QUALITY EDUCATION FOR MINORITIES (QEM) NETWORK
HBCU-UP LEADERSHIP DEVELOPMENT INSTITUTE (LDI)
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Overview of Research Foci at some of the NSF-supported Major Research Centers

American Association for the Advancement of Science (Center for Curriculum Materials in Science)
Through research and development projects carried out within and across the collaborating institutions, through doctoral and postdoctoral programs focused on science curriculum materials, and through model courses for preservice and inservice teacher development, the Center is helping to develop the national infrastructure for science curriculum materials development, analysis, selection, and implementation. The following principles guide all aspects of the Center's work: (1) the centrality of clearly stated science learning goals; (2) the importance of building pedagogical supports into instructional materials; (3) the usefulness of student investigations; (4) the value of incorporating learning technologies into instructional materials; and (5) the need to serve diverse learners by designing instructional materials that are accessible to all students.

Boston University (Center for Integrated Space Weather Modeling)
CISM creates physics-based computer models that describe the space environment between the Sun and Earth and provide advance warning of potentially harmful space weather events that could put astronauts at risk, disable satellites, disrupt communications, or cause costly damage on earth. The Center intends to create a model that can be used to predict the "weather' in space around the Earth.

Case Western Reserve (Center for Layered Polymeric Systems)
The Center has created an integrated research and education program focused on polymer science and engineering, particularly micro- and nano-layering technology. CLiPS researchers are working to miniaturize the coextrusion process, and to produce gradient-layer films and vertical multi-layered films. They also are working to create new polymeric structures with the multi-layer extrusion process, to exploit optical interference effects in one-dimensional crystal structures, and to understand transport phenomena in micro- and nano-layered systems. The research is meant to lead to the development of new materials and material systems.

City College of New York (Benjamin Levich Institute for Physico-Chemical Hydrodynamics)
The broad aim of the Institute has been to investigate key problems in physico-chemical hydrodynamics, which refers to phenomena governed by the interaction of fluid mechanics, heat and mass transfer, and chemical reactions, from a fundamental and multifaceted perspective.

Colorado State University (Center for Multi-scale Modeling of Atmospheric Processes)
The Center for Multi-scale Modeling of Atmospheric Processes (CMMAP) focuses on improving the representation of cloud processes in climate models. The research mission of CMMAP is to develop a new kind of global atmospheric model that can represent the effects of clouds on weather and climate with greatly improved realism; to evaluate the new model by comparison of model results with observations; and to apply the model to understand the interactions of clouds with other components of the Earth system, including the atmosphere, the vegetated land surface, and the oceans.

Duke University (Center for the Environmental Implications of NanoTechnology)
The Center for the Environmental Implications of NanoTechnology (CEINT) is dedicated to elucidating the relationship between a vast array of nanomaterials — from natural, to manufactured, to those produced incidentally by human activities — and their potential environmental exposure, biological effects, and ecological consequences. CEINT research draws on expertise in five key areas: (1) environmental toxicology and ecosystem biology; (2) nanomaterial transport, transformation, and fate in the environment; (3) biogeochemistry of manufactured and natural nanomaterials, and incidental airborne particulates; (4) nanomaterial chemistry and fabrication and; (5) environmental risk assessment and modeling.

Fisk University (Center for Physics and Chemistry of Materials)
The research focus of the Center for Physics and Chemistry of Materials (CPCoM) is the study of advanced materials, novel processing methods, new properties and phenomena that will enable new devices for science, industry and medicine. Phenomena and their applications will focus on detection, emission and modulation of electromagnetic radiation based on selected electronic and optical materials in the form of crystals, nanomaterials, glass-ceramics and thin films. The Center pursues four research thrusts: (1) controlled defect formation during processing of wide-gap semiconductors for optical and electro-optical applications (crystal growth and materials science); (2) fabrication of metal and semiconductor nanocrystals by pulsed laser deposition: linear and nonlinear optical properties (chemical physics and optics); (3) mesoscale materials for photonic applications (applied optics and spectroscopy); (4) modification, and characterization of new thin film optical materials (surface sciences).

