



AD ASTRA KANSAS NEWS

Spring 2008

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

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Think tiny Mars rovers

Imagine being able to launch a dozen or more robotic scout vehicles at a time to Mars instead of just the single scout vehicle such as Spirit or Opportunity.

For the past three years, scientists at Kansas State University, in cooperation with NASA Jet Propulsion Lab and Peregrine Semiconductor have been working on an ultra-high frequency micro-transceiver for just that purpose.

"Currently robotic scouts are of a size and weight allowing for only one per launch limiting the area that can be explored. With top-level revision to reduce the size of the scouts, there could be ten to fifty in a single launch—very cost effective," says William Kuhn, professor of Electrical and Computer Engineering and lead for the just-completed project.

As such it could enable new types of scout craft such as aerobots, balloons, disposable drop-off probes or network landers. This is not possible with

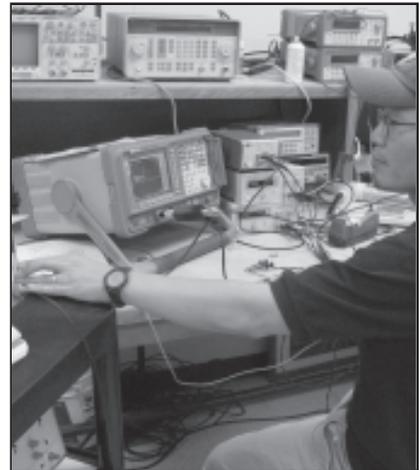
the current radio assets on board probes.

K-State's part in this goal of miniature scout vehicles has been the transceiver. "There are other efforts to reduce the size and mass of planetary radio link, but to the best of our knowledge no one else is working at this level—we are the only one looking to reduce the size by two orders of magnitude (a factor of 100)," says Kuhn.

"On the Spirit and Opportunity the radio equipment is the size and weight of a brick. Our goal is to get it down to the size and weight of a small hand-held calculator," says Kuhn.

Among requirements for this transceiver are near-continuous reception capabilities, low power requirements with the ability to gear up to levels sufficient for varying levels of data (photos), ability to communicate robot to robot and robot to orbiter. As part of this size reduction, the micro-transceiver must be able to work without being

cont. Mars pg. 3



K-State Ph.D. student Jeongmin Jeon tests the radio frequency (RF) power amp he designed for the UHF micro-transceiver project.

Hawley is homebound

With the news that Kansas astronaut Steve Hawley will be relocating back to his home state and alma mater, The Ad Astra Kansas News contacted Hawley for an e-mail interview:

Q: What made you decide to come back to Kansas at this time in your life / career?

A: "This is something I've thought about doing for several years and may very well be the only thing I'd leave NASA for. After 30 years it seemed like now was the logical time in my NASA career to seriously consider if I wanted to do something else. It also seemed like if I was going to have a second career I needed to get on with it before I get too old!"

Q: What will be your focus back here in Kansas and at the University of Kansas?

A: "I will be a professor of physics and astronomy and I look forward to teaching astronomy, including sharing many of the new discoveries enabled by the space program. The university also has asked me to be an advocate in the state for science and math education. That is an interest of mine because I believe that the country needs a population with science literacy and critical thinking skills."

Q: What are you most looking forward to in taking this new direction?

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National LDRS launch to be held in Argonia this summer



A one-third scale Mercury Redstone rocket with a P motor is launched at a KLOUDBUSTERS event. Photo courtesy of KLOUDBUSTERS.

The sky will not be the limit as the KLOUDBusters Rocketry Club of Argonia hosts the 2008 Tripoli 27th Annual National LDRS (Large and Dangerous Rocket Ship) Launch this summer.

This will be the fifth time KLOUDBusters has hosted a national event. "We are one of the premier launch sites in the country because of the wide open spaces and our high flight waiver," says Lance Lickteig, president of the KLOUDBusters organization. East of Kansas there is extreme density in FAA flight patterns and west one has to go someplace like New Mexico.

Due to a lucky fluke in the FAA airspace flight patterns, this 40-acre site about an hour southwest of Wichita has no air traffic patterns, allowing for the FAA waiver.

With its usual FAA launch ceiling of 34,500 feet extended by a special waiver of 50,000, expect to see some real power this August.

