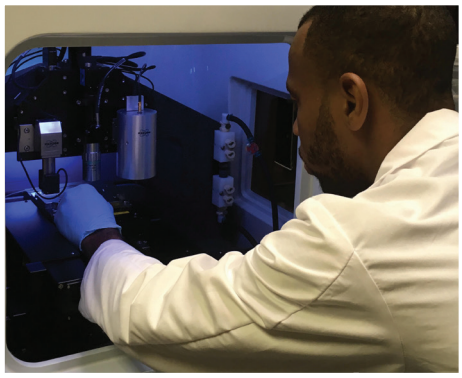
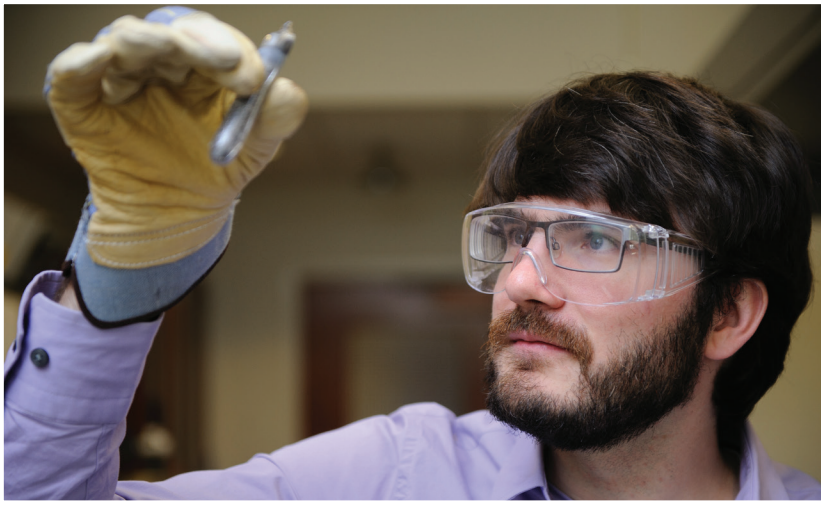
2017 – 2018
Annual Report to the Alabama Commission on Higher Education





Alabama EPSCoR
December 2018

NSF EPSCoR works to develop a stronger science and technology base, increase geographic distribution of research and technology resources, strengthen and expand education and training opportunities in science, engineering, mathematics, and technology, and increase opportunities for women and minorities.

DOE EPSCoR supports collaborative research programs of importance to state priorities, develops partnership programs with federal labs, supports young investigators, and links the State's diverse and dispersed technological communities, institutions and industries involved in Energy Research and Development.

NASA EPSCoR seeks to effect a permanent increase in the national competitiveness of a jurisdiction's basic programs in targeted aeronautics and space research areas: remote sensing for improved crop production, nanotechnology materials, and smart sensor arrays.

USDA EPSCoR works to increase the amount of agricultural research at academic institutions in the state through identification of critical issues facing agriculture today, stimulating the development of collaborative networks across the state and providing resources and funding.

The NIH Institutional Development Award (IDeA) program broadens the geographic distribution of NIH funding for biomedical research. Alabama is currently ineligible for IDeA funding.

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TO THE ALABAMA COMMISSION ON HIGHER EDUCATION

Alabama EPSCoR, Established Program to Stimulate Competitive Research, is dedicated to the advancement of economic development via scientific and engineering research through a collaborative effort among the State's research universities. The focus of activities is designed to attract and retain distinguished scientists and researchers for Alabama; to develop new cutting-edge technologies and high-tech industry; and to stimulate state competitiveness in medicine, biotechnology, engineering, and other applied sciences. Three major achievements stand out for 2018 - Alabama State University joining the family of ALEPSCoR institutions; NSF Day held at UAB on May 1, 2018; and the development and launch of a searchable research capabilities map/database for the eight university research institutions, Southern Research and HudsonAlpha on the Alabama EPSCoR web site at https://alepscor.org/.

The Research Capabilities Interactive Map/Database outlines Alabama expertise by each of eleven state research priorities including: Advanced Manufacturing, Agricultural Products/Food Production, Biosciences/ Biotechnology, Chemical/Petrochemical, Energy, Forestry Products, Information Technology and Cybersecurity, Metal and Advanced Materials, Nanotechnology, Plasma Sciences, and Transportation. Our hope is that this resource will be used by economic developers to show the great wealth and depth of expertise in our state and by researchers to locate knowledgeable collaborators.

Major awards for 2017-2018 include the FY17, $20M NSF EPSCoR Research Infrastructure Improvement (RII) Track 1 research award entitled, CPU2AL: *Connecting the Plasma Universe to Plasma Technology in Alabama* led by Dr. Gary Zank at UAH and includes researchers at AAMU, AU, ASU, TU, UA, UAB and Huntsville's Oakwood University. This research award is accompanied by eight new NSF EPSCoR RII Track 4 awards begun during FY17 and 18; eight new NSF FY17 Co-funded awards and seventeen new FY18 NSF Co-funded awards; four new DOE EPSCoR awards; a new NASA EPSCoR Cooperative Agreement Notice (CAN) award; and a portion of a NSF EPSCoR RII Track 2 collaborative project with the University of South Carolina. The new FY18 awards will bring an expected $7.5M into the state over the next few years. Research expenditures during FY18 neared $15.5M.

State support for the ALEPSCoR program during FY 2018 included $343K for administration and nearly $766K for the Graduate Research Scholars Program (GRSP). The GRSP has supported over 280 graduate students since 2006, leading to 58 Master's degrees and 176 Ph.D. degrees as of December 2018. During the fall of 2018, 35 students were awarded GRSP funding in Round Thirteen, 20 are new awardees. More information regarding the GRSP can be found in Volume 11 of the GRSP Booklet published December 2018.

The ALEPSCoR program continues to be a valuable contributor to scientific and engineering infrastructure, research capabilities, education, and economic development across the state. We look forward to continued investment for a stronger, more prosperous Alabama. We encourage you to review some of the many exciting EPSCoR research projects making an impact in our state.

Respectfully,

Chris Brown, PhD
Chair, Alabama EPSCoR Steering Committee
Vice-President for Research
University of Alabama at Birmingham

Christopher M. Lawson, PhD
Executive Director, Alabama EPSCoR
Chair, Coalition of EPSCoR States
Professor, Department of Physics
University of Alabama at Birmingham

OVERVIEW & HIGHLIGHTS

The Established Program to Stimulate Competitive Research (EPSCoR), originally named *Experimental* Program to Stimulate Competitive Research was started by the National Science Foundation (NSF) in 1978 when Congress authorized the agency to create a new program in response to broad public concerns about the extent of geographical concentration of federal funding of research and development (R&D). Eligibility for EPSCoR participation is limited to those jurisdictions that historically received lesser amounts of federal R&D funding and demonstrated a commitment to develop their research bases and to improve the quality of science, technology and engineering research conducted at their universities and colleges.

The success of the NSF EPSCoR program during the 1980s subsequently prompted the creation of EPSCoR and EPSCoR-like programs that currently exist in four other federal agencies: the Department of Energy (DOE), the U.S. Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), and the largest of all, the National Institutes of Health (NIH).

The mission of EPSCoR was originally designed to meet the NSF statutory function **"to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education."** During FY 2018, ALEPSCoR was eligible to receive new awards through EPSCoR programs associated with NSF, DOE, and NASA. While ALEPSCoR has ongoing projects supported by the USDA AFRI/FASE program, we became ineligible for new awards in 2016. Alabama is also ineligible for the NIH EPSCoR-like program called IDeA or the Institutional Development Award.

EPSCoR GOALS

- To provide strategic programs and opportunities for EPSCoR participants that stimulate sustainable improvements in their R&D capacity and competitiveness.
- To advance science and engineering capabilities in EPSCoR jurisdictions for discovery, innovation and overall knowledge-based prosperity.

EPSCoR OBJECTIVES

- To catalyze key research themes and related activities within and among EPSCoR jurisdictions that empower knowledge generation, dissemination and application.
- To activate effective jurisdictional and regional collaborations among academic, government and private sector stakeholders that advance scientific research, promote innovation and provide multiple societal benefits.
- To broaden participation in science and engineering by institutions, organizations and people within and among EPSCoR jurisdictions.
- To use EPSCoR for development, implementation and evaluation of future programmatic experiments that motivate positive change and progression.

OVERVIEW & HIGHLIGHTS

ALEPSCoR Specific Goals

- Increase R&D funding in Alabama to the national level.
- Increase competitiveness of all research institutions in the state by measured publications, patents, research faculty, research equipment, etc.
- Increase minority and under-represented group participation.
- Develop industry-government-university partnerships to contribute to technology development and economic growth in Alabama.
- Increase effectiveness of EPSCoR programs.

ALEPSCoR Plan for Achieving Goals

- Develop a coordinated plan for research within the state and aid in the development of consistent plans for each agency.
- Provide guidance in conducting competitions, where possible.
- Select programs which have the greatest potential for achieving national competitiveness and determine the resources required to reach that potential.
- Use strengths and focus areas identified in the review and selection process.
- Function as a liaison with the Alabama Commission on Higher Education.
- Participate in EPSCoR Foundation and Coalition activities, as well as other groups that have impact on federal funding agencies.

ALEPSCoR is a consortium of academic, government, and industrial organizations established in 1985. The core ALEPSCoR academic institutions in Alabama include the eight Ph.D. granting research universities: Alabama A&M University, Alabama State University, Auburn University, University of Alabama, University of Alabama at Birmingham, University of Alabama in Huntsville, Tuskegee University, and the University of South Alabama. Other academic institutions participate in and benefit from program activities through satellite or outreach efforts and NSF Co-funding.

The primary goal of the consortium is to establish the infrastructure needed to increase sustained national science and technology research competitiveness. This goal is accomplished by:

1. Supporting research clusters based on current Alabama research strengths.
2. Carefully planning major equipment purchases that significantly increase state capabilities.
3. Facilitating the hire of new faculty and research personnel in targeted areas.
4. Broadening participation of students in research cluster-related science and engineering fields.
5. Linking these clusters with higher education, government agencies, and the private sector.

2017-2018 Alabama EPSCoR Notable Achievements

- In 2018, ALEPSCoR launched a searchable research capabilities database available at https://alepscor.org/
- Alabama State University became an AL EPSCoR institution in May 2018
- Over 245 attendees and 15 Program Managers participated in NSF Day hosted May 1, 2018
- In September 2017, Alabama EPSCoR was awarded a $20M (projected total award) NSF RII Track 1 entitled, *CPU2AL: Connecting the Plasma Universe to Plasma Technology in Alabama*, led by Dr. Gary Zank at the University of Alabama in Huntsville. This grant will last until August 2022 and include research work at UAH, AAMU, ASU, AU, TU, UA, UAB, UAH, USA and Oakwood University in Huntsville
- GRSP funded 35 students in Round 13 with 20 new awardees starting August 2018
- Research expenditures exceeded $14.6 M in FY2017 and $15.4M in FY2018
- New EPSCoR awards exceeded $27.9M in FY2017 and $7.5 in FY2018
- In FY 2017, Alabama researchers were awarded three new NSF RII Track 4 awards, the recipients include Drs. Ryan Summers, (UA); Ryan Littlefield, (USA), and Cheng-Chien Chen of UAB. Auburn PIs Wendy Hood and Andreas Kavazis were awarded a portion of a NSF RII Track 2 award with the University of South Carolina at Columbia as the lead institution
- Five NSF FY18 Track 4 award recipients include one at UA that begins September 1, 2018 while the other four began October 1, 2018 (FY19). The recipients include: Vishesh Vikas (UA); both Scott Glabermann and Saeed Latif at USA, Kannatassen Appavoo (UAB), and Jeffrey Krause of the Marine Environmental Sciences Consortium at Dauphin Island Sea Lab
- New NSF Co-funded awards exceeded $2.9M in FY 2017 and $6.7M in FY 2018. Fourteen new NSF Co-funded awards began during FY18 while three NSF Co-funded awards won't begin until FY 2019.
- Alabama DOE EPSCoR recieved four new FY17 awards which includes two Early Career awards. Early Career award recipients are Dr. Jared Allred at The University of Alabama and Dr. Steven Mansoorabadi at Auburn University. Auburn University PIs Eduardus Duin and Guillaume Laurent recieved the other two DOE EPSCoR FY17 awards
- In May 2018, Science PI Claudia Mewes along with Science Co-PIs Tim Mewes and Greg Thompson at UA began the NASA FY18 CAN (Cooperative Agreement Notice) Award entitled, *Micro-Magnetic Driven Design for Multi-Component Magnetic Alloys for Advanced Electric Propulsion.* Dr. Dale Thomas, UAH NASA EPSCoR Agency Director serves as the managing PI for the project
- Alabama EPSCoR welcomed Dr. Paul Mohr as the Alabama Commission on Higher Education's representative following the retirement of Dr. Elizabeth French. Dr. French was a long-time member of the Alabama EPSCoR Steering Committee and witnessed the program's growth from the time Alabama became eligible for NSF EPSCoR to the present
- AL NASA EPSCoR ranks in the top third of NASA EPSCoR jurisdictions for awards over the past 20 years, over $11M has been awarded to Alabama NASA EPSCoR since 1994 and over $10.6 M of non-EPSCoR research dollars have been awarded since 1994 to graduates of Alabama NASA EPSCoR

OVERVIEW & HIGHLIGHTS

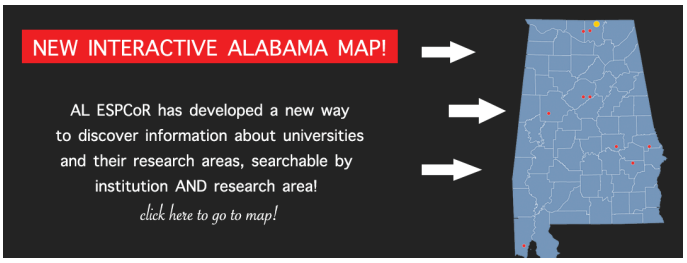
The ALEPSCoR program is dedicated to the advancement of economic development via scientific and engineering research through a collaborative effort among the State's research universities. The focus of activities is designed to attract and retain distinguished scientists and researchers for Alabama; to develop new cutting-edge technologies, companies and opportunities; and to stimulate state competitiveness in medicine, biotechnology, engineering, plasma science, mathematics and other applied sciences.

ALEPSCoR seeks to increase Research and Development (R&D) competitiveness through the development and utilization of science and technology resources residing in Alabama's major research universities. It strives to achieve its objectives by stimulating sustainable infrastructure improvements at the state and institutional levels that significantly increase the ability of ALEPSCoR researchers to compete for federal and private sector R&D funding, and accelerate the movement of ALEPSCoR researchers and institutions into the mainstream of federal and private sector R&D support.

As a member of the EPSCoR program, Alabama receives federal funds to stimulate nationally competitive research and to increase the ability of its scientists to compete successfully for research funds from NSF and other federal agencies. The ALEPSCoR consortium of academic, government, and industrial organizations supports projects that establish an infrastructure within the state capable of developing and sustaining high-quality science and engineering research and education that can potentially contribute to statewide national competitiveness.

Over the long term, ALEPSCoR is enhancing valuable resources that can influence Alabama's research capacity in the 21st Century. Alabama depends on its colleges and universities to provide well educated workers that leading companies require if they are to compete in a knowledge-based global economy. A highly educated work force is the most critical factor in attracting and retaining the kind of leading companies that bring 21st century jobs to the state.

Increasing Alabama's scientific and technology research competitiveness is critical for the long term economic health of the state. Specifically, ALEPSCoR makes a difference to Alabama through education, outreach, increased diversity, partnerships, infrastructure building, economic benefit/jobs, business opportunities, and a system that encourages graduation and self-sustainability.



ALEPSCoR Develops Research Expertise Searchable Database

In FY 2018, AL EPSCoR, in response to a request by the Department of Commerce, developed a searchable database of research capabilities at Alabama A&M University, Alabama State University, Auburn University, Tuskegee University, University of Alabama, University of Alabama at Birmingham, University of Alabama in Huntsville, University of South Alabama, Southern Research and HudsonAlpha. Eleven research priority areas include: Advanced Manufacturing, Agricultural Products/Food Production, Biosciences/Biotechnology, Chemical/Petrochemical, Energy, Forestry Products, Information Technology and Cybersecurity, Metal and Advanced Materials, Nanotechnology, Plasma Sciences, and Transportation. Searchers on the web site enable one to access a list of research capabilities for each institution or drill down to specific areas within each research priority to discover the depth of research expertise in our state. For more information log onto: https://alepscor.org/

ALEPSCoR NSF Day held May 1, 2018

NSF (National Science Foundation) Day was held May 1, 2018 at the Hill University Center Ballroom on the University of Alabama at Birmingham campus. Fifteen NSF Program Managers representing Geosciences; Engineering; Biological Sciences; Education and Human Resources; Social, Behavioral and Economic Studies; Math and Physical Sciences; Computer and Information Science and Engineering; Office of Integrated Activities (includes EPSCoR); Office of International Science and Engineering; and Budget, Finance, and Award Management provided information on the federal budget and appropriation process; research initiatives and priorities for each Directorate; how to find NSF funding opportunities; NSF proposal submission types; how to develop and write

a proposal; the NSF review merit process and timeline; and reasons for proposal declines. The 245 attendees were from EPSCoR institutions including: Alabama A&M University, Alabama State University, Auburn University, Tuskegee University, University of Alabama, University of Alabama at Birmingham, University of Alabama in Huntsville, University of South Alabama; along with Birmingham Southern College, Samford University, Stillman College, Talladega College, Troy University, the University of West Alabama, and the University of North Alabama. Out of state attendees represented State University of New York, Northeastern University, Georgia State University, and Georgia Southern University.

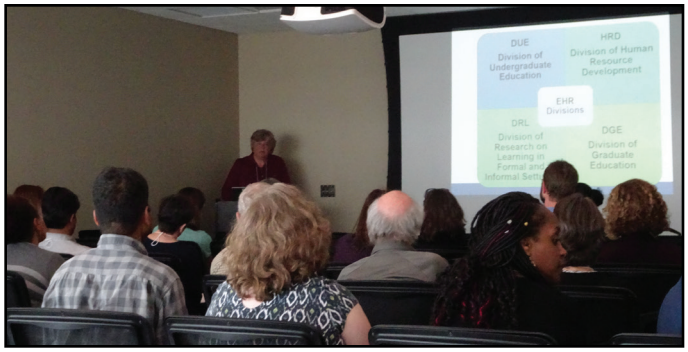
A lunch panel of funded Alabama NSF awardees included Drs. Glen Borchert (USA), Mahesh Hosur (TU), Lori McMahon (UAB), Yohesh Vohra (UAB) and provided an opportunity for attendees to learn more from successful researchers who have been awarded NSF funding. Afternoon activities provided small group gatherings with individual Program Managers to ask specific questions regarding the Directorate's initiatives and the proposal process. In addition, twelve GRSP (AL EPSCoR Graduate Research Scholars Program) awardees exhibited their NSF research.

ALEPSCoR Improves Education

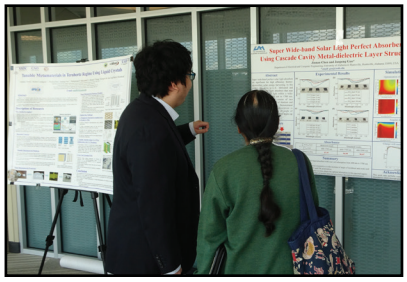
ALEPSCoR makes a difference through the state's colleges and universities, their science and engineering faculty, and students. A primary focus is preparing students for careers in engineering, materials sciences, biological sciences, physics, plasma science, energy, forestry, etc. Through

NSF Day, held May 1, 2018 at UAB, had over 245 attendees with 15 NSF Program Managers available for presentations, discussion and questions

NSF Day Lunch Panel Discussion: (from left to right) Yogesh Vohra (UAB), Mahesh Hosur (TU), Lisa-Joy Zgorski (NSF), Glen Borchert (USA) and Lori McMahon (UAB)



Above and Below: NSF Day afternoon sessions with Program Managers



UAH GRSP Awardee Jinnan Chen discusses his research with NSF EPSCoR Program Director Uma Venkateswaran during the NSF Day Poster exhibit

mandates by NSF and other EPSCoR agencies, a portion of the agency investment goes to promote programs for K-12. Citizens of the state benefit by outreach efforts which includes basic community programs, teacher education opportunities, and development of new science-based curricula. These efforts improve K-12 education without significant investments from the state.

ALEPSCoR Encourages Partnerships

ALEPSCoR cooperates with state leaders in government, higher education, and business to establish productive, long-term partnerships between universities, colleges, K-12 educational institutions, Alabama businesses, and other governmental agencies. These partnerships are designed to stimulate local action resulting in lasting improvements to the state's academic research infrastructure and increased national research and development (R&D) competitiveness.

