

Biosensing and NSF Perspectives

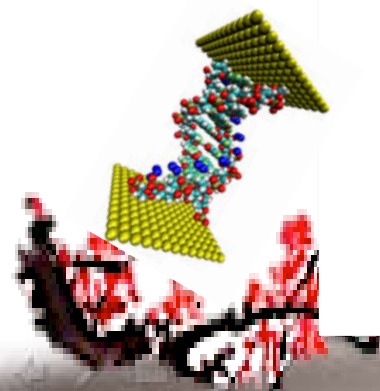
Prof. Chenzhong Li

NSF Program Director
chli@nsf.gov

**Nano and Biosensing Program, Chemical, Bioengineering,
Environmental, and Transport (CBET) Division, National
Science Foundations**

**Department of Biomedical Engineering
Florida International University, Miami**

2018 AFSOR
BIOPHYSICS





ENGINEERING (ENG) DIRECTORATE

ENG Mission: Investing in engineering research and education and fostering innovation to benefit society

ENG Divisions

**Chemical, Bioengineering,
Environmental
& Transport Systems
(CBET)**

**Emerging Frontiers &
Multidisciplinary Activities
(EFMA)**

**Civil, Mechanical & Manufacturing
Innovation
CMMI**

**Industrial Innovation &
Partnerships
(IIP)**

**Electrical, Communications, &
Cyber Systems
(ECCS)**

**Engineering Education & Centers
(EEC)**



Asst. Director of ENG
Dawn Tilbury

Credit: Joseph Xu

- \$ 8.0B budget (FY2018, NSF total), 300 M increased



Chemical, Bioengineering, Environmental, and Transport Systems Division (CBET)



Richard Dickinson
Division Director

Timothy Patten
Deputy Division Director (Acting)

Chemical Process Systems



1401
Catalysis
Bob McCabe



1417
Process Separations
Angela Lueking



1403 – Process Systems, Reaction Eng & Molecular Thermodynamics
Triantafillos (Lakis) Mountziaris



