and launch their own balloon. After all of the equipment was packed up, we thanked the students for their help and wished them luck with their future projects.

That afternoon we accompanied Ben and his wife across the Texas countryside in pursuit of the balloons which had landed around 120 miles west of Houston. Using the GPS devices, we found the two experiments with ease and recovered nearly a thousand photos and 7 hours of amazing video footage. Project Aether turned out to be a success in every way that it was intended and Ben is now scheduling future launches to take place in Costa Rica in September and Houston in late October. These projects will continue to provide great outreach tools to keep students actively involved in the future of aerospace as well as pure visual and imaginative inspiration to anyone following the results of Project Aether at www.projectaether.org.

Eldon Summerson is from Nebraska, an AIAA Student Member, and a senior mechanical engineering student at the University of Nebraska. He is completing his summer internship at Ad Astra Rocket Company.

Dr. Benjamin Longmier is a research scientist at Ad Astra Rocket Company, the Professional Development Chair with AIAA-Houston, and founder of Project Aether.

*Image credits: Project Aether*

Feature

# Project Aether: "I Knew When"

CHARLES POWELL, BENJAMIN LONGMIER

Project Aether
Principal Investigator: Benjamin Longmier, Ph.D.
Undergraduate Mentors: Eldon Summerson, Charlie Powell
Sponsors: AIAA, Dr. Barry Lefer's University of Houston balloon group, AIAA-Houston, GoPro, Praxair, Dr. Edgar Bering of UH, undergraduate volunteers, Christine Haman and Darrell Anderson of the University of Houston.

*Image credits: Project Aether*

As I navigate to the AIAA homepage (www.aiaa.org), I'm confronted with a prying question: "when did you know?" That's a question I can't answer. As a current undergraduate student, I can assure you that I have no idea about what my future career entails. Although I share an interest set that is aligned with the aerospace industry, I have yet to have a revelatory experience where I suddenly become aware that aerospace is my life's calling.

When I was in sixth grade, I took a small, nine-week class - taught by a volunteer from NASA - on HAM radio operation. It wasn't a calculated undertaking, it just happened to be the class that all of my friends were in. As it turned out, amateur radio piqued my interest: I got my technician's license (at the ripe age of eleven) and became a fairly active member of the local HAM community. Admittedly, my current participation has lapsed in recent memory, the point remains – I was interested and active purely because one volunteer teacher spent five hours a week teaching a class.

Not too long ago, one of my internship advisors, Dr. Ben Longmier, asked me to participate in a balloon launch. The details of this operation ambiguous, and with the planned launch at the alienating hour of 9 A.M. on a Saturday, I was noticeably hesitant. I only knew that it was named "Project Aether" and enlisted the use of both high-altitude weather balloons and HD cameras. But, in a vain attempt to please my superiors, I promised my appearance.

When I arrived at the

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*Right: (Editor) The only person I recognize is Ben Longmier, second from right.*

Feature

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launch site, I met 18 obviously-tired-and-exasperated students from Booker T. Washington High School in Houston, Texas. They had been dragged there wearing collared shirts and khakis on a Saturday morning, still during summer break, in the Houston heat. Ben hadn't expressed much in the way of plans to me, and apparently had decided to build (and design) the payload on-site. So after unpacking all of our materials, I started to help out by assembling a PVC frame for our balloon's payload. Perhaps I had underestimated the power of curiosity, but immediately, the students started asking me what I was doing, why I was doing it, and how they could do it themselves. Epiphany struck, and suddenly we were making two balloons: one "test" device that was built by the "pros", and a similar device built entirely by the students. The balloons were functionally the same, but since this was the first time half of the "pro" team had built and launched a balloon, we worked one step ahead of the student team to work out any potential kinks.

The design was pretty simple, consisting of a square PVC frame with cameras bolted onto it. We started the students off with assembly, which was accomplished in all of a matter of seconds. The frame was anything but secure, however, as lifting any side unevenly would cause it to spontaneously disassemble. Herein lay our first engineering challenge. With the limited supplies of duct tape and nylon string , the students started fashioning an internal tension mechanism. After watching me progress with more ways to strengthen the frame, a student dutifully explained the process to the rest of her compatriots, where they began work without any direction.

As the construction process continued, the students became more autonomous. Every once and awhile, when trying to recreate a feature they saw in our payload, they would ask, "how did you do that?" Most of the answers were as trivial as tying a certain style of knot, which, after learning, they zipped right back to work. Every student seemed to be energized, and they buzzed about the launch site purposefully completing one task after another. As we began preparations to launch the "pro" balloon, the anticipation continued to build.

After inflating our balloon, the next step was letting the 300–or-so feet of payload line out slowly. We explained to our students that the string was quite long so that the pendulum's period of motion was increased, which helped maintain stability during flight. With 300 feet of thin nylon line to manage, it's a logistical nightmare, but these students were quick on their feet to pick up the slack (pun intended). They

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*Image credits: Project Aether*

*Left: (Editor) That's Ben Longmier in the center of that frame.*

## Feature

*Image credits: Project Aether*

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organized, completely independently, in a W-shape and spooled the line around like pulleys during the launch.

After the collective giddiness and awe after the first lift-off, the students went right back to work readying their own craft. The bar had been set by the relatively painless and problem-free launch. Everybody was twitching from excitement, ready to repeat that same gratifying moment. In no time, we were back to launch choreography, and the student's balloon ascended just as dutifully and powerfully as the first.

Project Aether provided a number of experiences that these students were unlikely to find in school. Besides giving a real world context to many concepts they might learn in a traditional physics class, it was an opportunity to be a part of a real design team with a real design challenge. The project empowered students to lead their own path with their own creativity. Most importantly, the students had an immediate sense of accomplishment. They saw their project evolve through their own handiwork, and saw their work rival the pros. Their treat: amazing photos from the edge of Earth and the pride attained by a successful mission.

Being a part of this mentorship team made me reflect about my not-too-distant secondary school career. In hindsight, I think the only reason why I became involved in the HAM community is simply because my teacher shared his passion for it with me. That excitement remains contagious. Despite largely being surpassed by modern communication technologies for most (read: any) practical uses, HAM radio represents a large hobbyist community - just because it's fun. Planes and spaceships are more than just fun; they are the future of American industry. If amateur radio can catalyze energy and action within students, then aeronautics and astronautics shouldn't be any more difficult.

It is in the interest of AIAA (and any organization aiming to lure the best and the brightest) to engage in outreach activities that enchant secondary school students, and motivate them to be active in the aerospace community. In an era where the Space Race no longer dominates headlines, it's hard to imagine where students will find their inspiration in aerospace. That and, who actually knew what they wanted to do in high school (… or col-

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Feature

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lege)? It is possible, however, to capture the imagination of an otherwise apathetic youth by simply exposing them to something intriguing – or challenging – or practical. If a mentor can relate to a pupil in 'why' they do something, the 'how' question will surely follow. It's up to AIAA members to take on the task themselves, to reach out to the community, enlist young scholars, and build the foundation of tomorrow's industry.

So, when did you know? If you can pinpoint the exact moment you knew you wanted to join the ranks of aerospace, then you should realize that the answer isn't as important as the sentiment it instills, and the potential to provide that experience to impressionable young adults. Educational stewardship is everyone's responsibility.

Charles Powell is a Houston native, AIAA Student Member, and sophomore physics student at Bard College at Simon's Rock. He is completing his second summer internship at Ad Astra Rocket Company.

Dr. Benjamin Longmier is a research scientist at Ad Astra Rocket Company, the Professional Development Chair with AIAA-Houston, and founder of Project Aether.

*Image credits: Project Aether*

Feature

# Project Aether: Glenda Reyes in our Cover Photograph

GLENDA REYES & BENJAMIN LONGMIER

*Image credit: Project Aether*

*What are some of the interesting aerospace projects you worked on in high school?*

One project was the One Mile One Pound Rocket. It required that we research, design, and build a rocket that could reach the altitude of a mile carrying a one pound payload. Another project is the building of the Transonic Rocket. I was the project manager of the team. With this rocket we had to do the same as in One Mile One Pound, but also we had to reach transonic speed or higher. Another recent aerospace project for me is Project Aether, in collaboration with Dr. Longmier. We launched a weather balloon to the Altitude of 100,000 feet. This balloon helped my team and me gather data that was necessary for the calculations of the current project, the High Altitude Rocket. We are required to build a rocket to reach an altitude of 100,000 feet.

*Please describe your background and family/friend support for your education and your career.*

I came to the United States from El Salvador when I was seven years old. When I came I knew I loved to dream big. I started school in the U.S and it was difficult since I didn't speak English. Eventually I learned and that is when I knew I could do anything because the hardest thing, adapting to and learning a new language, had already been accomplished. I am the oldest daughter and I will be the first one to go to college. For this reason my parents are and have always been very supportive with my education and all my dreams.

*When did you know that you wanted to pursue a career in aerospace?*

I decided I wanted to become an astronaut when I was in seventh grade. It started as I looked at the stars one night and I felt that I wanted to one day be able to be up there in the sky rather than just look at it from Earth. I also had a feeling that there was more to space than just stars. Once I started building rockets I felt that if I could build a rocket today than I could fly a rocket someday. Even though now my interest is not as much in becoming an astronaut, I still want to become an engineer in maybe aerospace engineering.

*What are your ultimate career goals (what do you want to be when you grow up), and how do you plan to achieve these goals?*

My ultimate career goal is becoming an astronaut, but I also want to establish my own collaborative engineering business to help the environment. I love life which is why there are many things I want to accomplish. I am interested in engineering and though there are many obstacles I am determined to succeed. I will set my career goal as a high priority and do what it takes to achieve my goal. One thing I will never do is give up because the day I give up is the day everything will end and it will be the day I will lose the most important thing, my dreams.

*What impact on the world do you want to make and how do you see yourself helping others?*

I love life as well as people and when I grow up I want to help anybody who I can by sharing with them my knowledge and the mistakes I've made so that one day they can correct those mistakes and make things better. Like my teacher Dr. Le says, "The best get better.", which is what we need to do to make the world more innovative than it already is. I want to make things better. Hopefully with my research we can one day be able to explore beyond our planet to make life for humanity better.

## NASA Photos

*ISS027-E-036619 (23 May 2011) --- This image of the International Space Station and the docked space shuttle Endeavour, flying at an altitude of approximately 220 miles, was taken by Expedition 27 crew member Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23, 2011 (USA time). The pictures are the first taken of a shuttle docked to the International Space Station from the perspective of a Russian Soyuz spacecraft. Onboard the Soyuz were Russian cosmonaut and Expedition 27 commander Dmitry Kondratyev; Nespoli, a European Space Agency astronaut; and NASA astronaut Cady Coleman. Coleman and Nespoli were both flight engineers. The three landed in Kazakhstan later that day, completing 159 days in space. Image credit: NASA*

*http://spaceflight.nasa.gov, space station, Expedition 27*

Feature

# An Astronaut Takes a Slow Flight

JAMES C. MCLANE III


*Right: Talking to the Goodyear representative (in the cowboy hat)*

*Image credits: James C. McLane III*

In the early days of the manned space program many firms made special efforts to show their support for NASA. For example in the summer of 1964 Goodyear sent a blimp to Texas as a promotional gesture to welcome the Manned Space Craft Center (now named Johnson Space Center) to Houston. A temporary Blimp base was established in Clear Lake City on a large mowed open field on the northeast side of El Camino Real. Only a year earlier that street had been a rough dirt road. The site was close to where the Clear Lake City fire station is situated and located about where Hercules Avenue runs today.

Goodyear sent invitations to certain NASA folks to take a ride. On the first morning of the event our family (my father, mother and I) went to the rough field where a temporary mooring mast had been erected. The famous Goodyear blimp Columbia (tail number N2A) was moored to the top of the small tower. I'd never seen one of these things up close so I was fascinated. We met the local Goodyear representative. He wore a Stetson cowboy hat, as indeed many Texans sported back then. We also met astronaut Dick Gordon and his family (who would be riding with us). The Gordon's lived on our street in Clear Lake City, just a few houses from us, so we were neighbors.

The blimp could carry perhaps 6 passengers. My

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*Right: From left to right, astronaut Dick Gordon and family, James McLane Jr. and wife Dorothy with Goodyear representative (wearing the cowboy hat)*

Feature


*Left: Waiting to board. Astronaut Dick Gordon's family at left, James McLane, Jr. and Dorothy McLane at right.*

*(Continued from page 16)*

mother and father plus astronaut Gordon and a couple of his kids boarded for the first flight. Gordon's wife and their remaining three kids would ride with me on the second trip. It was all very interesting. The crew and passenger pod rested on one large single wheel with a pneumatic tire. We boarded by stepping up a short ladder below a door on the right. The cabin was roomy and bus-like, with big windows offering a terrific 360 degree view. No one, not even the pilot had a seat belt. The two piston engines were inside pods, one on each side of the cabin. They were quite noisy. These were

*(Continued on page 18)*

*Image credits: James C. McLane III*


*Left: Walking to the blimp*

## Feature


*Right: Blimp Columbia attached to temporary mast*

*(Continued from page 17)*

pusher type installations with propellers near the aft end of the passenger compartment. The single landing wheel was also located to the rear of the passenger compartment under the engines.

Rather than moving a central control yoke as in a convent.ional airplane, the Blimp pilot steered the vehicle with large wheels positioned vertically, one next to each side of his seat. These wheels looked something like those on a hospital wheelchair. Manually rotating one wheel pulled on cables that extended back to the tail elevator to control vehicle pitch. The other wheel worked cables that moved the rudder to affect yaw. These were totally manual controls (not boosted) that worked very large surfaces. In flight the pilot was continuously rotating the two

*(Continued on page 19)*

*Image credits: James C. McLane III*


*Right: A steep takeoff*

## Feature


*Left: Climbing out with the Webster power station in distance*

*(Continued from page 18)*

wheels with his arms and hands –a lot of exercise! The main gas bag was full of helium, but since there had to be way for the gas to expand during the heat of the day (they didn't vent the expensive gas overboard) inside the main envelop a variable size compartment held ordinary air. This compartment was inflated by air scoops resembling tubes situated behind the propellers. The prop blast kept the internal expansion compensator expanded. The vehicle seemed to have a slight negative buoyancy, so in order to climb the pilot would apply power, start moving ahead and then point the nose up. It was possible to point the nose up at a very sharp angle, say 30 degrees or more and the machine would climb away steeply, but slowly and majestically with its loud engines racing.

The sensation for passengers was quite different than being in a conventional airplane. The blimp's noisy mo-

*(Continued on page 20)*

*Image credits: James C. McLane III*


*Left: Blimp disappearing to the east*

## Feature

*Right: Approaching Highway 3 (Old Galveston Road). Webster is to the right.*

*Image credits: James C. McLane III*

*Below: Webster electric generating station. This is now gone.*

*(Continued from page 19)*

tors were a distraction, but the ride was smooth. We passed over deer and cattle that remained grazing and seemed unperturbed by our presence. We flew south along Texas HY#3 and near Clear Lake before transiting the Manned Spacecraft Center at low level. The term airship is very accurate because the handling seemed ponderous and slow like a ship. When the blimp would encounter an uprising thermal of warm air its nose would be pushed upward. Then when the tail of the ship got into the same thermal it would also be pushed up and briefly we would be flying level again.

The opposite would happen when we exited the thermal. So the nose constantly bobbed slowly up and down in a series of gentle oscillations.

Passing over the new NASA center I took photos of the massive construction that was is full swing. We flew directly over Building 32. From

*(Continued on page 21)*

Feature

*Left: Pilot steers the Goodyer blimp Columbia around Clear Lake*

*Image credits: James C. McLane III*

*(Continued from page 20)*

the air I could see the huge space environmental Chamber A in building 32 being built.

Back in Clear Lake City our landing was smooth and uneventful. However, the Texas wind started kicking up and soon all blimp flights had to be cancelled. Because of the windy weather very few folks ever got to go up, so I consider myself quite fortunate.

I didn't really think about our neighbors, the Gordons again until a couple of years later. One morning I went out to collect the newspaper from the front yard and saw a long line of cars and news vans parked along our street and people standing

*(Continued on page 22)*

*Below: NASA building 32 space chamber A takes shape under a red metal frame*

## Feature

*Right: Low level flying*

*Image credit:*
*James C. McLane III*

*(Continued from page 21)*
around everywhere. Dick Gordon was up in space on Gemini XI. He later flew to the moon as Command Module Pilot on Apollo 12.

*Article ends on next page.*

## Feature

*Left: Approaching to land with the NASA Manned Spacecraft Center in the distance*

*Image credits: James C. McLane III*

*Below: Ground crew leads the blimp to its mooring mast*

Feature

# Mars Rover Celebration
# Fun and Learning with Virtual Space Missions

EDGAR A. BERING, III, PH.D., AIAA ASSOCIATE FELLOW, & JENNIFER T. JAMES

You are unlikely to recall a time when you did not find science and engineering exciting, compelling and consuming subjects of your intellectual passion. For engineers, fascination with airplanes, rockets and the way things work has motivated and defined our development from an early age. Unfortunately, too few of today's young people have been inspired by their teachers and mentors to dream the dream of building a bigger, faster rocket to Mars or designing the next generation of airliner or fighter plane. It is indisputable that the shortage of American children entering college with the intention of majoring in science or engineering is becoming a major long-term threat to the future of the American economy. This problem is deep-seated in our national culture, and will not yield to single "silver bullet" solutions. The critical problem is that the pipeline has already emptied before the students arrive at our nation's universities. They have made curriculum decisions in middle school and high school that render them unable to major in science or engineering. The K-12 STEM Outreach Program is the AIAA's contribution to a broad community coalition of efforts aimed at reversing this trend.

The purpose of this article is to describe one of the AIAA's efforts to make a substantive contribution to solving this problem. The University of Houston/AIAA Mars Rover Model Celebration is the only national student participation K-8 program the AIAA offers. This program was developed by Houston Section members and is still offered by UH in partnership with the Houston Section.

The heart of the issue is that far too many students are experiencing science in elementary and middle school with hackneyed approaches that convince them that science and engineering are boring, incomprehensible, irrelevant, and much too hard for them to understand. Ultimately, this problem can only be solved one teacher at a time. However, what organizations such as the AIAA can do is organize and provide enrichment programs and curriculum units that make engineering more engaging and fun for kids. All of us know that engineering professionals get paid to spend their time solving really fun puzzles and playing with captivating toys. It should not be so difficult to convey that information to kids. The Mars Rover Model Celebration is an enrichment program designed to help solve this problem. It is based on the problem of prototyping a mobile robot, or "rover," to explore the surface of Mars. There are two parts to the program, a curriculum element and a competition. The curriculum element is structured as a 6-

*(Continued on page 25)*

*Right: Former astronaut Joan Higgenbotham and Physics Professor Edgar Bering presenting an award to one of the 2011 winning teams.*

Feature

(Continued from page 24)
week planetary science unit for elementary school (grades 3-5). It can also be used as an enrichment program or extracurricular activity in grades 6-8 by increasing the expected level of scientific sophistication in the mission design and adding more detailed written reports to the end product. The second part is a capstone event held annually at UH to select the most outstanding models.

Mars Rover Celebration 2011 was the largest and most successful in its nine-year history. Approximately 550 students representing 29 elementary and middle schools brought 170 model Mars rovers to the University Center on January 29 to compete in several categories. Among the University's premiere outreach events, Mars Rover Celebration offers high-impact engagement in educational activities that inspire interest in STEM subjects, teaches students how to define and achieve a long-term goal, improves their oral and written communication skills, and emphasizes the importance of teamwork. Figures 1 and 2 illustrate the enthusiasm and diversity of the participants. Figure 3 shows a typical model rover.

Physics Professor Edgar Bering, the event's founder, expounded on the program's conceptual underpinnings. "Mars Rover Celebration is an enrichment program for grades 3-8 aimed at creating a much higher level of excitement about science and engineering than contemporary curricula do. This program begins with the children researching Mars and choosing a question to investigate that really interests them. The teams decide how they're going to address the question, then design and build a model rover that answers the question using what we charitably call art supplies." The supplies consist of found objects and art supplies with a maximum cost of $25 to maintain budgetary frugality so that even poorly funded schools can participate. The program includes six weeks of preparation during which teams define and develop their rovers with guidance from their teachers, who participate in a training seminar and receive curriculum materials developed by Dr. Bering and his collaborators.

An integral part of the capstone event involved 90-minute campus tours with demonstrations and hands-on activities offered by faculty committed to enriching the event with critical STEM subject matter. Among the day's favorites included weather balloon launches conducted by atmospheric chemist Barry Lefer; experiments conducted by chemist Simon Bott's graduate students; a demonstration by physicist Robert Dubois; and a 3D roller coaster ride in the TLC2 visualization theater.

The excitement was palpable throughout the day as teams presented their mission objectives and rovers to a panel of expert judges trained by Dr. Bering to fairly evaluate the rovers in accordance with meticulously developed criteria for free form, radio controlled, and solar models. Quail Middle School student Eisha Rao shared her enthusiasm for the experience. "I had fun with it and learned how to program stuff. I felt like I was an engineer making a rover that was actually going to Mars."

Parents and teachers were nearly as delighted as the children. Smith Middle School teacher Alex Swing commented on the program's ability to engage students who are typically less motivated. "I've seen students who get involved and are excited to participate in this every day after school who I never guessed would be interested in this type of program."

*Left: Mars, here we come!*

(Continued on page 26)

*(Continued from page 25)*

Presenters included Keri Bean, a graduate student from Texas A&M who summarized the Phoenix mission in "One Summer in the Martian Arctic;" Microsoft's Jonathan Fay, who discussed World Wide Telescope; Tess Caswell of NASA, who presented the "Future of Space Exploration;" and former astronaut Joan Higginbotham, who conducted the final award presentations. Higginbotham also took the time to chat and pose for photos with a large number of participants, which excited the youngsters enormously. "This is hugely important for the children," said Higginbotham. "We're living in a time where funding is tight for everything, especially for extracurricular activities, so any program that piques children's interest in science, engineering, and math is just crucial for them."

The event was planned and hosted by the Texas Learning & Computation Center (TLC2) in conjunction with the Texas Institute for Measurement, Evaluation, and Statistics (TIMES), and the Departments of Physics and Electrical and Computer Engineering. TLC2 produced a compelling video (see http://vimeo.com/19771470) that captured the essence of the capstone event and the positive impact of the program overall.

Mars Rover 2012 will be held on Saturday, Jan 28 from 9 am to 6 pm in the Houston Room, University Center at the University of Houston's University Park campus. Owing to the success of the program, it has become necessary to split the event into two parts, elementary school in the morning and middle school in the afternoon. From the perspective of the AIAA Houston Section's members, this change has two implications: the duration of an individual volunteer judging stint has been reduced from the previous 5 hours to 2.5 hours, and the number of volunteers required has doubled. The volunteer registration web page will become available on November 1. Additional calls for volunteers will be issued in the fall.


