

### AD ASTRA KANSAS MEETING TO FOUND NEW ORGANIZATION

After ten years as a fledgling group, the Ad Astra Kansas Initiative is taking the step to becoming a 501c3 organization. Our board is currently being formed and we will hold a founders' meeting November 4 and 5 in Topeka. Anyone interested in attending will find our contact info on page 4.

We plan also to submit a request to the 2012 legislative session for a designation of an annual Ad Astra Kansas Day to celebrate science in Kansas.

Ten years ago, our second newsletter included an anecdote from one of our group's founders, Dr. Randall Chambers. Networking at a space conference in Denver for our 21st century vision of Kansas as the Ad Astra State--a leader in high-tech and space-tech R&D--he found people were very interested. "But," he said, "They asked 'Why Kansas?'"

Our goal then and now continues to be to provide answers to that question. Pride first starts at home. We feel most Kansans have no idea of the cutting edge science (not just space science) going on in our state. And that plays into a self-effacing view of Kansas. Self-effacing is good, but it often spills over into an inferiority complex.

So that's what we've tried to do--get the word out, Yes, to scientists, but also to the public, because it's their perception of our state that drives all segments of society.

One outreach example is our sesquicentennial science trading card project which features 150 Kansans, past and present, and their work. Geared towards inspiring youth, it honors our science legacy.

We'd like for Kansas to be seen as more than just the Sunflower or Wheat State--possibly the Ad Astra State. Our excellent "To the Stars" state motto is very 21st-century.

*Jeanette Steinert*

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## NASA composites research grant awarded

Ever patched a tire only to have it fail? It happens with composites repair also.

Fixing that problem is the goal of a recent \$750,000 three-year NASA research grant to Wichita State University (WSU) as lead institution and three partner Kansas universities. With matching funding, the project total budget will be \$1,125,000.

According to project Principal Investigator Bob Minaie from the Department of Mechanical Engineering at WSU, the research will focus on carbon fiber based composites. These are the type of materials on which NASA relies heavily for its spacecraft because of the lighter weight and higher strength. Team members will work with NASA Langley and Glenn Research Centers.

The cross-disciplinary team consists of Bob Minaie from WSU, Kevin Lease (from KSU Department of Mechanical Engineering), Mark Ewing (from KU Department of Aerospace Engineering), and Katie Mitchell-Koch (from Department of Chemistry at Emporia State). Each will research different aspects with all coming together in the Mechanical Engineering Department at WSU.

When a patch is applied for repair, the cure temperature must be in a specific range or it will not properly bond. There is also no way to measure

at what stage the cure is except for time and temperature, so the quality of the cure is not known until afterwards. A puzzle to researchers is that sometimes even with the correct temperature, the repair still fails. Conversely, in other instances, though the temperature may be outside the specified range, the patch holds.

Researchers will be trying to take the guesswork out of the repair process.

They will experiment with a variety of methods, including putting infinitesimal microwires in the patch. Using the microwires, the temperature at the bondline and at different thicknesses inside the patch material will be measured during cure. These microwires will feed back realtime data on the curing process which will be used to correlate the stages of the cure to the final properties of the repaired part.

Once perfected, this technology can be extended to be applied across the board to glass composites, ship or auto applications, according to Minaie.

This is a good opportunity for WSU in an area where there is definitely a need. Generally, commercial planes contain about 20 percent

Cont. "Repair" page 2

## Looking for salty Martians

What's to be found on Mars? Little green men or gaunt-faced aliens? Think smaller and simpler, says Mark Schneegurt, professor of biology at Wichita State University, who has been working on such a NASA project for four years.

"Life on Mars is most likely microbial," he says. He and his team researches what kind of organisms might live in Mars' hostile environment for basic scientific knowledge and also to learn about what might contaminate spacecraft on a possible Mars mission.

NASA scientists want Mars to remain its own microcosm, the same with Earth.

That's why NASA workers, from laboratory to spacecraft assembly plant techs, wear white coats and caps; to make sure microbes, bacteria, archaea, or fungi from here on Earth don't hitch a ride to Mars.

Most contamination would come from us as humans, according to Schneegurt, but human

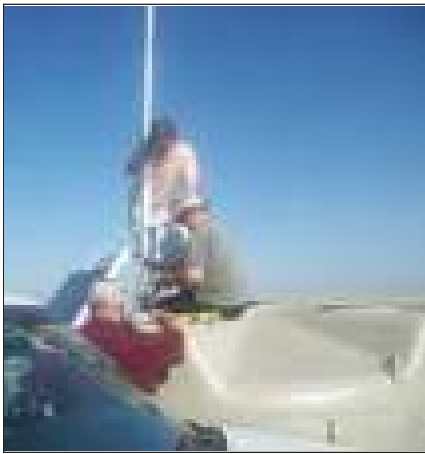
bacteria would not survive. However, it's possible other contaminants in our Earthly soils or surroundings might.