ALEPSCoR Enhances Infrastructure

Human infrastructure is enriched by opportunities to establish relationships with national laboratories, to use equipment and collaborate with federal researchers, and hiring new faculty in targeted research "growth" areas which enables Alabama to achieve "critical mass" in these high growth research areas. Equipment infrastructure is improved by targeted equipment purchases which enable Alabama researchers to perform research in new cutting-edge technologies.

ALEPSCoR Provides Economic Benefits and Jobs

External EPSCoR funded grants support new faculty hires which provide salary for new research assistant professors, post-doctoral research associates, graduate student stipends and tuition, as well as undergraduate student support. These external grant funds provide jobs for hundreds of people in the state, helping to stimulate the state's economy. By establishing the research infrastructure in the state's targeted areas, Alabama researchers become competitive in obtaining federal non-EPSCoR grant funding. New external grant funds provide an additional economic benefit to the state by providing support for faculty and graduate students.

In FY 2017, Alabama was awarded a $20M NSF RII Track 1 award, a portion of a collaborative NSF RII Track 2 award, four new NSF Track 4 awards, eight new NSF Co-funding awards, four new DOE EPSCoR awards, and a new NASA EPSCoR CAN award. New EPSCoR-related awards exceed $27.6M while research expenditures for ongoing EPSCoR projects during FY 2017 neared $ 14M.

In FY 2018, NSF EPSCoR awarded Alabama researchers five new Research Infrastructure Improvement (RII) Track 4 awards and seventeen new NSF Co-funded awards, several of these will begin Oct.1, 2018 (FY19). Alabama was also awarded a FY18 NASA Cooperative Agreement Notice (CAN) Award. New award totals for FY18 exceed $7.5M while research expenditures for the same period are estimated to be $ 15.5M.

	FY 2017		FY 2018	
EPSCoR Agency	New EPSCoR Related Awards	EPSCoR Related Research Expenditures	New EPSCoR Related Awards	EPSCoR Related Research Expenditures
NSF RII	22,002,759	2,520,742	250,956	5,194,518
NSF Co-Funding	2,907,792	9,423,988	6,787,015	7,819,724
DOE	2,244,661	264,254	0	688,472
NASA	750,000	562,167	750,000	466,333
USDA	0	1,853,466	0	1,287,914
Total	$27,905,212	$14,624,617	$7,537,015	$15,456,961

Alabama EPSCoR Steering Committee

Dr. Chris Brown
Chair, ALEPSCoR Steering Committee

The ALEPSCoR Steering Committee (AESC) is responsible for fiscal and programmatic aspects of ALEPSCoR activities. Members include representatives from eight research institutions, Alabama A&M University, Alabama State University, Auburn University, Tuskegee University, University of Alabama, University of Alabama at Birmingham, University of Alabama in Huntsville and University of South Alabama as well as the Alabama Commission on Higher Education and the Economic Development Partnership of Alabama. Alabama State University became an EPSCoR institution in May 2018.

Dr. Shaik Jeelani
Vice-Chair, ALEPSCoR Steering Committee

In March 2018, Dr. Chris Brown was elected Chair of the Alabama EPSCoR Steering Commitee while Dr. Shaik Jeelani became the Vice-Chair. Dr. Brown serves as the Vice President for Research at the University of Alabama at Birmingham. Dr. Jeelani serves as the Vice President for Research and Sponsored Programs as well as Dean of Graduate Studies at Tuskegee University.

In August 2017, The Alabama EPSCoR Steering Committee amended the Bylaws revising the official name from Alabama Experimental to Established Program to Stimulate Competitive Research, reflecting the revised name enacted at the national level on January 6, 2017 per the American Innovation and Competitiveness Act.

ALEPSCoR Executive Director

Dr. Christopher Lawson has served as ALEPSCoR Executive Director since 2010. He previously served as ALEPSCoR Associate Executive Director from 2007- 2010 and ALEPSCoR Co-Director from 1999-2005. Dr. Lawson is

Alabama EPSCoR Steering Committee

Standing Committee

Dr. Christopher S. Brown
Chair, Alabama EPSCoR Steering Committee (3/2018)
Vice President for Research
University of Alabama at Birmingham

Dr. Paul B. Mohr, Sr.
Proxy for Dr. James Purcell
Director of Special Programs
Alabama Commission on Higher Education

Dr. Shaik Jeelani
Vice-Chair, Alabama EPSCoR Steering Committee (3/2018)
Vice President for Research and Sponsored Programs
Dean of Graduate Studies
Tuskegee University

Dr. Robert (Bob) Lindquist
Interim Vice President for Research and Economic Development
The University of Alabama in Huntsville
Ms. Lynne U. Chronister
Vice President for Research and Economic Development
University of South Alabama

Dr. Daniel Wims
Provost and Vice-President for Academic Affairs
Interim Vice-President for Research
Alabama A&M University

Dr. Jennifer Kerpelman
Interim Vice President for Research
Auburn University

Dr. John C. Higginbotham
Interim Vice President for Research and Economic Development
The University of Alabama

Dr. Christine Thomas
Associate Vice President for Institutional Effectiveness
Alabama State University

Mr. Steve R. Spencer
President, EDPA

Advisory Committee

Angela Till
Deputy Secretary and Proxy for
Greg Canfield, Alabama Department of Commerce

Arthur Tipton, PhD
President and Chief Executive Officer
Southern Research

a Professor of Physics at the University of Alabama at Birmingham, with a research specialty of optical sensing and nonlinear optics, and has published over 70 journal articles and 10 books or book chapters in these areas.

Dr. Chris Lawson

The Executive Director is the chief administrative officer of ALEPSCoR, and is appointed by the AESC. The ALEPSCoR Executive Director has overall responsibility and authority for the day-to-day operation, management and coordination of the ALEPSCoR program. He is responsible for constructing and administering a budget that best serves the needs of all federally funded EPSCoR programs and providing reports to the Alabama Commission for Higher Education, fiscal agent for state funds in support of EPSCoR. He also supervises and administers the state funded Graduate Research Scholars Program (GRSP). The ALEPSCoR State Agency Directors and GRSP Campus Coordinators report to the Executive Director.

In November 2016 Dr. Lawson was elected by the EPSCoR Coalition Board of Directors to serve as Chair of the Coalition of EPSCoR/IDeA States (http:www.epscorideacoaliltion.org). The Coalition is a national, non-profit organization aimed at promoting the importance of a vibrant science and technology enterprise, primarily though improving the university research infrastructure and competitiveness in states that historically have received smaller amounts of federal research and development funding.

As Chair, Dr. Lawson organizes coalition activities including visits with members of Congress, coordinates with federal agencies, and plans annual retreats and conferences. Dr. Lawson, as the face for the Coalition, has provided numerous testimonies to Congress advocating for EPSCoR programs.

An EPSCoR/IDeA Coalition and Foundation Joint Board of Directors Retreat was held in Nevada in July 2017. This meeting was led by Coalition Chair and ALEPSCoR Executive Director Chris Lawson and Foundation Chair and Vice Chancellor for Research at UAMS Larry Cornett. At this retreat, the joint Board members tackled many specific issues such as the future of NSF EPSCoR and NIH IDeA, as well as broader issues, such as how to define research competitiveness in the EPSCoR/IDeA states, how to increase EPSCoR/IDeA representation on agency advisory Boards, national scientific commitees and panels, and finally, how to increase the participation of EPSCoR/IDeA states in SBIR/STTR programs.

Board members have formed working groups to author position papers dealing with a few of the issues discussed at the retreat, to be subsequently shared with the funding relevant agencies, Members of Congress, and of course with the EPSCoR/IDeA community at large.

ALEPSCoR Staff

Charlotte Nix has been with Alabama EPSCoR since 2006 and serves as the Alabama EPSCoR Program Administrator at The University of Alabama. Ms. Nix is responsible for managing the Graduate Research Scholars Program, EPSCoR grant listings, EPSCoR reports, and Steering Committee coordination and communication. Ms. Nix earned her B.S. degree from The University of Alabama in 1980.

Ms. Briauna Perryman graduated from the University of Alabama at Birmingham in 2017 with a degree in Marketing Management and plans to return for her MBA spring 2019. As of October 2017, she diligently serves as the Program Coordinator II for Alabama EPSCoR.

Agency Directors

The ALEPSCoR Agency Directors provide oversight responsibility for the day-to-day operations of federal EPSCoR research programs in Alabama, including responsibility for coordination, notification and supervision of all EPSCoR announcements and awards issued by the federal government. The ALEPSCoR Agency Director is the administrative officer for a designated EPSCoR program in Alabama. He/She is appointed by the ALEPSCoR Steering Committee and is responsible for the administrative functions of the AESC, providing management, coordination and direction of the EPSCoR program in Alabama and for such other duties assigned by the Executive Director and AESC. ALEPSCoR currently has an EPSCoR Agency Director for NSF, DOE, and NASA. Currently, Alabama is not eligible for new awards from USDA AFRI Program.

Alabama NSF EPSCoR State Agency Director

Dr. Gary Zank is the Alabama NSF EPSCoR Agency Director as well as Principal Investigator (PI) on the NSF-EPSCoR RII Track 1 grant entitled, *RII Track-1: CPU2AL: Connecting the Plasma Universe to Plasma Technology in Alabama* headquartered at the University of Alabama in Huntsville. Dr. Zank joined UAH in 2008 and currently serves as Director of the Center for Space Plasma and Aeronomic Research (CSPAR) and Chair of the UAH Department of Space Science. He was elected to the National Academy of Sciences in May 2016. Dr. Zank is currently the only member of the University of Alabama System to be a member of NAS. In recognition of Dr. Zank's global achievements in teaching, research, and innovation, he was recently named Trustee Professor, the highest award for a faculty member in The University of Alabama System.

Dr. Zank earned his BS (1982) and PhD (1987) degrees at the University of Natal, South Africa and did Post-doctoral studies at the Max-Planck-Institut fuer Kernphysik and Max-Planck-Institut fuer Aeronomie (Germany) from 1987-1989 and Bartol Research Institute at the University of Delaware from 1989-1991. His research specialties include space and solar physics, plasma physics, and computational physics. Previous positions include Pei-Ling Chan Chair of Physics-and-Chair, Physics Department, University of Alabama at Huntsville; Chancellor's Professor of Physics and Astronomy, University of California, Riverside and Director, UCR Institute of Geophysics and Planetary Physics (IGPP) -and- System-wide Director, IGPP (July 2001 – June 2008). Dr. Zank can be reached at 256-961-7401 or garyp.zank@gmail.com.

Alabama DOE EPSCoR State Agency Director

Dr. John W. Steadman, P.E, serves as the Alabama Department of Energy (DOE) EPSCoR State Agency Director, the Dean of Engineering at the University of South Alabama, and is a licensed professional engineer. Dr. Steadman previously served as Associate Dean and Head of the Department of Electrical Engineering at the University of Wyoming. He earned B.S. and M.S. degrees in electrical engineering from the University of Wyoming and the PhD degree from Colorado State University. Dr. Steadman was a research engineer for General Dynamics, Convair Division in San Diego, California before joining the faculty at the University of Wyoming and served as a Distinguished Visiting Professor at the United States Air Force Academy.

Dr. Steadman has received several awards, including the IEEE United States Activities Board Citation of Honor, the NCEES Distinguished Service Award with Special Commenation, the Wyoming Engineering Society Outstanding Engineer Award, and the AT&T Foundation Award for Excellence in Teaching. Professor Steadman was appointed to the Board of Registration for Professional Engineers and Professional Land Surveyors in Wyoming by three different governors serving on that board for more than sixteen years. He has also been active in the National Council of Examiners for Engineering and Surveying (NCEES), serving on several of the national committees, as treasurer, and as the national president in 1993-94.

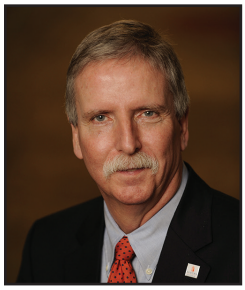
In addition to his engineering education responsibilities, Dr. Steadman was 2004 President of IEEE-USA, Past Chair of the Board of Governors of the Order of the Engineer, and participates in accreditation of engineering programs for ABET. Dr. Steadman is the author of more than 60 journal publications, book chapters and patents. He has been honored with election to Fellow grade in the National Society of Professional Engineers and the American Society for Engineering Education. For more information, contact Dr. Steadman at 251.460.6140 or jsteadman@southalabama.edu.

Alabama NASA EPSCoR State Agency Director

Dr. L. Dale Thomas was appointed as the Alabama Space Grant Director in August 2017. Dr. Thomas currently serves as a Professor and Eminent Scholar of Systems Engineering in the Department of Industrial and Systems Engineering and Engineering Management at the University of Alabama in Huntsville. He teaches system engineering students in the art and science of systems architecture and design, systems integration, test, and verification, and systems management. Dale also serves as director of the Alabama Space Grant Consortium and as deputy director of the UAH Propulsion Research Center.

Prior to his retirement from NASA in July 2015, Dale served as the Associate Center Director (Technical) for the NASA Marshall Space Flight Center (MSFC) in Huntsville, Alabama, providing technical leadership for all MSFC spaceflight projects. For more information, Dr. Thomas can be contacted at 256-824-4243 or dale.thomas@uah.edu.

Alabama USDA EPSCoR State Agency Director



While Alabama is not currently eligible for USDA EPSCoR, Dr. Frank F. (Skip) Bartol served as the Alabama USDA EPSCoR State Agency Director, and is Alumni Professor of Reproductive Biology in the Department of Anatomy, Physiology and Pharmacology, Associate Dean for Research and Graduate Studies, and Interim Director of the Scott-Ritchey Research Center in the College of Veterinary Medicine at Auburn University (AU). Additionally, since its establishment in September 2014, Dr. Bartol serves with Dr. Greg Barsh of the HudsonAlpha Institute for Biotechnology, as co-Director of the HudsonAlpha/Auburn University Center for Comparative Genomics and Translational Research. A member of the AU faculty since 1983, Bartol obtained the BS degree from Virginia Tech and both MS and PhD degrees through the Interdisciplinary Reproductive Biology Program from the University of Florida. Additionally, he obtained advanced training in molecular biology as a Visiting Scientist and Scholar in the Center for Animal Biotechnology at Texas A&M University. In 2005, Bartol was honored by his doctoral alma mater when he was named a Donald Henry Barron Lecturer at the University of Florida in recognition of "outstanding research and scholarly activities in the field of reproductive biology." His research, which focuses on identification of mechanisms regulating development and function of female reproductive tract tissues in domestic ungulates, has been supported by competitive grants from the USDA National Research Initiative, the National Institute of Food and Agriculture (NIFA), the National Science Foundation, and private organizations in the U.S. and abroad, as well as by the Alabama Agricultural Experiment Station. Dr. Bartol served as Panel Manager for the U.S. NIFA Animal Reproduction program in 2014 and 2015. He is an active member of the Society for the Study of Reproduction (SSR), the American Society of Reproductive Immunology (ASRI), and the Society for Theriogenology (SFT), and was elected as an Honorary Member of the Society of Phi Zeta, the honor society of veterinary medicine, for "distinguished service in the advancement of science relating to the animal industry." For more information, contact Dr. Bartol at 334.844.3700 or bartoff@auburn.edu.

GRADUATE RESEARCH SCHOLARS PROGRAM

Graduate students who represent the next generation of researchers and innovators are critical to the advancement of Alabama's high-tech human resource capacity. To assist our institutions of higher education in training this next generation of scientists and engineers, investments are required to attract the brightest and best scholars who will contribute to the state's vision of economic growth and prosperity.

During FY 2018, the Alabama Legislature continued the appropriation to ALEPSCoR through the Alabama Commission on Higher Education for the purpose of funding the GRSP. Since its inception in 2006, the program has funded over 280 exceptional graduate students.

Round Thirteen began in the Fall of 2018 by funding 35 students with 20 new recipients conducting research funded by EPSCoR (Established Program to Stimulate Competitive Research) programs at the National Science Foundation, National Aeronautics and Space Administration, U.S. Department of Agriculture, and the U.S. Department of Energy Office of Science. Of the thirty-five students, thirty (30) are pursuing a PhD while five (5) are working towards a Master's. Students are selected competitively by a team consisting of one campus coordinator from each of the PhD granting institutions in the ALEPSCoR Program. Renewals are granted each year subject to satisfactory progress in a given year and available funding. Alabama State University joined the AL EPSCoR program in May 2018 and will be participating fully in the GRSP during Round Fourteen.

The goal of the ALEPSCoR GRSP is to invest in Alabama universities to expand research output and attract eminent senior faculty and quality graduate students. The program's objective is to provide a highly trained workforce to fuel the growth of high technology companies in Alabama.

The quality of work generated as part of the first twelve funding rounds was both cutting-edge and novel. Encouraged by the success of the program, researchers have leveraged state funds with other research based resources to supplement the GRSP and increase participation in the program. Students whose proposed research or field of study and career interests are congruent with the funded science and technology programs of the NSF, DOE, NASA, USDA at Alabama EPSCoR universities are eligible to apply. The AESC created a GRSP Subcommittee to monitor and continually make revisions to improve the program.

Additional information regarding the GRSP can be found in Volume 11 GRSP Booklet published December 2018.

Auburn GRSP awardee Jafar Orangi (center) wins S&T Open House Ph.D. Physical Sciences poster contest, September 2018. Also pictured (l to r) Carlos Reinhold (NSF Track 1), Shaik Jeelani (TU), along with Uma Venkateswaran and Loretta Moore of NSF EPSCoR.

GRSP Campus Coordinators

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SUMMARY

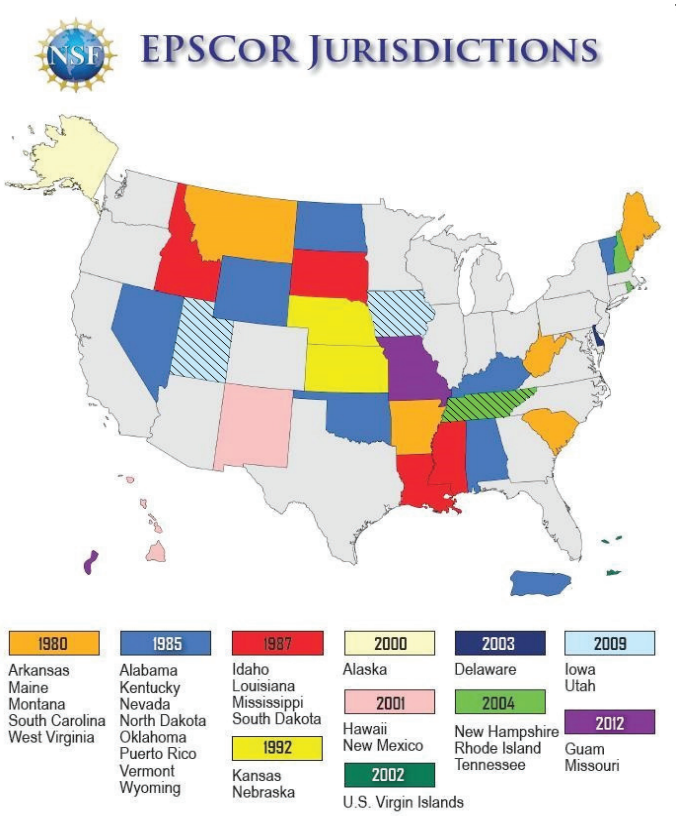
In summary, the Alabama Established Program to Stimulate Competitive Research is dedicated to the development of scientific and engineering capabilities through state research university collaboration. Research performed by our universities represents a substantial industry in Alabama. Activities are designed to attract distinguished scientists, young investigators, and researchers from various fields, fostering economic development through investments that result in cutting-edge technologies and stimulate competitiveness in medicine, biotechnology, engineering, mathematics, and other applied sciences.

Alabama EPSCoR was successful in securing new funding from the NSF, DOE, and NASA during FY2017 and FY2018 Significant state commitment is necessary to sustain the ALEPSCoR activities and to provide concrete evidence to the NSF and other agencies that the State is willing to partially match the large federal research investment in these activities. Continued state support ensures EPSCoR federal funding will continue to be available for our scientists and demonstrates a willingness on the part of the State of Alabama to make a full commitment to building research capabilities to support state economic development. For more information on Alabama EPSCoR programs within the NSF, DOE, USDA, and NASA see the following sections.

