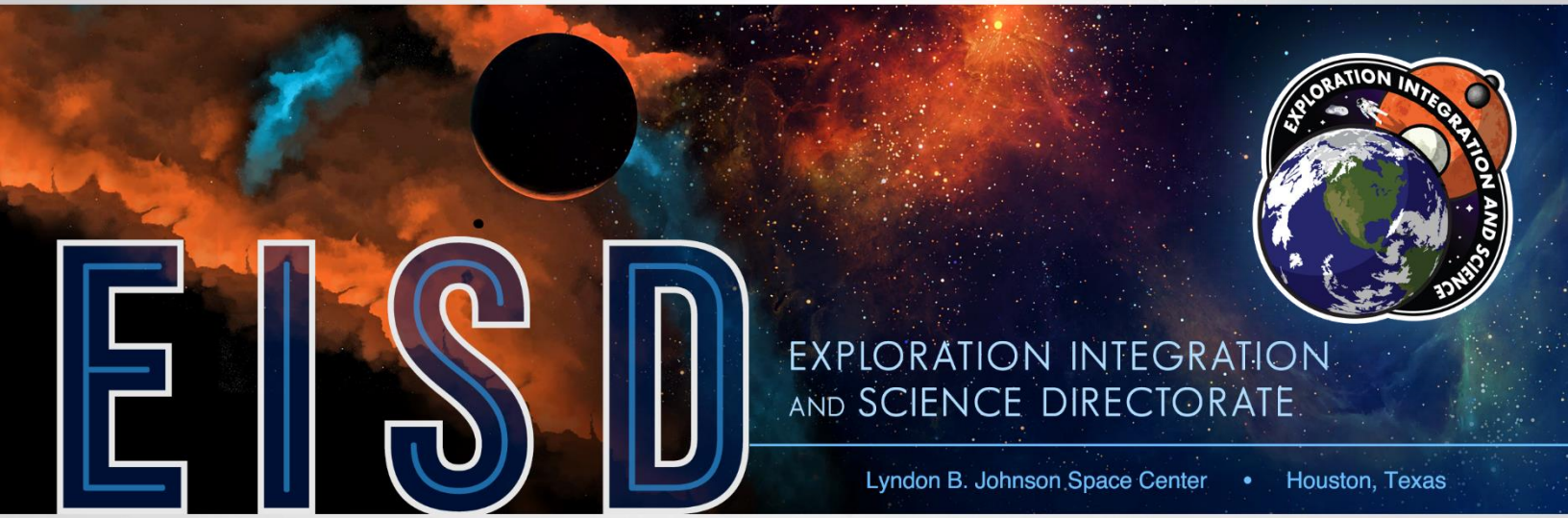


NEWSLETTER

MAY 2016

FROM THE DIRECTOR

What amazing accomplishments I have witnessed since starting as Director of EISD only 2 months ago. The STRATA-1 payload, developed using the Class 1 E process, was installed and activated on ISS; the Meter Class Autonomous Telescope (MCAT) installation on Ascension Island is complete and we are preparing for user readiness review; BEAM was installed and deployed on ISS; and EISD provided SE&I support (imagery analysis and on-orbit security assessment).

We are leading test and evaluation of the EMU 3011, returned from 6 years and 3 months of being on ISS via SpaceX 8. Understanding the water in the helmet anomaly is critical to enable the return of scheduled EVA's on ISS by August 2016 for the International Docking Adapter (IDA) installation. During this year's PPBE18, we provided a strategy for developing EVA hardware that can be used and tested on the ISS, and is extensible for exploration EVA's.

And we have continued to support planning and SE&I for exploration missions, both near term – EM1 and EM2, and further in the future for proving ground missions and for the evolvable Mars campaign (EMC).

I hope you were able to attend our All Hands held on May 12th, where I shared how EISD is involved in every phase of NASA's Journey to Mars…Phase 0: Exploration Research and Systems Testing on ISS, Phase 1: Cislunar Flight Testing of Exploration Systems, and Phase 2: Cislunar Validation of Exploration Capability. I also shared EISD's 2016 Goals, which are listed on the second page of this newsletter intro.