"That would be bad, because we would be 'seeding' the planet," says Schneegurt.

Cont. "Salty" page 2



WSU biology students collect samples on a salt plain.



The first stage of the \$127 million Auger North Cosmic Ray Observatory (see Fall 2010 issue) in southeastern Colorado is operational. WSU is the control center for the project. Above: WSU researchers helped with installation this past July.

## Topeka Highland launches robotics

This school year brought a new two-hour robotics class to students in Topeka. The site is Highland Park High School on the city's east side.

According to the district's official news website, the program is a partnership between the Topeka Public Schools, The GO Topeka Entrepreneurial and Minority Business Development Plan and Washburn Institute of Technology. Yaskawa Motoman Robotics, one of the world's leaders in robotics, is providing training for the program. The instructor is Bruce Babin, a former KSU mechanical engineering professor.

Though other high schools have robotics programs, this is the first time a worldwide company is specifically training students on how to use their own equipment, enabling them to be certified as a technician.

The new robotics class is drawing plenty of notice. "We already have people in California and the East Coast wanting to get involved and we are going to lead the way. So, I think this is a phenomenal experience for USD 501 and the kids," says Board of Education member Hal Gardner. The class will be open to students in all high schools in the district.

### Cont. "Salty" page 1

From accumulations on the Phoenix Mars lander struts, soil samples churned up by the Mars rovers and spacecraft remote sensing information, it appears that Mars soil has a lot of sulfate salts, mostly Epsom salts. Studies of the warm slopes of Mars show what appear to be grooves caused by rivulets of water. And whatever water there might be is likely very briny.

Schneegurt has been working at two lakes in the Pacific Northwest with high Epsom salt levels to find out what can survive in this extreme environment. He compares these results with samples of organisms found on materials from NASA and the European Space Agency. "We just got a set of samples from NASA. We're going to grow a culture and isolate the organism," he says.

So far, they have found organisms that tolerate some of the extreme conditions, but have found

# Kansas NASA space science student ambassador speaks from experience

Numerous internships with NASA during his college career have put 2011 Kansas NASA Space Science Student Ambassador Shawn Georg up close and personal with NASA science.

As one of 102 NASA student ambassadors nationwide for 2011, he works on a collegiate and high school level to "promote the agency's mission and to motivate the current younger generation to pursue NASA science or other STEM fields."

For example, he's presented at his hometown Sabetha High School. "I talk about what's happening in the agency and my experiences. I also address misconceptions such as that there are only two or three NASA main centers when actually there are 11 to 16 over all depending on how you categorize a center. I communicate current NASA projects and the agency's future beyond the space shuttle program," says Georg.

Georg is a mechanical engineering senior at Kansas State University with several stints at NASA Dryden Flight Research Center (DFRC) in California. He has worked with structural dynamics and done thermal testing on unmanned space planes. In 2010 he served in flight operations as a flight test engineer on the project's demonstrator phase of a highly modified F-16 fighter jet that could prevent ground strikes. The onboard computer automatically detected if the plane's flight path was on a collision course with the ground and the system would pull up the aircraft. The technology will be used on F-22 raptors and F-35 strike fighters. Eventually this could be used in commercial aviation.

Another 2010 NASA project was the ALHAT (Autonomous Lander Hazardous Avoidance Technology) program testing lunar and Mars lander sensors. The system uses lasers to detect

hazards such as rocks, craters, and/or other obstacles that could cause problems during a spacecraft landing. The project at NASA DFRC used a heavy-lift helicopter to lift the 2.5 ton equipment pod. The pod housing the landing sensors was then flown over a target field and data gathered for analysis.

Currently Shawn is again working with NASA DFRC on a senior design project at KSU. NASA has tasked the six-member senior design team with designing and testing a volcanic ash cloud simulator. "Basically we'll be producing a machine that will kick out an enormous amount of volcanic ash and a huge jet engine will ingest this cloud. After the Iceland volcano eruption in 2010 shut down air travel in Europe, more research is needed into the effects of ingesting volcanic ash into an engine. The team and I are thrilled to work with a NASA agency, especially Dryden, and I'm



bleased to have such a talented team. I can't wait to actually test our idea," says Georg.