7644
Energy for Sustainability
Carole Read

Engineering Biology & Health



1491
Cellular & Biochem Engineering
Steve Peretti



5345
Engineering Biomedical Systems
Michele Grimm



7236
Biophotonics
Leon Esterowitz



7909
Nano-Biosensing
Chenzhong Li



5342 – Disability & Rehabilitation Engineering
Michele Grimm



Engineering Biology & Health Programs
Christy Payne
Assoc PD

Environmental Engineering & Sustainability



1440
Environmental Engineering
Karl Rockne



1179
Biological & Enviro Interactions of Nanoscale Materials
Nora Savage



7643
Environmental Sustainability
Bruce Hamilton



022Y
INFEWS
Jim Jones



Environmental Eng & Sustainability Programs
Brandi Schottel
Assoc PD

Transport Phenomena



1407
Combustion & Fire Systems
Song-Charng Kong



1443
Fluid Dynamics
Ronald Joslin



1415
Particulate & Multiphase Processes
Susan Muller



1406
Thermal Transport Processes
José Lage



Engineering Biomed Systems
Carol Lucas
EXPERT

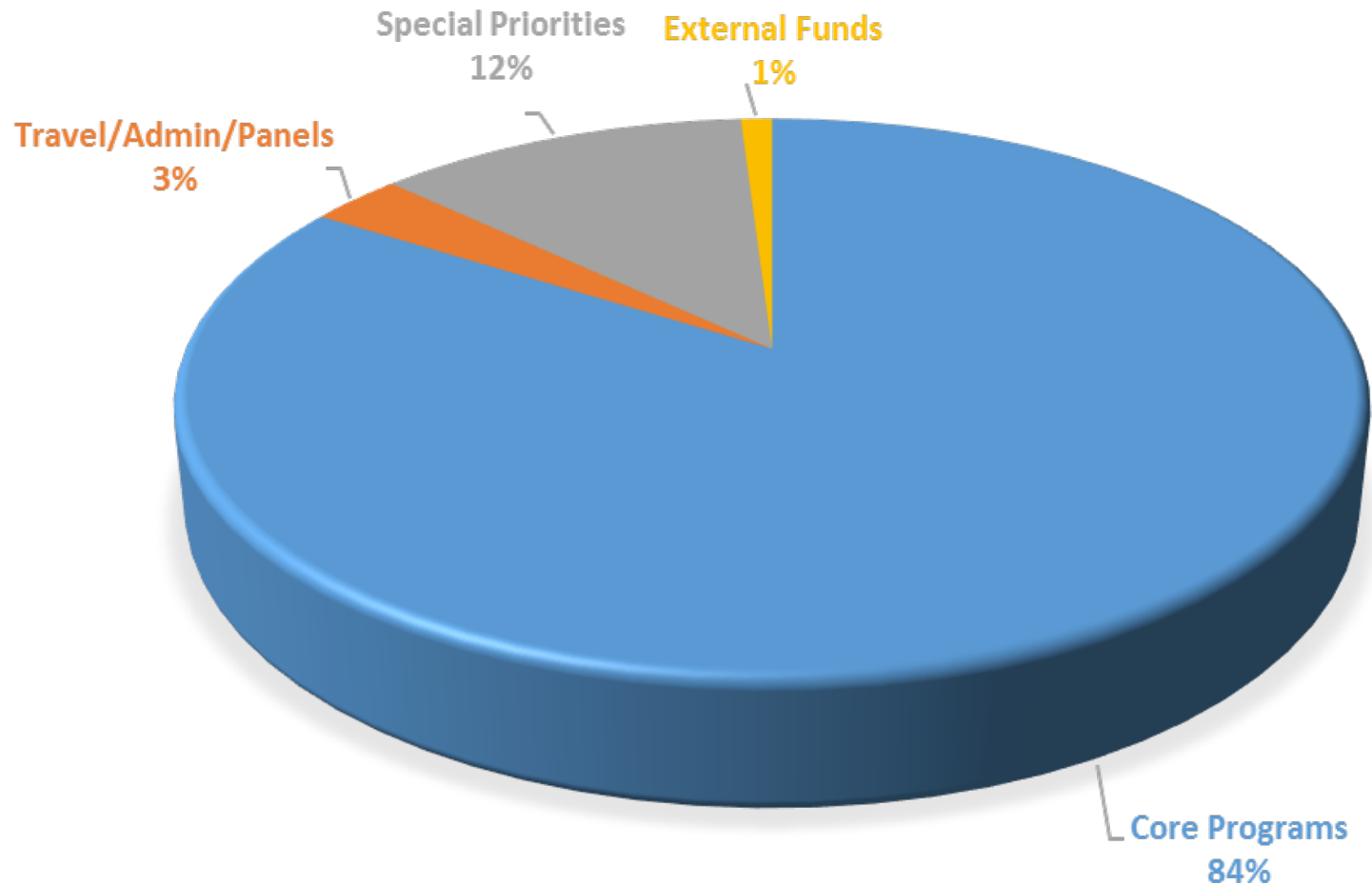


Multiple Programs
Geoff Prentice
EXPERT



NSF CBET BUDGET

FY2017 BUDGET: \$184.5M





National Science Foundation

ENGINEERING BIOLOGY & HEALTH

Chenzhong
Li



Nano-biosensing

- Multi-purpose sensor platforms
- Novel transduction principles, mechanisms and sensor designs
- Nano-biosensors for biomolecular interactions
- Intracellular biosensing

Michele
Grimm



Engineering Biomedical Systems

- Models for tissues and organ systems
- Advanced biomanufacturing of 3-D tissues and organs
- New tools to study physiological processes

Disability and Rehabilitation Engineering

- Neuroengineering
- Rehabilitation robotics

Leon
Esterowitz



Biophotonics

- Macromolecule Markers
- Micro- & Nano-photonics; Low-Coherence Sensing @ Nanoscale
- Neurophotonics and Optogenetics

Steve
Peretti



Cellular & Biochemical Engineering

- Biomanufacturing: Metabolic eng, “omics”, single cell dynamics and synthetic biology
- Quantitative systems biotechnology
- Cell culture technologies
- Protein and enzyme engineering