Finally, I would like to thank you for your very warm welcome. I am looking forward to meeting each and every team member, as we jointly press forward in implementing our vision and mission:

***Vision*: Extend humanity's reach to the cosmos!**
***Mission*: Lead space exploration through research, strategy, mission planning, systems development, and integration.**

Sincerely – Vanessa

IN THIS ISSUE

Featured EISD Team
Exploration Development Integration Office, XS

Solar System Internet
A complex communications network is conquered

I Am an Explorer
Brenda Lyons, Guest Editor

CoFR Like Nothing Before
Flight readiness for a new generation

Cyber Space
Keeping spaceflight safe from hackers and adversaries

Announcements
A directorate on the go

FEATURES

EISD Goals for 2016

EISD will focus on JSC's Center Goal: "Support the Programs" – ISS, Commercial Crew, Orion, and future exploration missions. Everyone in EISD is invited to provide inputs to our goals by contacting one of the POCs listed under each goal description.

- **Objective:** Entire workforce has a personal mission to "make the Programs successful." Everyone should understand the dependencies of each Program, including the planning for future exploration missions, to the others, and why making them successful is critical to us getting to exploration of the universe

EISD: Will be the stewards for the "Future Exploration Missions"

- **Goal 1**: Communicate to all employees the strategies and goals of each Program, and the planning efforts for future exploration missions, and their interdependencies and why making each program successful is critical to the success of the other

  EISD POC for Goal 1 is Yolanda Marshall

- **Goal 2:** Foster an environment that supports increased collaboration across organizational lines to maximize efficiencies that free up resources for other program tasks

  EISD POC for Goal 2 is Lisa Pace

- **Goal 3**: Provide designers and implementers with flexibility and adaptability by supporting tailoring of standards and requirements for their projects.

  EISD POC for Goal 3 is Burt Laws

A Newsletter Makeover

This issue is the pilot for several newsletter improvements! If you are reading this, you have already taken advantage of e-newsletter packaging, giving you complete control over the choice and order of what you read. While you are on this page, be sure to check out the new overall look of the publication.

We are also introducing the newsletter guest editorship. Every other month we will host a guest editor from one of the EISD offices. The guest editor will lead the content of the newsletter, focusing on their home organization.

Brenda Lyons, of the Exploration Development Integration Office, mail code XS, is our first guest editor. Brenda did a wonderful job! We used a new feature, I Am an Explorer, to *highlight her editorship and to get to know her a little better.*

FEATURES

Who is EDI?

By Burt Laws

The Exploration Development Integration Office, or EDI, is an organization that provides cross-program systems engineering and programmatic integration for the Exploration System Development (ESD) Enterprise within the Human Exploration and Operations Mission Directorate (HEOMD).

The EDI was formed in 2011 as a division of the Human Exploration Development Support Directorate. It originated from the Constellation Program Level 2 integration offices during the formulation of the Orion, Space Launch System (SLS) and Ground Systems Development and Operations (GSDO) as programs. Following the shutdown of the Constellation Program, NASA ESD requested help to establish a new integration approach for the Enterprise. This integration model was led out of Headquarters and matrix technical support from the EDI office.

EDI personnel provided the expertise to develop the formulation products and provide cross-program integration. To get the Enterprise moving, EDI produced a technical plan with deliverables scheduled to meet ESD life cycle milestones. The office developed the Level 1 Performance Requirements and the ESD Concept of Operations (Con Ops) from architecture work performed at the Agency level. The ESD Requirements and Con Ops enabled the three programs to develop their design specifications from functional allocations.

In 2014, EDI became a member division of the newly formed Exploration Integration & Science Directorate (EISD). As a member of EISD, the organization provided the engineering products and successfully conducted integrated design reviews for the ESD Enterprise. The office has incorporated the mission integration function for ESD and currently is defining the EM-1 mission definition products. In addition, EDI has incorporated a system security and asset protection function for all HEOMD programs and provides project management for NASA's Delay/Disruption Tolerant Networking project.

The EDI Logo

The three graphics: the SLS Rocket, Orion Spacecraft, and VAB, represent the three primary exploration programs - SLS, Orion, and GSDO – served by EDI integration.

