AD ASTRA KANSAS NEWS

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

Fall 2003 Vol. 2, No. 2

You are cordially invited to the

AD ASTRA KANSAS DAY 2

(April 25, 2004)

Planning Meeting

Saturday, Nov. 1

at the

National Institute for Aviation Research
Wichita State University
Seminar Rooms 307, 308, 309
1-3 p.m.

Agenda:
Sites, speakers, activities, etc.
for second annual observance of
Ad Astra Kansas Day.

To RSVP see contact info on page 2

Kansas Team to Fly on NASA KC-135 Microgravity Aircraft

Undergraduate engineers or scientists from Kansas are invited to team up and propose a microgravity project for the 2004 Johnson Space Center KC-135 Student Flight Program.The selected team will design, build, fly and evaluate a reduced gravity experience over a six-month period.

According to Donn G. Sickorez, JSC University affairs officer, this is unique among NASA's programs because:

* it gives students hands-on experience designing and building microgravity experiments as well as the experience of microgravity.
* the team is allowed to invite a local (or national) journalist to accompany them during preparation, flights and post-flight activities, resulting in excellent, positive coverage for their university.
* some universities have incorporated it into their senior design curriculum

This will be Kansas' first team to fly in the KC-135 program. Find details at microgravityuniversity.jsc.nasa.gov Contact: Donn G. Sickorez, Ph.D., University Affairs Officer, Mail Code AH2, Johnson Space Center, Houston, TX 77058 281.483.4724 (phone) donn.g.sickorez@jsc.nasa.gov

In this issue

Kansas flies high in remote sensing

by Jeanette Steinert

There's a reason Kansas is well-known for its remote sensing work.

"We are unique in the kind of remote sensing we do. A lot of states do research using satellite data. What makes us different is we take the applied approach—taking satellite data [to the next step] to prepare a product that helps the decision-makers," says Ed Martinko, director of the Kansas Biological Survey.

For example, the excess of carbon dioxide in the air globally is impetus for research on carbon sequestration on the Great Plains. The Great Plains is a carbon sink, so called because of the potential of its land and vegetation to store carbon. Kansas Applied Remote Sensing (KARS) scientists are figuring out how to use satellite remote sensing to analyze how and where carbon is being stored. Carbon stored is carbon not polluting.

One potential application has to do with a movement afoot in Congress to give farmers carbon credits (money) to use low-till farm practices or other land management practices that increase soil carbon storage, according to Kevin Price, assistant director of KARS and professor of geography at the University of Kansas. In a NASA-supported project, University of Kansas and Kansas State University researchers use satellite imagery to study invasion rates of red cedar, a noxius tree species, and its effect on carbon storage of surrounding land cover.

Or take the coniferous forests of the northern Rockies and Yellowstone National Park. Using remote sensing and geostatistical methods KARS scientists can go beyond mapping land cover to calculate forest age, density, type and condition, even do fire-behavior modeling and assess plant and animal diversity. A current project maps forest cover types and assesses for insect damage. Software is being developed to interface with current remote sensing systems, eventually making data available to forestry managers.

A staple at KARS is the GreenReport™ an application of satellite data which can, for example, predict crop yields with a high level of accuracy. The GreenReport™ does work nationwide, with more detailed work, such as drought monitoring, being done in Kansas. Other KARS work ranges from EPA watershed classification to urban planning to a state land inventory for the GIS Policy Board. One current project, America View, aims to help all 50 states develop a satellite dataset of their own state.

KARS, a part of the Kansas Biological Survey, is a NASA Regional Earth Science Applications Center (RESAC) in environmental remote sensing. "Having done over 300 projects for our state over the past 30 years, we have a strong commitment to Kansas. But we also do work all over the world, bringing recognition back to Kansas," says Price.

Recent KARS projects have been located in Mexico, El Salvador, Brazil and China, with ongoing ones in Zambia, Tanzania and Kenya.

Another major project is "Hyper Spatial Imagery of Rural Environments (HYSPIRE)," under the auspices of the NASA EPSCoR program. A multi-university effort, HYSPIRE currently focuses on Cheyenne Bottoms and the Konza Prairie.