National Science Foundation

NANO- BIOSENSING

Program Scope

- **Support engineering research on biosensor design and fabrication for novel biological analysis.**
- **Examples of biosensors include, but are not limited to, electrochemical/electrical biosensors, optical biosensors, plasmonic biosensors, paper-based and nanopore-based biosensors**
- **Biosensor-based technologies to address critical needs for biomedical research, public health, food safety, agriculture, forensics, environmental protection, and homeland security are highly encouraged**
- **Miniaturization of biosensors for lab-on-a-chip and cell/organ-on-a-chip applications to enable measurement of biological properties and functions of cell/tissues in vitro.**
- **Biosensors that enable measurement of biomolecular interactions in their native states, transmembrane transport, intracellular transport and reactions, and other biological phenomena**



BIOSENSING

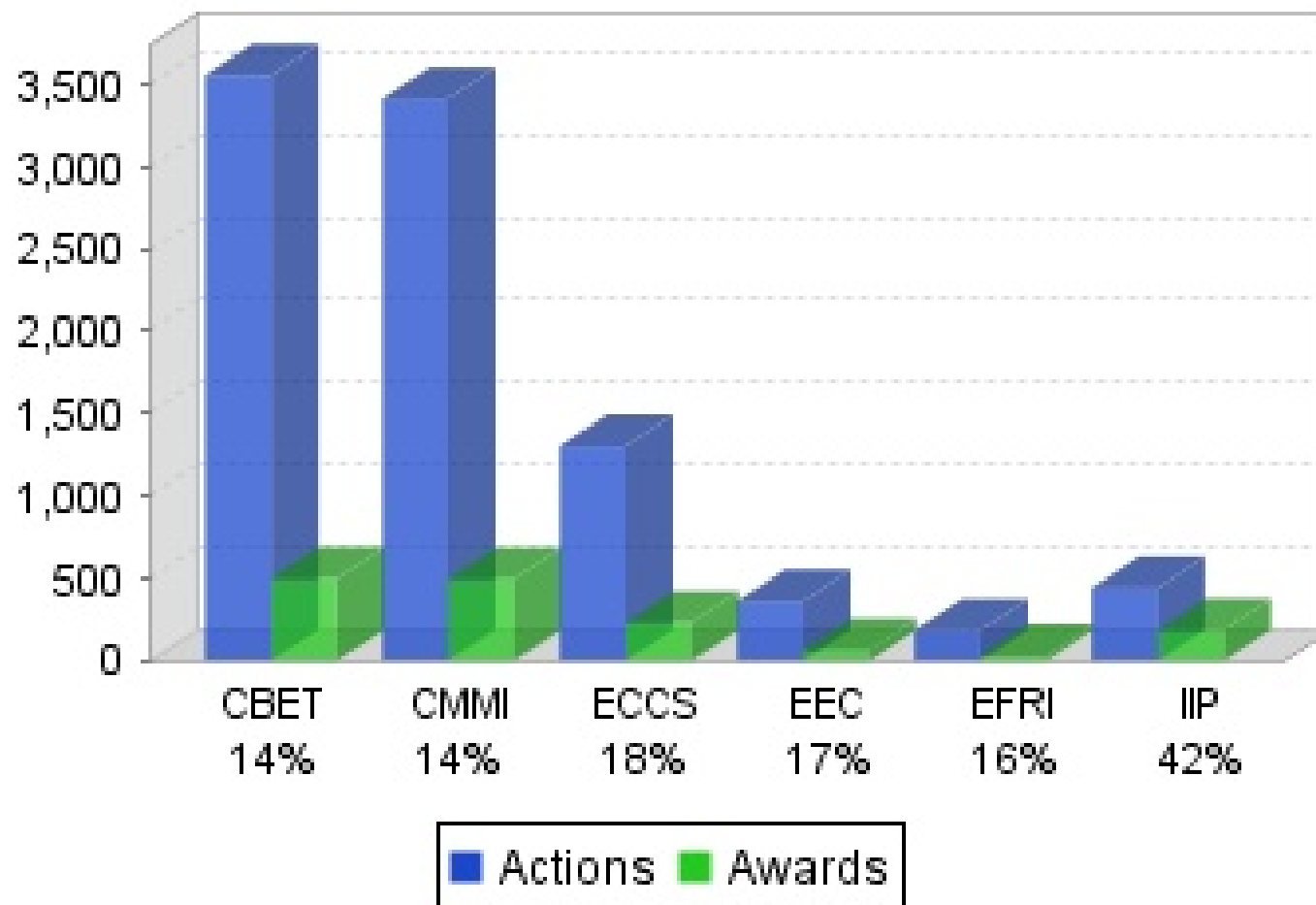
Key Components

- Multi-purpose sensor platforms are especially encouraged
- Novel transduction principles and sensor designs
- Experimental validation of sensor responses expected
- Translational potential of the research expected
- Proposals that incorporate emerging nanotechnology methods are especially encouraged (not required)