*Right: One of the Mars Rover Celebration 2011 participants proudly displays her work.*

# EAA and EAA Chapter 12 Information

**Chapter Mission**

The Experimental Aircraft Association's Chapter 12, located at Ellington Field in Houston, is an organization that promotes all forms of recreational aviation. The organization includes interest in homebuilt, experimental, antique and classic, warbirds, aerobatic aircraft, ultra lights, helicopters and commercially manufactured aircraft and the associated technologies.

This organization brings people together with an interest in recreational aviation, facilitating social interaction and information sharing between aviation enthusiasts. Many of the services that EAA offers provide valuable support resources for those that wish develop and improve various skills related to aircraft construction and restoration, piloting, aviation safety, and aviation education. Every individual and organization with an interest in aviation and aviation technology is encouraged to participate (EAA membership is not required, but encouraged). Meetings are generally from 6:30 PM to 9 PM at Ellington Field in Houston Texas. We welcome everyone. Come as you are and bring a guest; we are an all aviation friendly organization!

Ideas for a meeting? Contact Richard at rtsessions@earthlink.net, Chapter web site: www.eaa12.org
Experimental Aircraft Association web site: www.eaa.org

**Scheduled/Preliminary Chapter 12 Event/Meeting Ideas and Recurring Events:**
Monthly Meeting: Chapter 302, 2nd Saturday, 10 AM, Lone Star Builder's Center, Lone Star Executive, Conroe TX
1st Saturday of each month – La Grange TX BBQ Fly-In, Fayette Regional (3T5)
1st Saturday – Waco/Macgregor TX (KPWG), Far East Side of Field, Chap 59, Pancake Breakfast with all the goodies 8-10 AM, Dale Breedlove, jdbvmt@netscape.com
2nd Saturday – Lufkin TX Fajita Fly-In (LFK)
2nd Saturday – New Braunfels TX Pancake Fly-In
3rd Saturday – Wings & Wheels, 1941 Air Terminal Museum, Hobby Airport, Houston TX
3rd Saturday – Jasper TX BBQ Lunch Fly-In (JAS)
3rd Saturday – Tyler TX Breakfast Fly-In, 8-11, Pounds Field (TYR)
4th Saturday – Denton TX Tex-Mex Fly-In
4th Saturday – Leesville LA Lunch Fly-In (L39)
4th Saturday – Shreveport LA Lunch Fly-In (DTN)
Last Saturday – Denton Fly-In 11AM-2 PM (KDTO)

*Last issue we started our series EAA/AIAA profiles in general and experimental aviation with Lance Borden, who is rebuilding his Inland Sport airplane, an aircraft manufactured by his grandfather's 1929 - 1932 company. We intend to present our second profile in our next issue, our August issue. We plan to be a bimonthly publication starting with this June 2011 issue. Target dates for publication at www.aiaa-houston.org are June 30, 2011, and August 31, 2011.*


*Left: A few months ago Richard Sessions took off from the 1940 Air Terminal Museum at Hobby Airport in the LongEZ. The Southwest Boeing 737 airplanes made a nice background when a zoom lens was used and the photograph was cropped. Image credit: Douglas Yazell*

Museum

# The 1940 Air Terminal Museum at Hobby Airport An AIAA Historic Aerospace Site

DOUGLAS YAZELL, EDITOR

*Above: The museum in August of 2010.*
*Image credit: Douglas Yazell*

Tom Hile and I attended the monthly Wings & Wheels lunch programs in March and May 2011. He and I have the same camera, a Canon Powershot SX10IS. The only difference is mine has a lens hood. Tom knows how to use the many features of the camera better than me. I have the instruction manual here at my home somewhere near my desk, so I will skim over it one day soon.

Mr. Michael Bludworth was there to give a lecture both days, and he has a unique perspective on the building's history. He was there as a child from time to time. His father flew in and out of there on business and vacation with his family, back when people dressed up formally to be on a commercial flight.

I missed the April 2011 Wings & Wheels program since my wife and I drove to Magnolia, Texas for the annual Depot Day celebration. Celeste Graves (celestegraves.org) is an author I got to know at the museum. She contributed the materials for the WASP display at the museum. WASP is Women Airforce Service Pilots. That World War II program would not have existed at all if its first class did not succeed, and that first class took place in Houston, not in Sweetwater, Texas. The city of Magnolia has a visitor center built around its historic train depot building. My wife and I enjoyed good music, good BBQ, and good company during our brief visit there. Celeste's book about the WASP is called A View from the Doghouse. She has also written a book about the history of Magnolia, Texas.

Tom and I spent quite a while looking at the giant poster photographs of opening day for the museum, September 28, 1940. Quite a few attendees were outdoors on the roofs of the first, second, and higher floors in those photographs. Currently, the museum does not allow anyone above the ground floor, probably due to fire danger and regulations. But the ground floor is a spectacular place to visit, with its main lobby being such an elegant room. And the air conditioning in the building is very modern and works well.

We were fortunate to visit with Captain A. J. High at the May 2011 Wings & Wheels program. We met his wife Claudette, too, for the first time. She was working on payroll for Trans-Texas Airways. That's the airline that operated from 1947 to 1969 before buying another airline called Continental. Captain High generously donated the contents of a beautiful display at the museum, items from his aviation career. Captain High also fills an important volunteer role for the museum. His memoir, Meant to Fly, is a memorable book. More details are visible at http://meant-to-fly.com/.

*(Continued on page 29)*


*Right: The 5th annual raffle airplane. Tickets are $50. At most 2,500 tickets will be sold, and the date of the drawing is sometime in July 2011. Photograph: Thomas K. Hile*


## Museum

*www.1940airterminal.org*

*Left: The museum on Saturday, March 19, 2011. Twelve airplanes called "Moonies" were on display along with the raffle airplane. Photograph: Thomas K. Hile*

*(Continued from page 28)*

Blair McFarlaine was also one of the volunteers for the May 2011 Wings & Wheels. The December Wings & Wheels theme is traditionally airplane spotting, as described at the web site HoustonSpotters.net. You will see quite a few airplane photographs by Blair on that web site. During that December Wings & Wheels program, an airport minivan or a similar vehicle is used to allow attendees to take photographs from all around the airport. The Southwest Boeing 737 airplanes are very attractive, and quite a few other memorable aircraft fly in and out of Hobby airport every day.


*Left: The MetLife blimp with Snoopy on its nose flew over the museum on Saturday, March 19, 2011. Some frieze details are also shown. Photographs: Thomas K. Hile*

I recently flew to Charleston, South Carolina. Recent renovations are major and quite nice at Hobby airport. Everything inside has changed for the better. It's a pleasant visit. And Hobby Airport is quite a bit larger than Charleston International Airport.

*(Continued on page 30)*

## Museum

*Right: "Millionairess" aircraft at the May 2011 Wings & Wheels program. Image credit: Thomas K. Hile*

*(Continued from page 29)*

The following announcement on the museum's blog describes an event I will attend if possible. "The American Association of Museums is coming to Houston! We have been selected to host an evening event here at the 1940 Air Terminal Museum. In conjunction with the Lone Star Flight Museum, we'll take you on a night tour of the museum as if you were taking a flight in 1940. Speak with the pilots, stewardess' (yes we can say that) and all of the aviation-related industry reps that made it happen back in the day. Tour through vintage aircraft and enjoy catered hors d'oeuvres and champagne. Step into our fun photobooth and take a silly souvenir home." It's an event set for Wednesday, May 25, 2011, from 7:00 to 10:00 PM, and its admission price is $30. Tickets can be purchased by phoning the museum at 713-454-1940. I am writing this paragraph on Monday, May 23, 2011. I have not yet seen the museum at night.

I missed Aeros & Auros at Ellington Field this year. I attended the past two years, the first two years of this annual event. This year it took place on May 7. It was quite a bit larger in its second year than in its first year.

A collection of posters from past Wings Over Houston airshows is something I would like to collect, especially in digital form. It's quite an impressive airshow every year, and the posters are memorable. Please feel free to e-mail me at editor@aiaa-houston.org if you care to

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*Right: A Chevy Corvair on display at the May 2011 Wings & Wheels lunch program, the third Saturday of each month. It's odd to see a motor and a spare tire in what appears to be the trunk at the rear of the car. Image credit: Thomas K. Hile.*

*Right: This beacon is the original one from opening day, September 28, 1940. Its light bulb was a single color. Other air terminals later used a different color for each side. This is a relatively new display in the main lobby of the museum. Image credit: Thomas K. Hile.*

## Museum

*Left: One of the model T Fords at the museum for the May 2011 Wings & Wheels luncheon program. Below that is another eye-catching antique car on display that same day. Image credit: Thomas K. Hile.*

*(Continued from page 30)*
help me fill that collection. They will not be published without permission.

Here are a few notes from the timeline on the museum's web site, 1940airterminal.org.

"Houston's Aviation History Timeline

"The year is 1910. Horses still provide the primary mode of transportation in Houston. A troupe of Frenchmen led by Louis Paulhan visit Houston to demonstrate their Bleriot monoplane. 2,500 people pay $1 each to watch Paulhan fly the fragile Bleriot.

"When Paulhan decides the winds are too strong, the crowd becomes unruly. The next day they watch Paulhan make short, straight flights.

**"February 18, 1910:**

"Louis Paulhan makes first airplane flight in Houston.

**"November 27, 1917:**

"Ellington Field opens to train pilots for WW I."

**"May, 2008**

"Houston Airport System opens the new Hobby Airport concourse, placing into service a massive and modern redesign of much of the 1954 Houston International Terminal.

**"February, 2009**

"The Houston Aeronautical Heritage Society completes the second phase of restoration of the 1940 Air Terminal, and more than triples the Museum's area by incorporating the newly restored space. The Museum's initial restoration of the 1929 Carter Field Airmail Hangar is also completed."

AIAA Houston Section enjoyed an event or two at the museum in recent years. I always encourage dinner meetings and similar meetings at this place, especially when it's a change of pace for our section. Details about such event planning are visible on the museum's web site.

*(Continued on page 32)*

*Left: Quite a few antique Fords on display for the May 2011 Wings & Wheels luncheon program. Image credit: Thomas K. Hile.*

## Museum

*Right: An antique car from the May 2011 Wings & Wheels. Image credit: Thomas K. Hile.*

Quite a few souvenirs are available at the museum's web site. I especially like the V-neck short-sleeved sport shirts which have a museum logo on the front, but they are a bit short on supplies for the moment. I have one of these shirts in white, but that's not my first choice among the colors I have seen on those shirts.

When visiting the museum for the first time, do not assume it's part of the terminal at Hobby Airport. The

*Right: Antique Fords at the May 2011 Wings & Wheels. Image credits: Thomas K. Hile.*

## Museum


1940 Air Terminal Museum is a few blocks away from the Hobby Airport terminal building. The museum is one or two blocks away from Telephone Road. If the Hobby Airport terminal building were home base in baseball and the runways were the base paths, the Museum would be up against the right field line just off the field.

Happy Landings!

*Left: Another view of Millionairess, an aircraft in front of the 1940 air terminal. This is from the May 2011 Wings & Wheels program. Image credit: Thomas K. Hile.*

*Left: A warbird which is now in a private collection. This image is from the May 2011 Wings & Wheels program. Image credit: Thomas K. Hile.*

## Current Events

*Photographs: A view from Space Center Blvd on Friday, June 3, 2011, including City of Houston Fire Station No. 72. Image credits: Douglas Yazell*

**From AIAA Daily Launch e-mail news summary**

# Lander Test Starts Grass Fire At JSC.

The Houston Chronicle (6/2, Glenn) reports, "A new lunar lander that NASA workers were testing apparently sparked a grass fire this afternoon on the grounds at the Johnson Space Center, officials said." The lander was part of Project Morpheus. The fire "was brought under control within about two hours" with no injuries reported.

# State of the Johnson Space Center

Dinner Meeting

SHEN GE, TEXAS A&M UNIVERSITY AND ELLEN GILLESPIE, PAST CHAIR

On Thursday, March 24th 2011 AIAA Houston Section and INCOSE (International Council on Systems Engineering) held a joint dinner meeting entitled "The state of the Johnson Space Center (JSC) Address" at Space Center Houston. This dinner meeting had a strong showing due to the excellent promotional and organizational efforts of INCOSE and the AIAA Houston Programs Chair, Angela Beck. Surrounded by the Space Center Houston astronaut space suit collection, those who attended enjoyed good food, good music, and excellent presentations by Jonathan Churchill-Sandys and JSC Center Director Michael Coats. Two-time Grammy nominee Lydia Salnikova performed with Clint Black's own Dane Bryant. A later musical performance by Bandella (Micki Pettit with astronauts Chris Hadfield and Steve Robinson) rounded out the social portion of the dinner meeting.

Jonathan Churchill-Sandys, the great-grandson of Winston Churchill and a big NASA supporter, provided an inspirational and well received program opener. Winston Churchill defied great odds in a time where defeat was not a far possibility with dissenters in his own government advocating conditional surrender. Jonathan reminded us that Winston refused most adamantly with his oft-quoted "…whatever the cost may be, we shall fight on the beaches, we shall fight on the landing grounds, we shall fight in the fields and in the streets, we shall fight in the hills; we shall never surrender…" As Jonathan pointed out, the analogy extends very well to the situation at NASA today where there is also the need to remain stalwart in difficult times.

JSC Center Director Michael Coats then spoke on the state of the center, starting with recent Space Shuttle successes and upcoming work. Exciting challenges remain with the launch of STS-134, the last flight of Space Shuttle Endeavor, to deliver the Alpha Magnetic Spectrometer and important parts to the ISS. Mr. Coats shared his excitement on the recent return of his favorite shuttle Discovery to Earth with the conclusion of STS-133. (Mr. Coats was Pilot on Discovery's first flight, and his other two space shuttle missions were also aboard Discovery.) Since its first flight in1984, Discovery spent 365 days in space.

Director Coats stated that per the President's policy, NASA will work on the following activities:

1. Complete the Space Shuttle Program
2. Develop a new launch system
3. Continue ISS operations and conduct science missions
4. Engage in commercial partnerships to gain ISS access
5. Develop a Multi-Purpose Crew Vehicle (MPCV)
6. Invest in Research and Technology
7. Invest in education
8. Cut costs and improve effi-

*(Continued on page 36)*

*Left: NASA/JSC Center Director Michael Coats, Section Chair Sarah Shull, and INCOSE President Tony Williams. Image credit: Douglas Yazell*

## Dinner Meeting

*(Continued from page 35)*

ciency

Congress is in the process of considering the fiscal budgets for both 2011 and 2012. Since the continuing resolution (CR) is ongoing with more CRs possibly arising in the future, NASA's fiscal future remains uncertain. JSC Management is working hard to cut costs and improve efficiency to absorb a proposed 10% budget cut.

Director Coats focused on some of the work being done at JSC that makes him most proud. Space Shuttle stringers were repaired or replaced as needed on all Space Shuttles. Director Coats also talked about how NASA technology and personnel from JSC help save the lives of Chilean miners last fall by providing medical, psychological, and escape capsule design advice and expertise. JSC staff also worked with GM on the development of the R2 robot now living aboard the ISS.

An announcement by NASA Administrator Charlie Bolden is expected on April 12th 2011 on the museums selected to receive a Space Shuttle for display.

Future JSC work includes development of a heavy lift rocket called the Space Launch System (SLS), and development of a crew capsule to explore beyond Earth's orbit called the Multi-Purpose Crew Vehicle (MPCV), which is expected to have a flight test in 2013. JSC is also expected to receive $50 million for advanced space technology, next generation life support, and autonomous landing and hazard avoidance technology. Future software work with Ford Motor Company is also expected as a result of successful cooperation with GM on R2.

New exciting challenges lie ahead for those at JSC who are willing to step up and tackle new Programs and projects. The AIAA Houston Section will continue to serve as a forum for growth and development in the Houston area.

*This article ends with five photographs on the next page.*


*Right: Jonathan Churchill-Sandys making a few remarks and introducing NASA/JSC Center Director Michael Coats. Image credit: Douglas Yazell*

*Right: Section Chair Sarah Shull, invited speaker Jonathan Churchill-Sandys, and INCOSE President Tony Williams. Tony is presenting a framed set of NASA lapel pins to Jonathan. Image credit: Douglas Yazell*


## Dinner Meeting

*Left column:*
*Top: Left to Right, Micki Pettit, Dane Bryant, and Chris Hadfield*
*Middle and bottom: Dane Bryant and Lydia Salnikova*
*Right column:*
*Top: NASA/JSC Director Michael Coats*
*Bottom: AIAA Houston Section Chair Sarah Shull*
*Photographs: Douglas Yazell*

*Editor's note: Programs chair Angela Beck continues to attract professional musicians to perform at our dinner meetings. Lydia Salnikova stands out as one who supported two of our section's events, this dinner meeting and an evening at Chelsea wine bar as part of the 2011 Yuri's Night Houston events. Her web site www.lydiasalnikova.com now allows free downloads of four MP3s from her live tracks.*


Packing for Mars

# An Evening with Mary Roach

## John B. Charles, Ph.D., Chief Scientist of NASA's Human Research Program, Johnson Space Center

*New York Times #6 Best-seller*

Mary Roach is that most helpful of writers: the explainer. As a science writer, she makes complex topics comprehensible and simple. Plus, she is not shy about taking on topics that some might consider provocative, like cadavers, ghosts and sex. She honed her combination of native talent , curiosity and ability to explain things during twenty-five years of writing for popular science magazines culminating in a rapid-fire series of books, starting with *Stiff: The Curious Lives of Human Cadavers* (2003), followed by *Spook: Science Tackles the Afterlife* (2005), and *Bonk: The Curious Coupling of Science and Sex* (2008), and now *Packing for Mars: The Curious Science of Life in the Void* (W.W. Norton and Co., New York, 2010). These titles seem to form a natural progression, as if her earlier works on the human aspects of death and coitus (covering two-thirds, more-or-less, of Ben Franklin's big three) were merely preparation for this, her first book with a multi-word main title.

*The Space Center Lecture Series, initiated a few years ago by Gary Kitmacher and Dr. Benjamin Longmier. The web site www.SpaceCenterLectureSeries.com includes video recordings of this and past presentations.*

In *Packing for Mars*, Mary takes us along on her journey away from the Earth to show us the earthiness of the human endeavor of space exploration. Her fans are not disappointed when she includes their old favorites cadavers and sex, and augments them with tales of astronaut dandruff and poop and, ultimately, the inspiration to be found when sailing the heavens.

Mary asks the obvious questions than any curious reader unfamiliar with the topic at hand would ask, and answers them, and then asks some not-so-obvious questions, and answers those, too. She provides depth through humor, so the reader stays entertained while becoming educated. She has the ability to talk to specialists and understand what they are saying, then repeat it back to them and make sure she has it correct. Mary's writing gives us a chance to share our fascination with people not lucky enough have astronauts as neighbors nor taking periodic trips to Florida to see rockets being launched. Her ability to explain complex topics clearly and simply is an important asset to those of us who are not gifted enough to explain what we find so fascinating in what we deal with every day, but which appears to others as non-intuitive or even counterintuitive, obscure and byzantine (especially the bureaucracy), and highly technical and mechanical.

Norton's publication of the paperback on April 4 found Mary already promoting it in Boulder. She crisscrossed the country from Denver to Cleveland, back home (almost) to San Francisco for Yuri's Night, then east to New York City and Philadelphia before winging westward again to Austin and Houston, finally making it back to Moffett Field and then home to Oakland.

I was pleased to interview Mary in Clear Lake on Friday, April 29, at the ninth stop on her whirlwind 33-day book-signing tour for the paperback edition of *Packing for Mars*. She was invited to speak at the University of Houston at Clear Lake as part of the AIAA-Houston section's Space Center Lecture Series (www.spacecenterlectureseries.com/Mary_Roach.html). Robert Pearlman of CollectSpace was originally to have been her interlocutor, and had plans to use items from his huge collection of spaceflight memorabilia and artifacts (www.spacecenterlectureseries.com/Robert_Pearlman.html) to stimulate the discussion. But

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*Right: Mary Roach and Dr. Charles. Image credit: Mrs. Charles*

*(Continued from page 38)*
when STS-134's launch slipped by several weeks to that very date, Mary asked me to substitute. Ironically, the launch was cancelled about midday on April 29, depriving Robert of both the blast-off and the interview. His misfortune was my good fortune.

Even at this late stage in an exhausting travel schedule, her enthusiasm never flagged as she told us stories of our own heritage of spaceflight. After about 30 minutes of my leading questions, we asked the audience if they had questions, and the lively discussion continued for nearly another hour.

I am impressed by the research that Mary did, including lots of literature work, interviews with historical figures, to get the straight scoop from our predecessors in the space business, and an awful lot of hard work on her part. For instance, she interviewed Jim Lovell, not about Apollo 13, but about his first spaceflight, Gemini 7, a record-setting 14-day endurance test of man's ability simply to survive in space for the duration of the longest planned Apollo moon mission. She found him to be very good-natured, even when she asked if dandruff and flaking skin inside of the weightless capsule made it seem like they were living in a snow globe. (His response: "Mary, you're investigating a rather unusual aspect of space flight.") Thanks to NASA's online searchable mission transcripts (one of many resources she discovered at www.nasa.gov), she has given us a new image of Gemini 7: two men, circling earth for two weeks in a space the size of the front seat of a sports car, trying to avoid discussing skin care with Mission Control.

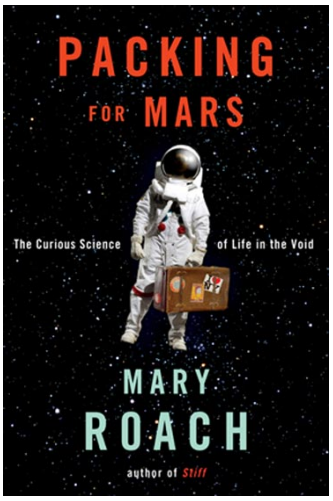
Mary came to Mars, as to her earlier science articles and books, in the role of a self-proclaimed "absolute outsider, with a liberal arts degree, not a BS." Luckily for us, she uses that liberal arts education to understand the human aspects of what might seem to be the most un-human of human activities: climbing onto a huge rocket and leaving Earth. Away from Earth, she focuses on Mars, until recently NASA's human spaceflight goal for the third decade of this century.

One of the guides inspiring her towards Mars was Rene Martinez, whom she met while collecting Martian meteorites in Antarctica, and who now helps manage NASA's head-down bed rest facility at The University of Texas Medical Branch in Galveston. As Mary explained, head-down bed rest is an analog, a convenient but imperfect means for imitating some of the effects of weightlessness on the human musculoskeletal system. For her, it typifies the myriad of behind-the-scenes ways that NASA and its international partners are preparing, decades in advance, to send astronauts to Mars.

