



Fall 2007

To the stars through high-tech / space-tech R &amp; D

Vol. 6, No. 2

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SPACE SCIENCE SURVEY

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[www.adastra-ks.org](http://www.adastra-ks.org)

webmaster: Bill Hook

## Kansas has space for space industry

Do we have a space industry in Kansas? That's a question the Ad Astra Kansas News is asking in a first-ever state-of-the-state in space science survey.

While we're waiting for the results we spoke with Dr. Scott Miller, Kansas State Grant Consortium (KSGC) director, Dr. Richard Hale, recent KSGC assistant director of the KSGC and Kevin Carr, chief operating officer of KTEC.

"There is no lack of interest in space here in Kansas," said Miller. "The question is how industry and research might fit into the picture."

Space is definitely a burgeoning industry, according to Hale. "It would be very wise to look into this industry. With the NASA EPSCoR and the KSGC programs and grants we have workforce development. Through our universities, we have space-related knowledge. With industries graduates might stay. We need a state focus."

It would mean bringing together a critical mass. "One thing we do very well in Kansas is collaborate industry and academia. [We could do it] "Not in just a little piece—we have lots of different expertise. I've seen proposals for a Mars flyer—we could do all that in Kansas. We are on the cutting edge," said Miller.

According to Miller and Hale, Kansas strengths with space applications include: aerospace engineering, remote sensing, communications / information technology, system integration of vehicle manufacturing, composites, observation / astronomy, alternative fuels / fuel cell development, and UAV-intelligent vehicle control.

They acknowledge there's stiff competition. "It's a matter of getting it all together—the market and opportunities, enabling technology and the best value," said Miller.

"The contract system for space-based contracts for small businesses here in Kansas has been a roller coaster. We have had businesses acquire large space-related contracts,  
**Space Industry cont. page 3**

## KU scientists' theory sheds light on the effects of cosmic rays on extinctions on Earth

It's a small universe after all if cosmic radiation from the outer regions of our Milky Way Galaxy have been a cause for massive life changes here on Earth as a new theory suggests.

Research by University of Kansas astrobiologist Adrian Melott and colleague Mikhail Medvedev, associate professor of physics and astronomy, connects the movement of our solar system in the Milky Way Galaxy to mysterious die-offs on Earth about every 62 million years.

When two California scientists, Richard Muller and Robert Rohde, found evidence from fossil records that the Earth's biodiversity—the number and variety of living things—changes radically over a 62-million-year cycle that has held true for about the last 500 million years, Melott, who has spent most of his research life as a cosmologist concerned with the large scale structure of the universe, found that interesting.

"What intrigued me was that there was no cause associated with this, making for a fascinating problem. It seemed coincidental that this cycle of time is about the same as it takes for the sun to orbit the Milky Way Galaxy in a motion that bobs up and down perpendicular to the galaxy disk," he says.

After independently confirming Muller and Rohde's findings with KU paleontologist Bruce Lieberman, Melott tried to deduce what stage of motion the solar system was in during these die-offs. It appeared to be on the north side of the galaxy disk.

"This caused a connection with cosmology because the [flat] north side of the Milky Way Galaxy disk is the side falling towards the Virgo Cluster of galaxies at a speed of 200 kilometers per second due to the Virgo Cluster's gravitational pull," says Melott. This causes shock waves along the leading edge of the our galaxy much like a jet traveling through gases. Enter Medvedev, an expert on shock waves and plasma-astrophysics, which deal with hot ionized gases.

As the sun follows its bobbing circular motion around the Milky Way Galaxy, the galaxy's magnetic field generally provides shielding from cosmic rays. But at a certain point in the cycle our solar system reaches the north side and bobs itself up out of the galaxy's protective shield enough to make Earth vulnerable to large amounts of high-energy cosmic radiation.

This vulnerability lasts for about ten million years each time.

"This is not a sudden thing, it is an additional stress that takes its toll over time," says Melott. Effects can include a change in the ozone layer, ultraviolet rays reaching Earth, more cloud cover which can cool climate, more radiation which could cause mutation or cancer.

"I don't think this theory will replace other ideas

about extinction-it will only add to the other ideas. These cosmic rays are another source of stress [besides] meteors, earthquakes, climate changes, volcanoes. Suppose you have the flu and then get shot. [For earth] the radiation is comparable to the flu and then whatever else happens only makes things that much worse," he says.

The KU researchers presented their theory last spring to the American Physical Society. Since then it has received worldwide coverage, even

**Cosmic cont. page 3**

## Pittsburg State: a moonbuggy master

NASA began its annual Great Moonbuggy Race in 1994 on the 25th anniversary of the Apollo lunar landing. Pittsburg State University has been competing in it since 1996.