- Integration of AI to biosensing technology is encouraged

The Biosensors Program does not encourage proposals addressing

- Surface functionalization and modulation of bio-recognition molecules
- Development of basic chemical mechanisms for biosensing applications
- Circuit design for signal processing and amplification, computational modeling, and microfluidics for sample separation and filtration.
- Medical imaging-based measurements are out of the scope of the program interests.
- Proposals for optimizing and/or utilizing established methods for specific applications should be directed to programs focused on the application.

Overall FY 2014 ENG Funding Rate: 16%





NSF UNSOLICITED AND DCL

- **Dear Colleague Letter - focuses the community on responding topically in a “core”, unsolicited program in a specific directorate; normally \$300-500K for 3-5 years**
- **Solicitations – directed toward specific needs; cross directorate; larger \$\$**
 - NSF Research Traineeship
 - INFEWS
 - NCS

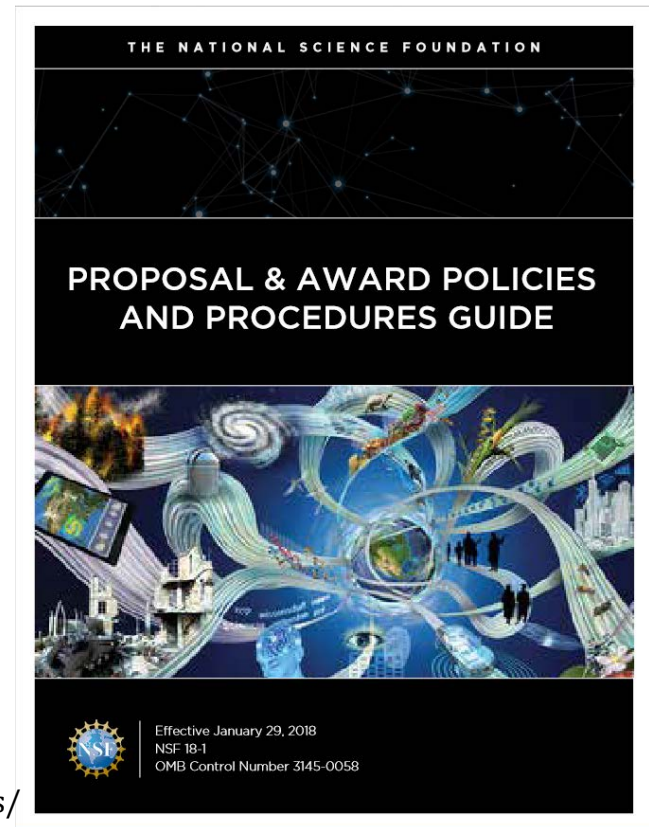
FRONTIERS Proposal Preparation Guidance

Please visit the website
www.nsf.gov/ncs/
read the solicitation, 18-533
and the NSF Grant Proposal
Guide

https://www.nsf.gov/pubs/policydocs/pappg18_1/index.jsp

View the webinar on the 2018 edition:
<https://nsfgrantsconferences.com/pappg-update-webinar/>