Florida International University (Center for Innovative Information Systems)
Each of the Center's mutually-supportive subprojects builds on the strong research foundation established by FIU's first-phase CREST award and each sets ambitious research goals that will result in the increased competitiveness of FIU's CISE researchers. "Subproject 1: Effective Access to Complex Multimodal Data with Applications in Disaster Mitigation" will focus on developing effective techniques for managing and providing access to data that varies in type, source, location, time, and certainty by addressing storage optimization, data management, indexing and search, query techniques, and data presentation. Among its applications, it seeks to develop techniques to get the right information to the right people at the right time, thereby helping to mitigate disasters and to recover from them quickly. "Subproject 2: Integrated Approach to Information Processing in Neuroscience" focuses on an integrated imaging/signal processing approach that will result in comprehensive views of the human brain in greater depth and detail through faster, affordable, more effective, and less invasive methods. "Subproject 3: Human Computer Interaction for Universal Access" has a long-term goal of enabling any prospective computer user to interact with computer-based systems, regardless of their disability status and regardless of the interaction challenges derived from the context in which the interaction is taking place. "Subproject 4: Complex System Modeling, Analysis, and Realization" will focus on essential methodologies for modeling complex systems, a unified underlying semantic model, fundamental methods for compositional model analysis, and model-driven engineering technologies.

Georgia Institute of Technology (School of Chemical and Biomedical Engineering)
The Georgia Tech MRSEC program includes a single Interdisciplinary Research Group (IRG) on Graphene Science and Technology. Its mission is to (1) develop the science and technology of graphene and other electronic materials to permit fabrication of devices and circuits for post-CMOS low power electronics; (2) integrate the science/technology developed with educational programs, student/teacher training, and industrial needs to ensure availability of the necessary workforce and tech

transfer capabilities for future electronic materials and processing; and (3) enhance the diversity of students and faculty involved in the development and fabrication of future electronic materials, devices, and circuits.

Harvard University (MRSEC)
The Harvard University MRSEC has four collaborative Interdisciplinary Research Groups (IRGs). These IRGs include: (1) Multiscale Mechanics of Film and Interfaces, which investigates mechanical properties in thin films and interfaces that are both a scientific challenge and an important technological problem; (2) Engineering Materials and Techniques for Biological Studies at Cellular Scales, which focuses on understanding the mechanical properties of the cell, a central object of study in biology, and its structural components; (3) Interface-Mediated Assembly of Soft Materials, whose goal is to make important advances towards directing the assembly of soft materials, by using interfaces between distinct materials as templates for controlling the dynamic assembly of structure; and (4) Materials and Physiology, grown from a seed effort whose goal is to investigate the mechanical behavior responsible for physiological function of biological systems.

Iowa State University (Engineering Research Center for Biorenewable Chemicals)
The unique focus of the Engineering Research Center for Biorenewable Chemicals (CBiRC) will be exploiting the integration of biocatalytic and chemical catalytic technologies to efficiently produce biorenewable chemicals. CBiRC will develop a new paradigm for producing biorenewable platform chemicals based upon the combinatorial metabolic processes of the polyketide biosynthetic pathway. The three research thrusts of CBiRC are: new biocatalysts for pathway engineering, microbial metabolic engineering, and chemical catalyst design.

Jackson State University (JSU-UCSB Partnership for Research and Education in Materials)
The mission of the JSU-UCSB PREM is to foster collaborative, interdisciplinary research and education in polymer self-assembly and biological nano-structured materials that will address the future needs of society and will increase the participation of minorities in material science research and education. Its research focus is to develop: (1) organic semiconductors based on small molecules or conjugated polymers which are extremely promising materials for many types of applications, ranging from electronic circuitry to flexible displays, and from solar cells to biological and chemical sensors; and (2) optical nanosystems using Laser Induced Fluorescence (LIF) technique at the nano-bio interface to detect DNA damage, RNA interaction and modification of nucleic acid bases.

Massachusetts Institute of Technology (Center for Materials Science and Engineering)
CMSE has a special mission: to foster collaborative, interdisciplinary research and education in the science and engineering of materials that will address the future needs of society. CMSE promotes collaboration among MIT faculty and between MIT faculty and researchers of other universities, industry, and government laboratories.

