UNM SCHOOL of ENGINEERING

UNM Collaboration and Workforce Training with the NM Federal Laboratories

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Dean, School of Engineering
Associate Provost for National Laboratory Relations
Professor, Chemical and Biological Engineering

Science, Technology, and Telecommunications Committee
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Background

- Over the past 30 years, UNM has strengthened its research programs and aligned many of them with areas critical to New Mexico's national security laboratories, Sandia National Laboratories and Los Alamos National Laboratory, the Air Force Research Lab (AFRL) and White Sands Missile Range
- UNM has hired new faculty in key areas for the labs, and has also been very successful in securing funding that has supported research, along with graduate students and post-doctoral fellows
- As a result of this and UNM's proximity to the laboratories, UNM faculty and Federal Laboratory researchers have built increasingly productive and vital research collaborations
- These collaborations have provided outstanding opportunities for training graduate students and post doctorial fellows jointly with National Laboratory scientists and engineers.
- This vital and rich collaborative environment has helped both UNM and the National Laboratories attract "the best and the brightest"

Areas of Collaboration

- Currently, UNM is actively working with the Laboratories in foundational areas, including:
  - Nanodevices and microsystems
  - Biomedical engineering and bioscience
  - Quantum information and computing
  - Materials science
  - Advanced energy
  - Nuclear engineering
  - Infrastructure security
  - High-energy-density physics
  - High-power microwaves
  - Advanced communication
  - Global and national security policy

UNM's partnership with Sandia

- Over 2400 Sandians have degrees from UNM, including 180 PhDs
- Sandia invests more research funding at UNM than any other academic institution
- There are currently 368 UNM summer interns and 367 UNM year round interns at Sandia
- Sandians support UNM on boards, curricula preparation, and class instruction
- UNM and Sandia have together won multiple R&D 100 Awards
- Sandia and UNM operate a joint research facility, the Advanced Materials Laboratory
- Where permitted by the government, Sandia and UNM team to compete on proposals to provide external funding for joint research pursuits

Joint Appointments with Sandia

- Currently, there are three Sandians who hold joint appointments at UNM as tenured faculty members:
  - Dr. Jeffrey Brinker, Distinguished and Regents' Professor, Department of Chemical and Biological Engineering and Sandia Fellow
  - Dr. Richard Kemp, Professor, Department of Chemistry and Principal Member of the Scientific Staff at Sandia
  - Dr. Fernando Garzon, Professor, Department of Chemical and Biological Engineering and Principal Member of the Scientific Staff at Sandia
- One ongoing search for a professor in high-performance/scalable computing
- Three additional future searches planned in high energy density physics, quantum information, and cyber security
- Five Sandians hold the title of UNM/National Laboratory Professor
- 25 Sandians hold appointment as Research Professor

Sandia Strategic Alliance

- **Members:**
  - University of New Mexico
  - University of Texas
  - University of Illinois
  - Georgia Tech
  - Purdue
- **Purpose:**
  - Jointly define the future of science and engineering for national security
  - Increase research interactions and collaborations between individual staff, faculty, and students
  - Focus research efforts toward important national objectives
  - leverage the capabilities and facilities of UNM
  - create awareness of Sandia as a potential employer for UNM students.

Sandia Strategic Alliance

- **UNM Technical Focus Areas:**
  - quantum computing and information science
  - nanoscience and microsystems engineering
  - nuclear engineering
  - high energy density science
  - energy and water
  - cyber security and bioscience for national security
- **Strategies**
  - Explore the potential for future innovative facility partnerships
  - Jointly explore strategies enabling the future of engineering for national security
  - Joint recruitment and hiring of nationally prominent faculty/technical staff

UNM's partnership with LANL

- The New Mexico Consortium (NMC)
  - Formed by UNM, NM Tech, and NMSU to engage universities and industry in scientific research and increase the role of LANL in science, education and economic development in NM
  - UNM Board of Directors members include:
    - Dr. Richard Larson, UNM/HSC Executive Vice Chancellor and Vice Chancellor for Research
    - Dr. Gabriel Lopez, UNM Vice President for Research
  - Areas of Collaboration
    - Advanced computing – UNM Department of Computer Science
    - Biomedical Technology – UNM Center for Biomedical Engineering
    - Quantum Information – UNM Department of Math and Statistics

Advanced Fuel Cell Catalysts

UNM Center for Micro Engineered Materials (CMEM)

The Science And Engineering of Durable Ultralow PGM Catalysts $6,000,000

Los Alamos National Laboratory (lead) Fernando Garzon
Ballard Power Systems
University of California Riverside
University of New Mexico Abhaya Datye
Oak Ridge National Laboratory

Engineered Nano-scale Ceramic Supports for PEM Fuel Cells $2,000,000

Los Alamos National Laboratory (lead) Eric L. Brosha
University of New Mexico Timothy Ward
Oak Ridge National Laboratory

Durability Improvements Through Degradation Mechanism Studies $8,725,000

Los Alamos National Laboratory (lead) Rod Borup
Ballard Power Systems
Ion Power
Argonne National Laboratory
Laurence Berkley National Laboratory
Oak Ridge National Laboratory
University of New Mexico Kateryna Artyushkova

Development of Micro-structural Mitigation Strategies for PEM Fuel Cells: Morphological Simulation and Experimental Approaches $6,000,000

Ballard Material Products / Ballard Power Systems Silvia Wessel
Queen's University
Georgia Institute of Technology
Los Alamos National Laboratory
Michigan Technological University
University of New Mexico Plamen Atanassov

DOE Hydrogen Program

Examples of recently completed programs (left block) created a broad base for fuel cells materials development at UNM and engaged several faculty in the enterprise.

