

AD ASTRA KANSAS NEWS

PROMOTING HIGH TECH /SPACE TECH
R&D IN KANSAS

Spring 2002

Vol. 1, No. 1

Kansas Cosmosphere and Space Center has stellar mission

The Kansas Cosmosphere and Space Center aptly illustrates where looking to the stars can lead. In 1962, science lover Patty Carey spearheaded the opening of Kansas' first public planetarium, the Hutchinson Planetarium, in an empty corner of the Kansas State Fairgrounds poultry building.

Forty years later, this humble project has evolved into the 105,000 square-foot, internationally-known Kansas Cosmosphere and Space Center on the Hutchinson Community College campus. Now one of the world's premier space museums, it houses the most significant collection of American space artifacts outside of the National Air and Space Museum, also the largest collection of Russian space artifacts in the Western world.

Last year 285,000 visited this affiliate of the Smithsonian Institution. Almost 33,000 Kansas students made field trips. KCSC received the U.S. Space Foundation's 2000 Education Achievement Award for outstanding work in K-12 education. KCSC has at least five age-appropriate space camps available, including the Future Astronaut Training Program and the Elderhostel Astronaut Training Program, both nationally recognized. Also, the long-standing teacher workshops are funded in part by the Kansas Space Grant Consortium.

Restoration is another facet. Using technology specifically developed by craftsmen at the Cosmosphere 20 years ago, more than 100 major replication and restoration projects have been done. Best known is restoration of the Apollo 13 command module "Odyssey" and of Gus Grissom's 1961 Liberty Bell 7 spacecraft, recovered from the Atlantic in 1999.

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Kansas has high-tech hopes in 21st century

Kansans have always looked to the future.

Adopted in 1861, our state seal's glowing vistas envision agriculture, commerce and wealth. With feet firmly planted on Kansas soil at the brink of the Civil War, U.S. Senator John Ingalls proposed our inspiring state motto, "Ad astra per aspera," or "To the stars through difficulties." Assuredly, he looked upward for Divine guidance and toward dreams of prosperity and peace for our new state.

The 20th century brought new, even literal facets to the motto. Flight began in Kansas in 1910, birthing a new industry. Clyde Tombaugh discovered Pluto in 1930. Astronauts Ron Evans, Apollo 17; Joe Engle, Space Shuttle Columbia STS 2; also Steve Hawley, who deployed the Hubble Space Telescope from the Space Shuttle Discovery--all blasted Kansans into a new frontier.

Technology is the new frontier of the 21st century, with society and economy revolving increasingly around it. The 2001 Kansas legislature passed the KAN-ED network bill, authorizing a high-speed Internet connection to link schools, libraries and hospitals statewide for long-distance learning. In January, Kansas tied with Illinois for first place as a leader in information technology in a report issued by the national Progress and Freedom Federation and the Center for Digital Government.

Our state, long recognizing the importance of emerging technology in economic development, established the non-profit Kansas Technology Enterprise Corporation (KTEC) in 1987, its mission "to create and grow Kansas enterprises through technological innovation." KTEC works in research, investment and business assistance areas, ably overseen by administrators such as Kevin Carr, VP of Investment & Commercialization.

In the research field, KTEC has designated five Kansas Centers of Excellence, each dealing with an important area of Kansas technology. These are:

★ **Advance Manufacturing Institute (AMI)**, Kansas State University, Brad Kramer 785-532-6329 ami@ksu.edu

★ **Higuchi Biosciences Center (HBC)**, University of Kansas, Charles Decedue 785-864-5183 decedue@ku.edu

★ **Information and Telecommunication Technology Center (ITTC)**, University of Kansas Tim Johnson 785-864-4896 johnson@ittc.ukans.edu

★ **Kansas Polymer Research Center (KPRC)**, Pittsburg State, Phil Halstead 620-235-9425 jhalstea@pittstate.edu

★ **National Institute for Aviation Research (NIAR)**, Wichita State University, Gerald Loper 316-978-6427 gerald.loper@wichita.edu

KTEC also participates in the Experimental Program to Stimulate Competitive Research (EPSCoR), matching federal dollars in six areas, to boost research in Kansas, and provides direct investment to companies statewide for applied engineering or scientific research.

Kansas has three research colleges. Kansas State University, Manhattan, received total research awards of \$84 million in fiscal year 2001

At the University of Kansas, Lawrence, for fiscal year 2001, \$156.5 million was funded in the science, engineering, research and development areas alone.