<http://www.nsf.gov/ncs/>





DCL- Signals in the Soil (SitS)

Dear Colleague Letter: Signals in the Soil (SitS)

February 22, 2018

Dear Colleagues:

The National Science Foundation (NSF) Directorate for Engineering (ENG) in collaboration with its Directorates for Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), and Geosciences (GEO), aims to encourage convergent research that transforms existing capabilities in understanding dynamic near-surface processes through advances in sensor systems and dynamic models. The goal of this Dear Colleague Letter (DCL) is to encourage submission of Early-Concept Grants for Exploratory Research ([EAGER](#)) proposals for early-stage, high-risk, high-reward research on technologies, models, and methods to better understand dynamic soil processes, including interactions of the macro- and microbiomes with soil nutrients, the rhizosphere, and various abiotic and biotic processes within the soil.



Other topics that meet the goals of this DCL, but are not included in these four themes, are also strongly encouraged.

1.Sensors: Novel sensors and other materials for sensing soil biological/metagenomics, chemical, or physical characteristics to monitor soil health and changes in properties under different uses, and to address needs for inexpensive sensors buried for long time periods in highly variable soil conditions.

2.Wireless Systems: Advances in wireless communications to collect and transmit data from sensors buried in soils over extended periods of time.

3.Advanced Cyber Systems and Data Analytics: New methods for data fusion and analytics of sensor measurement outputs (data visualization and reporting tools, etc.).

4.Modeling Soil Ecosystems: Next-generation models of soil biological, chemical, and/or physical components, making use of new sensing and data communications capabilities that can describe interactions among soil biological, chemical, and physical processes at different temporal and spatial scales.

RESEARCH CONCEPT OUTLINE - SUBMISSION

The NSF ENG directorate as well as the BIO, CISE, and GEO directorates are interested in receiving these Research Concept Outlines. These Research Concept Outlines should be no longer than 2 pages and must be submitted by April 13, 2018. They must contain the following information:

- 1.Title of the SitS research.
- 2.The suggested directorate(s) that may be interested in the topic. For a RAISE topic, more than one program must be listed, and there should be a clear link to each of those programs. Please note that these program listings are just suggestions. Multiple programs will view these Research Concept Outlines to determine programmatic fits.
- 3.Description of and justification for the proposed research.
- 4.Names and affiliations of researchers.
- 5.Contact information of the researchers (emails and phone numbers).

NSF'S 10 BIG IDEAS



NSF's Big Ideas for Future Investment

RESEARCH IDEAS

HARNESSING THE DATA REVOLUTION

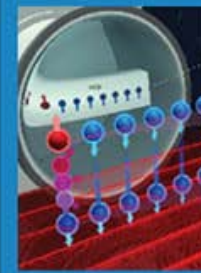
Work at the Human-Technology Frontier: Shaping the Future



Windows on the Universe: The Era of Multi-messenger Astrophysics



The Quantum Leap: Leading the Next Quantum Revolution



Understanding the Rules of Life: Predicting Phenotype



Harnessing Data for 21st Century Science and Engineering



Navigating the New Arctic

PROCESS IDEAS

Mid-scale Research Infrastructure



NSF 2050



Growing Convergent Research at NSF



NSF INCLUDES: Enhancing STEM through Diversity and Inclusion



Mechanisms for Contact



Email NSF Program Director

Study desired Program Description on NSF Website (www.nsf.gov)
One-page Summary (Intellectual Merit & Broader Impacts)
to PD by email
Program Director (PD) provides Feedback by email

Visit NSF Program Director



Contact cognizant Program Director with dates to visit

Telephone Program Director

Request a phone conversation by email

Submit a Proposal Concept prior to call

Provide a list of questions by email at least 24 hours before the call

NSF & YOU



Serve as an NSF Panelist

Email Program Director
2-page NSF Biosketch

State how your expertise
compliments the Program

Seek service in multiple
Programs and Divisions



NSF Outreach by Program Directors

Visiting Campus

NSF workshops in major
conferences