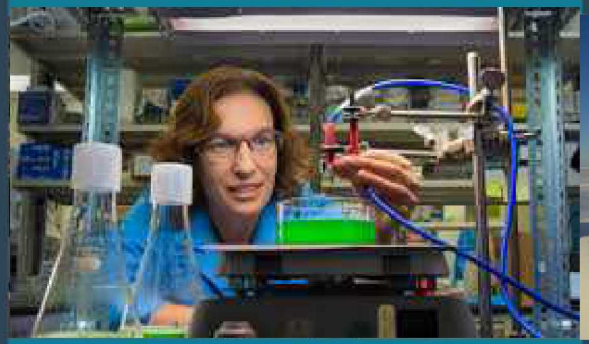
SAND2018-11218PE

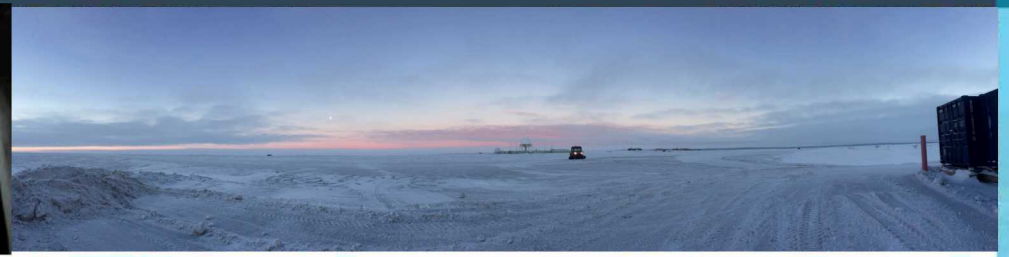
Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY

Office of Science

SANDIA BER PROGRAM REVIEW





PRESENTED BY

Carol L. Adkins

Director, Secure Energy and Earth Systems Program

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AGENDA

- Introduction
- Rapid Fire Presentations
  - Earth & Environmental Science Topics
  - Bio Topics
- Proposed Earth & Environmental System Measurement SFA
- Proposed Bio-related SFA
- Earth & Environmental Science Programs Updates
- Bio Programs Update
- Feedback

SANDIA PORTFOLIOS & RESEARCH FOUNDATIONS

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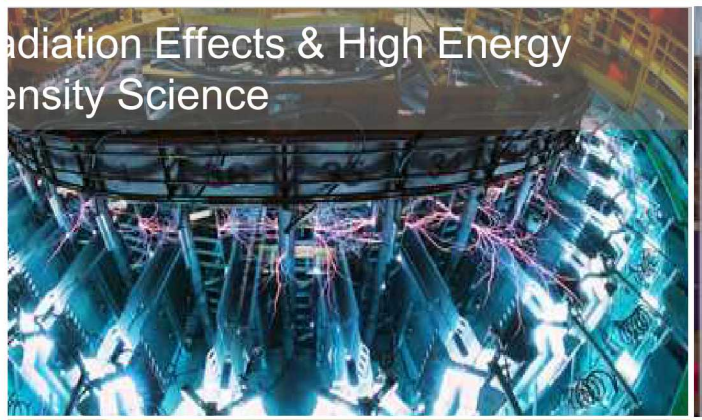
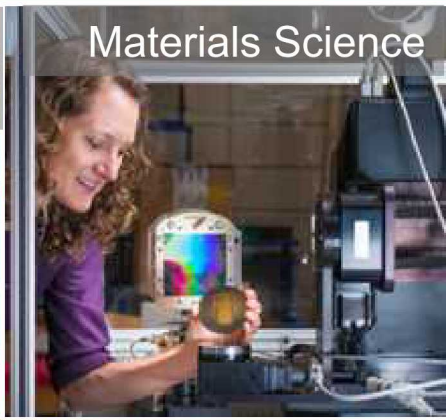
ensity Science



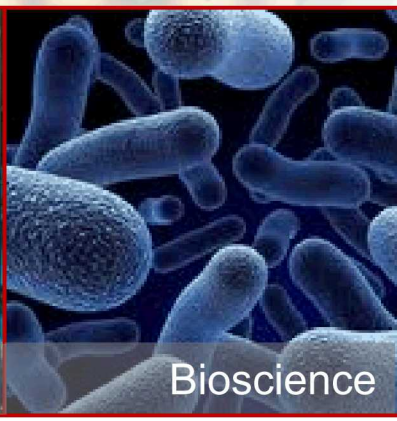
Materials Science



Nanodevices & Microsystems

ineering
Science

Earth Science



Bioscience

Cor
Inf

SANDIA'S BER PROGRAM LEADERSHIP

Two Sandia Associate Lab Directors and four Sandia Directors connected to BER Programs

