AD ASTRA KANSAS NEWS

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

Spring 2006 *Vol. 5, No. 1*

Astronomy and space physics research active in Kansas

Astronomy and space physics research can be found in Kansas at many levels.

Kansas has nine observatories, all of which have schedules for public viewing, education and presentations--and a number of private ones.

Take C.W. Robertson's Setec Observatory. Robertson, an engineer at a Wichita aircraft plant, built his own 10 x 12 ft. roll-off roof observatory north of Goddard. Equipped with a 12" telescope and a CCD camera designed to measure starlight, the telescope is programmed to track a designated star or group of stars moving across the night sky. "On a good night, it can get 600 to 800 images," says Robertson. He is part of an international network of amateur and professional astronomers tracking delta scuti stars, which are short period variable stars, meaning the brightness fluctuates several times over the course of a night. As the sun rises in Kansas, it sets in Belgium and a colleague there takes up the tracking. So it goes across the globe.

Using Maxim DL Software, Robertson reduces down the data and e-mails it to the others. "There are two types of researchers: experimentalists and theoreticists. I am an experimentalist--I do two things. I take the first level data and reduce it to see how the brightness of stars change with time. Also, I try to identify the different components which are added together to make up these brightness changes in much the same way one identifies the strings one strums to make up a chord on a guitar. The goal is to collate that with what's going on inside the star," says Robertson.

This information is sent to theoreticists who uses it to figure out how stars evolve, grow old and die. Robertson's team of amateur and professional astronomers have had four papers published in peer-reviewed publications such as the Astronomy and Astrophysics Journal.

Continued "astronomy" page 2

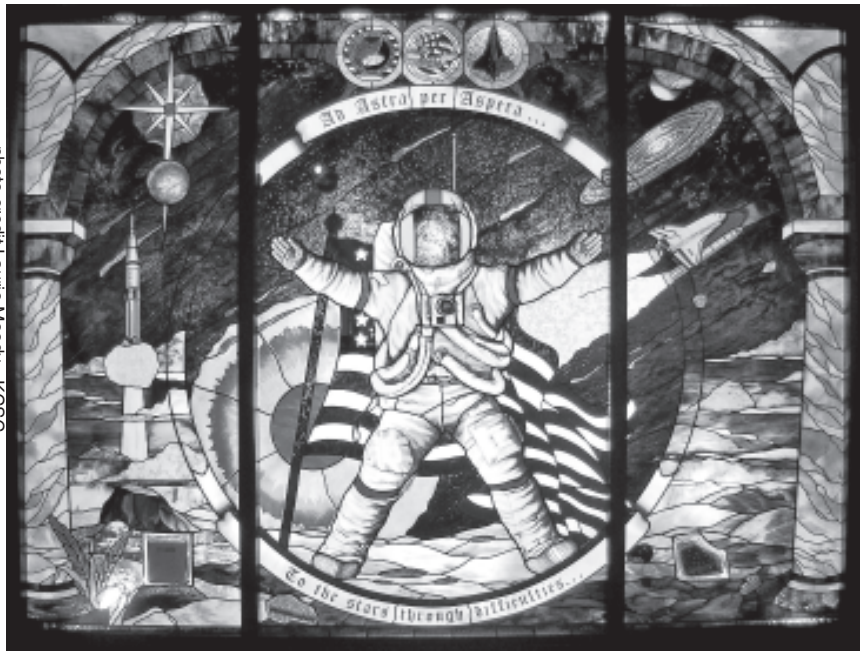

photo credit Laurie Moody --KCSC

Designed to pay tribute *to 17 American astronauts whose lives were lost in the pursuit of space exploration, this 8 x 11-foot stained glass masterpiece was created for the Kansas Cosmosphere and Space Center over 18 months with 4,000 hours of mostly volunteer work by 19 artists at Rayer's Bearden Stained Glass Supply, Wichita. It is now on permanent display in the Cosmosphere rotunda.*

Ad Astra display to be in capitol rotunda

This year Ad Astra Kansas Day will be marked by a display at the Kansas state capitol building with the theme "Kansans reaching for the stars through space-tech education, research and commerce."

Participating in the display, which will be in the first floor rotunda from April 23-29, will be around two dozen Kansas private, public, governmental, non-profit, educational and commercial entities with ties to space-tech science.

Ad Astra Kansas Day has been honored twice, in 2003 and 2005, with a governor's proclamation recognizing the importance of science and technology to Kansas' future.

Kansas Observatories

***Clyde W. Tombaugh Observatory**, University of Kansas, Lawrence. Named for the Kansan who discovered Pluto.

***Crane Observatory,** Washburn University, Topeka. Its 1889 Warner-Swasey telescope is still in use for public viewing.

