



AAKF points of interest:

- Founded in 2001
- Grassroots organization to promote space science and education in Kansas
- Unfunded affiliate of Kansas Space Grant Consortium since 2003
- Sponsor of five Ad Astra Kansas Day Space Celebrations and six Galaxy Forums since 2008

Inside this issue:

- Galaxy Forum journeys to Stars **2**
- K-State researchers design biosensory space suit **2**
- Randall Chambers Ad Astra Kansas Award **2**
- Don't forget the Dream Rocket Project **3**
- Researchers to gauge supernova disaster **3**
- NASA #SkyScience activity **3**
- NASA opens Mars science challenge to public **3**
- Interstellar R & D **4**

Haskell Indian Nations University awarded NASA grant

LAWRENCE—Haskell Indian Nations University (HINU) is one of three tribal colleges nationwide awarded educational funds through the 2014 NASA Tribal College and University Experiential Learning Opportunity (TCU-ELO) program.

These three-year awards range in value from \$512,700 to \$783,000. They will assist tribal colleges and their partners in creating experiential learning opportunities for students.

The winning proposals offer innovative methods, approaches and concepts to make appropriate use of current NASA-unique engineering and scientific resources. There is also a strong emphasis on engaging students and educators in all grades.

NASA's Goddard Space Flight Center in Greenbelt, Md., manages and administers TCU-ELO activity. This supports NASA's goal of engaging tribal community in the critical STEM disciplines and focuses on inspiring a new generation of explorers.

With a history that began in 1884, HINU has evolved from its beginnings as a boarding school for American Indian children into an institute of higher learning. In 1993 it was designated Haskell Indian Nations University. With a typical enrollment of about 1000, its student body represents about 140 tribal nations and Alaskan native people.

KSU space biology research studies the immune system

Knowledge gained from space research often has applications on Earth.

One example is the biological research project awarded in August to Dr. Stephen Chapes of Kansas State University by the NASA Biology Space Research Program.

This project is based on the already-demonstrated fact that the spaceflight environment causes changes in many processes connected with our immune system, such as the production of white blood cells and cytokines, small proteins important in cell signaling for immune responses.

"In spite of the fact that we know these changes occur, NASA will not allow experiments with infectious microorganisms on the International Space Station or shuttle to determine if these changes cause problems after infection with an infectious organism. Therefore, little is known about how compromised the host immune response is in space and whether someone will get sick following an in vivo challenge," says Chapes, professor of biology.

His lab will be working on this \$1 million project with researchers at Loma Linda University in California.

"The rationale for this study is that the ability to generate an immune response following a vaccination is important. More important is the

ability to respond to a pathogen once you have been vaccinated. Therefore, the ISS will provide an ideal laboratory...to determine if immunization of mice with the tetanus toxoid vaccine is affected when mice are vaccinated in space or whether their ability to respond to the antigen is affected if they have been previously immunized," says Chapes.

"This study...will directly test the hypothesis that host immunological health will be compromised in space. We will measure antibody responses

Cont. "Biology" page 3



The Chapes lab at KSU will be sending experiments on three ISS missions over the next three years. The first is scheduled for February of 2015. Photo credit NASA

High Altitude Balloon launches give students "aha" moments

In mid-November, 19 students in Barbara Livengood's junior high gifted class from South Middle School in Salina will launch a High Altitude Balloon (HAB) with payload of experiments, hoping to top the 94,142 feet altitude of last spring's class launch.

That March balloon traveled from its launch site at Fort Hays State University nearly 75 miles to near Kanopolis in Ellsworth County. Of course, how high and how far it travels is just one small part of this cool project.

Students will devote about 12-15 hours on it over the period of a couple of months, according to Livengood. Past experiments have studied the

temperatures at which various liquids freeze or the relationships, if any, between altitude and pressure and altitude and temperature.

Besides physics and engineering, there's a lot to learn about the scientific method. "They have to research payload ideas, determine materials needed, make a hypothesis about their particular experiment—we will probably have 4-5 experiments going at the same time—retrieve and analyze data and then prepare a presentation about their findings for the Salina Education Foundation Board," says Livengood, who also mentored the March launch.



Last March's HAB launch reached the stratosphere. Photos courtesy Barbara Livengood

Cont. "HAB" page 2

Galaxy Forum journeys to the Moon, Mars and the stars



The goal of the Galaxy Forum Kansas is 21st century education—getting to know our place in the Universe.