"[I want to provide students with] a spark of motivation and inspire them to personal endeavors. If you can achieve this then your opportunities are boundless," says Georg.

### Cont. "Repair" page 2

composites by weight. And this is only going to get higher.

"The trend is to use more and more composites," says Minaie. "For example, Boeing's new 787 Dreamliner contains about 50 percent composites by weight and a majority of this is in structural components—the whole fuselage and wings. There will be more and more need for repairs."

Minaie envisions this project as laying the ground for an eventual national center for composite repair in Wichita. Such a center would be an entirely new addition to the regional aerospace industry.

This is a notable award. "This was a nationally peer-reviewed competitive grant. We look forward to doing a good job and to continuing our productive work with NASA," says Minaie.

Besides NASA and the other universities, other collaborations will be with Lockheed Martin, Hawker Beechcraft, Spirit AeroSystems, Bombardier-Learjet, American Airlines, and the National Institute for Aviation Research.

Don't forget to check out our 150 scientists at [www.adastra-ks.org](http://www.adastra-ks.org)

no perfect one that thrives in all four critical criteria of the Mars environment: extremely salty, needs no oxygen, an average temperature of -70 degrees F., and can handle the freeze/thaw cycles on Mars (temperature ranges are from -220 degrees F to 70 degrees F).

If organisms could be found, from an astrobiologist's point of view it would be good. It might give insight into early organisms, even the origin of life on Earth. At one time, Mars may have been more suitable for the development of life than Earth.

"A gee whiz! factor about the environment on Mars is that if life ever existed on Mars, it is probably still there. Life is adaptable, it survives. Even [if] Mars was once warm and wet and is now dry and cold, it is probably still there in some form, even though there may not be much of it," he says.

*The following is part of an ongoing reference directory featuring representative research projects in Kansas. An Ad Astra Kansas goal is to serve as an information hub in Kansas focusing on different areas of high-tech and space research for networking and educational purposes.*

## AEROSPACE

**“Acoustically Tailored Composite Rotocraft Fuselage Panels,”** Liang-Wu Cai, KSU Dept. of Mechanical / Nuclear Engineering. NASA funding of \$37,335.

## ASTRONOMY / PHYSICS

**“Isolating the Environmental Effects on the Evolution of Galaxies over Cosmic Time,”** Gregory Rudnick, KU Dept. of Physics and Astronomy. This project focuses on clarifying how the evolution of galaxies is affected by the places in which they live over cosmic time. Kansas National Science Foundation EPSCoR funding.

## ENERGY

**“Exploring Structure, Optical and Electro-mechanical Properties of Polymer-Derived SI (B) CN-Multi-Wall Carbon Nanotube Composite nanowires,”** Gurpreet Singh, KSU Dept. Mechanical and Nuclear Engineering. \$50,171. The long term project goal is to find applications in energy based devices such as thermal detectors, solar cells or rechargeable batteries. NSF award 3-11.

## INFORMATION TECHNOLOGY

**“Biosensor Networks and Telecommunication Subsystems for Long-Duration Missions, EVA Suits, and Robotic**

**Precursor Scout Missions,”** Bill Kuhn, Bala Natarajan, Steve Warren, Dwight Day, and Don Gruenbacher, KSU Dept. of Electrical / Computer Engineering. \$750,000. Funding through NASA EPSCoR program. The project will develop technologies applicable to human spaceflight and robotic scout missions, while building cooperative links with NASA centers and Kansas businesses. Funding through NASA EPSCoR program 6-11.

## Randall Chambers award given

The winner of the 2011 Randall Chambers Ad Astra Kansas Award was named at the Wichita State University Engineering Open House last spring.

Erin Waggoner, a senior with an aerospace engineering major and mathematics minor, received the award for her project “The Near Space Launch Platform.” This is awarded for the best project or design addressing aerospace safety concerns.

## ONE YEAR INTO NASA PROJECT, K-STATE SPACE FITNESS RESEARCH LEADS TO NEW FINDINGS

MANHATTAN —Despite recently ending its Space Shuttle program, NASA still needs basic information to improve astronaut safety.

A K-State exercise physiology research team is one year into its three-year NASA research mission to develop ways to measure astronauts’ physical capacities and keep them safe, whether on the International Space Station or a future mission to Mars. The microgravity of space weakens astronauts’ muscles, bones and heart systems, making it more difficult to do even simple physical tasks.

“The question is what is the minimum level of conditioning astronauts need to maintain so that when they get to their destination, they’re going to be strong enough to perform the tasks that they are going to have to do,” said Thomas Barstow, professor of kinesiology and principal investigator.

