Horizons

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Hayabusa's Return Home

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Spring 2010

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Cover: Artist's conception of the Hayabusa spacecraft during its visit to the asteroid Itokawa. After encountering various difficulties during the mission, the spacecraft is scheduled to return to Earth this June.

Turning Point

As you are aware, there have been some major changes in the future of manned spaceflight since our last issue. Chances for an extension of the Shuttle program were all but gone for some time, Altair was put on hold indefinitely until plans were finalized by the White House, and then finally rumors about cancellation of the Constellation program altogether materialized with the January announcement of President Obama's budget plan. It appears that the main message behind the Augustine Commission, that NASA has not been funded to a level commensurate with its mission, resulted in a scaling back of goals rather than an increase in budget.

However, rather than pity ourselves as the one generation in history potentially both too young and too old to have participated in a manned mission to another body in the Solar System, for those of us working in the Shuttle program, it is worth reflecting on our blessings. Many of our careers have been almost exclusively comprised of Shuttle-related activities, almost unheard of in an industry in which projects generally have lifespans measured in months rather than decades. Future generations will also regard the Space Shuttle, a reusable space vehicle capable of missions as diverse as Space Station construction, satellite servicing, and microgravity research facility, as ahead of its time in history.

With the end of the Shuttle program, members of our profession will now have to become reacquainted with the volatility for which the aerospace industry is known. Re-evaluation of NASA's direction will no doubt delay real progress in manned spaceflight in the immediate future, but also will have major ramifications on contractors in the Houston area. While we may not have seen the end of the Constellation program yet (recall that in June 1993, a bill to cancel the Space Station program failed by one vote in the House of Representatives) we will soon see a reshuffling of personnel among contractors and projects in the next few years.

Along the lines of change, we will also soon be seeing a change in the editor for our newsletter Horizons. The next issue planned for June will be my last as editor, so I'd like to invite anyone who is interested in the position to contact me or our local chapter chairperson. As editor I have had the privilege of interacting with employees from other contractors and local businesses with whom I would otherwise have had no contact. There is no better time to remember the advantages of networking among colleagues as afforded by AIAA involvement.

From the Editor

From the Chair

Chair's Corner

ELLEN GILLESPIE, SECTION CHAIR

The President has presented the NASA community with an R&D challenge while commercializing low Earth orbit flight. This is a turning point in our country's space program.

Here at JSC, we've been part of an incredible time in our industry. We've had the opportunity to mature and operate the Space Shuttle to the vehicle it is today while ISS grew to a research grade facility.

Last year was the 40th anniversary of the Apollo Program. As we continue to celebrate this anniversary and take the time to look back on all of our accomplishments, we can consider what lies ahead. An increased NASA budget will enable us to pursue new technology development to take us to the stars.

Our AIAA Houston events for the rest of this year will provide us with a look ahead.

In the immediate future, a Space Center Lecture Series (www.spacecenterlectureseries.com) is to be held on "Collecting and Curating the Space Shuttle" by Robert Pearlman.

Our Annual Technical Symposium (ATS) 2010 is planned for April 30 and will include a session on Space Shuttle Knowledge Capture. We plan to use ATS 2010 as an opportunity to bring forward new technology topics as well as to review the excellent technical achievements made in the Constellation Program by JSC.

The Houston Section is hosting the AIAA Region IV Student Paper Conference this April first and second. Our local students will be bringing forth their work and new ideas as we move into R&D projects. Consider volunteering for this opportunity to meet the next generation of Aerospace Engineers to join the market. Even if you do not have time to volunteer, an AIAA Houston Section dinner meeting is planned during the conference to give our students a chance to meet the current Houston professionals. Our Region IV Director, James Walker, is to speak on Near Earth Objects at the dinner meeting.

We're planning to end the year with an Awards Dinner presentation on June 26th by our Distinguished Lecturer Dr. John Purvis on "Accident Investigation." Dr. Purvis is an expert on this topic with 41 years of experience at Boeing.

Let's thoroughly enjoy the rest of the last year of space shuttle operations and set ourselves up for the exciting new work to come. See you there!

Event

George Observatory Event Report

ELLEN GILLESPIE, SECTION CHAIR

The AIAA Houston Section had the opportunity to visit the George Observatory on Saturday January 30th.This stargazing event was originally planned for January 16th, but clouds and rain on that date obscured visibility causing a two week postponement.

The George Observatory is a satellite facility of the Houston Museum of Natural Science. Museum members receive the museum discount when visiting the George.

The George has a beautiful facility in the Brazos Bend State Park one hour south of Houston. George directions are marked from Hwy 288 South.

There are three domed telescopes at the George Observatory: the largest is the 36 -inch Gueymard Research Telescope, one of the largest telescopes in the nation open to the public on a regular basis. The George Observatory has a 11 inch F 15 refracting telescope. The 11 inch is mounted on the Gueymard 36" (.9 meter) RC Tinsley Reflector. Used for inquiry and education, the telescopes at the Observatory allow both amateur and professional astronomers to conduct research, while visitors can gain firsthand knowledge of the beautiful and awe-inspiring sights of the night sky. Additionally, amateur astronomers are in attendance with their own telescopes to observe the night sky from the George Observatory deck.

The George Observatory is open for public viewing on Saturday evenings, and is available by reservation on Friday nights for groups of 30 or more. For our AIAA night, we attended on a Saturday night with the general public to eliminate cost to the AIAA Houston Section. The Observatory opens every Saturday night at 5:00 PM for $5 ticket sales. Visitors select their 45 minute presentation time and their Gueymard telescope viewing time from 6:00 PM to 10:00 PM. The George has a small meteorite exhibit and gift shop which can be viewed while you're waiting for the sun to set. The George presentation includes safety information as well as information on the telescopes as well as what you may see in the sky that evening.

For our January 30th visit to the George, Mars and the Moon were expected to have the best viewing conditions. Early evening clouds obscured Mars, but provided an excellent view of the Orion system. As the partial cloud cover shifted, a wonderful view of a binary star system near M35 was provided. We received an excellent view of the moon rise, only to have the resulting full moon preclude all further visibility. Those who attended this event starting at 5 PM enjoyed a mostly clear and cold 38 degree evening with good viewing conditions; those who attended later in the evening were disappointed at the lack of visibility.

For more information and Observatory weather, visit http://www.hmns.org/see_do/george_observatory.asp. Twenty five RSVPs were made for this AIAA event, which will be repeated in the future. This was a fun night out and is recommended to all.

Event

Notes from the Meeting of the Lunar Exploration Analysis Group (LEAG)

LARRY JAY FRIESEN, SECTION MEMBER

The annual meeting of the Lunar Exploration Analysis Group (LEAG) was held November 16-19, 2009. The meeting was hosted by the Lunar and Planetary Institute (LPI) and took place at the LPI facility in Houston, Texas. LEAG is a community-based organization of scientists and engineers who provide scientific advice and technical expertise to NASA related to lunar science and exploration in support of NASA's Space Exploration Initiative.

The theme for this year's meeting was Sustaining Lunar Exploration. I do not have space to discuss every presentation here. For additional details, material presented at this meeting can be found on the LPI website at http://www.lpi.usra.edu/leag/ . Select the "LEAG Meeting Information" menu option. Once there, under "Annual Meeting of the Lunar Exploration Analysis Group, November 15-19, 2009, Houston, Texas," click on "Meeting Presentations."

Monday morning's session was devoted to community updates and to discussing what is required to make lunar exploration sustainable. W. M. Hawes presented a summary of the Augustine Commission report. C. Culbert and J. Hanley offered an overview of the current state of the Constellation program.

Three presentations discussed the planetary science decadal survey. This involves seeking input from planetary scientists as to what programs, technologies, instruments, facilities, and missions should have highest priority for the next ten years. The criteria for priority are: what will do most to advance the discipline? This provides guidance for funding sources, government or private, as to what scientists in the discipline consider to be of greatest value or urgency. The planetary science community treats the Moon as one of the solar system bodies to be studied, and this survey puts investigation and exploration of the Moon in the perspective of understanding the solar system as a whole.

Below: credit: NASA/JSC Lunar Surface Systems Project Office

J. Olsen provided an OSEWG update. OSEWG is the Optimizing Science and Exploration Working Group. It gets input from LEAG, among other sources. Included in this was a mention of what people in the international space community are thinking about lunar and solar system science and exploration.

David Morrison discussed the NASA Lunar Science Institute (NLSI) which he currently leads. Note: the NLSI is not the Lunar and Planetary Institute (LPI), which was once known as the Lunar Science Institute (LSI). The LSI/LPI has been in operation since Apollo days, operates under a university consortium, and is located in Houston. NLSI is a NASA

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organization only a couple of years old, and is currently headquartered at NASA-Ames. NLSI is a place for researchers to propose research. One current project is the Lunar Orbiter Image Recovery Project. Data gathered by the Lunar Orbiter series of spacecraft in the 1960's was stored on magnetic tape. The current project is attempting to recover that data and store it in high fidelity digital form.

Clive Neal of Notre Dame, presently leader of LEAG, presented the LEAG roadmap review.

Jeff Taylor of the University of Hawaii spoke on the question: Why settle the Moon? Taylor discussed multiple reasons. Among them: To challenge ourselves. To promote global partnerships. To prepare the way for Mars. To establish a vibrant commercial sphere.

There were two sessions Monday afternoon. The first was: How does a sustainable lunar exploration program benefit lunar science and solar system exploration? The second was: How will the results of current and future international missions facilitate a sustainable lunar architecture?

Paul Spudis discussed factors that relate to sustainability, including societal, technical, economic, and political elements.

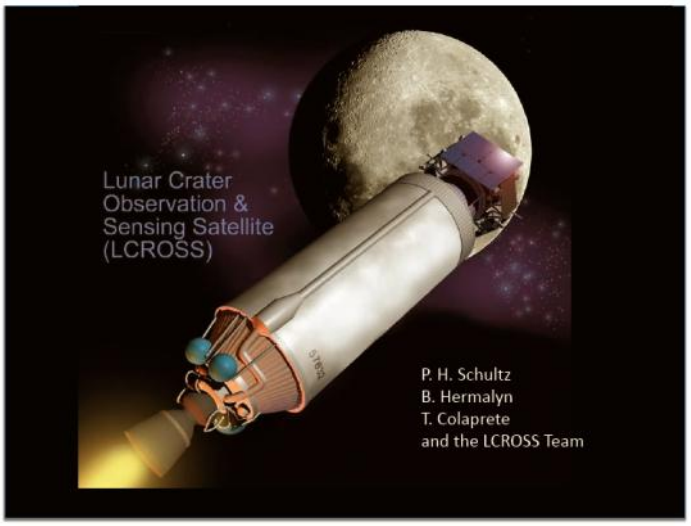
Brad Blair spoke on lunar economic modeling. Like Spudis, he spoke of multiple aspects of sustainability, citing biological, logistic, and economic aspects.

During the second session, Carle Pieters informed us that we now know of water on the Moon in three forms: 1. Polar ice (see the LRO and LCROSS results, below). 2. In many places on the lunar surface (a recent, surprising discovery scientists are still striving to understand). 3. Water found in green volcanic glass. This water came from the lunar interior, and may be up to 700 parts per million (for comparison, this is comparable to the proportion of water thought to be in Earth's mantle).

Poster sessions were held Monday and Tuesday evenings. The same posters were displayed both evenings.

The Tuesday sessions, both morning and afternoon, were devoted to results from the Lunar Reconnaissance Orbiter (LRO) and LCROSS missions. A global topography map derived from LRO plus data from earlier missions (Chandra, etc.) was shown. The Diviner instrument saw a temperature of 35 K inside Amundsen crater, near the lunar south pole. This is lower than any other temperature so far observed in the solar system! Neutron observations of hydrogen enhancements are not confined solely to permanently shadowed areas, but extend to some nearby areas that are shadowed for part of the year. The LCROSS impact showed definite water features in the impact plume spectrum. The spectrum also has features suggesting the presence of other volatiles, but exactly what types of volatiles and in what proportions is still being analyzed.