NATIONAL SCIENCE FOUNDATION EPSCoR

On January 6, 2017, the American Innovation and Competitive Act, renamed EPSCoR as the Established rather than Experimental Program to Stimulate Competitive Research, revised various program components and included language in support of EPSCoR. The EPSCoR program was designed to fulfull the mandate of the National Science Foundation to promote scientific progress nationwide. The NSF EPSCoR program began in 1978 and is a federal-state partnership designed to help America maintain its global leadership by capitalizing on talents and resources available in all states of the union. The program promotes the intellectual and human development missions of NSF by supporting basic research activities which span a broad range of science, engineering and technology and by supporting training of future scientists and engineers in states where NSF research support is equal to or less than .75 per cent of the total NSF research and related activities budget for the previous three years. The NSF EPSCoR Office is located in the Office of the NSF Director where all EPSCoR awards are made through a rigorous merit review process.

NSF's EPSCoR Program is broadly set up as federal-jurisdiction partnerships. To participate in the program, an eligible jurisdiction is required to form its own EPSCoR steering committee and develop a science and technology (S&T) plan specific to the jurisdictions needs and goals. Each steering committee is expected to undertake "a recent comprehensive analysis of the strengths, barriers, and opportunities for further development of its institutions in support of overall objectives in research, education and innovation." Through these activities, steering committees work closely with partners in academia, government, and the private sector to build statewide networks.



Note: As of FY16 Iowa, Tennessee, and Utah were no longer EPSCoR-eligible

NSF Funding Rates FY 2012-2017

		2012	2013	2014	2015	2016	2017
All NSF Directorates	No. of Proposals	48,717	49,150	48,206	49,630	49,306	49,425
	No. of Awards	11,628	10,981	11,120	12,016	11,893	11,457
	funding rate	24%	22%	23%	24%	24%	23%
Alabama Portion (All NSF Directorates	No. of Proposals	670	648	666	583	607	656
	No. of Awards	111	95	103	85	102	116
	funding rate	17%	15%	15%	15%	17%	18%
NSF Office of the Director O/D (includes EPSCoR)	No. of Proposals	992	579	755	671	420	416
	No. of Awards	344	269	336	312	217	249
	funding rate	35%	46%	45%	46%	65%	60%
Alabama Portion (O/D) (includes EPScoR)	No. of Proposals	18	11	17	12	11	10
	No. of Awards	7	4	3	2	6	7
	funding rate	39%	36%	18%	17%	55%	70%
All NSF Funding	Total*	6,730,420	6,548,925	6,766,552	6,967,463	7,110,054	7,016,546
Alabama (All NSF)	Total*	47,367	45,987	45,305	34,281	46,041	51,155
Overall NSF O/D Funding	Total*	496,472	343,784	385,949	460,863	462,073	454,777
Alabama NSF O/D	Total	7,945,231	5,262,194	4,797,819	2,611,006	4,486,653	9,151,080
Alabama EPSCoR	Total	7,579,458	4,851,399	4,239,226	2,420,866	4,017,754	9,140,280

***Amount shown in thousands**

NATIONAL SCIENCE FOUNDATION EPSCoR

Alabama first became eligible for EPSCoR funding in 1985. In FY 2016, eligible NSF EPSCoR jurisdictions were reduced to twenty-five states, the District of Columbia, one commonwealth, and two territories. The colleges and universities in all the 25 EPSCoR states plus Guam, Puerto Rico and the U.S. Virgin Islands receive only about 10 percent of the NSF budget. The remaining ninety percent of NSF funding goes to non-EPSCoR jurisdictions.

NSF allocated nearly 90 percent of research funding through a competitive merit review process as grants or cooperative agreements to individual researchers and groups at colleges, universities, academic consortia, non-profit institutions, and small businesses. In FY 2017, the grand total of NSF awards distributed across the world was $7,016,546K while the US total was $6,997,652K. Alabama recieved $51,155K. NSF's Office of the Director awarded $9,140,280 directly to six (AU, TU, UA, UAB, UAH and USA) of the seven PhD granting institutions for EPSCoR related research, major instrumentation awards, graduate research fellowships, and EPSCoR Co-funding.

NSF EPSCoR uses four major investment strategies to achieve its goal of improving the R&D competitiveness of researchers and institutions within EPSCoR jurisdictions. These strategies are:

Research Infrastructure Improvement Program:

- Track-1 (RII Track-1) Awards. RII Track-1 awards provide up to $4 million per year for up to five years. They are intended to improve the research competitiveness of jurisdictions by improving their academic research infrastructure in areas of science and engineering supported by the National Science Foundation and critical to the particular jurisdiction's science and technology initiative or plan. These areas must be identified by the jurisdiction's EPSCoR governing committee as having the best potential to improve the jurisdiction's future R&D competitiveness.
- Track-2 (RII Track-2) Awards. Track-2 Focused EPSCoR Collaborations (RII Track-2 FEC) awards build interjurisdictional collaborative teams of EPSCoR investigators in scientific focus areas consistent with NSF priorities. Projects must include researchers from at least two RII-eligible jurisdictions with complementary expertise and resources to tackle proposed projects. Funds provide up to $1 million per year for up to four years as collaborative awards between two EPSCoR jurisdictions or up to $1.5 million per year for up to four years to a consortia of three or more EPSCoR jurisdictions.
- Track-3 (RII Track-3) Awards. Piloted in FY 2013, RII Track-3 awards provide up to $750,000 for up to five years to support the strategic goal of broadening participation to improve future R&D competitiveness of EPSCoR jurisdictions. These awards are intended to broaden participation of underrepresented groups in STEM fields supported by NSF - underrepresented minorities, women, persons with disabilities and those in underserved rural regions of the country.
- Track-4 (RII Track-4) EPSCoR Research Fellows provides opportunities for non-tenured investigators to further develop their individual research potential through extended collaborative visits to the nation's premier private, governmental, or academic research centers. Through these visits, the EPSCoR Research Fellows will be able to learn new techniques, benefit from access to unique equipment and facilities, and shift their research toward transformative new directions. The experience gained through the fellowship is intended to provide a foundation for research collaborations that span the recipient's entire career. These benefits to the Fellows are also expected to in turn enhance the research capacity of their institutions and jurisdictions.

Co-Funding of Disciplinary and Multidisciplinary Research:

EPSCoR co-invests with NSF Directorates and Offices in the support of meritorious proposals from individual investigators, groups, and centers in EPSCoR jurisdictions that are submitted to the Foundation's research and education programs, and crosscutting initiatives. These proposals have been merit reviewed and recommended for award, but could not be funded without the combined, leveraged support of EPSCoR and the Research and Education Directorates. Co-funding leverages EPSCoR investment and facilitates participation of EPSCoR scientists and engineers in Foundation-wide programs and initiatives.

Workshops and Outreach:

The EPSCoR Office solicits requests for support of workshops, conferences, and other community-based activities designed to explore opportunities in emerging areas of science and engineering, and to share best practices in planning and implementation in strategic planning, diversity, communication, cyberinfrastructure, evaluation, and other areas of importance to EPSCoR jurisdictions. (NSF document # 12-588). The EPSCoR Office also supports outreach travel that enables NSF staff from Directorates and Offices to work with the EPSCoR research community regarding NSF opportunities, priorities, programs, and policies. Such travel also serves to more fully acquaint NSF staff with the science and engineering accomplishments, ongoing activities, and new directions and opportunities in research and education in the jurisdictions.

New 2017 and 2018 NSF Research Infrastructure Improvement (RII) Awards						
Award No	Title	Inst	PI	Collaborators	Period of Performance	AL award
FY2017 Awards						
1655280	RII Track-1: CPU2AL: Connecting the Plasma Universe to Plasma Technology in Alabama	UAH	Gary Zank	collaboarators at AAMU, UAH, UA, UAB, UAH, USA, ASU and Oakwood	9/1/2017 - 08/31/2022	20,000,000
1738497	RII Track-4: Selection of methylxanthine-responsive aptamers	UA	Ryan Summers		09/15/2017 -8/31/2019	258,968
1738564	RII Track-4: Quantifying Muscle Assembly in Live C. elegans Using Super-Resolution Light Microscopy	USA	Ryan Littlefield		9/1/2017 - 8/31/2019	128,020
1736150	RII Track-2 FEC-Genome to fitness: An Analysis of the Stress Response in Peromyscus	AU	Wendy Hood and Andreas Kavazis	Lead PI: Hippokratis Kiaris at the University of South Carolina at Columbia	8/1/2017 - 7/31/2021	1,348,649
1738698	RII Track-4: Big Data and Massive Computation Approaches to Non-Equilibrium Dynamics of Strongly Correlated Materials	UAB	Cheng-Chien Chen		9/15/2017 - 8/31/2019	222,122.00
FY 2018 awards						
1832993	RII Track-4: EASE - Functional Electrical Stimulation and Mechanical Actuation of Soft Exoskeletons	UA	Vishesh Vikas		09/01/2018 - 08/31/2020	250,956
FY2018 awards (start dates FY19)						
1832898	RII Track-4: Designing Solution-Processed Hybrid Metamaterials via DNA Self-Assembly	UAB	Kannatassen Appavoo		10/01/2018 - 09/30/2020	246,292
1833065	RII Track-4: A Functional Genomics Approach to Explain the Evolution of Large Bodies and Long Life Spans	USA	Scott Glaberman		10/01/2018 - 09/30/2020	134,930
1833016	RII Track-4: Investigating 3-D Dispersed Smart Antenna Arrays for Nearly Full Spherical Scanning by New Radios (NRs)	USA	Saeed Latif		10/01/2018 - 9/30/2020	170,046
1833053	RII Track-4: Peering into Nature's Glass Boxes - using nano-Raman Spectroscopy to answer Novel Questions in Diatom-focused Environmental Research	Marine Environmental Sciences Consortium	Jeffrey Krause		10/01/2018 - 09/30/2020	121,325

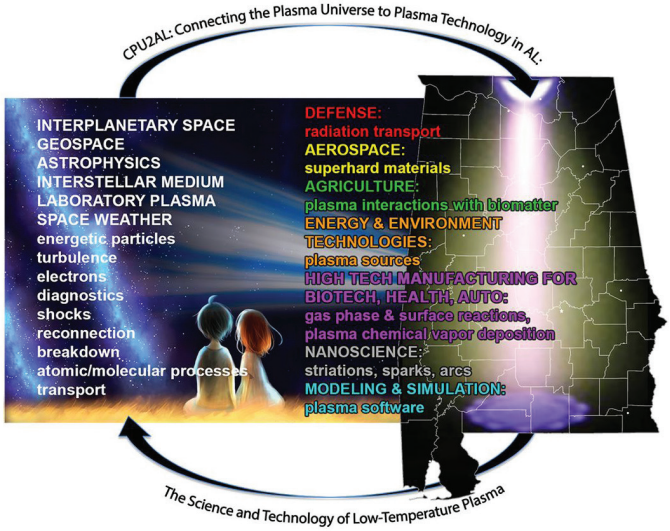
NSF EPSCoR RII Track 1

In September 2017, Alabama NSF EPSCoR was awarded one of the five new NSF Research Infrastrucure Improvement (RII) Track 1 grants entitled, *CPU2AL: Connecting the Plasma Universe to Plasma Technology in Alabama* led by Dr. Gary Zank at the University of Alabama in Huntsville. This five-year, $ 20M grant, will fund researchers across the state at the University of Alabama in Hunstville, Auburn University, Alabama A&M University, The University of Alabama, University of Alabama at Birmingham, University of South Alabama, Tuskegee University, Alabama State University and Oakwook University in Huntsville.

RII Track-1: CPU2AL: Connecting the Plasma Universe to Plasma Technology in Alabama

With the help of the Research Infrastructure Improvement (RII) Track-1 five-year CPU2AL award from the National Science Foundation (NSF), an integrated, statewide collaborative effort has been launched that seeks to understand, predict, and control the transfer of power from electromagnetic fields to electrons, ions, atoms, molecules, and surfaces, and chemical reactions in plasma and on surfaces in low-temperature plasma (LTP) environments. The effort is led by the University of Alabama in Huntsville (UAH) and engages a consortium of nine Alabama (AL) universities including Auburn University (AU), the University of Alabama in Birmingham (UAB), Tuskegee University (TU), the University of Alabama (UA), Alabama A&M University (AAMU), the University of South Alabama (USA), Alabama State University (ASU), and Oakwood University together with an industrial partner, Computational Fluid Dynamics Research Corp. (CFDRC). The collaborative project brings theory, modeling, and experimental validation to industrial applications of plasma to realize the extraordinary potential of LTP science for transformative technological solutions that address societal grand challenge problems, advanced manufacturing and materials, biomedicine, agriculture, and food safety.

During the fall of 2017, the CPU2AL Team compiled a Strategic Plan to guide and direct effort and allocation of resources to achieve the goals articulated in the proposal. Project activities in Year 1 include three research thrusts, infrastructure improvements, workforce development, diversity, communication and dissemination, and project management.



NSF RII Track 1 CPU2AL PI List

University of Alabama in Huntsville
Gary Zank (Lead PI), Nick Pogorelov, Vladimir Kolobov, Kunning Xu

Alabama A&M University
Srinivasa Rao Mentreddy, Armitra Jackson-Davis, Ernst Cebert
Leopold Nyochembeng, Venkateswara Sripathi

Alabama State University
Komal Vig

Auburn University
Edward Thomas (Co-PI), David Ennis
David Maurer, Joe Perez, Stuart Loch,
Uwe Konopka, Yu Lin

Tuskegee University
Alfred Tcherbi-Narteh, Vijay Rangari,
Michael Curry, Maria Calhoun

University of Alabama
Gary Cheng, Mruthunjaya Uddi,
Rich Branam

University of Alabama at Birmingham
Yogesh Vohra (Co-PI), Vinoy Thomas,
Chen Cheng-Chien, Arron Catledge

University of South Alabama
Edmund Spencer

Oakwood University
Alexandre Volkov

CFD Research Corporation
Robert Arslanbekov

Research Thrusts 1, 2, 3, and infrastructure improvements

During Year 1, we launched three cross-institutional research thrusts (RTs) to address the major challenges facing LTP science today: basic understanding of plasma kinetics and diagnostic techniques (RT 1), collective processes (RT 2), and plasma interactions with solid, liquid, and soft matter (biomaterials) and bio-matter (seeds and food) surfaces (RT 3).

RT 1 addresses the prediction, control, and diagnostics of LTP kinetics through two goals. The first goal is to develop the capability to accurately model the properties of LTP in order to understand naturally occurring plasma environments or to tailor a plasma state to accomplish a particular industrial task. Four objectives are pursued that address the development of theoretical and computational models from a physical kinetics perspective, including a focus on modeling the charged-particle kinetics in the presence of electromagnetic (EM) fields, collisions, and turbulence. The second goal of RT 1 is to design and develop diagnostics capable of measuring plasma properties in LTPs far from equilibrium and their initial formation through steady-state conditions. It is crucial to perform high-quality measurements of plasma properties with sufficient temporal and spatial resolution to enable validation of theoretical models. Three objectives are pursued to develop plasma diagnostic tools based upon emission spectroscopy and laser-induced fluorescence to measure line-integrated basic plasma parameters such as the plasma density and electron temperature, acquire and develop in-situ diagnostics that can provide localized measurements of plasma parameters, and develop fast diagnostic systems that can measure the time evolution of a variety of plasma structures.

T 2 addresses electron kinetics and collective phenomena through two goals. The first goal is to study the temporal and spatial ordering of plasma systems, and investigate fundamental properties of waves, instabilities, nonlinear processes, and self-organization in LPT. Two objectives are pursued focusing on the physics of dusty plasmas and understanding and controlling plasma stratification. The second goal of RT 2 is to develop a state of the art computational tool to simulate high-frequency EM field interactions with plasma, validate the tool for selected benchmark problems, and apply it to problems of interest to the CPU2AL Team.

RT 3 addresses plasma interfaces (solid, liquid, bio-matter) through two goals. The first goal is the LTP synthesis of novel superhard materials, specifically to study the formation of superhard materials from C, N, O, and B (CNOB) in LTPs and develop an understanding of the formation process and resulting material properties. Two objectives are pursued: to synthesize novel superhard materials based on CNOB using existing LTP systems and carry out plasma treatment of graphitic carbon synthesized from renewable waste sources for incorporation into polymer composites and to develop large area (> 100 cm2) plasma systems required for synthesis of superhard materials for applications in automotive, biomedical, and aerospace industries. The second goal of RT 3 is related to plasma interactions with soft matter and biomatter, specifically to understand the effect of LTP on biomaterials, plants, seeds, and agricultural products, and the fundamental processes responsible for their bioactivity. Two objectives are pursued: to study effects of LTP on scaffold biomaterials and to investigate seed and food decontamination and protection, and electrical and biophysical responses of plants.

To meet the goals and objectives in the CPU2AL Strategic Plan, in Year 1 we have begun the process of sharing and integrating resources across institutions and acquiring experimental equipment for plasma processing and plasma diagnostics at TU, UAB, and UAH.

Workforce Development and Diversity

The workforce development (WD) goal of CPU2AL is to make diverse, measurable, and long-lasting improvements in the Science, Technology, Engineering, and Mathematics (STEM) pipeline and workforce in Alabama that will link academic research activities to the Alabama LTP industry. To accomplish the goals in the Strategic Plan for Year 1, the CPU2AL Team became actively involved in recruiting and appointing a large number of participants at all levels through different channels. In all, the CPU2AL Team for Year 1 involved 98 participants, including 45 students and 10 postdocs.

Whenever possible, the appointment of women and underrepresented minority (URM) participants was

prioritized and special efforts were devoted to recruit and retain such groups of participants.

Communication and Dissemination

Recognizing the importance of raising the awareness of plasma science and the potential opportunities that LTP can provide to AL, we have aggressively and widely promoted the CPU2AL project through the CPU2AL website, email campaigns with program announcements postings at career centers of all partner institutions, postings in national job search engines for students and URMs, STEM outreach events, emails/meetings with industry partners, (vii) CPU2AL colloquia, the Science and Technology Open House (STOH), the CPU2AL Annual Meeting, and presentations at national and international meetings.

Management

The CPU2AL Management Team comprises representatives from eight campuses and the industrial partner, together with a Project Manager (PM). Since its inception, the CPU2AL Management Team ensures that communication lines remain open and efficient and that cross- campus activities (scientific, academic, workforce and diversity) are on schedule and achieving their specific goals. Communications include monthly virtual meetings and two in-person meetings of the Management Team. The CPU2AL Education, Outreach, and Diversity (EOD) Specialist plays an integral part in the coordination of project activities and participates in all meetings of the Management Team.

The management structure will undoubtedly evolve as CPU2AL evolves and was initially established at the CPU2AL retreat for senior team members during November 17-19, 2017. Besides building cross-campus scientific and social relationships, the retreat helped establish the basic management and planning tools and the allocation and management of resources, particularly the Central Education, Recruitment, and Impact Fund (CERIF). One important management tool developed during the retreat and immediately afterwards is a very detailed project timeline where responsible parties for each task in the strategic plan were identified along with monthly milestones for each task. In addition, the CPU2AL Management Team adopted the ERCore module to collect all NSF EPSCoR reportable data. By the end of Year 1, the UAB Center for Educational Accountability, led by Dr. Scott Snyder, will develop internal and self-evaluation protocols to prepare for future external evaluation and reverse site visits.

Above: Prof. Ed Thomas (AU) demonstrates a magnetic field using iron filings. Below: Students interacting with plasma balls and "ping-pong ball" states of matter.

Students observing a working plasma experiment, the glowing purple and blue colors in the glass tube are from the partially ionized gas in the chamber.

Science and Technology Open House outreach activities held Saturday, September 8, 2018 in Montgomery.

Above and below: Demonstrations using ping pong balls to illustrate the forces of nature.

NATIONAL SCIENCE FOUNDATION EPSCoR

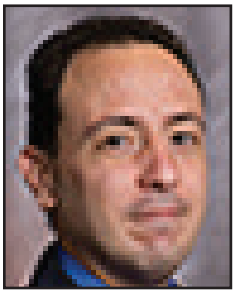
NSF EPSCoR RII Track 2

In FY 2016 the NSF NSF RII Track 2 FEC (Focused EPSCoR Collaborations) grant research focus was "Understaning the Brain" while Genome to Phenome was the FY 2017 research focus. In 2018, "Understanding the Relationship between Genome and Phenome" was the focus and in 2019, the research focus is "Harnessing the Data Revolution to solve problems of national importance".

In 2017, Alabama recieved portions of two EPSCoR RII Track 2 awards while in 2018, there was no involvement by Alabama researchers in NSF RII Track 2 wards.

RII Track-2 FEC: Genome to fitness: An Analysis of the Stress Response in Peromyscus

Drs. Wendy Hood and Andreas Kavazis
Auburn University



This collaborative project explores how genetic differences determine the response of individual animals to various stress-inducing stimuli. At the level of a cell or an individual organism, stress-inducing stimuli can involve a number of factors such as oxygen deficiency, poor diet, or exposure to toxic chemicals. The stress responses vary among cells and tissue types and how these responses impact the animal's functions and survival is not well understood. This project applies a combination of genomic analyses coupled with stress tests at cellular and organismal levels to understand the fitness of mammals using North American deer mouse as a model. The project is a collaborative effort that will be led by the University of South Carolina with faculty and students from Claflin University, an Historically Black College and University (HBCU) in South Carolina, and Auburn University in Alabama participating in the research, education, and outreach activities. A new Rodent Performance Testing Laboratory will be established at Auburn University and two early careeer faculty will be hired to augment and strengthen the resources for collaborations. Senior faculty members will provide strong mentorship for junior researchers for career advancement and will work together in training a diverse group of graduate and undergraduate students and postdocs.