***Elk Creek Observatory,** on the Holton High School campus.

***Farpoint Observatory,** Eskridge, next to Mission Valley High School. Farpoint is known as the site of the discovery of one of the faintest comets ever discovered by an amateur.

***Kansas Wesleyan Observatory,** Salina. On the Kansas Wesleyan campus.

***Lake Afton Public Observatory,** part of Wichita State University's Fairmount Center for Science and Mathematics Education

***Mabee Observatory,** Bethel College, North Newton

***Pittsburg State-Greenbush Astrophysical Observatory**, Girard

***Powell Observatory**, Louisburg. With its 30-inch mirror, it is one of the largest telescopes available for public viewing in the five-state area.

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"Getting off the Planet" chronicles the behind-the-scenes research that went into the U.S. space program

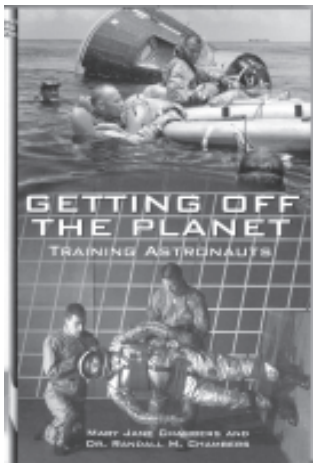
Written to fill in missing links on the early history of U.S. Space exploration, Wichita State University's Dr. Randall Chambers' recently published book "Getting Off the Planet," is both an educational resource and an interesting read for anyone who's ever paused to watch a countdown.

Co-authored by wife Mary Jane Chambers, a prizewinning journalist in her own right, the book gives, in laymen's terms, a first-hand account of Dr. Chambers' years as NASA project director for acceleration research and training for many of the first astronauts from 1958-74.

Remember, this was a time when computers filled whole rooms, and rockets still had over a 61 percent failure rate. It took scientists from two dozen disciplines at government, private industry and university levels to accomplish sending a man into space and eventually, to the moon.

The book takes readers into this new field of science developed specifically for the space program--human factors engineering--and explains how they started at square one.

For example, to escape Earth's gravitational pull it takes a speed of 17,000 mph. During launch and re-entry the astronaut endures great physical pressures—heart stress, breathing difficulties; chest, arm and leg pain; speech and vision distortion, burst capillaries in the eyes and skin. The brain needs to be protected.



Before the first astronauts even began training on the centrifuge, Dr. Chambers and other researchers were the original guinea pigs. They rode sitting upright or lying down or in any position they could think of while "flying" in the centrifuge as it spun, rolled or twisted forwards, backwards or upside down at G-forces up to 13-G while vacuum pumps sucked out atmospheric pressure. For about nine months, disorientation, distorted perceptions, blackouts, nausea, bloodshot eyes and painful bruises became the order of the day as they collected data about the physiology of acceleration stress and the ability to perform tasks under this exposure to G-force stress. Besides being used to design a training program for the astronauts, this data was used by engineers in designing the control panel, space suits and the capsule.

"I can't train them to do something I don't know how to do myself. Besides, I don't want anything to happen to them while I'm in charge," Dr. Chambers explains to his wife who is protesting the dangerous research.

By the time John Glenn flew his first flight, which had a malfunction, so well-trained was he that he was able to use the manual re-entry technique he had practiced on the centrifuge and bring it down safely. In his official report he wrote,"I could note no difference between my feelings of decelaration on this flight and my training sessions in the centrifuge."

Note: Published by Apogee Books, "Getting Off the Planet" may be found at Amazon.com, Barnes and Noble, the Kansas Cosmosphere and the WSU bookstore.

"Astronomy" cont. from page 1

In a NASA-funded project astrobiologist Adrian Melott at the University of Kansas is studying gamma ray bursts (GRB). GRBs, powerful explosions sending out beams of radiation throughout the universe, are believed to be caused by energy released when a star collapses to form a black hole. The question here is "do GRBs damage planetary biospheres?"

Also studying GRBs are the students in Mike Ford's astronomy class at Holton High School, which has its own observatory, Elk Creek Observatory. Founded in 2000 with a Christa McAuliffe Foundation grant, besides its main telescope, a 20-inch Ritchey Chretien, Elk Creek has six others ranging from 6-16 inches in diameter. Currently, Ford has about 30 students taking astronomy as an elective for which they get advanced credit.