John Gruener discussed three types of potential resources available on the Moon: polar ice deposits, pyroclastic deposits, and high-titanium, high-iron regions. Sarah Noble discussed the Lunar Mapping and Modeling Project.



Above: credit: NASA

Wednesday morning focused on lunar in situ resource utilization (ISRU). R. S. Wegeng introduced the topic of bringing the Moon into Earth's economic sphere. G. B. Sanders described some benefits and hurdles of incorporating ISRU into an exploration program. The latter part of the morning was spent in a panel discussion centered around some things desired for lunar prospecting.

Wednesday afternoon was the only time during the meeting when two parallel sessions were held. One session continued the topic of lunar ISRU. The other was on the subject, Lunar samples and simulants: where engineering and science meet.

On Wednesday evening, the Space Resources Roundtable hosted a town hall meeting on microgravity and partial gravity research.

The final session of the meeting took place on Thursday morning. This was a synthesis session, discussing inputs and refinements to the sustainability theme of the lunar exploration road map.

Event

Hayabusa Asteroid Sample Return Mission

STEVEN EVERETT, EDITOR

After some brief comments by Douglas Yazell announcing some upcoming chapter events, Al Jackson, our chapter's Astrodynamics Committee Chair and event organizer, introduced Dr. Paul A. Abell. Dr. Abell stated he would provide an overview of the mission and then play a twenty-minute video produced by JAXA describing the mission and its highlights.

Hayabusa, which means falcon in Japanese, was originally named MUSES-C, and was the third in a line of technology demonstration missions. The refrigerator-sized spacecraft was launched on May 9, 2003, on a roundabout trajectory to the Itikawa Near Earth Asteroid, its destination having been selected at the last moment when its original target was deemed unsuitable. It consisted of cameras for navigation and imaging, LIDAR, spectral analyzers, a coffee can-size rover named MINERVA, and a sample collection device and was intended to test propulsion with ion thrusters, automatic navigation and control with image processing, surface sampling in a micro-g environment, and atmospheric entry from an interplanetary trajectory.

Dr. Abell illustrated the relatively small size of Itikawa at only 540 m in length with pictures of it adjacent to the Eros (about 33 km in length) and the International Space Station (about 100 m in length). It is oblong, and, according to the Japanese, was the shape of a sea otter. A large boulder named Yoshinodai, at 50 m about the size of the object that created Barringer Crater in Arizona, could be seen at the tip of the rotating object. Pictures revealed Itikawa to be essentially a floating "rubble pile" with a 40% porosity, an unexpected finding which changed our way of thinking about asteroids.

The touchdown point for the small craft selected was a flat area name Muses Sea (a play on the original mission title), deemed better than the rocky Woomera site. Three target markers, reflective spheres which could be imaged easily, were carried by the spacecraft to be fired into the potential landing sites. The terrain seen in pictures taken as the spacecraft approached consisted of size-sorted gravel, similar to the smooth area called Eros pond imaged as the NEAR spacecraft approached that body.

Despite the failure of several of the ion thrusters and reaction wheels, the spacecraft is still expected to return its sample to Earth by making its maneuvers using the remaining control effectors and solar pressure on its solar panels. Reentry of the sample return capsule is planned for June of 2010 in Australia, where it will experience a soft landing under a parachute and announce its location with a signal beacon. The terrain in the landing ellipse consists of rough outback and is in a secure military zone. Any material collected will be retrieved after the subsequent ground search. A capture by helicopter was not considered, in part due to the intended night time reentry. While the original plan was that the spacecraft would alter its trajectory so that it flies by the Earth after the sample capsule has been released, the various failures will probably result in the spacecraft burning up as it reenters in the atmosphere.

Before the video, Dr. Abell addressed a question regarding the forces holding the object together. While it is not clearly understood, he did state that a "rubble pile" may be more difficult to disrupt than a solid object of corresponding size, due to the larger energy such an object can absorb on impact.

The somewhat lengthy video was played for the audience next. While Dr. Abell stated that it had not been released to the public, it is actually available at http://spaceinfo.jaxa.jp/inori/en/index.html. The story of the Hayabusa mission is told from the point of view of the spacecraft and is accompanied by original music com-

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Below: Artist's conception of Hayabusa's encounter with the asteroid Itikawa

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posed for this video. It is subtitled in English, and Dr. Abell provided a commentary while it played. It described in more detail the sequence of events during the mission, including its launch, Earth gravity assist, and arrival at Itikawa. With a combination of computer generated images and real images from the spacecraft's camera, the video illustrated the maneuvers executed to establish station keeping near the asteroid's surface, the release of the target markers and MINERVA rover (which unfortunately missed the surface because of a timing mistake made due to the long communication delay), and the descent to the surface. A period during which the spacecraft tumbled out of control, one descent in which the spacecraft came to rest on the surface of the asteroid, and a loss of contact with the craft were also dramatically portrayed. While a final touchdown allowed the sample arm to make contact, it was determined that only micrograms of material were probably collected when dust floated into the collection tube, rather than the tens of grams which were expected. The video ended with some final comments by Dr. Abell.

SHUTTLE PROGRAM END PATCH

Above: Patch design commemorating the end of the Shuttle program, voted as winner in people's choice contest in January.

Below: Entry by our own Horizons assistant editor Don Kulba. Don's design was one of 15 finalists among 85 entries. Source: collectSPACE.com and updated art by Mr. Kulba.

Cover Story

A Notional Hayabusa-2 Trajectory Design

DANIEL ADAMO, SECTION MEMBER

Unofficial Japanese Aerospace Exploration Agency (JAXA) information obtained in June 2009 indicates the *Hayabusa-2* robotic mission to near Earth asteroid 162173 (1999 JU_3) is being planned according to the following major events:

1) Launch in 2014.
2) Obtain an Earth gravity assist during interplanetary cruise to 1999 JU_3.
3) Arrive at 1999 JU_3 in 2018.
4) Depart 1999 JU_3 ~90 days after arrival.
5) Return 1999 JU_3 samples to Earth in 2020.

From these approximate and preliminary JAXA constraints, a notional *Hayabusa-2* mission trajectory design is constructed and illustrated by the ensuing 6 figures. The design assumes interplanetary cruise undergoes accelerations limited to Earth and Sun gravitation. This assumption is likely a simplified approximation to JAXA trajectory designs in at least two respects.

A) Like its *Hayabusa* predecessor, *Hayabusa-2* is thought to utilize electric propulsion with protracted interplanetary cruise duty cycles.
B) According to the Jet Propulsion Laboratory's (JPL's) *Horizons* ephemeris system, 1999 JU_3 passes 13,362,000 km from Mars on 2020 April 12. This event almost certainly falls during *Hayabusa-2*'s Earth return interplanetary cruise.

The notional trajectory design heavily depends on 1999 JU_3's ecliptic descending node and its proximity to Earth's orbit. As predicted by *Horizons* ephemeris JPL#82, this node falls very near Earth's ecliptic longitude on 2014 December 4. Earth gravity assist is therefore planned for this date following launch one year earlier. The preceding Approximation A is likely responsible for the notional mission design's late 2013 launch date. With JPL#82 also predicting 1999 JU3 Earth approach to 9,055,000 km on 2020 December 29, Earth return is planned during this timeframe. Heliocentric Lambert boundary value process-

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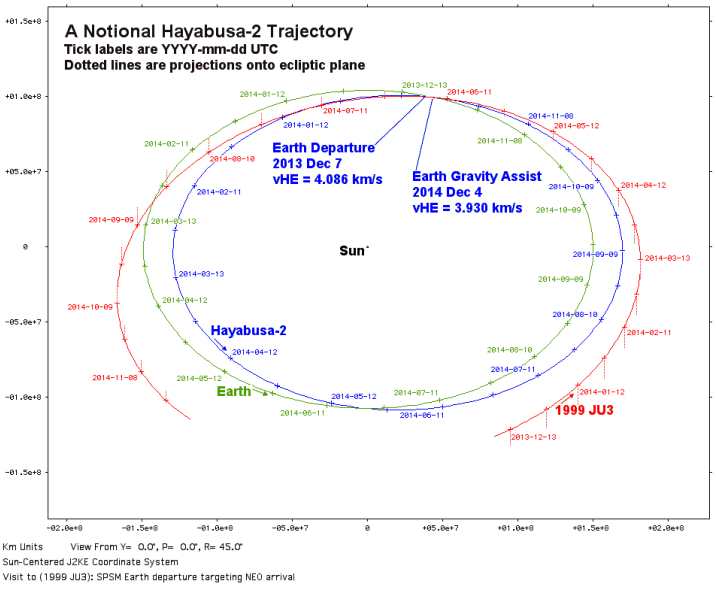
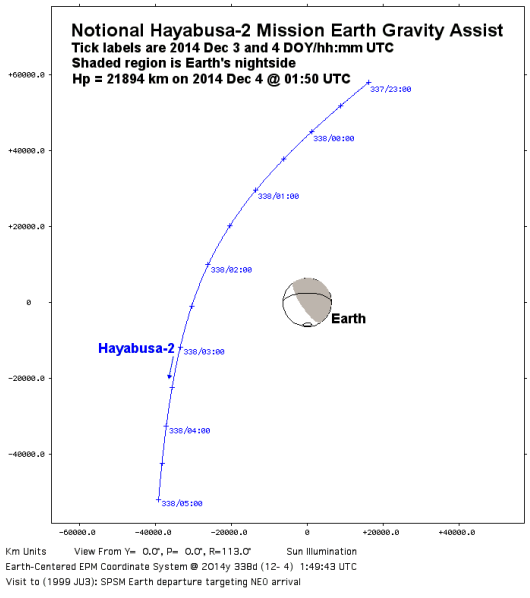
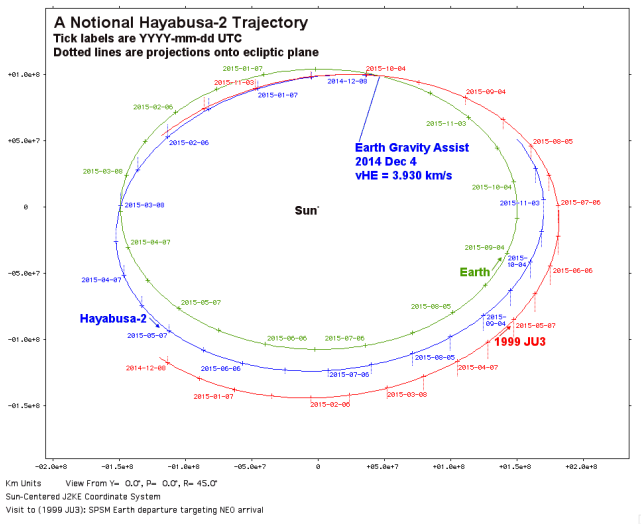
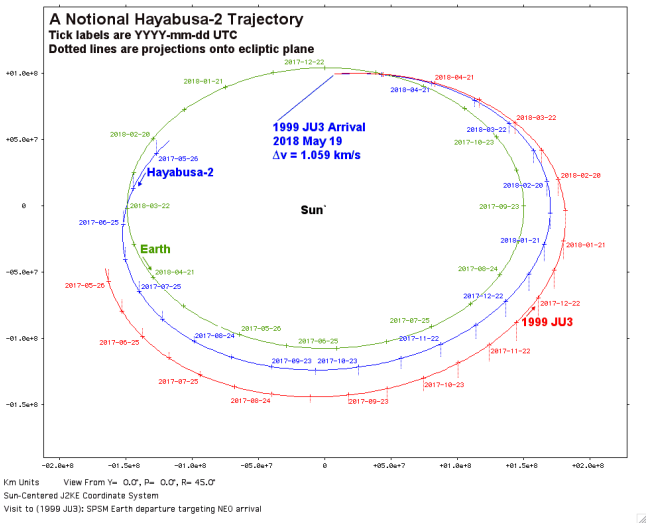
Figure 1: (below) *This heliocentric plot commences with the notional trajectory's Earth departure on 2013 December 7 and ends with its Earth gravity assist on 2014 December 4. Perspective in this and all ensuing heliocentric plots is from a location 45° north of the ecliptic plane at an ecliptic longitude of 270°. Using this perspective and dotted line projections from 1999 JU_3's orbit onto the ecliptic, note 1999 JU3's descending node on the ecliptic at a point near Hayabusa-2's Earth gravity assist. Also note the degree to which Hayabusa-2's trajectory remains coplanar with Earth's orbit prior to the gravity assist.*