NSF EPSCoR RII Track 4

NSF EPSCoR RII Track 4 - EPSCoR Research Fellows funds non-tenured faculty to further develop their individual research potential through extended visits to learn new techniques, benefit from state-of-the-art equipment and facilities and shift their research toward transformative new directions to benefit the research capacities of their institutions and jurisdictions. Experiences gained through fellowships are intended to provide benefits impacting the recipient's career for years to come and in turn enhance the research capabilities of their institutions and jurisdictions. Any research topic the fits within NSF's overall portfolio is available for support. There is a limit of three proposal submissions per eligible jurisdiction.

Alabama NSF EPSCoR recieved three of the thirty (across 20 states) Track 4 awards during FY 2017. Alabama awardees include Dr. Ryan Summers at The University of Alabama, Dr. Cheng-Chien Chen at the University of Alabama at Birmingham, and Dr. Ryan Littlefield at the University of South Alabama. In 2018, Alabama was awarded five new NSF RII Track 4 awards, only one beginning during FY18, the other four begin October 1, 2018. The list includes Dr. Vishesh Vikas at the University of Alabama, Dr. Kannatassen Appavoo at the University of Alabama at Birmingham, one award each to Drs. Scott Glaberman and Saeed Latif at the University of South Alabama and one to Jeffrey Krause, (University of South Alabama) at the Marine Environmental Sciences Consortium at Dauphin Island Sea Lab.

RII Track-4 EASE- Functional Electric Stimulation and Mechanical Actuation of Soft Exoskeletons

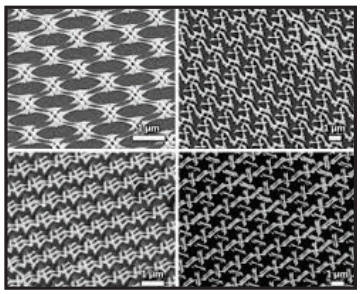
Dr. Vishish Vikas, UA

Soft material robotics is envisioned to be the future of robotics that combines the concepts of the Internet of Things (IoTs), wearable sensors, material science and artificial intelligence to fabricate robots that can assist and collaborate with humans. This field is of special interest to roboticists and engineers as it has multiple fundamental challenges and there are tremendous benefits for applications to fields such as agriculture, disaster robotics to assistive rehabilitation. This project will enable researchers from the University of Alabama to enhance their capabilities to develop next-generation soft material exoskeletons (exosuits) stimulated by mechano-neuromuscular actuators through a collaboration with researchers at the University of Pittsburgh. Mechanically and electrically actuated soft exosuits are envisioned to have an impact on the fields of assistive robotics, rehabilitation robotics, and elder care. The research will result in the development of design and control principles for mechano-neuromuscular actuated soft wearable exosuits, thus greatly enhancing life and reducing rehabilitation cost for individuals who suffer from paralysis, stroke, and spinal cord injuries. The applied nature of this research will play an instrumental role in attracting students to STEM fields that include computer science, electrical engineering, mechanical engineering and biomedical engineering.

RII Track-4: Designing Solution-Processed Hybrid Metamaterials via DNA Self-Assembly

Dr. Kannatassen Appavoo, UAB

With increasing demands to build devices that have a smaller footprint but operate at greater speeds, it is critical to develop materials with never-before-seen properties. These demands in performance are tied with developing nanofabrication techniques that are cheap and scalable in order to rapidly deploy these advanced materials into novel energy, communication and medical technologies. Metamaterial, a class of material that does not occur in nature, can possess exotic properties as determined by their periodic, organized structures rather than the intrinsic material properties of their individual units. However, fabricating metamaterials is often costly and time-consuming, thus requiring sophisticated tools to create periodic arrays of nanostructures with high precision. In this project, the Principal Investigator will partner with experts at Brookhaven National Laboratory to develop a low-cost solution-process technique to fabricate three-dimensional metamaterial (BNL). The goal is to use self-assembly, the natural process by which complex structures are put together, to arrange subunits of different nanostructures into a three-dimensional metamaterial, providing real-time insights on the environmental factors that modify this process. This highly interdisciplinary project provides education and training opportunities in the fields of photonics, nanofabrication and high-resolution microscopy, and enables graduate and undergraduate students from Alabama to conduct research at BNL. If successful, this project will offer a strategy to create metamaterial on a large scale, aligning with the Materials

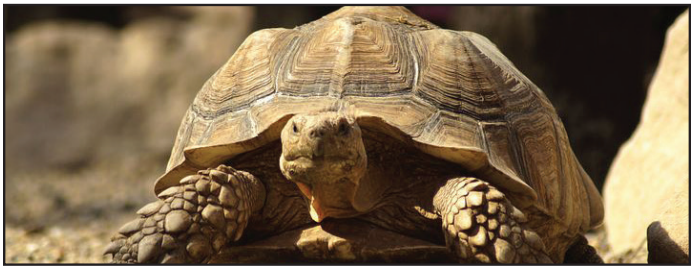


Genome Initiative's vision to discover, manufacture, and deploy advanced materials in half the time and at a fraction of the cost.

RII Track-4 A Functional Genomics Approach to Explain the Evolution of Large Bodies and Long Life Spans

Dr. Scott Glaberman, USA

We use reptiles, specifically giant tortoises, to study the processes behind aging and cancer. Mammals, including humans, have long been used to study these topics, with obvious applications for improving health. However, it is becoming clear that all kinds of animals -not just mammals- have evolved ways of delaying aging and avoiding cancer. Thus, focusing on mammals limits our arsenal for understanding how biology has solved these major physiological challenges. In this project, we will investigate which genes have allowed giant tortoises to mitigate cancer and other biological processes in order to grow so big and live so long. Specifically, we will use cells from long-lived, giant tortoises and their small tortoise relatives to see whether certain genes related to aging and cancer behave differently in these two types of tortoises. This work will not only expand how we look at the importance of animal diversity for meeting challenges in human health, but will also shed light on why we see such amazing diversity in animal life spans and body sizes in nature. The project also has a large outreach component including the development of high school learning modules to teach students cutting-edge technologies in genetics.



RII Track 4: Investigating 3-D Dispersed Smart Antenna Arrays for Nearly Full Spherical Scanning by New Radios (NRs)

Dr. Saeed Latif, USA

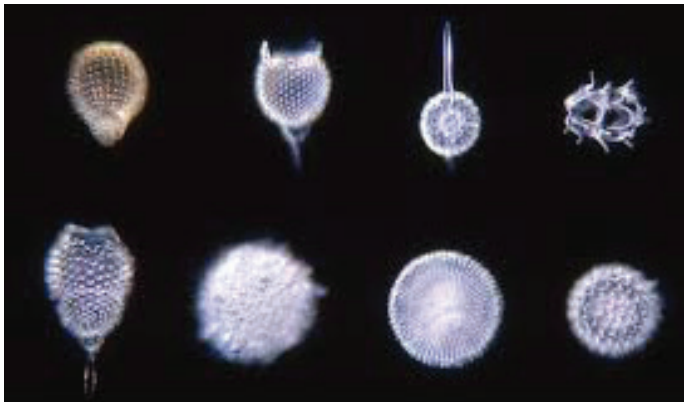
The existing 4G cellular systems have stretched their capabilities to a limit that they can no longer be extended or incrementally improved to meet the mounting demand for high bandwidth-consumptive mobile services. As the demand for large bandwidth and high data rate for mobile applications is at all-time high, future 5G (5th Generation) mobile terminals must operate at unused millimeter wave (mmWave) bands. It is also expected that existing lower frequency 4G bands will continue to be needed for wide area coverage. In this project, it is proposed to investigate the performance of a new generation of smart dispersed array antenna architecture for future 5G new radios (NRs). The mmWave arrays will be integrated into recently designed 4G/LTE multi-slot antennas for interoperability between cells of 4G networks and future 5G heterogeneous cells. This will provide a unified connectivity platform for existing and emerging connected services. This fellowship will be a unique opportunity for the PI and a graduate student to access state-of-the-art facilities and advanced fabrication equipment. The project outcomes will be utilized to attract members of minority and underrepresented groups to engineering education in the Gulf Coast region. This will also boost the University of South Alabama's recruiting effort to attract outstanding undergraduate students, and drive up new mobile-based economic development opportunities in the Gulf Coast and in the State of Alabama.

NATIONAL SCIENCE FOUNDATION EPSCoR

RII Track-4: Peering into Nature's Glass Boxes - using nano-Raman Spectroscopy to answer Novel Questions in Diatom-focused Environmental Research

Dr. Jeffrey Krause
Marine Environmental Sciences Consortium

Diatoms are abundant microscopic oceanic 'plants' which have a protective shell made of glass. Despite their small size, diatoms' collective importance in marine ecosystems is immense. They produce as much oxygen globally as all the rain forests combined. Their glass shell (i.e. diatomaceous earth) also has many industrial applications. Unlike land plants which grow relatively slow, diatom biomass accumulates fast and is rapidly recycled in seawater. The recycling of diatom biomass releases 5-10 billion metric tons of carbon back into the ocean annually -a quantity of carbon which exceeds global fossil-fuel emissions. This project will use state-of-the-art technology to examine the properties of the glass shell and determine how they affect diatom-biomass recycling. This technology uses single-cell analysis, instead of traditional methods which require thousands of cells, thereby enabling new understanding and insight of single-cell material composition and structure. This project will help entrench this technology into diatom-based research and provide training for a Ph.D. student. The project collaboration with Stony Brook University based scientist will help researchers at the Alabama-based Dauphin Island Sea Lab personnel to emerge as leaders in their subfields. Also considering the vast industrial application for diatomaceous earth, these approaches may be useful for industry. This expertise will enable future work to serve the unique environmental research needs in the northern Gulf of Mexico (Alabama, Mississippi, Louisiana).



NSF EPSCoR and Alabama

Since 1985, Alabama EPSCoR has been awarded $108.9M whcih is comprised of $52.4M in RII (Research Infrastructure Improvement Grants), $56.2M in Co-funding and $323,500 for outreach.

**NSF Day power point slide*

NSF Co-funding

To accelerate the movement of EPSCoR researchers and institutions into the mainstream of NSF support, EPSCoR Co-funding is available to provide joint support for certain meritorious proposals submitted to NSF's research, education and cross-cutting competitions. The objectives of the EPSCoR Co-funding mechanism are:

- To increase the number and competitiveness of EPSCoR jurisdiction investigators and institutions who participate in NSF research, technology, and education programs;
- To increase the participation of EPSCoR jurisdiction researchers and institutions in regional alliances and national collaborations;
- To broaden participation in science and engineering by institutions, organizations and people within and among EPSCoR jurisdictions.

NSF Co-funding is not a program that can be applied to directly but works internally at NSF to provide joint support for certain meritorious proposals submitted to NSF's research, education, and cross-cutting competititions.

NATIONAL SCIENCE FOUNDATION CO-FUNDED EPSCoR

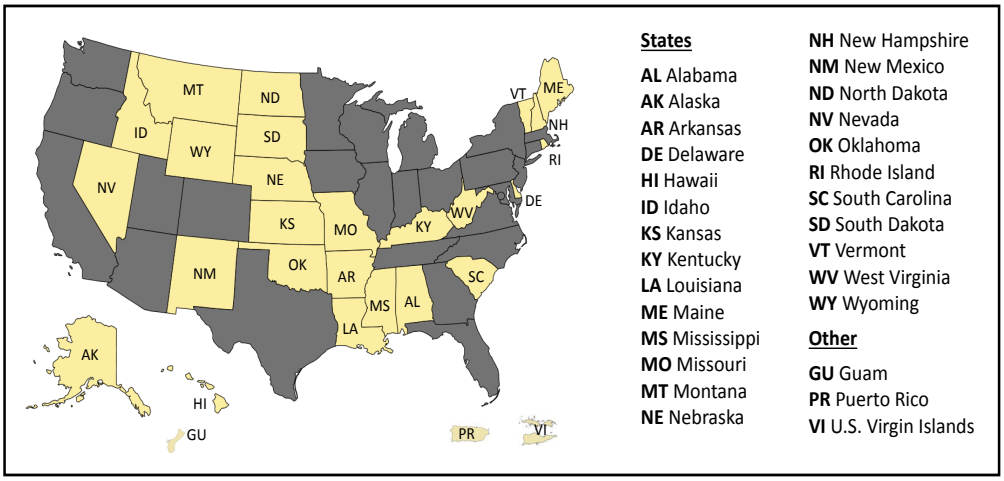
The EPSCoR Co-funding mechanism focuses on those "Fund-if-Possible" proposals, which the NSF merit review process finds to lie at or near the cutoff for funding by the programs to which they were submitted. EPSCoR co-funds meritorious proposals that would otherwise not be supported due to availability of funds or other overriding program priorities.

For such proposals, the managing Program Officer first decides whether to make an award recommendation and the amount and duration to be recommended for the award. The decision to recommend an award or declination rests with the managing program. Once these decisions are made, a request for partial support via EPSCoR Co-funding can be forwarded to the EPSCoR for consideration. NSF EPSCoR Co-funding Mechanism is dependent on the number and quality of proposals submitted from EPSCoR jurisdictions and the availability of EPSCoR funds for Co-funding.

Proposal characteristics that will enhance the likelihood of EPSCoR co-funding are: (a) researchers who have not previously received NSF awards or researchers whose awards ended three or more years ago; (b) requests reflecting collaborative efforts within and across participating jurisdictions and at regional, national and/or international levels; (c) projects submitted to cross-discipline or cross-directorate programs; (d) projects that are synergistic with NSF investment and funding priorities in the current fiscal year; (e) projects that increase participation of members of underrepresented groups and/or institutions; (f) requests for instrumentation that build research capacity at the institutional or jurisdictional level; (g) student programs that will significantly enhance institutional research capability and competitiveness or provide training opportunities for K-12 students and professional development for K-12 teachers; and (h) programs that exemplify NSF's commitment to the integration of research and education.

In FY 2017, Alabama researchers were awarded 8 new NSF Co-funded awards. These include one CAREER award, two collaborative projects and two REUs (Reseach for Undergraduates). In 2018, Alabama researchers were awarded seventeen new NSF Co-funded awards. These include three CAREER awards; three MRI awards, one GOALI award, one EAGER and one RCN-UBE award. CAREER awards are a Foundation-wide funding mechanism and is NSF's most prestigious award in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the mission of their institution. The Major Research Instrumentation (MRI) Program's goal is to increase access to shared scientific and engineering instruments for research and training in U.S. institutions of higher education, not-for-profit museums, science centers, and scientific/engineering research organizations. GOALI

NSF EPSCoR FY17 Co-funding Eligibility



States

AL Alabama
AK Alaska
AR Arkansas
DE Delaware
HI Hawaii
ID Idaho
KS Kansas
KY Kentucky
LA Louisiana
ME Maine
MS Mississippi
MO Missouri
MT Montana
NE Nebraska
NH New Hampshire
NM New Mexico
ND North Dakota
NV Nevada
OK Oklahoma
RI Rhode Island
SC South Carolina
SD South Dakota
VT Vermont
WV West Virginia
WY Wyoming

Other

GU Guam
PR Puerto Rico
VI U.S. Virgin Islands

EPSCoR states and other U.S. jurisdictions eligible for EPSCoR co-funding during FY 2017.
This includes twenty-five states, Guam, Puerto Rico, and the U.S. Virgin Islands.

NATIONAL SCIENCE FOUNDATION CO-FUNDED EPSCoR

(Grant Opportunities for Academic Liason with Industry) awards seek collaboration between academic research institutions and industry. EAGER awards fund exploratory work in its early stages on untested, but potentially transformative research ideas of approaches, this is often considered high-risk, high payoff.

New FY 2017 NSF Co-funded awards					
Award No.	Title	Inst	PI	POP	Awarded
1642133	Collaborative Research: CICI: Secure and Resilient Architecture: Data Integrity Assurance and Privacy Protection Solutions for Secure Interoperability of Cloud Resources	AU	Wei-Shinn Ku	10/1/2016 - 9/30/2019	640,440
1659845	REU Site: Parallel and Distributed Computing	AU	Sanjeev Baskiyar	05/15/2017 - 4/30/2020	291,590
1719062	NeTS: Small: VC-VANET: A Sustainable Vehicle-Crowd Based Vehicular Ad Hoc Network Supporting Mobile Cloudlet Computing	UA	Xiaoyan Hong	08/15/2017 -07/31/2020	515,201
1727875	Multi-scale Modeling of Deformation in Nanostructured Metallic Systems	UA	Lin Li	08/01/2017 - 07/31/2020	224,557
1642078	Collaborative Research: CICI: Secure and Resilient Architecture: Data Integrity Assurance and Privacy Protection Solutions for Secure Interoperability of Cloud Resources	UAB	Ragib Hasan	10/1/2016 - 9/30/2019	224,557
1658965	REU Site: Summer Program in Neuroscience	UAB	Lucas Pozzo-Miller	03/01/2017 - 02/29/2020	352,349
1728044	Collaborative Research: How Military Service Shapes STEM Trajectories	UAH	Christina Steidl	09/01/2017 - 08/31/2019	54,308
1653915	CAREER: Near-The-Horizon Steerable Phased Array Antennas with Reconfigurable Inter-Element Spacing and Radiation Patterns	UAH	Maria Z. A. Pour	03/01/2017 - 02/28/2022	500,000
					2,937,792

New FY 2018 NSF Co-funded awards					
Award No.	Title	Inst	PI	POP	Awarded
1809847	Exploration of Electronic and Catalytic Behavior in Epitaxial Complex Oxide Films and Nanocomposites	AU	Ryan Comes	07/01/2018 - 06/30/2021	531,981
1752654	CAREER: Secondary Amine Selective Petasis (SASP) Bioconjugation	AU	Monika Raj	07/01/2018 - 06/30/2023	650,000
1751296	CAREER: Uncovering mechanisms that shape variation in how males and females differ in their gene expression	AU	Rita Graze	08/01/2018 - 07/31/2023	392,665
1761675	GOALI: Prediction and Mitigation of Undesirable Acoustic Phenomena in Combustors and Power Generation Systems	AU	Joseph Majdalani	9/1/2018 - 8/31/2021	386,553
1827690	Partnership for Research and Education in Multiferroic Polymer Nanocomposites Between Tuskegee University and University of Nebraska-Lincoln	TU	Vijaya Rangari	09/01/2018 - 08/31/2024	1,288,750
1826775	Embodying Emotion in Interaction: A Biocultural-Linguistic Study of Communication and Physiology	UA	Sonya Pritzker	07/15/2018 - 6/30/2021	315,859
1800214	Collaborative Research: Atomistic Switches on Pyridinol Based Pincer Ligated Catalysts for Carbon Dioxide Reduction	UA	Elizabeth Papish	07/15/2018 - 06/30/2021	357,919
1748371	Implicit Biases and Discretionary Prosecutorial Decision Making	UA	Jennifer Cox	08/01/2018 - 07/31/2020	284,959
1812930	Collaborative Research: A Regularized Poisson Boltzmann Model for Fast Computation of the Ensemble Average Polar Solvation Energy	UA	Shan Zhao	08/15/2018 - 07/31/2021	230,000
1749837	CAREER: Engineering biomimetic environments to elucidate mechanisms of dormancy in brain metastatic breast cancer cells	UA	Shreyas Rao	09/01/2018 - 08/31/2023	407,524
1831512	Dimensions: Collaborative Research: Processes that Generate and Maintain Phylogenetic, Genetic, and Functional Diversity of the Freshwater Mussel Holobiont across Multiple Scales	UA	Carla Atkinson	09/01/2018 - 08/31/2022	977,466
1837698	EAGER: ISN: Anticipatory Interdiction in Narco-Trafficking Networks	UA	Nicholas Magliocca	9/1/2018 - 8/31/2020	292,974
1755464	CRII: OAC: Scalable Cyberinfrastructure for Big Graph and Matrix/Tensor Analytics	UAB	Da Yan	06/01/2018 - 05/31/2020	170,941
1826988	RCN-UBE: The Research on STEM Education Network: Improving Research Inclusivity through a Grassroots Culture of Scientific Teaching	UAB	James Morris	08/01/2018 - 07/31/2023	499,424
					6,787,015

New FY 2018 NSF Co-funded awards					
Award No.	Title	Inst	PI	POP	Awarded
1828232	MRI: Acquisition of an Atomic Force Microscope for Materials Research and Education	UAB	Eugenia Kharlampieva	10/01/2018 - 09/30/2020	314,912
1828729	MRI: Acquisition of an X-Ray Photoelectron Spectrometer for Advancing Multidisciplinary Research and Education in Quantum Mechanics, Nanotechnology, Biosensors, and Energy Storage	AAMU	Stephen Egarievwe	10/01/2018 - 09/30/2020	628,558
1828678	MRI: Development of an Underwater Mobile Testbed Using a Software-Defined Networking Architecture	UA	Aijun Song	08/01/2018 - 07/31/2023	300,000
					1,243,470

NATIONAL SCIENCE FOUNDATION CO-FUNDED EPSCoR

CAREER: Secondary Amine Selective Petasis (SASP) Bioconjugation

Dr. Monika Raj, Auburn University

With this award, the Chemistry of Life Processes Program in the Chemistry Division is funding Dr. Monika Raj from Auburn University to develop a chemical method that can selectively label a specific site on a biomolecule in the presence of sea of other similar sites. In this case, the specifically labeled site is known to "turn on" or "turn off" very important functions inside the cell which are responsible for cell growth, as well as the transfer of information from one cell to another. The proposal aims to use the new chemical labeling method to better understand the biological significance of the reactive sites, that is how they control cellular function. Dr. Raj develops methods based on innovative applications of classical chemical reactions for visualizing biomolecules and tagging them with dye. This project also supports continued efforts toward increasing diversity in science fields by allowing graduate and undergraduate students from underrepresented minorities to gain training in both organic chemistry and biochemistry. Outreach activities engage high school students (especially women and underrepresented minorities) and expose them to basic concepts of science through fun experimentation, ultimately encouraging them to pursue studies and academic careers in STEM fields.