Much of that preparation requires the use of other analogs for different parts of space missions, and Mary sampled them as much as possible. In addition to Antarctica, a well-known venue for hardship and isolation as well as meteorites, she visited the Haughton Mars Project on Devon Island in northern Canada to observe a simulated two-week, two rover lunar expedition. She also flew on the zero-gravity airplane as the journalist assigned to cover a team of university students experimenting with weightless welding. Consistent with her practice of immersion in her research, Mary volunteered to put on a space suit and experience *faux* weightlessness underwater in the Neutral Buoyancy Laboratory here, and applied to be locked into the Russian Mars simulation chamber in Moscow. Sadly for her readers, she was not allowed to do either. But, just as space explorers use such analogs to prepare for the real thing, Mary notes that they let an author go to space without leaving Earth, and come closer to some of the sensations that are unique to spaceflight.

Finally, at the end of the long discussion and an equally-long and equally-cheerful book-signing session, Mary Roach left her Houston fans understanding that she is not a starry-eyed space groupie, but, more helpfully, a realist who appreciates the place of space exploration in the human experience. As she wrote in concluding *Packing for Mars*, "Yes, the money could be better spent on Earth. But would it? Since when has money saved by government redlining been spent on education and cancer research? It is always squandered. Let's squander some on Mars. Let's go out and play."

## Packing for Mars




*Above: Packing for Mars. Image credit: www.maryroach.net*

*The Space Center Lecture Series, initiated a few years ago by Gary Kitmacher and Dr. Benjamin Longmier. The web site www.SpaceCenterLectureSeries.com includes video recordings of this and past presentations.*

## NASA Photos

*ISS027-E-036697 (23 May 2011) --- This image of the International Space Station and the docked space shuttle Endeavour, flying at an altitude of approximately 220 miles, was taken by Expedition 27 crew member Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23, 2011 (USA time). The pictures are the first taken of a shuttle docked to the International Space Station from the perspective of a Russian Soyuz spacecraft. Onboard the Soyuz were Russian cosmonaut and Expedition 27 commander Dmitry Kondratyev; Nespoli, a European Space Agency astronaut; and NASA astronaut Cady Coleman. Coleman and Nespoli were both flight engineers. The three landed in Kazakhstan later that day, completing 159 days in space. Image credit: NASA*

*http://spaceflight.nasa.gov, space station, Expedition 27*

# Apollo Lunar Module LM-2: Delivered but Not Flightworthy!

History

CAPTAIN ANDREW HOBOKAN, NASA RETIRED

I hadn't been at Grumman more than a week or two, trying to find the elusive or non-existent Lunar Module Project Manager, when the secretary advised me that a group of RASPO employees wanted to talk to me. I immediately thought, here it comes, they will say "How do I get a transfer out of this outfit?" I asked her to let me have a minute to gather my thoughts, and after I made up my mind that the answer was, "No one leaves without me having a replacement on hand." I said to tell them to come in.

This office had a large, glass-covered conference table and I took the seat at the head of the table and asked them to sit down. After a few niceties, I asked what was on their minds. To my complete surprise, the answer from several was LM-2. I said, "What about LM-2? It is being crated for delivery to KSC and it had a Customer Acceptance Review (CAR), somebody signed a DD-250, and we need to concentrate on LM-3 and sub." Someone replied, "You don't understand, we are trying to tell you that LM-2 is not flightworthy." I was completely shocked. I exploded, "How can you say that? You were responsible for ensuring its design, fabrication, and test. That's your job. Why are you now saying it wasn't done properly? All of that was done. Why are you telling me this now? Why didn't you make your worries known at the CAR? You were responsible for this vehicle."

Then I heard something I didn't want to hear. Their response was that they weren't responsible. The NASA contract said the Navy was responsible, and they had no say in Grumman's manufacturing and test operations. I asked about the CAR that usually precedes NASA acceptance and they said they weren't asked to participate. Only Grumman, Navy, and the Manned Spacecraft Center (MSC) were participating.

Our argument continued for more than an hour, me telling them they were responsible for the LM and them telling me they had nothing to do with it. I could tell they were tormented internally because they could not answer my questions. No one looked me in the eye. They looked at each other for support, or they looked at the glass tabletop. I, too, had some terri-

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*RASPO: Resident Apollo Skylab Program Officer*

*Left: March 7, 1969, NASA/JSC image AS9-21-3212*

*View of the Apollo 9 Lunar Module "Spider" in a lunar landing configuration photographed by Command Module pilot David Scott inside the Command/Service Module "Gumdrop" on the fifth day of the Apollo 9 earth-orbital mission. The landing gear on "Spider" has been deployed. lunar surface probes (sensors) extend out from the landing gear foot pads. Inside the "Spider" were astronauts James A. McDivitt, Apollo 9 Commander; and Russell L. Schweickart, Lunar Module pilot.View of the Apollo 9 Lunar Module "Spider" in a lunar landing configuration photographed by Command Module pilot David Scott inside the Command/Service Module "Gumdrop" on the fifth day of the Apollo 9 earth-orbital mission. The landing gear on "Spider" has been deployed. lunar surface probes (sensors) extend out from the landing gear foot pads. Inside the "Spider" were astronauts James A. McDivitt, Apollo 9 Commander; and Russell L. Schweickart, Lunar Module pilot.*

## History

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ble thoughts, like, if I can't believe them now, will I ever have confidence in their words? What kind of organization will we have? These were not just-out-of-college people. They were high-level engineers who had been with NASA and on other programs for some years. Even worse, I was thinking if I didn't believe them now, what would they do if another really serious problem showed up? Would they tell me about it? Or would they just allow the problem to occur, saying I didn't do anything the last time? I was thinking rapidly. I knew I was in a very serious position.

Then I said, "If you had nothing to do with LM-2, how do you know it is not flightworthy?" Now they really had answers. They said they had watched the manufacturing and test processes as they were taking place and had looked over all the manufacturing and test data and there was no accounting for the configuration tested. I knew Lew Fisher was very competent in the configuration management area. He and I and his Air Force assistant, a Major, went through this at every Gemini CAR. Now a Mr. Liccardi and a Mr. Clickner said there was no full-up vehicle to test a mission profile with test results that would say that all systems functioned normally in an integrated fashion. I didn't know these two men very well, Russell Clickner and Terry Liccardi, so I wasn't too eager to press them. Furthermore, Harry Briggs kept saying the wire harnesses were not secured properly and the harnesses passed through the holes, which were sharp, and would probably cut through the wires on launch. In addition, manufacturing personnel conducted the tests on the systems and they did the work piecemeal, never conducting full-up systems tests. For me, this confirmed their doubts about the configuration tested. In general, I was appalled with their comments and I finally gave up, saying, "What would you have me do?" Then I got an answer I didn't want to hear. Two, in unison, said, "We want you to call George Low and tell him we believe that LM-2 is not flightworthy." I couldn't believe this, and after all this conversation, I thought I had no alternative. I had to advise George Low since they were so firm in their beliefs.

Oh my! A short time on the job and I have to call the Program Manager and tell him I heard so many negatives that he most probably had a non-flightworthy vehicle on his hands. Now I didn't think I had any alternative. LM-2 was to be a test in low Earth orbit and I was not going to have this mission go on without my boss knowing what the RASPO team was saying. So I told everyone to be quiet, do not talk under any circumstances, do not even breathe hard, this is a conversation between George Low and me and I do not want to start an inquisition. I would place the call on the speakerphone and they could listen, but at no time should anyone make a sound.

I then asked the secretary to get George Low on the phone so I could speak to him personally, and I'd put it on the speakerphone. I thought about whether or not I should keep going. Finally, when he came on the line, I blurted out, "I have the senior RASPO personnel in my office and they insist that LM-2 is not flightworthy and they insist that I tell this to you." I don't know who held his breath longer, George Low or me. After a long silence, he said, "Who is saying this?" I looked around the table and gave him some names. Again he was quiet. Then he said, "Go and inspect LM-2 by yourself. Take

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*Right: March 7, 1969, image AS09-21-3236 from NASA/JSC. The Lunar Module "Spider" ascent stage is photographed from the Command Service Module on the fifth day of the Apollo 9 Earth orbital mission. The Lunar Module's descent stage had already been jettisoned.*

*(Continued from page 42)*
a few days. Dig deep and call me back." From that abrupt answer, I almost thought he had expected something like this. Now the responsibility had changed from the RASPO people back to me. I hung up the phone and addressed the group. I did not hear a deep sigh of relief. I think they now knew they had to prove their point. I said, "Now you've got me involved and I have to make the decision. I want each and every one of you to write down every detail that brought you to this point. You are going to do the inspection with me and show me exactly what is wrong with the LM. Be prepared to start at eight o'clock tomorrow morning. No excuses. No exceptions." The QA manager, Harry Briggs, was to show me discrepancy reports that were dispositioned, "Use as is." Liccardy was to show me that testing was insufficient. Fisher was to show me that manufacturing processes did not meet drawing requirements. It was going to be a long couple of days.

We went over everything in great detail. I didn't know much about the technical requirements for the LM. But after all of my experience on Mercury, Gemini, and Skylab, I could recognize a well-engineered, well-built, and well-checked-out spacecraft by checking the paperwork. The LM and the data left much to be desired. The work that disturbed me most was the wiring. I'd never seen such slipshod work before. The wires were not neatly packed in wire bundles. They were draped haphazardly over and around the structure. In some places, large, excess lengths were coiled up and taped to the structure. There was no anti-chafe protection where wires passed around corners or went through holes in the structure. I was sure that if this LM was sent to KSC, they would write a lot of Discrepancy Reports (DRs), and they would have a lot of bad things to say about Grumman and JSC management. Such work certainly would not survive the launch environment, in my opinion. And I also thought, "If this LM was delivered to KSC, would the workers at Bethpage think this was acceptable and do that same bad things on the next one?"

We were all pretty upset after this review. I said that I certainly agreed that this vehicle needed much more work to make it acceptable for flight. I said I was going to tell the boss exactly that. I set up a meeting with them for the next morning. When all were gathered, I again said no talking under any circumstances, it was my opinion I was expressing.

The conversation wasn't very pleasant, and Mr. Low said he wanted to think about what to do. Then he asked, "Do you have a recommendation?" I said we could scrap it, but he immediately said, "Don't use that word! I have enough problems with the CSM and MSFC now. That would be all that MSFC

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*Left: April 21, 1972, NASA/JSC image AS16-113-18339*

*Astronaut John W. Young, commander of the Apollo 16 lunar landing mission, jumps up from the lunar surface as he salutes the U.S. Flag at the Descartes landing site during the first Apollo 16 extravehicular activity (EVA-1). Astronaut Charles M. Duke Jr., lunar module pilot, took this picture. The Lunar Module (LM) "Orion" is on the left. The Lunar Roving Vehicle is parked beside the LM. The object behind Young in the shade of the LM is the Far Ultraviolet Camera/Spectrograph. Stone Mountain dominates the background in this lunar scene.*

## History

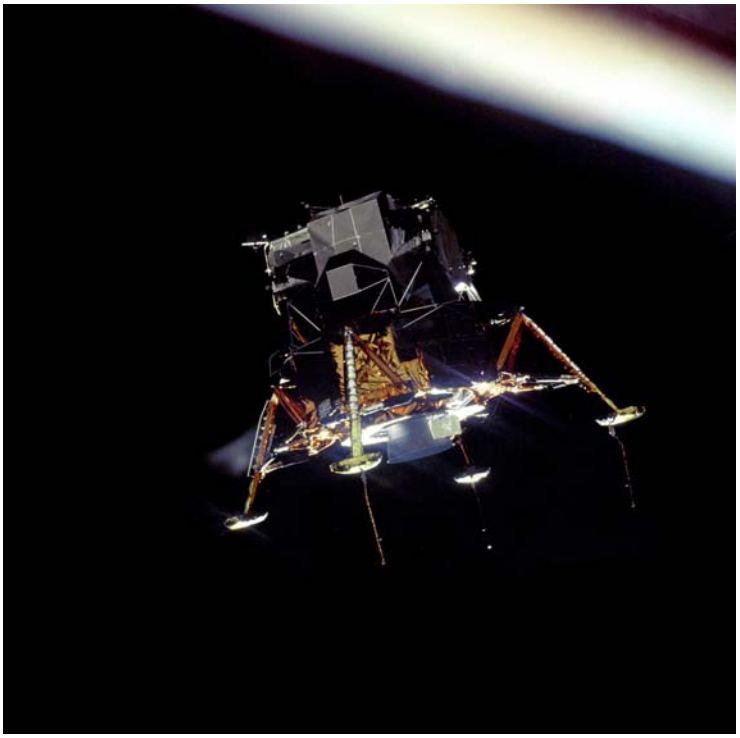
*(Continued from page 43)*
would need to invade the LM program as they did the CSM program." I told him the line between being flightworthy and non-flightworthy was blurry, but I was sure that if he had us deliver LM-2 to KSC, we'd have more DRs than we'd care to see. He thought a while and then asked, "Would you fly it?" I said, "Not without a detailed review of all the DRs, a thorough integrated test program, and especially, I'd require a complete re-do of the wire harnesses which are so long that the excess wire is coiled up and scotch taped to the structure. It wouldn't survive the launch."

He asked me to keep it quiet while he thought about what to do. I agreed. I asked everyone to keep this quiet and not to let the MSFC representative know of our meeting.

*This question, "Would you fly it?" had been put to me once before. The Gemini program manager called me to meet him at KSC and showed me the start-up anomaly on a 4-gimbal inertial platform. I knew that platform's start-up anomaly well. I had seen it perhaps 20 times. We had the contractor re-work and re-test it at least 12 times, but he could not correct it. But they consistently verified that it was an excellent platform after it warmed up. I didn't hesitate. I said, "Yes, I would fly it." He said, "You can go home now. I just wanted you to tell me that personally."*

The next few days were kind of uneventful, but I was still trying to get a handle on schedules. I finally got to a Grumman person who said that he was in charge of schedules. When I asked to see a schedule for LM-3, 4, 5, and 6, he asked me for the delivery dates I wanted. "How nutty can this be?" I said to myself. I couldn't give him delivery dates. That was his job. We argued for a while. I finally turned and left, saying I needed to talk to a more competent person. I was returning to the office when I saw Lilly motioning to hurry. George Low was on the phone. I asked if he had an answer for LM-2. He said yes. He would have it delivered to JSC and it would be used in a landing drop test program. He said he's always wondered why there was no drop test in the program. He said he would do it with LM-2. He also said he'd been under some pressure to provide an Apollo display at the World's Fair in Tokyo, Japan. He said he would send LM-2 to Tokyo after the drop test. He said sometimes things worked out OK. I said to myself, "What a way to start my new job!"

I think LM-2 is now on display in the Smithsonian Air & Space Museum. It's the only place we can see LM production hardware. If we can see LM hardware elsewhere, it's test item hardware, not production hardware.



*Right: Image AS11-44-6581, NASA/JSC, July 20, 1969*

*The Apollo 11 Lunar Module (LM) "Eagle", in a landing configuration is photographed in lunar orbit from the Command and Service Modules (CSM) "Columbia". Inside the LM were Commander, Neil A. Armstrong, and Lunar Module Pilot Edwin E. "Buzz" Aldrin Jr. The long "rod-like" protrusions under the landing pods are lunar surface sensing probes. Upon contact with the lunar surface, the probes send a signal to the crew to shut down the descent engine.*

## NASA Photo

*ISS027-E-036673 (23 May 2011) --- This image of the International Space Station and the docked space shuttle Endeavour, flying at an altitude of approximately 220 miles, was taken by Expedition 27 crew member Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23, 2011 (USA time). The pictures are the first taken of a shuttle docked to the International Space Station from the perspective of a Russian Soyuz spacecraft. Onboard the Soyuz were Russian cosmonaut and Expedition 27 commander Dmitry Kondratyev; Nespoli, a European Space Agency astronaut; and NASA astronaut Cady Coleman. Coleman and Nespoli were both flight engineers. The three landed in Kazakhstan later that day, completing 159 days in space. Image credit: NASA*

*http://spaceflight.nasa.gov, space station, Expedition 27*

ATS 2011

# Annual Technical Symposium 2011

STEVE EVERETT, CONTRIBUTOR

*Right: Volunteers at the registration table. Image credit: BeBe Kelly-Serrato*

Another successful Annual Technical Symposium was hosted by the AIAA-Houston section on May 20, 2011, at the Gilruth Center at Johnson Space Center. Attended by around 80 registered attendees and presenters, the day started with a discussion of the commercial space activities being overseen by JSC by Mark Erminger, Chief Safety and Mission Assurance Officer of the Commercial Crew and Cargo Program Office (C3PO). He explained that the purpose of the Program Office is to implement the administration's policy and to facilitate space activities of commercial industry. Cargo capabilities are being encouraged through the Commercial Orbital Transportation Services (COTS) program, funded through Space Act Agreements. Under these contracts, funding is awarded based on conditionally met milestones. (Unable to meet its commitments, the funding provisionally awarded to Kistler was withdrawn and given to Orbital Sciences). There is currently a $270

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*Right: Mark Erminger, Chief Safety and Mission Assurance Officer of the Commercial Crew and Cargo Program Office Below: Attendance at the morning's address by Mark Erminger Image credits: Douglas Yazell*


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million award to SpaceX for development of its Falcon launch vehicles and Dragon capsule. Capable of carrying both pressurized and unpressurized cargo, it made a successful orbital demonstration fight in December, with another planned to the International Space Station (ISS) for this December. Orbital Sciences was awarded $170 million, with which it is developing the Taurus II launch vehicle and Cygnus spacecraft. It consists of a Service Module and pressurized cargo module, essentially a mini-MPLM, and will be launched out of Wallops, VA. A test flight is planned for August, with a demonstration flight to the ISS the following December.

Mr. Erminger continued by describing the Commercial Crew Development (CCDev) program, which distributed $50 million in funds from the Economic Recovery Act last year among several contractors, including United Launch Alliance (ULA), Blue Origin, Boeing, Paragon, and Sierra Nevada. With $3.7 million, Blue Origin is developing a biconic space capsule featuring solid pusher abort system and composite pressure vessel. The Boeing Company used its $18 million to take development of its 7-person capsule from concept to Systems Definition Review (SDR), including construction of a structural test article and heat shield and execution of a drop test. Paragon is developing an air revitalization system with its $1.44 million, and Sierra Nevada used its $20 million to develop the Dream Chaser. A structural test article of this HL20 derivative with hybrid propellant has been built and fairing tests conducted with ULA. CCDev2 funding through another Space Act Agreement was also just awarded in April to four companies, Blue Origin, Sierra Nevada, SpaceX and Boeing.


In answer to the questions following his talk, Mr. Erminger relayed the commercial sector's plans to launch cargo to the ISS by March 2012, followed by a crew in 2013 or 2014. He also clarified the intended plans by SpaceX to reuse their launch vehicle, although on the first and second test flights, the situation made this impossible. In response to a concern that a return to manned capsule spaceflight was a mistake, Mr. Erminger pointed out that NASA does not dictate configuration to commercial companies, only requirements (although he did indicate his belief that capsules were the cheapest and simplest method of crewed spaceflight, if not the most versatile). Additional customers which strengthen the business case for commercial space vehicles, such as Bob Bigelow and his planned inflatable space sta-

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## ATS 2011

*Left: Jennifer Mitchell presenting a talk on Project M/ Morpheus.*
*Image credit: BeBe Kelly-Serrato*

*Left: ATS 2011 General Chair Satya Pilla. Image credit: Douglas Yazell*

## ATS 2011

*Above, left: George Parma during his presentation on the NASA Docking System. Photo: BeBe Kelly-Serrato*

*Above, right: Rob Kelso posing a question to Brewster Shaw Photo: Douglas Yazell*

*(Continued from page 47)*

tion as well as other countries which would like to fly their own experiments and crew, would ultimately lower the cost of purchased space transportation to NASA.

Along with the morning's technical tracks on Guidance, Navigation, and Control (GN&C), astrodynamics, structures, etc., were a series presented by INCOSE on Systems Engineering and Integration. These were followed by an inspirational lunch keynote address by Boeing Vice President and former astronaut Brewster Shaw. He related a poignant story of an experience he had when flying with John Young on the Space Shuttle Columbia. As a pilot on this science mission, his duties allowed him some time to watch the Earth below from the window. Marveling at the technical achievement of which he was a part, he said that the sense of privilege he felt spurred him on to devote his career to enabling as many others on Earth to share the same experience. He reflected on the completion of the ISS and the logistical challenge it would pose with the impending end of the Space Shuttle Program, which he described as having not met its unreasonable expectations but nevertheless having an immeasurable value. He listed a few of the numerous innovations introduced by that program, and described some of the innovations Boeing was incorporating into its new space capsule. Agreeing that NASA's future is uncertain, he stressed the importance of replacing the space transportation system and how that need is being used to "prime the pump" for the nascent commercial space travel industry. In response to the perceived dullness of developing a mere delivery sys-

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*Right: Boeing Vice President and former astronaut Brewster Shaw, presenting his views on the future of commercial space flight. Photo: BeBe Kelly-Serrato*

## ATS 2011

*Top, left: Presentation of appreciation gift to the afternoon's keynote speaker, Boeing Vice President Brewster Shaw*
*Top, right: Presentation of appreciation plaque from Engineers as Educators*
*Image credits: BeBe Kelly-Serrato*

*(Continued from page 48)*
tem, he pointed out that this role frees up NASA to do longer range technical development and exploration not appropriate for the commercial sector. He reassured those who are concerned about the future of commercial spaceflight that Randy Babbitt of the Federal Aviation Administration (FAA) and NASA Administrator Charlie Bolder are attempting to define the regulatory environment which would decrease the uncertainty in entering this new market. He also stressed the importance for companies to establish the same checks and balances NASA has attempted to create so that safety can be ensured in the face of business pressures. After a few brief questions, including one on the need to avoid overlap of commercial and government markets through well-defined contracts, Mr. Shaw was presented with a poster as thanks for his participation, as well as a plaque from "Engineers as Educators" for Boeing's sponsorship of that organization. (See page 50 for more information about their workshop during the ATS.)

Among the afternoon's various technical tracks was a planned panel discussion on space journalism. Unfortunately, with the exception of Jim Oberg, those invited were unable to attend due to responsibilities in covering the ongoing Space Shuttle mission. However, the session evolved into a discussion with Mr. Oberg and those attending on his background and perceived responsibilities as a space journalist. He reminisced about reading about Sputnik when he was twelve and receiving a book by Jules Verne from his grandfather. He claimed not to have any advice on choosing the career path he has followed, calling it a series of lucky and unlucky accidents. His biggest client is NBC, for whom he spends much of his time correcting misinformation. With some irony, he pointed out that while the public is very knowledgeable about space, much of that knowledge is incorrect, and that a weakness of existing internet search engines is that information has no referencing of opposing or critical views. In response to a question on the effect of blogging on journalism, he felt somewhat surprisingly that the emergence of email rejuvenated the art of letter writing, although it did seem more effective to produce a two-minute YouTube video than to report on events through typical avenues.