Figure 2: (below) *This geocentric plot is viewed from a perspective normal to the notional Hayabusa-2 Earth gravity assist's trajectory plane during 2014 December 3 and 4 Coordinated Universal Time (UTC). Note the 57° turn angle between incoming and outgoing asymptotic velocities, together with the lit south geographic pole near its summer solstice (the circumscribing small circle is at 80° south latitude). A southerly outgoing velocity is required to achieve 1999 JU_3's heliocentric orbit plane near its descending ecliptic node. Also evident from the plot's perspective is Hayabusa-2's +21,894 km perigee height.*









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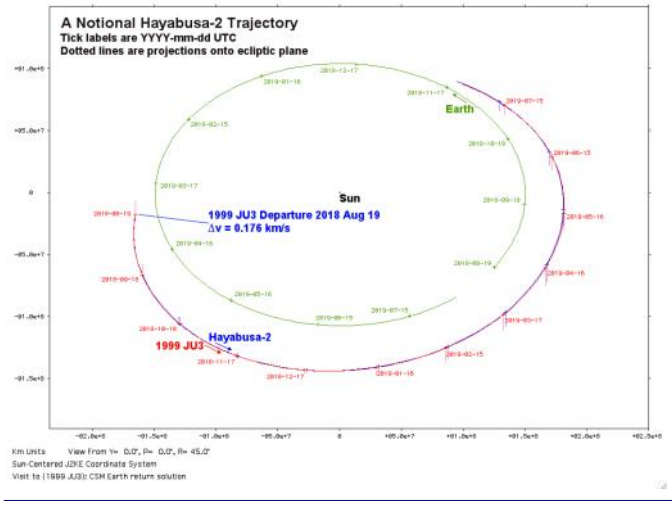
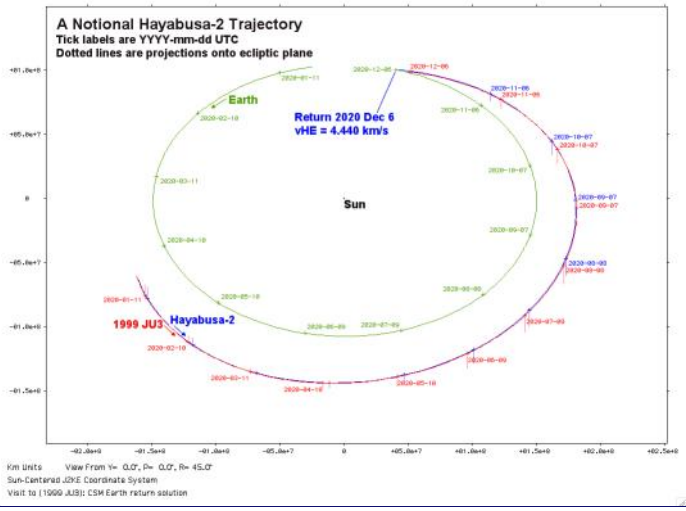
ing for the notional Earth return trajectory indicates 1-revolution, long-way, lower-energy solutions are associated with minimal 1999 JU_3 departure speed Δv. These solutions depart 1999 JU_3 in the 2018 June to September timeframe and return to Earth in 2020 early December. The notional trajectory design therefore targets operations in the vicinity of 1999 JU_3 from 2018 May until August. Additional Lambert processing identifies 3-revolution, short-way, higher energy solutions as having minimal 1999 JU_3 arrival Δv in mid-2018 following the 2014 December 4 Earth gravity assist.

As illustrated in Figure 2, the notional Earth gravity assist trajectory requires a geocentric turn angle of 57°. When coupled with geocentric asymptotic speed vHE near 4 km/s, the gravity assist's perigee height is +21,894 km. An unacceptably large 122° turn angle leading to negative perigee height is incurred if the gravity assist is targeted with an inferior approach from inside Earth's heliocentric orbit. The notional gravity assist Earth approach is therefore from a superior direction, as illustrated by Figure 1.

Figure 3: (upper left) *This heliocentric plot commences with the notional trajectory's Earth gravity assist on 2014 December 4 and continues for the next year. Note the degree to which Hayabusa-2's trajectory has been rendered coplanar with 1999 JU_3's heliocentric orbit following the gravity assist.*
Figure 4: (upper right) *This heliocentric plot illustrates the notional trajectory's motion for the year ending with 1999 JU_3 arrival.*
Figure 5: (lower left) *This heliocentric plot illustrates the notional trajectory's motion for the year following 1999 JU_3 departure. Note the low speed required to depart 1999 JU_3 and intercept Earth more than 2 years later.*
Figure 6: (lower right) *This heliocentric plot illustrates the notional trajectory's motion for the year ending with Earth return.*





JSC 1968

Five Photos from the McLane Archives

JAMES C. MCLANE III

In the course of going through old slides, I came across some photos I took in the summer of 1968 at JSC (then the Manned Spacecraft Center). These pictures show the inside of Building 32 during a peak of activities related to Apollo testing. In the summer of '68 manned testing of the Apollo Capsule and the Lunar Module were carried out at about the same time inside two large vacuum chambers in the Space Environment Simulation Laboratory.

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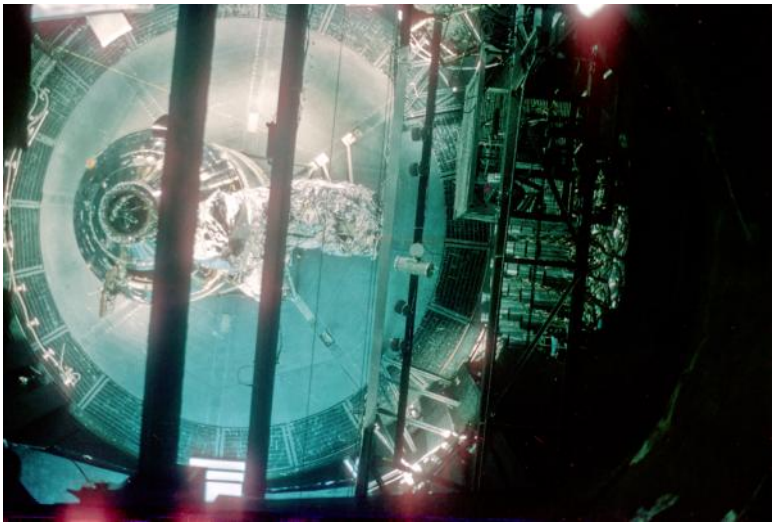

Above: a view of the test setup looking down from a porthole near the top of chamber A. The beams that crisscross the chamber served as attachment points for sensors.

Above: a view into Chamber A through its open 40 foot diameter door. An Apollo Command and Service Module is mounted vertically. Astronauts Joe Kerwin, Vance Brand and Joe Engle spent about a week living inside the 2 TV-1 spacecraft while the chamber provided the high vacuum and severe thermal loads expected during the mission. The tests were supported by contractor personnel from Rockwell.

Below: the Apollo Command Module

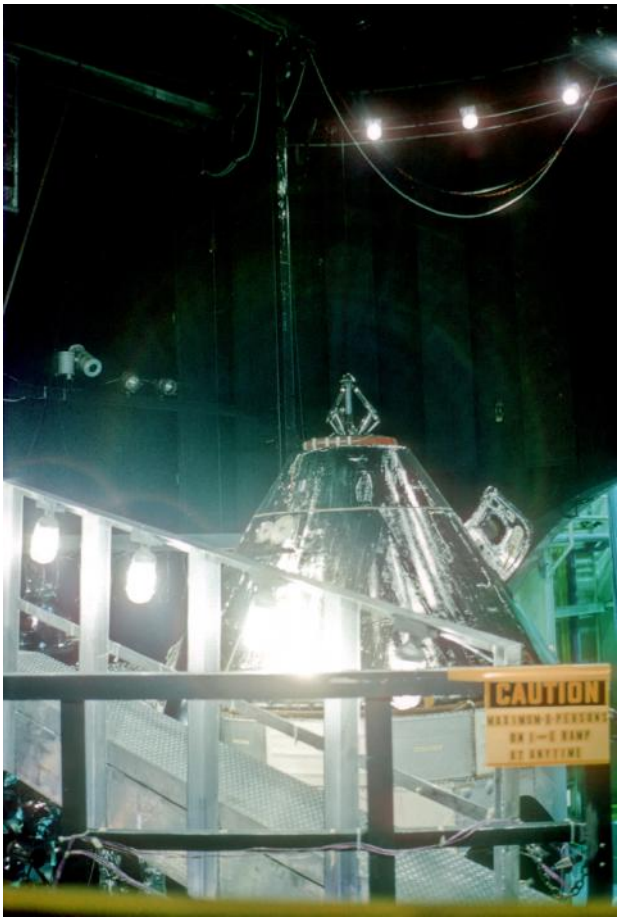

Photo Credits: James C. McLane III

Five Photos from the McLane Archives

JSC 1968

JAMES C. MCLANE III

Photo Credits: James C. McLane III

Left: a view looking out over the Building 32 high bay. The drapes at left enclose fixtures used to set up the Apollo 2 TV-1 test. In the center can be seen the reinforced, dish-shaped top of Chamber B and its lifting fixture. The top of the chamber had been removed so the Lunar Module test item (LTA-8) could be inserted into the chamber (located on the right of the photo under a protective cone-shaped tent). The thermal vacuum test of the Lunar Module involved Astronaut Jim Irwin and Grumman test pilot Gerry Gibbons. The LM tests were supported by contractor personnel from Grumman.

Below: James C. McLane, Jr., the Chief of the Space Environment Test Division, standing in the ACE (Automatic Checkout Equipment) control room for Chamber A. There were two ACE rooms in Building 32, one for Chamber A and one for Chamber B. Mr. McLane was our AIAA Houston Section 1971-1972 Chair .

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In recognition of the critical role they played in the Apollo moon landing program, these two space environment simulation chambers were designated as National Historic Landmarks by the Department of the Interior. The Lunar Module used in these tests (LTA-8) can currently be seen hanging from the ceiling in Space Center Houston.

Lunch and Learn

Apollo XII Anniversary Panel Discussion

STEVEN EVERETT, EDITOR

Above: Apollo XII mission patch

Al Jackson opened this event by noting that this was the third panel discussion he has organized, the first two being for Apollo VIII and Apollo X. The importance of this mission, which demonstrated remarkably accurate navigation, is often overlooked in view of the historic first of Apollo XI and the drama of Apollo XIII. It was the Apollo XII mission which delivered the lunar lander to within 600 feet of the site of the unmanned lunar lander Surveyor 3. Al continued by giving each of the three panel members —Frank Hughes, Floyd Bennett, and Emil Schiesser—a brief introduction.