The Penrose triangle in the center represents the integration of the three primary exploration programs. Close inspection shows the Penrose triangle is an impossible shape. This does not mean that integration is an impossible task, but rather, can often be very difficult and requires looking deeper than just the surface.

The gray crescent and the red circle represent the Moon and Mars respectively, two possible destinations for exploration missions, with Mars being the primary goal.

Recent Staff Changes in EDI

GAINS

Lisa Blok: Joined EDI from ISS to support payload integration.

DEPARTURES

Lisa Hammond: Transferring to Orion Vehicle Integration Office as Cross Program Integration Lead.

Amhad Albu-Shamah: Completing her spring internship and returning to North Carolina A&T State University.

FEATURES

DTN: The Solar System Internet

Communicating reliably in a challenged environment

By Adam Schlesinger and Brenda Lyons

Communicating from Earth to any spacecraft is a complex challenge, largely due to the extreme distances involved. When data are transmitted and received across thousands and even millions of miles, the delay and potential for disruption or data loss is significant. Standard or traditional Internet Protocol (IP) communication would time-out and fail under such conditions. Delay/Disruption Tolerant Networking (DTN) is NASA's solution to reliable inter-networking for space missions.

DTN was originally conceived and developed for interplanetary use, where the speed of light can seem slow and delay-tolerance is the greatest need. However, DTN may have far more diverse applications where disruption-tolerance is the greatest need, including on Earth. The potential Earth applications span a broad range of commercial, scientific, military, and public service applications.

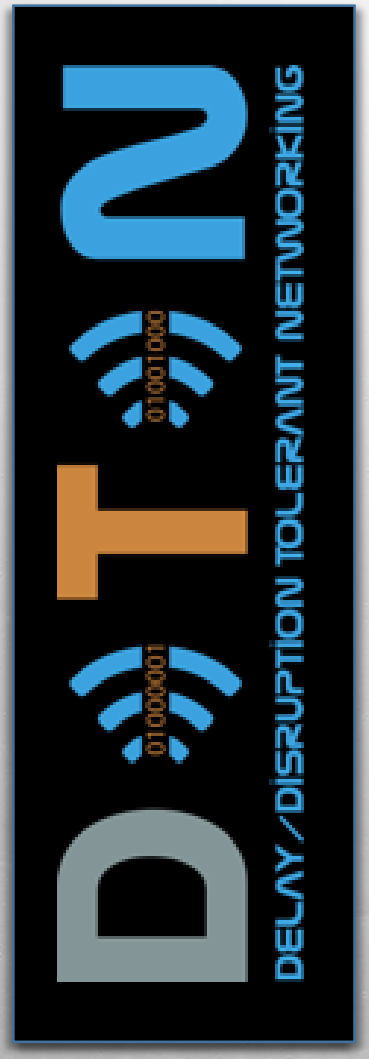
The usability of the Terrestrial Internet Protocols depends on some important assumptions:

- **Continuous, Bidirectional End-to-End Path;**
- **Short Round-Trips;**
- **Symmetric Data Rates;**
- **Low Error Rates; and**
- **Trusted Networks**

Many evolving and potential communication environments (including the space environment) do not conform to these underlying assumptions, and require a different mechanism for efficient communication. These environments are characterized by:

- **Intermittent Connectivity;**
- **Long or Variable Delay;**
- **Asymmetric Data Rates;**
- **High Error Rates; and**
- **Untrusted connections**

FEATURES



DTN: The Solar System Internet *conclusion*

DTN, a critical piece of the Solar System Internet, is a suite of protocols that enable reliable inter-networking in challenged environments such as space. The core of DTN is a "bundle protocol" (BP) that relies on store-and-forward mechanisms to take advantage of any communication link available, even if it does not immediately have an end-to-end communication path to the destination. In contrast, the terrestrial Internet requires a sustained end-to-end path to exist for the duration of the communication session. Some benefits of DTN include improved operations and situational awareness, interoperability and reuse, space link efficiency, utilization and robustness, security, and quality-of-service (putting critical data through first).

The DTN Project is part of Advanced Exploration Systems, and is supporting the standardization of the protocol by both the Consultative Committee for Space Data Systems (CCSDS) and the Internet Engineering Task Force (IETF). These international standards boards are shepherding the process to create open international standards supported by open-source software. Several open-source implementations of DTN already exist and are publically available, including NASA's Interplanetary Overlay Network (ION). The DTN Project does not intend to become a capability provider in the sense of being the sole NASA focus for DTN implementation – rather the project aims to transition the technologies to other organizations for operations and maintenance.