Photo credit: Ken Moun

Marking the 45th anniversary of the first lunar landing mission, Apollo 11, attendees at the 2014 Galaxy Forum on July 19 were treated to "The Moon for all Mankind," a powerpoint exploring that historical event and its importance for the future.

Then attendees traveled to a 'cool' planet, Mars (temperatures as low as -225 degrees F), which has been losing atmosphere for billions of years. That's the "why" of the new MAVEN mission to Mars. Saturn and Jupiter were the next on the travelogue.

A presentation about the types of stars in our galaxy ended with the illustration that if we shrink our solar system down to the size of a quarter,

proportionately, our Milky Way Galaxy would span across North America. How is that for giving a person perspective?

Many thanks to the wonderful presenters: Shawn Carithers, Kansas Cosmosphere and Space Center educator; Lake Afton Observatory Director Greg Novacek; astrophysicist Daniel Webb and Jerelyn Ramirez of the Kansas Astronomical Observers.

The Galaxy Forum Kansas is sponsored by the Ad Astra Kansas Foundation in late summer every year and held at the Kansas Cosmosphere and Space Center. The forum is free, open to teachers and others interested in space.

It is part of an international Galaxy Forum program begun in 2008 as an educational project by the International Lunar Observatory Association / Space Age Publishing Company, Kamuela, Hawaii and Palo Alto, California. Over the last six years there have been over 100 presentations in a dozen countries around the world.

To access the 2014 Galaxy Forum Kansas presentations as well as other 2014 presentations go to <http://galaxyforum.org/archives/galaxy-forums-2014/#kansas14>

To view past Galaxy Forum presentations from around the world, go to <http://galaxyforum.org/archives/>

K-State researchers design wireless bio-sensor technology for space suits



K-State student researcher in space-suit cooling garment during trip to Johnson Space Center.

Astronauts working on long-duration activities outside the spacecraft will encounter many challenges, some of which may lead to fatigue and lack of productivity.

Current spacesuits only monitor heart activity and oxygen levels. Using tiny, low-power, commercial wireless electronics, a new generation of biomedical monitoring devices is possible, ensuring astronaut safety and enhancing productivity.

In a three-year NASA EPSCoR Research project, Kansas State University Departments of Kinesiology, Electrical and Computer Engineering and Electronics Design Laboratory have been at work designing sensors, associated energy-harvesting methods and a model space suit to allow testing the new technologies. The model suit was developed by K-State's Department of Apparel, Textiles, and Interior Design.

Many types of sensors are being looked at and incorporated. One with particular promise is the EMG. It measures muscle activity, which can provide early signs of fatigue.

This sensor data is envisioned to be collected from multiple locations on the astronaut's body and relayed to a base of operations using a low-power wireless network within the suit coupled to a backpack radio.

Outfitting a space suit with over a dozen bio-sensors and sending signals wirelessly has many challenges. For instance, the aluminized mylar used in the suit's outer layer for thermal insulation affects transmission of sensor data. Research shows that a lossy coaxial transmission system is the best model for the wireless link and that the losses are sufficiently low to allow the system to operate well.

Care must be taken, however, when

powering sensors in a space suit. A space suit is an oxygen-rich environment, and sparks from high-energy sources like batteries must be avoided. One solution may be to skip batteries entirely and use energy-harvesting techniques such as operating biosensors and their radio transmitters using thermoelectric generators powered from the temperature difference between the body and the suit's liquid cooling garment.

Then there's the size element. The prototype integrates the bio-sensory, energy-harvesting radio transmission and antenna systems into a piece of hardware the size of a wristwatch and requires no batteries or external power. The radio being developed is based on single-chip integrated circuit radio technology research by K-State in the Mars Technology Program.

"Wireless" cont. page 3

Cont. "HAB" from page 1



Check out results of the South Middle School students' HAB launch in March at <http://smshab.weebly.com>

Photo courtesy Barbara Livengood

Actively participating in experiments with things affected by altitude, pressure and radiation; learning teamwork; analyzing data that may be different from what they expected and then going back to see why the results are different is a new experience for many. "There are a lot of 'aha!' moments in a project like this," says Livengood.

The class will travel to Fort Hays State University to launch under the guidance of physics professor Dr. Paul Adams and his students. FHSU has the balloon, files the flight plan with the FAA and has the tracking systems. Using GPS, the class will follow the balloon, recovering it, the equipment and data and then analyze it.