The current DOE-EERE project has LANL as "validator". It has been "mirrored" by an internal investment (DR) and another DOE-EERE program funded to LANL. UNM currently has 2 standing proposals in this area for FY16.

Development of Novel Non-PGM Electrocatalysts for PEM Fuel Cell Applications
$5,400,000

Northeastern University (lead)	Sanjeev Mukerjee, Gene Smotkin
University of New Mexico	Plamen Atanassov, Boris Kiefer (NMSU)
Michigan State University	Scott Calabrese Barton
University of Tennessee	Tom Zawodzinski, Stephen Paddison
Los Alamos National Laboratory	Piotr Zelenay
BASF	Emory De Castro
Nissan Automotive	Kev Adjemian
PAJARITO POWDER	Paul Short, Barr Halevi

Center for Biomedical Engineering Collaborations

- **Biomaterials and Biointerfaces**

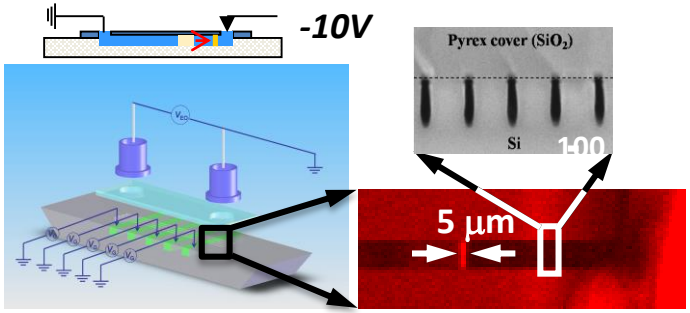
(e.g., polymeric materials for tissue engineering applications; collaborations with SNL)

- **Instrumentation and Diagnostics**

(e.g., development and application of flow cytometry instrumentation and bio-analytical methods; collaborations with SNL and LANL)

- **Computation and Modeling**

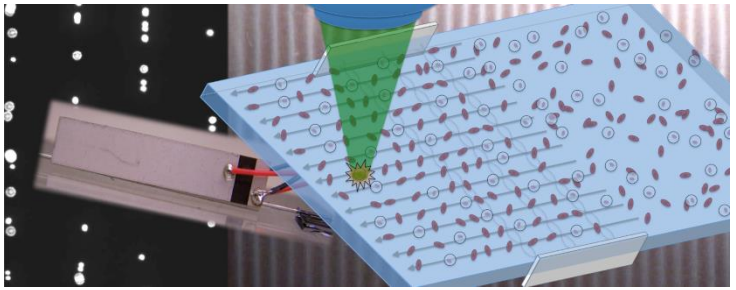
(e.g., modeling of energy flow in natural and biomimetic material systems; collaborations with LANL)



Metrics of national lab research collaborations over recent two year period:

72 total publications
29 involving SNL/LANL co-authors (40%)

34 patent disclosures
17 involving SNL/LANL co-inventors (50%)



Department of Mechanical Engineering (ME) Chris Hall, Chair - Collaborations with LANL

- Ron Lumia (MTTC) collaborates with
  - Kurt Anast, DAHRT - Dual Axis Radiographic Hydrodynamic Test
- Svetlana Poroseva collaborates with
  - Tim Clark, Eulerian Applications (joint NASA project), and Tim Clark is now a research professor in ME
  - R. Linn, Team Leader for Atmospheric Modeling and Weapons Phenomenology Team
- Mehran Tehrani collaborates with
  - Steve Doorn, Center for Integrated Nanotechnologies (CINT)
- Peter Vorobieff collaborates with
  - Gregory E. Dale, High Power Electrodynamics Group
  - Katherine Prestridge, Extreme Fluids Team

Department of Nuclear Engineering (NE) Anil Prinja, Chair – LANL Collaborations

- **Mohamed El-Genk:**
  - Nanoporous UO2-compatible oxide particles for accident tolerant fuels (fission gas retention, performance under high irradiation, temperature and pressure conditions) and enhanced burnup.
- **Adam Hecht:**
  - Measurements of fission fragment yield and basic nuclear data with applications to nuclear nonproliferation
- **Anil K. Prinja:**
  - Model development for continuous-energy Monte Carlo reactivity temperature coefficient.
  - Computationally efficient methods for Monte Carlo charged particle transport
  - Advanced deterministic methods for neutral and charged particle transport
  - Modeling stochastic neutron populations