Dori Ellis
Associate Labs Director
Energy & Homeland Security

Anup Singh
Director
Chemical, Biological, Radiological, Nuclear Defense & Energy Technologies

Paul Bryan
Senior Scientist
CBRN Defense & Energy Technologies

Carol Adkins
Director
Energy, Earth, & Complex Systems

Erik Webb
Senior Manager
Geoscience Research & Applications

U.S. DEPARTMENT OF ENERGY

Office of Science

BIOLOGICAL & ENVIRONMENTAL RESEARCH

BASIC ENERGY SCIENCES

OFFICE OF SCIENCE PROGRAMS

Susan Seestrom
Associate Labs Director
Advanced Science & Technology

Scott Collis
Director
Center for Computing Research

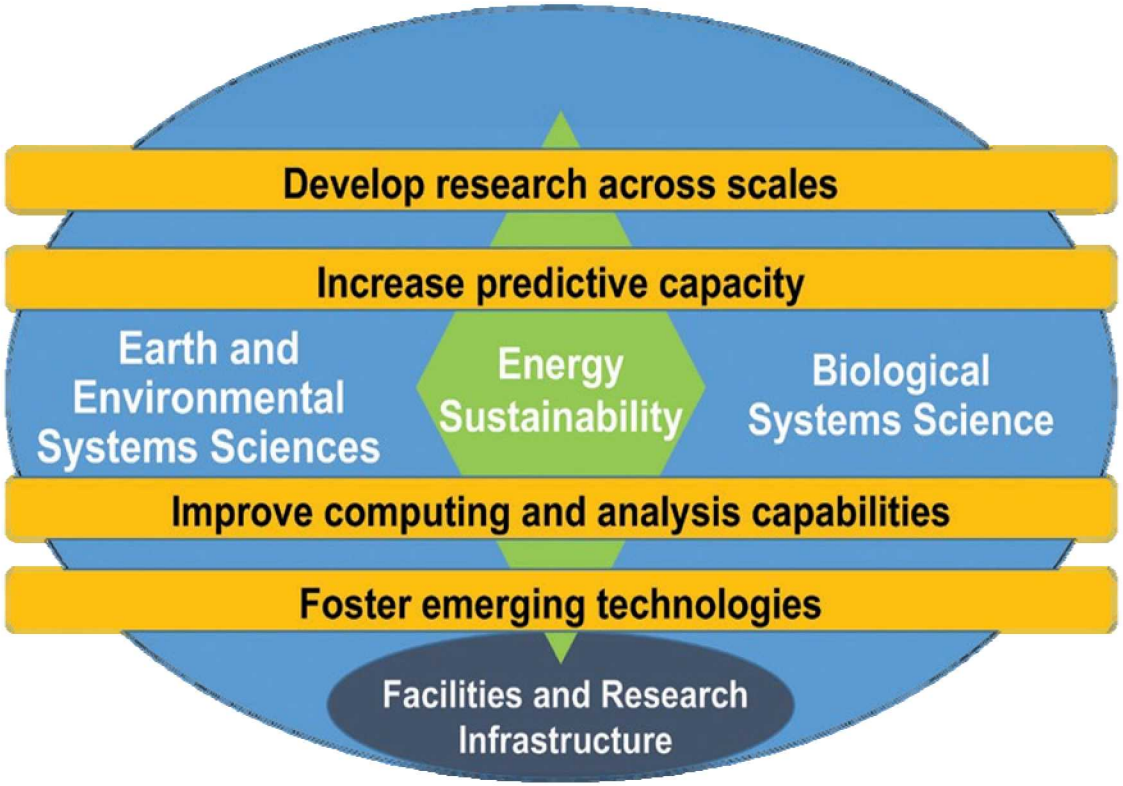
Jim Stewart
Senior Manager
Computational Sciences & Math Group

Grant Heffelfinger
Director
Energy & Homeland Security Program Management

WE ARE STRATEGICALLY ALIGNED

BERAC GRAND CHALLENGE AREAS

Source: Grand Challenges for Biological and Environmental Research: Progress and Future Vision, November 2017



SANDIA ATMOSPHERIC SCIENCE OBJECTIVES:

- High performance computing to support models
- High resolution earth models
- Regional models
- Process models
- Observational technologies