Adams and Jack Maseberg, also a professor of physics, began the HAB project in 2011 as part of the FHSU undergraduate research experience, focusing on engineering design, cos-

mic rays and high altitude bacteria.

In 2013 Adams decided to expand the program by taking it to public schools through the Kansas NASA Space Grant Consortium. Currently, FHSU provides the launch services. The South Middle School received a grant from the Salina Education Foundation. The project cost is about \$2,000.

As a primer for this project, Livengood attended a workshop at FHSU and went through the same steps as the students to launch two payloads.

"Dr. Adams and FHSU continue to provide amazing workshops for educators that can easily be implemented in the classroom. I do a lot of activities related to outer space when my students study this in science. I don't think Dr. Adams and his department get enough credit for the amazing way they contribute to a solid

education in science through the workshops and support they give..." says Livengood.

FHSU will be holding a spring program for 10th and 11th graders in 2015 to do launches. For info about HAB, contact padams@fhsu.edu

★ **RANDALL CHAMBERS
AD ASTRA KANSAS
AWARD WINNERS
2014 WSU
Engineering Open House**

★ **Abel Assefa, Griffin Chodak,
Khumbo Kawonga and Hieu
Nguyen**

★ **"Spirit Chemical Fishing Tank
Line Analysis"**

★ Award in honor of the late Dr. Randall Chambers,
NASA pioneer, WSU Distinguished Professor
Emeritus in Engineering and co-founder of
Ad Astra Kansas Initiative, now Foundation.

Cont. "Biology" from page

and determine the kinds of B cells (the cells that make antibody) that are induced during the experiment (after vaccination,)" says Chapes.

"This experiment is relevant to people on Earth because the unloading that occurs to astronauts in space induced the same kind of physiological changes that occur to people who are bedridden. We will learn how severe immune system decay is," he says.

This is one of 26 proposals worth \$12.6 million awarded by the NASA Space Biology Research Program in August to investigate how microbes, cells, plants and animals respond to changes in gravity aboard the ISS.

Wireless" cont. from page 2

A hardware prototype of the system is nearing completion and should serve as a reference design for future research and application.

"We hope to have a demo of multiple sensors operating in the model suit soon – although this is not the same as being integrated into real suits. But we have established connections with Johnson Space Center (NASA/JSC) to look at testing in real suits as well," says William Kuhn, professor of electrical and computer engineering

Many of the technologies being researched are broadly applicable to general low-power biosensor and radio and network applications,

ranging from home healthcare to those needed on future robotic precursor scout-craft missions to the outer planets and moons.

To help begin transfer of the research results into products, a spin-off radio is currently being investigated by a local commercial partner, Ultra Electronics—ICE, and is expected to be useful for high-reliability wireless links where custom reconfigurable radio assets are needed.

Source: "Biomedical Sensing and Wireless Technologies for Long Duration EVAs and Precursor Scout Missions," 2014 Aerospace Conference



Don't forget the Dream Rocket Project—

—5,000 panels of artwork with the theme "Dare to Dream" pieced into a 32,000 square-ft. quilt to wrap NASA's Saturn V replica in 2015.

This Kansas-based project (see AAK Fall 2013 issue) encourages people worldwide to express their dreams and aspirations using the expansiveness of space as a catalyst to free hearts and minds. Artwork has been received from 47 states and 20 countries.

There's still time to donate or participate. Find out how you can help. With a deadline of October 10, funds are now being collected to build a framework to hold the quilt. To find out more go to [Dream Rocket](http://www.dreamrocket.org)



Top: Saturn V image NASA Bottom: Panel from Buhler High student/ courtesy Dream Rocket

Researchers will gauge hypothetical supernova disaster

LAWRENCE— If a supernova ignited close to Earth — say, within 30 light years of our planet—the disastrous effects would crest for hundreds or even thousands of years.

NASA recently awarded \$500,000 to a research team based in part at the University of Kansas to painstakingly assess the potential damage from such a catastrophic event.

"A supernova is the explosion of a star, which comes at the end of the 'life' of large stars, when they collapse after running out of fuel," says Adrian Melott, professor of physics and astronomy, who leads the KU Astrophysics Biology Working Group that earned the grant.

Melott is working with Andrew Ovrholt of MidAmerican Nazarene University and Brian Thomas of Washburn University to perform computer modeling and data analysis on supercomputers such as the National Science Foundation's Teragrid. The 3-year study will use data from NASA space missions

Swift, Chandra, GALEX and Fermi.