Thanks to all those who participated and attended, making this another successful and informative event for our profession. We look forward to seeing everyone next year!

*Left: James Oberg, discussing space journalism. Photo: Steve Everett*

Conference

# Highlights of the 42nd Lunar and Planetary Science Conference

DR. LARRY JAY FRIESEN, VICE CHAIR OPERATIONS

This is a brief account of things I learned at the 42nd Lunar and Planetary Science Conference (LPSC). This conference has taken place in the Houston area each year since 1970, when the First Lunar Science Conference ("Planetary" was added later.) was convened to allow scientists to share their initial findings from the then very new Apollo samples and from instruments that Apollo 11 and 12 had left on the Moon. This year, the conference took place March 7 through 11 in the Marriott Hotel and Conference Center at the Woodlands. This is the third year the LPSC has taken place at that location. In the years immediately prior to 2009, it had taken place at South Shore Harbour in League City, and before that at Johnson Space Center, locations closer to the Lunar and Planetary Institute (LPI), which is the host organization and which organizes the annual conferences.

Jim McLane has also submitted an article about the 42nd LPSC, which he has kindly let me review. It appears to me that his report deals mostly with the experience, what it is like to be at the conference.

This report focuses more on content; things I learned about the Moon, the solar system, and related topics. Even for content, it hits only the highlights. As is typical, the conference usually had four parallel tracks of papers going on at the same time, and on at least one occasion, five. Although a person can switch from one session to another, and occasionally I did, no one could hear all the papers. Fortunately, as part of the registration package, each person attending received a flash memory containing the abstracts of every conference paper. In previous years, conference abstracts were on CD's, and before that, in large bound paper volumes.

Nor will I detail every paper I personally heard; even that would be too lengthy. I will present an overview of the conference, then highlight papers and discoveries that seemed to me most significant, newsworthy, or of greatest interest to an AIAA readership.

**Overview**

The conference really began Sunday evening. As has been typical for previous LPSC's, as people arrive and get registered, they gather around and socialize. A large, broad hallway area adjacent to the registration tables was available for this, and drinks and hors d'oeuvres were available. Scientists renewed previous acquaintances, made new ones, networked with each other, and discussed topics of all sorts, some scientific, some not.

Paper sessions, Monday through Friday morning and afternoon, were organized by topic. I'll not try to list all topics; that list would be rather long. All topics pertained to solar system objects (other than the Sun, which is not considered part of planetary science), origin, history or processes. I spent most of my time in sessions related in some way to the Moon, since that is the solar system topic that interests me most, but I also spent some time in other sessions.

Monday afternoon began with a plenary session at which the Dwornik Student Awards were presented and at which the annual Mazursky

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*Right: Career development award. Image credit: LPSC.*

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Lecture was given. The Dwornik Awards are given for the best papers presented by students at the previous year's LPSC. The Mazursky lecture is presented by a lunar or planetary scientist in honor of the late Harold Mazursky, a very distinguished lunar scientist from the Apollo days. On Monday evening, the results of the Planetary Science Decadal Survey were revealed. These are recommendations from the planetary science community as to what missions in the next ten years will do most to advance their field. Wednesday night was NASA night, where a NASA representative discussed what planetary science plans currently look like from NASA's perspective, including the budget situation. I will present more details later on the Mazursky Lecture, the Decadal Survey, and NASA night.

Tuesday and Thursday evenings were devoted to poster papers. So many poster papers were presented that even though the area devoted to posters was quite large, the Tuesday posters had to be cleared away immediately after Tuesday evening's session, in order to make room for the Thursday poster papers. This has been the case for the last several years.

**Highlights**

Monday morning, a group reported observations from the Wide-field Infrared Survey Explorer (WISE) satellite which pertain to near Earth objects (NEO's). These have been put into a database called NEOWISE. 157,000 solar system objects were observed, including 585 NEO's, 123 comets, 2000 Trojan asteroids (both in the L4 and L5 locations of the Jovian orbit). Among these were 34,000 discoveries of objects previously not cataloged.

Another Monday morning paper presented evidence that the Moon is not quite so depleted in volatiles as had once been supposed. Greenwood *et al.* inferred that water must have been involved in the formation of mare basalts, and perhaps in highland volcanism, too. This suggests that there may have been significant cometary water addition during the Moon's very early "magma ocean" phase, when the entire face of the Moon down to a considerable depth was probably molten.

A paper by Minton and Levinson addressed the question of why Mars is as small as it is. The solar system formation simulations they run consistently seem to produce a planet in roughly Mars' orbit that is 5 to 10 times as massive as the Mars we actually see in our solar system. However, when they allowed for giant planet migration, they found that can interfere with planet growth.

**Mazursky Lecture**

This year's Mazursky Lecture was delivered by Dr. Robin Canup. Dr. Canup is an experienced modeler of the formation of planetary systems and of the formation of moon systems around planets; she has done much modeling work on the "giant impact" hypothesis for the origin of our Moon, where the Moon originated from the debris of the crash of a Mars-size body into the proto-Earth during the formation period of our solar system. Early in her career, she worked with the late A. G. W. Cameron, who was a real pioneer in giant impact simulations; since then, she has continued such work. Her topic for this lecture was the Formation of Planetary Satellites. She concentrated on dynamical models for forming the systems of regular satellites of the giant planets, the ones that look like miniature solar systems.

All of the regular systems in our solar system, the regular satellites of Jupiter, Saturn, and Uranus, have nearly constant mass fractions (when you add up the major moons) relative to their primaries, around $2x10^{-4}$. Origin by impact is a workable model for the origin of Earth's Moon, the moons of Pluto and Haumea (a large Kuiper belt object), and perhaps even for the moons of Mars, but it does not seem to work for the regular moons of the giant planets. Her simulations that do work involve a coupled model of a growing planet plus an orbiting disk of material surrounding it. The pattern that typically emerges in these simulations is that moons form in the disk. As they interact gravitationally with the remaining disk material, they spiral inward and eventually fall into the growing planet. As moons spiral inward, more moons form in the disk beyond them, and the process repeats. (All this time, material is accumulating onto the disk from the surrounding solar nebula, which is itself a disk on a larger scale.) In this scenario, the icy ring system of Saturn can result when a differentiated Titan size moon spirals in and gets within the

*(Continued on page 54)*

*The Roche limit is the distance from a gravitating object (star, planet, moon, or whatever), within which the tidal forces from the gravitating object are so strong they will tear apart any object that gets closer. (Approaching objects that are held together primarily by their own gravity, that is.)*

Educators

# Engineers as Educators Workshop

DON KULBA, CONTRIBUTOR

The Engineers as Educators Workshop was held on May 20, 2011, in two sessions at the Gilruth Activity Center of Johnson Space Center (JSC). There were two sessions, from 10:00 a.m. to noon and from 2:00 p.m. to 4:00 p.m. Thirty students (i.e., potential engineer-educators) attended the first session, and 24 students attended the later session. Another event is planned in the fall. Two air plunger-powered straw rocket launchers were donated to the Houston AIAA Science, Technology, Engineering, and Mathematics (STEM) committee for use by the section membership in STEM outreach. A plaque was given to Boeing in recognition of their generous sponsorship of the Engineers as Educators event. Represented at this event were: Jacobs Engineering, NASA, Science Application International Corporation (SAIC), Boeing, United Space Alliance (USA), Embry Riddle, Muñiz Engineering, Inc. (MEI), Hamilton Sundstrand, and retired NASA employees and NASA contractors.

Erin McKinley (AIAA STEM teacher) led the lessons. Lisa Bacon (Program Manager, AIAA National STEM Outreach), Edgar Bering (Regional AIAA Deputy Director, STEM) and Daniel Nobles (AIAA Houston) also spoke and assisted in teaching the lessons.

The hope is that as many AIAA members as possible would visit kindergarten through twelfth grade schools for at least two sessions per year. This would have a significant impact on increasing student interest in science and technology. That would be beneficial, but it would be even more effective to appear at a school on a weekly or monthly basis. It is best to discuss the goals with the teachers/administrators of the school as opposed to only telling them what we will do. Interacting with them can get them to be part of the outreach and help things to work more smoothly. Teachers and students work best with volunteers who are involved for the long term. The students at the schools can also remember the activities better with repeat sessions that will reinforce what they have are exposed to. Homework can be assigned and reviewed the following week. There is a great deal of outreach at Clear Creek and other local schools, but downtown Houston schools and schools outside of the Clear Lake area have much less outreach from

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*Right: Engineers as Educators presenting during the morning sessions. Image credit: BeBe Kelly-Serrato.*

## Educators

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NASA and contractor employees. It was mentioned that the Conrad Foundation has competitions for students, and a group of students had their nutrition bar selected to go to orbit after meeting nutrition, taste and other requirements. Outreach volunteers can search NASA websites for educational resources. For more information on STEM events or training in Houston, please feel free to contact one of your local AIAA officers.

Several lessons were given, and Ms. McKinley asked the participants questions and engaged in dialogues with us. The emphasis was on using inexpensive supplies, most of which teachers have available in their classrooms (e.g., paper, cardboard, Scotch tape, clay, hot glue, straws). One lesson involved cutting two equal-size strips from a piece of thin cardboard, pushing a brass paper fastener through them to form a cross with the strips, and then marking where a fuzzball "astronaut" is to be hot-glued on the cross by an instructor. Ms. McKinley then asked us to define up, down, left and right on the cross. The point is that without a way to establish an orientation anchor on the cardboard cross spacecraft in orbit, the astronaut does not know which way is forward inside the spacecraft (especially with few windows on the craft). On the International Space Station (ISS), directions are marked inside the station to provide a directional reference for the astronauts. Having a sense of direction and orientation also helps the astronauts with motion illness.

Another project was to build a rocket using a drinking straw, a clay nose weight and other materials available in a plastic box on our tables. The rocket requirements were that the clay nose weigh the same as a dime, that there be at least three fins on the rocket, and the time allowed for design and building was only 15 minutes. We fired the rockets by sliding the straw onto a tube on one of two air plunger-powered straw rocket launchers, positioning the elevation angle of the tube, and letting the instructor drop the plunger to launch the straw rocket (by air pressure). We all launched our rockets, had the distance to the landing point measured, and returned to our tables to make modifications. We then had a second launching, and the rocket with the farthest distance was declared the winner. It was a good demonstration of the engineering process for a relatively new design/variation, and I thought it was lots of fun.

Members of AIAA are invited to volunteer for outreach at schools by contacting Svetlana Hanson (the local AIAA Houston STEM Committee Director). Teachers at schools can obtain a $200.00 grant, which coincidently would pay for the cost of an air plunger-powered straw rocket launcher, which can be ordered from a scientific/educational supplier.

*Left: AIAA chair Sarah Shull with Dr. Edgar Bering from Engineers as Educators. Image credit: BeBe Kelly-Serrato.*

## Conference

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Roche limit. Saturn's tidal forces will strip off the icy mantle, while the rocky core spirals on in and falls into Saturn. Tidal spreading of the ring over the age of the solar system will reduce the mass to something like the current ring system. This process also forms icy moons (and several of Saturn's inner major moons are quite icy *i.e.* they have densities very close to water or ice) from material spreading outward beyond the Roche limit.

Following the Mazursky lecture Monday afternoon, Williams *et al.* presented refinements of the lunar moments of inertia from the laser retroreflectors left on the Moon. Their results provide further support for the presence of a fluid core in the Moon.

Also Monday afternoon, Weber *et al.* obtained a more detailed picture of the Moon's deep interior by re-analyzing Apollo seismic data with a new technique. They find a partial melt boundary at a radius from the center of the Moon about 480 km, a core-mantle boundary at about 330 km, and an inner core boundary at about 240 km. The inner core is solid, the outer core is fluid.

**Decadal Report**

For the past twenty years, planetary scientists have taken a page from their astronomer colleagues, who started the idea fifty years ago or so. Every ten years, astronomers, and now planetary scientists, have collected from their respective communities input about what new instruments (and for planetary scientists, missions) would do most to advance their field. They have ranked those recommendations in order of priority, and presented them to Congress and the funding agencies. Both groups have found that by settling any differences among themselves, and presenting a united front, they get much more traction with members of Congress and funding agencies.

This planetary science decadal survey took two years to complete. The people participating in the study committees sought input from as many people in the planetary science community as they could. They chose to focus on three overarching themes for this report: building new worlds; planetary habitats; and workings of the solar system. The leaders of the survey insisted on realistic cost estimates for any missions proposed. That meant cost estimates by outside experts, not just the mission proponents. Full details of the survey results can be found on the Web.

One recommendation was to keep all current, planned, and ongoing missions. Another was to strongly support research and analysis, technology development, Discovery class (low cost) missions, and to support the Mars Trace Gas mission, where NASA is partnering with ESA. The survey recommended reducing the cost cap for New Frontiers (the middle level of mission cost ranges) missions to $1.0 billion, but to exclude launch costs from this cap. The survey recommends selecting four New Frontiers for the next ten years, out of a list of five. All five would be good missions, but the survey leaders did not expect there would be sufficient budget to do all five in the next ten years.

Insisting on realistic cost estimation resulted in serious sticker shock for some proposed missions. However, it gives NASA and Congress a much better picture of what they are buying into. As a consequence, some missions will have to be greatly de-scoped if they are to go forward. Steve Squyres, who presented the report, pointed out that wonderful science can be done with de-scoped missions. He reminded everyone that Voyager, which discovered so much about Jupi-

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*Right: Mazursky lecture. Image credit: LPSC*

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ter, Saturn, Uranus, Neptune, and their rings and moons, was a massively de-scoped version of what had been proposed as the Grand Tour.

The decadal report's recommendations for flagship missions are:

1. Begin a NASA/ESA Mars Sample Return campaign with a descoped MAX-C1 ExoMars.

2. A strongly descoped Jupiter -Europa Orbiter (JEO).

3. A Uranus orbiter and probe.

If funding is less than originally hoped (see NASA Night, further on), the report's recommended strategy is as follows: First, descope or delay flagship missions. If adjustments to flagship missions don't solve the problem, then skip a New Frontiers or a Discovery mission. In all cases, protect money allocated for research and analysis, and money for technology development. There is no point in doing planetary missions if we do not then analyze the data they return, and technology development is the seed corn that will enable us to do in the future missions that we can't do with the tools we now have.

A subject of concern is that launch costs are growing; they make up a larger portion of mission costs than they once were, so steps need to be taken to reduce them.

Another concern is that production of Plutonium 238 needs to be restarted. Nuclear energy is the only power source adequate for outer solar system missions, and existing stocks of this isotope are rather short. The decadal survey recommended switching to advanced Stirling cycle radioisotope generators, which are a much more efficient way to generate power from the Plutonium than current systems.

One factor that "blindsided" the decadal study participants was a budget crunch. When the survey began, they anticipated an approximate budget for planetary science based on recent history. What the President actually proposed for the next fiscal year is much less, and Congress and the President have been at loggerheads trying to get any budget passed.

Wednesday morning, Pieters *et al.* presented a paper on the composition of the lower lunar crust, using material excavated by large (therefore deep) impact basins as a way of investigating this. Their findings indicate that the Moon's crust has a great deal of complexity both vertically (with depth) and laterally (across different regions of the Moon's face).

**LEAG Town Hall**

During lunchtime on Wednesday, the Lunar Exploration Analysis Group (LEAG) held a Town Hall meeting, open to any Conference attendees who were interested. LEAG is a group of scientists who advise NASA about what science should be performed in preparation for or in support of human lunar exploration, and what science can be performed on the Moon once human presence is established. Clive Neal presented an update to the Lunar Exploration Roadmap. Version 1.1 is on web site http://www.lpi.usra.edu/leag.

This Roadmap has added one goal for feed-forward. (In LEAG terms, feed-forward refers to conducting science and other operations on the Moon which will help prepare for human missions beyond the Moon.) This new goal is preparing for future missions to other airless bodies. Further discussion focused on synergies; for example, technologies usable for more than one target.

Wednesday afternoon, Muirhead and Zhong reported on a re-analysis of deep moonquakes reported by the seismic stations left on the Moon by Apollo astronauts. Newer techniques permit insights that were not available in earlier years. They concluded that 72% of deep moonquakes occurred within 5° of mare basalts. This raised a question in their minds: did those deep moonquakes originate in residual material left behind by mare basalts? That raised two further questions: Did mare basalts originate from great depths? And does this residual material help trigger or facilitate deep moonquakes?

Zanetti *et al.* presented a paper about Aristarchus Crater. The impactor that formed Aristarchus Crater impacted roughly half on, half off the Aristarchus Plateau. They estimated the crater's age at approximately 175 million years.

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## Conference

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Ashley *et al.* reported on three pits observed on the lunar surface by the LROC narrow angle camera that appear to be "skylights" opening into lava tubes. One is in the Marius Hills, one in Mare Tranquilitatis, and one in Mare Ingenii on the far side. All of these are well separated from mare edges. By getting both nadir and off-nadir images, they were able to get a good sense of the three-dimensional geometry of the pits. The Marius Hills pit is 60 by 47 meters across, and 41 meters deep (± 2 meters). The floor to ceiling distance of the lava tube is approximately 17 meters. The lava that formed its roof appears to have many layers. The Marius Hills hole is associated with a rille.

Hiesinger *et al.* reported that they finally have good enough imaging of Mare Crisium to do crater count dating of it. They did crater counts within spectrally identified mare units. Ages derived for mare units ranged from 3.7 to 2.7 billion years. The Luna 24 location in Mare Crisium is 3.4 billion years old. Individual samples collected by Luna 24 have been dated at 3.34 billion years, 3.22 billion years, and 2.52 billion years.

Spudis *et al.* reported evidence for large lunar shield volcanoes from Lunar Orbiter Laser Altimeter (LOLA) data. (Small shield volcanoes have long been known on the Moon.) Spudis made note that not all shield volcanoes have summit pits, and put forward some larger candidates, including the Marius Hills and Cauchy.

Antonenko and Osinski reported that that the Apollo basin appears to have a lower elevation than anything else in the South Pole-Aitken basin (SPA), a far side basin which is the largest, deepest impact basin on the Moon.

**NASA HQ briefing**

Wednesday night, James Green presented the NASA Headquarters briefing. All of his information is available on the NASA web site. First he mentioned some upcoming events. The Messenger probe was due to enter orbit around Mercury on March 17 (which did indeed happen). The Dawn spacecraft was (and is) expected to go into orbit around Vesta in July.

Then he discussed the budget climate. At the time, the budget was in a continuing resolution, and Dr. Green thought one possibility was that we might have a continuing resolution for a full year. Evaluations for Discovery missions were in progress, but announcements were contingent on having a full year budget decision. No selections were anticipated for the NEO observation program for this year. For research and analysis, he said that there were selectable proposals, but at the time things were in "active grant management". I understood that to mean that funds were being juggled so that researchers with grants could continue to work while the budget situation was being resolved.

He then discussed the plutonium 238 situation. This isotope is used to power spacecraft headed to the outer solar system, where solar power is insufficient. Current supplies are low. A measure has been approved to resume domestic production as a shared activity with other government agencies; however this had not been funded by the continuing resolution. A possibility of purchasing plutonium 238 from Russia was also discussed.

He pointed out that the plans set forth in the Decadal Survey would be strongly affected by future budgets. Those plans were made with the expectation that funding for planetary science would continue at roughly the same fraction of the total NASA budget as they have been for the past several years. However, it appeared to Dr. Green,

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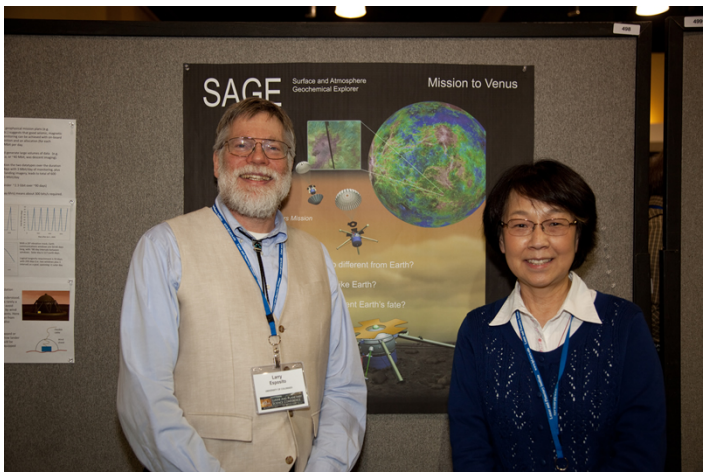


*Right: Poster session. SAGE, Mission to Venus. Image credit: LPSC.*

## Conference

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looking at the Obama Administration's plans, that the planetary science budget is likely to go down after fiscal year (FY) 2012, and he guessed the budget would be flat after FY 2016.

There are typically a significant number of Japanese scientists present at the LPSC. This year, Japan had an especially large representation, because they were presenting results from their Hayabusa mission at a special session Thursday morning. Until the spacecraft returned to Earth, no one knew whether or not the spacecraft had succeeded in gathering a sample from asteroid Itokawa; the craft did not have any instrument on board capable of reporting that. Everyone, not only the Japanese, was very excited to learn that Hayabusa did succeed in getting a sample from the asteroid, and in returning it to Earth. Several research teams in Japan have succeeded in performing analyses on it. This sample helps establish a link between asteroid classes (determined by telescopic observations) and meteorite classes (determined by laboratory analyses on Earth), so that we can figure out which types of meteorites come from which types of asteroids. Itokawa was already known to be an S type asteroid. By comparing its composition with known classes of meteorites, it was found to be a large LL chondrite.

The horrible irony was that the very week those Japanese researchers were in Houston to announce their findings was the week when the massive earthquake and tsunami hit Japan. Shortly after news of that double tragedy reached us, the conference organizers offered assistance to anyone who needed to extend hotel stays or change travel arrangements on account of it.

In other Thursday morning papers, Renno and Mehta offered spectral evidence for liquid brines today on Mars. They discussed possible implications of this for habitats for life on Mars, noting that certain organisms on Earth live in briny habitats.

On Thursday afternoon, Haruyama *et al.* discussed the three deep holes on the Moon that appear to be "skylight" openings into lava tubes; these were observed by the Japanese Kaguya lunar orbiter spacecraft. After carefully searching through the Kaguya data base, on three such holes were found, at least in the size range of a few tens of meters in diameter. This means that these features are rare. Temperatures observed within these holes were mild (compared with extremes elsewhere on the Moon), ranging from -20°C to +30°C. Some debris blocks have been observed at the bottoms of the holes. Whether water might accumulate within such lava tubes is not yet known.

Walsh *et al.* offered a possible model for making the equator-circling ridge on Saturn's moon Iapetus. During the formation period of the solar system, a major impact onto Iapetus can generate a sub-satellite and a ring. Depending on impact parameters, the sub-satellite will tidally evolve outward and be lost. The ring will tidally evolve inward and land on the moon, at low enough speed to pile up as a ridge rather than make craters.