Chemical strategies that can target a particular functional group at a single site in the presence of reactive amino acid side chains on protein surfaces are limited. Even more rare are organic reactions that can proceed under conditions mild enough to label biomolecules. To address these challenges, this research project develops a new multicomponent bioconjugation method based on the classical organic Petasis reaction for selective labeling of proteins containing secondary amines. This method is employed for labeling mono-methyl lysine containing posttranslational modifications (PTMs) on proteins with various cargoes. The dysregulation of these mono methyl lysine PTMs has been linked to a variety of different biological malfunctions, yet the chemical methods for selective detection of mono methyl lysine PTMs are still lacking. This research provides a highly selective chemical tool that can effectively detect mono methyl lysine PTMs which, are present not only on histone proteins but also on other proteins and dictate various protein-protein interactions and functions. Thus, the proposed research has a great potential to further our understanding of how these PTMs regulate various cellular signaling processes and how the PTMs themselves are regulated.

CAREER: Uncovering mechanisms that shape variation in how males and females differ in their gene expression

Dr. Rita Graze, AU

Males and females often differ in appearance, as well as in less visible traits like how they respond to stress or how they age. These differences are largely explained by differences in how males and females express genes: how each sex uses the information in the genome to produce RNA and proteins. This type of difference in gene expression is thought to evolve as a result of genetic conflict - expression of a gene in the same way in both males and females could benefit one sex while having harmful effects in the other. Differences between males and females in gene expression can resolve such conflicts by allowing each to express a gene in a way that is beneficial for itself. In addition, differences in expression could even be fine-tuned to maximize the benefit according to the organism's environment. However, little is currently known about the molecular causes of differential gene expression between males and females, how it varies, and how it affects traits. This project focuses on differential expression in hormone signaling and looks at its genetic and environmental variation. It connects expression differences to reproductive traits and survivorship in typical and stressful environments. It will also test whether hormone signaling can resolve

genetic conflict between the sexes. The project includes outreach and educational programs that will increase student awareness of and skills in research science in the areas of genomics, evolution and computational biology. A free summer science educational enrichment program for gifted students from underrepresented backgrounds in Alabama and Georgia will be run, supporting opportunities for these students and their teachers to engage in a summer research experiences at Auburn University. Also, work related to the project will be integrated into course-based undergraduate research experiences for Auburn University undergraduates

CAREER: Engineering biomimetic environments to elucidate mechanisms of dormancy in brain metastatic breast cancer cells

Dr. Shreyas Rao, UA

A majority of breast cancer-related deaths worldwide occur as a result of the cancer spreading to one or more organs, often described as becoming "metastatic." Accumulating evidence suggests that cancer cells can reside in vital organs (e.g., brain) in a sleep mode (dormant) for extended periods of time and could reawaken at a later stage resulting in disease relapse and often death. However, the mechanisms by which metastatic breast cancer cells in the brain stay dormant and later become activated are not well understood, making it difficult to develop new therapeutic strategies. A few experimental models have been devised for studying dormancy in metastatic breast cancer cells; however, experimental model systems to study dormancy in brain metastatic breast cancer cells outside of a living organism (in vitro) are not available. This project focuses on developing an engineered biomimetic three dimensional in vitro experimental model of dormancy to study how biophysical, biochemical, and cellular signals of the brain tissue microenvironment regulate dormancy in brain metastatic breast cancer cells and define the associated molecular mechanisms. The technologies developed and insights gained could be broadly applied to fundamental investigations of neural development, tissue regeneration, and stem cell engineering as stem cells typically stay in a dormant state until activated to promote tissue repair, and could be used to study dormancy in other types of brain metastatic cancers. The education and outreach plans are well integrated with research and include: providing educational sessions in high schools and in a "Scientist for a Day" program, initiating a four-day mentored research experience for students and teachers from Alabama's economically challenged Black Belt region, providing research experiences for undergraduate students and enhancing undergraduate and graduate education by developing a course in cancer bioengineering and tailoring existing coursework to incorporate problems with biological relevance. These activities are designed with the goal of motivating pursuit of STEM careers for students from socially and economically challenged backgrounds, women, and minority students.

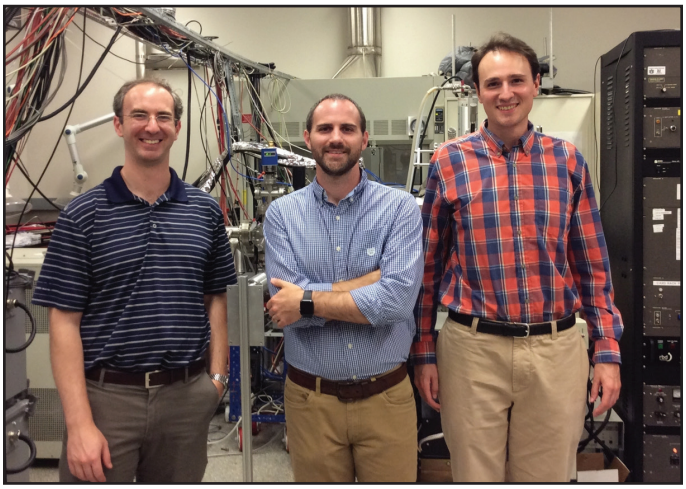
The project focuses on developing an in vitro model to test the hypothesis that biophysical, biochemical and cellular cues in the brain microenvironment regulate the dormancy of breast cancer cells that have metastasized to the brain. Three dimensional (3D) tissue-mimetic hydrogel scaffolds using hyaluronic acid will be engineered to replicate biochemical composition, mechanics and cellular components of the brain. The

GRSP Awardee Akshay Narkhede making hydrogels in the Rao lab.

scaffolds created will provide controllable systems to investigate microenvironment-tumor cell interactions, to study the mechanisms controlling dormancy and to test if the dormant phenotype observed in BCBM cells is reversible by modulating the scaffold environment. The Research Plan is organized under 4 specific aims: 1) Investigate the influence of mechanical cues (stiffness and mechanotransduction pathways) in regulating tumor dormancy in vitro; 2) Investigate the influence of biochemical cues (biomolecules found in the brain tumor extracellular matrix) in regulating tumor dormancy in vitro; 3) Investigate the influence of cellular cues (astrocytes) in regulating tumor dormancy in vitro and 4) Examine known signaling pathways (e.g., p38 and TGF-Beta) regulating dormancy in the biomimetic environment in vitro and identify additional pathways using a systems biology approach (proteomics and genomics), i.e., to elucidate the mechanisms governing dormancy in the engineered biomimetic scaffold, linking microenvironmental factors to the ultimate cellular phenotype: "dormant" or "proliferative."

Exploration of Electronic and Catalytic Behavior in Epitaxial Complex Oxide Films and Nanocomposites

Dr. Ryan Comes, AU



Left to right: Dr. Ryan Comes, Physics; Dr. Byron Farnum, Chemistry; along with Physics Graduate Student Miles Blanchet in the FINO (Films, Interfaces, and Nanostructures of Oxides) Lab, Auburn University

Thin films of metal oxides have long been studied for their various unique physical properties. It is only in the past few years, however, that research exploring oxide thin films for practical applications has emerged. Many of these materials exhibit excellent chemical performance, rivaling that of expensive precious metals such as platinum and iridium. This is particularly true for reactions that are relevant to fuel cells: the oxygen evolution and oxygen reduction reactions, which are both necessary for fuel cell technology. Various oxides have been shown to perform well in one reaction or the other, but few, if any, individual materials match the performance of platinum in both reactions. This project focuses on the synthesis of a composite material that combines two distinct types of oxides into a single surface so that their combined behavior can lead to catalytic performance that matches or exceeds precious metals. The research is integrated with outreach activities to encourage middle and high school students to pursue careers in science, math, and technology through participation in the Auburn University Summer Science Institute and Destination STEM. Through these programs, the PIs will perform demonstrations and lead group activities for students in rural and underserved areas of Alabama to broaden their exposure to science.

GOALI: Prediction and Mitigation of Undesirable Acoustic Phenomena in Combustors and Power Generation Systems

Dr. Joseph Majdalani, AU

This Grant Opportunities for Academic Liaison with Industry (GOALI) project aims at creating methods to improve the safety, performance, and stability of large combustors and power generation systems. A unifying approach will be pursued that can have a significant impact on both the aerospace and power generation industries. For example, understanding and suppressing instabilities that arise in combustors will aid in advancing

hybrid combustion technology and its use as a safe and clean propulsion alternative in both space and land applications. This methodology will therefore help in the advancement of large combustors and chemical rockets and thereby advance the country's defense capabilities. The advancement of more stable propulsion concepts will transform our nation's launch infrastructure with drastically reduced costs in space exploration, space tourism, satellite deployment, and weaponry development. The broader impacts include training of several graduate students, offering of specialized courses, broad dissemination of research outcomes, as well as the sharing of first-hand knowledge and experience with industrial partners. Furthermore, the project will enhance STEM education efforts by exposing high school students to modern research concepts in acoustic noise control and rocket propulsion through strategically planned short courses, summer training, technical exchanges, and competitive design challenges.

The development of a unified, physics-based, acoustic stability framework for rocket motors will provide a diagnostic tool to quantify the behavior of acoustic oscillations in large combustors. This methodology can also be extended from solid and hybrid motors to liquid rockets, ramjets, preburners, augmenters, and gas turbine engines. With the physics-based framework in hand, it will be possible for future combustors seeking higher performance to be operated more efficiently and closer to their stability limits. The program will seek to obtain more realistic mean and unsteady flow models for solid and hybrid rockets with arbitrary geometric configurations, spatially sensitive grain regression rate equations for hybrids, and a triglobal stability formulation to capture the amplified acoustic oscillations and pressure jumps. It will also lead to the training of several graduate and undergraduate students, a technical guide for building safer and more stable rockets, and two modern courses on aeroacoustics and hybrid rocketry. Finally, partnership with the industrial sponsor, the Space Propulsion Group, will benefit the development of the Mars Ascent Vehicle, which is presently under development by NASA.

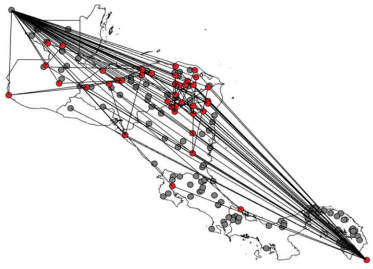
EAGER: ISN: Anticipatory Interdiction in Narco-Trafficking Networks

Dr. Nicholas Magliocca, UA

This Early-concept Grants for Exploratory Research (EAGER) project will promote progress in scientific understanding of illicit supply networks by providing insights into how processes designed to disrupt Central American cocaine trafficking networks influence citizen security in the region and in the US. Counterdrug interdiction efforts are designed primarily to seize or disrupt drug shipments between South American source zones and US markets, and remain a core commitment of US supply-side drug policy and national security strategy. In response to these efforts, trafficking networks have fragmented existing trafficking routes into new and more numerous locations, resulting in a geographically diverse drug trafficking space. This research builds an interdisciplinary understanding of the structure and function of narco-trafficking networks and their co-evolution with interdiction efforts to investigate how different interdiction approaches might impact traffickers' spatial, organizational, and economic behavior. This research establishes new intellectual bridges between operations engineering, geographic, and criminological perspectives, leading to more comprehensive and spatially detailed insights needed to inform effective drug policy. This award supports outreach activities to increase public understanding about the current state of drug trafficking in Central America as a consequence of US drug policy. The accompanying education plan will push the boundaries of conventional graduate education to meet the emerging needs of illicit support network research to inform policy.

This research will investigate temporally and spatially adaptive behaviors of narco-trafficking networks in response to various interdiction strategies within the cocaine transit zone of Central America and associated maritime areas. An integrated agent-based model that

includes operational elements will be used to assess how the spatial and structural relationships of cocaine flows and prices along trafficking routes change in response to alternative interdiction strategies. This research represents a new paradigm in which trafficker-interdiction interactions are conceived of as a complex adaptive system and modeled as a co-evolutionary phenomenon. The integrated models will test hypotheses about the factors that explain the location and extent of emerging trafficking nodes in an expanding transit zone. The models will be parameterized with a novel application of data from the Consolidated Counterdrug Database (CCDB). Using a criminological lens, we will map the vulnerability of spaces in the so-called "transit zone" to enable a holistic analysis of the environmental and operational aspects of locations of new narco-trafficking activity.



A map of Central America (from north to south- Panama, Costa Rica, Nicaragua, Honduras, El Salvador, and Guatemala) with the modeled trafficking network (black lines) and nodes (red and grey dots) showing simulated trafficking routes from narcotic countries to consumer countries.

RCN-UBE: The Research on STEM Education Network: Improving Research Inclusivity through a Grassroots Culture of Scientific Teaching

Dr. James J. Morris, UAB

Less than half of the students who begin their university careers in STEM majors ultimately graduate with a STEM degree, and this number is even lower for underrepresented minorities (URMs). Educational approaches that employ active, inquiry-based activities have been shown to improve persistence in STEM majors, but these methods are rare in introductory STEM classes, especially in the satellite colleges (e.g., community colleges and technical schools) where many URM and lower income students start their university career. The ROSE Network will seek to address this deficiency by creating a social network of faculty from both research universities and satellite colleges who share an interest in STEM education reform. ROSE will specifically work to introduce active learning and research-driven coursework to introductory biology courses at satellite colleges, and to increase the professional development opportunities for satellite college faculty. By implementing these reforms in areas with high URM populations, ROSE will seek to improve academic outcomes for these groups as well as to increase the proportion of URMs who choose graduate school or research careers after graduation.

The ROSE Network will undertake three primary tasks in its first five years of existence. First, it will organize meetings linking STEM-education interested faculty from 3 research-intensive, URM-serving universities as well as a number of satellite colleges associated with them. These meetings are expected to nurture STEM education reform collaborations as well as to provide a critical support network for satellite college faculty looking to reform their courses. Second, ROSE will create a website and social media presence designed to increase awareness of STEM education research and resources available for faculty who wish to reform their courses. Finally, a ROSE postdoctoral fellow will be appointed who will provide critical assistance to satellite college faculty who submit proposals to design and implement active learning reforms in their classrooms. By seeding a culture of STEM education research and reform at the "grassroots" level of satellite college faculty, ROSE hopes to create a growing and persistent impact on undergraduate biology education.

Partnership for Research and Education in Multiferroic Polymer Nanocomposites Between Tuskegee University and University of Nebraska-Lincoln

Dr. Vijaya Rangari, TU

This Partnership for Research and Education in Materials (PREM) involves a collaboration between Tuskegee University (TU) and the University of Nebraska-Lincoln's Materials Research Science and Engineering Center (UNL-MRSEC) to establish a world-class collaborative research program in multiferroic polymer nanocomposites. The overarching broad goal is to provide the highest quality research and education opportunities, and to increase recruitment, retention, and graduation of students from underrepresented groups in advanced degrees in emerging field of materials science and engineering. The other objective of the collaborative research program is to develop fundamental knowledge and a new class of nanocomposite materials combining polymers with multiferroic nanomaterials. This work has the potential for significant impact in many fields including structural nanocomposites and sensing applications. The Tuskegee PREM is committed to increasing broader participation of underrepresented groups in materials science through research and educational activities. The partnership will produce African American graduates in emerging areas of materials science & engineering through exposure to cutting-edge research in multiferroic composite materials and their applications. These graduates will help bring much-needed diversity to the nation's advanced technology workforce. It is also anticipated that the knowledge gained by the students through their involvement in new research areas developed through this grant will eventually result in new design and manufacturing methodologies that may well lead to patentable processes for large-scale applications.

This new partnership will strengthen TU's expertise in synthesis, manufacturing and characterization of advanced polymer nanocomposites, along with UNL-MRSEC's expertise in multiferroic materials. The collaborative research will focus on developing new class of composite materials comprising polymers and multiferroic nanoscale particles. These novel materials are expected to have structural, electronic, energy, and sensing applications. Towards this, the team will carry out research in three areas: 1) synthesis and characterization of multiferroic nanoparticles; 2) fabrication of multiferroic polymer composites and investigation of their applications; and 3)

Rangari and student researchers in his materials science lab

development of multifunctional polymeric nanocomposites utilizing multiferroic nanoparticles and study of their mechanical, thermal, magnetic and electrical properties.

Embodying Emotion in Interaction: A Biocultural-Linquistic Study of Communication and Physiology

Dr. Sonya Pritzker, UA

Personal relationships are often a source of comfort and support, but they can also be a source of stress and conflict. Previous laboratory and self-report research indicates that communication between partners is predictive of relational satisfaction and well-being. It also demonstrates that relational behaviors are linked to physical responses in the body that impact both short- and long-term health, and suggests that everyday emotion-laden communication between intimate partners influences physical outcomes and that, in turn, physical responses concurrently influence communication. We only have limited understanding, however, of what this relationship between communication, emotion, and the body looks like on a day-to-day basis, and on how this process differs in relation to racial, socioeconomic, and other cultural pressures influencing different couples. Therefore, understanding the multi-directional processes through which culture, communication, and physiological regulation co-emerge, outside of the laboratory and in specific emotion-laden interactions between intimate partners at home, can lead to more developed scientific understanding about how interpersonal behavior and physical wellbeing are connected. Findings from this research will provide insight into how communication between partners functions as a mediator of both intermediate and long-term effects on wellbeing. Ultimately, this research has implications for individual, relational, and societal health and wellbeing. At the University of Alabama, the project also contributes to the development of a new interdisciplinary program, and the training of both graduate and undergraduate students, including underrepresented minorities.

Drs. Sonya Pritzker, Jason DeCaro, and Joshua Pederson of the University of Alabama at Tuscaloosa will develop innovative theoretical and methodological models for understanding how the human body affects and is affected by everyday communication in the context of culture. The purpose of this research is to provide evidence for the ways that regular co-constructed patterns of emotion communication relate to physiological outcomes, ultimately affecting psychosocial wellbeing among couples in everyday life. The research thus takes an ethnographic approach to the study of relating among adult partners in the Southeastern U.S., emphasizing naturalistic observation, video-recoding, in-depth interviews, and close monitoring of physiological activity over multiple days. The researchers aim to collect anthropologically sound evidence for the reciprocal ways moment-to-moment physiology is affected by and affects emotion communication in everyday life, and how this process impacts indicators of psychosocial wellbeing among partners. The overarching intellectual merit of this research is the development of theoretical frameworks and methodological tools for innovative research programs examining intersections between language, culture, and the human body in multiple settings. This project thus brings together disparate subfields of anthropology and related disciplines, contributes to psychological understandings about the dynamics of emotions, and provides unprecedented insight into the ways in which everyday communication among intimate

Pritzer (center) Co-PIs Joshua Pederson (left) and Jason DeCaro (right) along with grad students

partners is linked to physiological processes. Building on the findings from laboratory studies, this project further addresses the complex layers of culture and communication in relationships within everyday lived experiences.