Other KSU researchers include Steven Warren, electrical and computer engineering; Dale Schinstock, mechanical and nuclear engineering; Russell Taylor, Electronics Design Laboratory; doctoral students Carl Ade and Ryan Broxterman.

This year, working with NASA, researchers designed four obstacle courses that simulate lunar tasks, such as climbing ladders, traversing a rock wall, turning knobs and moving weights with a wheelbarrow. Using these courses, researchers are developing tests to evaluate an astronaut’s general fitness.

The team is excited about the results so far. They have discovered that by putting a participant on a treadmill at different speeds and timing how long it takes them to fatigue, they can fairly accurately predict that person’s time in the obstacle course. “What’s interesting is that the obstacle course represents a variety of physical tasks,” Barstow said. “And yet, with all those different varieties of physical movements and tasks, a person’s characterization of their fatigue with a treadmill run gives us the best ability to predict what their time is going to be during these tests.”

More than that, Broxterman’s thesis research found that a three-minute all-out running test could also accurately predict a person’s physical ability.

“With the research, we have actually shown that measurements that come out of this test are very strong predictors of performance on most of our field tests,” he said. “If we can utilize one treadmill test instead of multiple testing sessions, that would be beneficial for us and eventually for NASA.”

“This kind of information is fundamental to NASA,” Barstow said. “The kind of information we can gather here in our lab is going to be critical to NASA as long as humans are exploring space.”

The research team still has two years left in the \$1.2 million NASA funded project. They have worked with 30 participants in the obstacle course and hope to gather data from more than 100 participants, split evenly between males and females. They are still looking for people to participate in the obstacle course. If interested, contact Barstow at [tbarsto@k-state.edu](mailto:tbarsto@k-state.edu) or Carl Ade at [cade@k-state.edu](mailto:cade@k-state.edu).

## Land of Oz Observatory Update

by Ron Abbott

*Note: Ron Abbott’s Land of Oz Observatory in Linn County was featured in our Spring 2009 article “Stellar activity thrives in Kansas.”*

In the time since my observatory was featured in an article on amateur observatories in Kansas, I have made a number of upgrades because of my increasing involvement with astrophotography using CCD (Charge Coupled Device) cameras.

Guided astrophotography requires extremely accurate tracking of the movement of deep sky objects, due to the length of exposures required. The telescope’s mount must also be extremely rigid and be able to carry the weight of the auxiliary equipment. With this in mind, the original factory fork-style mount of my 11-inch Celestron telescope was replaced with a heavy duty German equatorial mount manufactured by Mountain Instruments. It has a weight capacity of 75 pounds and tracks to an accuracy of +/- 3 arc-seconds.

Next, my telescope’s optical system was modified by installing the HyperStar 3 imaging system. This changes the focal ratio of the telescope from f/10, which is too slow for deep sky photography, to f/2, which allows faint objects to be captured in less than 1/10 the time required at f/10.

The last upgrade was the addition of a precision micro-focusing device and software that allows automatic focus of the telescope via the computer that also controls the CCD camera. All of these upgrades make it possible to capture stunning images of the deep sky objects which I love to observe. Results of my CD astro photography can be found at: <http://www.astrolandfoz.com>



Senior Carissa Rogers, Fredonia, takes part in the obstacle course stairs that simulates lunar tasks.



Abbott and telescope before upgrades.

# Interstellar R&D

## Ad Astra Kansas News

*This "Interstellar R&D" feature in this Ad Astra Kansas News twentieth 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 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

#### Dark Energy: A New Phenomenon Masked in Many Mysteries

Within the last 15 years, one of the greatest revolutions in astronomy and the understanding of our Cosmos was made possible through Hubble Space Telescope observations of Cepheid variables and Type Ia supernovae as reliable distance markers to measure the Universe's expansion rate. The findings — confirmed in May 2011 by the space-based Galaxy Evolution Explorer telescope survey of 200,000 galaxies — indicated that the Big Bang expansion of the Universe was not slowing over time due to gravity, as everyone assumed, but has actually been accelerating. Astronomers were thrown for a loop.

Theories to explain this accelerating expansion, first noticeable about 7.5 billion years ago when objects began flying apart at a faster rate, proposed a mysterious, dark force that is overpowering gravity and pulling galaxies apart, that astronomers call "Dark Energy." "The action of dark energy is as if you threw a ball up in the air, and it kept speeding upward into the sky faster and faster," said Chris Blake of Swinburne University in Australia. Dark energy, now believed to make up an amazing 70-75% of the Universe, remains largely a mystery with three or four leading possible explanations: That it is a property of space, agreeing with early Einstein gravity theories, containing a cosmological constant; That it is a new type of matter "quintessence" (partially disproven); That it does not occur uniformly in space and derives from the quantum theory of matter; Or, that our current theory of gravity (Einstein) is not correct, requiring a new one.