Department of Nuclear Engineering (NE)
Anil Prinja, Chair – NL Collaborations

- **Anil K. Prinja:**
  - Model development for continuous-energy Monte Carlo reactivity temperature coefficient.
  - Computationally efficient methods for Monte Carlo charged particle transport
  - Advanced deterministic methods for neutral and charged particle transport
  - Modeling stochastic neutron populations

Joint IP with the National Labs

	Sandia	Los Alamos
Joint Patents	180	39
Commercialization Agreements	74	23
Total Start Ups from Joint IP	7	

UNM/NM National Laboratories Joint Advisory Board

- Empaneled by UNM President, Dr. Bob Frank, to explore the relationship between the University and New Mexico's two DOE/NNSA laboratories
- Establish a baseline understanding of interactions between the university and both labs
- Recommend to the university and the labs steps to be taken to strengthen the relationship
- Serve as a conduit for DOE/NNSA objectives for national security to inform UNM research
- Help integrate DOE's and University's economic development and technology transfer/commercialization strategies and programs
- Review progress under the Sandia Strategic Alliance and recommend future initiates
- First meeting held at UNM April 28-29, 2015

Joint Advisory Board (April 2015)

- Dr. Paul Peercy (Chairman), Dean, Emeritus, College of Engineering, University of Wisconsin
- Dr. Paul Hommert, Director, Sandia National Laboratories and President of Sandia Corp
- Dr. Charlie McMillan, Director, Los Alamos National Laboratory
- Dr. Bob Frank, President, UNM
- Dr. Michael Anastasio, former Director, both Los Alamos National Laboratory and Lawrence Livermore National Laboratory
- Dr. Paul Fleury Dean of Engineering, Emeritus, Yale University
- Dr. Bob Logan, Senior Fellow at the Center for Global Security Research, LLNL
- Dr. Jim Tegnelia, former Director, Defense Threat Reduction Agency and former EVP, SNL
- Mr. William Knauf (Secretary of the Board), formerly Sandia National Laboratories

UNM's partnership with Air Force Research Laboratory (AFRL)

- Research and educational partnerships with:
  - School of Engineering departments:
    - Chemical and Biological Engineering
    - Civil Engineering
    - Computer Science
    - Electrical and Computer Engineering
    - Mechanical Engineering
  - College of Arts & Sciences Departments:
    - Biology
    - Chemistry
    - Physics
  - Anderson School of Management

FY15 AFRL/AFOSR Center of Excellence: *The Science of Electronics in Extreme Electromagnetic Environments*

Dr. Edl Schamiloglu (ECE)

Research areas:

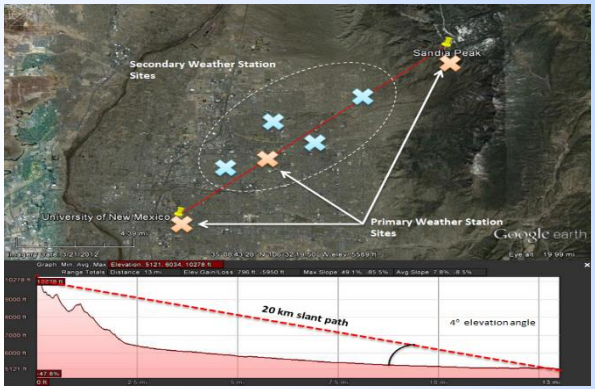
- understanding how electronics behave when they are stressed beyond their nominal operating point
- developing predictive models to describe such behavior
- exploring emerging technologies in electronics/photonics and expanding our understanding to cover these devices (FinFETS, optical interconnects, etc.)

UNM and AFRL/RD have a long history of collaborating in High Power Electromagnetics!

Future Satellite Communications

Christodoulou

W/V-Band Atmospheric Propagation Research – joint activity with AFRL and NASA GRC.



Profile view of transmitter/receiver slant path from Sandia Mountain to COSMIAC/UNM to establish the first terrestrial link at 72/84 GHz

Facilities

- **Cleanroom**
  - COSMIAC has a sixteen foot by eight foot cleanroom designed for satellite integration and testing
- **Helmholtz Cage**
  - Six foot cubed Helmholtz cage for attitude control testing
- **Ground station**
  - Monitoring LEO satellites

Additive Manufacturing

- Working with University of Texas El Paso, NASA Glenn and Northrop Grumman partners on 3D Printing
- Current work for AFRL involves printing satellite for functional check of components and wiring measurements as well as outgas research for directed energy applications

UNM's partnership with White Sands Missile Range (WSMR)

- WSMR Academic Partnership Initiative
  - Includes UNM, NMSU, and UTEP
  - Conduct research, development, test and evaluation on high-level test projects in support of WSMR's leadership vision
  - 3 year $500k contract with UNM Department of Electrical and Computer Engineering for
    - Wideband Autonomous Cognitive Radios (WACRs) for Spectrally-efficient and Agile Multiband/Multimode Communications