There should be 2,000 flights over the six day event which runs August 28 through September 2. Expect to see some exotic rockets there, accord-

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In Memoriam

Chambers was a national treasure

Not too many people are lucky enough to know someone who could truly be called a national treasure. For a mere six years in conjunction with our Ad Astra Kansas work I was.

Dr. Randall Chambers' work as a NASA Chief Life Scientist from 1958 through 1974 was a cornerstone for the development of the U.S. Space Program. From the void that was the human experience in space in the 1950s, he and his team of scientists were charged with creating that experience for the Mercury, Gemini and Apollo astronauts. Training them for what was then the unknown birthed a new area of science—human factors in space. In figuring out every variable of the physical, mental and psychological stress encountered by humans in space, he and other scientists went through the same bruising battery as their trainees would in gathering data that would be used to design the training program, as well as be used by engineers in designing the control panel, space suits and the capsule.

In 1988, he was appointed Distinguished Professor of Industrial Engineering at Wichita State University. In 1996, he became a Distinguished Professor Emeritus and continued to inspire and

advise professors and students in the field of human factors psychology and engineering.

Chambers will be honored at the 2008 International Space Development Conference, the annual meeting for members of the National Space Society, in Washington D.C. beginning May 29. "He did so much with his life with his NASA work, the books he has written, the people he has taught and he was very well-liked," says Candace Pankanin, NSS national vice-president of chapters.



Quiet, self-effacing, he had that still-water-runs-deep quality one often finds with great men. And he was always patient and generous in sharing his knowledge.

In a last gesture of love for his work, shortly before his death last December Chambers donated his lifetime of research materials to NASA where it will be digitized for computer access. Then the original physical materials will be transferred to the National Archives. So, it appears much of his life will be preserved where national treasures are preserved.

Ad Astra, Randall Chambers. You are already there.

Jeanette Steinert

Ad Astra Kansas Day observance planned

The sixth annual Ad Astra Kansas Day event will be marked April 19 by a display at Exploration Place, Wichita.

This year's theme will be "Getting off the Planet-Kansas Style" in memory of Dr. Randall Chambers. The display will be in the Science in Motion Gallery.

At 2 p.m. Mary Jane Chambers will give the presentation in the Kemper Theater that was given to NASA Houston by Dr. Chambers and her last October.

The display will be up from April 19-May 11.

Wichita State ranks third in aerospace R & D

According to the most recent National Science Foundation data, Wichita State University now ranks third among all U.S. universities in aerospace engineering and development.

The top five U.S. universities ranked by aeronautical R & D expenditures in FY06 were:

1. Johns Hopkins University
2. Georgia Institute of Technology
3. Wichita State University
4. Massachusetts Institute of Technology
5. Texas A & M

WSU's ranking is largely due to the research and testing programs at the National Institute for Aviation Research (NIAR).

Rockets cont.

ing to Lickteig. In recent years, a group from Nebraska has launched a one-third scale Mercury Redstone. Another group has shot off a Delta III, the rocket Boeing uses to lift off satellites.

Lickteig and his group are working on an exotic rocket of their own. Thirty inches in diameter, 21 feet tall with fins about the size of a half sheet of plywood, it will be using a P motor.

"It will have 10,000 pounds of total thrust which translates into 1200 to 1300 pounds of thrust for seven seconds," says Lickteig. "It uses an ammonium perchlorate composite propellant similar to that of the solid rocket boosters for the space shuttle."

State-of-the-art launch control electronics can handle up to 64 pads simultaneously, though the largest mass launch to date has been 48, according to Lickteig.

The heavy duty launch pads can accommodate up to 200 pounds. There's a public address system and FM broadcasts of the launch control officer's audio.

This is technically hobby rocketry, with the club's 100 members coming from all spectrums including aeronautical engineers, plumbers, electricians, farmers and salesmen. Membership comes not only from Kansas but also from Missouri, Illinois, Indiana, even one from Tennessee.

Rocketry power grades begin at A with each grade doubling the one before it in power. By definition, high power begins at level C. KLOUDBUSTERS must be over 18 and certified.