On Friday morning, Ivanov *et al.* estimated that the projectile that formed the large south polar impact crater on asteroid Vesta was 40 to 90 km in diameter, and suggested that the crater may be deep enough to expose the Vesta mantle inside it.

*Left: Hayabusa team member. Image credit: LPSC*

Conference

# Impressions of the 42nd Lunar and Planetary Science Conference (LPSC)

JAMES C. MCLANE III P. E., AIAA ASSOCIATE FELLOW, HOUSTON, 3/17/11

From March 7 through 11 it was my pleasure to attend the annual conference of the Lunar and Planetary Science Institute held in the Woodlands north of Houston. From modest beginnings four decades ago this event has grown into a world-class exposition on all extraterrestrial things circling our sun. The conference had a major corporate sponsor, Northrop Grumman, and there were exhibition booths with representatives from big aerospace companies, private commercial entities, universities, think tanks and government labs. About 1,600 people attended and many presented oral papers and displayed fascinating posters on imaginative and often surprising investigations and projects. The affair had a very international flavor. I spoke with European visitors who were enjoying the balmy Houston weather. Some attendees were college graduate students, and many were in their first technical jobs after school. A large contingent came from Japan. The Japanese were celebrities since their Hayabusa space probe successfully returned samples from the asteroid Itokawa. A glance around the floor indicated that cosmology, space science and astrogeology are attracting women. It's likely that more than 40 percent of the attendees were female.

Since I occasionally attend other major annual technical conferences in Houston (e.g., the Offshore Technology Conference [OTC]), it's interesting to compare OTC to the LPSC. The OTC is far larger and also features technical paper sessions, but the real attraction is the hundreds of floor displays, hardware demos and booths by suppliers to that lucrative industry. The OTC attracts a mostly male audience of engineers and sales representatives. Attendees to the LPSC are mostly scientists, and there are lots of females. The focus is not on displays of hardware, but rather on hearing some astonishing papers and the chance to swap notes with some of the world's greatest scientific minds.

Oral presentations at the LPSC were managed in an efficient, professional manner, with strict attention to time limits -15 minutes for each talk, including any questions. The Woodlands Convention facility is a modern venue with several large presentation halls and numerous smaller meeting rooms. All the talks I attended had good sound systems, and visual aids included huge screens. Lighting in the presentation halls was balanced so one could take notes and still see the bright screens.


*Right: Planetary scientist Steven Squyres at LPSC. Image credit: LPSC*

I found myself wondering about the motivations of the speakers. Most of the talks, and even the posters resulted from collaborative efforts of several people, often from institutions located in different ends of the country or even different countries. Most presenters seemed passionate about their work and highly motivated to be recognized as the first to discover or point out some obscure new bit of information. Foreigners delighted in highlighting concepts pioneered in their own countries decades ago. Some presentations supported hypotheses (e.g., about the formation of the Moon) that contradicted hypotheses put forward in other presentations. I enjoyed such lively conflict.

In general, things related to our Sun or other stars were not covered, nor was there much that was applicable to manned space flight. A few presentations and posters described desert studies on Earth

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that might help support future human missions to the moon or Mars. Virtually all the planets and minor objects in our solar system were the subject of multiple papers. A link to the synopsis of all papers is located at:

http://www.lpi.usra.edu/publications/absearch/?meeting=335&keywords_all=&submit.search=Search

Tuesday and Thursday afternoons featured a massive Poster Session in a cavernous hall. Attendees stood along hundreds of feet of movable partitions to talk to passers-by about their pet projects. The range of ideas was tremendous. Some folks have developed complex hardware, like chambers to simulate the environment on Venus or to test the strength of ice under conditions that might exist on a Jovian moon. Other projects involved software or computer modeling.

Photos of conference activities can be viewed at the following web site (search for "LPSC 2011 Royalty Free Images"):

http://www.lpi.usra.edu/meetings/lpsc2011/?view=press

I spoke with an enthusiastic man from Hungary who heads a team competing for the Google Lunar X-prize, a private effort to land a rover on the moon. I also heard many novel theories. One attendee had an astonishing presentation on her idea that observations of an increasing rate of expansion of the universe are not due to some mysterious dark energy, but rather to the possibility that the speed of light in a vacuum is decreasing over time.

I talked to a lady from Goddard Space Flight Center attending because she obtained project grant money, without which her NASA project probably could not spare funds for her travel. I spoke with a Chinese graduate student from a school in Florida and his Japanese friend. I talked to old NASA hands who left the Clear Lake area after working on Apollo, but still retain an interest in space. I met someone from Glenn Research Center developing a rocket to bring a small sample of Mars rocks back to earth. He said the rocket was so small that it was like something a hobbyist might make.

There was a significant panel discussion by experts on near-earth objects. Like many conference presentations, it was streamed out over the internet. Since a collision with such an object could well terminate life on earth, it's a serious subject where space technology can play a critical roll. Current surveys of threatening objects are hampered by an inability to look between the earth and the sun. Identification of all major threats will probably require that a new detection spacecraft be placed in space trailing Venus. There are major questions about what actions might be taken and who would be in charge of the response effort if Earth were threatened.

A conference highlight was the release of a study by a prestigious committee of the National Research Council with recommendations for prioritizing unmanned programs to solar system objects over the next 10 years. This so-called Planetary Decadal Survey forms the basis for long range planning by the government and NASA, and it was eagerly anticipated. A link to the report (recorded videos) is located at:

http://www.livestream.com/2011lpsc/video?clipId=pla_18e48f98-4a78-4acc-ad2a-



*Left: Womens' breakfast at LPSC. Image credit: LPSC*

## Conference

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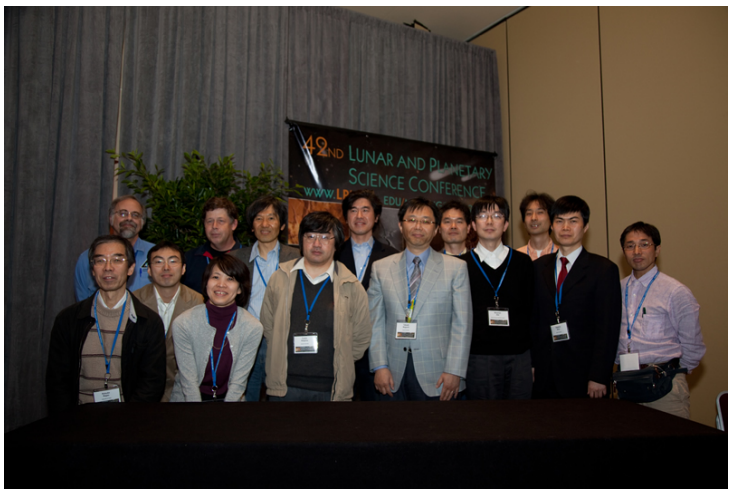
Perhaps the largest contingent of attendees at this convention came from the Jet Propulsion Laboratory (JPL), a major player in the unmanned space exploration game. One of the more bizarre meetings was an informal presentation on the history of a lawsuit filled by JPL employees to try to prevent Caltech and NASA from undertaking open-ended, unconstrained background investigations for the purpose of rebadging. The lawsuit took over three years to wind its way up to the US Supreme Court. At issue was the right of the federal government to require private employers to investigate an individual's personal history without a compelling reason to do so. The scientists lost when the Supreme Court ruled that the Constitution doesn't guarantee a right of privacy. More information about the case can be found at: http://hspd12jpl.org/

*Right: A speaker at LPSC in the Woodlands. Image credit: LPSC*


*Right: The Hayabusa team, first to return samples from an asteroid to Earth. Image credit: LPSC*




*Right: A poster session at LPSC. Image credit: LPSC*

As one walked the halls of the convention center, there was the constant buzz of conversation between experts discussing problems. This is the real benefit of such a conference, to see your colleagues and compare notes. It was refreshing to experience the enthusiasm of the conference attendees. It reminded me of the infectious excitement present in the manned space program back during the Apollo era. There is a renaissance occurring at this time in planetary science akin to the exciting time 500 years ago when the first explorers brought back news to Europe about the New World. Our recent space probes have returned massive amounts of fresh data, and even information collected decades ago is being revisited with new computer tools. There is so much data that huge opportunities exist for a researcher to find something entirely new. After seeing the amenities and experiencing the efficient organization, I think the conference registration fee ($205 for professionals, $100 for students) is a real bargain. The programs went on non-stop, and the dilemma was choosing which of the fascinating presentations one might want to attend next.

# The Red Baron Scenario in an Interplanetary Context

Astrodynamics

DANIEL ADAMO, ASTRODYNAMICS CONSULTANT

Even young readers without aeronautical interests will recall the dog fighting exploits of a certain heroic beagle in his self-imagined World War I flying ace persona, as portrayed by Charles Schulz in the comic strip *Peanuts*. More often than not, aerial combat would commence with Snoopy's archrival, The Red Baron, diving at him from out of the Sun's glare. Bullet holes would immediately riddle our hero's Sopwith Camel biplane, faithfully depicted by Schulz as a doghouse with Snoopy astride the ridgepole.

A similar scenario plays out all too often as humanity struggles to detect populations of small-sized near-Earth objects (NEOs). Although we've found nearly 90% of NEOs having diameters 1 km or more, the population with diameters less than 100 m is far more prolific and more than 95% of this population has yet to be detected. These diminutive NEOs are significant for two reasons. First, they encompass the minimum size thresholds capable of inflicting local to regional damage should a member impact Earth. For example, the Tunguska impact, in which 2000 $km^2$ of Siberian forest were decimated in June 1908, is thought to be associated with a NEO 30 to 50 m in diameter. Second, a NEO destination 50 to 100 m in diameter is considered the minimum size justifying cost/risk of a human space flight (HSF) mission sent to explore it.

Due to their small size, these NEOs *must* approach Earth closely or they'll escape detection because all our instrumentation is currently confined to Earth's surface. Such discoveries are typically made in a clear dark sky at near-zenith elevation. If a NEO approaches Earth from the Sun's general direction, as roughly half do, it'll go undetected by Earthbound instrumentation until its apparent angular separation from the Sun, or *solar elongation*, approaches 180°. If the NEO's aphelion falls inside Earth's heliocentric orbit, *this geometry never occurs*.

In the case of an impacting NEO 30 to 50 m in diameter or larger, approach from Earth's dayside is a Red Baron scenario with potential consequences far greater than those Snoopy ever suffered. Even in the context of HSF, a NEO approaching from Earth's day side greatly hampers mission planning because the prospective destination remains undetected until it's already receding from Earth. Current human factors limitations from microgravity and radiation exposure impose HSF mission durations well under a year on travel to a NEO and back to Earth. Consequently, a viable NEO destination must be no more than about 0.1 AU (15 million km) from Earth when humans arrive to explore it. If a NEO is near that threshold and *receding* from Earth at arrival, this visit will likely be disappointingly brief.

Red Baron scenarios during close NEO Earth encounters develop with surprising frequency. Let's look at two relevant examples observed so far in 2011 using data from the Jet Propulsion Laboratory (JPL) Solar System Dynamics Division's (SSD's) *Horizons* online ephemeris computation service, accessible at URL http://ssd.jpl.nasa.gov/?horizons. Our first example, a NEO with provisional designation[1] 2011 $CQ_1$, was benign with respect to the Red Baron scenario during its

*(Continued on page 62)*

*Footnote 1*

In our solar system, small body provisional designations consist of the discovery year, followed by a space, two letters, and zero or more subscripted numeric digits. The first letter is alphabetically incremented such that {A, C, E,..., X} cover the first 15 days of each possible discovery month and {B, D, F,...,Y} cover remaining days of each possible discovery month. Neither "I" nor "Z" is used as a first letter. The second letter indicates the chronological order of discovery during a particular half-month, and "I" is again excluded. No numeric subscript is appended for the first 25 discoveries in a half-month, but it is incremented from 0 and appended each time the second letter recycles from "Z" to "A". Thus, beginning on March 16 and extending through March 31 in a particular year, letters and subscripts would progress through the sequence {FA, FB,...FZ, $FA_1$, $FB_1$,...$FZ_1$, $FA_2$, $FB_2$,...}.

*Footnote 1*

## Astrodynamics

discovery timeframe. According to *Horizons*, it came to perigee on 2011 Feb 04.8 UT at a geocentric distance of 0.000079 AU (12,000 km). But 2011 $CQ_1$ came to *perihelion* 111.6 days later on 2011 May 27.4 UT at a heliocentric distance of 0.665 AU. With Earth always orbiting the Sun at a distance near 1 AU, 2011 $CQ_1$ therefore approached Earth in February from its night side.

A NEO's motion relative to the Earth/Sun line can be illustrated using *heliocentric UV plots*. In this application, the "UV" signifies plots are projections onto Earth's heliocentric orbit plane, the *ecliptic*. From such plots, a NEO's geocentric apparent solar elongation is readily perceivable, typically over many years. As defined below, Earth's heliocentric orbit motion at any specified instant in time or *epoch* defines the basis for a Cartesian UVW coordinate system from which UV plots are generated.

***U***: unit vector directed from the Sun toward Earth's position at epoch.

***V***: unit vector of Earth's velocity component orthogonal to ***U*** at epoch.

***W***: unit vector orthogonal to the ecliptic plane at epoch such that $\boldsymbol{U} \times \boldsymbol{V} = \boldsymbol{W}$ in the right-handed convention.

Figure 1 is a heliocentric UV plot for 2011 $CQ_1$ spanning calendar years 2006 through 2015. The start of each year

*(Continued on page 63)*

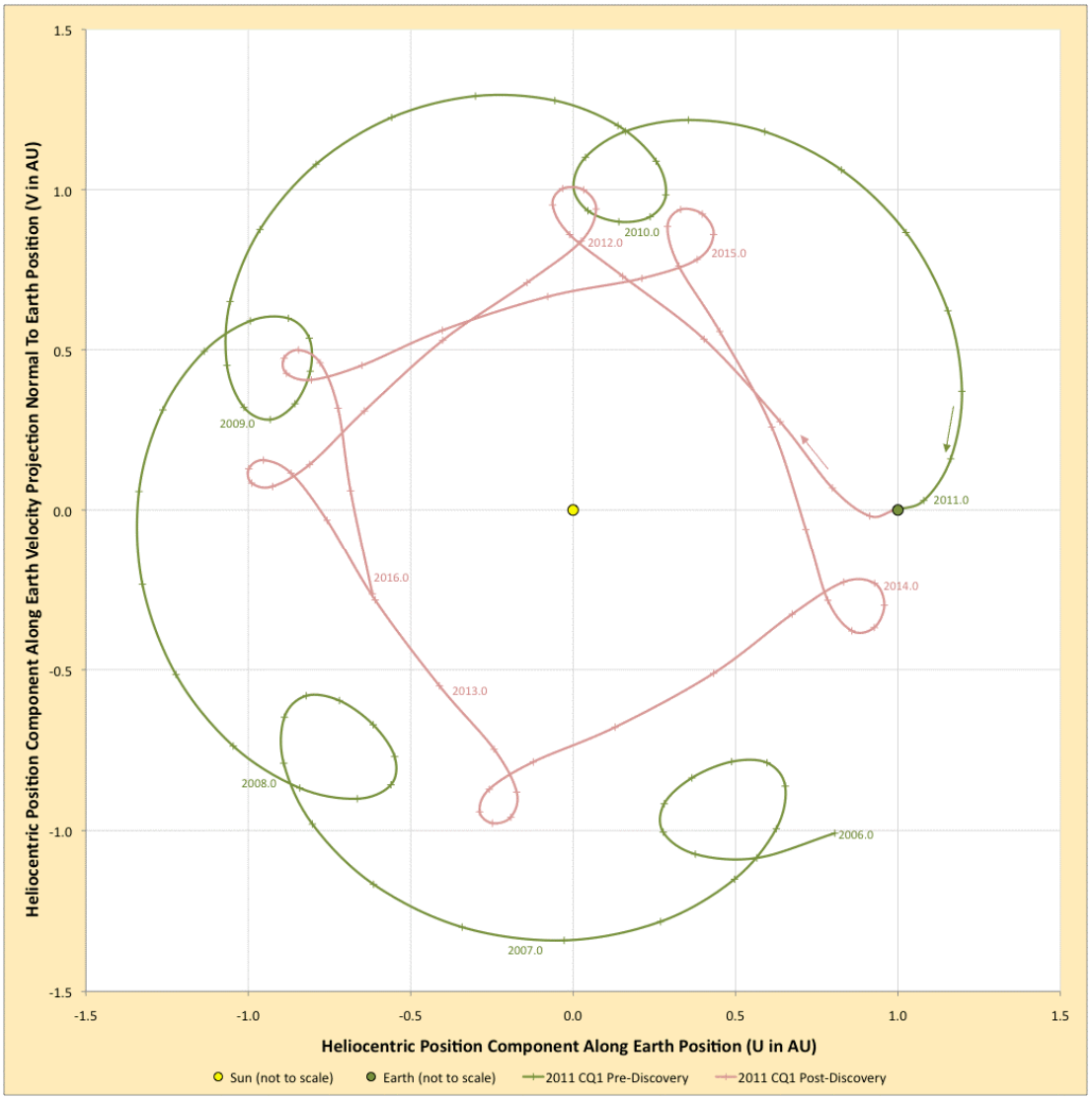



**Figure 1. Heliocentric UV Plot of 2011 $CQ_1$ Relative To The Earth/Sun Line**

(Continued from page 62)
during this interval is annotated adjacent to the UV locus, and "+" time ticks appear on this locus at 30-day intervals. Prior to its year 2011 discovery, 2011 $CQ_1$ was a member of the *Apollo* orbit group as denoted by the UV locus colored green. An Apollo orbit crosses Earth's but has a mean heliocentric distance or semi-major axis *a* exceeding 1 AU. A NEO in an Apollo orbit tends to approach Earth from the +***V*** direction because Earth's orbit period is shorter. After February 2011, 2011 $CQ_1$ became a member of the *Aten* orbit group due to Earth gravity perturbations on its heliocentric orbit, and its UV locus is colored russet. An Aten orbit also crosses Earth's, but its *a* is less than 1 AU. Consequently, a NEO in an Aten orbit tends to approach Earth from the -***V*** direction.

To attain a geocentric apparent solar elongation greater than 90° in Figure 1, 2011 $CQ_1$ must have a ***U*** position component exceeding +1 AU. Elongation can approach 180°, satisfying geometry necessary for Earthbound discovery, only when 2011 $CQ_1$ lies very nearly in the +***U*** direction from Earth. Figure 1 indicates this geometry prevailed for about 30 days prior to perigee, but another factor undoubtedly delayed 2011 $CQ_1$ discovery: its absolute magnitude[2] $H$ = +32.037. Assuming 2011 $CQ_1$ is about as dark as conceivable, with a reflectivity of 5%, the following formula estimates its near-maximum possible diameter $d_X$ = 2.3 m. It's therefore no sur-

(Continued on page 64)

## Astrodynamics

*Footnote 2*

*Footnote 2:*

Absolute magnitude is a measure of an astronomical object's *intrinsic* visual brightness at a distance of 1 AU from the observer. Note that, because visible wavelengths are used, an ambiguity arises in relating absolute magnitude to the object's size: it could be relatively large and dark, or it could be relatively small and bright. A magnitude decrease of 5 units is equivalent to a brightness increase by a factor of 100. To the Earthbound human eye, the dimmest stars have an *apparent* magnitude of +6, and the brightest star Sirius has an apparent magnitude of -1.4.

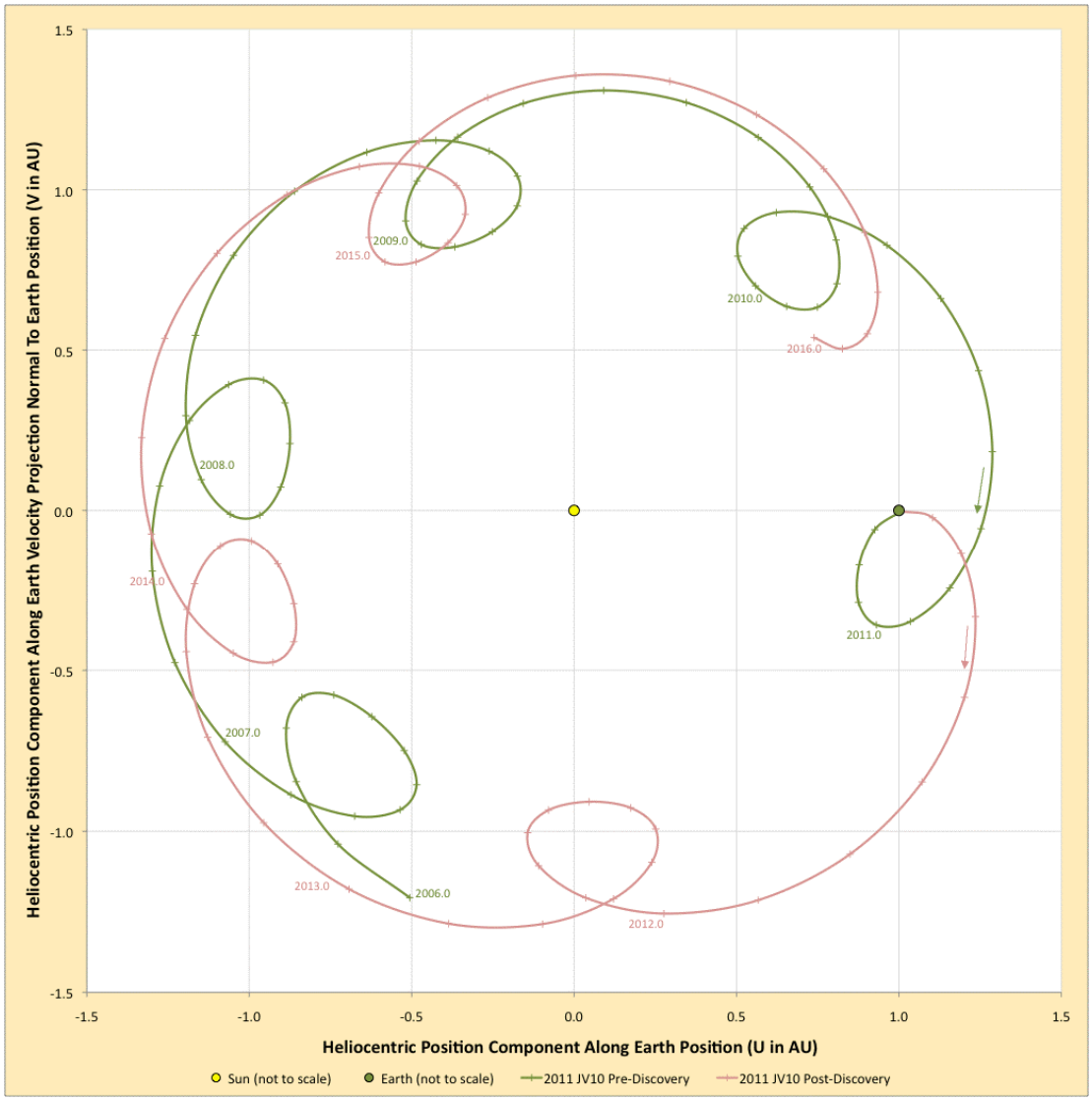



**Figure 2. Heliocentric UV Plot of 2011 $JV_{10}$ Relative To The Earth/Sun Line**

## Astrodynamics

(Continued from page 63)
prise that all 35 usable observations of 2011 $CQ_1$ were confined to 2011 Feb 04.

$$d_X = 5{,}944{,}000 * 10^{-0.2\,H}$$

With observations confined to an interval less than one day, our ability to model 2011 $CQ_1$ heliocentric motion years into the future or past is problematic at best. For the Figure 1 scale and time interval, UV coordinates are reasonably correct, but a 2011 $CQ_1$ approach to Earth sufficiently close to obtain additional ground-based observations and a refined orbit is likely decades in the future. Consequently, 2011 $CQ_1$ has been assigned an orbit condition code (OCC) of 5[3]. It's indeed fortunate that 2011 $CQ_1$ is of a size not posing an impact threat to Earth. From post-discovery motion in Figure 1, it's evident 2011 $CQ_1$ will likely pose a Red Baron scenario during its next close Earth approach.