Using information on GRBs from SWIFT, students head for the telescopes to get the afterglows. SWIFT is an unmanned multi-wavelength observatory/spacecraft dedicated to GRB science. It observes GRB with gamma ray, x-ray, ultraviolet and optical telescopes.

They are also studying active galaxies and the micro-variability of black holes and jets. "We compare images with information from Sloan Digital Sky Survey and Gort Observatory in California and look for anomalies," says Ford. Also on their project list are near-earth objects and blazars, which are galaxies with black holes with jets which are shooting directly towards earth. "We are looking right down the throat of the black hole," says Ford.

Barbara Anthony-Twarog, a researcher in physics and astronomy at the University of Kansas, has been studying photos brought back from Cerro Tololo Inter-American Observatory in Chile. She and her colleagues have identified star cluster NGC 6253 as the most metal-rich in our galaxy--referring to all elements except hydrogen and helium present in the star's atmosphere. These metals help in studying the evolution of the galaxy.

Answering questions about the evolution of the planets was on NASA's mind when it launched the Cassini-Huygens mission to Saturn.

Dr. Thomas Cravens of the University of Kansas is part of a group of 200 scientists from 19 countries working with this mission. He is part of the mass spectrometer team.

When it reached Saturn in 2004, Cassini maneuvered itself into Saturn's orbit. According to Cravens, they expected to find a little bit of gas and a lot of water vapor in the composition of its rings. But they were surprised to find molecular oxygen of the type we breathe here on earth with an electrically charged atom--O_2+.

Saturn's moon Titan is also of interest, says Cravens. Titan is being explored three ways: 1) By taking samples of the uppermost part of Titan's atmosphere. 2) By remote via visible, infrared and ultraviolet telescopic measurement. 3)Via the probe Huygens detaching from the Cassini, going down into the atmosphere near the surface.

"Titan has atmosphere, a denser, more pressured one than Earth. Our moon has no atmosphere. It is a vacuum. Titan is chemically complex. It has molecular nitrogen like Earth, but no molecular oxygen. But it has methane gas, which is like natural gas here on Earth, and with the other many chemicals that are present in Titan's atmosphere there is the possibility for numerous hydrocarbon compounds to be created," says Cravens. Think smog.

"The big question on Titan is why does Titan retain its atmosphere when our moon has no atmosphere and other moons which at one time had atmosphere have lost theirs? Also, how energy is input into the atmosphere and affects the atmosphere," says Cravens.

One other surprise so far is Saturn's small icy moon Enceladus. It has a bare icy surface with a tenuous atmosphere in one region only with water vapor, carbon monoxide and nitrogen and riffs in the surface which are hotter than normal—and ice geysers. This was an item in national news recently. Cravens' mass spectrometer team was part of this discovery. Scientists want to learn how this active geyser affects the Van Allen Radiation Belt.

Jason Ferguson, WSU, is studying low temperature opacities. Low temperature means stars whose temperatures are below 2000 degrees Kelvin. He is trying to understand how light passes through matter such as dust clouds in space or gas clouds around stars and to calculate that value.

Opacity is a number. For example, steam, water and ice each have different opacities. The wavelengths of red (hotter) starlight are different from that of blue (cooler) starlight and pass through the same matter differently. In order to understand the evolution of stars, "We need to know the temperature and opacity at its stages of life," says Ferguson.

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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 / PHYSICS

"CAREER: Neutrinos in and Beyond the Standard Model and Outreach Connections," Danny Marfatia, KU Dept. of Physics and Astronomy. National Science Foundation sponsorship 785-864-4591 marfatia@ku.edul

"Theoretical Investigation of Ultracold 3-Body Collisions," $57,670, Brett Esry, KSU Dept. of Physics, National Science Foundation funding awarded 5-05 785-532-1630 besry@ksu.edu

AVIATION

"Medium Aperture Lightweight Mirrors," Rick Hale, KU Flight Research Lab. Awarded by Bennett Optical Research, Inc. 785-864-2949 besry@ksu.edu

"AX2 Fuselage Damage Tolerance Testing," $50,000, D. Cope, WSU Dept. of Aerospace Engineering. Liberty Aerospace funding awarded 4-05

BIOTECHNOLOGY

"Automated Microfluidic Devices for Monitoring Biological Systems in Space," $100,000, Christopher Culbertson, KSU Dept of Chemistry. NASA funding awarded 4-05 785-532-6685 culbert@ksu.edu

ENERGY

"Electro-Optic Laser-Sampled Neutron Detector," $99,786, Kenneth Shultis and Douglas McGregor, KSU Dept. of Mechanical and Nuclear Engineering. U.S. Dept. of Energy funding 785-532-5284 mcgregor@ksu.edu