Frank Hughes began the discussion by presenting and commenting on a series of photographs from the Apollo XII mission. He first reviewed the history of the Apollo program for those less familiar members of the audience, noting the advancements in computer power, fuel cell technology, and thrusters as the space program advanced through the Mercury and Gemini missions. In a side comment, he stressed it was the intent of NASA at that time to explore the solar system; fifteen Saturn V vehicles had been ordered by the government, and an order for 10 more was eventually cancelled when the program ended. He showed the control panels in the cockpit and in mission control and the simulators in St. Louis and eventually at Kennedy Space Center, along with several pictures that illustrated members of the Apollo crews. The simulator was inside a sphere on which were projected images of the starfields, films of the Earth's surface, models and video of associated vehicles, and video shot of models of the moon's surface. The lunar surface was modeled at a reduced scale, and a camera was maneuvered over it to produce images as they would be viewed by the spacecraft. Frank noted that the modeled surface was suspended upside down to avoid collecting dust, which was clearly visible in the video at this reduced scale. He also related some humorous incidents when, to the surprise of the crew, a captured roach or some other object was attached to the surface along the flight path! After completing the rendezvous simulation, the crew would exit the vehicle to a separate Lunar Module landing simulator, where they would climb down the ladder to the floor and even plant a flag in a patch of dirt in the building floor. They would then exit the building to yet another lunar rover simulation, where they would drive around the site and, in the case of the Apollo XVI crew, one time encounter an alligator across the simulated lunar terrain. Frank then showed pictures of the Lunar Landing Training Vehicle (LLTV) and noted that three out of the four vehicles eventually crashed with no fatalities resulting, the remaining vehicle being on display near Teague Auditorium in Building 2 at Johnson Space Center. He closed with pictures from the lunar landing site itself, showing how close the landing was to the Surveyor 3 site, stating that they could have landed even closer but didn't want to "sandblast" the unmanned lander. He had only one color picture of the site, since the color TV camera had burned out almost immediately upon being inadvertently pointed to the sun, which was low on the horizon.

Floyd Bennett continued the discussion by stressing the remarkable accuracy of this landing, noting that Apollo XI which immediately preceded it actually missed its intended target by three nautical miles. He also illustrated the descent trajectories and maps of the landing sites of Apollo XI and XII. The improved navigational abilities of the lunar lander on this mission provided the confidence to land the subsequent missions Apollo XV near Hadley Rille and Apollo XVII among several mountains. Frank also recalled watching the Apollo XII launch, during which there were two lightning strikes on the ascending Saturn V. Fortunately, the situation was coolly handled since a similar situation had been tested in a simulator earlier.

Emil Schiesser concluded the panel members' presentations with more photographs from the Apollo XII mission and a more detailed discussion of the navigational technology used. He recalled

(Continued on page 15)

(Continued from page 14)
after the overshoot of the Apollo XI landing being told by George Mueller, "Next time I want a pinpoint landing." Emil reviewed the timelines of each of the Apollo XI and XII trajectories and showed pictures of the Manned Space Flight Network tracking dish in Corpus Christi, Texas. He described several methods used in the craft's navigation using the tracking dish data and the radar altimeter readings above the Moon's surface. Worksheets were created on which computations were executed and filled in by hand to provide the final navigational data. He closed by showing the recent pictures from the LCROSS satellite of the Apollo XII landing site, with the descent stage and foot tracks faintly visible.

The audience was then invited to ask questions as the event ended. Emil confirmed that computations were actually being done by hand at the console in real time, and noted that he had to get special permission to buy an expensive calculator at one point. It was also noted that Apollo XIII was the first of the missions which was not on a free-return trajectory. When asked to relate what happened to some of the Apollo trajectory data, Emil stated that after 1966 when funding was beginning to be cut, justification for purchasing every data tape reel was required, and tapes eventually stopped being kept.

Al closed by presenting speaker gifts, 40th anniversary NASA commemorative coins, and Douglas introduced several members of the audience and noted that he has copies of the earlier Apollo mission anniversary panels on DVD for those who are interested. Some of the panel remained for additional questions as the event ended.

Left: Navy Panther, illustrated by Don Kulba, Horizons assistant editor

Anniversary

First Flight in Texas

DOUGLAS YAZELL, ASSISTANT EDITOR

The first documented powered airplane flight in Texas was almost exactly 100 years ago, February 18, 1910. Thanks to Michael Bludworth, the 1940 Air Terminal Museum (www.1940airterminal.org), The Sloane Gallery (www.sloanegallery.com) and the web site www.waymarking.com for calling attention to this local event in our Houston Clear Lake area back in 1910. In fact, the 1940 Air Terminal Museum at Hobby Airport now has a nice display about this subject.

Marker Number: 10660
Marker Text:
First Airplane Flight Over Texas
The first documented flight of a heavier-than-air flying machine in Texas occurred over this site on February 18, 1910, two weeks before the first military airplane flight by Lt. Benjamin Foulois at Fort Sam Houston in San Antonio. The South Houston flight was part of a land development promotion sponsored by the Western Land Corporation and the Houston "Post."

French aviator Louis Paulhan, on a coast-to-coast flying exhibition tour of America, was commissioned to demonstrate his flying skills. The promoters arranged for special excursion trains to transport spectators to the site from downtown Houston. Headlines in the "Post" proclaimed, "This is the first opportunity for Texans to see a real demonstration of man's ability to fly. Don't fail to come and see demonstrated the greatest invention of the present era."

A crowd of more than 2,500 people gathered on Friday, February 18th, to witness Paulhan's first Texas flight in his Farman biplane. Because of high winds and inclement weather, the aviator was not able to perform some of his most spectacular stunts, but the crowd was thrilled with the aerial display. A second flying exhibition on the following day drew almost 6,000 people. (1991)

AIAA Houston Section

American Institute of Aeronautics and Astronautics

HOUSTON SECTION • P.O. Box 57524 • Webster, Texas 77598

Web site: www.aiaa-houston.org

April 30, 2010 (Friday)
NASA/JSC Gilruth Center

Luncheon Keynote Speaker
JSC Center Director: Michael Coats

Abstracts Due:
April 16, 2010 (Friday)

Image Courtesy of www.wikipedia.com

Annual Technical Symposium
Call for Abstracts

Abstract Submission

Submit abstracts with short author biographies electronically at the AIAA Houston Section web site:

www.aiaa-houston.org/ats2010

Abstract Guidelines:

- Abstracts should be 250 words or less.
- Abstracts should use the [#] notation to cite references in the abstract text.
- Note the tracking number and password supplied when an abstract has been submitted.
- Submitted abstracts may be updated using the tracking number and password.
- Abstracts will be published. No paper is required.
- Abstracts, Posters, and Presentations must be cleared by authors (not AIAA) for Export Compliance.
- ATS registration is a separate process from the abstract submittal process.
- Authors will be notified on Friday, April 23, 2010 of abstract acceptance.

Contact the ATS Chair for more information: Satya Pilla, vicechair-tech@aiaa-houston.org

AAS 2009

IMAGINE '09: Ideas at Work

DOUGLAS YAZELL, ASSISTANT EDITOR

This American Astronautical Society (AAS) event took place December 2-3, 2009, at NASA/JSC Gilruth Center. I later looked at the Houston Chronicle's CosmoSphere blog and found Justin Kugler's news about this event, including a link to live webcasts of the presentations. The AAS web site states that presentations will be there for all to enjoy. This annual AAS meeting alternates every year between Houston, Texas and Pasadena, California.

Here is a list of speakers from the pre-conference publicity:
Armen Berjikly talks about the power of uniting people who can improve each other's lives - technology start-up entrepreneur, and founder/CEO of The Experience Project.
Steve Boehlke talks about the need for innovators to break (the right) rules - coach to leaders ranging from executives to rural farmers in developing countries, and founder/President of SFB Associates.
Christopher Bronk talks about Gov 2.0 and NASA as the next Google - diplomat, Baker Institute Fellow in Technology, Society and Public Policy, Rice University.
Charles Chafer talks about the power of public participation space missions - high-tech entrepreneur, pioneer of commercial space, CEO of Space Services Inc., founding partner of Team Encounter, LLC, and co-founder of Celestis, Inc.
Dr. Franklin Chang Diaz talks about looking beyond today's propulsion technology - astronaut, inventor of the magnetoplasma rocket, entrepreneur, Chairman/CEO of Ad Astra Rocket Company.
Nancy Conrad talks about designing the future and what to do when the pipeline is dry - entrepreneur, innovator, philanthropist, founder/CEO of the Conrad Foundation.
Dr. Dan Durda talks about barn-storming the space frontier - planetary scientist, pilot, diver, Senior Research Scientist at Southwest Research Institute.
Dr. Betty Sue Flowers talks about the myths that shape our world - consultant/editor for TV series and book *The Power of Myth* with Joseph Campbell, host of radio series *The Next 200 Years*, Director of the LBJ Presidential Library, strategy consultant.
Richard Garriott talks about the private astronaut transformation - video game developer, entrepreneur, space tourist, Vice-chairman of the Board for Space Adventures, and a Trustee of the X PRIZE Foundation.
Bill Gerstenmaier talks about the importance of remarkable ideas and innovation to NASA – researcher, operations manager, program manager; NASA Associate Administrator for Space Operations.
John Gibson talks about "people fusion," the power to solve tough technical problems through open innovation communities - amateur racketeer, President and CEO of Paradigm, and former President of Halliburton Energy Services.
Wayne Hale talks about choosing the future - NASA flight director, Space Shuttle Program Manager, blogger, Deputy Associate Administrator of Strategic Partnerships.
Bryan Guido Hassin talks about how, with just a nudge, individuals can change their behavior dramatically for the good of the whole - Head of Global Operations at Poken, technology start-up entrepreneur, CEO of Enistic, Inc.
Thomas B. Pickens, III talks

Above: Will Pomerantz, Senior Director of Space Prizes for the X PRIZE Foundation, showing an image of the Raymond Orteig Prize check for $25,000 paid to Charles A. Lindbergh in New York on June 17, 1928

about commercial use of weightlessness to benefit humankind - chairman/CEO for many companies during startup, growth, and turnaround in a challenging environment, President/CEO of Astrotech Corp.
Will Pomerantz talks about revolution through competition - co-founder of SpaceAlumni.com, zero gravity coach, Senior Director of Space Prizes for the X PRIZE Foundation.
Dr. Howard Prince talks about ethics, leadership and spaceflight - U.S. Army General Officer, clinical psychologist, Director of LBJ School's Center for Ethical Leadership, University of Texas.
Bob Rogers talks about public engagement in 2010, and being careful what you wish for - themed entertainment producer, inventor, futurist, Academy Award nominee, founder/ Chairman of BRC Imagination Arts.
Joe Rohde, creator of Disney's Animal Kingdom, talks about the use of narrative to create strategy and build teams - adventurer, Executive Designer and VP/Creative at Walt Disney Imagineering.
Dr. Evan Thomas talks about sustainable development powered by social innovation and space technology - NASA life support engineer, Engineers Without Borders-USA team member, entrepreneur.
Brett Williams talks about using rockets to teach and inspire high school students - marine biologist, teacher at Fredericksburg High School, founder of SystemsGo student launch program.

The Discovery Dome was on display. It is a portable inflatable dome that shows movies and photos inside the dome using a convex mirror instead of a fisheye lens. There is excellent content, such as a movie recreating the Apollo 11 Moon landing (astronauts stepping out onto the Moon for the first time). This movie uses computer animation to show this event as if it were filmed in color with great clarity by someone adjacent to the astronauts on the lunar surface. This version of the Dome could hold 20 or more students sitting on the floor while some adults use chairs. This is free for groups such as public schools and non-profit conferences. See www.e-planetarium.com and www.DiscoveryDome.com .

Above: Richard Garriot, private astronaut

Wayne Hale is Deputy Associate Administrator of Strategic Partnerships at NASA, and his influential blog appears on the NASA web site. He is a very experienced flight director and a former Program Manager for the Space Shuttle program. He is also a student of history, and his presentation about China and Portugal 600 years ago energized the audience, and it related directly to choices about space exploration that our nation and other nations are now making.

Richard Garriott is a graduate of Clear Creek High School, and his father is Owen Garriott, a Skylab astronaut, now 80 years old. Richard recently (2008) completed his stay as a private citizen and passenger/ astronaut on ISS. In the breakout session, Richard showed us his movie, the first science fiction movie filmed in space. It might be on the NASA TV Channel soon. Richard voluntarily did a lot of science and commercial work during his ISS visit, with only one day set aside for relaxation. However, during scheduled sleep time, he and astronaut Greg Chamitoff often enjoyed their shared hobbies of magic and juggling.

Many thanks to AAS for an affordable, quality event in our NASA community.