The group usually has three main events a year with monthly family fun fly events and is active in education—especially helping scout groups earn merit badges. In 2003, the first Discovery Channel Rocket Challenge was held at Argonia.

The 40-acre launch site is surrounded on all sides by farms. In good-neighbor fashion area farmers allow the launches and the club reciprocates by taking a hiatus from mid-April to mid-July for the wheat harvest.

KU TEAMS SELECTED FOR NASA MICROGRAVITY UNIVERSITY

Three team proposals from the University of Kansas have been accepted for the 2008 NASA Reduced Gravity Student Flight Opportunities Program (RGSFOP). Forty teams were selected with the three being the most from any university.

This program gives undergraduates the chance to take a project through the scientific process from conception and design to building, testing in a weightless environment and evaluating. The program is centered at Johnson Space Center with the reduced gravity flight taking place over the Gulf of Mexico with over 30 parabolic maneuvers. Just past the plane's zenith as it begins descent there will be about 25 seconds of zero gravity.

According to NASA's website these proposals are:

1. "Effects of Energy Dissipation for Communications Satellites" In this proposal students will attempt to quantify the effects of internal energy loss in microgravity on the stability of a mock satellite similar to a communications satellite. The purpose of the projects is to aid in future satellite attitude control design. This project will fly in June.
2. "SMART-HAWKER: A Smart Wire Actuated Robotic Arm" This project aims to push the envelope of robotic shape memory alloy (SMA) technology with a mechanical arm that can move in three different directions at three different points. This project flies in July.
3. "Assembly of Spacecraft Systems by Electro-Magnetic Binding and Locking Equipment" (ASSEMBLE) The goal of this project is a low-energy, highly adaptable means of manufacturing parts for spacecraft in a microgravity climate. Tested will be an orbital docking process using electromagnets. June is the flight date for this project.

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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

"Heavy Quark and Neutrino Physics," \$36,000, Timothy Bolton et al. KSU Dept. of Physics. U.S. DOE funding 8-07. 785-532-1664 tbolton@ksu.edu

"Testing Supersymmetric Origins of Lepton Flavor/Number Violation with the LHC--Large Hadron Collider," Danny Marfatia, KU Dept. of Physics/Astronomy. KUCR General Research Fund award FY 2008.

BIOTECHNOLOGY

"Differentiation of Bone Marrow Macrophages in Space," \$18,000, Stephen Chapes, KSU Dept. of Biology. NASA funding 9-07. 785-532-6795 skcbiol@ksu.edu

Downlink connects fifth graders to astronauts

Ninety-five fifth graders from Anderson Elementary School, Wichita, spoke with astronauts on the International Space Station via a live downlink at Exploration Place on January 23.

The downlink is part of NASA's Teaching From Space program, aimed at inspiring youth in math and science. The opportunity was available because of an agreement between NASA and Exploration Place science museum to host the downlink, one of only two during the six-month Expedition 16 mission.

For excited students extra classroom work prior to the event included going to the Starbase program at McConnell Air Force Base one day a week for five weeks. There students studied flight, saw simulations, had hands-on math and science experiences, according to Anderson fifth grade teacher Terry Manning.

"Each of the four classes then brainstormed questions to ask the ISS crew members: What to do during middle school and high school to prepare for being an astronaut? Why do experiments in water? What do you eat and how do you take a shower? Do tears float? Interestingly, they don't. They collect by the corners of the eyes," says Manning.

The original talk was scheduled for 20 minutes but was extended to about 35. "Students were so excited. Afterwards, they wrote papers on what they will tell their own kids about this experience and what it was like talking to astronauts," says Manning.

As a result students follow NASA more closely now, according to Manning. And the classes are now getting into Lego robotics. "The robotics goes with the Starbase and the downlink. It's connected all through, taking science to another degree," says Manning.

Anderson Elementary is a Title I school with 550 students and a predominately Hispanic student body.