The DTN Project is currently focusing on maturing the DTN technology suite and supporting operational infusion of DTN capability into NASA and partner missions and systems. The end goal of this approach is to remove NASA from the developer/maintainer role and allow NASA to become a user of what emerges as a commodity set of products – as ubiquitous as IP-based networking is today. The AES DTN Project will achieve this goal by maturing DTN technologies to the TRL 7-9 point (ready for operational deployment, and operational in some instances) and then providing the expertise and guidance to mission and system implementers to take ownership of their specific instance of DTN.

The International Space Station (ISS) recently implemented an institutional DTN service to support payloads. The ISS institutional DTN implementation greatly enhances the reliability of the payload science data transmissions and reduces operational overhead and planning, while providing an architecture to support future mission support applications and advancing DTN technology to support the future Solar System Internet.

Brenda Lyons

This issue of the EISD Newsletter launches the concept of guest editorship with Brenda Lyons of the Exploration Development and Integration Office (XS) serving as the first guest editor. She graciously agreed to sit down as the first subject of the new I Am an Explorer *feature.*

Brenda Lyons at Kennedy Space Center in the Vehicle Assembly Building during Shuttle processing.

What first drew you to a job as a NASA explorer?

I grew up in Houston in the Hobby Airport area. Several of my friends' dads worked at JSC and my sister worked part time in JSC's Human Resources through a high school study/work program. While I was in high school, she helped me get a JSC summer job doing clerical work supporting Engineering in Building 16. That was in 1981, the year of the first Shuttle launch. It was a really exciting time to be at JSC!

How did you come onboard?

After studying math and computer science in college, I wanted to see if I could work at JSC. Friends at the center routed my resume. It ended up in a stack on the desk of a manager in MOD's *[Mission Operations Directorate's]* Crew Training Division.

Apparently two competitive items during my Rice University career led to an interview – my membership on a women's softball team and membership on a Beer Bike Team. The manager interviewing me was in need of women for his JSC softball team and he really wanted to know more about the Beer Bike Team.

OK, we have to ask. What is a Beer Bike Team?

It is a relay race. A chugger will chug, and when finished, a biker will ride a lap. When the biker gets back in the pit, the next chugger chugs, and so on. I was an "Iron Woman," meaning I would do both – ride one of the laps then take my turn chugging.

And did you get the job?

Turns out there were no job slots. I was instead referred to Rockwell, the prime MOD contractor, who hired me to work in the DPS and NAV *[Data Processing System and Navigation System]* area of crew training.

Brenda Lyons - concluded

What course did your career take to go from that first job to XS?

After Crew Training, I worked as Shuttle assistant MER Manager *[Mission Evaluation Room Manager]*. I then transferred to ISS launch package management. From there I moved into a civil service job in the ISS Vehicle Office.

During Shuttle Return to Flight, I moved to Shuttle SEI *[Systems Engineering and Integration]* to do Orbiter Element Integration, and then managed the Integrated Hazards for SE&I. Next I took the SE&I role as lead for the Imagery Integration Team. After Shuttle ended, I transitioned to YA, which evolved into the organization that I am in today in EISD, but with a new mail code!

What was a highlight of your career journey?

One of the most memorable times was my work in building and deploying the ISS Floating Potential Probe, or FPP. There was a lot of concern with the possible effects of ISS electrical charge build-up due to the ionosphere that could potentially damage hardware and harm EVA crewmembers. This probe was designed to collect data to enhance our understanding. I worked with a lot of interesting people on this project – scientists at the leading edge of the field, astronauts, and members of the EVA project, MOD, etc.

What do you want to see NASA accomplish in your lifetime?

I want NASA to take a woman beyond LEO! We've gone to the Moon and it has been a long time since we've done something like that. Women astronauts have been important role models and this would be another way to continue that important aspect of NASA inspiration.

Thank you Brenda for leading this edition of the newsletter and for being a role model in your own right!