Cheyenne Bottoms, in central Kansas, covers about 60 square miles of wetlands. Because millions of shorebirds stop there during migrations, it may be the most important bird migration site in North America. As part of ongoing efforts to reclaim its natural habitat, this three-year project traces land cover changes over the last 20 years. The goal for Emporia State University researchers is to develop hyper-spatial and hyper-spectral remote sensing techniques, which allow detailed physiology and biological analysis.

KU's portion of HYSPIRE aims to use satellite data to study grassland condition and predict nutrient value of crops. Also, they hope to tell land use, whether grasses are cool season or warm season native grasses and how environmental variables affect carbon storage.

At the Konza Prairie, an untouched native tallgrass research area south of Manhattan, the idea is to "monitor the prairie using satellite instruments 700 miles in space and infer in finer detail from coarser data," says Doug Goodin, HYSPIRE principal investigator of Kansas State University. "Using a pilot's term, we want to figure out a behavioral envelope for the prairie. If something deviates, we want to detect it. But first we have to know what's normal and that takes a long time." This project has been ongoing for ten years.

Other current KSU remote sensing projects include studies of land cover changes and human-environment interaction in southwest Kansas; research on South America's Interior Atlantic Forest, which is even more endangered than the rainforest; and deforestation and wildlife habitat in Paraguay.

At KU's Information and Telecommunication Technology Center (ITTC) another type of sensing work is going on in their Radar and Remote Sensing Lab: Polar Radar for Ice Sheet Measurements (PRISM). Backed by NASA and NSF grants, KU scientists and engineers are developing radar technology and robotic rovers to determine basal water conditions at bedrock level in Greenland and Antarctica. Prototypes being developed include a radar system capable of instantly analyzing data and then passing it to another radar system working nearby. PRISM engineers must design a robotic rover able to withstand harsh polar conditions, move the ground-level radar systems around and provide power for itself, data and radar systems.

ITTC's Greenland Data Project uses aerial surveys to track sea ice melting.Last spring KU researchers flew a mission with NASA Goddard Space Flight Center to Greenland. NASA flew laser

Cont. "Remote" page 3

So you want to be an astronaut?

by Randall Chambers, Ph.D. DABFM, DABPS, BCETS

From 1959-1972, while serving as a NASA aerospace engineer and a Department of Defense civilian scientist, I was assigned to serve as project director, engineer and/or scientist in the Mercury, Gemini, and Apollo missions. The space program has continued to expand since then. Once mostly consisting of military pilots, today astronauts often include civilians. And as the scope for space exploration and interplanetary travel broadens, interest in how to become an astronaut increases.

NASA Johnson Space Center is primarily responsible for training U.S. astronauts and some international candidates. Candidates may be selected as needed, and as pilot astronauts, mission specialists, or a variety of other engineering, research and technical categories. Civilians may apply at any time. Military personnel must apply through their parent service and be nominated by their military service.

Applicants are evaluated by discipline panels who review for academic and intellectual criteria, medical and psychological functioning, flight training and/or technical performance capabilities, behavioral and moral suitability, linguistic ability, training in aeronautics and astronautics, and piloting and/or professional specialty experience. The Astronaut Selection Board recommends candidates who are then assigned to the Astronaut Training Office at the Johnson Space Center for two years. Upon completion of the JSC training and evaluation program, civilian candidates are expected to remain with NASA for at least 5 years. Military candidates are detailed to NASA for a specified tour of duty. For international and professional astronauts, there may be criteria for the Multilateral Coordination Board, and the ISS Multilateral Crew Operations Panel.

Astronaut training is provided through the JSC Astronaut Training Office and NASA's associated training programs, such as the Mission Control Center, NASA Kennedy Space Center, and the Payload Operations Center at Marshall Space Flight Center. Candidates attend classes in science and technology, mathematics, geology, astronomy, navigation, oceanography, orbital dynamics, physics, interstellar research and development, materials and spacecraft systems. Also, they receive training in land and sea survival training, SCUBA diving, spacesuits, life support systems and procedures, and extravehicular activity. They are trained in a wide variety of flight simulators, and exposed to hypobaric and hyperbaric atmospheric pressures. In addition, using a modified KC-135 jet aircraft, candidates are given many exposures to weightlessness. They maintain their flying proficiency and build up jet aircraft hours in T-38 jets, and also practice Orbiter landings in the Shuttle training aircraft and propulsion control systems.