"High-Efficiency Thin-Film-Coated Semiconductor Neutron Detectors for Active Dosimetry Monitors," $107,774, William Dunn and Douglas McGregor, KSU Dept. of Mechanical and Nuclear Engineering. U.S. Dept. of Energy funding. 785-532-5628 dunn@ksu.edu

"Semiconductor Radiation Detectors with Frisch Collars and Collimators for Gamma Ray Spectroscopy and Imaging," $117,055, Douglas McGregor and Dale Schinstock, KSU Dept of Mechanical and Nuclear Engineering. U.S. Dept. of Energy funding 4-05. 785-532-2608 dales@ksu.edu

"Understanding Vibrational Energy Transfer and Spectra in Microporous and Mesoporous Materials," Ward Thompson, KU Dept. of Chemistry. Project awarded by the National Science Foundation. 785-864-3980 wthompson@ku.edu

INFORMATION TECHNOLOGY

"Center for Remote Sensing of Ice Sheets (CReSiS)," $19 million over 4 years, Prasad Gogineni P.I., KU Dept. of Electrical Engineering and Computer Science. National Science Foundation award 2005. 785-864-8800 pgogineni@ku.edu

"A Geographic Information System (GIS) Application to Ice Sheet Mapping and Mass Balance Analysis," David Braaten, Joel Plummer, KU's Information and Telecommunication Technology Center (ITTC). NASA project awarded. 785-864-3801 braaten@ku.edu

"SGER: Index Switchable III-Nitride Planar Lightwave Circuits for Optical Communications," Rongqing Hui, KU Information and Telecommunication Technology Center (ITTC). Sponsored by the National Science Foundation. 785-864-8814 rhui@ku.edu

"Waveform-Diverse Sensors," Shannon Blunt, KU Information and Telecommunication Technology Center (ITTC). Project sponsored by the Office of Naval Research. 785-864-7392 sdblunt@ku.edu

MANUFACTURING and ADVANCED MATERIALS

"High Speed Penetration Failure Mechanisms of Textile Fabrics and Armor-Grade Textile Composites," $97,824, Youqi Wang, KSU Dept. of Mechanical and Nuclear Engineering. U.S. D.O.D. funding 4-05. 785-532-7181 youqi@ksu.edu

Source: KU Center for Research Sponsored Project Awards, KSU Research and Sponsored Program Awards, WSU Office of Research Administration

Aerospace education workshop to be offered this summer

An aerospace education workshop will be held at Fort Hays State University on June 20-22.

The workshop, which will run from 9 a.m. to 4 p.m. at 201 Tomanek Hall, will include a presentation by a NASA space educator.

Topics will include aeronautics, earth science, microgravity, rocketry and ISS toys.

Educators can earn one credit hour (TEEL 670 or PHYS 670) by attending the workshop

For more information, contact Dr. Paul Adams by phone at 785-628-4204 or e-mail at padams@fhsu.edu. Or address inquiries to him at the FHSU Mathematics and Science Education Center, 600 Park St., Hays, KS 67601.

Wellington Challenger Center continues education mission of astronauts

Wellington is the site of the 53rd Challenger Space Center.

Founded by families of the crew of 1986's Challenger disaster as a living memorial to their loved ones, Challenger Space Centers in the United States and several other countries continue the mission of education.

The goal is to make creative use of technology to facilitate the learning experience. Classes of up to 32 students can fly a three-hour mission simulation. But first, the class' teacher will attend a half-day seminar at least two-months before the mission. Educators are given 4-6 weeks worth of cross- curricular materials ranging from math to science to the arts, to integrate into their studies in the weeks prior to the mission. "It is this essential classroom component that lifts a mission at the Challenger Space Center from the confines of an everyday field trip," according to Challenger educators.

The Challenger Space Center's Technology flight Deck features over $1 million in technology, including a Mission Control room designed after Johnson Space Center; the Spacecraft, designed to simulate a room onboard the International Space Station (ISS); and the Airlock, which transports teams of crew members up to the ISS so they can live and work in space.

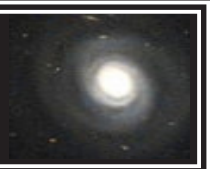
Photo courtesy of Challenger Space Center

Also offered are two-hour public missions to give the general public a chance to experience activities and challenges that astronauts face.

If successful, there may be the possibility of establishing more in the state, possibly in western and southeastern Kansas, according to information provided by the CSC.

