Experimental Program to Stimulate Competitive Research (EPSCoR)
Administered by Office of Education, NASA

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PROJECT DESCRIPTION

Public Law 102-58, passed in 1992, authorized NASA to initiate NASA EPSCoR to strengthen the research capability of jurisdictions that have not in the past participated equably in competitive aerospace research activities.

The twenty-eight jurisdictions currently eligible to participate are Alabama, Alaska, Arkansas, Delaware, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, the Commonwealth of Puerto Rico, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, West Virginia, and Wyoming.

The goal of NASA EPSCoR is to provide seed funding that will enable jurisdictions to develop an academic research enterprise directed toward long-term, self-sustaining, nationally-competitive capabilities in aerospace and aerospace-related research. This capability will, in turn, contribute to the jurisdiction's economic viability and expand the nation's base for aerospace research and development. Since its inception, NASA EPSCoR has been closely linked to the National Space Grant College and Fellowship Program (Space Grant).

PROJECT GOALS

The specific objectives of NASA EPSCoR are to:

- Contribute to and promote the development of research capability in NASA EPSCoR jurisdictions in areas of strategic importance to the NASA mission;
- Improve the capabilities of the NASA EPSCoR jurisdictions to gain support from sources outside the NASA EPSCoR program;
- Develop partnerships between NASA research assets, academic institutions, and industry;
- Contribute to the overall research infrastructure, science and technology capabilities, higher education, and economic development of the jurisdiction; and
- Work in close coordination with the Space Grant consortium in the jurisdiction to improve the environment for science, technology, engineering and mathematics (STEM) education.

PROJECT BENEFIT TO OUTCOME (1, 2, OR 3)

EPSCoR directly supports Outcome 1, which comprises five Objectives. EPSCoR directly contributes to Objectives 1.1 and 1.5 and may also contribute to Objectives 1.2, 1.3, and 1.4.

- **Objective 1.1 – Faculty and Research Support:** Provide NASA competency-building education and research opportunities for faculty, researchers, and post-doctoral fellows.
- **Objective 1.5 -- Targeted Institution Research and Academic Infrastructure:** Improve the ability of targeted institutions to compete for NASA research and development work.

The two main components of NASA EPSCoR are:

-- Research Infrastructure Development (RID)
The RID Cooperative Agreements enable jurisdictions to build and strengthen relationships with NASA researchers. The RID has a three-year base period of performance with a potential single, two-year renewable period of performance. Awards are $125,000 per year. A one-to-one cost-sharing (cash or in-kind) is required for every NASA dollar awarded. The most recent RID was announced and awarded in 2007. NASA intends to announce the RID opportunity every three to five years, pending funding availability.

-- Research
The Research Cooperative Agreements address topic-specific, high-priority NASA research and technology development needs. Awards are up to $750,000 for a three-year performance period. Awards are required to provide cost-sharing, the percentage of which may vary from year to year. NASA intends to announce the EPSCoR CAN for Research Awards yearly, pending funding availability.

PROJECT ACCOMPLISHMENTS in 2009-2010
(all data are self-reported by the Principal Investigators)

EPSCoR Research Infrastructure Development Cooperative Agreements

Cooperative Agreements Reporting	26
Faculty/Post-docs	277
Students	376
Peer Reviewed Publications Accepted / Published	122
Other Publications Accepted / Published	67
Talks/Presentations at Professional Meetings	287
Collaborations (NASA)	102
Collaborations (Other)	228
Number of New Grants Awarded	84
Value of New Grants Awarded	$18,837,864

2007 Research Awards Year 3 Reports (does not include Project Final Reports)

Cooperative Agreements Reporting	15
Faculty/Post-docs	107
Students	150
Peer Reviewed Publications Accepted / Published	62
Other Publications Accepted / Published	85
Talks/Presentations at Professional Meetings	142
Collaborations (NASA)	18
Collaborations (Other)	61
Number of New Grants Awarded	34
Value of New Grants Awarded	$25,683,796

2008 Research Awards Year 2 Reports

Cooperative Agreements Reporting	11
Faculty/Post-docs	57
Students	111
Peer Reviewed Publications Accepted / Published	44
Other Publications Accepted / Published	34
Number of Talks/Presentations at Professional Meetings	82
Collaborations (NASA)	26
Collaborations (Other)	44
Number of New Grants Awarded	27
Value of New Grants Awarded	$12,094,967

2009 Research Awards Year 1 Reports

Cooperative Agreements Reporting	28
Faculty/Post-docs	146
Students	177
Peer Reviewed Publications Accepted / Published	72
Other Publications Accepted / Published	50
Number of Talks/Presentations at Professional Meetings	147
Collaborations (NASA)	42
Collaborations (Other)	102
Number of New Grants Awarded	52
Value of New Grants Awarded	$14,233,057

PROJECT CONTRIBUTIONS TO PART MEASURES

The data below are a list of the number of different institutions that participate in Office of Education projects, including Space Grant, the Minority University Research and Education Program (MUREP), and the Graduate Student Researcher Project (GSRP), in those states served by EPSCoR.