Training is provided in single systems trainers (SST) for the operation of Orbiter subsystems and mission checklists. Training is also provided in the Shuttle Mission Simulator (SMT) for shuttle vehicle operations and systems tasks associated with the major flight phases of relaunch, ascent, orbit operations, entry and landing, payload operations, retrieval, and rendezvous.

Centrifuges and other motion simulators, and fixed base simulators, are used in training for flight phases and specific payload operations, and digital image generation for out-the-window scenes and missions. The motion base simulated crew stations are used to train pilots and commanders in the mission phases of launch, descent, and landing. Motion systems sometimes provide 6-degree-of-freedom motion cues which also allow the flight deck to be rotated to simulate lift-off and ascent.

Astronauts receive training in the Shuttle Mission Simulators (SMS) using generic training software, When assigned to a flight mission, they train on a flight simulator with flight-specific software.They also train with flight controllers in the Mission Control Center (MCC). SMS and MCC are linked by computer in the same way the Orbiter and MCC are linked during an actual mission. The astronauts and flight controllers learn teamwork, solving problems and working nominal and contingency mission time lines.

cont. "Astronaut" pg. 3

NASA travel grants available

The Gerald A. Soffen Memorial Fund 2003 Travel Grant opportunity for undergraduate and graduate students studying in fields of space science and engineering.The $500 grants enable student recipients to attend professional meetings to present research. Application deadline is November 15, 2003.

Application materials are located at: www.nasa-academy.org/soffen Questions may be sent to: travelgrant@nasa-academy.org

KSGC members / affiliates display at EAA AirVenture

The Ad Astra Kansas News and Exploration Place Museum were present at the EAA AirVenture event in Oshkosh, Wis., this past July thanks to their new status as affiliates of the Kansas Space Grant Consortium

A longtime exhibitor at the airshow, which featured 11,000 aircraft, the KSGC displayed materials from its members and affiliates, and reminded visitors of Kansas' place in aviation history. A multi-university staff of volunteers manned the booth. Materials given out for all ages ranged from the Ad Astra Kansas News to over 1,000 NASA comic books. The main types of organizations making up KSGC membership and affiliates are educational institutions, museums and industries. The KSGC sponsors scientific programs, competitions and events statewide.

Space flight notables present at Wichita Aviation Festival

When over 75,000 turned out for Wichita's Aviation Festival Sept.18-21, they had a chance to rub elbows with some real star trekkers.

A lecture for the public was given by Gene Cernan, the last man on the moon. Workshops were given by former astronaut Charles "Sam" Gemar, former Russian mission control specialist Dr. Alexandre Martynov and cosmonaut Yuri Usachev, who has been in six space walks. On display was NASA's Future of Flight Exhibit, hosted by the Kansas Cosmosphere and Space Center. NASA also provided a live message from ISS ALPHA.

The Aviation Festival is part of a year-long recognition of the centennial of flight and Wichita's history as the "air capitol" of the U.S.. Since 1921, Kansas companies have built more than 70 percent of the world's general aviation aircraft--a statistic still accurate today.

Looking Ahead...

October

22-25 Ntl. Council of Space Grant Directors annual fall meeting, Wichita

22-26 KCSC and NASA -sponsored **Advanced Teachers and Space Houston Trip.** 1-800-397-0330 teresa@cosmo.org

November

1 Ad Astra Kansas Day 2004 planning meeting, NIAR at WSU. 620-669-8558

13-14 Global Education and Internet2 Days at WSU Hughes Metroplex. Dr. Bob Ballard, discoverer of the sunken Titanic, will talk on the JASON Project, which enables students, via satellite, to do field studies camparing their local environment with that of another part of the world.

13-16 Annual KCAE 4-H Aviation / Space Encampment, Cosmosphere and State Fairgrounds, Hutchinson 785-234-8948

15KCAE Meeting, 10 a.m. at KCSC, Hutchinson. 785-234-8948

17-8 KCSC Robotics in the Classroom In-service for grades 4-12. Only $25 for Kansas teachers thanks to funding by the KSGC. 1-800-397-0330

Scientific role models needed

Would you like to be a hero? Scientist role models are needed to provide inspiration for the 2004 AD ASTRA KANSAS DAY poster contest to be held for grades 4-6. To inspire youth for this activity, age-appropriate material focusing on six Kansas scientists will be made available to teachers.