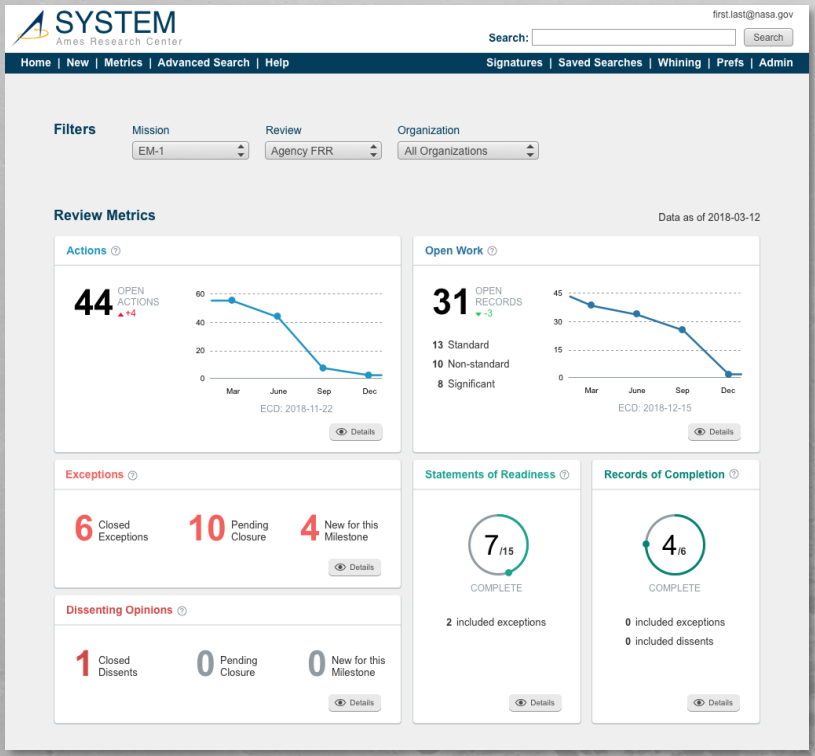
FEATURES

Electronic Certification of Flight Readiness

By Phillip Harris and Roger Galpin

In 2018, we will launch the first of many Exploration Missions, leading us to explore beyond low Earth orbit. Teams across the world are working to make various components, design mission plans, and prepare the next generation of human spaceflight for launch. As we near 2018, a critical aspect will be successfully completing flight certification of the flight vehicles, ground systems, facilities, personnel, and procedures to assure readiness for flight and to safely accomplish the mission.

EISD's Flight Certification Integrated Task Team members are working to provide an electronic means to aid in this process. The major goal is to provide significant reduction in the time needed to collect the information, providing more time for analysis and to actively close actions and open work affecting final endorsement of flight certification. This system is called the Electronic Certification of Flight Readiness, or "eCoFR" for short.



eCoFR System Metrics View Representation

The eCoFR has several advantages over the traditional paper-based CoFR process. In the past, over 80% of the time spent performing the CoFR process involved collecting data that the accountable parties needed to analyze and determine flight readiness. The eCoFR will leverage the ESD host of interconnected databases to automatically find information relevant to the CoFR process, as specified by the accountable parties, and provide a single location from which to access and analyze the information.

This reduces the time needed to trace down each individual piece of the overall puzzle and provides a much larger percentage of the available time to analyze an organization's readiness to proceed to mission operations.

FEATURES

Electronic Certification of Flight Readiness, *conclusion*

The eCoFR doesn't stop at simply providing more time for analysis, it also assists in the review process itself by providing a single location for all CoFR-related data and the ability to trace CoFR decisions through the life of the Enterprise. Organizations such as ESD will use eCoFR to automatically roll up the pertinent data from individual cross program teams to higher levels of management for review.

Within each Program it will be possible for a subsystem team to certify that their hardware, software, or products are ready pending identified open work, and this readiness will be reviewed by the component/element team lead. All systems readiness will be evaluated by the vehicle team, and so on rolling up to the Program Manager level and above.

CoFR exceptions and dissenting opinions are also managed through the system and automatically follow their defined processes for review – ensuring that everyone's opinions are adequately heard and addressed.