Wichita State University's fiscal year 2001 awards for research, training and service reached \$25.6 million, up 20 percent from 2000. Research projects in science, engineering and mathematics accounted for 44 percent of '01 grant/contract funding.

Other regents colleges which participate in research are Emporia State, Pittsburg State and Fort Hays State universities.

This newsletter has a vision of a Kansas on the forefront of high-tech and space research and education--*a Kansas known nationally and internationally as the "Ad Astra" state.*

You are cordially invited to an
AD ASTRA INITIATIVE Open Statewide Meeting

Saturday, May 4, 2002 at the

Kansas Cosmosphere and Space Center

1100 N. Plum, Hutchinson, Kansas,

in the Boardroom, 2nd floor, from 10 a.m. to 12 noon.

Topic: Discussion of Ad Astra Kansas News and Ad Astra initiatives past, present and future.

Contact information found on page 2

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- 2 High-Tech and Space Research Projects in Kansas
- 3 Space Serendipities and Spinoffs
- 4 Interstellar R & D

The following listing is the first installment in an ongoing reference directory featuring representative research projects in Kansas. Part of this newsletter's 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.

AVIATION

"An Integrated Computational Tool for Hypersonic Flow Simulations," \$29,347, Klaus Hoffmann, WSU Dept of Aerospace Engineering. KTEC funding extended to 3/31/03. 316-978-6327

"Development of Three-Dimensional Braiding Process for Aircraft Structural Components," \$150,000, Youqi Wang and Prakash Krishnaswami, KSU Advanced Manufacturing Institute, Funded by ADMRC, 8/1/99-12/31/02. 785-532-7181 youqi@ksu.edu

"Damage Tolerance of Composite Sandwich Airframe Structures, Phase III, Stage C," \$150,000, John Tomblin, WSU Dept. of Aerospace Engineering. Thin gage facesheets bonded to honeycomb aluminum or syntactic foam cores increase bending rigidity without adding extra weight. FAA funding extended to 3/16/03. 316-978-5234 john.tomblin@wichita.edu

"Evaluation of Jet Fuel as Rocket Propellants," \$5,500, Ray Taghavi, KU Dept. of Aerospace Engineering. Awarded by NASA-Glenn Research Center, 7/01. 785-864-2973 rtaghavi@ukans.edu

BIOTECHNOLOGY

Lack of gravity causes dysfunction in living things. Studying organisms' reactions to microgravity helps scientists understand the effects and apply this knowledge on earth.

"Water Purification Project Involving Nano-Particles." Nano-particles are a unique purifier of blue/green algae, a problem with groundwater on earth. Research by BioServe Space Technologies, KSU; George Marchin, BioServe research affiliate, KSU Dept. of Biology. Sponsor Nanoscale Materials, Inc., Manhattan, Kansas. Ongoing project began in 2001. 785-532-6635 gmarchin@ksu.edu

"Lignin Production in Plants," a project to examine genetics components of arabidosis plant, is scheduled to go up on ISS 9A in Aug. 2002, in a plant growth chamber built by BioServe Space Technologies, KSU. Co-investigator: BioServe research affiliate Judith Roe, KSU Division of Biology. Funded by a consortium of the USDA and commercial sponsors. 785-532-3174 jroe@ksu.edu

"Gene Expression Assay Development to Assess Plant Pathogen Acceptability During Spaceflight." Lead:

Jan Leach, KSU Dept. of Plant Pathology. Funded by NASA EPSCoR, extended to 9/02. 785-532-1367 jleach@ksu.edu

"Neural Crest Development in Micro-Gravity." Lead: Gary Conrad, KSU Dept. of Biology. Studies how neural crest cells, necessary for normal development of the heart and cornea, are impacted by microgravity. Funded by NASA EPSCoR, extended to 9/02. 785-532-6662 gwconrad@ksu.edu

"Immune Response Gene Control of Host Defense." Lead: Stephen K. Chapes, KSU Dept. of Biology. Study of the impact of microgravity on the development of infectious disease, especially lung infection, in animals. NASA EPSCoR funding extended to 9/02. 785-532-6795 skcbiol@ksu.edu

"Investigation of Changes in Red Blood Cell Membrane Properties Associated with Exposure to Microgravity." Lead: Dr. David Saunders, ESU Dept. of Biological Sciences, NASA EPSCoR award. 620-341-5610 saunderd@emporia.edu

"Differentiation of Bone Marrow Macrophages in Space," \$337,293, Lead: Stephen K. Chapes, KSU Dept of Biology. NASA EPSCoR funding extended to 9/02. 785-532-6795 skcbiol@ksu.edu

INFORMATION TECHNOLOGY

Remote sensing uses electromagnetic waves to produce surface, subsurface and atmospheric imaging.