In that ten year period, the university has shown itself to be a powerhouse, winning three first, three second and two third places.

For example, in the 2007 competition held at Marshall Space Center in Huntsville, Ala., the school won the Best Design competition over 22 colleges nationwide. In 2006, PSU took first in the actual race, beating out over 15 competitors.

"When we first started competing, everyone thought we were from Pennsylvania," says Larry Williamson, professor of manufacturing and mechanical engineering at PSU. "Now the announcers make sure people know we are from Kansas."

Williamson acknowledges their presence can be intimidating. "We've built about forty moonbuggies since 1996, often three a year. We never take the same one back, it's always a new design. In fact, we're already building one for the next competition in April 2008."

The team of six students are taking a very non-traditional approach—making it out of composites. And they want to add instrumentation to get live data during the run.

"We use the moonbuggy project as a capstone experience for mechanical and manufacturing majors to bring together education and experience," says Williamson.

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## OPINION

Dear Readers,

Earlier this year, Hawaii became the first-ever state to enter into a memorandum of understanding with NASA to explore collaborations supporting NASA's Vision for Space Explorations, commercial space initiatives and research, education and workforce development programs.

They have location—center of the Pacific Rim where there's a lot of space activity and observatories. "Okay," I thought. "Can't fight that."

As it turns out, they now also have one of our Kansas NASA-connected / experienced scientists. As part of this initiative, the University of Hawaii is working to develop small satellites. And they hired away Dr. Trevor Sorensen of the University of Kansas, who has been working with the Kansas Universities' Technology Evaluation Satellite (KUTESat) program to develop pico satellites since 2002. One of his goals, as he explained in his presentation at our Ad Astra Kansas Day event in 2005, was to eventually start a space industry around Lawrence to build these satellites once they were perfected. They, as I have since read, are the new wave in satellites—going to be a good industry for someone.

Yes, scientists change jobs just like the rest of us and I'm sure the new director of the KUTESat program will do a fine job. But the point remains, this is another example of the brain drain that Kansas experiences too often. And this is what can be fought.

We may not have tropical climate (though we're getting there), but we do have location (midway U.S.A.), brilliant scientists and other resources.

Look at NASA's 2006 Strategic Plan ([http://technology.arc.nasa.gov/docs/2006\\_NASA\\_Strategic\\_.pdf](http://technology.arc.nasa.gov/docs/2006_NASA_Strategic_.pdf)) and tell me Kansas can't fit in somewhere. Why couldn't we do like Hawaii did, assess and pool our many strengths and see if we couldn't get a memorandum of understanding—basically an agreement (no money exchanged) to explore collaborations in support of the Vision for Space Exploration, NASA's plan to return humans to the moon and later travel to Mars? (I especially recommend looking at "Scenarios for the Future: Looking Beyond 2016" on page 37.)

This is one reason why the Ad Astra Kansas News is doing a Kansas space science survey. Possibly, a meeting between academia, business and government to discuss all this would be a good idea.

Ad Astra,

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### Moonbuggy cont.

The criteria for the competition mirrors that of the original moonbuggy: the unassembled buggy must fit in a 4X4X4 cube, be able to be carried 20 feet by two people with no aid. When assembled the width must be no more than four feet, it must have a turning radius of no more than 15 feet, and be able to traverse simulated lunar surfaces including slopes of up to 30 degrees forward and sideways. Propulsion is human power.

"This is no cakewalk. A lot of schools never finish the race. We always test before we go down there," says Williamson.

The whole idea of the contest, which has a high school and a college event, is to put science and math into practice. In high school the event helps get students interested in engineering. Because of PSU's mentoring, over ten high schools in Kansas and Missouri have gotten involved in the competition.

One success story is Erie High School in Erie, Ks., which in just the last two years has placed second among 17 teams in the speed race and received the Most Unique Buggy award.

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## Kansas space scientist addresses NASA

A Wichita State University distinguished professor emeritus who was one of the United States' first space scientists fifty years ago will be giving a presentation in Houston in early October.

Dr. Randall Chambers, NASA project director for acceleration research and training from 1958-74, has been invited to speak to The NASA Engineering and Safety Center Workshop on the Assessment of Gravitational Loads and Environments. This event will be held Oct. 10-12 at the Center for Advanced Space Studies next to Johnson Space Center.