State	Institutions	State	Institutions
Alabama	4	Nevada	5
Alaska	5	New Hampshire	5
Arkansas	17	New Mexico	8
Delaware	6	North Dakota	11
Hawaii	12	Oklahoma	10
Idaho	9	Puerto Rico	5
Iowa	5	Rhode Island	7
Kansas	10	South Carolina	11
Kentucky	6	South Dakota	10
Louisiana	8	Tennessee	10
Maine	6	Utah	3
Mississippi	8	Vermont	6
Montana	16	West Virginia	12
Nebraska	13	Wyoming	6
		Total	**234**

This table shows the amount of the awards and the match provided by the jurisdictions in the two EPSCoR Programs in FY2010:

EPSCoR 2010 Awards and Cost-Share

	Award	**Cost-Share**	**Total**
RID FY 10	$6,525,000	$6,719,999	$13,244,999
Research FY10	$16,682,378	$9,600,602	$26,282,980
Totals	**$23,207,378**	**$16,320,601**	**$39,527,979**

PROJECT PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

NASA science and engineering personnel are associated with all EPSCoR Research Cooperative Agreements. Each Research cooperative agreement is assigned a Technical Monitor (TM) who provides guidance and technical advice, reviews annual reports, and provides feedback to the EPSCoR staff. These TM's, most of whom are located at NASA Centers, are nominated by the Education Liaison of the appropriate Mission Directorate.

Examples of benefits in addition to the accomplishment of the research objectives -

Arkansas:
Research PI Dr. Gary Anderson at the University of Arkansas at Little Rock and Co-Research PI Dr. Edmond Wilson at Harding University have worked together for almost 15 years. They have enhanced this particular research project by adding Dr. Charles Wu from Harding University and Dr. Cang Ye from the University of Arkansas at Little Rock. These team members have traveled to each campus to setup a stable foundation for "Mobile Surveying for Atmospheric and Near-Surface Biosignature Gases." A second collaboration is reconnecting with the only NASA contracted company in the state, BEI Systems and Space Division. Dr Murray Clark, a former UALR student, is adding commercial elements and concerns to the research. The third collaboration is not a new one, but has been strengthened. That is the work between the Program office, ASTA and other state science agencies

Nebraska:
Significant NASA collaborations have evolved as a result of the different projects at this jurisdiction. For example, the project "Miniature In Vivo Surgical Robotics for Long-Term Space Flight" has established important relationship with one of the technical project manager – Brian Wilcox of the Jet Propulsion Laboratory (JPL). A student working on this project (Tyler Wortman) will perform work in Mr. Wilcox's group at JPL during the summer at 2010. Also, significant contacts have been made with Dr. David Baumann, Dr. Sharmila Watkins, and Dr. Carla Guidry, flight medical doctors and designers at NASA's Johnson Space Flight Center and NASA Ames. These are entirely new contacts.

This project has also strengthened collaboration between the University of Nebraska-Lincoln and the University of Nebraska Medical Center where Dr. Dmitry Oleynikov is a Co-Investigator.

For the period of 09/30/09 – 09/29/2010, UNL and UNMC received $1,350,000 follow-on funding from NASA under the title "Supporting Surgical Options in Space."

Kansas:
Wichita State University and Hawker Beechcraft Corporation are investigating resilient aircraft flight control systems that adapt to unanticipated failures occurring during flight. Wichita State University's unique role has been to investigate applying this DoD and NASA technology to general aviation. This project significantly expands the general aviation research into a full flight test demonstration of Calise's methods on the Hawker Beechcraft Corporation CJ-144 NASA SATS fly-by-wire testbed, and an exploration of the real-time capabilities of Balakrishnan's adaptive critic methods. (PI: Nhan Nguyen).

Interaction with NASA has been at the NASA Aviation Safety conference in November, 2009, and a WebEx with NASA IRAC project personnel in February 2010. Five graduate students and 2 undergraduate students were involved in this project. Three of these graduate students and 1 undergraduate are interning at NASA centers this summer and fall. Two publications were accepted for the AIAA GNC conference in August 2010.

Vermont:
As a result of the dramatically reduced size, nanosats will require unique and miniaturized propulsion and control systems to provide the extremely low levels of thrust/impulse necessary for orbital maneuvering and precise station-keeping. MEMS-based propulsion systems and MEMS-based thruster concepts are being developed because they offer the capability of effectively miniaturizing designs. This technology will potentially positively impact the aerospace and electronics industries in Vermont.