"Architecture for Space-Based Internets," \$362,000, Joseph Evans and Gary Minden, KU Dept. of Electrical Engineering and Computer Science-ITTC. NASA award, 8/01/00-8/01/03 785-864-4830 evans@eecs.ukans.edu

Aviation Navigation Software, named Anywhere Map, uses global positioning technology to give general aviation pilots access to navigation technology usually only available to commercial aircraft. KTEC Applied Research Manufacturing Fund (ARMF) award of \$100,000 to Control Vision Corp., Pittsburg. 800-290-1160

"Remote Sensing of Kansas Rural Environments," \$55,000, Doug Goodin, KSU Dept. of Geography. Funded by NASA EPSCoR, extended until 12-31-02. 785-532-3411 dgoodin@ksu.edu

"Hyspire: Hyper Resolution Remote Sensing of Kansas Rural Environments," \$716,000, Doug Goodin, KSU Dept. of Geography; Kevin Price, KARS; James Aber, ESU Dept. of Earth Science. Three-year grant awarded 12/01 by NASA

EPSCoR will focus on smaller area, greater detail than the previous study. 785-532-3411 dgoodin@ksu.edu

"Development and Evaluation of a Range-Gated Step-Frequency Radar," \$60,000, Sivaprasad Gogineni, KU Dept. of Electrical Engineering and Computer Science-ITTC. Awarded by NASA-Jet Propulsion Laboratory, 4/01. 785-864-8800 pgogineni@ukans.edu

"Landsat 7 Satellite Imagery Database," \$57,500, Lead: Jerry Whistler, KU Dept of Kansas Applied Remote Sensing (KARS). KU, Lawrence campus, is a NASA Center of Excellence in environmental remote sensing. Project awarded by the Kansas Geographic Information Systems (GIS) Policy Board, 8/01. 785-864-3107 whistler@ku.edu

"Development of a Hybrid RF/Laser Radar," \$150,886, Christopher Allen and Sivaprasad Gogineni, KU Dept. of Electrical Engineering and Computer Science-ITTC. Awarded by NASA-Langley Research Center, 3/01. 785-864-8801 callen@eec.ukans.edu

MANUFACTURING and ADVANCED MATERIALS

"Studies of the Role of Surface Treatment and Sizing Of Carbon Fiber Surfaces on the Mechanical Properties of Composites Containing Carbon Fibers," \$159,186. Lead: Peter Sherwood, KSU Dept. of Chemistry. Carbon materials are useful for high-temp applications because they keep strength and stiffness above 2,500 degrees K. NASA/EPSCoR funding extended to 9/02. 785-532-6689 escachem@ksu.edu

"Role of the Filler Wire Compositions in Crack Nucleation and Propagation of Aluminum-Lithium 2195 Alloys Welds," \$99,652, Jorge Talia, WSU Dept. of Mechanical Engineering, NASA/Marshall Space Flight Center grant extended to 7/17/02. 316-978-6343 talia@me.twsu.edu

"Project #24, High-Speed Friction Stir Welding," \$54,899, George Talia, WSU Dept of Mechanical Engineering. Funded by Aircraft Design & Manufacturing Research Center (ADMRC), 1/01/02-12/31/02. 316-978-6343 talia@me.twsu.edu

"Mechanical Performance and Quantitative Nondestructive Evaluation of Textile Composites," Richard Hale, KU Dept. of Aerospace engineering; Youqi Wang, KSU Dept. of Mechanical and Nuclear Engineering FY01, Kansas NSF EPSCoR. 785-864-2949 rhale@ukans.edu

ENERGY

"Mixed-Metal, Multielectron Photocatalysts for Solar Energy," \$112,000, D. Paul Rillema, WSU Dept. of Chemistry, Dept. of Energy funding extended until 3/31/02. 316-978-3120 Paul.Rillema@wichita.edu

"Cost Effective Solar Power in the Heartland." \$25,000, Gale Simons, KSU Dept of Engineering. Kansas Corporation Commission funding awarded 11/01. simons@ksu.edu

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Space serendipities and spinoffs enhance life quality on earth

by Dr. Randall Chambers, Ph.D

Accomplishment of space flight missions and their primary objectives includes many spinoffs, discoveries, and serendipities which benefit medical technology, industrial productivity and manufacturing, commerce, development, and education. Frequently, these are unexpected innovations which bring space technology back to earth and enhance life quality.