National Center for Engineering and Technology Education
The National Center for Engineering and Technology Education is a collaborative network of scholars with backgrounds in technology education, engineering, and related fields. Our mission is to build capacity in technology education and to improve the understanding of the learning and teaching of high school students and teachers as they apply engineering design processes to technological problems. The Center conducts research to: (1) define the current status of engineering design experiences in engineering and technology education in grades 9-12; (2) define an NCETE model for professional development by examining the design and delivery of effective professional development with a focus on selected engineering design concepts for high school technology education; and (3) identify guidelines for the development, implementation, and evaluation of engineering design in technology education.

North Carolina State University (Future Renewable Electric Energy Delivery and Management Systems Center)
The Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Center is headquartered on NC State University's Centennial Campus. Some of the FREEDM Systems Center's goals are to: develop the fundamental knowledge base for the FREEDM system and provide fundamental breakthrough technology in energy storage and power semiconductor devices; form long-term partnerships with large and small firms to speed the translation of ERC research into commercially viable products, stimulate formation of start-up companies based on ERC intellectual property, and involve students in all phases of the innovation process; develop a diverse group of adaptive, creative, and innovative graduates who advance fundamental knowledge, enabling technology and engineered systems innovations in renewable electric energy delivery and management systems; and increase the diversity of the proposed Center's leadership, faculty, and students to exceed academic engineering nationwide averages within the first five years of operation.

Pennsylvania State University (Center for Nanoscale Science)
The Center supports collaborative, interdisciplinary research efforts in the area of nanoscale materials. The research themes of the Center are focused broadly on molecular nanofabrication, complex inorganic materials, biological and nanoscale motors, low-dimensional electronic nanostructures, and integrated optical metamaterials. These research themes are integrated with major efforts in educational and industrial outreach.

Princeton University (Engineering Research Center for Mid-InfraRed Technologies for Health and the Environment)
The Engineering Research Center for Mid-InfraRed Technologies for Health and the Environment (MIRTHE)'s goal is to develop Mid-Infrared optical trace gas sensing systems based on new technologies such as quantum cascade lasers or quartz enhanced photo-acoustic spectroscopy, with the ability to detect minute amounts of chemicals found in the environment or atmosphere, emitted from spills, combustion, or natural sources, or exhaled. Through its fundamental research and prototyping in materials, sources, detectors, sensing systems, and applications testbeds, MIRTHE addresses a broad range of technologies and industry sectors - semiconductors, test and measurement, medical equipment manufacturers, chemical and petrochemical, and homeland security - as well as government labs and hospitals. MIRTHE provides interdisciplinary and practice oriented education for a diverse U.S. workforce and seeks to educate the public about chemical sensing with applications in environment, homeland security, and health.

State University of New York–Stony Brook (Garcia Center for Polymers at Engineered Interfaces)
The Garcia Center for Polymers at Engineered Interfaces consists of an Interdisciplinary Research Group (IRG). The focus of the Center is the design of polymer thin film properties through precise control of interfacial structure. The uniqueness of the investigations is the synthesis and study of engineered interfaces. At these interfaces, molecular-level control of surface energy via chemical functionalities, symmetry, and order is accomplished. This is a significant departure from existing experiments on semiconductor, metal and metal oxide surfaces, with little or no control of surface interactions. A central goal of this Center is to address technological problems related to polymer thin films, and to develop cutting-edge enabling technologies that take existing polymeric systems and markedly improve their properties.

Temple University (Spatial Intelligence and Learning Center)
Spatial thinking is both a key intellectual issue in cognitive science and a critically important aspect of problem solving in science, engineering and mathematics. It provides the foundation for a wide range of reasoning and communication skills, as varied as the design of buildings, the solution of mathematics problems, and the use of spatial metaphor in everyday language. Thus, progress and performance in various science, technology, engineering and mathematics (STEM) fields is strongly tied to improving people's ability to reason about spatial configurations and their properties.

University of Arizona (Engineering Research Center for Integrated Access Networks)
The vision of the Center for Integrated Access Networks (CIAN) is to create transformative technologies for optical access networks where virtually any application requiring any resource can be seamlessly and efficiently aggregated and interfaced with existing and future core networks in a cost-effective manner.