The findings of NASA's Hubble and GEE space telescopes, complemented by those from the Wilkinson Microwave Anisotropy Probe WMAP in 2001 and ESA's Herschel Space Observatory in 2009, consistently reveal the Universe composition to be only 4-5% of 'normal' atomic, or Baryonic matter (atoms in life, planets, stars), 20-25% of also mysterious "Dark Matter" and the remaining 70-75% Dark Energy. Solving the mystery of dark energy and dark matter is a major challenge for astrophysics and cosmology requiring ever-more and ever-better data as the 21st century progresses.

### TRANSPORTATION

#### World Ship Pioneers

In 1949, Robert Enzmann developed a bold concept and strategy for moving human civilization throughout the Galaxy: the World Ship. A world ship is a mega-spacecraft housing a crew of hundreds or thousands. It is an inverted world of its own, in many ways, some even designed with interior oceans. It is a space craft which is more like a "Bio-Sphere" than a "Noah's Ark" transport scenario.

The British Interplanetary Society (BIS) held a conference on 17 August 2011 on the world ship concept. Many of the presenters were Project Icarus participants, including Kelvin Long, founder of Project Icarus.

Long's presentation was "The Enzmann Starship: History and Engineering Appraisal" and included every drawing known to exist on the topic. He spoke about a 30,000 tonne structure, utilizing 3 million tonnes of Deuterium fuel, cruising at 27,000km/sec on a 60 year journey and then extrapolated that to a 300,000 tonne structure on a 150 year journey at 13,500km/sec and finally to a 3,000,000 tonne World Ship on a 350 year journey at only 4200km/sec.

These conceptualizations would start with 200, 2,000 and 20,000 human inhabitants, respectively. By the end of the journey, the numbers would approximate 2,000, 20,000 and 200,000 inhabitants. Comparing each scenario's final population, in relation to the mass of the World Ship, it was determined that the ship's mass per person ranged from 150 tonnes to 50 tonnes. It is interesting to note that previous NASA space settlement studies suggested a ratio of 65 tons per person to be optimum.

Andreas Hein, also a Project Icarus participant, addressed the possibilities and probabilities for this form of human migration. He considered what he called "push" and "pull" factors. The "push" factors were those of survival and necessity such as wars, genocide or extreme poverty. The "pull" factors included education, wealth, security and job opportunities. He also felt a key factor would be the distance to a habitable planet.

Speaker Stephen Ashworth suggested the human race may reach extinction prior to launching a World Ship. His calculations roughly estimate the possi-

bility of a World Ship by the year 2357, however this assumes consistent progress in life support and propulsion systems. If propulsion system development speeds up, a ship could launch significantly sooner. However, if propulsion does not evolve as hoped, and the main progress is only in life support, a World Ship launch would probably be pushed back to at least 2450.

Key to all of this is economics, and perhaps a devastating war would not spur escape to other parts of the Galaxy, since it would eat up all the resources needed to build and outfit the spacecraft. Frederik Ceyssens noted that a World Ship would be an ultra-long project at a great cost, comparing Project Apollo at \$100 billion and the Manhattan Project at \$22 billion to a \$10,000 billion World Ship.

Interestingly, some participants went so far as to suggest that the World Ship might ultimately prove to be the preferred habitat, as opposed to the new habitable planet chosen to be its destination. Many disagreed with this thought, but if humans continue to find comfort in the familiar, this may well be the case. The effort it will take to make a life off of Earth may be best used to create an entirely nomadic culture, never again held back by gravity.

### COMMUNICATION

#### World Ship Diaspora

Pat Galea, a Project Icarus designer, made a presentation to the recent World Ship conference entitled, "Communications Between World Ships." He described the Project Daedalus communications system, derived from Project Cyclops, which was originally intended for SETI use. In this scenario, a 40m transmitting antenna with 1MW power output would download data to Earth at 864 kbps from a distance of six light years. Switching from a dish antenna to a laser would allow much smaller transmitters and receivers.

For network topology configuration, Galea harkened to Claudio Maccone's concept of using the Sun as a gravitational lens to significantly improve reception from more distant World Ships. The Earth would act as a router, forming the basis of an interstellar internet, or "DiasporaNet."

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