Interstellar R&D

Ad Astra Kansas News



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

New Astrophysics Technologies Increase Cosmos Understanding: Laser Guide Star Adaptive Optics; HESS Array

Reality of the Material infalling to the Galaxy Center black hole and cosmic rays emanating from it are more clearly observed and understood through utilizing the latest astronomy technology advances. The Laser Guide Star adaptive optics at Hawaii's 10-m Keck 2 Observatory enables the clearest picture yet of the Center of our Milky Way Galaxy including the area surrounding the supermassive black hole and detailing dramatic infrared light variation. The High Energy Stereoscopic System (HESS), an array of four gamma-ray telescopes sited in Namibia, provides the first direct evidence for recently accelerated cosmic rays coming from the Galaxy Center.

The Laser Guide Star adaptive optics allow astronomers to "generate an artificial bright star" exactly where they want it, which reveals the atmosphere's distortions. Laser Guide Star professor / researcher Andrea Ghez of UCLA notes that in overcoming these distortions in the atmosphere and producing high-res images, astrophysicists can use differing wavelengths to study the infrared light coming from the very hot material about to be pulled through the black hole's 'event horizon' — at the center of our Galaxy some 26,000 light-years distant. "We are learning the conditions of the infalling material," she observes, "and whether this plays a role in the growth of the supermassive black hole. The infrared light varies dramatically from week to week, day to day and even within a single hour."

The HESS array enables astrophysicists to observe very-high-energy gamma ray emissions from gas clouds near the Galaxy Center — radiation very likely the result of cosmic rays interacting with these gas clouds. HESS scientists think this cosmic-ray signature may be produced in a single supernova remnant.

COMMUNICATION

Terrestrial Communications Spur Interstellar Travel

Centauri-Dreams.org is the website of Raleigh, North Carolina author Paul Gilster, a computer specialist who has decided to pursue his childhood dream and reach for the stars. "Centauri Dreams goes back to when I was a kid. I was fascinated with the whole idea of deep space travel," states Gilster.

Gilster intends to continue the work of NASA's Breakthrough Propulsion Physics Project, a short-lived effort in the 1990s to identify means of propulsion which could realistically go to the stars. "The site is really aimed at the scientific community so they could use it as sort of a clearing house specifically on interstellar flight issues," notes Gilster. Primarily a news site, Gilster updates six days a week. His dedication has led some scientists to send their papers before they are actually published.

Gilster is often surprised by new contacts through the site. A colleague of the late Carl Sagan provided him with a description of how a "worm hole" might look, based on research for the film "Contact."

Gilster's site builds off his hardcover book, "Centauri Dreams: Imagining and Planning Interstellar Exploration." The web site includes Recent Posts, Archives, and specific categories such as Sail Concepts and Antimatter.

TRANSPORTATION

Ion Thruster Innovations Place Stars Within Reach

Ion thrusters utilize an electric field to accelerate a beam of ions away from the spacecraft. Perhaps when NASA began examining the technology in the 1960's, it seemed as exotic as Positron Drive or quantum entanglement do today. Nonetheless, ion thrusters are in use and improvements in that technology may make a trip to the stars a real possibility.

Former astronaut Franklin Chang-Diaz led development of ion thruster technology while at NASA and currently is with Ad Astra Rocket Company, continuing work on the Variable Specific Impulse Magnetoplasma Rocket (VASIMR). VASIMR uses magnetic force fields to control the exhaust jet and prevent the nozzle from melting. The potential commercial applications include re-boost of large, orbiting platforms, satellite delivery, and cargo transport to the Moon.

"The promise this system holds could dramatically reduce the travel time for interplanetary mission, cutting trip times to Mars by one half or better," indicates Chang-Diaz. NASA's agreement with Houston-based Ad Astra Rocket Company allows for some funding over the next two years to facilitate a smooth transition for the project.

An Australian National University team designed and built the Dual-Stage 4-Grid (DS4G) thruster in less than four months. It is based on a concept British mathematician David Fearn suggested in 2001. The DS4G may offer tenfold speed compared to the Hall thruster which propelled SMART-1 to the Moon.

Ion thrusters generally use a one step process to extract ions from the reservoir and expel them. DS4G was designed as a two step process. Ions are extracted via two closely placed grids that operate at about 3000V - 5000V. Acceleration of those ions occurs between the second and third grids, where an extremely high voltage is applied. A fourth grid, again at low voltage, prevents stray electrons in the exhaust plume from moving backward.

This design allows for differences up to 30,000V to accelerate the ions. In testing, the exhaust plume traveled at 210 km per second. "And there's even talk of interstellar missions [beyond the solar system]," states Orson Sutherland, who led the team that built the engine.

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