The topic of the power point presentation, "Getting Off the Planet" reviews some of the same subjects: acceleration stress--tested with the centrifuge, weightlessness--tested in water and the ability for a living being to survive in space--tested using chimpanzees, covered in Dr. Chambers' 2006 book of the same name, a first-hand account of the early years of the space program.

The powerpoint presentation will be narrated by Mary Jane Chambers, co-author of the book, after which Dr. Chambers will be open to questions.

According to NASA communications with Chambers, the audience will be space experts from both military and academic sectors, current and former NASA researchers and engineers as well as scientists in charge of the design of Constellation, the next-generation space shuttle. Several Mercury through Apollo astronauts will also be at the workshop.

### On the Horizon...

#### October

**20 Kansas BEST (Boosting Engineering, Science and Technology)** Competition for high schools. Theme--2021: A Robot Odyssey. Heskett Center, WSU [www.kansasbest.org](http://www.kansasbest.org)

#### November

**10 Martin Collins**, curator National Air and Space Museum presentation, KCSC 50th space anniversary event. Free and open to public 6 p.m. 1-800-397-033

**10-11 Distant Thunder**, KLOUD-Busters rocketry launch, Argonia <http://www.kloubusters.org/launch.cfm>

**15-16 65th annual Four-States Regional Technology Conference**, Pittsburg State University

#### December

**7-8 Michael Neufeld**, chair of space history division of the National Air and Space Museum presentation, KCSC 50th anniversary event. Free and open to public. 1-800-397-0330

Submit calendar items to :  
steinj@ourtownusa.net

The following list is part of an ongoing reference directory featuring representative research projects in Kansas. 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.

## ASTRONOMY AND PHYSICS

**"Atomic and Molecular Physics in Strong Fields,"** \$10,500, Chu Shih-I, KU Dept. of Chemistry. U.S. D.O.E. funding 4-07. 785-864-4094 sichu@ku.edu

**"Quantum Dynamics in Particle Interaction with Atomically Flat and Nano-Structured Surfaces,"** \$65,000, Uwe Thumm, KSU Dept. of Physics. NSF funding awarded 6-07. 785-532-1613

**"Quantum Physics of He Near the Double Ionization Threshold--Quantum Chaos and the Wannier Threshold Law,"** \$50,000, Chii Dong Lin, KSU Dept. of Physics. NSF funding 3-07. 785-532-1617 cdlin@ksu.edu

**"Structure and Dynamics of Atoms, Ions, Molecules and Surfaces,"** \$1,875,000, Charles Cocke, KSU Dept. of Physics. U.S. DOE funding 7-07. 785-532-1609 cocke@ksu.edu

## INFORMATION TECHNOLOGY

**"Radar Soundings of Fast Flowing Glaciers in Greenland,"** \$157,637, Sivaprasad Gogineni and David Braaten, KU Depts. of Electrical Engineering/Computer Science and Geography, respectively. NASA Glenn funding 4-07. 785-864-8800 pgogineni@ku.edu 785-864-3801 braaten@ku.edu

**"Wide-Band Integrated Si-Based Single Chip TR Module for UHF Radar,"** \$60,000, William Kuhn, KSU Dept. of Electrical / Computer Engineering. NASA funding 3-07. 785-532-4649 wkuhn@ksu.edu

## MANUFACTURING and ADVANCED MATERIALS.

**"Water Management in PEM Fuel Cells by Material Engineering,"** \$270,244, Trung Van Nguyen, KU Dept. Chemical and Petroleum Engineering. NSF funding awarded 4-07. 785-864-3938 cptvn@ku.edu

SOURCES: KSU Research and Sponsored Program Awards; KU ITTC Project Listing

## Space attraction "8 Wonders" ballot can be found online

Here's your chance to make sure space gets its due here in Kansas.

The Kansas Cosmosphere and Space Center is one of 24 finalists in the Kansas Sampler Foundation's quest to find the 8 Wonders of Kansas. The top eight, chosen by popular vote, will complement the Kansas Dept. of Commerce's "As Big as You Think" branding campaign to publicize Kansas for tourism and economic development purposes.

Since the KCSC is second only to the Smithsonian in the size of its space artifact collection and also has the largest collection of Soviet space hardware in the Western world, it truly is a wonder here on the windswept plains of Kansas.

Go to [www.KansasSampler.org](http://www.KansasSampler.org) to cast your ballot for the Cosmosphere as well as seven other interesting sights. The deadline is Dec. 31, 2007. Winners will be announced by Governor Sebelius on Kansas Day, January 29, 2008.

## Space Industry cont.

but when the time comes to get them renewed they don't have the small industry support needed, so they go back to their work related to aircraft," said Hale.