SANDIA COMPUTATIONAL MODELING OBJECTIVES:

- Algorithms, HPC and software engineering to improve E3SM
- Multi-institution project management
- Computational expertise, tools and practices

SANDIA ENERGY AND WATER (INFRASTRUCTURE DEPENDENCIES) OBJECTIVES:

- Advanced modeling and analysis capabilities
- Develop interoperable frameworks
- Assess vulnerabilities of infrastructure system
- Identify adaptive measures

SANDIA MEASUREMENTS OBJECTIVES:

- Facilitate field campaigns on the North Slope
- Instrumented tethered balloon operations to Arctic clouds
- Provide experts and mentors for ARM

SANDIA BIOMASS PROGRAM OBJECTIVES:

- Bio-derived ionic liquid for deconstructing biomass
- Lignin valorization
- Designer chemicals using synthetic biology
- Algae crop protection
- Turf algae for water treatment, biofuel, and products

SANDIA WORK COMPLEMENTS BER AND NNSA MISSION

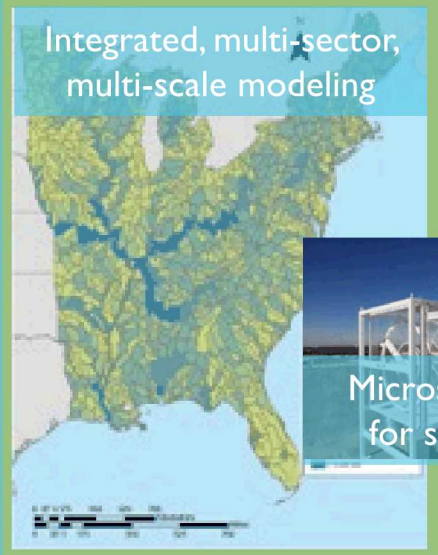
NNSA National Nuclear Security Administration

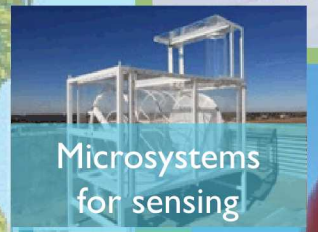
Sandia National Laboratories

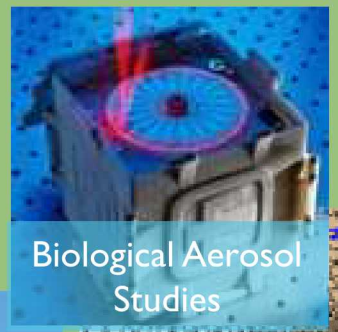
U.S. DEPARTMENT OF ENERGY | Office of Science

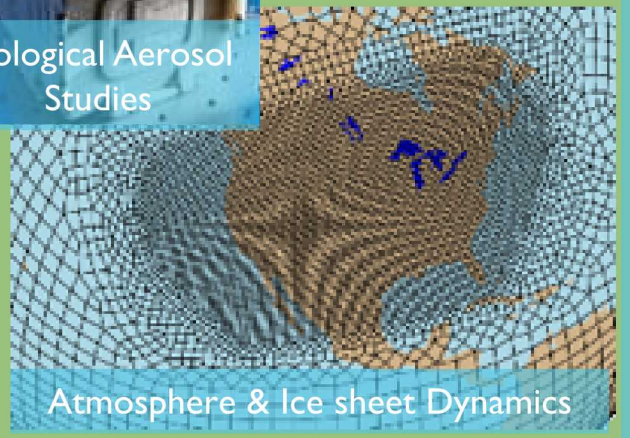
Office of Biological and Environmental Research

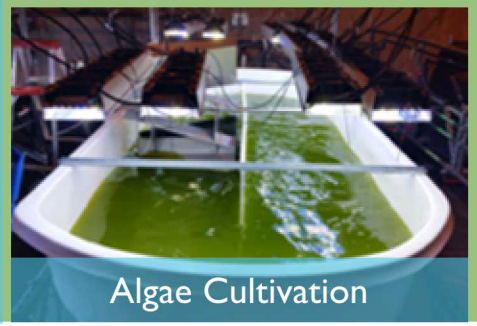
- WMD Surveillance (UAVs)
- High Performance Computing
- Operating in Extreme Environments
- Atmospheric Measurements
- Non-proliferation
- Satellites
- LIDAR/RADAR Capabilities