3AF TMP

The Unfinished Dream of Space

PHILIPPE MAIRET, 3AF TMP (FRANCE), TRANSLATED BY D. YAZELL

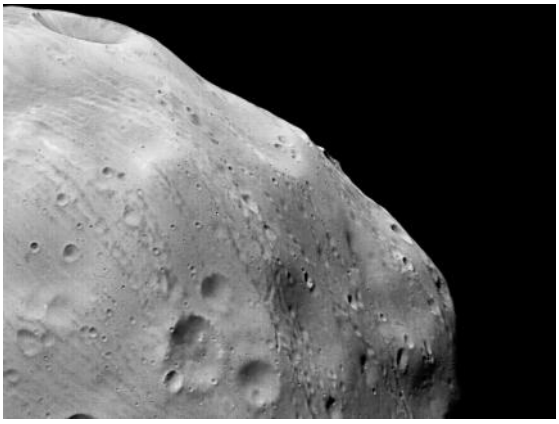
The news arrived on February 1, 2010: the American space program Constellation, and with it, Ares I, Ares V, Orion, and Altair, are abandoned. Across the Atlantic, the dream of space, begun under the Presidency of George W. Bush, is unfinished, mainly due to budget problems. At least, the dream is unfinished from a program point of view. Indeed, the Obama administration has, in addition, decided to increase the budgets concerning technologies (launchers, orbital refueling systems, …)

Europe and Japan, among others, had at least some cause for celebration: the exploitation phase of the International Space Station (ISS) has been prolonged by five years in this proposal, with respect to the 2015 deadline. So if all goes well, ISS will not be deorbited until 2020, and maybe later?

Thus more good days lie ahead for space research onboard ISS. We will learn more about the effects of microgravity on experiments which will be undertaken. But that is not all! The large space-faring nations are learning to work better together, and, like a cherry on the cake, it appears Earth observation will continue from ISS, supporting, among other things, the study of the knotty problem of climate change.

For the US, of course, the dream of space is unfinished. Not so long ago, the 40th anniversary of man on the Moon was celebrated, and it was proposed to return there to stay at least a while in a "lunar base" or, at least, in a "lunar outpost."

The new NASA Administrator recently said, "The natural destinations remain: the Moon, Mars, and the asteroids." Let us hope that between now and 2050, the human race, whether they are Americans, Europeans, Russians, Indians, or Chinese, will know how to do better than their elders of the Apollo missions.



Right: This image of Mars' moon Phobos was taken by the High Resolution Stereo Camera (HRSC) on Mars Express. The HRSC camera is operated by the German Aerospace Center and the Mars Express mission is operated by the European Space Agency. The HRSC took this image using the nadir channel on March 7, 2010, on HRSC Orbit 7915. The image has been enhanced to bring out the features in the less illuminated areas. Visit the German Aerospace Center page for 3-D and other imagery of Phobos. Image Credit: ESA/DLR/FU Berlin (G. Neukum)

Editor's note: The articles by Mr. Mairet and Mr. Rieugnie starting on this page are scheduled to appear in the newsletter, La Gazette, of AIAA Houston Section's French sister section, L'Association Aeronautique et Astronautique de France, Toulouse—Midi-Pyrenees chapter (3AF TMP). This French-American tradition of sister section work, including exchanging newsletter articles, is now in its third year.

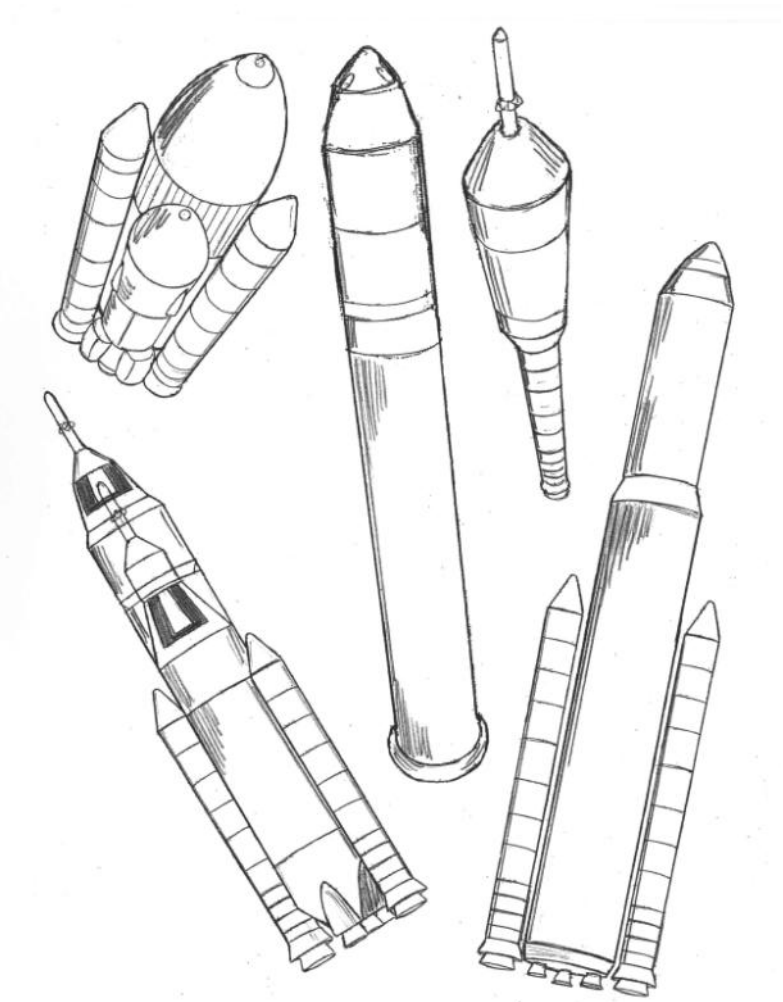
Extensive details regarding traditions and current work of AIAA Houston Section's International Space Activities Committee (ISAC) going back to 1987 were recorded at www.aiaa-houston.org/tc/isac, but our web site has now been greatly improved. That address has changed, and quite a few documents, etc., do not yet appear on the new ISAC web page. To see the current version of this ISAC web page, please go to www.aiaa-houston.org, click on Technical Committees, then click on International Space Activities Committee, where the address now looks like this: http://www.aiaa-houston.org/InternationalSpaceActivitiesCommittee.aspx.

Space Exploration: A Sudden Stop or a Renewal?

3AF TMP

MARC RIEUGNIE, 3AF TMP (FRANCE), TRANSLATED BY DOUGLAS YAZELL

In the 2011 NASA budget proposal, the American administration of President Obama asks for putting a stop to the Constellation program of returning to the Moon. Is this the end of space exploration? Things are not as simple as the large media outlets portray them. They tell us the NASA budget was "cut." The reality is completely different: it grows by 1.5% with respect to the 2010 NASA budget, then by 2.5% per year on average for the following years. One cannot accuse the Obama administration of not supporting NASA: the proposed growth resembles the Bush administration pre-crisis budgetary projections, but in a new context where the desire is to freeze federal spending. To add more details, space exploration, targeted specifically to human spaceflight beyond low Earth orbit, receives $3.8B (3.8 billion dollars) in 2011, increasing to $5.5B in 2015. It is also important to notice a line in the budget for $500M in 2011 and $1M for the following years, excluding exploration, titled, "Space Technologies", something which did not exist in prior years. For comparison, the last budget of the Bush administration, that of 2009, foresaw $7B per year for space exploration starting in 2011, of which only $500M was for programs other than Constellation, in particular, space medicine and all the technological developments needed for long-lasting installation of people on the Moon. The budget for space exploration is thus certainly reduced, but the amount of money still used for that purpose is considerable. The fundamental change is in the method used to spend that money.



Above: art by Assistant Editor Don Kulba, "Vehicles Uncertain"

Let's go back to the origins of the space exploration program, the "Vision for Space Exploration" (VSE), presented in 2004 by President Bush. It consisted of putting into place the conditions for a lasting space exploration program beyond low Earth orbit and an expansion of (American) people in the solar system. The official VSE development document , dated February 2004 and available on the NASA

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web site, can be summarized as follows:

"The fundamental goal of this vision is to advance U.S. scientific, security, and economic interests through a robust space exploration program. In support of this goal, the United States will:
• Implement a sustained and affordable human and robotic program to explore the solar system and beyond;
• Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
• Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration; and
• Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests"

We must note that the first VSE budgets, for 2005 and for 2006, carried more than $2000M ($2B) per year for space biology, robotic precursors, and development of technologies for supporting human exploration.

Most of the technology developments and robotics missions linked to exploration which appeared in the 2005 budget disappeared in the 2009 budget in favor of a system of launchers and capsules developed with the least technological risk, based on the systems of the years 1960 – 1970, mastered by NASA. Space Exploration, under the direction of Mr. Griffin, was concentrated little by little on the creation of this system, with the aim of landing on the Moon before 2020. It was Constellation, or "Apollo on Steroids". But this program did not result in technological spinoffs like those of Apollo because proven technologies were used, and that left little room for preparation for the successor to that Apollo exploration. It is this approach which was severely sanctioned by the Obama administration: they remain loyal to the spirit of the VSE presented above.

The task at hand is thus now to begin a lasting expansion in the solar system, familiar as it is thanks to the past 50 years of discovery, with the means we have developed until now, but also with other means to be developed so that this exploration does not return to a round trip lunar ticket with no tomorrow. That is why technology demonstrators now receive in this proposed NASA budget from $600M to $2B per year.

The exploration of the solar system will not unfold in the manner dreamed of by Goddard, Tsiolkovski, Oberth, or Esnault-Pelterie. In that era, the solar system was eight planets, and the closest could have been habitable or at least relatively hospitable. The asteroids were what their name said, "quasi-stars", punctual and without interest. One could not have conceived of the exploration of the solar system except as travel from a planet A to a planet B. Today we have learned to work in microgravity and we know that these planets are all inhospitable. Their principal advantage, the gravity which allows astronauts to maintain their physical capacities, is also their biggest drawback, a

Above: A specialized transporter brought the payload canister to Launch Pad 39A in preparation for the STS-131 mission. The canister, which is the same dimensions as the shuttle's cargo bay, held the Leonardo supply module during the move from processing to the shuttle. Leonardo will be packed inside space shuttle Discovery for launch. In this image, the payload canister holding the Leonardo supply module is hoisted to the clean room at Launch pad 39A. Image Credit: NASA/Amanda Diller

gravitational well which requires a way out, and a surface gravity which requires a minimum thrust to any propulsion system. And Earth's gravitational well is the biggest obstacle for space exploration. A heavy lift launcher is necessary for any human space exploration program. In the 2011 proposed NASA budget, preparatory studies for heavy lift launchers receive from $600M to $750M per year.

For a sustainable space exploration program, it is also necessary to determine first of all what are the tasks requiring human intervention, what easily accessible resources are offered to us by the solar system, then how to exploit them to minimize the mass to be launched from Earth, all of which are aspects of a rational exploration. That is the aim of "robotic precursors" which receive $500M to $900M per year in this proposed NASA budget. Among the bodies "easily accessible" from Earth, there is the Moon and the Earth-crossing asteroids. The delta-velocity (delta-V) needed is similar for these two destinations, with an advantage for the latter: their gravity is negligible, which relaxes the constraints for the propulsion system. They have a definite scientific interest, they might contain useable resources, and they also might be targets and way-stations farther and farther from Earth on our way to Mars and beyond. That is what the Augustine committee suggests in recommending a "flexible path" to Mars. It has also been shown recently that the Moon might contain fairly important resources of water. Evaluation of these resources is thus an obvious objective for at least a robotic precursor. The cost/benefit studies for various exploration strategies remain to be conducted, based on specific demonstrators.

Finally, exploitation of the International Space Station (ISS) is prolonged and supported in this proposed NASA budget. In effect, ISS is an irreplaceable laboratory, both for international cooperation in space and for the study of biology and systems in prolonged weightlessness. These studies are a necessary condition for a human exploration program beyond the Moon, coherent with the VSE. The idea of stopping the exploitation of ISS in 2016 while developing Constellation since 2006, that is to say with a minimal investment in ISS utilization, would have made all exploration beyond the Moon infinitely more difficult.