There is a history. The original Beechcraft, in Wichita, was a subcontractor for the Apollo program back in the 1960s. "I'm going to go out on a limb and say that once [Kansas] companies in the aviation field realize there's a smaller gap from what they're doing now to the space side of things [than they think we may see some action,]" said Miller.

Hale agreed, "No question—aeronautics and the transition to astronautics is a very short learning curve. We need small industry support."

At the forefront of the state's bioscience and other technology initiatives, KTEC has been involved with NASA EPSCoR in recent years. KTEC serves as a catalyst to bring together business, industry and academia partnerships for commercialization, according to Carr.

Carr understands the dilemma. "The next phase of technology is going to need government funding to get it over the hump. It's tough for industry to take its eyes off its base capabilities to expand to a new field."

"[That's why] KTEC periodically reviews its strategic plan to figure some of the areas that need to be stimulated," said Carr.

## Cosmic cont.

from as far away as India. An article was published in the *Astrophysical Journal* and this past summer presentations were made to the American Astronomical Union and the International Astronomical Union.

"There is interest in this idea. There is also a healthy skepticism. But people are very interested—the coincidence is very empowering," says Melott. An article on this in the website *Science Now* was the month of August's biggest hit.

The next step is to figure how large some of these effects are using computer modeling to calculate how cosmic ray showers would behave. Four work stations will run thousands and thousands of simulations to see what the average cosmic effect might be. "It will take several weeks to get just the first stages set up," Says Melott.

## Robotics competitions foster scientific thinking

Fall means the start of high school robotics competitions in Kansas. The two main ones are the Kansas BEST (Boosting Engineering, Science and Technology) and Kansas FIRST (For Inspiration and Recognition of Science and Technology) Competitions.

In these competitions, the robot is actually a tool for more important purposes, according to Noel Duerksen, an engineer and educator who has coached both BEST and FIRST teams. "Students are developing leadership, project development and management skills, teamwork and a sense of accomplishment," he says.

Both BEST and FIRST programs provide a teacher to oversee and an industry professional to mentor students in the basics of engineering physics and electricity. Students then learn scientific thinking skills as they design a concept, test, modify and compete.

The Kansas BEST hub comes out of Wichita and is sponsored by Wichita State University. It has about 28 teams, some from as far away as Oberlin, Independence and even Bentonville, Ark.

The 2007 area competition at WSU will be held October 20 with a theme of "Mission to Mars." Supplies have been dropped on Mars. The teams, who are given their assignments only about six weeks before the competition, must design and build a robot to collect the supplies and move them, traversing an inclined plane when needed. Directing via radio control are a driver and a spotter. Because the robot is out of the driver's sightline, he must rely on the spotter's communications to issue orders to the robot.

"The Kansas BEST hub is the most competitive BEST hub in the U.S.," says Duerksen. Teams from the Wichita hub have won five out of six and four out of six of the trophies given at the regional competition in Ft. Smith, Ark., in the last two years.

"One of BEST's strengths is that it emphasizes the soft skills of engineering," says Duerksen. Students learn documentation, creating and presenting power-point presentations of tech-

nical aspects and giving trade show demonstrations.

It also fosters school spirit as teams bring school bands, cheerleaders and school mascots. "Our goal is to make science and technology interesting to students and to make heroes out of the people in the competitions just like an athlete would be a hero," says Duerksen.

In the BEST competition, which has no registration fee, teams learn to work with precise restrictions. All are given the same kit of supplies like plywood, nuts, bolts, pvc pipe or a radio control kit for use in building the robot.

While BEST is mainly a Midwest/Southern competition, FIRST is nationwide with its Kansas City regional held in March.

In FIRST, teams are also given a mission with a limited work time, but means for doing it are less restrictive.

"One of FIRST's strengths is that it uses much larger and more difficult-to-work-with materials like aluminum, steel or fiberglass composite and pneumatic systems. From an education standpoint, this complexity means there must be more planning," says Duerksen. It also allows for more creative freedom.

The robots are software controlled, so whatever the students can conceive of and make work as they write their own software is allowed. Students also have access to professional level animation and computer-aided design software and compete in making computer-generated animation.

There are about 20 teams in the Kansas FIRST program, most in the Kansas City area, though there are some from Parsons, Newton and Liberal. The FIRST registration is \$6,000 yearly and in recent years most teams in Kansas and Missouri have been partially funded by grants from the Ewing Marion Kauffman Foundation of Kansas City.

"The BEST and FIRST competition teach different but similar lessons based on different rules and they complement each other particularly well," says Duerksen.