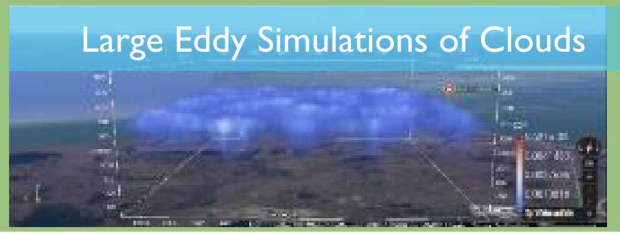












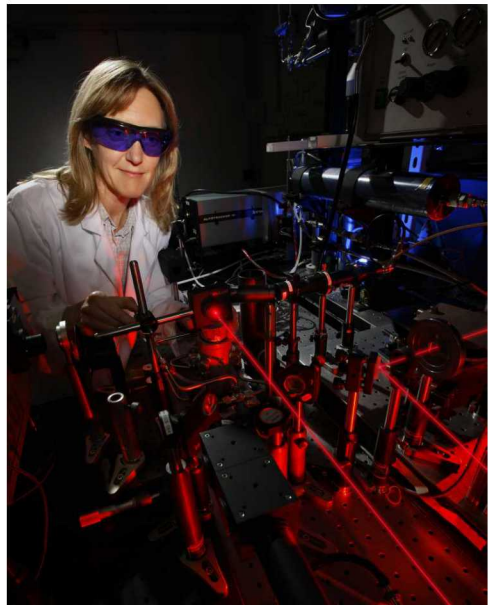
- Chemical and Biological Defense
- Infectious disease research
- Biological and chemical detection
- Decontamination and Restoration
- Combustion research
- Biomass valorization

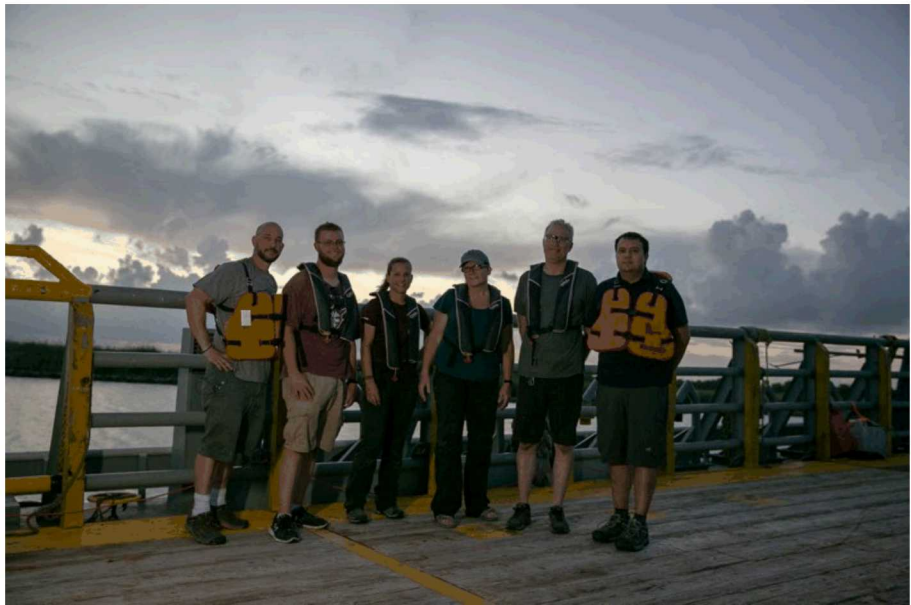
The BER program supports researching focusing on the interconnections between energy production, the living environment and national security

BER WORK PROMOTES STAFF DEVELOPMENT

In addition to providing funding for leading edge science that benefits our nation, our relationship with BER provides significant collateral benefits to our staff:

- An opportunity to develop and hone their thinking about fundamental science.
- Promotes an ethos of curiosity that ultimately benefit Sandia's core mission as staff bring outside-of-the-box thinking to complex, national security challenges.
- Connects our principal investigators to the rest of the lab system and universities and promotes a collaborative research environment.

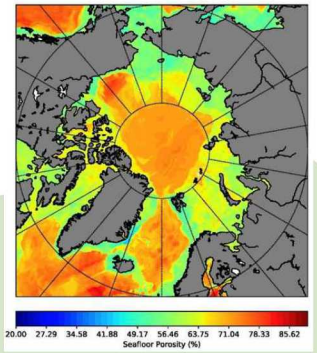




Brief History of Jennifer M. Frederick at SNL

Permafrost bluff erosion along Beaufort Sea coastline (Drew Point, Alaska)

Sandia National Laboratories



Arctic seafloor porosity map created using machine learning (Naval Research Lab).