*Footnote 3*

*Footnote 3:*

A NEO with an OCC in the range of 3 to 5 may or may not be acquired when it's next observable. With an OCC from 6 to 9, a NEO is effectively lost after discovery observations cease. Only at OCC values of 0, 1, or 2 is a NEO likely to be observed during the next opportunity to do so.

Our second example Red Baron scenario received provisional designation 2011 $JV_{10}$ after discovery on 2011 May 08. According to *Horizons*, it came to perigee on 2011 May 05.7 UT at a geocentric distance of 0.0023 AU (340,000 km). In this case, 2011 $JV_{10}$ came to perihelion 65.1 days *earlier* on 2011 March 04.6 UT at a heliocentric distance of 0.895 AU. Because 2011 $JV_{10}$ approached Earth from its day side in 2011, a Red Baron scenario was in effect, delaying discovery until after perigee. This geometry is illustrated in Figure 2's UV plot.

Unlike the 2011 $CQ_1$ example in Figure 1, 2011 $JV_{10}$ remains in an Apollo orbit after its 2011 Earth encounter. As is evident from the UV arcs at the top of Figure 2, 2011 $JV_{10}$'s Earth encounter at discovery does little more than slightly increase aphelion.

With $H$ = +29.705 and an inferred $d_X$ = 6.8 m, 2011 $JV_{10}$ wasn't an easy object to observe from Earth even after it moved into the night sky post-perigee. A total of 18 usable observations were obtained during 2011 May 08 - 10. Although this dataset extends over a longer period than the few hours 2011 $CQ_1$ was observed, 2011 $JV_{10}$'s perigee distance was 0.88 of the Moon's mean distance from Earth or 28 times that of 2011 $CQ_1$'s perigee. The relative lack of 2011 $JV_{10}$ observational data in close proximity to Earth is likely responsible for its current OCC = 6.

Projected onto the ecliptic plane, the Figure 2 UV plot's russet segment indicates future close Earth approaches by 2011 $JV_{10}$ could occur before or after perihelion, making it difficult to determine whether or not such an approach will be a Red Baron scenario. But only post-perihelion Earth orbit crossings occur near an ecliptic plane crossing or *node*, so any pre-perihelion approaches from Earth's night side will also be millions of km "below" the ecliptic plane and unobservable with current instrumentation.

Public notifications associated with our two Red Baron scenario examples present a noteworthy contrast. Because 2011 $CQ_1$ had a geocentric perigee distance well under half the Moon's mean geocentric distance (equivalent to 0.001285 AU or 192,200 km) following its discovery, SSD's policy is to inform news media channels of the event. The associated news release can be viewed at URL http://neo.jpl.nasa.gov/news/news170.html.

On the other hand, notifying the public of events like 2011 $JV_{10}$'s close Earth approach would quickly overwhelm channels with relatively insignificant news items issued at roughly weekly intervals. The only known public notification of the 2011 $JV_{10}$ Red Baron scenario in 2011 was posted to JPL's Space Calendar homepage at URL http://www2.jpl.nasa.gov/calendar/. Because of this scenario, however, the approach was history by the time it was posted.

The only public notifications of Earth approaches *farther* than about 0.001285 AU are associated with objects of special interest, such as 2005 $YU_{55}$. This NEO's next perigee, at a geocentric distance of 0.00217 AU (325,000 km), falls on 2011 Nov 09.0 UT. With an OCC = 0, confidence is high in this prediction. Special interest in 2005 $YU_{55}$ undoubtedly lies with its $H$ = +21.929, inferring a $d_X$ = 244 m. According to the JPL news release at http://neo.jpl.nasa.gov/news/news171.html, 2005 $YU_{55}$ was observed with radar in 2010 "and shown to be a very dark, nearly spherical object 400 meters in diameter". If an object this large impacts Earth, devastation on a continental scale is estimated to result.

As SSD notes in the 2011 $CQ_1$ news release, "small objects of this size create visually impressive fireball events [should they enter Earth's atmosphere] but only rarely do even a few small fragments reach the ground". In citing Red Baron scenario examples

(Continued on page 65)

*(Continued from page 64)*
involving harmless NEOs evading Earth so far, the long-term message is that dire consequences could easily prevail from very similar approaches in which larger objects impact Earth.

Ongoing research indicates the most cost-effective means of greatly reducing or eliminating Red Baron scenarios is with NEO survey instrumentation operating at least a million km from Earth. In addition to improving prospects for defending our planet from devastating impacts, such instrumentation will vastly extend our knowledge of arguably the most extensive and poorly understood territory in the inner solar system. This knowledge will certainly contribute to planetary science's advancement. It will also greatly inform our selection of the most rewarding and appropriate NEO destinations for HSF. With this instrumentation, close Earth approaches by at least some of the myriad NEOs 50 m or more in diameter can be accurately predicted many years in advance. In some cases, this advance knowledge will be sufficient to plan and launch HSF missions taking advantage of NEO approaches with adequate accessibility from Earth.

A NEO survey conducted from a deep space vantage point therefore offers a triple payoff, with beneficiaries in planetary defense, planetary science, and HSF exploration. This payoff can be achieved with mature technology, much of it already having flown in space. It's hard to imagine instrumentation with a greater return on investment to offer taxpayers.

Nearly all the general NEO information conveyed in this article is more formally and thoroughly documented by two recent publications available for free download as follows.

1) National Research Council Committee to Review Near-Earth Object Surveys and Hazard Mitigation Strategies, *Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies: Final Report*, The National Academies Press, Washington, D.C., 2010, downloadable from URL http://www.nap.edu/catalog.php?record_id=12842.

2) Barbee, B. W. (ed.), *Target NEO: Open Global Community NEO Workshop Report*, 2011, downloadable from URL http://www.targetneo.org/.

## Astrodynamics

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New Book

# John F. Kennedy and the Race to the Moon by John M. Logsdon, Ph. D.

DOUGLAS YAZELL, EDITOR


*Right: The featured speaker, Professor John M. Logsdon. This was not an AIAA event, but our membership was informed in advance about this free presentation. Image credit: Douglas Yazell*

Roger Weiss took the initiative to create an evening presentation by John M. Logsdon on Monday, May 23, 2011, at NASA/JSC Gilruth Center. This was open to the public. Earlier the same day, Professor Logsdon made the same presentation at NASA/JSC in a building usually open only to badged employees.

Professor Logsdon's new book is *John F. Kennedy and the Race to the Moon.* John Logsdon is Professor Emeritus of Political Science and International Affairs at The George Washington University's Elliot School of International Affairs, where he taught for 38 years and founded GW's Space Policy Institute. He is also author of the 1970 book, *The Decision to Go to the Moon: Project Apollo and the National Interest.*

As JFK deliberated about his next steps after the Bay of Pigs debacle in Cuba, he was told by Werner von Braun and others that both the USSR and the USA would need a new rocket if they intended to land a person on the Moon and return that person safely to Earth. Von Braun said, "In a rocket-building race given adequate resources for me and my team, we will win."

There was political influence to place the launch site in Massachusetts, so a rule was created with help from NASA Administrator James Webb requiring the launch site to be south of the Mason-Dixon line in order to allow work to be done outdoors year-round in the warmer climate.

With the Apollo project announced, the NASA budget increased 89% the first year, 101% the second year, and 40% the third year. Major capital investments included the Manned Spacecraft Center in Texas and Launch Complex 39 in Florida. In just over two years, the civil service

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*Right: Roger Weiss introducing the speaker. Image credit: Douglas Yazell*

*(Continued from page 66)*
workforce doubled and the contractor workforce quadrupled.

In last year's dollars, Apollo cost $151B. For comparison, the Panama Canal cost $8B, the Manhattan project cost $28B, the 30-year interstate highway project cost $128B, and the International Space Station (after space shuttle costs are removed) cost $55B.

Representative Albert Thomas was the most influential in placing a NASA center in Texas. George Brown of Brown & Root also influenced that decision. Lyndon Johnson had "not so much" input into that decision, though the center is named for him.

Now that NASA's Constellation is cancelled due to unrealistic budget planning, this quote from JFK stuck with me.

*"I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth. No single space project in this period will be more impressive to mankind, or more important in the long-range exploration of space; and none will be so difficult or expensive to accomplish."*

*John F. Kennedy*
*Special Joint Session of Congress*
*May 25, 1961*



## New Book

*Left: Two images of our guest of honor, Professor John M. Logsdon. Image credits: Douglas Yazell*

Video recording of talk by John Logsdon, PhD, based on his book, *"John F. Kennedy and the Race to the Moon."* (NASA/Johnson Space Center's Gilruth Center, May 23, 2011), thanks to Ben Longmier for production assistance.

http://www.youtube.com/watch?v=Lgwnj7QXyQA

Recent article, *"Analyzing the new Kennedy tape,"* by John Logsdon
(The Space Review, May 31, 2011)

http://www.thespacereview.com/article/1856/1

## Crew Return

# STS-133: Last Voyage of Discovery

DOUGLAS YAZELL, EDITOR

*Right: STS-133 patch. Image credit: NASA*

On March 10, 2011, a large crowd gathered to welcome the STS-133 crew back to Houston's Ellington Airport the day after their space shuttle landing. NASA/JSC Center Director Michael Coats reminded the audience that this final mission for Discovery was its 39th flight, and Discovery completed 365 days on orbit.


Among the short speeches by crew members, Nicole Stott thanked the team

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*Right: NASA/JSC Center Director Michael Coats flew on three space shuttle missions, all on Discovery. From left to right, mission patches for 41-D (Discovery's 1984 first flight), STS-129 (1989), and STS-139 (1991). Image credits: NASA*




*Right: Crew return at Ellington Field with NASA/JSC Center Director Michael Coats. From right to left: Mr. Coats, Commander Steven Lindsey, Pilot Eric Boe, and Mission Specialists Alvin Drew, Stephen Bowen, Michael Barratt, and Nicole Stott. Stephen Bowen replaced Timothy Kopra after Tim was injured in a bicyle accident. Image credit: Douglas Yazell*

## Crew Return

*Left: One of the Riders in the Sky meets one of the many fans. Image credit: Douglas Yazell*

for a horizon-to-horizon view from the International Space Station (ISS) cupola while operating the space station robotic arm.

STS-134 is the next-to-last space shuttle mission, still on orbit with ISS as of Saturday, May 28, 2011. STS-134 delivered the Alpha Magnetic Spectrometer (AMS) to the ISS.

STS-135 is the last planned space shuttle mission. It will use the Atlantis orbiter to dock with ISS.

Discovery's final stop will be the Smithsonian Institution, where it will replace the Enterprise space shuttle orbiter. Enterprise was never launched but was used for five free flights during approach and landing tests prior to 1981's STS-1.


*Left: Riders in the Sky. The wake-up music the prior Saturday for this on-orbit crew was Woody's Roundup, a song from Toy Story 2 performed by this group. Image credit: Douglas Yazell*

## Crew Return

# STS-134: Last Flight for Endeavour

DOUGLAS YAZELL, EDITOR

*Right: STS-134 patch. Image credit: NASA*

A large and enthusiastic crowd appeared for the historic crew return to Ellington Airport in Houston, celebrating the last flight of space shuttle orbiter Endeavour. The date was Thursday, June 2, 2011, the day after the landing.

Joining NASA/JSC Center Director Michael Coats were (from left to right in the image below) Commander Mark Kelly, Pilot Greg H. Johnson, and mission specialists Michael Fincke, European Space Agency astronaut Roberto Vittori, Andrew Feustel, and Greg Chamitoff.

Endeavour's final destination will be a museum exhibit in the California Science Center in Los Angeles.

Mark Kelly pointed out that the team completed the last four spacewalks of the space shuttle program, and space station assembly required more than 1,000 hours of EVA time. One of their four spacewalks was the 6th longest of all time, around 8.5 hours.

Greg Johnson remarked on the solitude waiting for launch in the Pilot's seat, looking east as night turned to day, followed by an explosion and sensory overload when the launch started. He introduced Mike Fincke noting that Mike's three spacewalks on this mission resulted in a total of nine spacewalks for his career, and Mike now holds the record for an American for the longest time in space.

Mike Fincke noted that he is a former International Space Station (ISS) com-

*Right: Crew return at Ellington Field with NASA/JSC Center Director Michael Coats. Image credit: Douglas Yazell*

## Crew Return

*Left: Italian astronaut Roberto Vittorio with the microphone.*
*Image credit: Douglas Yazell*

mander, so he was happy to return there. He noted that three ISS crew members left for Earth in a Soyuz spacecraft halfway through this mission.

Italian astronaut Roberto Vittorio explained that this was his first space shuttle flight and he was a member of the 1998 astronaut class known as the Penguins. He described re-entry as a 5,000-mile trip from Mach 25 to the runway with no engine and only once chance, with thanks to the engineers and other people who made that so reliable. Retiring the space shuttle leaves only the best legacy for future generations. He explained that the sky changed from blue to pink, then red one re-entry started.

Drew Feustel was the EVA leader for the crew. He noted that he did three spacewalks on his prior space shuttle mission to the Hubble telescope, but he was surprised by the size of ISS as they approached. He wished a happy wedding anniversary "today" to his wife in the audience.

Like Drew, Greg Chamitoff is a scientist and a civilian, and both have a Canadian background. Greg emphasized what an adventure this was. He stayed on ISS for six months mostly with two Russian cosmonauts. Four months later Mike arrived. Mike, Drew and Greg were the EVA team, two outside and one inside. Greg mentioned that the Alpha Magnetic Spectrometer (AMS) was unlike any of the other great observatories since it looks at particles and not light. Why is there more matter than anti-matter in the universe? Is that really the case? The rotations of the galaxies do not match the mass we observe, so we search for the missing matter, or dark matter. AMS will help with those questions. Greg described the view during an EVA from the highest point on the space station and noted an apparent harmony with the natural Earth below and the space vehicle technology in Earth orbit. And he congratulated the team on this milestone: ISS assembly complete!

*Left: NASA/JSC Center Director Michael Coats paraphrased: "We select our astronauts based on their capability to compartmentalize and focus, and Mark Kelly probably had a bigger challenge than most. He did a terrific job. Thanks, Mark!"*
*Image credit: Douglas Yazell*


*Left: Pilot Greg Johnson signing autographs. Image credit: Douglas Yazell*

Celebration

# NASA-Mir Reunion and 10th Anniversary Splashdown Party

SVETLANA HANSON, CONTRIBUTOR

*Above: Left to right: Svetlana Hanson and Shannon Lucid. Image credit: Svetlana Hanson*

On March 25, 2011 Clear Lake space community had yet another reason to celebrate space history: the NASA-Mir Reunion and 10th Anniversary Splashdown Party. Almost 80 people attended and shared memories, met old friends, and just had a good time together at Turtle Club on Clear Lake.

Among the lead organizers were Bob Hoyt, Susan Freeman, David Wolf, Gary Kitmacher, Trent and Yvonne Mills. They prepared food, door prizes, event memorabilia (patches, flags, wrist bands) that every attendee received. Patches and flags given to each guest were flown on STS-71, the first Shuttle docking mission with the Mir.

Throughout the evening video featuring various flights and increments was played, open mike was available for those willing to jump in and share a story or two from the years past on visits to Moscow, meetings with counterparts, or some of the funny events on board the Mir space station. Among the attendees were two former Mir residents: Shannon Lucid and David Wolf.

One of the funny stories was told by David Wolf from his time on Mir. There was a package of "Great Black Currant Jelly (with the pulp)" that needed to have water added to it to make it drinkable. Accidently cutting the wrong side of the package and later realizing that water needs to be added, he followed instructions on the package which directed him to add water and then squeeze to mix. That motion resulted in the content exiting the package under great pressure and with a motion of a missile bulleted strait to the panel on the other side of the module. It made a huge mess. It ended up being an unplanned experiment of zero -g effects on fluids as well as an illustration that one should read instructions before starting any procedure on Mir, even if it involves your food.

"By all accounts, the reunion was a smashing suc-

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*Right: Event memorabilia. Image credit: Svetlana Hanson*

*(Continued from page 72)*

cess." says Bob Hoyt.

The next NASA-Mir Reunion and Anniversary Splashdown Party are planned for 2016. Hope to see you there!

Pictures and videos from the party are posted on NASA-Mir Reunion Website at http://nasamirreunion.shutterfly.com/

**A brief history of the NASA -Mir program:**

1991– It all started in with negotiations leading to the establishment of the NASA-Mir program.

1994– In February, the first cosmonaut, Sergey Krikalev, flew on board of the Shuttle.

1995 – First rendezvous with Mir. Space shuttle orbiter Discovery performed a fly-around, but did not dock.

March 14, 1995 - First astronaut on Mir, Norm Thagard

June 27, 1995 – First docking (STS-71)

November 15, 1995 - New Docking Module (STS-74)

1996 – Continues US presence (starting with STS-76 on March 22)

1998 – Last of seven astronauts on Mir, Andy Thomas , was picked up by STS-91. Phase 1 came to a close.

2001– Mir re-entered

## Celebration

*Above: Left to right, ?, David Wolf, Gary Kitmacher, ?, David Hanson. Image credit: Svetlana Hanson*


*Left: The cake. Image credit: Ed Bowers*

Yuri's Night

# Space Fest and Yuri's Night Houston 2011

MICHAEL FROSTAD, YOUNG PROFESSIONALS

The days of April 10th through April 17th were a busy week for AIAA Houston. During that time five events were attended, three of which were planned by AIAA Houston. These events were to celebrate Humanity's first steps into Space, specifically Yuri Gagarin's flight of Vostok-1 and STS-1 Space Shuttle Columbia's first flight.

The week began with Space Day on April 10th which was a partnership of AIAA Houston, Excalibur-Almaz, and the Society of Women Engineers to provide space exhibits and hands-on activities at Discovery Green in downtown Houston. Spacesuits and water rockets carried the day to excite young minds passing through the park.

The next event was hosted by the Houston Museum of Natural Science with the AIAA Yuri's Night team, NASA, and the University of Houston working in partnership for a 'SpaceGeek' Tweetup. The tweetup was an event for tweeting space enthusiasts to meet in person and share their passions for space exploration. The event culminated in the viewing of clips of the HMNS planetarium shows.

The 'SpaceGeek' Tweetup was a pre-event for Dr. Neil deGrasse Tyson's talk at the University of Houston the following day. Prior to his talk we joined the HMNS in the MD Anderson Library and spoke to students about spaceflight firsts before attending Dr. Tyson's talk. His talk was to a packed house and many people had to be turned away at the door. His talk was about the past, present, and future of America in Space — a very timely topic that was very engaging and well done.

The next event in the line-up was at Challenger 7 Memorial Park, the Yuri's 5k

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*Image credits: Yuri's Night Houston 2011*

*(Continued from page 74)*

Fun Run. It is a great course for an early morning race in April with a variety of surfaces and scenery to run through. In addition there is also a kids 1k run prior to the main event that is also a lot of fun. This event was a great success this year with over 400 people coming out in the early morning to raise nearly $5000.00 for the Challenger Learning Center for Space Science Education.

The final event of the week took place April 17th at the House of Blues, Yuri's Night Houston 2011. The event started with a viewing of a space documentary entitled Orphan's of Apollo introduced by the director Michael Potter. Then it was time for a great local band to take the stage – The Jud Johnson Band. Their music lit up the House of Blues and as the 501st Squadron made their way through the crowd things really got moving. Following the great music of The Jud Johnson Band was the Zero-G raffle, the chance for one lucky winner to experience weightlessness. This year there were also other prizes from Excalibur-Almaz and a private donor. Excalibur - Almaz gave away a very nice glass enclosed model of their spacecraft.

The private donor gave away a framed poster of Yuri Gagarin with an engraved quote that read as follows:

> *Circling the Earth in my orbital spaceship I marveled at the beauty of our planet. People of the world, let us safeguard and enhance this beauty – not destroy it!'- Yuri Gagarin.*

After the raffle the night continued with one final band directly from JSC, The Rocket Scientists. If you want some talented people, The Rocket Scientists are the real deal by day and definitely helped rock the night away too!

And with the close of events for the week another celebration of Human Space Flight firsts was complete in Houston. We would like to thank some of our sponsors of Jacobs Technology, Excalibur – Almaz, and ERC. Without their support these events for the public and industry would not be possible. Furthermore, we would like to thank all the people who supported the events; we hope to see you again next year!

## Yuri's Night

*Image credits: Yuri's Night Houston 2011*

Anniversaries

# AIAA Membership Anniversaries

DOUGLAS YAZELL, EDITOR & LISA VOILES, MEMBERSHIP CHAIR

Our membership and community congratulate these distinguished members celebrating AIAA anniversaries of 25, 40, and 50 years!

**25 Years**

Juergen F. Bahr
Mr. David A. Blake
Dr. Rodney D. Bowersox
Dr. John F. Cashen
Mr. Jerry R. Goodman
Mr. Dennis. Halpin
Tuyen Hua
Dr. Amos S. Johnson
Dr. Hyoung M. Kim
Patrick K. LeMoine
Dr. Ronald G. Lovely
James C. McLane, III
Dr. Jon B. Olansen
Mr. Kevin S. Partin
Dr. Jayant V. Ramakrishnan
Jesus Reyna
Mr. David L. Strack
Dr. John Valasek

**40 Years**

Mr. Jonathan C. Coopersmith
Mark K. Craig
Mr. Thomas S. Honeycheck
Frank E. Hughes
Mr. John V. Rivers
Mr. Darrell E. Stamper

**50 Years**

Mr. James C. McLane, Jr.

We note at least two past Chairs of AIAA Houston Section in this list, Dr. Jayant Ramakrishnan and James C. McLane, Jr.

We thank Dr. John Valasek of Texas A&M University for outstanding and sustained contributions to AIAA and AIAA Houston Section.