Because this year's theme will be "SUPER SLEUTHS—Researching for the Stars" we are looking for scientists in the areas of astronomy, chemistry, geography, physics, aerospace engineering (technology) and life science.

We are hoping for a diverse group of scientists so all Kansas youth can find role models in our project. To volunteer or ask questions, call 620-669-8558 or e-mail steinj@ourtownusa.net Sponsored by the Ad Astra Kansas Initiative.

Gemini 6 and 10 in Hutchinson

HUTCHINSON--Two flown Gemini 6 and 10 spacecraft are on display and undergoing restoration at the Kansas Cosmosphere and Space Center through the end of the year. Starting October 13, restoration can be seen live at www.cosmo.org/restoration. Upon restoration the Gemini 10 will remain at KSCS on long-term loan from the Smithsonian, whereas the Gemini 6 will be sent to Oklahoma City.Well known for its space artifact restoration work, KCSC craftsmen have done over 100 projects in the past 20 years, the most famous being the Apollo 13 module and the Liberty Bell 7.

Correction: *Last spring's issue incorrectly stated that the ULTRA technology telescope proposal involved three Kansas universities. In fact, the University of Kansas is working with San Diego State and Dartmouth College on this. JS*

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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.

Mars

Sept. 3, 2003
1:55 a.m.

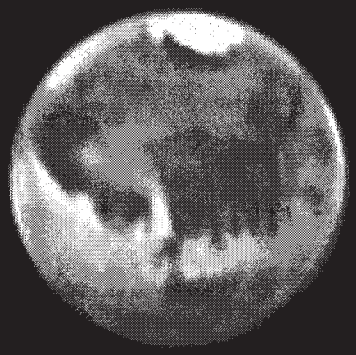

Photo courtesy of KU alum David Kolb, Kansas City, is a composite of 2059 frames.

AVIATION

"Ice Particle Trajectory Program," $27,352, M. Papadakis and J. Tan, WSU Dept. of Aerospace Eng., Aircraft Design and Manufacturing Center (ADMRC) funding 2-03 316-978-5936 michael.papadakis@wichita.edu

"Robust Control of Passive and Non-Passive Aerospace Systems," $31,345, David A. Pacey, KSU Dept. of Mechanical and Nuclear Engineering. NSF funded 11-02. pacey@ksu.edu 785-532-210

"Vortex Dynamic Mechanisms and Innovative Modeling of Aerodynamic Noise Generation in Slats," $39,375, Zhonquan Zheng, KSU Dept. of Mechanical and Nuclear Engineering. NASA funding awarded 1-03. zzheng@ksu.edu 785-532-6132

BIOTECHNOLOGY

"BioSentinels: Biology-Based Microfluidic Reporter Technology for Monitoring Environmental Stressors," $40,000,Christopher Culbertson, KSU Dept. of Chemistry. Funding awarded by NASA 5-03. culbertson@ksu.edu 785-532-6685

"Development of a Microfluidics Package for on a KC-135 Flight at NASA JSC," $50,000, Christopher Culbertson, KSU Dept. of Chemistry. Funding awarded 4-03 by U.S. Dept. of Energy. culbert@ksu.edu 785-532-6685

ENERGY

"Creation of an Enhanced Geothermal System Through Hydraulic and Thermal Stimulation," $46,000, Daniel Swenson, KSU Dept. of Mechanical and Nuclear Engineering. Funding awarded 6-03 by the U.S. Dept. of Energy swenson@ksu.edu 785-532-2320

INFORMATION TECHNOLOGY

"Hardware and Software Evaluation, Development and Testing Supporting a New Generation Computer for Airborne and Space Applications," $46,000 Dwight Day and John Devore, KSU Dept. Electrical /Computer Engineering. Dept. of Energy funding 5-03. day@ksu.edu 785-532-4660

"ITR/SI+AP, Mobil Sensor Web for Polar Ice Sheet Measurement," $102,500. Sivaprasad Gogineni, Arvin Agah, Christopher Allen, David Braaten, Victor Frost, Glenn Prescott, Constantinos Tsatsoulis, KU Dept of Electrical and Computer Eng. NASA Goddard Space Flight Center funding 2-03. 785-864-8800

"High Performance Wireless Communications Systems Using Multiple Antennae Arrays and Efficient Source-Channel Coding Schemes," $79,986, S. Jayaweera and K. Namuduri, WSU Dept. of Electrical and Computer Eng., NASA/ KNEP funding awarded incrementally 3-03 sudharman.jayaweera@wichita.edu 316-978-6320

Fully Integrated, Switchless T/R Module for SAR Applications," $24,793, William B. Kuhn, KSU Dept. of Electrical and Computer Engineering. NASA funding awarded 5-03 wkuhn@ksu.edu 785-532-4649

"Remote" cont.

systems. KU flew two radars, an ice penetrating and a newly-developed snow accumulation radar.