Collaborative Research: Atomistic Switches on Pyridinol Based Pincer Ligated Catalysts for Carbon Dioxide Reduction

Dr. Elizabeth Papish, UA

With funding from the Catalysis Program of the Chemistry Division, Dr. Elizabeth Papish of the University of Alabama at Tuscaloosa, Dr. Jared Delcamp of the University of Mississippi, and Dr. Charles Edwin Webster of Mississippi State University are engaged in collaborative research designing new catalysts that can harness sunlight to convert carbon dioxide, a greenhouse gas leftover from fuel combustion, into carbon monoxide, a fuel precursor. The ability to convert carbon dioxide to carbon monoxide is challenging, and is an important step in a strategy to harness sunlight to make diesel fuel from carbon dioxide. This conversion may become useful for securing the energy future of the US, as it can provide a means to replace oil reserves as are they are depleted. Furthermore, solar fuel formation coupled with fuel combustion can be considered carbon neutral, as this process does not add carbon dioxide to the atmosphere. The research team is using synthetic chemistry to make new catalysts, test those catalysts, and computationally optimize and understand the critical steps in this process. The key innovation has been understanding how changes to small, remote groups on the catalyst can influence the course of the reaction. This project uses metals that are earth abundant and non-toxic making the chemical reactions more sustainable and environmentally friendly. This project is training a diverse group of graduate and undergraduate students at universities in Alabama and Mississippi. This synergistic collaboration enhances the learning experience for the students in these groups. The Papish group is conducting outreach events, including "Careers in Chemistry" seminars at the University of Alabama and science demonstrations at a nearby elementary school to engage students in STEM education.

Drs. Papish, Delcamp, and Webster combine a wide variety of expertise in organometallic synthesis and mechanistic studies, light driven catalysis and harnessing solar energy, and organometallic computational chemistry. Their groups are designing, testing, and studying new catalysts bearing pincer ligands with oxygenated substituents on the periphery that are bound to both precious and earth abundant metals. The groups are elucidating how the protonation state of the remote oxygenated substituents on the ligands alters catalyst lifetime, reaction rate, and selectivity with these complexes. By understanding how electron donor groups influence proton coupled electron transfer (PCET) and reduces the energy requirements for catalytic processes, the groups are designing highly durable and active catalysts. This team is taking an iterative, mechanistic approach with feedback between the synthesis, catalysis, and computational studies that is leading to the development of highly active, durable catalysts. These catalysts are also being integrated into a complete photoelectrochemical cell where carbon dioxide reduction is coupled with water oxidation. This project is training a diverse group of undergraduate and graduate students over the project period. Dr. Papish is hosting "Careers in Chemistry" seminars at the University of Alabama each year. She and her group are also visiting local elementary schools to perform demonstrations and discuss opportunities in science with the students. New experiments are also being developed for undergraduate chemistry labs to introduce catalytic chemistry research to the teaching lab.complexes. By understanding how electron donor groups influence proton coupled electron transfer (PCET) and reduces the energy requirements for catalytic processes, the groups are designing highly durable and active catalysts. This team is taking an iterative, mechanistic approach with feedback between the synthesis, catalysis, and computational studies that is leading to the development of highly active, durable catalysts. These catalysts are also being integrated into a complete photoelectrochemical cell where carbon

Papish Group

dioxide reduction is coupled with water oxidation. This project is training a diverse group of undergraduate and graduate students over the project period. Dr. Papish is hosting "Careers in Chemistry" seminars at the University of Alabama each year. She and her group are also visiting local elementary schools to perform demonstrations and discuss opportunities in science with the students. New experiments are also being developed for undergraduate chemistry labs to introduce catalytic chemistry research to the teaching lab.

Implicit Biases and Discretionary Prosecutorial Decision Making

Dr. Jennifer Cox, UA

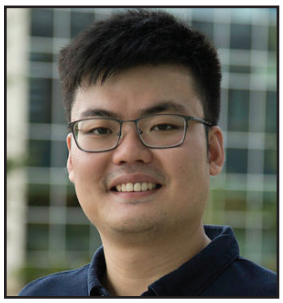
In the United States, prosecutorial discretion provides criminal prosecutors with the ability to decide whether to pursue or dismiss initial criminal charges, and whether to negotiate a plea bargain. However, not much is known about the factors that may motivate prosecutors when they make these significant legal decisions, including whether any biases may influence their decisions. Understanding this decision-making process is particularly important when the crime involves intimate partner violence (IPV). This project will study and compare potential implicit biases in prosecutorial decisions in cases of IPV.

This project will employ an experimental approach with prosecutors recruited to participate. Measures will be taken to assess any explicit and implicit biases. In the experiments the prosecutors will then be provided with materials from the initial stages of an IPV criminal investigation, including the arrest report and witness statements. The gender and sexual orientation of the individuals involved in the alleged offense will be manipulated and varied. Prosecutors will then determine how they would proceed in the case, including whether to charge a felony or misdemeanor, and whether to offer a plea bargain. This multidisciplinary project engages theoretically in the psychology and criminal justice literatures. The research will provide insight into various influences on prosecutors when rendering decisions in IPV cases. As well, by offering a more comprehensive understanding of prosecutorial discretion, it has the potential to guide reform and improve practice.

UA "Witness Stand" lab where researchers are preparing to film an expert witness' testimony

CRII: OAC: Scalable Cyberinfrastructure for Big Graph and Matrix/Tensor Analytics

Dr. Da Yan, UAB



The existing distributed graph and matrix analytics frameworks are designed with data-intensive workloads in mind, rendering them inefficient for compute-intensive applications such as graph mining and scientific computing. The goal of this project is to develop novel big

data frameworks for two compute-intensive tasks, graph mining and matrix/tensor computations, respectively. The two frameworks advance the field of big data analytics by motivating future systems for compute-intensive analytics, and promoting their application in various scientific areas to improve research productivity. The two systems will be available for public use, and can serve several cross-disciplinary projects in computer forensics, computational physics, and bioinformatics. The project includes mentoring graduate students and training K-12 students through summer internships, as well as related new course materials and outreach activities to help the public learn big data technologies. Thus, the project aligns with the NSF's mission to promote the progress of science and to advance the national health and prosperity.

The graph mining system and the matrix/tensor platform share the design of (i) a tailor-made storage subsystem providing efficient and flexible data access, and (ii) a computation subsystem with fine-grained task control for data-reuse-aware task assignment and load balancing. The graph mining system, called G-thinker, aims to facilitate the writing of distributed programs which mine from a big graph those subgraphs that satisfy certain requirements. Such mining problems are useful in many applications like community detection and subgraph matching. These problems usually have a high computational complexity, and existing serial algorithms tackle these problems by backtracking in a duplication-free vertex-set numeration tree, which recursively partitions the search space. G-thinker adopts an intuitive programming interface that minimizes the effort of adapting an existing serial subgraph mining algorithm for distributed execution. The subgraphs to mine are spawned from individual vertices and they grow their frontiers as needed, and memory overflow is avoided by spilling subgraphs to disks when needed. In each machine, vertices and edges shared by multiple subgraphs need only be transmitted and cached once, which minimizes communication (and hence data waiting) so that CPU cores are better utilized. To address the load-balancing problem of power-law graphs, G-thinker explores recursive decomposition and work stealing to allow idle machines to steal subgraphs for mining from heavily-loaded machines. The project also explores a distributed matrix/tensor storage and computing framework, where matrix/tensor partitions are stored in multiple replicas using different storage schemes to efficiently support all kinds of submatrix access operations. This flexible storage scheme offers the upper-layer computations much more opportunities for fine-grained optimizations, including smarter task scheduling and in-situ updates. The use of this framework is exemplified by matrix multiplication and LU factorization. Both of the proposed frameworks can help build a cyberinfrastructure for collaborations with scientists in science, medicine, and industry.

Dimensions: Collaborative Research: Processes that Generate and Maintain Phylogenetic, Genetic, and Functional Diversity of the Freshwater Mussel Holobiont across Multiple Scales

Dr. Carla Atkinson, UA

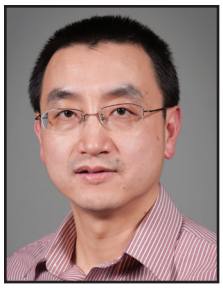
The term 'holobiont' is used to refer to an organism as the sum of the interactions between the host and the microbes associated with them (the 'microbiome'). Yet, the extent to which diversity at different levels of biological organization in host and microbiome communities influence functional diversity within ecosystems represents a considerable gap in our understanding of global biodiversity. This project will represent a landmark in understanding what generates and maintains biodiversity in river ecosystems. Freshwater mussels are a highly imperiled, species-rich group of animals that play critical roles in rivers through their filter-feeding and cycling of nutrients. Although the ecological value of freshwater mussels is widely appreciated, little is known about how factors like genetic diversity of individual species, species composition and diversity of mussel communities, or interactions between mussel communities and their gut microbiomes structure these ecological processes

across environments and geographic scales. Similarly, little is known about how host-microbiome interactions have structured the evolution of both groups over time. If the processes and mechanisms underlying patterns of biodiversity in these animals can be identified, managers will be better armed to make informed decisions for conservation and restoration efforts that will ultimately benefit the entire ecosystem.

Using approaches that scale from individual-to-population-to-species levels and above, this project seeks to understand ecological and evolutionary associations among the environment, genetic diversity, functional traits, and community assembly across both host and microbiome phylogenies in contemporary taxa and ancestral lineages. This research will integrate analyses of (1) intraspecific genetic diversity in a suite of freshwater mussel species, (2) phylogenetic diversity of communities of mussel species as well as their associated microbiomes, and (3) functional diversity of the mussel-microbiome holobiont. Integrating these three dimensions of biodiversity will allow us to comprehend the mechanisms that underpin the roles that freshwater mussels play in ecosystems, and to understand the fundamental ecological and evolutionary processes that structure biodiversity in space and over time. Furthermore, this work will extensively populate public databases with new data on species distributions, abundances, microhabitat environmental characteristics, and DNA sequence variation that will have impacts on basic evolutionary and ecology research while also informing conservation and management of a highly imperiled and ecologically important group.

Collaborative Research: A Regularized Poisson Boltzmann Model for Fast Computation of the Ensemble Average Polar Solvation Energy

Dr. Shan Zhao, UA



This collaborative research project will develop mathematical models and simulation tools for studying the interactions between large biological molecules, for example proteins, and surrounding water molecules modeling an aqueous environment. The energy computation for characterizing such interactions is complex because the structures of biomolecules are not completely fixed or rigid, and the surrounding water molecules are also in constant motion. Thus, to deliver quantities that are comparable with experimentally-measurable energies, one must account for these conformational changes in the corresponding mathematical description. A new theoretical model will be formulated in this project by combining appropriate biophysical considerations with mathematical advances, allowing simulations to mimic the effect of conformational changes in both macromolecule and water atoms. The proposed mathematical development will benefit researchers in molecular biosciences and biophysics. Moreover, the proposed models and algorithms will be implemented in DelPhi, which is distributed free of charge to academic users, to ensure extensive usage by practitioners from mathematics, chemistry, physics, and biology. In addition, this project will provide interdisciplinary research and training opportunities for undergraduate and graduate students in biological modeling, computation and mathematical analysis.

Experimentally-observable solvation energies are ensemble averaged. However, direct Poisson-Boltzmann (PB) calculations of such energies require the generation

of a representative ensemble of structures in terms of thousands of snapshots, which is computationally very expensive. Tremendous savings in computational time can be achieved if one can calculate the ensemble average solvation energy by employing a single structure by mimicking the effect of conformation changes of macromolecules via heterogeneous dielectric distributions. In this project, a novel super-Gaussian PB model will be formulated embodying three key innovations: (1) incorporation of environment-dependent atomic characteristics of macromolecules within the continuum electrostatic partial differential equation (PDE); (2) development of a novel, regularized formulation to treat singular charges, with new elliptic PDEs developed through rigorous mathematical analysis: partial charges and water molecules (inside cavities, bonded to the protein, and in bulk solvent) will no longer be modeled as homogeneous spatial regions as in the current Gaussian model, but will reflect the flexibility of the entire solute-solvent system; and (3) elimination of the need to determine a sharp molecular surface, for macromolecules in both vacuum and water environments. Model benchmarking and biological applications tests will be carried out for validation, and the resulting tool will be incorporated into the widely-used DelPhi program package for computing ensemble-average solvation energies. This project is supported jointly by the Division of Mathematical Sciences Mathematical Biology Program, the Division of Chemistry Chemical Theory, Models and Computational Methods Program, and the Established Program to Stimulate Competitive Research (EPSCoR)

MRI: Acquisition of an Atomic Force Microscope for Materials Research and Education

Dr. Eugenia Kharlampieva, UAB

This Major Research Instrumentation award supports the University of Alabama at Birmingham to acquire an atomic force microscope for interdisciplinary materials research and education. This microscope supports a diverse, multi-departmental research in soft materials ranging from soft synthetic hydrogels to relatively dense composites and biological structures. The instrument provides enhanced capabilities for quantitative nanoscale mapping of electrical, mechanical, biological, and chemical properties. It also plays a vital role in student education in the fields of chemistry, materials science, biomedical science and biomedical engineering. Educational opportunities are available not only for undergraduates, graduate students, and postdoctoral fellows on the campus, but they expand via outreach to local middle and high school students. These multidisciplinary educational efforts are important to increase the recognition of the research efforts in the Departments of Chemistry, Medicine, and Biomedical Engineering in order to improve student recruiting, especially among underrepresented populations. A high caliber research environment is also vital to the regional economy in Central Alabama through raising community awareness toward biomedical and soft-materials technologies.

NATIONAL SCIENCE FOUNDATION CO-FUNDED EPSCoR

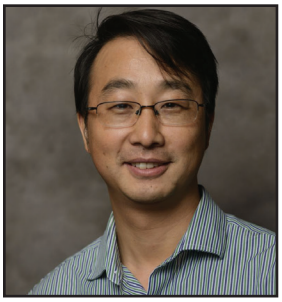
MRI: Acquisition of an X-Ray Photoelectron Spectrometer for Advancing Multidisciplinary Research and Education in Quantum Mechanics, Nanotechnology, Biosensors, and Energy Storage

Dr. Stephen Egarievwe, AAMU

This award from the Major Research Instrumentation program and the Established Program to Stimulate Competitive research (EPSCoR) supports Alabama Agricultural and Mechanical University to acquire a state-of-the-art high-performance X-ray Photoelectron Spectrometer (XPS) to advance multidisciplinary research and discovery in emerging and future technologies, while promoting diversity by broadening the participation of underrepresented minority men and women. The instrument has excellent capabilities in characterizing surfaces, nanomaterials, thin films, and functional interface materials. It will support faculty and student research activities in quantum mechanics, nanotechnology, biosensors, and energy harvesting and storage. It will also aid undergraduate and graduate students in characterization techniques, and in developing excellent analytical and interpretational skills. In addition, the XPS will have significant impacts on education and training through the many outreach and summer research programs at Alabama Agricultural and Mechanical University. These programs benefit K-12 education, high school bridge programs, and transfer of 2-year community college students to 4-year STEM degree programs. Thus, this instrument will also enhance recruitment, retention and graduation rates into the STEM workforce.

MRI: Development of an Underwater Mobile Testbed Using a Software-Defined Networking Architecture

Dr. Aijun Song, UA



This project, developing one of the first Software Defined Network (SDN)-based underwater mobile testbeds to support the operation of marine robot fleets, aims to address a technological bottleneck, that of achieving integrated communications and navigation underwater. A fleet of Autonomous Surface Vehicles (ASV)s are directed to follow sampling Autonomous Underwater Vehicles (AUVs) to provide acoustic and Magnetic Induction (MI) communication over relatively short ranges. Launching the following effort thrusts: Acoustic & MI Communication; Control of ASVs & UAVs; SDN architecture; and Integration and evaluation.

The testbed will be designed to achieve cost-effectiveness, transferability, flexibility, and scalability and is expected to become a stable instrument that is accessible by multiple research communities that include ocean acoustics, communication and networking, robotics, oceanography and environmental sciences. The hybrid acoustic/MI communication will be used to achieve reliability and high data rates across the mobile network for ASVs and AUVs, while smooth autonomy of the fleet would be ensured by cooperative localization and real-time data transfer among the ASV-AUV pairs. The testbed is expected to enable various research directions, including underwater swarming, deep-learning-based underwater joint networking and navigation, and integrated oil spill responses.

DEPARTMENT OF ENERGY
EPSCoR

The DOE EPSCoR Program is positioned in the Office of Science and is the single largest supporter of basic research in the physical sciences. It supports both basic and applied research and development across a wide range of interdisciplinary program areas that include, Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, Nuclear Physics.

The goals of the DOE EPSCoR program are to:

- Improve the capacity to conduct sustainable and national competitive energy-related research
- Jumpstart infrastructure development through increased human and technical resources, training scientists and engineers in energy-related areas
- Build beneficial relationships with ten world class laboratories in designated states and territories, leverage DOE national user facilities, and take advantage of opportunities for intellectual collaboration across the DOE system.

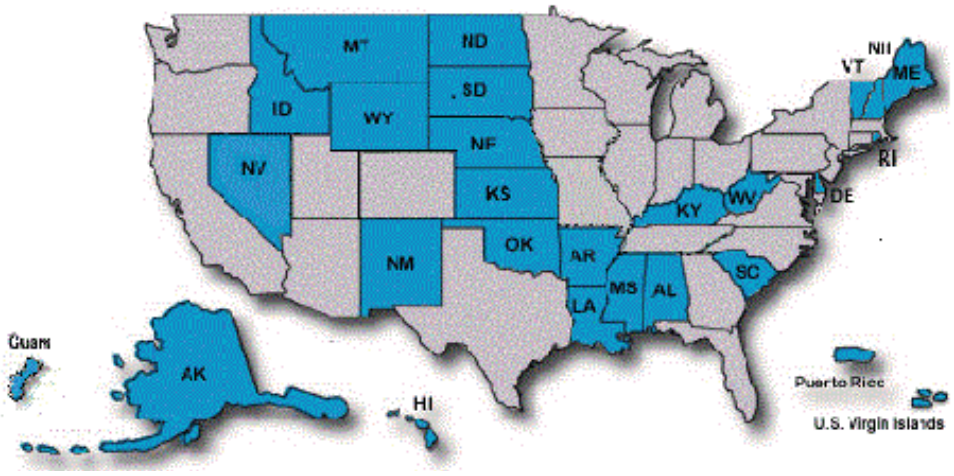
DOE uses NSF EPSCoR eligibility criteria. Twenty-four states are currently eligible for DOE EPSCoR. DOE EPScoR provides funding support through three types of awards including the Implementation Grant, National Laboratory Partnership Grants, and the Early Career Research Program, each are described below.

The Implementation Grant is for a maximum period of six years with an initial period of three years. Maximum funding for Implementation Grants is $2,500,000 per year and until recently only one active implementation grant per state or territory was permitted at a time. Now any EPSCoR state or territory can apply when there is an open Funding Opportunity Announcement (FOA). It has been several years since the last funding opportunity announcement for a DOE Implementation grant.

The EPSCoR-State/National Laboratory Partnership Grant is for a maximum period of 3 years. Maximum funding for these grants is $200K per year with no state matching funds required. PIs on current DOE grant awards are not eligible to serve as PIs on Partnership Grant applications. Grants allow EPSCoR researchers to work closely with DOE National laboratories to conduct collaborative research and train students. Multiple submissions per state and laboratory are permitted and expected. There is no limit to the number of state or laboratory submissions per year. All funding resides within the EPSCoR state and no EPSCoR funds are permitted to support DOE National Laboratory activities.

DOE Office of Science Early Career Research Awards are limited to applications received from academic institutions in EPSCoR jurisdictions. A particular DOE Program Area/ Office many nominate meritorious applications that would not have been otherwise considered for joint consideration by multiple program areas on a funds available basis.

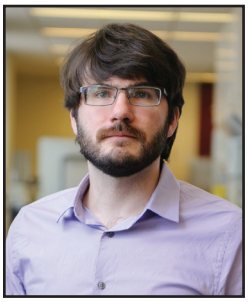
In FY 2017, due to limited time, there was no DOE EPSCoR solicitation, but the DOE EPSCoR office funded four FY17 projects. Alabama recieved no DOE EPSCoR funded projects in 2018.