The proposed 2011 budget thus tends to maximize the technological return of space exploration, all the while staying coherent with the general objectives of the VSE presented by G. W. Bush. The worry (and the deception) that one might be experiencing is that there is no proposal for a specific program for a launcher replacing the space shuttle. The Obama administration is betting on the American spirit of enterprise (free enterprise, hard work, know-how, etc.) to offer to the nation a way to access low Earth orbit for the lowest price. The underlying idea is that the corresponding technologies have already been mastered and are thus no longer the domain of NASA, where the bureaucracy would apply a brake to these endeavors. The bet is risky, despite the confidence that these newcomers attach to this enterprise.

Left: Expedition 22 Crew Lands

The Soyuz TMA-16 spacecraft is seen as it lands with Expedition 22 Commander Jeff Williams and Flight Engineer Maxim Suraev near the town of Arkalyk, Kazakhstan on Thursday, March 18, 2010. NASA Astronaut Jeff Williams and Russian Cosmonaut Maxim Suraev are returning from six months onboard the International Space Station where they served as members of the Expedition 21 and 22 crews. Image Credit: NASA/Bill Ingalls

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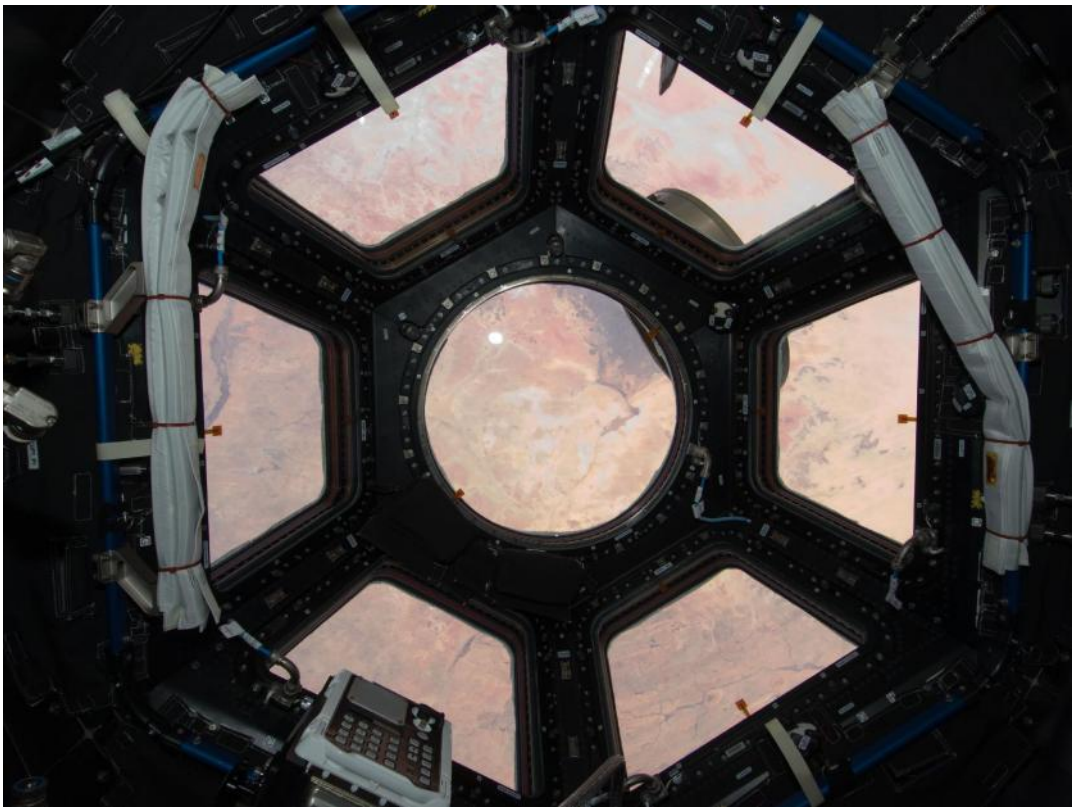
The bet is a little bit forced, too. The Augustine Committee showed that the Ares I launcher could not be ready in a reasonable time frame to be of service to ISS, due to a lack of sufficient NASA financing in the preceding years and due to delays in development which are normal in programs of this type.

The heavy lift launcher program is also not taking off, though it is very clear that it rests in the domain of NASA. The are many reasons for this: NASA, while concentrating on the means to return to the Moon during the last five years, did not show that they had coherent exploration plan beyond a repetition of Apollo, thus the realization of the heavy lift launcher and the elevated costs which accompany it can wait, in today's difficult financial context, all the more so since the technological returns from its realization are doubtful. Finally, we put our finger once more on the insufficiency of this current space program budget with respect to the related ambitions for human exploration. NASA finds itself incapable of leading at the same time the necessary technological developments and the programs which should make them appear, and this has been going on since the Apollo missions. Today, it is the technologies that have the priority because they appear to be the best investment for the American economy. One thinks once again of exploration in relation to its visible technological returns and not of potential discoveries and benefits brought about by the act of exploration itself. And yet a real pioneer spirit would consider the latter, by its nature unknown, to be more important.

In this context, Europe no doubt has cards to play. The Obama administration has shown a willingness to cooperate in space. It is easier to insert oneself into a flexible ensemble of technological developments and of support to an existing program of cooperation than to grab onto a new program structured under total American control. Europe can call attention to its competen-

Above: Window to the World. Floating just below the International Space Station, astronaut Nicholas Patrick put some finishing touches on the newly installed cupola space windows. Patrick was a mission specialist onboard the space shuttle Endeavor's recently completed STS-130 mission to the ISS. Image Credit: NASA



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Above: Let There Be Light. Endeavour pilot Terry Virts opened the windows of the newly installed cupola one at a time early Wednesday, giving spacewalkers Robert Behnken and Nicholas Patrick an early look into the International Space Station's room with a view that they had helped install. The cupola's fully opened windows look down on the Sahara Desert in this image that was 'tweeted' from space by JAXA astronaut and Expedition 22 flight engineer Soichi Noguchi. Image Credit: NASA

cies in terms of launchers, space medicine, satellites, and automated cargo vehicles. And once again it is necessary to give us the means. While the proposed NASA budget increases by 2.5% per year on average, the European Space Agency (ESA) budget is frozen for at least the next two years. While the NASA exploration budget is attaining a level of $4B or $5B, the corresponding budget for ESA amounts to about 100 million euros (with one euro worth about $1.35). This gives a measure of the political will that exists for the European space program.

It is all the more surprising that the large emerging nations treat space like a technological priority and a motor for their development rather than a budgetary adjustment variable. The Chinese programs and now the Indian programs appear methodical, with a will to master all aspects of access to space (useful satellites, launchers, scientific satellites, human spaceflight, the return of lunar samples, …), an ambition which, it seems, was abandoned more than 15 years ago in Europe. Their long term aims are unfocused, but it is difficult to believe that they will limit themselves to access to low Earth orbit. The recent evolution of the space programs of these nations shows that they are turning more and more to exploration, without neglecting the more immediate applications of space.

These proposed new directions for NASA are certainly a bad surprise ("deceiving") in the short term, but at least they tend to form new bases for exploration with a rational, global approach. At the same time, we can only regret the lack of specific objectives, strong will, and a long term vision behind these new directions. Our departure from our worldwide home port is once again postponed. At the same time, elements are being put into place for this departure on both sides of the Pacific.

News

Virgin Galactic: VSS Enterprise's First Flight

PRESS RELEASE

World's First Commercial Spaceship Takes Inaugural Flight

Mojave Air and Spaceport, Mojave, California

Monday 22nd March, 2010

Virgin Galactic announced today that its commercial manned spaceship, VSS Enterprise, this morning successfully completed its first "captive carry" test flight, taking off at 07.05 am (PST) from Mojave Air and Spaceport, California.

The spaceship was unveiled to the public for the first time on December 7th 2009 and named by Governors Schwarzenegger and Richardson. VSS Enterprise remained attached to its unique WhiteKnightTwo carrier aircraft, VMS Eve, for the duration of the 2 hours 54 minutes flight, achieving an altitude of 45,000ft (13716 metres).

Both vehicles are being developed for Sir Richard Branson's Virgin Galactic, by Mojave based Scaled Composites. Founded by Burt Rutan, Scaled developed SpaceShipOne which in 2004 claimed the $10m Ansari X prize as the world's first privately developed manned spacecraft. Virgin Galactic's new vehicles share much of the same basic design but are being built to carry six fare paying passengers on sub-orbital space flights, allowing an out-of-the-seat zero gravity experience and offering astounding views of the planet from the black sky of space.

Virgin Galactic has already taken around $45m in deposits for spaceflight reservations from over 330 people wanting

VSS Enterprise's inaugural captive carry flight. Credit: Mark Greenberg

to experience space for themselves.
The first flight of VMS Enterprise is another major milestone in an exhaustive flight testing programme, which started with the inaugural flight of VMS Eve in 2008 and is at the heart of Virgin Galactic's commitment to safety.

Commenting on the historic flight, Burt Rutan said: "This is a momentous day for the Scaled and Virgin Teams. The captive carry flight signifies the start of what we believe will be extremely exciting and successful spaceship flight test program."

Sir Richard Branson, Founder of Virgin Galactic added: "Seeing the finished spaceship in December was a major day for us but watching VSS Enterprise fly for the first time really brings home what beautiful, ground-breaking vehicles Burt and his team have developed for us. It comes as no surprise that the flight went so well; the Scaled team is uniquely qualified to bring this important and incredible dream to reality. Today was another major step along that road and a testament to US engineering and innovation."

The VSS Enterprise test flight programme will continue though 2010 and 2011, progressing from captive carry to independent glide and then powered flight, prior to the start of commercial operations.

For further information go to www.virgingalactic.com For background details, downloadable images and graphics go to: www.virgingalactic.com/captivecarry

Editor's note March 29, 2010: Houston Virgin Galactic Accredited Space Agents Tara Hyland and Diane Vest recently sold two flights. Both future astronauts are Houstonians.

Above: AIAA members at Congressional Visits Day (CVD) in Washington, DC, at Congressman Ron Paul's office
Left: Michael Kezirian, AIAA Houston Section International Space Activities Committee (ISAC) member
Center: Melissa Gordon, AIAA Houston Section Programs Chair
Right: Wayne Rast, Public Policy Director, AIAA Region IV

SCLS Space Center Lecture Series

DOUGLAS YAZELL, ASSISTANT EDITOR

Above: left to right: Dr. Benjamin Longmier, Gary Kitmacher, and Robert Pearlman. Ben and Gary created the successful Space Center Lecture Series (www.spacecenterlectureseries.com: look for presentation material, videos, and more here). Our section is one of the co-sponsors. Mr. Pearlman was the featured speaker recently. His popular web site is www.collectSPACE.com.

Right: items on display by Mr. Pearlman, including a red cover used to protect and RCS thruster from the weather while on the ground.

Photo Credits: Ellen Gillespie and Douglas Yazell

Above: Richard Garriot, private astronaut and Clear Creek High School graduate, member of International Space Station (ISS) Expedition 18.

Right: Ben, Richard, and Gary at the University of Houston Clear Lake (UHCL), the site of recent lectures in this series. The most recent lecture in this series was Mr. James Oberg, Houston area resident and space writer and journalist. The next lecture in this series will be presented by Mr. Sy Liebergot, the Apollo 13 EECOM veteran flight controller and author of a book about his life and his NASA experiences: Thursday, April 29, 2010, UHCL Bayou Bldg. Theater, 7 to 9 PM, free parking in the student section.