Seawinds is a scanning scatterometer on the Japanese Earth Observing Satellite 2 concerned with wind measurement for weather prediction purposes. ITTC scientists are charged with developing algorithms to sort through data clutter caused by various atmospheric conditions to get to the pure data.

It is exciting to work on the cutting edge in so many areas of remote sensing. "We owe a great deal of gratitude to NASA and the NSF because a lot of the work we've done for Kansas and others around the world is a result of their support," says Price.

MANUFACTURING and ADVANCED MATERIALS

"Chemical Analysis of Nacelle Composites," $80,000, Dennis Burns, WSU Dept. of Chemistry. Boeing Commercial Airplane funding awarded 3-03. 316-978-3120 dennis.burns@wichita.edu

"Gelatin in Aerosols: Non-Mean-Field Aggregation Kinetics," $90,000, Christopher Sorenson and Amitabha Chakrabarti, KSU Dept. of Physics. Funded by NASA in 3-03. sor@ksu.edu 785-532-1626

"High Temperature Adhesives for Application to Aerocapture," $65,000, C. Yang, WSU Dept. of Mechanical Engineering. NASA funding awarded 4-03. 316-978-6312 charles.yang@wichita.edu

"Stiffness and Strength of Polymer Network and Carbon Nanotube Reinforced Polymer Network," $51,316, Youqi Wang, KSU Dept. of Mechanical and Nuclear Engineering. NASA funding 1-03. youqi@ksu.edu 785-532-7181

Sources: WSU Office of Research Adm., KSU Research and Sponsored Programs and KU Research Award Listings

"Astronaut" cont.

Part-task trainers are also used.The Neutral Buoyancy Laboratory (NBL) provides controller neutral buoyancy operations in the facility water tank to simulate the zero-g or weightless condition. The facility provides important pre-flight training in becoming familiar with planned crew activities and dynamics of body motion under weightlessness.

There are also several full-scale mockups.They are used for onboard systems orientation and habitability training in which astronauts practice meal preparation, equipment stowage, trash management, use of cameras, experiment familiarization, emergency egress training, emergency pad egress, and bailout operations. The manipulator development facility is a full-scale mockup of the payload bay with full-scale hydraulically operated RNS, the mechanical arm on the Orbiter which is used to move payloads in and out of the payload bay, and to practice deploying and reberthing of payloads into the orbiter.

Pilots training for a specific mission receive intensive instruction in Orbiter approach and landing in Shuttle Training Aircraft (STA), which are Gulf stream business jets modified to perform like the Orbiter during landing. Assigned pilots receive about 100 hours of STA training prior to a flight. In between training sessions, crews keep up-to-date on the status of the spacecraft and payloads for their assigned mission. Also, they study flight rules and flight data file procedures, and participate in mission-related technical meetings. They also participate in test and checkout activities at the NASA Kennedy Space Center, train in their assigned spaces flights and add to their space flight knowledge base.

Astronauts who participate in the Russian Space Station MIR program receive Russian language training before transferring to the Yuri Gagarin Cosmonaut Training Center for 13 months, then return to JSC to train for final preparation.

For an application package write to the Astronaut Selection Office, Mail Code AHX, Johnson Space Center, Houston, TX 77058-3696

Interstellar R&D

Ad Astra Kansas News

*This "Interstellar R&D" fourth-time feature in this **Ad Astra Kansas News** fourth 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 millenium'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, Jennifer Valcov*

OBSERVATION

Cosmic Rays

High-energy "particles and high-energy light that bombard the Earth from *anywhere* beyond its atmosphere are known as cosmic rays," according to NASA. Galactic cosmic rays, coming from outside the solar system and / or galaxy; anomalous cosmic rays, from interstellar space at the edge of the heliopause, and solar cosmic rays from solar flares and other energetic solar events, hit the Earth from every different direction in space with a wide range of energies up to 10^{20} electron volts. Such ultra high energy particles can be created only by astrophysical phenomena which are investigated as to their origin and composition by scientists worldwide.