FY 2017 DOE EPSCoR Awards					
Inst	PI	Award	Title	Funding	Period of Performance
UA	Jared Allred	DE-SC0018174 (Early Career Award)	Investigation of Short-Range Ordering in Transition Metal Compounds by Diffuse Scattering	750,000	9/1/2017-8/31/22
AU	Steven Mansoorabadi	DE-SC0018043 (Early Career Award)	Mechanistic Studies of a Primitive Homolog of Nitrogenase Involve in Coenzyme F430 Biosynthesis	750,000	9/1/2017 to 8/31/2022
AU	Eduardus (Evert) Duin	DE-SC0018011	Expression of recombinant methyl-coenzyme M reductase in the methanogenic archaeon Methanococcus maripaludis for the examination of activation and the role of post-translational modifications	303,333	9/1/2017-8/31/2020
AU	Guillaume Laurent	DE-SC0017984	Real-time Observation of Multi-electron Processes in Atoms and Diatomic Molecules	441,328	8/15/2017 to 8/14/2020

Investigation of Short-Range Ordering in Transition Metal Compounds by Diffuse Scattering

Dr. Jared Allred, The University of Alabama



Future energy needs and sustainability require new materials with novel properties for such applications as energy production, storage and transport and microelectronics. Quantum materials with several competing interactions at the electronic level offer tremendous opportunity to discover, design and tune properties for such applications. Although it has been recognized that small deviations in atomic positions, driven by the competing electronic interactions, in these crystalline materials can have significant impact on their properties and tunability, it remains a challenge to accurately characterize such deviations (short-range order). The planned project will contribute to this challenge in conducting research on a class of materials with novel properties that is tunable by strategically replacing some atoms with others, coupled with the measurement of diffuse scattering at the recently developed advanced neutron and synchrotron x-ray scattering instruments at the DOE's scattering facilities. The diffuse scattering from any short-range order in materials will span a wide solid angle and hence the datasets are extremely large and complex, posing a challenge in accurate data analysis. High purity single crystal samples of model transition metal compounds will be grown and the short-range order will be characterized by using neutron and x-ray scattering. Efficient data analysis tools will be developed to fully use the large datasets to accurately measure the short-range order in these materials toward understanding its role on properties and to direct the material design for improved properties. The project thus will unveil new insights on quantum materials and concurrently contribute to the development of new approaches and analysis tools to characterize the short-range order in materials, that will be broadly useful to the larger scientific community.

Mechanistic Studies of a Primitive Homolog of Nitrogenase Involved in Coenzyme F430 Biosynthesis

Dr. Steven Mansoorabadi, Auburn University

Methyl-coenzyme M reductase (MCR) is the key enzyme in the biological formation and anaerobic oxidation of methane (AOM). Methane is a potent greenhouse gas and the major component of natural gas. Given the abundance of natural gas

reserves in remote areas, there is great current interest in a scalable bio-based process for the conversion of methane to liquid fuel and other high-value chemicals. MCR holds much promise for use in such a methane bioconversion strategy. However, MCR cannot currently be produced in an active form in an industrially viable strain, due to the lack of genetic and biochemical information about the formation of its unique nickel-containing coenzyme, F430. The coenzyme F430 biosynthesis (Cfb) pathway was recently elucidated and the key step was found to involve an unprecedented reductive cyclization reaction that converts the intermediate Ni-sirohydrochlorin a,c-diamide to the immediate precursor of F430, 15,17^3-seco-F430-17^3-acid. This remarkable transformation, which involves a 6-electron ring reduction, cyclization of an acetamide side chain to form a γ-lactam ring, and the formation of 7 stereocenters, is catalyzed by a primitive homolog of nitrogenase (CfbCD). Nitrogenase is a two-component metalloenzyme that catalyzes the adenosine triphosphate (ATP)-dependent reduction of nitrogen gas to ammonia and hydrogen gas (biological nitrogen fixation), a reaction of great industrial importance. Homologs of nitrogenase are also involved in the biosynthesis of the photosynthetic pigments chlorophyll and bacteriochlorophyll. Phylogenetic analysis of the CfbCD complex suggests that it is representative of a more ancient lineage of the nitrogenase superfamily, and a thorough investigation of its structure and function is likely to shed light on the mechanisms and evolution of these important metalloenzymes. Moreover, a detailed understanding of the mechanism of the CfbCD complex may aid in the development of specific inhibitors to help reduce natural greenhouse gas emissions and can be exploited for the production of MCR for use in methane bioconversion. Towards these goals, the objectives of this research are focused on 1) the identification of physiological electron donors and in vivo coenzyme F430 synthesis, 2) the analysis of the iron-sulfur centers, structure, and oligomerization state changes, and 3) the characterization of transient intermediates and the intercomponent electron transfer of the CfbCD complex.

Expression of recombinant methylcoenzyme M reductase in the methanogenic archaeon Methanococcus meripaludis for the examination of activation and the role of post-translational modifications

Dr. Eduardus Duin, Auburn University

This is a collaborative proposal with the University of Georgia at Athens.

Methanogens, or methane-producing acrhaea, are obligate anaerobes that form methane as a major product of their energy metabolism. They catalyze a significant component of the carbon cycle on Earth and are responsible for most of the methane in the Earth's atmosphere. The methanogens are also closely related to the archaea that anaerobically consume methane (called ANME). This radiatively important trace gas has more than doubled since the beginning of the industrial revolution and contributed to the current global warming.

The methyl-coanzyme M reductase (or Mcr) is a key enzyme in both the formation and anaerobic oxidation of methane. In this biosynthetic direction, it catalyzes the reduction of methyl-coenzyme M (CH_3-S-CoM) by coenzyme B (HS-CoB) to form methane and the heterodisulfide, CoM-S-S-CoB. The prosthetic group of this unique enzyme is the nickel tetrapyrrole, coenzyme F_{430}. When active, the metal must be in the Ni(I) oxidation state. Because the redox potential of the F_{430}NI(II)/F_{430}NI(I) couple is near 650 mV, the stability of the Ni(I) prothetic group is critical for maintaining enzyme activity. The enzyme also contains unique posttranslational modification (PTMs) near the active site. The proposed research will address the mechanism of Mcr activation and the role of one of the PTMs. Not only will it provide basic insight in a major biogeochemical process, this research will enable the design of highly selective and efficient bio-inspired catalysts for direct activation of methane, formation of biofuels through improved biochemical pathways for methane production, and design of specific inhibitors

to lower greenhouse gas production by ruminants and improve feed efficiency.

Key to advancing these core research areas is the capability to express recombinant and active Mcr. In preliminary studies, recombinant *Methanothermococcus okinawensis* Mcr ($Mcr_{ok)}$ was successfully expressed in the methanogenic archaeon *Methanococcus maripaludis*. Although inactive, the recombinant Mcr_{ok} contained coenzyme F_{430} and the same 4 PTMs as present in the native enzyme. To our knowledge, this represents the first successful expression and assembly of hte holoenzyme. In parallel to our studies of expression of recombinant Mcr, an in-frame deletion mutant was constructed for the gene encoding the methogen marker protein 10 (Mmp10). Of the four PTMs found in the native Mcr from M. *maripaludis*, only the Me-Arg was absent. The Me-Arg PTM was restored when the mutant was complemented with the *mmp10* gene on an expression plasmid.

Building upon these preliminary studies, the proposed research as three specific aims:

1. Characterizaion of the activation complex from *Methanothermobacter marburgensis*. In preliminary results, recombinant proteins provided partial activation of the Mcr in vitro. Further experiments will be perfored to optimize these reaction to obtain basic insights into the activation process.

2. Activation of the recombinant Mcr either in vivo or in vitro. Based upon what is learned in the first aim, activation of the recombinant Mcr will be optimized. This goal has a high priority because it will enable site-directed mutagenesis and a large number of other studies on the mechanism of the enzyme.

3. Elucidation of the role of the Me-Arg PTM in catalysis. The Me-Arg PTM is especially interesting because it is absent in the anaerobic methanotrophs of hte ANME-1 group. For this reason, it has been speculated that it plays an important role in determining the physiological direction of Mcr, either CH_4 production or oxidation.

Real-time Observation of Multi-electron Processes in Atoms and Diatomic Molecules

Dr. Guillaume Laurent, Auburn University

We propose to implement a novel experimental approach to observe, in real-time, electron dynamics in atoms and molecules at the attosecond time scale. Despite significant efforts that are underway, time-resolved studies at the attosecond time scale are still restricted to a few benchmark systems possessing an electronic structure sufficiently simple to make it possible to isolate a particular electronic process and univocally dissect its dynamic. In this project, we propose to merge the forefront expertise and state-of-the-art techniques of distinct scientific fields, namely laser physics and collision physics, to explore both the electronic and nuclear motions in more complex systems. We aim to combine high-repetition-rate attosecond sources and sophisticated multi-particle imaging techniques to investigate in kinematically complete experiments the correlated electron dynamics in atoms and the coupled electron nuclear motion in small molecules. The multi-differential measurements carried out in this project will foster the development of new theoretical models that are essential for a quantitative interpretation of experiments on complex systems. Finally, we expect that this new capability will offer promising possibilities to enhance our fundamental understanding of electron dynamics in atomic and molecular species, and ultimately to identify ways to control them, which will open a new path toward laser-controlled chemistry at the attosecond timescale. The enzyme also contains

NATIONAL AERONAUTICS & SPACE ADMINISTRATION EPSCoR

The NASA EPSCoR program began in 1994 and works to strengthen the research capabilities of 27 jurisdictions that have in the past not participated equably in competitive aerospace and aerospace-related research activities. EPSCoR provides eligible jurisdictions with funding to develop a more competitive research base within their jurisdiction and member academic institutions. NASA EPSCoR objectives are to:

- Contribute to and promote the development of research infrastructure in EPSCoR jurisdictions in areas of strategic importance to the NASA mission.
- Improve the capabilities of the jurisdictions to gain support from sources outside the NASA EPSCoR program.
- Develop partnerships between NASA research assets, industry, and EPSCoR jurisdictions' academic institutions.
- Contribute to the overall research infrastructure, science and technology capabilities, higher education, and/or economic development of the jurisdiction.

NASA EPSCoR Jurisdictions

Alabama	Nevada
Alaska	New Hampshire
Arkansas	New Mexico
Delaware	North Dakota
Guam	Oklahoma
Hawaii	Puerto Rico
Idaho	Rhode Island
Kansas	South Carolina
Kentucky	South Dakota
Louisiana	Vermont
Maine	U.S. Virgin
Mississippi	Islands
Montana	West Virginia
Nebraska	Wyoming

The primary funding opportunities of NASA EPSCoR are:

- Research Cooperative Agreement Notice (CAN) Grant, which solicits topic-specific proposals addressing high-priority NASA research and technology development needs. Awards are up to $750,000 for a three-year performance period. NASA intends to announce the EPSCoR Cooperative Agreement Notice, or CAN, for Research Awards yearly, pending funding availability; 50% cost share is required.
- EPSCoR Research Infrastructure Development awards, or RID. This component enables jurisdictions to build and strengthen relationships with NASA researchers. The RID has a three-year base period of performance with a potential one-year no cost extension. Awards are $125,000 per year and requires 100% cost share by the awardee. NASA intends to announce the RID opportunity every three to five years, pending funding availability.
- EPSCoR International Space Station, or ISS, Flight Opportunity Awards provide opportunities to launch mature research projects to the space station. Awards are up to $100,000 for a three-year performance period with no cost share obligations. NASA intends to announce the EPSCoR CAN for ISS Flight Opportunity Awards yearly, pending funding availability.
- NASA Travel Grants (TG) were created to encourage collaboration with researchers at all NASA Centers, provides up to $ 1,500 per trip, awards up to $12,000 per year to faculty state-wide, and awards are announced annually pending availability.
- NASA Rapid Response Research Solicitation (RRR) is a new funding opportunity from NASA for quick turn-around of research needs by NASA for one year period of performance, no cost share for the $100,000 award is required. Proposals are limited to three pages for the technical section, these proposals are submitted quarterly pending funding and topic availability.

NATIONAL AERONAUTICS & SPACE ADMINISTRATION EPSCoR

The Alabama NASA EPSCoR program builds upon existing strengths within the State, using facilities and personnel at the Space Grant Universities and at the NASA Marshall Space Flight Center (MSFC) but extending these to a new set of teachers, researchers, students, and industrial collaborators. The Alabama NASA EPSCoR Program Director also serves as the Alabama Space Grant Consortium Director. The goals of Alabama NASA EPSCoR are to (1) effect a permanent increase in the national competitiveness of Alabama's basic research programs in targeted areas; (2) enhance research areas which already have strength and which are closely related to the special needs of Alabama; and (3) provide the basis for continuing expansion of basic research in Alabama in the post-EPSCoR era.

Alabama NASA EPSCoR elected a new Agency Director, as well as Alabama Space Grant Director, Dr. Dale Thomas in August 2017. Dr. Thomas currently serves as a Professor and Eminent Scholar of Systems Engineering in the Department of Industrial and Systems Engineering and Engineering Management at the University of Alabama in Huntsville.

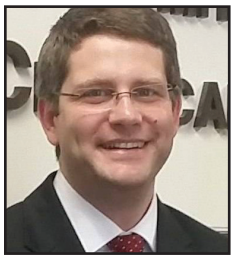
During FY 2018, Alabama NASA EPSCoR had two ongoing Cooperative Agreement Notice (CAN) awards, one awarded in October 2013 entitled, *Experimental Investigation of Noise and Thermoacoustic Instabilities in Low-Emission, High-Efficiency Combustion Systems for Aviation* and the October 2016 CAN award entitled, *Development of Dust Free Binders for Spacecraft Air Revitalization Systems.* Alabama was awarded a new CAN award entitled, *Micro-Magnetic Driven Design of Multi-Component Magnetic Alloys for Advanced Electric Propulsion* in May 2018. In addition, the FY15 Research Infrastructure Development Award was ongoing which will continue through January 2019. Five NASA travel grants were awarded to researchers at three Alabama institutions- Auburn University, University of Alabama in Huntsville and the University of Alabama. Principal Investigators are: Xiaoyuan Lou at Auburn University, David B. Landrum at University of Alabama in Huntsville and Anwarul Haque, Patrick Kung and Vinu Unnikrishnan at the University of Alabama.

NEW FY17 and FY18 NASA EPSCoR awards					
CAN Award NNH16ZHA001C	Dale Thomas	Development of Dust Free Binders for Spacecraft Air Revitalization Systems	UAH	750,000	5/1/2018-4/30/2021
	Science PI: Grant Glover		USA		
FY 18 CAN	Dale Thomas	Micro-Magnetic Driven Design of Multi-Component Magnetic Alloys for Advanced Electric Propulsion	UAH	750,000	5/1/2018-4/30/2021
	Science PI: Claudia Mewes		UA		

ALABAMA NASA EPSCoR COOPERATIVE AGREEMENT NOTICE (CAN) AWARD

Development of Dust Free Binders for Spacecraft

PI: Dr. Dale Thomas, University of Alabama in Huntsville
Science Investigator: Dr. Grant Glover, University of South Alabama


T. Grant Glover

The International Space Station's air revitalization system currently removes CO_2 from the station using adsorbent beds. Unfortunately, during operation the adsorbent pellets contained in the system breakdown and produce a fine dust that is carried downstream of the adsorbent bed and causes mechanical failures in the air revitalization system. Therefore, the work proposed will develop binders for traditional zeolites and MOF adsorbent powders that will provide effectively zero dusting when regenerated numerous times under vacuum and heat. The work is collaborative with the Marshall Space Flight Center, the Johnson Space Center, the Ames Research Center, the University of Alabama, and the University of South Alabama (USA). To eliminate dusting, adsorbent pellets will be encapsulated with either polyvinylidene fluoride (PVDF) or Matrimid, both of which are commercially available polymers that are typically used in gas membrane systems. The effectiveness of pellet encapsulation at eliminating adsorbent dust will be quantified by measuring the pressure drop across an adsorbent bed containing the encapsulated pellets during numerous adsorption and regeneration cycles. Pellets will be formed from adsorbent powders by pressing the powders with polyvinyl alcohol or clay binders. Encapsulated pellets will be provided to NASA for evaluation and it is anticipated that NASA scientists and the Glover Research Group will work collaboratively to produce academic publications detailing the results of this program. With the program creating a novel way to maintain mechanical integrity of adsorbents and catalysts, it is likely that it will generate intellectual property. Additionally, the project will partner with existing USA outreach programs to identify two students from underrepresented groups and provide these students paid internships in the Glover Research Group.

Micro-Magnetic Driven Design of Multi-Component Magnetic Alloys for Advanced Electric Propulsion

Dr. Claudia Mewes, University of Alabama

Electric based propulsion has emerged as a strategic investment for NASA Aeronautics for the design and implementation of ultra-efficient aircraft to assist our nation in the transition to low-carbon propulsion. In electric motors, magnetic materials assist in the conversion of electrical energy to mechanical energy. During this conversion, alternating current energy losses occur which would be substantially reduced through the proposed development of a new class of (Fe,Co)-based amorphous and nanocrystalline magnetic composites. Such new materials will be a key requirement for NASA as it aims to improve the efficiency of electric motors that scale from the kilowatt to megawatt levels as outlined in NASA's next generation electrical and hybrid aircraft technical readiness plan. To provide a systematic development of these alloys, faculty at The University of Alabama (UA) will team with Glenn Research Center (GRC) scientists and engineers to create a synergistic partnership that leverages expertise and infrastructure at each institution. UA will lead a materials-by-design approach based on atomistic and micro-magnetic models that will predict the optimal phase distributions within these magnetic composites. Through the use of modern computational tools, we will be able to accelerate the experimental direction of processing of these alloys that will be done in partnership at the NASA facility. To assist NASA's processing control needed to achieve the modeled composite microstructures, UA will provide

targeted phase transformation and kinetic studies of crystallization that will quantify the effects of annealing temperature and times on microstructural evolution. Furthermore, the analytical characterization of the materials will be forward fed back to our models to accurately capture the physics that gives rise to various magnetic attributes. Through joint UA-NASA magnetic characterization, we will verify, validate, and refine our models to the physically measured properties, with UA providing unique broadband thermomagnetic resonance studies that will reveal the loss performance in our alloys. This research positions UA-NASA as a formidable leader in nanocomposite magnetic material development through a closed loop interaction of modeling-processing-characterization. Through this research, the national workforce development in science and engineering will be strengthened by supporting the rising generation of STEM students as well as outreach programs that will inspire the next generation of scientists and engineers.

ALABAMA NASA EPSCoR RESEARCH INFRASTRUCTURE DEVELOPMENT (RID)

The purpose of the Alabama NASA EPSCoR RID program is to build core capabilities at Alabama's universities and other collaborative institutions. We shall build competitive research and technology development capabilities in areas of interest to both NASA and the State of Alabama. The interests of NASA are defined in the CAN, in the 2014 NASA Strategic Plan, and by the 3 strategic goals of the Office of Education's ARCD. The interests of the State of Alabama in this regard are defined by the Alabama State EPSCoR Committee (SEC), which oversees all EPSCoR programs within the state. The PI of this proposal is Dr. Dale Thomas, the Alabama NASA EPSCoR Director, the Alabama Space Grant Consortium Director, and a professor at UAHuntsville. There are five ongoing projects supported by the NASA Research Infastructure Development (RID) Award.

The following FY15 RID projects continue until January 2019

Dielectric Polymer Nanocomposites Based on Novel Two-Dimensional Transition Metal Carbides

Dr. Majid Beidaghi, Auburn University

Dr. Beidaghi (right) and GRSP PhD student Armin VahidMohammadi discuss the testing of energy-storage devices based nanocomposites being developed

High dielectric constant (εr) materials are crucial for many applications in advanced electronics and electric power systems including embedded capacitors, energy storage devices and actuators. Compared to ceramic dielectrics, polymer or polymer composite dielectrics offer many advantages such as being lightweight, having higher breakdown strengths, greater reliability, flexibility and scalable processing. Polymer nanocomposites with high flexibility and based on dielectric polymers and conductive fillers, or conductor-dielectric composites (CDCs), have attracted much attention because of their high dielectric constant, low loss and high flexibility. The dielectric response of CDCs is due to the percolation phenomena and is affected by the geometry of the filler particles and the chemical interactions between the fillers and the polymer matrix. 2D conductive materials, such as graphene, are recently reported as excellent fillers with significant effects on the dielectric constant of the composite. However, graphene sheets are very difficult to disperse in polymers and their chemical interaction with the matrix is limited, hindering the wide application of graphene-based CDCs. This project is aimed at using an alternative filler material based on a 2D transition metal carbide (Ti3C2) and developing flexible polymer nanocomposites with high dielectric constants and low loss. This novel 2D titanium carbide is highly conductive, shows high temperature stability and a tunable surface chemistry that can be utilized to design nanocomposites with high dielectric constants and superior mechanical properties and flexibility. The dielectric polymer nanocomposites developed in this

study will be based on the copolymer poly(vinylidene fluoride-co-trifluoroethylene), in short P(VDF-TrFE), which shows better dielectric performance compared to many other polymers. Our experimental work in the project will involve controlled dispersion Ti3C2 in P(VDF-TrFE) copolymer to fabricate nanocomposites with various filler contents and assessment of their dielectric and mechanical performance. The project will result in development of better dielectric materials for applications including some important applications related to NASA's missions. The outcome of this project will be shared and discussed with researchers at NASA Marshal Space Flight Center.