CoFR reviews, such as the Agency Flight Readiness Review, will also be conducted out of the system. It has been designed to reduce the use of presentations to present CoFR data, which were often just copied and manually updated for each flight. The eCoFR will now automatically generate near-real time metrics to show current CoFR readiness and what is remaining open before a decision can be rendered – instead of needing to update charts. The eCoFR will also manage all of the agendas, minutes, and other review materials – providing easy access during and after the review milestones.

Flight Certification is a very involved process integrating readiness assessments and objective evidence from the lowest levels all the way up to an Agency decision to fly. The eCoFR takes full advantage of today's technology realities. Dynamic data linkages across various systems provides for faster research and identification of related items or issues, eCoFR provides a single location to manage all CoFR data, reviews, and signatures instead of having to search through hundreds of systems individually. The system's ability to automatically provide open work and open endorsement burn down metrics will assist in managing the CoFR process.

In short, eCoFR will provide more time for everyone to focus on closing open work - and ultimately making the Enterprise more efficient.

FEATURES

NASA and Cyber Space

By Jason Soloff

The Exploration Missions with Orion and Space Launch System will deal with a particular aspect of space flight in a new way – cybersecurity in space. The operation of our next generation of space vehicles will rely upon the use of cybersecurity for communications, commanding, and data collection.

And with this technological leap, comes a need for NASA to factor cybersecurity into their spacecraft and architecture designs to shield missions from hackers and adversaries.

This aspect complicates the important NASA process of identifying risks for space missions and potential mitigations. NASA has an established set of risk classes – loss of mission, loss of crew, loss of vehicle, injury to personnel or harm to the public, environmental impact, schedule and cost impact, etc. These risk classes have historically dealt with fixed causal events, an example being a lightning strike, a debris hit, or a component failure. The class of cyber risks is different. It involves the human element of the causing event – intentional harm from hackers and adversaries.

NASA has limited experience with mitigating the effect of adversaries, but several other federal organizations are *experts* in cyber-attack methods, mitigations, and counter strategies. The Constellation Program was the first to reach across the national intelligence community (IC) to solicit collaboration in addressing cybersecurity risks.

The collaboration brought together an amazing team, and the logo graphic below shows the immensity of the team that continues to serve as a rich source of expertise. This important work now continues under EISD leadership, within EDI's HEO Systems Protection Office. The team is chartered with addressing cybersecurity and space systems protection as an organic element of the Enterprise.

The partnership between NASA and the security community reveals cultural differences in the ways that risks and hazards are communicated and evaluated within the IC, as opposed to NASA's approach. The IC works with a large degree of uncertainty due to things we, as a Nation, simply do not know, as well as limited access to information due to a decision maker's true "need to know."

As such, IC methods of presenting risk and threat seem vague and ill-defined to the engineer- and operations-heavy NASA management community which expects to see risks presented with full supporting analysis in a concise "5x5" view. Additionally, the NASA community fully expects to be able to discuss and debate identified hazards, threats and mitigations in open forums, an approach that is unheard of within the National Security Space community.

Logos of the many federal agencies and organizations that came together work on cyber security for human spaceflight.

But with diligence, a bridge has been built between the two worlds to identify potential outcomes of hacking and adversarial actions in cyber space and improvements to our spacecraft. Thanks to the team, Orion has already incorporated four design changes to mitigate cyber threats.

ANNOUNCEMENTS & EVENTS

CONGRATULATIONS
Awarded as of May

Silver Snoopy
Generoso (Bum) Jacinto, XX

NPSE Federal Engineer of the Year
Christopher Hansen, XX

Fellow of the Meteoritical Society
Lindsay Keller, XI

Superior Accomplishment Award
John Holder, XI

Group Achievement Award, SpaceCom Working Group and Exhibit Teams
Mary Kincaid, XP

On The Spot Award
Mary Kincaid, XP

Time Off Award
Kevin Watts, XM

Congratulations to Andrea Mosie (XI)
Stellar Rotary Award Nominee
Late Career category

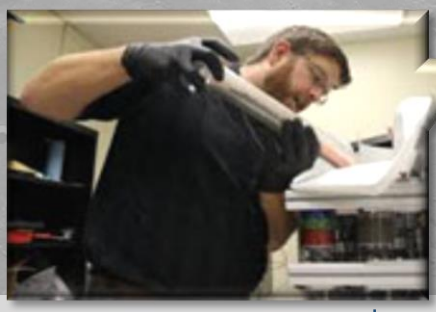
Andrea is the lead processor for the Apollo Lunar Sample Lab. She has worked in the Apollo Lunar Processing Lab since the 1970s, providing outstanding service to NASA and the planetary science community.