There have been many space spinoffs, serendipities, and technology transfers, especially from the Apollo, Shuttle and Skylab programs. Examples in health and medical technology include CAT scanners and magnetic resonance imaging--developed from the computer-enhanced lunar photo technology of Apollo. Also, cardiovascular conditioners--developed through biomedical engineering and exercises in space--are used in athletic rehabilitation centers.

Examples in industrial productivity and manufacturing include cordless re-chargeable power tools and appliances, magnetic liquids, welding sensor systems, microlasers, advanced welding torches, improved engine lubricants, magnetic bearing systems, and robotics. For industrial use, surface enhancement synergistic coatings were developed from a process used in Apollo for bonding dry lubricants to metals. Apollo and Skylab spacecraft offered developments in water purification, cooling towers, and filtering systems. Insulation barriers made from aluminum foil, propylene and mylar, for protecting astronauts and delicate instruments from radiation and other hazards, are widely used to protect humans in surface and air transportation. Vacuum metalizing techniques developed for space led to many applications in commercial products, insulated garments, wrappings, and reflectors in earth-bound systems.

Other space flight contributions improve lives through biomedical engineering and medical technology: improvements in cardiac pacemakers, longer-life battery technology, space fuel pump technology for miniaturized ventricular heart pumps and insulin pumps for precise control, improved kidney dialysis machines, portable blood-pressure cuffs and quick blood pressure recorders.

The protection of satellites from space debris offered scratch-resistant lenses for eyeglasses. Another serendipity is the medical and dental use of nitinol, a medical alloy which springs back into shape following tight contortion. The technologies for remote programming and interrogation for control of devices provided major benefits with electronic pain-control devices, miniature components inside the body like heart pacemakers.

Technology transfers from space have extended the capabilities to ground-based systems such as an advanced eye tracker

Kansas Cosmosphere cont. from page 1

Cosmosphere-built, museum-quality replicas were used in the Academy award-winning movie "Apollo 13" and in HBO's "From the Earth to the Moon."

For exhibition purposes, Cosmosphere clients include the National Air and Space Museum, Washington, D.C.; The Museum of Flight, Seattle; Olympic Cultural Center, Seoul, Korea; Pacific Space Center, Vancouver, BC.; Newsday, Inc. and Cradle of Aviation Museum, both of New York.

Corporate clients include Universal Studios and Dream Works, of California; and Johnson Engineering/NASA and The Cernan Corporation, both of Houston.

system, prosthetic master molds, and selectively lockable knee braces. Environmental and resource management spinoffs include microspheres for environmental control, environmental sensing devices, solar energy, satellite scanning systems which monitor and map forestation; wind and water monitoring systems; telemetry systems for commercial communications; radiation insulation and fire resistant materials.

NASA spinoffs in health/ medicine include laser angioplasty, digital imaging biopsy systems, ultrasound skin damage assessment, teleoperator, voice-control and robotics to operate facilities and instruments.

Public safety has use of radiation, noise, and other hazard detectors, and the development of emergency response robotics. There are a large number of transportation spinoffs: advanced lubricants; energy storage systems; new wing designs for corporate jets; improved aircraft engines; advanced de-icing technology; and air purification systems.

Scientists, engineers, industry and product-users have collaborated in making significant contributions to everyday lives. The serendipities and spinoffs from space exploration, examples of the application of advanced technology and industrial productivity, are expressions of special benefits

and high-tech hopes for Ad Astra Kansas in the 21st century.

Find information in NASA's Fact Sheets on Spinoffs from website <http://ntrn.hq.nasa.gov/success.index.html>. Also, NASA's Commercial Technology Network, NASA's Assistive Technology Office, and Office of Commercial Technology provide detailed information. Other sources are the National Space Society at <http://www.nss.org/>; and the American Institute of Aeronautics and Astronautics at <http://www.aiaa.org>.