Technical Leadership

- Principle Investigator: Forecasting Marine Sediment Properties On and Near the Arctic Shelf with Geospatial Machine Learning (Laboratory Directed Research & Development)
- Model Development Task co-Lead: A Predictive Model for Arctic Coastal Erosion (Laboratory Directed Research & Development)
- **SNL:** Senior Member of Technical Staff (2015-)

Professional Leadership

- U.S. Naval Officer of Meteorology and Oceanography (01 - Reserves)
- Member of American Geophysical Union, U.S. Permafrost Association, Permafrost Young Researchers Network
- Mentorship and Recruitment of Postdocs and New Staff
- **SNL:** Senior Member of Technical Staff (2015-)

Berkeley UNIVERSITY OF CALIFORNIA

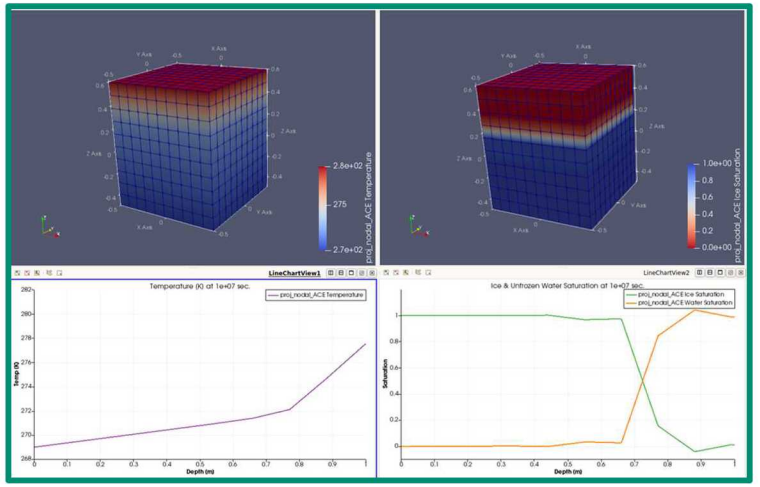
Education

- **Ph.D.**, Earth & Planetary Science; Computational Science & Engineering, U.C. Berkeley, 2013
- **M.S.**, Mechanical Engineering, U.C. Berkeley, 2010
- **B.S.**, Bioengineering, University of Illinois at Chicago, 2008

Research Interest Evolution

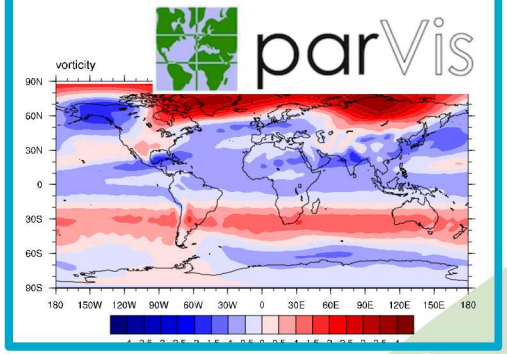
- **Ph.D. Thesis:** "*Numerical investigations of the fluid flows at deep oceanic and Arctic permafrost-associated gas hydrate deposits*"
- **Postdoc Research:** Development of a coupled numerical model to simulate submarine groundwater discharge along permafrost Arctic coastlines
- **SNL Research:**
  - Arctic Coastal Erosion
  - Arctic Ocean Seafloor Properties
  - Arctic Tipping Points Influencing Global Change
  - Development of new hydrological dynamical core for E3SM

Numerical Model Development: Permafrost temperature (left) and ice saturation (right)