University of California at Berkeley (Team for Research in Ubiquitous Secure Technology)
The Team for Research in Ubiquitous Secure Technology (TRUST) is focused on the development of cybersecurity science and technology that will radically transform the ability of organizations to design, build, and operate trustworthy information systems for the nation's critical infrastructure. TRUST activities are advancing a leading-edge research agenda to improve the state-of-the art in cyber security; developing a robust education plan to teach the next generation of computer scientists, engineers, and social scientists; and pursuing knowledge transfer opportunities to transition TRUST results to end users within industry and the government. TRUST also is addressing technical, operational, privacy, and policy challenges via interdisciplinary projects that combine fundamental science and applied research to deliver breakthrough advances in trustworthy systems in three “grand challenge” areas: Financial Infrastructures, Health Infrastructures, and Physical Infrastructures.

University of California San Diego (Temporal Dynamics of Learning Center)
The Temporal Dynamics of Learning Center (TDLC) aims to achieve an integrated understanding of the role of time and timing in learning, across multiple scales, brain systems, and social systems. The scientific goal of the center is therefore to understand the temporal dynamics of learning, and to apply this understanding to improve educational practice.

University of California, Los Angeles (Center for Embedded Network Sensing)
CENS, an NSF Science & Technology Center, is developing Embedded Networked Sensing Systems and applying this revolutionary technology to critical scientific and social applications. Like the Internet, these large-scale, distributed, systems, composed of smart sensors and actuators embedded in the physical world, will eventually infuse the entire world, but at a physical level instead of virtual. Across this wide range of applications, Embedded Networked Sensing systems promise to reveal previously unobservable phenomena. The researchers in CENS are investigating fundamental properties of Embedded Networked Systems, developing new enabling technologies, and exploring novel scientific and educational applications.

University of Chicago (Chicago Materials Research Center)
The overarching goal, common to all of the Interdisciplinary Research Groups (IRGs), is to produce the design principles for the next generation of materials. Each of the four IRGs addresses a fundamental issue applicable to a broad class of materials. Common themes include investigating materials formed far from equilibrium, exploring new paradigms for materials fabrication and response especially at the micro- and nano-scale, and exploiting feedback between structure and dynamics. These themes, reappearing in each IRG, deal with important basic problems exploring design principles that are far from conventional and whose prospects are far from certain.

University of Hawaii at Manoa (Center for Microbial Oceanography: Research and Education)
The center is designed to facilitate a more comprehensive understanding of the biological and ecological diversity of marine micro-organisms. C-MORE research is organized around four interconnected themes: (1) Marine microbial biodiversity: From genomes and cultivation to ecology; (2) Microbial metabolism and the mechanisms of C, N, P and energy flow; (3) Remote and continuous sensing of microbial processes and links to climate variability; and (4) Ecosystem modeling, computer simulation and prediction. The knowledge gained in our research will be incorporated into complementary field research and physical-biogeochemical modeling efforts that are already funded by independent teams of investigators. The proposed science themes parallel contemporary research foci in marine sciences.

University of Illinois, Urbana Champaign (Center of Advanced Materials for the Purification of Water with Systems)
The goal of WaterCAMPWS is to be the preeminent source of knowledge for advanced materials and systems in water purification. The focus is on the basic science of water to develop and employ advanced materials and systems to address the threats to our water supply. The Center seeks to develop materials and systems to purify the earth's waters for drinking, agricultural, industrial, and ecological purposes. Congruent to this mission is the development of diverse human resources to enhance the scientific research, educational, and industrial workforce for water purification.

University of Massachusetts - Amherst (MRSEC)
The Center unites the efforts of 40 faculty from 7 departments (Biology, Chemical Engineering, Chemistry, Electrical Engineering, Mechanical Engineering, Physics, and Polymer Science and Engineering) of the University, and has research collaborations and outreach programs with over 12 other institutions. The Center builds on a tradition of excellence in multidisciplinary research and education in polymer science and engineering in Amherst that has been fostered by 29 years of support from the National Science Foundation for interdisciplinary research at the frontiers of polymer science.