# Interstellar R&D

## Ad Astra Kansas News

This "Interstellar R&D" twelfth-time feature in this *Ad Astra Kansas News* twelfth 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

#### JDEM SNAP Space Observatory to Study Dark Energy Phenomenon for NRC Beyond Einstein Program

The Joint Dark Energy Mission JDEM is to be the first of NASA's Beyond Einstein cosmology missions to be developed and launched around 2015 according to the September 5 recommendation by the National Research Council. A team of UC Berkeley physicists hopes to win the JDEM three-project competition to build the billion-dollar NASA - DOE funded SuperNova / Acceleration Probe SNAP and discover how and why the universe is expanding faster than Einstein thought possible. The SNAP team hopes to answer the questions: What is the dark energy accelerating the expansion of the universe? What is the universe made of? Is the universe infinite? Will it last forever? Dark energy is the unknown entity believed to constitute about 75% of all the energy in the universe, and is considered "among the very most compelling of all outstanding problems in physical science."

SNAP is a multifunctional space-borne observatory with a powerful 2-meter class telescope and a half-billion pixel imager, designed to study dark energy by recording the distance and redshift of about 2,000 Type Ia supernovae per year. Using the "weak gravitational lensing" phenomenon, SNAP will make a high-resolution map of the heavens covering an area 2,000,000 times larger than the Hubble Deep Field.

Other competing JDEM projects are the Dark Energy Space Telescope DESTINY of the National Astronomy Observatory in Tucson and the Advanced Dark Energy Physics Telescope ADEPT of Johns Hopkins University.

### COMMUNICATION

#### In Deep Space, Is A Number Worth A Thousand Words?

SETI demands examination of modes of communication just as much as hardware considerations. If that signal arrived, how would it be analyzed, and responded to?

Many suggest that mathematics would be a common factor for any civilization using radio telescopes. Dutch mathematician Hans Freudenthal published *Lingua Cosmica*, his own attempt at an interstellar language, in 1960.

Sundar Sarukkai, physicist and philosopher at the National Institute of Advanced Studies in India, has his doubts. "Their (scientists) belief that nature is written in the language of mathematics actually reflects their belief that mathematics is a universal language," he cautions. "Even if numbers or counting can be a common genesis, who is to say that calculus is a universal, necessary consequence of mathematical thought?"

Sarukkai suggests there may be no "language" ready for use and researchers should not seek a one-to-one correspondence for communication, but rather "some kind of mapping which allows us to understand vaguely rather than with certainty."

### TRANSPORTATION

#### Antimatter Research Paves Path to the Stars

The possibility of travel to the stars hinges on identifying and harnessing revolutionary propulsion methods. Fuels which currently launch satellites and carry astronauts to the International Space Station...even to the Moon...are far too heavy and inefficient to carry humans out of the solar system.

But scientists are already working with a fuel

that may be ideal for starships: antimatter. Only one gram of antimatter, reacting with one gram of matter, releases energy comparable to that of a 20 kiloton bomb

However, significant research must be accomplished to realize these possibilities. Currently, only nanograms of antimatter are produced annually, with its containment and storage being a major stumbling block.

At this point, the Penning Trap, Penn State's Mark I, and NASA's High Performance Antiproton Trap (KiPAT) represent cutting edge technologies for storage of antimatter. All are dependent on magnetic fields, add significant weight, and hold very little antimatter.

Masaki Hori, a researcher from Japan working at the Max Planck Institute, has taken a new perspective on this problem. He is examining using radio waves, instead of magnetic fields, to store anti-protons. Hori calls his receptacle a "superconducting radiofrequency quadrupole trap" and believes it can be realized in a size commensurate with a wastebasket. Hori began his work by careful analysis and measurement of the anti-proton, to determine whether the exact level of symmetry between matter and antimatter conjectured by researchers is accurate.

His work has captured the interest of the European Science Foundation, which has granted Hori a EURYI Award, with financial benefits similar to a Nobel Prize, which will allow his groundbreaking work to continue.

NASA's Institute for Advanced Concepts has awarded Phase I & II awards to Steve Howe of Hbar Technologies, who is also working with antimatter. Howe has developed a concept for making even tiny quantities of antimatter useful for propulsion in space by bringing his interest in the solar sail into the mix.

Howe's Antimatter Sail utilizes a sail coated with uranium-235, against which milligram quantities of anti-hydrogen react. He believes that velocities exceeding 100 km per second might be attained and that a 10kg payload would take only ten years to reach the Kuiper Belt.