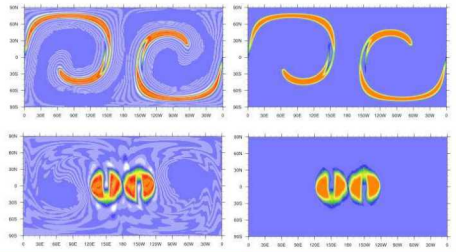


Brief History of Kara Peterson at SNL

Parallel Methods for Post-Processing Earth System Data using Intrepid



Optimization-based Tracer Transport



Arctic Tipping Points

Sandia National Laboratories

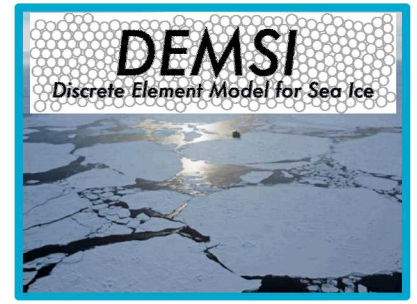
CCR Center for Computing Research

Technical Leadership

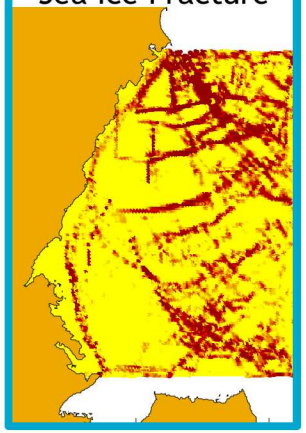
- SciDAC pilot project, Discrete Element Model for Sea Ice (DEMSI), Principal Investigator for Sandia
- Laboratory Directed Research and Development Principle Investigator "Arctic Tipping Points Triggering Global Change"
- **SNL:** Principal Member of Tech. Staff (2018-)

Professional Leadership

- Member of Society for Industrial and Applied Mathematics, Association for Women in Mathematics, American Geophysical Union
- Member of DOE National Laboratories Applied Mathematics Visioning Committee
- **SNL:** Senior Member of Tech. Staff (2010-2018)



Sea Ice Fracture



Research Interest Evolution

- Initial interest in discretization methods for PDEs applied to a variety of application areas including Earth system model components
- Interests have broadened to computing for heterogeneous architectures and machine learning
- How can we apply these methods to understanding Arctic system processes?
- **SNL:** Postdoc (2008-2010)
- **SNL:** Senior Member of Tech. Staff (2010-2018)

Part of development team for Intrepid library in Trilinos

Education

- **Ph.D.,** Applied Mathematics, University of New Mexico, 2008
- **Thesis Title**: "Modeling Arctic Sea Ice Using the Material-Point Method and an Elastic-Decohesive Rheology"
- **Advisor:** Professor Deborah Sulsky

UNM

Brief History of Kunal Poorey at SNL

Education

- SNL System Biology Department – Post-doc Scientist 2013-2017
- Ph.D. Biochemistry Molecular Biology and Genetics 2013
- M.S. Biological and Physical Sciences 2011
- M.S. Civil and Environmental Engineering 2007
- B.Tech. Chemical Engineering 2004

Science AAAS

Measuring Chromatin Interaction Dynamics on the Second Time Scale at Single-Copy Genes

Kunal Poorey, Ramya Viswanathan, Melissa N. Carver, Tatiana S. Karpova, Shana M. Cirimotich, James G. McNally, Stefan Bekiranov, David T. Auble

PLOS | GENETICS

Transcriptomes of six mutants in the Sen1 pathway reveal combinatorial control of transcription termination across the *Saccharomyces cerevisiae* genome

Xin Chen, Kunal Poorey, Melissa N. Carver, Ulrika Müller, Stefan Bekiranov, David T. Auble, David A. Brow

CSH PRESS GENOME RESEARCH

RNA synthesis precision is regulated by preinitiation complex turnover

Kunal Poorey, Rebekka O. Sprouse, Melissa N. Wells, Ramya Viswanathan, Stefan Bekiranov, and David T. Auble

UNIVERSITY of VIRGINIA

Gene Transcription Regulation

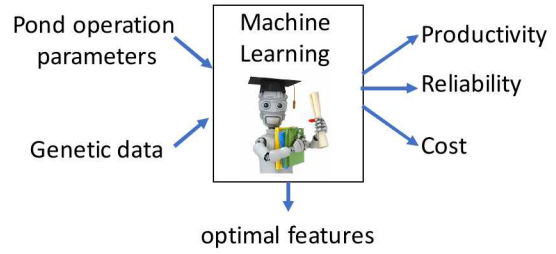
- Development of computational tools to quantify RNA expression and their defects
- Understanding the roles of general transcription factors in global gene regulation
- Understanding epigenetics and novel histone marks

Measuring Chromatin Dynamics

- Developing novel Genomic assays for measuring second time scale chromatin interactions genome wide. CLK-seq
- Further interested in using this novel application in designing optimal promoters and regulatory architecture for industrial applications

Understanding and utilizing Microbial Ecology for Bioenergy Applications

- Using data driven Big-Data approaches to optimize industrial algal biomass production in open systems
- Development of predictive machine learning models for optimization of biomass production
- Understanding complex adaptive systems in industrial applications



Sandia's relationship with BER is critical to the development of our capabilities and our researchers, solving difficult science challenges and fulfilling Sandia's mission.

WE WELCOME YOUR FEEDBACK