In part, the team's predictions will also hinge on evidence of a previous supernova. "This 2.5 million-year event is the only one we have concrete evidence of," Melott said. "There has been iron-60 found in mud cores taken from the ocean bottom, about 2 to 2.5 million years old. Iron-60 is a radioactive isotope that basically can only have been dumped there by a supernova possibly 150 light years away. The nearest in recorded history was about 7,000 light years away."

If humans lived to tell the tale, the consequence of a nearby supernova would change life for eons.

"We'd begin to get radiation effects," says Melott. "Depletion of the ozone layer and resulting danger from ultraviolet light is common to this. There would be an increase in cosmic rays for hundreds or thousands of years, some of which would increase radiation on the ground—such as muons or neutrons. This might increase cancer and mutation rates. Some have

argued that it may change the cloud formation rate or the rate of lightning, leading to climate change."

But how likely is this? While a supernova isn't expected to explode in our galactic neighborhood anytime soon, supernovae occur in the Milky Way on a surprisingly regular basis.

"There are 2 or 3 per century in our galaxy," Melott said. "On average you'd get one within 200 light years every million years or so. The killer events within 30 light years are likely every few hundred million years. Most would be easily spotted—but there is a type from merger events that could happen with no warning as they are due to the merger of dead stars that we don't see."

Melott said that in a worst-case scenario, a close supernova could bring on a large-scale die-off of life on Earth. "it can happen," he said. "It probably has. However, there is as yet no concrete evidence that a specific extinction is connected to a supernova."

NASA asks public to do #SkyScience activity

People around the globe — step outside during Earth Science Week, Oct. 12-18, look at the sky and share observations as citizen scientists.

NASA's #SkyScience activity encourages the public to engage in Earth sciences. Citizen scientists are asked to observe, photograph and report on clouds over their location as a NASA satellite passes over. Reports and photos will be compared to data collected by NASA Earth-observing instruments as a way to assess the satellite measurements. In addition to #SkyScience, NASA has had a cloud observation program for students through its Students' Cloud Observations OnLine (S'COOL) Project for years.

To learn how to participate, visit <http://go.nasa.gov/skysci>

NASA opens Mars science challenge to the public

Citizen scientists take note—NASA announced on Sept. 20 its Mars Balance Mass Challenge and the launch of its new website, NASA Solve.

"NASA is committed to engaging the public...through innovative activities like the Mars Balance Mass Challenge," said NASA Chief Technologist David Miller. "And NASA Solve is a great way for members of the public, makers and other citizen scientists to see all NASA challenges and prizes in one location."

Balance mass is dead weight jettisoned from Mars landers to balance spacecraft during entry and landing.

The question NASA hopes to answer is, "If you had 150 kg of ejectable mass prior to entry and another 150 kg dur-

ing the entry and landing phase of a Mars mission, what could you do with it that was useful and advances knowledge in a scientific or technological way?"

The payloads will serve two roles: perform scientific or technology functions that help us learn more about the Red Planet, and provide the necessary weight to balance planetary landers.

Submissions are due by Nov. 21 with a winner selected in mid-January 2015. The award is \$20,000.

This is a theoretical challenge that requires only a written proposal to be submitted. Ideas, drawings and detailed procedures are required. NASA Solve will host content for all agency

challenges and prizes, and feature information on this at:

<http://www.nasa.gov/solve/marsbalancechallenge>



The deadline for NASA's Mars Balance Mass Challenge is November 21. NASA image

INTERSTELLAR R & D

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This "Interstellar R&D" feature in the Ad Astra Kansas News twenty-sixth issue continues an enterprise to research and gather information on the most important developments preparatory to humanity's greatest adventure—voyaging to the stars. Now, at the millennium's turn, is an appropriate time for grand vision and forward thinking, and there are strong signs of a renaissance in interstellar travel thought and activity. This new feature and newsletter, thus, now set forth to develop a national / international / global clearing center and storehouse of knowledge and know-how for travel to the stars:

Ad Astra—Steve Durst, Michelle Gonella

Observation

Mars-Based Astronomy

A growing fleet at Mars -- in September 2014 -- of orbiters and landers is enabling Mars observation of both astronomy matters and other developments. Joining the Mars Reconnaissance Orbiter (2006), Mars Express (2003), and Mars Odyssey (2001), newly-arrived orbiters MAVEN from NASA and MOM from India / ISRO along with landed rovers Curiosity (2012) and Opportunity (2004) will continue alien observations of Earth (magnitude -2.5) and Luna (1.0), of Jupiter (-4), and of Mars moonlets Phobos (-9) and Deimos (-5) orbiting the "5th rock from the Sun".