Univ. of Massachusetts-Amherst (Center for Collaborative Adaptive Sensing of the Atmosphere)
The Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) is a multi-sector partnership among academia, industry, and government dedicated to engineering revolutionary weather-sensing networks. CASA will overcome the under-sampling of meteorological conditions in the lower part of the atmosphere—which is due to the Earth's curvature and other obstructions—by deploying low-cost networks of Doppler radars that operate at short range. This approach is called Distributed Collaborative Adaptive Sensing (DCAS). CASA will conduct fundamental research in electromagnetic wave atmosphere interaction, new computing and communication infrastructures to support the DCAS paradigm, and lower atmosphere physics to establish the foundation for a new sensing and predicting paradigm. CASA will also implement scalable prototype test beds in Oklahoma, Houston, and Puerto Rico, in collaboration with industry and government partners and users of weather data.

University of Minnesota (Center for Compact and Efficient Fluid Power)
The Center for Compact and Efficient Fluid Power (CCEFP) is a network of researchers, educators, students and industry working together to transform the fluid power industry—how it is researched, applied and studied. Center research is creating hydraulic and pneumatic technology that is compact, efficient, and effective. The CCEFP has four goals. The first goal is to dramatically improve the energy efficiency of fluid power in current applications; the second goal is to improve the efficiency of the transportation sector using fluid power by developing fuel efficient hydraulic hybrid technologies suitable for small passenger vehicles; the third goal is to develop un-tethered portable human-scale fluid power devices; and the fourth goal is to make fluid power more acceptable and ubiquitous.

University of Minnesota (MRSEC)
This multifaceted MRSEC enables important areas of future technology, ranging from biomedicine, separations, and plastic electronics to security, renewable energy, and information technology. The UMN MRSEC manages an extensive program in education and career development. Center research activities are integrated with educational programs, providing interdisciplinary training of students and postdocs.

University of Pittsburg (Quality of Life Technology Center)
The Quality of Life Technology (QoLT) Center's research deals with almost all aspects of human living. QoLT systems will affect people in different settings with different functionalities. The setting may be at home, providing personal support and help for daily living; it could be a neighborhood, where the systems help a person to engage in community activities; or it could be more societal where a person commutes to work and contributes to society through employment. In each setting QoLT systems provide different forms of functionality: enhancing dexterity and mobility, helping with some home chores, supporting memory, coaching through job functions, helping to drive cars, and so on.

University of Washington-Seattle (CMDITR)
The Center's focus is to develop new and "disruptive" technologies based upon new organic and hybrid materials, processed into devices at low cost. CMDITR's research mission is to create and use molecular building blocks in the rational design of new devices and subsystems for a broad spectrum of photonic and electronic applications, specifically in the areas of telecommunications, computing, lighting, energy, transportation, medicine and defense. The Center's work advances the understanding of the electrical and optical properties of novel organic and organic-inorganic hybrid materials, and of the dependence of these properties on the organizational structure of materials.

Utah State University College of Engineering
The Utah State University College of Engineering's mission is to foster a diverse and creative learning environment that will empower students and faculty with the necessary knowledge and facilities to be international leaders in creating new technologies and services that will improve tomorrow's economy and environment. The College is home to a number of national and state research centers including the Center for Space Engineering, the Institute for Natural Systems Engineering, the Utah Transportation Center, the National Center for Engineering and Technology Education, and the Center for Advanced Imagery LADAR.

UC- Santa Barbara- National Center for Ecological Analysis and Synthesis
The National Center for Ecological Analysis and Synthesis (NCEAS) supports cross-disciplinary research that uses existing data to address major fundamental issues in ecology and allied fields, and their application to management and policy. NCEAS' mission is to foster synthesis and analysis, turn information into understanding and, through effective collaboration, alter how science is conducted. Multiple measures evidence the impact of NCEAS. The Center facilitates integrative research aimed at synthesizing existing data and information, and subsequently making these data and inferences widely available. NCEAS fosters new techniques in mathematical and geospatial modeling, dynamic simulation, and visualization of ecological systems.