Send items of interest to
steinj@ourtownusa.net

INFORMATION TECHNOLOGY

"Antilles Geographic Information Systems (GIS) Project," \$50,000, John Harrington Jr. et al, KSU Dept of Geography. U.S. DOE funding 10-07. 785-532-6727 jharrin@ksu.edu

MANUFACTURING and ADVANCED MATERIALS

"High Speed Penetration Failure Mechanisms of Textile Fabrics and Armor-Grade Textile Composites," \$155,179, Youqi Wang, KSU Dept. of Mechanical and Nuclear Engineering. U.S. DOD funding 8-07 785-532-7181 youqi@ksu.edu

"Fundamental Research on Silicon Wafer Grinding to Foster a Quantum Leap in Manufacturing of Silicon Wafers," \$10,000, Zhijian Pei, KSU Dept. of Industrial and Manufacturing Engineering. NSF funding 12-07. 785-3436 zpei@ksu.edu

Sources: KSU Research and Sponsored Programs Extramural Awards listings; KUCR General Research Fund Awards FY 2008

Hawley cont.

A: "I think I look forward the most to sharing the excitement that I've found from learning about and doing science and to serve as an example of how someone growing up in Kansas and with the proper preparation can have the opportunity to participate in some really exciting things. I've said that KU gave me a great start in life and I want to help give today's students a great start, too."

Q: In a career of accomplishments, of what are you the most proud? Why?

A: "I think it was having developed the reputation as someone the other astronauts wanted to fly with. I suppose I'd have to add being inducted into the Astronaut Hall of Fame last year and being there with many of my childhood heroes like John Glenn, Jim Lovell and John Young."

Q: In a career of incredible experiences, is there one or two that stands out for you?

A: "It's hard to pick out just one or two, but I suppose I will always remember and be proud of my association with the Great Observatories and Hubble Space Telescope, in particular. It's very rewarding for me as an astronomer to have participated in a small way in the deployment and subsequent upgrade of the HST and to now see how the new knowledge acquired since 1990 has revolutionized our understanding of the universe. Only a small number of people ever got to work on HST and I got to do it twice."

Q: Is there any mission you wish you could have flown on?

A: "I think it would have been great to have had a chance to visit the International Space Station. I never flew that kind of flight. However, I wouldn't trade the ones I did fly for anything."

Mars cont.

encased in the usual warm box, meaning it must stand extremes of -100 degrees C or below. Also, there has to be a radiation tolerance since Mars has only a very thin atmosphere.

A main key to accomplishing this is the integration of analog and digital circuitry on a single chip. Challenges to that included ramping up its abilities compared with that of off-chip counterparts and compatibility with existing systems.

K-State provides the radio frequency (RF) portions of the micro-transceiver, NASA JPL the digital integrated circuit and Peregrine the radiation-tolerant silicon-on-sapphire fabrication expertise.

"The primary PI is at K-State, although JPL has an equal and major/complementary part of the work. Peregrine provides the expertise in the radiation-tolerant silicon-on-sapphire integrated circuit process being used. We have close and long-standing ties to each," say Kuhn.

Sapphire means a man-made combination of the atoms for the mineral/gem sapphire used as the substrate for the circuitry. It provides insulation, enabling the device to run faster with lower power, addresses temperature and radiation issues and prevents crosstalk problems.

In developing the UHF transceiver, K-State team members built and tested prototypes and finally assembled the designs onto a single integrated circuit to produce the desired micro-transceiver.

"This has been a successful three-year-effort and has attracted both government and industry-sponsored interest in related projects for various applications," says Kuhn.

"Research is complete and we are ready for a future Mars mission," says Kuhn.

WSU students working at NASA Dryden

Three Wichita State University aerospace engineering students are participating in a five semester co-op program with NASA Dryden at Edwards AFB in California.

John Bird is working in code RS, the structural branch, working in the aero/structural loads group. RS is responsible for all of the structural design, testing, and flight approval at Dryden. His group evaluates loads from aerodynamic forces as well as other sources such as vibrations and static.

As a junior engineer with a mentor, Bird has two main projects. The first is an analysis of the firepod on NASA's Ikhana aircraft which was used last fall to assist firefighters battling wildfires in southern California. Secondly, he is developing a computer program to do most of the analysis.

Other work includes supporting flights for NASA's Intelligent Flight Control System (IFCS) project.

Jordan Jensen is in code RS--aerodynamics and propulsion working on health monitoring on engines.

Erin Wagoner is in code RF--aircraft systems working on the SOFIA flying observatory.

Q: How does it feel to be an inspiration? Or does that title make you uncomfortable?