Mechanical Property relationship of Inconel 718 fabricated by selective laser melting using Combined In-Situ Characterization Measurements and Phase Field Crystal Plasticity Simulations

Dr. Lin Li, University of Alabama

Dr. Lin Li with former GRSP awardee Sharniece Holland

Additive manufacturing (AM) of metal components is a rapidly growing manufacturing paradigm that could revolutionize the design and production of complex metallic parts. However, the extreme processing conditions create unique material microstructures (e.g., various metallic phases, textures, localized stresses) that can affect their performance. This proposed program is to understand the relationship of process, microstructural evolution and mechanical performance of AM metal components using an integrated computational materials engineering (ICME) approach. A model material of Inconel 718 fabricated by selective laser melting (SLM) will be studied. A multicomponent and multiphase phase field (PF) model coupled with crystal plasticity (CP) finite element method will be developed and used iteratively to provide predictions of phase fraction, crystallographic texture, residual stress, and yield stress for comparison with the experimental measurements. The microstructural characterization will be performed using electron backscatter diffraction (EBSD) during post-production thermal-mechanical treatment. High temperature tensile an stress relaxation tests will be conducted to calibrate and validate the mechanical prediction of the coupled model. A successful implementation of the program will deliver a microstructure enhanced constitutive material mechanics model that links the extreme processing condition of SLM, Inconel 718 microstructures (e.g., phases, texture), internal stress state, and the mechanical performance. The proposed program is to directly address the top technological challenges in 2015 NASA Space Technology Roadmap on Computational Design Materials.

Large Eddy Simulations of Complex Turbulent Flows Using Non-Dissapative, Temporally and Spacially High-Order, and High Efficiency Unstructured Grid Flow

Dr. Sharma Rani
University of Alabama in Huntsville

Radiative heating is a crucial component of the overall aerothermodynamic environment experienced by hypersonic cruise and hypersonic atmospheric-entry vehicles. The goal of this NASA/EPSCoR research is to develop a predictive and efficient computational framework for modeling non-gray radiative heat transfer in hypersonic flows characterized by large variations in the medium optical thickness. The proposed framework consists of two principal modeling components. The first is a novel hybrid approach to solve the radiative transport equation (RTE) through a combination of the spherical harmonics (PN) method and the Monte-Carlo method. The second component involves modeling the non-gray effects of participating media through the full spectrum correlated k-distribution (FSCK) method. The overall computational approach is unique and innovative due to: (1) its ability to efficiently handle multiple orders-of-magnitude variation in medium optical thickness (through the hybrid RTE solution methodology), and (2) its ability to solve the non-gray RTE at a small fraction of the computational cost of

line-by-line calculations (through the FSCK method). In the first year of the NASA/EPSCoR project, the modified differential approximation (MDA) approach, along with the non-gray FSCK method, will be implemented and validated. MDA combines the lower order spherical harmonics (i.e., P1) method for the diffusive component with a simplified view-factor based method for the ballistic component of radiative intensity. In the following years, the view-factor method will be replaced with the more accurate and generalized Monte-Carlo method. Furthermore, the FSCK model will be improved to account for spatial inhomogeneities in temperature and in species concentrations. Both the hybrid and FSCK models will be enhanced to address non-equilibrium radiation, as well as ablation encountered in hypersonic re-entry flows. The radiation module will be coupled to an established flow solver of interest to NASA, and the integrated simulation tool will be validated against benchmark data for Fire II, Apollo IV, and Stardust, and other cases of interest to NASA

Activity of the Most Massive Super-Massive Black Holes

Dr. Ming Sun
University of Alabama in Huntsville

It is believed that every galaxy with a central bulge hosts a supermassive black hole (SMBH). The more massive the central bulge is, the more massive the SMBH is. SMBHs grow by accreting surrounding matter. It turns out that when matter is accreted into these giant monsters, a few percent of the mass energy will be released, which will have significant impact on galaxies and the surrounding medium. A SMBH actively accreting is called an active galactic nucleus (AGN) and is often luminous in different bands from radio to X-rays. There are still many significant questions unanswered, e.g., what feeds SMBHs? How is the AGN activity in different bands connected and triggered? How does AGN activity impact the host galaxies? Galaxy clusters are concentrations of thousands of galaxies, forming the most populated regions in the universe. The central galaxies in galaxy clusters are the most massive galaxies in the universe and likely host the most massive SMBHs. Thus, they are great objects to study SMBH activity. Over the last five years, we have collected a lot of optical, radio and X-ray data for cluster central galaxies. In combination with the rich archival data, several projects are made possible to address these outstanding questions. I ask for seed money from Alabama NASA EPSCoR to work on these projects, for my group to produce some initial results and prepare for large external proposals. The results will have significant impact in our understanding of SMBH activity, AGN feedback, galaxy formation and evolution.

Influence of High Temperature on Field Emission in Vacuum Nano-Electronics for Space Applications

Dr. Vinu Unnikrishnan, University of Alabama

Dr. Unnikrishnan with students in the Advanced Computational and Experimental Mechanics Lab (ACEML), UA

Survivability and operation of electronic systems in extreme environments is critical for the success of future landed NASA missions especially to Venus, Titan, and Europa. These mission environments exceed the limits of operation of current military and space-rated electronics and keeping them operational requires significant energy, and overheads. According to the 2014 NASA Flight Avionics Hardware Roadmap, nano-electronic technologies with carbon nanotubes (CNTs), are promising candidates for electronic devices in extreme environments. CNT based miniaturized field emission vacuum tube devices for use in extreme environments are currently developed by The Jet Propulsion Laboratory (JPL). However such technology is progressing through an empirical understanding of the field emission process, since a theoretical understanding is still in its early stages. This is primarily due to uncertainties in understanding the field-emission characteristics of nanotubes. In this proposed research, I plan to study using multiscale ab-initio computational procedures, the effect of high temperatures on field emission characteristics of CNT in vacuum nano-electronic devices through collaboration with the JPL. This study would help in significantly reducing the bulky space power electronics, and pave the way for development of optimized, leaner and efficient avionic subsystems for extreme environment space applications

US DEPARTMENT OF AGRICULTURE EPSCoR

The National Institute of Food and Agriculture's (NIFA's) Food and Agricultural Science Enhancement (FASE) Grants are designed to help institutions develop competitive projects and to attract new scientists and educators into careers in high-priority areas of national need in agriculture, food, and environmental sciences. FASE Grants consist of New Investigator Grants, Pre- and Postdoctoral Fellowship Grants, and Strengthening Grants. Strengthening Grants are further divided into Sabbatical Grants, Equipment Grants, Seed Grants, Strengthening Standard Grants, Strengthening CAP (Coordinated Agricultural Project) Grants, and Strengthening Conference Grants.

Strengthening Grants are available during each funding cycle to ensure researchers at institutions and states underrepresented in terms of Federal research, education, and/or extension funding receive a portion of AFRI funds. Strengthening Grants are limited to: (1) small and mid-sized or minority-serving degree-granting institutions that previously had limited institutional success for receiving Federal funds; or (2) State Agricultural Experiment Stations or degree-granting institutions eligible for USDA Established Program to Stimulate Competitive Research (EPSCoR). When determining eligibility for these grant types, the following definitions apply:

- Small and mid-sized academic institutions with a current total enrollment of 17,500 or less including graduate and undergraduate and full- and part-time students.
- Accredited academic minority-serving institutions whose enrollment of a single minority group or a combination of minority groups exceeds 50% of the total enrollment, including graduate and undergraduate and full- and part-time students.
- Limited institutional success means institutions not among the most successful universities/colleges for receiving federal funds for science and engineering research.

Every year, NIFA determines the states that are eligible for USDA EPSCoR funding. This list includes states having a funding level no higher than the 38th percentile of all states based on a 3-year rolling average of AFRI funding levels, excluding FASE Strengthening funds granted to EPSCoR states and small-mid-sized and minority-serving, degree-granting institutions, see table below. In FY 2016, Alabama became ineligible for USDA EPSCoR funding. A list of ongoing USDA EPSCoR projects can be found on the next page.

USDA Established Program to Stimulate Competitive Research (EPSCoR) States FY 2001-FY2018

State	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Alabama	yes	yes	yes	yes	yes	yes	yes	yes	yes	-	--	
Alaska	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Arizona	-	-	-	-	-	-	-	-	yes	-	-	-
Arkansas	yes	yes	-	-	-	-	-	-	-	-	-	yes
Connecticut	-	-	yes	yes	yes	yes	yes	yes	yes	yes	-	-
Delaware	yes	yes	yes	yes	-	-	-	-	-	-	-	-
Hawaii	yes	yes	yes	yes	yes	-	-	-	-	-	-	-
Idaho	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Kentucky	yes	yes	yes	yes	yes	yes	yes	yes	yes	-	-	-
Louisiana	yes	yes	yes	yes	yes	-	-	-	-	-	-	yes
Maine	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Mississippi	-	-	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Montana	-	-	-	-	yes	yes	yes	yes	yes	yes	yes	yes
Nevada	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
New Hampshire	-	-	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
New Jersey	yes	yes	-	-	-	-	-	-	-	yes	yes	yes
New Mexico	yes	yes	-	-	yes	yes	yes	yes	yes	yes	yes	yes
North Dakota	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Oklahoma	yes	yes	-	-	-	yes	yes	yes	-	yes	yes	yes
Rhode Island	-	-	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
South Carolina	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
South Dakota	yes	yes	yes	yes	-	yes	-	yes	yes	yes	yes	-
Utah	-	-	-	-	-	-	yes	yes	yes	yes	yes	yes
Vermont	yes	yes	yes	yes	yes	yes	yes	yes	yes	-	yes	yes
West Virginia	yes	yes	yes	yes	yes	yes	yes	-	-	yes	yes	yes
Wyoming	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Ongoing USDA EPSCoR projects during FY 2018					
Grant No	INST	PD Name	Period of Performance	Title	Award Amount
2015-67015-22975	AU	John Liu	1/15/2015 - 1/14/2018	Whole genome mapping of disease resistance/ susceptibility-associated SNPs in catfish	455,000
2016-68008-25030	AU	Terry Hanson	3/15/2016 - extended to 3/14/2019	Breaking the Cycle: Amending Aquafeeds to Mitigate Aeromonas hydrophilia outbreaks	199,832
2015-67015-23285	AU	Rex Dunham	3/15/2015 - extended to 3/14/2019	Xenogenesis To Improve Artificial Spawning of Reproductively Difficult Catfish	450,000
2016-65615-25539	UAH	Richard McNider	9/1/2016 - extended to 8/31/2019	Tools and Planning for Migration of Agriculture as as Sustainable Path for Agricultural Production	162,667
2013-67013-21408	AU	Edzard van Santen	9/1/2013 - 8/31/2018	Increasing Legume Grazing for Higher Beef Gain on Pastures: An improved High-Tannin Birdsfoot Trefoil Cultivar with Trans-Regional Potential	402,500
2014-67016-21570	TU	William H Witola	12/1/2013 - 11/30/2018	Identification of Inhibitors for Essential Phopholipid Biosythetic Enzymes in Haemonchus contortus	150,000
2013-68004-20357	AU	Christy Bratcher	12/15/2012 -12/14/2018	Identifying gaps between knowledge and practice in production and distribution of local and regional foods for a more secure food supply chain	2,407,836
2015-67014-23085	AU	Leonardo De La Fuente	1/15/2015 - 1/14/2019	Calcium regulation of interactions between a xylem-inhabiting pathogenic bactrerium and host plants	377,214
2013-67016-20523	AU	Frank Bartol	2/1/2013 - 1/31/2019	Maternal Lactocrine Programming of Female Productive Tract Development	700,000
2017-67020-26398	AU	David M Blersch	2/15/2015 - 2/14/2020	Systems Modeling of Nitrogen Recycling in Multi-Trophic Aquaculture Production	499,350
2015-69006-22927	TU	Robert Zabawa	2/15/2015 - 2/14/2020	Securing the Land for Agricultural and Community Development: Addressing Heir Property as as Asset Building Strategy	499,998

Whole genome mapping of disease resistance/susceptibility-associated SNPs in catfish

Dr. John Liu, Auburn University

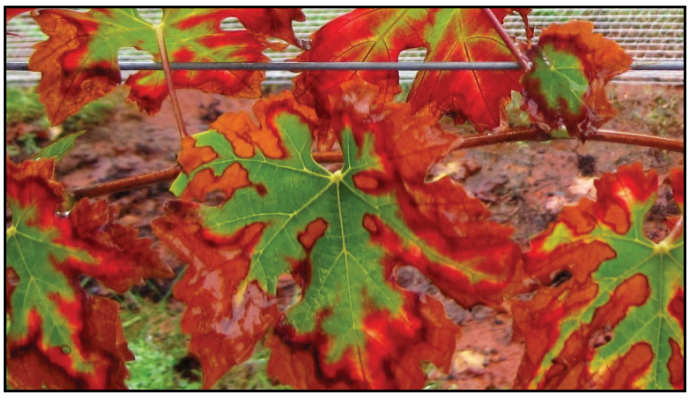
Toxoplasma gondii is a widely prevalent obligate intracellular zoonotic protozoan parasite that is of great economic significance in sheep production in which it causes abortions, fetal malformations, pre-term deliveries, stillbirths and neonatal deaths. Infected sheep meat is also a source of T. gondii infection in humans. There is currently no medicine to eliminate T. gondii infections in sheep and the live vaccine that is available has serious short-comings because of its short shelf life and safety concerns for those handling it. Thus, there is need for a non-infectious vaccine that would be safe and effective. Therefore, deciphering functionally significant T. gondii molecular mechanisms that lead to modulation of host cell responses to infection would be fundamental in designing new effective therapies and vaccines against T. gondii. The main aim of this proposed project is to undertake a detailed and thorough genetic, molecular, immunological and cellular biological analysis of the role of a T. gondii-secreted protein (herein called GRA10) in modulating ovine host cell defense responses to T. gondii infection and establish how this relates to the parasite's development and survival in the cells. Ultimately, our goal is to elucidate molecular mechanisms that would be crucial in developing new effective therapies and/or vaccines against T. gondii infections in sheep, leading to increased productivity and profitability of the sheep industry and safer sheep meat for human consumption.

Calcium regulation of interactions between a xylem-inhabiting pathogenic bacterium and host plants

Dr. Leonardo De Le Fuente, Auburn University

The bacterium Xylella fastidiosa causes destructive diseases in crops such as grapes, citrus, blueberries and others. These diseases are found mainly in the Americas, but there have been recent reports of this bacterium causing problems in Asia and Europe. This bacterium, transmitted among plants by insect vectors, lives inside the xylem vessels, which are the components of the vascular system of the plant involved in transporting water and mineral nutrients from the soil to the rest of the plant. Inside the xylem the bacterium forms biofilms, or agglomerates of bacteria surrounded by a sticky matrix, that clogs the passage of nutrients in the plant and is believed to be responsible for the development of symptoms. Currently there is no cure for the diseases caused by Xylella fastidiosa, and infected plants need to be removed and discarded.

Our research has shown that one particular mineral element, calcium, has an important role during the disease development, by increasing the virulence of the bacterium, and being accumulated in infected plants. Our data indicates that the plant defense response to infection may worsen the disease, analogous to what occurs in autoimmune diseases in animals. During this project we will elucidate the key proteins in both plant and bacteria that are involved in the calcium modification occurring during disease. This information will allow us to target those proteins for specific disease control methods.



Xenogensis To Improve Artificial Spawning of Reproductivity Difficult Catfish

Dr. Rex Dunham, Auburn University

Production of hybrid catfish with the current technology is labor intensive and requires more skill than most hatcheries possess. Genetic improvement of blue catfish is hindered by their erratic spawning. By using stem cell technology coupled with we should be able to produce channel catfish possessing blue catfish sperm or eggs. Then they could be mated naturally with each other or normal channel catfish to more easily produce either blue catfish or hybrid catfish. This could also be done with white catfish with the advantage of the early maturity of white catfish. The specific objectives are 1) to determine which is more effective, the channel catfish system or the white catfish system and 2) to determine which is more effective for producing these fish, introducing the stem cells a few hours after fertilization, at hatch or in young fish. We expect to produce channel catish that when mated together produce hybrid catfish or blue catfish, and to produce white catfish that when mated together produce hybrid catfish or blue catfish. The impact is that this research will make it much easier and cheaper to produce hybrid catfish. This will help rescue and grow a US catfish industry that is stressed by foreign imports. Success will return the catfish industry to its previous status, a multi-billion dollar industry.

Securing the Land for Agricultural and Community Development: Addressing Heir Property as an Asset Building Strategy

Dr. Robert Zabawa, Tuskegee University

Heir property causes land loss among African American farmers, ranchers, and forestland owners and constrains wealth creation within African American communities of the South. Heir property refers to land and improvements on land owned collectively by heirs of an owner who has died without a probated will; traditionally, African American landowners have been reluctant to write wills. Heir property has limited collateral value, and we estimate that there are tens of billions of dollars in asset value that cannot be used as collateral for business ventures or agricultural investments. Additionally, heir property owners are not eligible for important USDA programs to farmers and homeowners, representing another obstacle to African American wealth creation. The objectives of our integrated project (research, Extension, teaching) combine the faculty and graduate students at Tuskegee and Auburn Universities with two leading non-profit organizations, Land Loss Prevention Project and Alabama Appleseed, which have made major contributions addressing heir property. This project will compare four African American New Deal Resettlement Communities established to provide farmland, and four neighboring communities, to examine the impact of heir property on asset building, cultural continuity, and community development. The project will identify strategies to address heir property that impede asset building, use research findings to develop Extension and outreach publications and programs to serve heir property owners and communities, and establish a course taught jointly at Tuskegee and Auburn Universities that focuses on heir property and land loss in the context of asset building and community development in Alabama and the South.

EPSCoR and EPSCoR-like program budgets, by agency: FYs 2002–16

(Millions of dollars)

Agency	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
All agencies	288.9	358.0	353.3	367.4	367.1	363.1	418.9	437.2	460.1	436.0	483.4	461.0	488.6	508.8	562.0
DOD	15.7	15.7	8.4	11.4	11.5	9.5	17.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOE	7.7	11.7	7.7	7.6	7.3	7.3	14.7	16.8	21.6	8.5	8.5	8.4	10.0	10.0	14.8
EPA	2.5	2.5	2.5	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NASA	10.0	10.0	10.0	12.0	12.5	12.8	15.5	20.0	25.0	25.0	18.0	18.0	18.0	18.0	18.0
NIH[a]	160.0	210.0	214.0	222.0	220.0	218.0	223.6	224.3	228.8	226.5	276.5	261.6	273.3	273.3	320.8
NSF	79.3	88.8	93.7	93.4	97.8	101.5	120.0	133.0	147.1	146.8	150.9	147.6	158.2	165.5	160.0
USDA	13.7	19.3	17.0	18.6	18.0	14.0	28.1	29.0	37.6	29.2	29.5	25.4	29.1	42.0	48.4

[a] NIH has an EPSCoR-like program known as the Institutional Development Award program.

DOD = Department of Defense; DOE = Department of Energy; EPA = Environmental Protection Agency; EPSCoR = Established Program to Stimulate Competitive Research; NASA = National Aeronautics and Space Administration; NIH = National Institutes of Health; NSF = National Science Foundation; USDA = Department of Agriculture.

Note(s):
EPA and DOD discontinued issuing separate EPSCoR program solicitations in FYs 2006 and 2010, respectively. USDA's reported budget in FY 2012 included $6.8 million in unobligated funds. NASA made minor revisions to prior-year data in 2014.

Source(s):
Data are provided by agency EPSCoR representatives and are collected by the National Science Foundation Office of Integrative Activities, Office of EPSCoR, January 2017.

Science and Engineering Indicators 2018

EPSCoR/IDeA Funding Chart								
Updated EPSCoR/IDeA Budget Summary								
Amounts in millions								
Agency	FY15 Enacted	FY16 Enacted	FY17 Enacted	FY18 Enacted	FY19 Budget Request	FY19 Coalition Goals	FY19 House	FY19 Senate
NSF	$159.70	$160.00	$160.00	$170.70	$160.00	$170.70	$170.70	$177.00
NIH	$273.30	$320.80	$333.40	$351.00	TBD	$380.00	$365.60	$361.80
DOE	$10.00	$15.00	$15.00	$20.00	$7.70	$20.00	$20.00	$20.00
USDA	$48.7*	$52.5*	$56.3*	$60.00	n/a	15% Language	$62.3*	$60.8*
NASA	$18.00	$18.00	$18.00	$18.00	$0	$25.00	$18.00	$21.00
DOD	-	-	-	-	$15.00	$0	$12.00	
TOTALS	$509.70	$566.30	$582.70	$619.00	$636.60	$652.60		
* Represents 15 percent of the Agriculture and Food Research Initiative (AFRI) budget								

http://www.epscorideacoalition.org/legislative-action/budget-information