Congratulations to Jesse Buffington (XX)
Stellar Rotary Award Nominee
Early Career category

Jesse is the Exploration EVA Strategic Planning and Architecture Integration Lead. He has worked across JSC in various parts of the EVA Community since 2007, including the Shuttle, Constellation and ISS Programs.

EMU Return for Troubleshooting

EMU 3011 returned from ISS via SpX-8. The EMU will undergo test, teardown, and evaluation (TT&E) to troubleshoot water in the helmet anomaly that caused early termination of US EVA35 in January 2016.



NEW RESPONSIBILITIES

Joe Gard, XM
Manager, Asteroid Redirect Crew Mission (ARCM) Project

Randy Robinson, XX3
Manager , EVA Hardware Management Office

Paul Abell, XI
Chief Scientist, Planetary Small Body Exploration

EISD IN THE NEWS

Biomolecular Sequencer Payload
http://www.theatlantic.com/science/archive/2016/04/this-technology-will-allow-anyone-to-sequence-dna-anywhere/479625/

Strata-1 Payload
https://www.youtube.com/watch?v=vBAAawuBgyY&feature=youtu.be

Silicate Stardust Traces Histories of Dust in the Galaxy
http://cms.nasa.gov/press-release/silicate-stardust-traces-histories-of-dust-in-the-galaxy

ANNOUNCEMENTS & EVENTS

ANNOUNCEMENTS

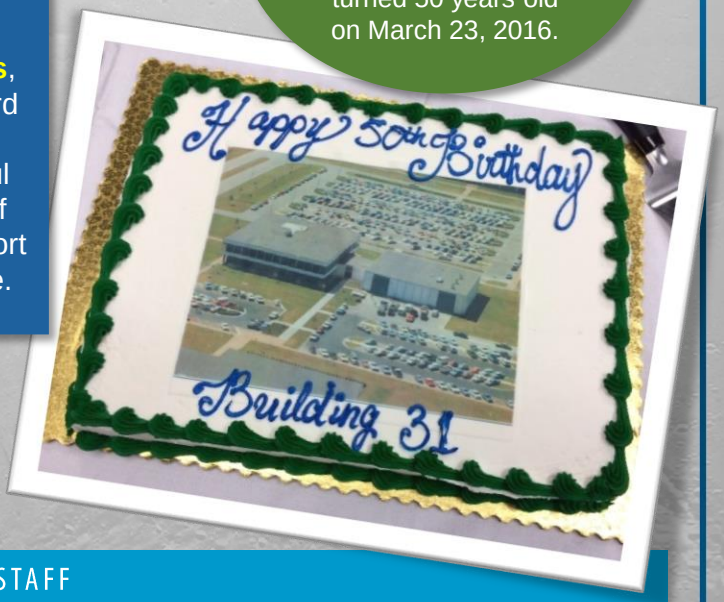
Annie Rose Kistenmacher
Born May 2, 2016
8 pounds, 12 ounces

Proud parents are XI's Kristen John and her spouse, Ryan Kistenmacher

A Salute to ARES Family in the Military

USAF Capt Julie Adams, daughter of Kathy Packard (XP) is an Air force JAG currently serving in Kabul Afghanistan in support of Operation Resolute Support in the NATO Legal Office.

Building 31, the home of EISD's Astromaterials Research and Exploration Division, turned 50 years old on March 23, 2016.



EISD NEWSLETTER STAFF

Contact your newsletter staff with comments, ideas, and submittals

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Tracy Calhoun	XI Reporter
Bake Dumesnil	Graphic Artist
Vickie Gutierrez	XB Reporter
Tracy Hom	XS Reporter
Joy Judas	IT Coordinator
Holly Kurth	XP Reporter
Debi Shoots	Technical Editor
Stephanie Sipila	XX Reporter