New Mexico:
The goal of "New Mexico Solar and Stellar Seismology" is to build the infrastructure needed for New Mexico to become nationally competitive for funding in the fields of solar and stellar seismology. These are two of the quickest growing research areas of astrophysics because they provide essential information about the structure of the Sun and other stars that has never before been available. No other university-based effort currently exists within the country that targets these areas. Project goals are tied to NASA Strategic Goal 3B "Understand the Sun and its effect on Earth and the solar system" and its space-weather focused "Living With a Star" program. The importance of these research areas is reflected in the number of major current and future NASA space missions devoted to them. These include the Solar and Heliospheric Observatory (SOHO), the NASA Solar Dynamics Observatory (SDO), and the Kepler mission. This NASA EPSCoR proposal leverages the scientific talent within the state by forming a partnership among scientists at New Mexico State University (NMSU), the University of New Mexico (UNM), Los Alamos National Laboratory (LANL), the National Solar Observatory (NSO), and the Air Force Research Laboratory Center for Excellence in Space Weather (AFRL). Our NASA center partner is the Goddard Space Flight Center (GSFC). In accord with the EPSCoR goal of creating infrastructure, two new tenure-track faculty members with expertise in the project research areas will be hired at NMSU. Currently, very few university faculty members in New Mexico have expertise in solar and stellar seismology. These new faculty members will provide a nucleus around which state-wide proposals will be developed. This group will also lead state efforts to increase collaborations with our partner institutes.

Specific NASA EPSCoR objectives addressed by this effort include:
1) Developing the research infrastructure of solar and stellar seismology among New Mexico's universities (NMSU, UNM), national laboratories (LANL, NSO, AFRL) and the New Mexico Space Grant Program

2) Establish self-sustainability from sources such as the NSF, NASA, and the AFRL
3) Strengthen ties between New Mexico and out-of-state NASA centers through increased scientific collaborations
4) Contribute to the NASA Education Strategic Coordination Framework by increasing the number of under-represented students in astronomy, by providing faculty and students with research support, and through targeted investments in the state's academic infrastructure.

South Carolina:
The "Development of Rapid Cycle Pressure Swing Adsorption Oxygen Concentrators for Extraterrestrial Applications" goal is to design a new onboard medical life support system to deliver oxygen to crewmembers on an emergency basis. It will meet NASA's needs in terms of low volume, mass, and power consumption. The project will improve the performance limits of a state-of-the-art medical oxygen concentrator developed by SeQual for land-based use by exploring the use of new adsorbent materials.

The project is clearly important to NASA. But, it also presents a unique opportunity to keep a very productive team of researchers from two different EPSCoR states (SC and TN) working together with the teams at the MSFC and SeQual, located in San Diego. The two faculty members from SC and TN have a long history of working with NASA. Professor LeVan has worked with NASA ARC and NASA MSFC for 15 years. Professor Ritter's research has been funded by NASA for the last five years. However, Professors Ritter and LeVan have never had the opportunity to work with NASA on a potential piece of flight hardware at a high TRL. This EPSCoR award will lead to other opportunities with NASA to develop flight hardware in the area of life support. It is expected to create opportunities in TN and SC for more interactions with NASA personnel on system level designs. The expectation is that funding opportunities will arise outside of the NASA EPSCoR domain to provide increased opportunities for these interactions. It is the hope of the investigators that this EPSCoR award will increase opportunities for other sources of such support with NASA and other federal agencies including DoD.

West Virginia:
This research program, "Aerodynamic Flow Control with Stimulus-Responsive Smart Skins for Tunable Dynamic Roughness," is investigating a novel flow control methodology for boundary layer management of external flows through application of a smart skin that generates dynamic roughness for flow control. The work involves the development of smart skins, an investigation of the capability of dynamic roughness for various flow control scenarios, and application of smart skins to several practical problems facing the aerodynamic community. The smart skins will be developed by embedding solid liquid crystal polymer rods in a variety of polymer films; the rods are actuated based on a small electrical stimulus which perturbs the solid film to generate dynamic

surface roughness. The dynamic roughness will be applied to both steady leading edge separation as well as unsteady separation such as dynamic stall on a rotor blade. The primary goal is to use these smart skins to delay or eliminate flow separation. The work will also perform a preliminary investigation into extending the dynamic roughness smart skins to address transition control.

The project uses an integrated multi-disciplinary approach which brings together the fields of materials and aerodynamics. A majority of the work is being conducted at West Virginia University (WVU), though we have teamed with a faculty from Iowa State University to incorporate the theoretical aerodynamics aspect.