Research cont. from page 2

ASTRONOMY

"Low Temperature Opacities: Astrophysical Research & Curriculum Development," \$61,830, Jason Ferguson, WSU Dept of Physics. Funded NSF/EPSCOR, 2/01/01-1/31/02. 316-978-3018 jason.ferguson@wichita.edu

"The Bulls-Eye Effect as a Probe of the Mass Density of the Universe," \$100,290, Adrian Melott, KU Dept of Physics and Astronomy. Extended by NSF, 3/01. 785-864-3037 melott@ku.edu

"Validation of AMSR-E and AMSU/HSB Level 1 Brightness Temperatures and Level 2 Cloud and Precipitation Parameters...", Ralf Bennartz, KU Dept. of Physics and Astronomy. Awarded by NASA-Goddard Space Flight Center, 9/01. 785-864-3949 bennartz@ukans.edu

"Spectroscopic Properties of (Sub) Stellar Objects," \$76,100, David Alexander, WSU Dept. of Physics. Ongoing funding by NASA/Goddard Space Flight, 316-978-3988 dra@twsumv.uc.twsu.edu

"Solar Wind Interaction with Non-Magnetic Planets," \$60,568, Thomas Cravens, KU Dept. of Physics and Astronomy. Awarded by NSF-Geosciences, 7/01. 785-864-4739 cravens@ku.edu

KANSAS ASTRONOMY ORGANIZATIONS

- ★ Astronomy Associates of Lawrence, 785-842-8426 gkweb@sunflower.com
- ★ Kansas Astronomical Observers, Wichita. <http://home.kscable.com/thekao/thaidai@kscable.com>
- ★ Kansas Astrophotographers and Observers Society, Kansas City area, 913-888-7744 cosmos21@swbell.net
- ★ Northeast Kansas Amateur Astronomers League, Topeka. <http://www.nekaal.org>
- ★ Northwest Kansas Astronomical Society, Goodland. 785-899-2053 kansasnightlife@hotmail.com
- ★ Salina Astronomy Club, Salina. 785-827-6004 k2r2@kscable.com

KANSAS SPACE ORGANIZATIONS

- ★ Kansas Organization for Space Modeling, Wichita. National Rocketry Society Section #427. 316-733-4804
- ★ Wichita Chapter of the National Space Society. 316-684-2614 randall.chambers@wichita.edu

EDUCATION

Special programs or opportunities in the sciences

★ Future Astronaut Training Program, Kansas Cosmosphere and Space Center. In its 18th year, this nationally recognized, week-long program for grades 7-10 includes space flight simulations, shuttle crew exercises, virtual spacewalks, g-force training in a centrifuge and more. Jody Gilley 620-662-2305 800-397-0330

★ Kansas High School Business Plan Competition. Teams write and present a business plan in the technology, science or engineering field. State competition April 20 sponsored by KTEC and the Youth Entrepreneurs of Kansas (YEK). 785-296-5272 ktec@ktec.com

★ Kansas Science Olympiad. Over 2,000 middle and high schoolers competed statewide April 6. Sponsored by the Fairmount Center for Math and Science Education, WSU. Greg Novacek 316-978-3854 greg.novacek@wichita.edu

★ The JASON Project. As a classroom project, grades 5-9 spend a semester studying an expedition location (recently Alaska) while doing local field studies. Culmination is a live interactive satellite relay between oceanographer/archeologist Robert Ballard at the expedition site and local students who compare the two sets of data. Amy Strong, 316-978-6503, Fairmount Center for Math and Science Education, WSU.

Interstellar R&D

Ad Astra Kansas News

This "Interstellar R&D" first-time feature of this **Ad Astra Kansas News** first issue begins 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

Observation is the first point of contact between our world and its neighboring star systems.

Ground-Based Observatories

To get the most out of ground based observing, a high-altitude site that can limit interference from the atmosphere is needed.

★ Mauna Kea, Hawaii, whose summit is located at 4,206 m, is home to 13 telescopes. Major scopes include the Kecks 1 and 2, 10 m mirrors and adaptive optics, Gemini North 8.1 m, uses infrared technology to penetrate gas clouds, and Japan's Subaru 8.2 m.