Hubble 3D: The New IMAX Movie

DOUGLAS YAZELL, ASSISTANT EDITOR

MARCH 19, 2010: Take an exhilarating ride through the Orion Nebula, a vast star-making factory 1,500 light-years away. Swoop through Orion's giant canyon of gas and dust. Fly past behemoth stars whose brilliant light illuminates and energizes the entire cloudy region. Zoom by dusty tadpole-shaped objects that are fledgling solar systems. This virtual space journey isn't the latest video game but one of several groundbreaking astronomy visualizations created by specialists at the Space Telescope Science Institute (STScI) in Baltimore, the science operations center for NASA's Hubble Space Telescope.

The cinematic space odysseys are part of the new Imax film "Hubble 3D," which opens today at select Imax theaters worldwide. The 43-minute movie chronicles the 20-year life of Hubble and includes highlights from the May 2009 servicing mission to the Earth-orbiting observatory, with footage taken by the astronauts. The giant-screen film showcases some of Hubble's breathtaking iconic pictures, such as the Eagle Nebula's "Pillars of Creation," as well as stunning views taken by the newly installed Wide Field Camera 3.

Source: hubblesite.org

Editor's note: now playing at the Houston Museum of Natural Science

Above: Installing a Room With a View. In the grasp of the Canadarm2, the cupola was relocated from the forward port to the Earth-facing port of the International Space Station's newly installed Tranquility node. The cupola is a robotic control station with six windows around its sides and another in the center that will provide a panoramic view of Earth, celestial objects and visiting spacecrafts. With the installation of Tranquility and cupola, the space station is about 90 percent complete. Image Credit: NASA (Editor's note: not a Hubble image, but a nice image!)

Aerospace Projects Review

APR Corner: Convair Amphibious C-5

SCOTT LOWTHER

APR Corner is presented by Scott Lowther, whose unique electronic publication is described as a "journal devoted to the untold tales of aerospacecraft design." More information, including subscription prices, may be found at the following address:

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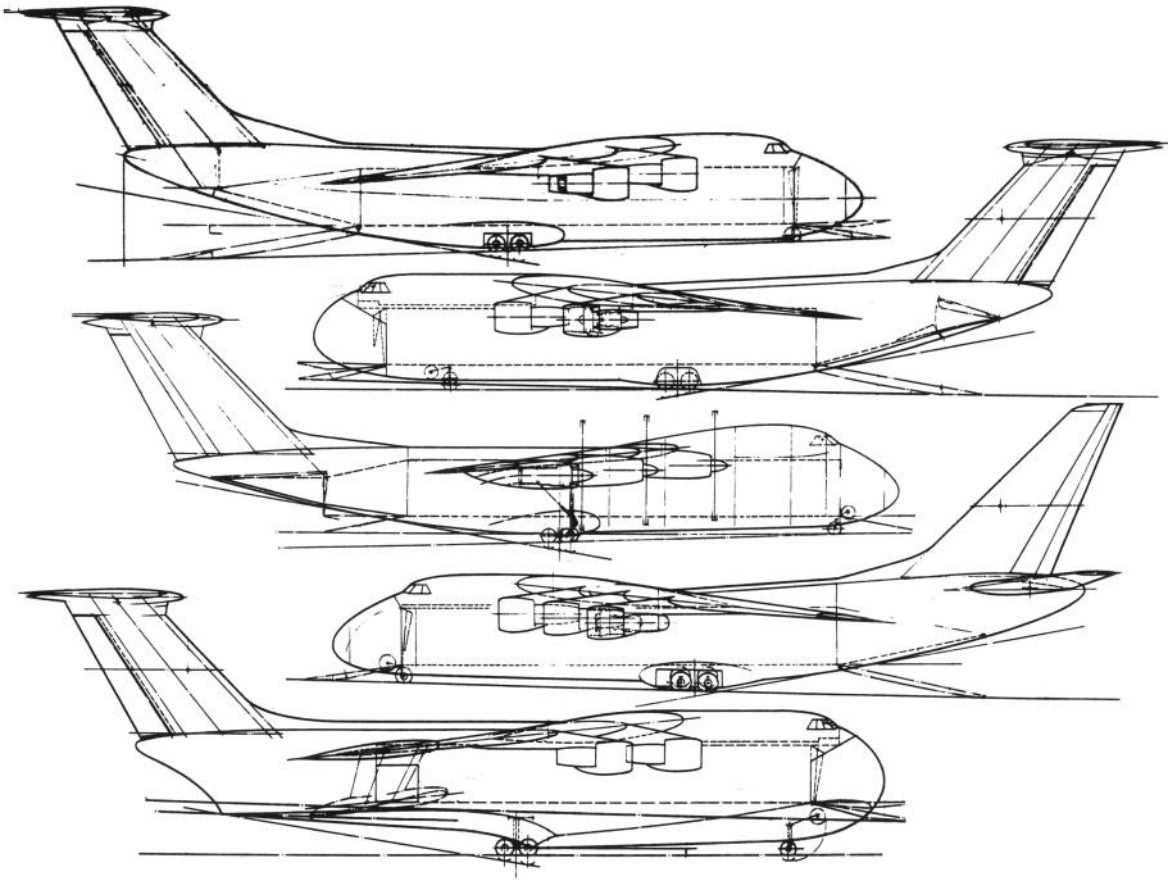
In the early 1960s, the limitations of the Lockheed C-141—in particular the narrow fuselage cross-section, too narrow to carry many of the larger Army payloads—were apparent. Additionally, the C-133 was becoming obsolete and needed replacing with a more modern, more efficient aircraft. Consequently the USAF ran several studies to rectify the problem… the CX-4 program in 1963 and the CX-HLS (Cargo Experimental – Heavy Logistics System) in 1964. Three-month study contracts for CX-HLS were awarded to Douglas, Boeing and Lockheed in June of 1964, with further contracts in December of that year. In September of 1965, Lockheed won the contract to design and build the C-5.

While only Lockheed, Boeing and Douglas won study contracts, they were not the only companies to produce preliminary designs to meet the CX-HLS requirements. General Dynamics (San Diego) performed such a design study, reporting in December of 1964 on a series of large cargo aircraft to fit the CX-HLS role. The baseline design was much like the Boeing, Lockheed and Douglas designs: a large aircraft with shoulder-mounted swept wings, four independently podded turbofans and nose and tail entryways. The Convair design featured a high T-tail to clear turbulence from the wing while at high angles of attack, such as takeoff and landing.

Along with the baseline, though, Convair also designed several variants including versions with larger wings, versions with eight turbojets or six turbofans, and versions with six turboprops (with or without air cushion landing assisted landing gear).

The most unusual variation was an amphibious version. A seaplane version would have the advantage of not needing prepared landing strips, but rather could land on any appropriate body of water in the forward area. To turn the baseline Convair heavy lifter into an amphibian, the aircraft above the floor line was identical, but the fuselage below that line was replaced with a conventional flying

(Continued on page 31)



Right: From top to bottom: baseline concept; larger-winged design; turboprop design; six-turbofan design; amphibian.

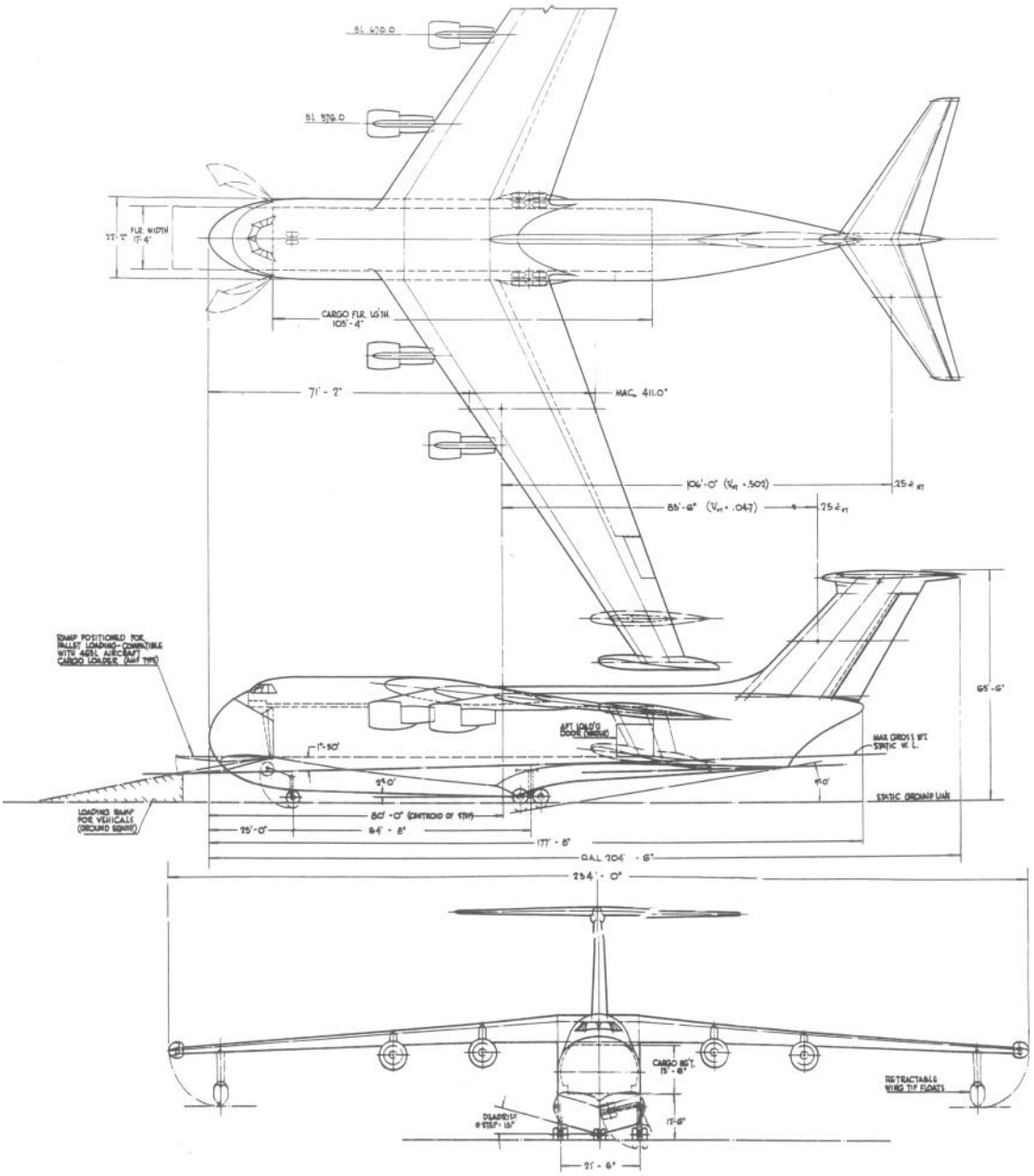
Aerospace Projects Review

(Continued from page 30)

boat planing hull. In addition, retractable floats were added to the wingtips, and the aft fuselage loading doors were removed. Instead side loading near the fuselage tail was added. The nose door of the fuselage was shortened and made substantially blunter. Landing gear was included, making the design truly amphibian. However, the landing gear was of short stature and was to be used solely for takeoff; landings were to be on water. Gross weight was 542,500 pounds. With a 100,000 pound payload, the amphibian could fly 5,000 nautical miles (cruising at 440 knots), offload, and then fly back 1,585 nautical miles without refueling. A maximum cargo load of 160,000 pounds was possible, with a shorter range. Without the tail loading doors, air-dropping of payloads was not possible. The cargo bay measured 103.3 feet long by 17.3 feet wide by 13.5 feet high.

The engines chosen were Pratt & Whitney STF-200-D2 turbofans with a by-pass ratio of 3.0 and a static thrust of 34,200 pounds each.

Thanks to Robert Bradley and the San Diego Air and Space Museum.



Event

Wings Over Houston

ELLEN GILLESPIE, SECTION CHAIR

The AIAA Houston Section had a static booth on the flight line at the Wings Over Houston Airshow on Saturday October 31st 2009. AIAA Houston was honored to share booth space with the Experimental Aircraft Association (EAA).