Cosmic rays were discovered in 1912 by Austrian physicist Victor Hess, who later received the Nobel Prize in Physics for the work involving high-altitude balloon research. Colliding with neutrons and other particles in Earth's atmosphere, high-speed mostly proton cosmic rays produce an "air shower" of many secondary particles such as meson, pions, muons, photons, etc, which arrive and can be detected and measured on Earth's surface. Cosmic rays may affect upper atmosphere weather and individuals involved in high-altitude airflight.

Advanced research is ongoing at The Institute for Cosmic Ray Research (University of Tokyo), the International Cosmic Ray Observatory at Yangbajing, Tibet (Chinese Academy of Sciences, Tibet University and University of Tokyo), the Utah High Resolution Fly's Eye, Japan Akeno Giant Air Shower Array, the Pierre Auger experiment in Argentina (a collaboration of 250 scientists from 16 nations), and with Europe's Extreme Universe Space Observatory to be mounted on the International Space Station NET 2005. Cosmic ray research from the Moon's surface is expected to have obvious advantages.

COMMUNICATION

Could Dolphins Help Humans Understand Signs of Extraterrestrial Intelligence?

Could an ability to decifer communication patterns of dolphins or other animals one day help humans in the search for extraterrestrial intelligence? Some SETI researchers think it might. Dr. Laurance Doyle, a Principal Investigator at the SETI Institute has analyzed dolphin whistles for patterns of complexity and found they are as complex as human speech — a sign of intelligence. He believes that this analysis may also be applied to signals detected from space to help distinguish between truly purposeful communication and inconsequential space noise.

Another SETI researcher, Dr. Lori Marino, is examining the relationship between brain size and body weight across several species to help determine whether evolution of intelligence is a common process, environmentally linked and driven by natural selection, or whether it is a random phenomenon. An understanding of how intelligence arises on Earth may help researchers uncover just how likely it is for intelligence to arise elsewhere in the universe.

TRANSPORTATION

Solar Sails

In his 1963 short story "Sunjammers," Arthur C. Clarke wrote about solar sail "yachts" participating in a race around the Moon. Today the solar sail idea is getting closer to making the leap from science fiction to fact as several experts, including Clarke, suggest it is a valid method for inter stellar travel. Propellled by sunlight, these gigantic, yet gossamer-thin sails would travel through space due to photons from the Sun hitting their reflective surfaces and exerting enough force to give the sails gentle push. Although the acceleration rate is small (acceleration for a typical sail could be five ten-thousandths meter per second per second),over time the cumulative effect would lead to a speed of 16,000 km per hour after 100 days or 160,000 km per hour in 3 years. At that speed a craft would be able to reach Pluto in less than 5 years.

In a conversation in Astrobiology Magazine, physicist Freeman Dyson, Planetary Society Chairman Bruce Murray and Executive Director Louis Friedman all speak in favor of the Cosmos 1 solar sail project being sponsored by the Planetary Society and Cosmos Studios, a media company headed by Carl Sagan's widow Ann Druyan. The Cosmos 1 project recently completed a major launch readiness milestone in August 2003 as the Russian Volna Launch vehicle successfully passed a test of the entire launch sequence using an engineering model of the solar sail payload. Cosmos 1 is expected to launch from a nuclear submarine in the Barents Sea between October 2003 and Spring 2004.

Another group looking at solar sails is Team Encounter LLC, which has just been awarded $6.5 million from NASA to fly the Inertial Stellar Compass navigation device on Team Encounter's Flight One solar sail demonstration launch set for 2005. The demonstration will be followed by the first official launch projected for 2007 aboard an Ariane 5 rocket. Dubbed "Humanity's First Starship" the craft will carry messages, drawings, photographs, and biological signatures (hair samples) submitted by up to 4.5 million people.

Interstellar transportation research received a blow recently when budget cuts stalled funding for NASA's Breakthrough Propulsion Physics project led by Marc Millis at Glenn Research Center. On a brighter note however is the 11 September notice that NASA Marshall Space Flight Center is soliciting industry partners in a solar sail flight validation experiment as part of NASA Space Technology 9 New Millennium Program.

211 E. 2nd
Hutchinson, KS 67501