A: "It has always made me feel somewhat uncomfortable because I've never thought of this being about me. This is about what the NASA team has been able to do on behalf of the country and I feel privileged to have been part of the team. There are numerous people who make these things happen that the public never hears about. These people do what they do because they believe in the NASA mission."

Interstellar R&D

Ad Astra Kansas News

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

Galaxy Forums 2008 Advance Interstellar Observation and Understanding

A series of Galaxy Forums sponsored by Space Age Publishing Company and the International Lunar Observatory Association starts July 4 in the Northern California San Francisco Bay Area, then 26 July in Vancouver, Canada, mid-October in Beijing, China, and possibly later in the year elsewhere, and will accelerate both scientific and general knowledge of our local, neighborhood Milky Way Galaxy.

A new domain for human understanding and exploration, mid-size between a finite Solar System and an infinite Cosmos, the Galaxy — with its 200 billion+ stars, 100,000 lightyear length, 270 million year period of revolution, and massively energetic center — provides a compelling focus and direction for 21st Century consciousness, education, and endeavor.

Astrophysical observation through galactic, sometimes dusty, interstellar space advances through multi-wavelength imaging — radio, microwave, sub-millimeter, far infrared, infrared, near infrared, optical, ultra violet, x ray, gamma ray — of the Galaxy's salient features: galactic center and bar, spiral arms, halo.

Galaxy education and interstellar learning 2008 is expanding rapidly through activities by Teacher in Space / astronaut educator Barbara Morgan, Galaxy Garden creator / artist Jon Lomberg, Virgin Galactic entrepreneur Richard Branson, among many others.

COMMUNICATION

Bracewell Probes and Other Nodes

The Search for Extraterrestrial Intelligence has been on the minds of philosophers, scientists and visionaries since before humans were capable of reaching space. Consequently, many well considered and creative plans for advancing communication throughout our galaxy and others still wait for the needed technology to move forward.

In 1960, scientist Ronald Bracewell suggested sending robotic messengers - now known as Bracewell Probes - on interstellar missions to search for intelligence. The probe would target a host star and, upon arrival, go into a circular orbit in that star's "habitable zone." It would then scan the region for communications-type transmissions and - if any were found - broadcast those transmissions back to their source to draw attention to itself.

The benefits are numerous. The probe would be delivering a powerful signal, easily noticed even if the other culture were not monitoring deep space transmissions in search of other life forms. The probe would also be able to broadcast along a wider frequency range in its closer proximity.

A Bracewell Probe would utilize artificial intelligence to conduct preliminary "introductions" with the new culture. This could be accomplished in real time, without waiting for transmissions to cross interstellar distances, and may even include artifacts or gifts which could be carried in the probe.

Other benefits include the probes' ability to provide a continuous beacon in one locale, waiting for nearby life to develop radio technology. The probe could also contact unknown life forms and screen for compatibility prior to disclosing the location of its makers.

Conceivably, Bracewell Probes and other communications devices might serve as nodes to facilitate deep space communications as our culture advances into the cosmos. Fred Bourgeois, founder of Google Lunar X Prize Team FREDNET, hopes to land a tiny roving communications device on the Moon, and follow on with landings on asteroids. He believes that emplacing these potential nodes will open new possibilities and pave the way for intergalactic communications.

TRANSPORTATION

Evolving Deep Space Missions

Careful planning is a key to success for long trips, so if you are developing a Deep Space mission - where distances are measured in light-years - there will be a lot of planning. But in this scenario where options are as numerous as the stars in the sky, how can the best path be identified?

A complex math algorithm called "differential evolution" is being applied by researchers at the University of Missouri to identify the most effective routes for space missions. Craig Kluever, an aerospace engineer at MU, along with former MU grad student Aaron Olds, applies the evolution simulating algorithm by treating possible solutions as individuals within a population.

As the population develops, individuals "mutate" and swap traits, with only the most successful surviving to the next round. With each repetition, the process narrows in on the best spacecraft trajectories.

Kluever and Olds tested their use of the algorithm against four actual space missions and were encouraged by their findings. "The Cassini results were actually very close to what was actually flown. A lot of event times and flybys were right on the same day or just off by one day," said Kluever.