★ In Chile, European Southern Observatory owns 627 km² at La Silla mtn at 2,400m. 9 of 18 scopes are in current use. ESO also operates facilities at Paranal, 2,635 m atop Cerro Paranal. Cerro Tololo Inter-American Observatory, east of La Serena at 2,200 m, operates 4 scopes. The int'l operated - Gemini South is located nearby, 2,737 m atop Cerro Pachón.

★ The Indian Astronomical Observatory, in Hanle, open in 2001, sits at 4,517 m, making it the world's highest observatory for optical/infrared/submillimeter observing.

★ Tibet's ARGO International Cosmic Ray Observatory at Yangbajing is located at 4,300m.

Space-Based Observatories

To really escape the effects of light and radio wave interference one must leave Earth entirely.

★ Hubble Space Telescope: Launched 24 April 1990 aboard Space Shuttle *Discovery*, orbits Earth at 612 km altitude. The mission, which cost \$2.2 billion at launch, may last 20 years. HST has enriched our scientific knowledge and awed us with its beautiful images of distant galaxies and stars.

★ Chandra X-Ray Observatory: Launched 23 July 1999 by Space Shuttle *Columbia* to observe X-rays from high energy regions of the universe, such as the remnants of exploded stars. Chandra is expected to stay aloft for 25-50 years, though the scientific mission will last only 15 years.

★ SIRTf, the Space Infrared Telescope Facility, scheduled to launch from KSC 9 January 2003. 2.5-year mission to obtain images and spectra by detecting the infrared energy radiated by objects in space between wavelengths of 3 and 180 microns. Most of this infrared radiation is blocked by the Earth's atmosphere and cannot be observed from the ground

★ NGST, the Next Generation Space Telescope, scheduled for launch in 2009, will replace HST for a 5-10 year mission to explore the origins of the universe. It is expected to cost \$1 billion to manufacture and \$2 billion to operate.

Moon-Based Observatories

An international lunar-based observatory / science facility is proposed by several researchers like David Schunk and Paul Lowman as an optimal location for work that cannot be done from Earth. Ongoing projects and efforts continue to push for this development.

COMMUNICATION

The SETI Institute, located in Mountain View CA, was founded in 1984 by Thomas Pierson and Dr. Jill Tarter to study the origin, nature, and distribution of life in the universe. Board members have included Dr. Carl Sagan and current Chairman Dr. Frank Drake. *Project Phoenix*, led by astronomer Seth Shostak, uses the 305 m radio scope in Arecibo, Puerto Rico to listen for signals of intelligent life. SETI@home allows people to donate computing time on their PCs to help the search. The Allen Telescope Array, now being constructed near Mt Lassen in CA, will soon let SETI listen for signals of life 24 hours a day.

TRANSPORTATION

"Interest and commitment to humanity's greatest adventure meets the new decade with a wave of growth unmatched since the nuclear-power interstellar scenarios of the 1950s and '60s" —*From Space Calendar, December 2000 / January 2001*

Now a year later, new NASA Administrator Sean O'Keefe introduces a breakthrough 21st century space nuclear power research and development program — \$1 billion over the next 3 years.

In February 2002, another instance of the renaissance of interest in interstellar travel is the widespread attention given the discussion by Dr. Geoffrey Landis, Glenn RC, of multi-generational space travel at the AAAS meeting in Boston.

NASA now operates programs established by the end of the 1990s:

★ The Interstellar Propulsion Research Center, Marshall SFC, Huntsville; Les Johnson, anti-matter

★ New Millennium Program Interstellar Probe / Gossamer Spacecraft / Interstellar Trailblazer, JPL, Pasadena, Sarah Gavit, solar microwave, laser

★ Breakthrough Propulsion Physics, Glenn RC, Cleveland ; Marc Millis, Gravity modification and quantum teleportation

★ Advanced Space Transportation Program; Gary Lyles, Glen Mucklow; Institute of Advanced Concepts, Robert Casano

Internationally, 21st century interstellar R&D is progressing in St. Petersburg, Russia (wormholes), Japan (BESS anti-matter project), and Germany's Max Planck Institute. Other promising interstellar transportation initiatives include Mini-Magnetospheric Plasma Propulsion, Robert Winglee, Univ of Washington; and the work of 'October Sky Rocket Boy' Homer H. Hickham, who sees "fusion, fission, anti-matter opening the entire solar system"; then magnetospheric plasma, laser propulsion to follow our Pioneers and Voyagers ... to the Stars.