Frank Hughes was one of three panelists last year at our section's lunch-and-learn celebrating the 40th anniversary of Apollo 12.

We note with great appreciation the father and son pair, the father, James C. McLane, Jr. (50 years), and the son, James C. McLane III (25 years).

We thank James C. McLane III for those inspiring articles in recent issues and the current issue of Horizons. We encourage him to prepare more such articles for us in the coming months and years.

James C. McLane, Jr. was our section chair for the 1971-1972 year, as noted on our section's web page for our history technical committee. A 1948 graduate of Clemson University, he was a P-51 Mustang fighter aircraft pilot in combat in 1945, serving in the United States Army Air Force, which he joined in 1943. His Mustang fighter group was the famous 357th, where the later famous speed-of-sound-breaking pilot Chuck Yeager had already come and gone.

From 1948 to 1951, Mr. McLane worked for the National Advisory Committee for Aeronautics in Hampton, Virginia, at the Langley Aeronautical Laboratory. From 1951 to 1963, he was located at the Arnold Engineering Development Center (AEDC), Arnold Air Force Base, in Tullahoma, Tennessee. From 1960 to 1963, he was a Civilian Supervisory Engineer, Space Chamber Technology, United States Air Force.

His NASA experience was at the Johnson Space Center (formerly called the Manned Spacecraft Center) in Houston from 1963 to 1981. He was awarded the NASA Exceptional Service Medal in 1969.

From 1967 to 1981, he was the NASA/JSC Chief of the Space Environment Test Division in the Engineering and Development Directorate.

Thanks to the NASA/JSC oral history project biographical data sheet for those details about Mr. McLane's career. That oral history recording was conducted on November 13, 2000. A few notes about his military career are here: http://www.world-wartwo.co.uk/second_world_war_signatures.php?Signature=512

And let the record show that as a teenager he built and flew the second gasoline-powered model airplane to fly in South Carolina.

Congratulations again to all of these listed honorees for these 25, 40, and 50 year membership anniversaries with AIAA!

*Below: Major James C. McLane, Jr., circa 1945. Image credit: the McLane family. Image taken from that WW II web site specified at right.*

# International Astronautical Federation 2011 Frank J. Malina Astronautics Medal

PHILIPPE MAIRET, 3AF TMP

3AF TMP

*3AF TMP: l'Association Aeronautique et Astronautique de France, Toulouse - Midi-Pyrenees chapter*

*Our French sister section is 3AF TMP. See our web page at www.aiaa-houston.org (technical committees, international space activities committee).*

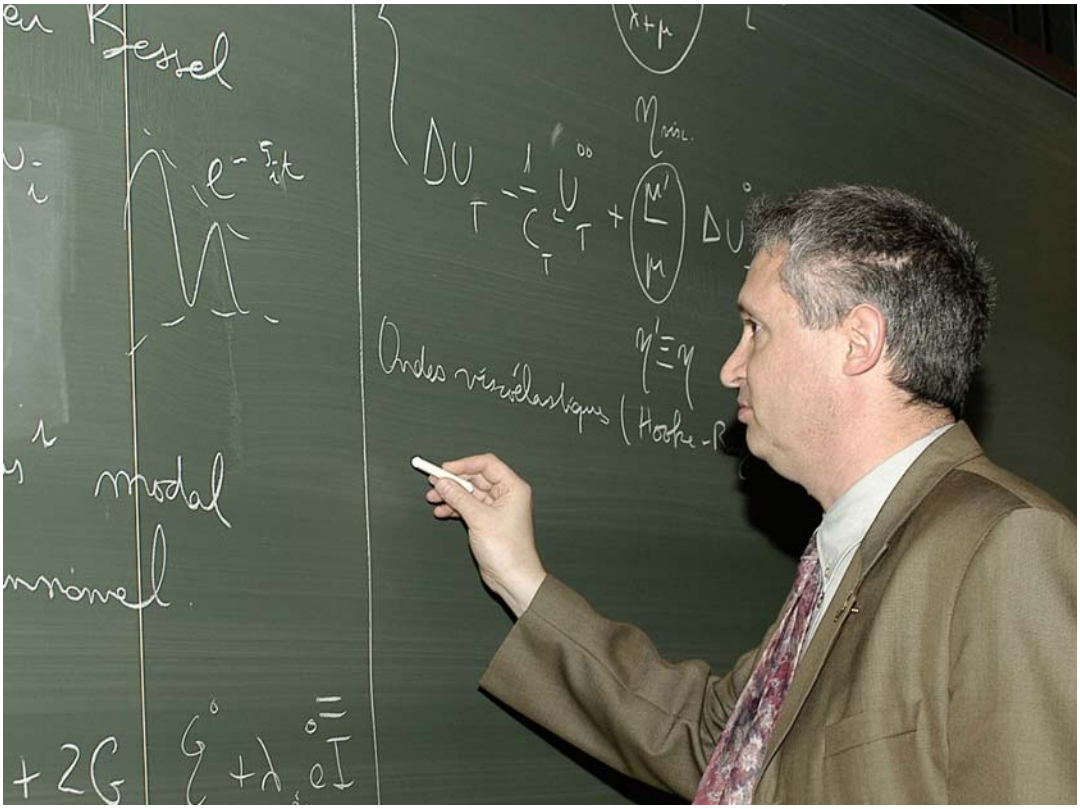
*English translation by Douglas Yazell.*

The International Astronautical Federation (IAF) recently awarded the 2011 Frank J. Malina Astronautics Medal to Yves Gourinat, a professor at The Institute Superior for Aeronautics and Space (ISAE) in Toulouse, France, and a member of l'Association Aeronautique et Astronautique de France (3AF), Toulouse – Midi-Pyrenees chapter (3AF TMP). This will be presented to him during the closing ceremony of the 62nd International Astronautical Congress in October of 2011 in Cape Town, South Africa.

Frank Joseph Malina, founder of The Jet Propulsion Laboratory (JPL), died in 1981. The IAF created a medal to be awarded in his name in remembrance of his recognized investment in the service of space programs.

"The IAF annually awards the Frank J. Malina Astronautics Medal for outstanding contributions to space education, to an educator who promotes the study of astronautics and space science. The most important criterion for this award is that he/she has taken the fullest advantage of the resources available to him/her to promote the study of astronautics and related space sciences."

The first laureate was Christa McAuliffe, the schoolteacher who died as part of the crew during the Challenger accident. Yves Gourinat is the second French citizen to receive this award. The first was Andre Lebeau in 1988.




*Left: 2011 IAF Frank J. Malina Astronautics Medal awardee Yves Gourinat. Image credit: ISAE*

E-Publication

# Aerospace Projects Review: Bell D-109 VTOL

SCOTT LOWTHER

*Aerospace Projects Review (APR) is presented by Scott Lowther, whose unique electronic publication is described as a "journal devoted to the untold tales of aero-spacecraft design." More information, including subscription prices, may be found at the following address:*

*Scott Lowther*
*11305 W 10400 N*
*Thatcher, UT 84337*
*scottlowther@ix.netcom.com*
*http://www.up-ship.com*

Bell Aircraft Corporation had studied VTOL fighters at least as far back as 1941, when a patent was applied for by Arthur Young for a tailsitter fighter utilizing a radial piston engine and contra-rotating props. Bell was studying helicopters at the time, and this configuration was an obvious outgrowth. Several designs for tailsitter "Convertoplanes" were produced, apparently also including jet-powered versions, shortly after WWII.

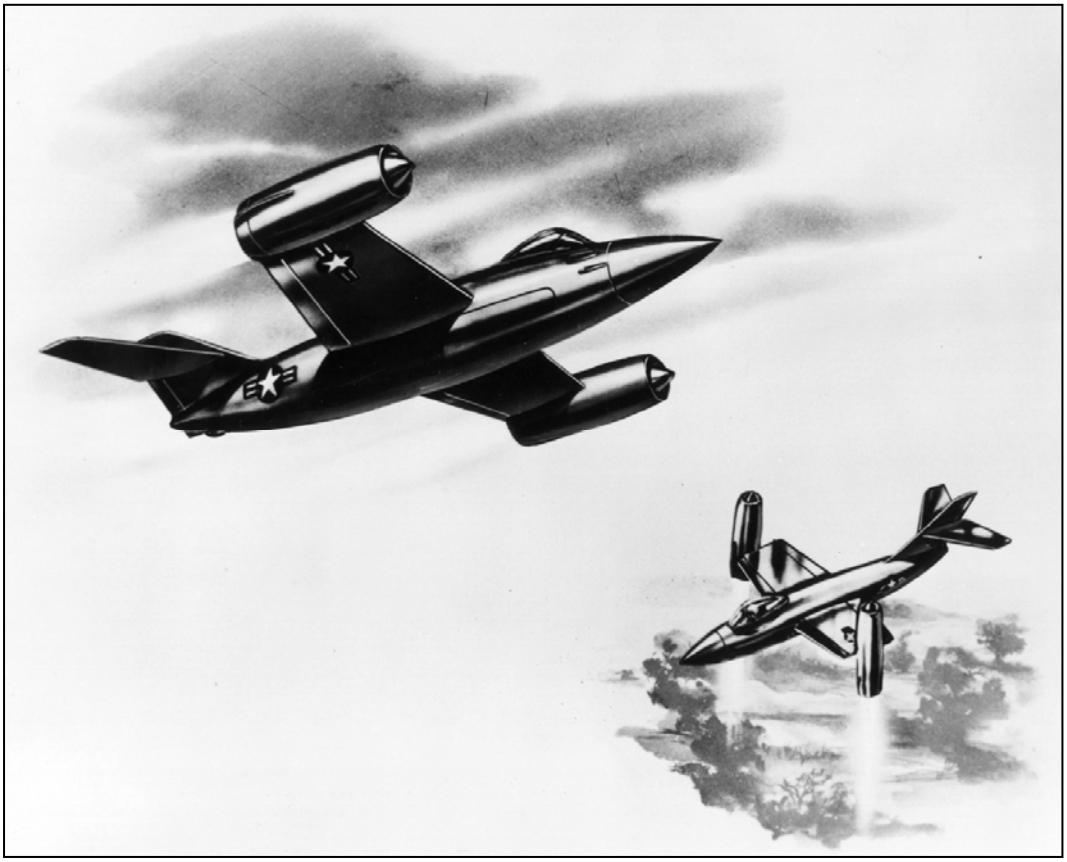
Jet engines became available during the Second World War and it was obvious that they were here to stay. The use of jet engines for VTOL propulsion was considered early on; however, early jet engines had such poor thrust to weight ratios that it was some years before realistic concepts arose.

By 1951, the Bell Aircraft Corporation had produced a design for Model D-109 Jet Convertoplane Fighter. This straightforward design featured a single seat fighter of generally conventional lines for the time; the only difference of note was the two engines mounted at the wingtips. The engine nacelles could rotate so that thrust was directed downwards, providing thrust for vertical flight. Compared to tailsitter concepts, the D-109 provided a more aerodynamic vehicle, better capable of flying and fighting at high speed; it also provided a much better environment for the pilot during takeoff and landing. Instead of having to have complex rotating cockpits or clumsy mirrors to see the landing field, the pilot of a D-109 could simply look out his canopy as usual. The horizontal position of the fuselage while on the ground also made for much easier pilot access and re-armament and maintenance access.

Along with the rotating wingtip jet engines, the D-109 had several features unusual for a similar, conventional aircraft. The complex

*(Continued on page 79)*

*Right: Bell artwork of the D-109 (via Niagara Aerospace Museum)*



*(Continued from page 78)*
wheeled landing gear of conventional aircraft was replaced with a much simpler retractable skid system, which folded against the side of the fuselage rather than stowing within the fuselage. This system saved weight, cost and complexity; and with vertical takeoff and landing, wheels weren't needed. Small deployable castor wheels were mounted to the skids so that ground crews could move the aircraft around without great difficulty. Emergency horizontal landings were possible with the skids; in fact, the skids allowed for safer water landings than if the aircraft was equipped with conventional wheeled landing gear.

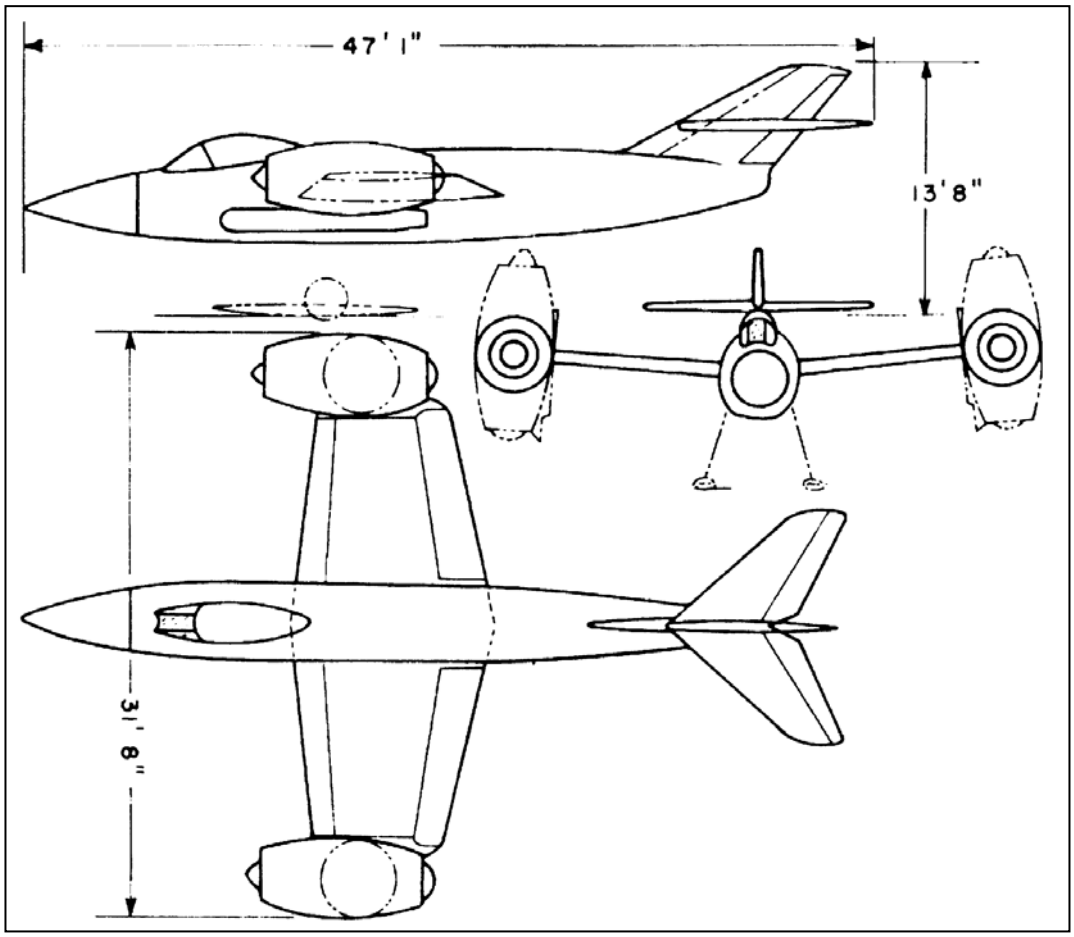
Another unusual feature was the inclusion of two 6500 pound-thrust liquid fuel rocket engines for takeoff assistance. For basic fighter missions (guns only), the D-109 was capable of taking off with just the jet engines; but to carry heavier loads (fuel, bombs, rockets), the use of nitric acid/gasoline rocket engines mounted near the aircraft CG was needed. Propellants for 20 seconds duration was to be carried.

The control surfaces were largely conventional in nature, but at low speeds they would provide no control at all. For yaw at hovering speeds, the engine nozzles could be tilted fore and aft differentially. Pitch control was by tilting the nozzles together. Roll control was by differential thrusting of the engines.

As the aircraft transitioned from hovering to forward flight or vice versa, both types of control systems would be used. But difficulty would arise from the tilting nozzles… the system which would provide yaw control in hover would become roll control in horizontal flight. A "scrambling" device would be used to control this. Automatic controls would be used during hover, as the aircraft would be statically unstable. However, it was expected that even without automatic systems the pilot could still easily handle the aircraft in hover, as the periods around all three axes were well damped.

Armament consisted of four cannon in the nose. Sec-

*(Continued on page 80)*




*Left: Bell D-109-I Jet Fighter. Image credit: NASA*

## E-Publication

*(Continued from page 79)*
ondary armament could be carried in an internal bomb bay 33" by 33" by 200" long. This bay was located near the CG.

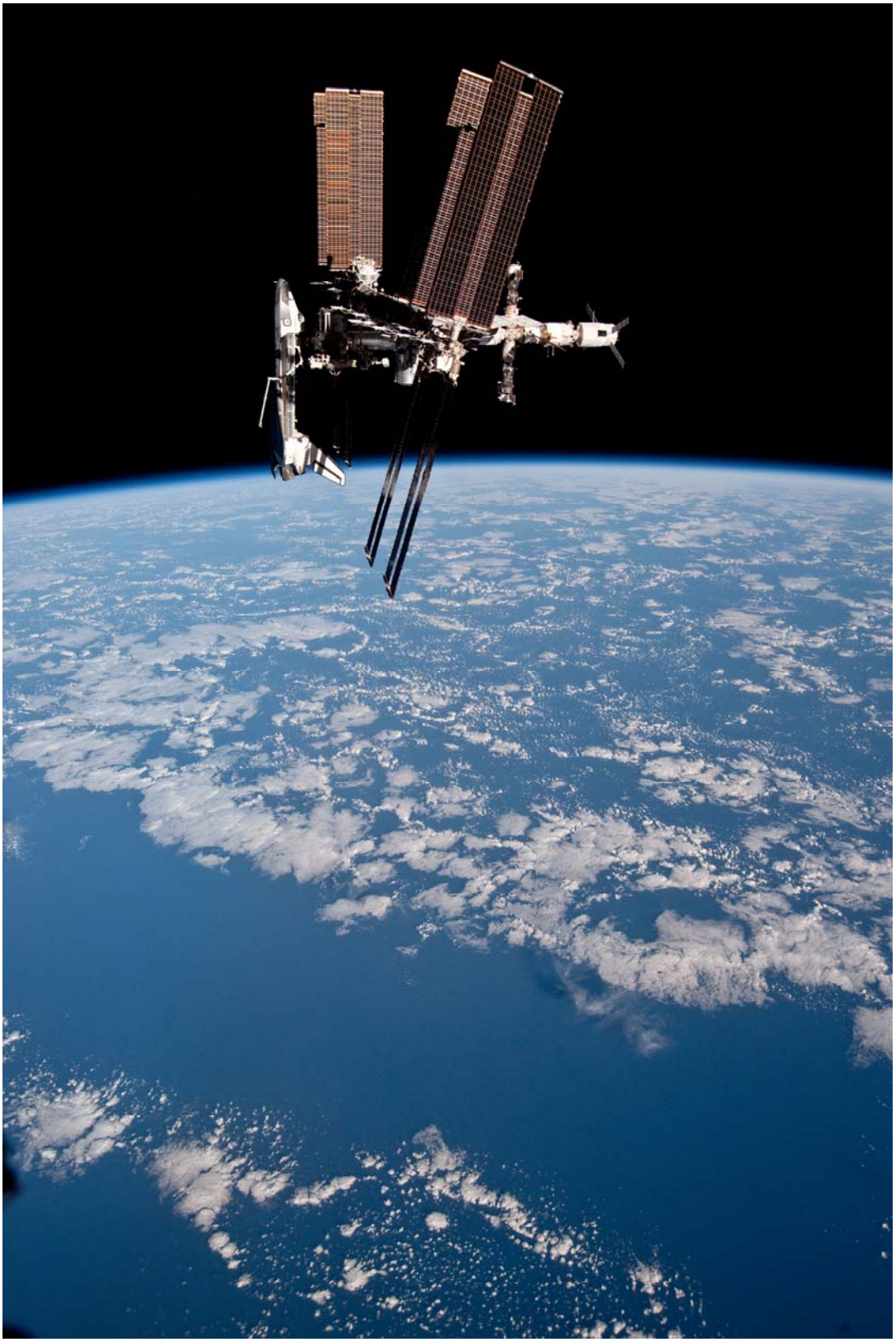
The D-109 was equipped with two Allison J33-A-16 jet engines, providing thrust of 7900 pounds each with afterburners, and weighing 1935 pounds each. These were rather early jet engine designs, being derivatives of the first American engines used on the Lockheed P-80. They were short in length, but large in diameter. While performance was limited, the engines provided the advantage of being readily available and well proven.

Though Bell did not receive funding to build the D-109, interest in VTOL fighters did not fade. Within just a few years, Bell would produce other, more detailed VTOL fighter designs and also have a test vehicle in the sky. The ultimate result of the D-109 study was the D188A design, a Mach 2 VTOL strike fighter with eight engines. This 1960 concept progressed to the point of several full-scale mockups. Bell tried to get the designation "XF-109" for the D188A but in the end neither the US Navy nor the US Air Force were interested. However, if your are interested in more on the D-109 or the D188A (and the designs in between), a book has been written on the subject: "Bell D188A: Mach 2 VTOL Fighter Project," available at http://scottlowther.magcloud.com

**D-109 Data**

| | |
|---|---|
| High speed, sea level | 630 knots |
| High speed, 35,000 ft | 572 knots |
| Best endurance, 35,000 ft | 326 knots |
| Endurance, 35,000 feet | |
| 862 gallons fuel | 2.66 hours |
| 1262 gallons fuel | 3.82 hours |
| Range at 35,000 ft (after climb) | |
| 862 gallons fuel | 986 n.m. |
| 1262 gallons fuel | 1400 n.m. |
| Best range speed, 35,000 ft | 416 knots |
| Rate of climb, sea level | 19,150 fpm |
| Service ceiling | 54,400 feet |
| Time to climb 35,000 ft | 2.67 minutes |
| Acceleration in VTO | 14.9 ft/sec² |
| Guns: | |
| 4-20mm or 4-30mm | |
| Ammunition: 600 rnds (20mm) or 400 rnds (30mm) | |
| Overload armament: 4000 pounds | |
| T.O. Wt. Normal | 19,640 lbs |
| T.O. Wt. Overload | 23,640 lbs |

## NASA Photos



*ISS027-E-036737 (23 May 2011) --- This image of the International Space Station and the docked space shuttle Endeavour, flying at an altitude of approximately 220 miles, was taken by Expedition 27 crew member Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23, 2011 (USA time). The pictures are the first taken of a shuttle docked to the International Space Station from the perspective of a Russian Soyuz spacecraft. Onboard the Soyuz were Russian cosmonaut and Expedition 27 commander Dmitry Kondratyev; Nespoli, a European Space Agency astronaut; and NASA astronaut Cady Coleman. Coleman and Nespoli were both flight engineers. The three landed in Kazakhstan later that day, completing 159 days in space. Image credit: NASA*

*http://spaceflight.nasa.gov, space station, Expedition 27*

# Staying Informed

COMPILED BY THE EDITOR

**Amazing Wide Angle Photos Taken Outside of the Space Station**
Thanks to Keith Cowing at www.nasawatch.com for publicizing these pictures.
http://www.onorbit.com/node/3422
http://spaceflight.nasa.gov (space station gallery, Expedition 28)

**AIAA Guidance, Navigation, and Control Conference**
**AIAA Atmospheric Flight Mechanics Conference**
**AIAA Modeling and Simulation Technologies Conference**
8 - 11 Aug 2011, Oregon Convention Center, Portland, Oregon (www.aiaa.org)

**Enjoy Space (www.enjoyspace.com/en)** Editor: Olivier Sanguy
English language version of a French web site devoted to space news and history

**Espace & Exploration (Space & Exploration) www.espace-exploration.com**
New French magazine devoted to space and exploration. Editor: Marie-Ange Sanguy.