Earth seen from Mars is an inner planet like Venus, a "morning star". Appearing like stars to the naked eye, the Earth and Moon would be seen as crescents through telescopes. Jupiter at opposition would blaze at greater than magnitude -4, with all four Galilean moons at mag 1 and their dance visible to the naked eye. Phobos and Deimos are too small to produce total eclipses seen from Mars, but their transits across the Sun can be observed.

The unique Martian atmosphere and sky presents observation challenges for future Mars spacecraft and astronomers. Magnetite dust particles about 1% of the atmosphere produce the reddish-pink, sometimes violet sky, and remain suspended by windstorms for long periods, reducing the surface to twilight for many months. The lack of an ozone layer makes UV stellar observation possible from the surface.

Mars Science Laboratory Curiosity in April 2014 observed Ceres and Vesta, first and third largest in the asteroid belt, and the transit of Mercury across the Sun on June 4. Comet Siding Spring C/2013 A1 on October 19 may approach Mars as close as 41,300 km at magnitude -6 in constellation Ophiuchus, and be monitored for spacecraft-damaging dust particles. An observer on the slopes of Elysium Mons can witness the transit of Earth, the Moon and Phobos all in front of the Sun on November 10, 2084.

Communication

SETI Discussions at 100YSS

One of the most highly regarded speakers at the 100-Year Starship Symposium in Houston, Tex., on September 18-21 was SETI founder Jill Tarter. At this year's event, she spoke about the importance of breadth versus intensity, stating, "Better to do more small but different things. For now, the philosophy is to go for deliberate signals and try to be affordable."

Tarter noted trends in optical communications and a need for larger apertures and more processing power. Individual photon counting can be done with a large aperture and has the capacity to identify very distant signals.

Tarter noted that SETI is involved with the Square Kilometer Array in South Africa, planned for 2023-2025. The new generation of telescopes, such as the European Extremely Large Telescope in Chile and Thirty Meter Telescope on Hawaii might provide opportunities for detectors of optical communications.

Transportation

100YSS Gets a "Kick" Out of KickSat and Tennessee Valley Looks to the Stars

At the 100 Year Starship Plenary Session entitled "State of the Universe," Cornell University's Mason Peck spoke about KickSat and the tiny "Sprites" which may pave a tiny road to the stars.

Inaugurated in 2011, KickSat was a mission in which a cubesat would deploy a large number of "Sprites" or femtosatellites. The Sprites are the size of a large postage stamp and work as a group to accomplish a goal, with each Sprite contributing its own tiny share of the work.

Mason Peck affectionately refers to the Sprites as "Sputnick on a

microchip" and sees many possibilities in their use as a small scale / low cost approach to exploration. For instance, a cubesat solar sail mission carrying Sprites could provide direct sensor readings in distant places.

SETI founder Jill Tarter posited that the tiny Sprites may even be used to form a "starshade" which would be deployed about 20,000 km from a large space telescope, to filter out some of the glare of a large parent star when looking at an exoplanet. This would enable spectroscopy to examine the exoplanet's atmosphere.

Tarter went on to suggest that the Sprites may be an excellent tool for studying cryovolcanoes, such as those on Europa and Triton. A swarm of Sprites could be deployed to actually fly through the ejecta. Peck responded that a large number of Sprites would not only increase the chance of some surviving the flight, but would provide "a stochastic look at the target."

The Tennessee Valley Interstellar Workshop is gearing up for their annual event November 9-12 in Oakridge, Tenn. Originally conceived as a regional event, the TVIW sprang into international prominence almost immediately upon its inception. The name "Workshop" was chosen to signify that TVIW is not just a conference, but an incubator for actual projects and an opportunity to collaborate.

Workshops will be led by some of the top visionaries in interstellar exploration. ISU's Chris Welch and Vanderbilt's Cassidy Cobbs will discuss "Evolution's Pace in Very Small Exosystems like the Worldship" in the B-for-Bio session, and Kelvin Long will examine "near-term and far-term concepts for traveling at interstellar ranges."