AIAA Houston booth volunteers (Melissa Gordon, Daniel Nobles, David Fuller, and Ellen Gillespie) were pleased to share information on AIAA programs and the two pieces of flight hardware on display at our booth. This event provided an opportunity to work with the general public on a beautiful airshow day to recruit new members and provide pre-college flight hardware mini-sessions.

AIAA volunteer David Fuller displayed a LR-101 rocket engine (used in the old Atlas boosters as a vernier thruster) at the Houston booth. This complete engine is about 15 inches long and weighs about 25 lbs. The top plates come off to show the oxidizer and fuel mixing chamber. David talked to booth visitors all day about how the LR-101 works and why.

Also on display at the AIAA booth was an Apollo R4D RCS thruster which was manufactured by the Marquardt Company, Van Nuys, CA, under contract to North American Aviation for the Apollo Program. This thruster would have been one of 16 thrusters, in groups of 4, located at 90 degree intervals around the Service Module (made by North American). It used hypergolic propellants which ignite on contact to avoid the need for an igniter. This RCS thruster fuel was monomethylhydrazine and the oxidizer was nitrogen tetroxide to provide 100 pounds of thrust. The thruster could fire in small bursts as short as 10 milliseconds and at a frequency up to 40 Hz. It could also fire steady state for sustained periods. The steady state thruster temperature in the combustion chamber was 2600 degrees F. The gray combustion chamber is made of a molybdenum alloy and the nozzle is a cobalt super alloy called L605.

The AIAA Houston booth enjoyed booth visitors and the airshow with our friends from EAA, who proudly displayed approximately 10 of their own aircraft, some of which were self built. EAA was very good to AIAA, sharing canopy space, providing tables, and sharing food. In a future airshow visit consider visiting the ever growing EAA/AIAA display.

Photos: Top left: David Fuller (center) and Melissa Gordon (right). Bottom left: David Fuller with rocket hardware. Bottom right: AIAA Houston Section Chair Ellen Gillespie in the Long-EZ as owner Richard Sessions looks on.

EAA Corner

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:
6 Apr 10: Spring Builders Series: Basic Ribbed Wing Construction – Part II, Workshop
4 May 10: Spring Builders Series: Basic Ribbed Wing Construction – Part II, Workshop
1 Jun 10: Pilot's Breathing Oxygen, Mikella Monroe, Airgas.com???

Recurring Events:
Monthly Meeting: Chapter 302 Monthly Meeting, 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 of Each Month – 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 of Each Month – Lufkin TX Fajita Fly-In (LFK)
2nd Saturday of Each Month – New Braunfels TX Pancake Fly-In
3rd Saturday of Each Month – Wings & Wheels, 1941 Air Terminal Museum, Hobby Airport, Houston TX
3rd Saturday of Each Month – Jasper TX BBQ Lunch Fly-In (JAS)
3rd Saturday of Each Month – Tyler TX Breakfast Fly-In, 8-11, Pounds Field (TYR)
4th Saturday of Each Month – Denton TX Tex-Mex Fly-In
4th Saturday of Each Month – Leesville LA Lunch Fly-In (L39)
4th Saturday of Each Month – Shreveport LA Lunch Fly-In (DTN)
Last Saturday of Every Month – Denton Fly-In 11AM-2 PM (KDTO)

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!

News
Notes from AIAA Daily Launch

First Pilot To Fly In Space On X-15 Dies.

The Los Angeles Times (3/24, McLellan) runs an obituary of Robert M. White, who "was a 38-year-old US Air Force major and record-setting test pilot at Edwards Air Force Base in 1962 when he joined the elite ranks of America's four astronauts." He flew into space "as the pilot of a rocket-powered X-15 research airplane, flying nearly 60 miles above the Earth's surface and completing a conventional landing on Rogers Dry Lake at Edwards Air Force Base." That "earned him the distinction of being the first man to earn a winged astronaut rating by piloting an airplane in space." White was 85, and "will be buried at Arlington National Cemetery."

Calendar

March 4
Space Center Lecture Series co-sponsored by our section, 7-9 PM
Richard Garriot: A Private Astronaut's Path to Space, UHCL Bayou Bldg Theater
March 25
Space Center Lecture Series co-sponsored by our section, 7-9 PM
James Oberg: Update: Russian Space Program, UHCL Bayou Bldg Theater

April 2
Dinner Meeting
Understanding and Mitigating Potentially Hazardous Near-Earth Objects
James D. Walker
5:30 pm - 9:00 pm
April 2
Conference
Region IV Student Paper Conference
9:00 am - 5:00 pm
April 10
Yuri's Night Houston (yurisnighthouston.net)
5 km fun run 8:00 AM, Challenger Park
Space Day, 11:00 AM—5:00 PM Discovery Green: Free!
Celebration: 8:00 PM—Midnight, Hilton Americas—Houston
And more! (yurisnighthouston.net)
April 12
Council Meeting
All current and prospective council members are welcome.
JSC Gilruth Center - San Jacinto Room
5:30 pm - 6:30 pm
April 26 (Monday)
Lunch-and-Learn, Dr. Jim Benford
How to Build Cost-Optimized Interstellar Beacons (and How to Search for Them)
NASA/JSC Gilruth Center Longhorn Room, start time TBD, probably noon (a one-hour event)
Contacts: astro@aiaa-houston.org (AAJ at work), aiaadyazell@me.com (DJY at home, work phone 281 244 3925)
April 29 (Thursday)
Space Center Lecture Series co-sponsored by our section
Sy Liegergot: Apollo 13: Anatomy of the Failure
UHCL Bayou Bldg Theater
7:00 - 9:00 PM
April 30 (Friday)
Annual Technical Symposium
JSC Gilruth Center
7:30 AM to 6:00 PM

May 3
Council Meeting
All current and prospective council members are welcome.
JSC Gilruth Center - San Jacinto Room
5:30 pm - 6:30 pm

June 7
Council Meeting
All current and prospective council members are welcome.
JSC Gilruth Center - San Jacinto Room
5:30 pm - 6:30 pm

Horizons published quarterly, online late March, June, September and December.
See http://www.aiaa-houston.org, then click on newsletter

Cranium Cruncher

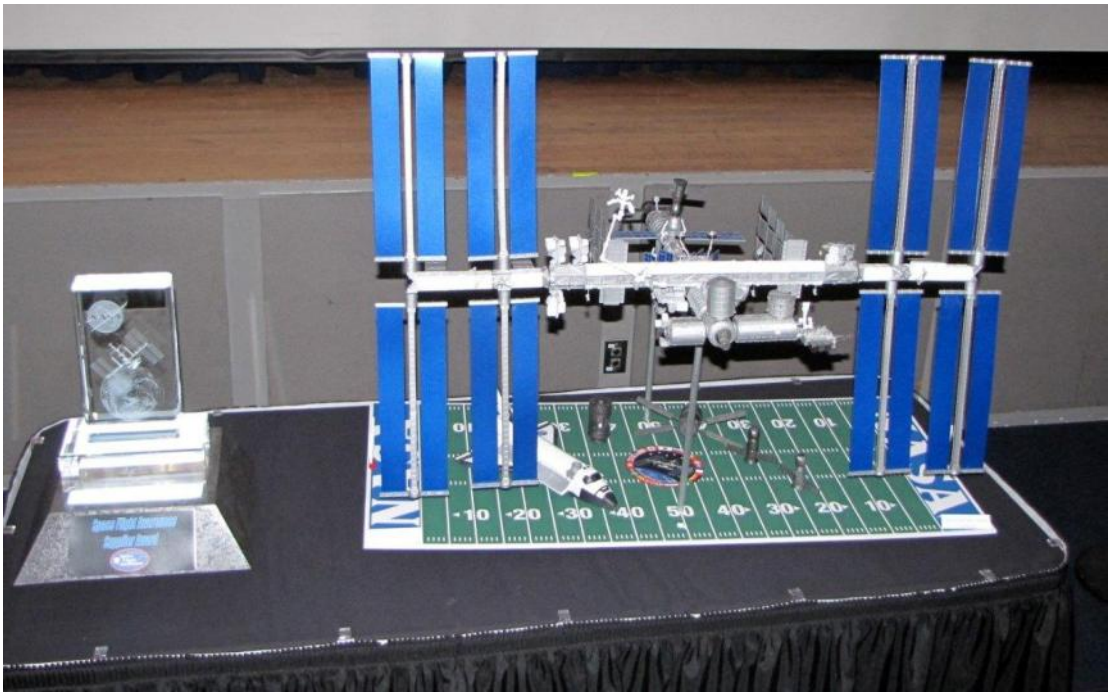
Steve Everett, Horizons Editor

The intended solution for the last issue's Cranium Cruncher was that a minimum of three astronauts, including the crewman to be transferred, would be required for a crewman transfer from Armstrong to Aldrin base. After setting off from Armstrong, at the end of the first hour they each have three hours worth of oxygen left. So, the third person can give each of the other two people one hour's worth and he or she will have the one-hour supply necessary to get back to Armstrong. So, at the end of the second hour the first two people are back to three hours of oxygen and the third person has made it safely back to Armstrong. At that point, if the second person gives the first person one hour's worth of oxygen, the second person will have the two hours of oxygen necessary to get back to Armstrong safely and the first person will have four hours of oxygen to travel the remaining four hours to Aldrin.

Congratulations to Ronny Newman and Joe Frisbee for their correct answers and explanations. Special recognition to Ronny Newman and Robert Howard for exploiting my lack of clarity and pointing out the transferring crewman need only carry extra tanks to make it the entire way alone. Thanks to all the others who also submitted less than optimal answers.

Now for a short one this month:

Find a number ABCDEFGHIJ such that A is the count of how many 0's are in the number, B is the number of 1's, and so on.



A snapshot of a model of the International Space Station (ISS) and an American football field. On March 5, 2010, NASA/JSC in Houston, Texas celebrated ISS completion, though some space shuttle flights remain. (Photo: Yazell)

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AIAA MOURNS DEATH OF AARON COHEN

Former Director of NASA Johnson Space Center and AIAA Honorary Fellow Was 79

March 1, 2010 – Reston, Va. – The American Institute of Aeronautics and Astronautics (AIAA) mourns the death of Aaron Cohen, former director of the NASA Johnson Space Center, Houston, Texas, and AIAA Honorary Fellow. Mr. Cohen passed away in Houston on February 25, 2010. He was 79.

AIAA President Dave Thompson stated: "Aaron Cohen's contributions to America's space program – from Apollo and the Space Shuttle to the International Space Station and beyond – were of critical importance in achieving and sustaining United States preeminence in human space exploration. An outstanding engineer and inspirational leader, Aaron directed NASA's Johnson Space Center and taught at Texas A&M University. As we mourn his passing, AIAA also salutes his many accomplishments that so powerfully advanced our country's space endeavors."

Cohen was made an AIAA Honorary Fellow in 1995. He had a 33-year career with NASA, joining the agency in 1962 and holding various leadership positions in NASA's Apollo program. From 1972 to 1982, he managed NASA's Space Shuttle Orbiter Project Office. Cohen served as Director of the NASA Johnson Space Flight Center from 1986 to 1993, and displayed particularly outstanding leadership in the wake of the Challenger disaster. He retired from NASA in 1993 to accept an appointment as a professor at Texas A&M University, his alma mater.

Cohen was the recipient of many awards during his career, including two Presidential Rank of Distinguished Executive awards; three NASA Distinguished Service Medals; the AIAA Goddard Astronautics Award; the AIAA von Braun Award for Excellence in Space Program Management; and the Theodore von Kàrmàn Lectureship.

AIAA is the world's largest technical society dedicated to the global aerospace profession. With more than 35,000 individual members worldwide, and 90 corporate members, AIAA brings together industry, academia, and government to advance engineering and science in aviation, space, and defense. For more information, visit www.aiaa.org.

Below: Former NASA Johnson Space Center Director Aaron Cohen. Image 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

Become a member of AIAA

Are you interested in becoming a member of AIAA, or renewing your membership? You can fill out your membership application online at the AIAA national web site: www.aiaa.org. Select the AIAA membership option.