**Marianne Dyson (www.mariannedyson.com)**
Author and speaker specializing in space and science. Marianne is a former NASA flight controller. She was master of ceremonies for our section's Apollo 8 40th anniversary lunch-and-learn.

**CollectSPACE.com (www.collectSPACE.com)** The Source for Space History and Artifacts.

**The Space Center Lecture Series (www.SpaceCenterLectureSeries.com)**
Created by Gary Kitmacher and Dr. Benjamin Longmier.
Our section has been a sponsor of this event since it started with a lecture by Apollo 17 moonwalker Harrison Schmitt. The most recent lecturer was Mary Roach, author of the new, best-selling book, Packing for Mars. Videos of this event and past lectures are available on the web site.

**Project Morpheus (Text description from the NASA web site)**

Morpheus is a vertical test bed demonstrating new green propellant propulsion systems and autonomous landing and hazard detection technology. Designed, developed, manufactured and operated in-house by engineers at NASA's Johnson Space Center, the Morpheus Project represents not only a vehicle to advance technologies, but also an opportunity to try out "lean development" engineering practices.

Morpheus is a NASA-designed vehicle. It was manufactured and assembled at JSC and Armadillo Aerospace. Morpheus is large enough to carry 1,100 pounds of cargo to the moon – for example, a humanoid robot, a small rover, or a small laboratory to convert moon dust into oxygen – performing all propellant burns after the trans lunar injection. The primary focus of the test bed is to demonstrate an integrated propulsion and guidance, navigation and control system that can fly a lunar descent profile to exercise the Autonomous Landing and Hazard Avoidance Technology (ALHAT) safe landing sensors and closed-loop flight control.

For more information about Morpheus testing, visit: http://morpheuslander.jsc.nasa.gov/

Calendar

**AIAA Houston Section events and other events related to aeronautics and astronautics**

Editor's note about recent and upcoming issues of Horizons:
July 2010: This was intended for publication online by June 30, 2010. It was a few days late.
May 2011: This was targeted for publication by September 30, 2010, then April 30, 2011. It was a few weeks late relative to that latter date. It was published on May 17, 2011.
June 2011: This issue is targeted for publication at www.aiaa-houston.org by June 30, 2011.
August 2011: This upcoming issue is targeted for publication online by August 31, 2011. Our schedule was quarterly for the two years ending with the July 2010 issue. We now plan to use a bimonthly schedule.

**AIAA Houston Section council meetings**

Time: 5:30—6:30 PM
Day: First Monday of most months
Location: Recent meetings used the San Jacinto room at NASA/JSC Gilruth Center
More information: chair@aiaa-houston.org or events@aiaa-houston.org

**AIAA Houston Section leadership retreat**

This annual event usually takes place in August. See the organization chart at www.aiaa-houston.org for contact information if you would like to join the meeting in order to help with our volunteer work.

**8 - 11 Aug 2011**

AIAA Guidance, Navigation, and Control Conference
AIAA Atmospheric Flight Mechanics Conference
AIAA Modeling and Simulation Technologies Conference
Oregon Convention Center, Portland, Oregon
www.aiaa.org

**15 October 2011 (Saturday) Wings Over Houston Airshow**

Our section will join the Experimental Aircraft Association (EAA) Chapter 12 (Houston) and collectSPACE (www.collecSPACE.com, or just collectSPACE.com), placing our displays and tables together. Our section and collectSPACE will not be there on Sunday, but the EAA group will be there on Sunday.

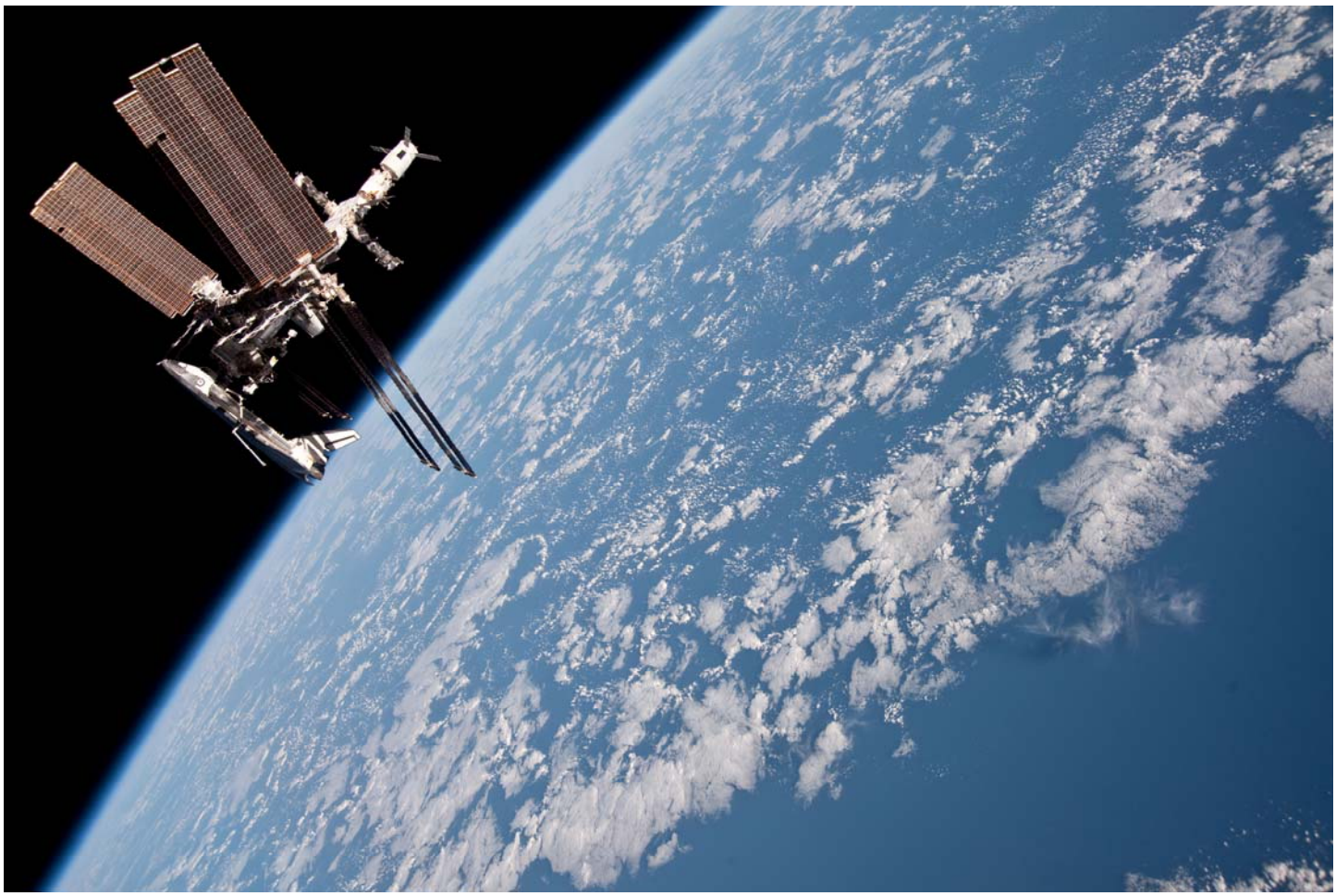
*Horizons will be published bimonthly starting in late June 2011. Current & back issues: http://www.aiaa-houston.org/horizons*

## NASA Photos

*ISS027-E-036747 (23 May 2011) --- This image of the International Space Station and the docked space shuttle Endeavour, flying at an altitude of approximately 220 miles, was taken by Expedition 27 crew member Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23, 2011 (USA time). The pictures are the first taken of a shuttle docked to the International Space Station from the perspective of a Russian Soyuz spacecraft. Onboard the Soyuz were Russian cosmonaut and Expedition 27 commander Dmitry Kondratyev; Nespoli, a European Space Agency astronaut; and NASA astronaut Cady Coleman. Coleman and Nespoli were both flight engineers. The three landed in Kazakhstan later that day, completing 159 days in space.*

*http://spaceflight.nasa.gov, space station, Expedition 27*

*Image credit: NASA*

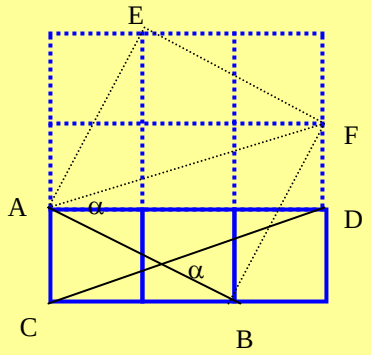


# Cranium Cruncher

Challenge

STEVE EVERETT

Recall from the last issue, the reader was asked to find the angle a defined in the figure below without using trigonometry. With a few additional lines, the answer may be found by inspection! The solid blue squares with line segments AB and CD were shown in the original figure. By adding the additional blue dotted squares, it is obvious that the quadrilateral AEFB is a square. Additionally, since the line segment AF is parallel to the segment CD, angle FAB also spans the angle a. AF is a diagonal for the square AEFB, so by inspection the angle a is equal to 45 degrees. Congratulations to Paul Grout (Boeing) for his correct solution, albeit by a more roundabout method , and my apologies to those who tried to response but couldn't due to a typographical error in my email address.




Now for this issue's puzzle, a self-referential aptitude test.

The following unusual logic puzzle was designed by Jim Propp, a mathematician at the University of Wisconsin at Madison. It has a unique solution, although it is possible to find the unique solution without making use of this fact. Jim writes:

*I should mention that if you don't agree with me about the answer to 20, you will get a different solution to the puzzle than the one I had in mind. But I should also mention that if you don't agree with me about the answer to 20, you are just plain wrong!*

1. The first question whose answer is B is question
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

2. The only two consecutive questions with identical answers are questions
(A) 6 and 7 (B) 7 and 8 (C) 8 and 9 (D) 9 and 10 (E) 10 and 11

3. The number of questions with the answer E is
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

4. The number of questions with the answer A is
(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

5. The answer to this question is the same as the answer to question
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

6. The answer to question 17 is
(A) C (B) D (C) E (D) none of the above (E) all of the above

*(Continued on page 86)*

## Challenge

*(Continued from page 85)*

7. Alphabetically, the answer to this question and the answer to the following question are
(A) 4 apart (B) 3 apart (C) 2 apart (D) 1 apart (E) the same

8. The number of questions whose answers are vowels is
(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

9. The next question with the same answer as this one is question
(A) 10 (B) 11 (C) 12 (D) 13 (E) 14

10. The answer to question 16 is
(A) D (B) A (C) E (D) B (E) C

11. The number of questions preceding this one with the answer B is
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

12. The number of questions whose answer is a consonant is
(A) an even number (B) an odd number (C) a square (D) a prime (E) divisible by 5

13. The only odd-numbered problem with answer A is
(A) 9 (B) 11 (C) 13 (D) 15 (E) 17

14. The number of questions with answer D is
(A) 6 (B) 7 (C) 8 (D) 9 (E) 10

15. The answer to question 12 is
(A) A (B) B (C) C (D) D (E) E

16. The answer to question 10 is
(A) D (B) C (C) B (D) A (E) E

17. The answer to question 6 is
(A) C (B) D (C) E (D) none of the above (E) all of the above

18. The number of questions with answer A equals the number of questions with answer
(A) B (B) C (C) D (D) E (E) none of the above

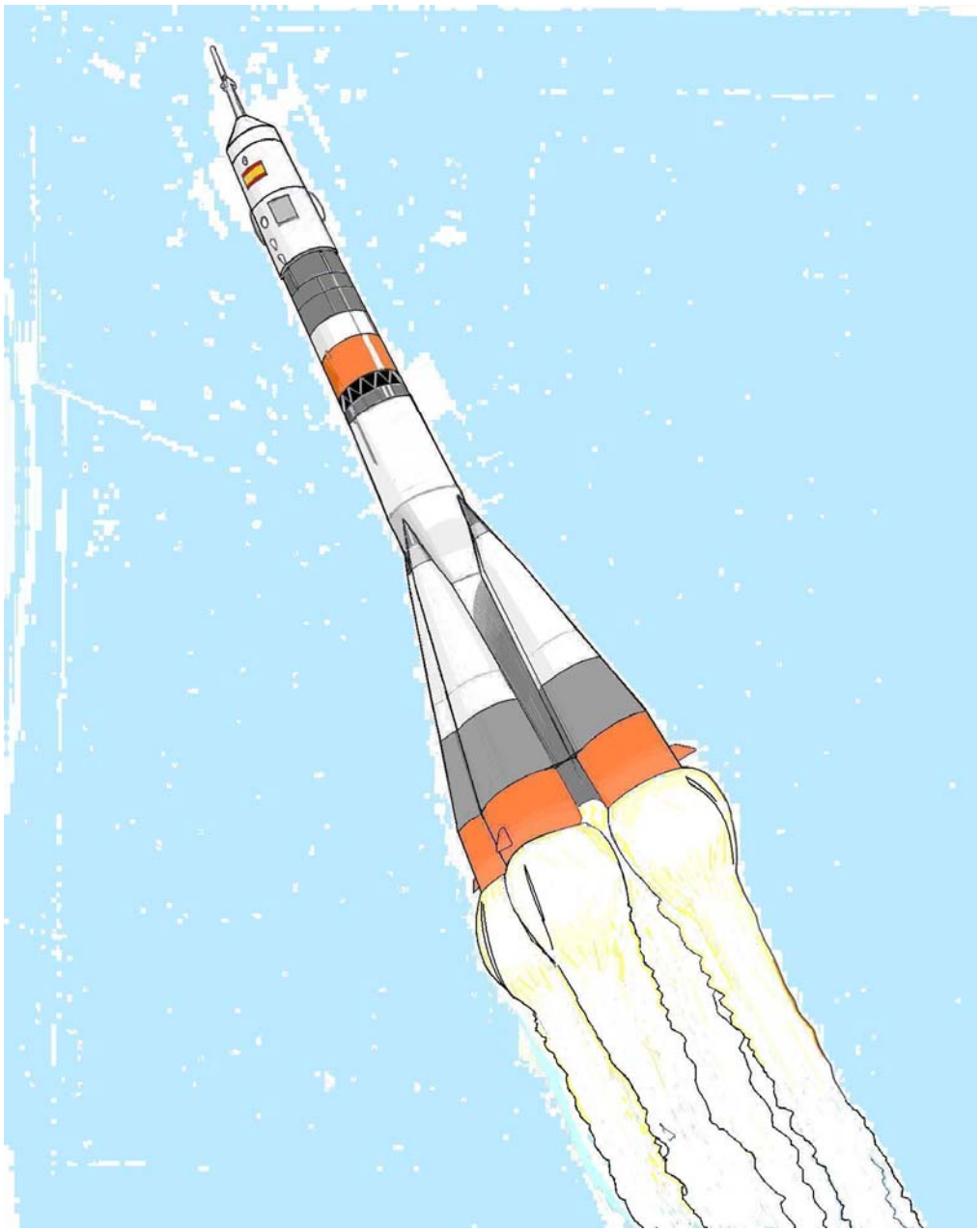
19. The answer to this question is
(A) A (B) B (C) C (D) D (E) E

20. Standardised test is to intelligence as barometer is to
(A) temperature (B) wind velocity (C) latitude (D) longitude (E) temperature, wind velocity, latitude, and longitude

Send solutions to steven.e.everett@boeing.com

*Below: Soyuz launch to International Space Station (ISS), illustration and text by Don Kulba, contributor*

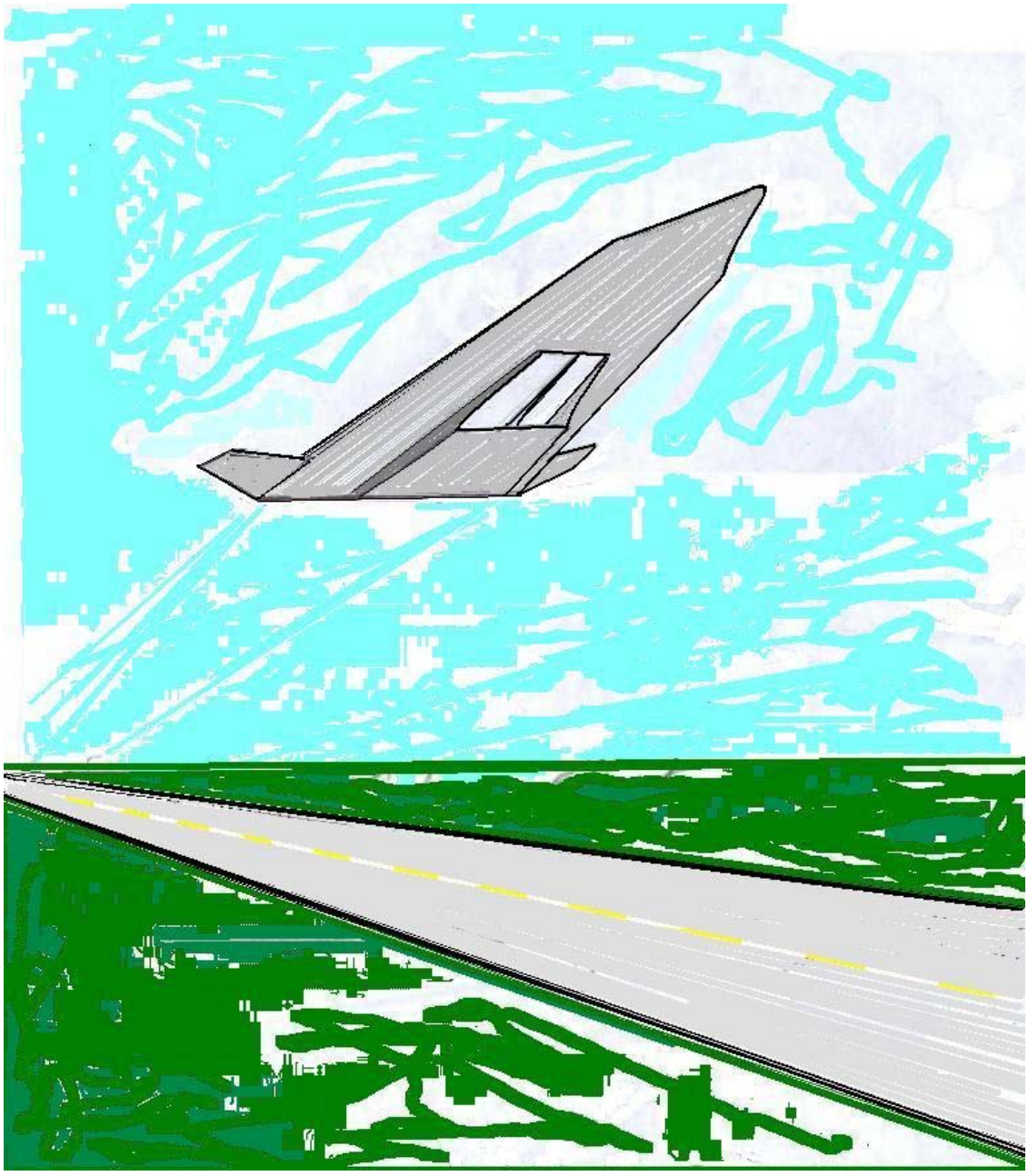
Conventional rockets and potentially other innovative types of vehicles will be used to transport cargo and crewmembers to the ISS after the last US space shuttle flight. The Soyuz has been flown for fifty years and is a relatively safe and reliable vehicle. One of the reasons for retiring the space shuttle is to improve safety for crewmembers by transporting them in a separable capsule as opposed to the crew compartment that is an integral and inseparable part of the shuttle structure. A capsule can be equipped with an abort rocket to lift it away from a launch rocket that is showing indications of imminent failure or going too far off course. This is a significant safety improvement. A further improvement might be to make the capsule capable of withstanding a sudden explosion of the launch rocket in case the abort rocket is not activated or fails, the capsule breaking free from the rocket and gliding away as it falls from the burning fuel and debris, then automatically deploying parachutes at the correct altitude and landing safely on land or water with the crew inside.



## Art

*Below: Orbital space plane takeoff, illustration and text by Don Kulba, contributor*

If orbital space planes are developed, they will be much more efficient than manned rocket launchers. They would have far less oxidizer and vehicle weight. A first stage is not required, so they could take off and land on a runway. There would be no stage separation, which is a leading cause of failure on rocket vehicles. The planes could use the jet engines for landing if the ram jets fail when attempting to build up to orbital speed high in the atmosphere. A fuel or propulsion system explosion should be less likely than on conventional rocket vehicles. If there were an engine failure or fuel leak, the craft may be able to land safely with the functioning jet engines (or possibly the rocket engines).



## Art

*Below: General Dynamics F-16, illustrated by Don Kulba, contributor*

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STS134-S-002 (15 Jan. 2010) --- Attired in training versions of their shuttle launch and entry suits, these six astronauts take a break from training to pose for the STS-134 crew portrait. Pictured clockwise are NASA astronauts Mark Kelly (bottom center), commander; Gregory H. Johnson, pilot; Michael Fincke, Greg Chamitoff, Andrew Feustel and European Space Agency's Roberto Vittori, all mission specialists. Photo credit: NASA

ISS027-E-036759 (23 May 2011) --- This image of the International Space Station and the docked space shuttle Endeavour, flying at an altitude of approximately 220 miles, was taken by Expedition 27 crew member Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23, 2011 (USA time). The pictures taken by Nespoli are the first taken of a shuttle docked to the International Space Station from the perspective of a Russian Soyuz spacecraft. Onboard the Soyuz were Russian cosmonaut and Expedition 27 commander Dmitry Kondratyev; Nespoli, a European Space Agency astronaut; and NASA astronaut Cady Coleman. Coleman and Nespoli were both flight engineers. The three landed in Kazakhstan later that day, completing 159 days in space. Photo credit: NASA

AIAA Mission & Vision Statement

*The shaping, dynamic force in aerospace - THE forum for innovation, excellence and global leadership. AIAA advances the state of aerospace science, engineering, and technological leadership. Core missions include communications and advocacy, products and programs, membership value, and market and workforce development.*

***The World's Forum for Aerospace Leadership***

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