

NSF Division of Materials Research (DMR) Update FY2017

Linda S. Sapochak
Division Director

*National Academies' CMMR
Committee Meeting
March 6-7, 2017*

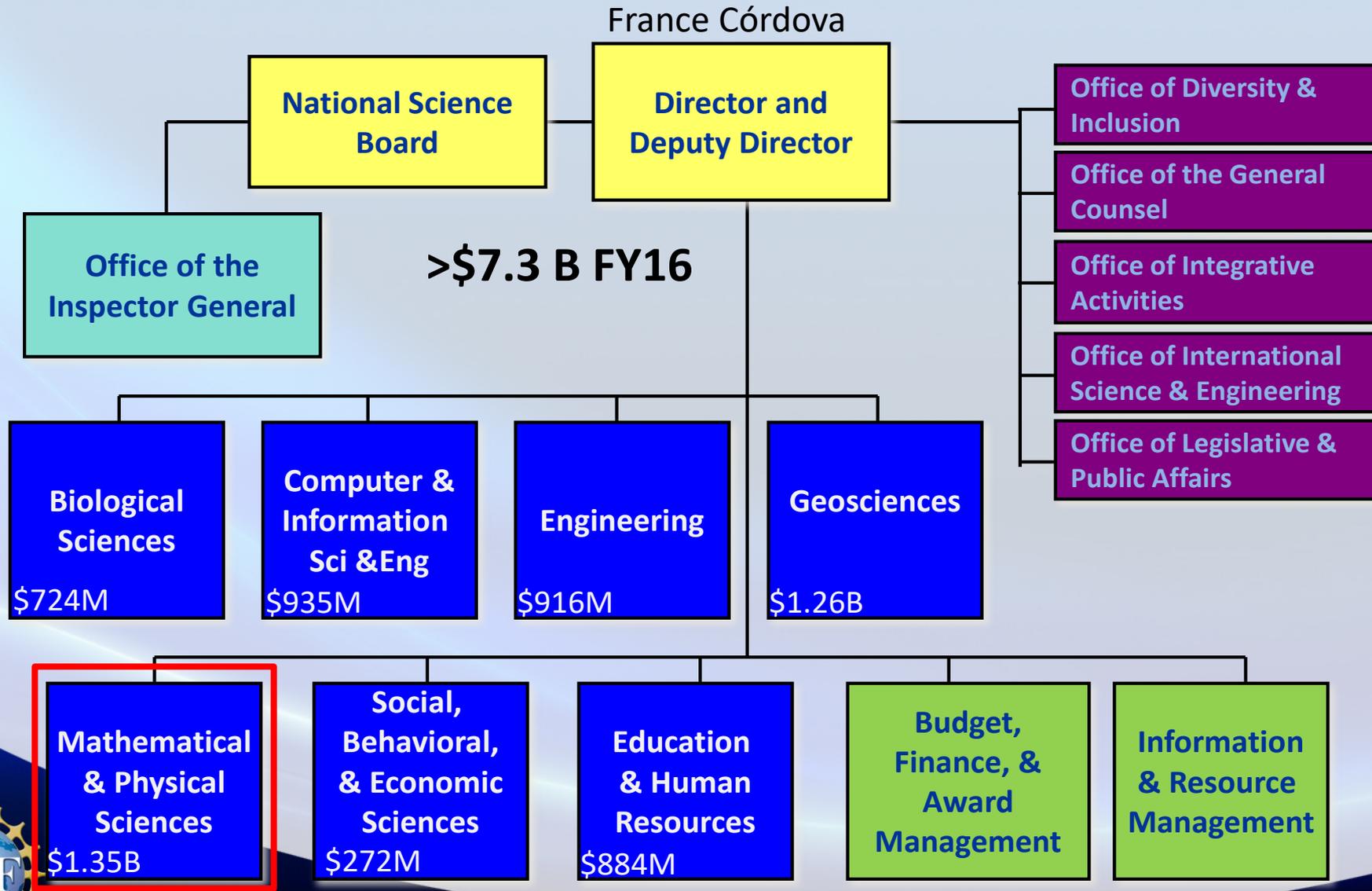


Presentation Outline

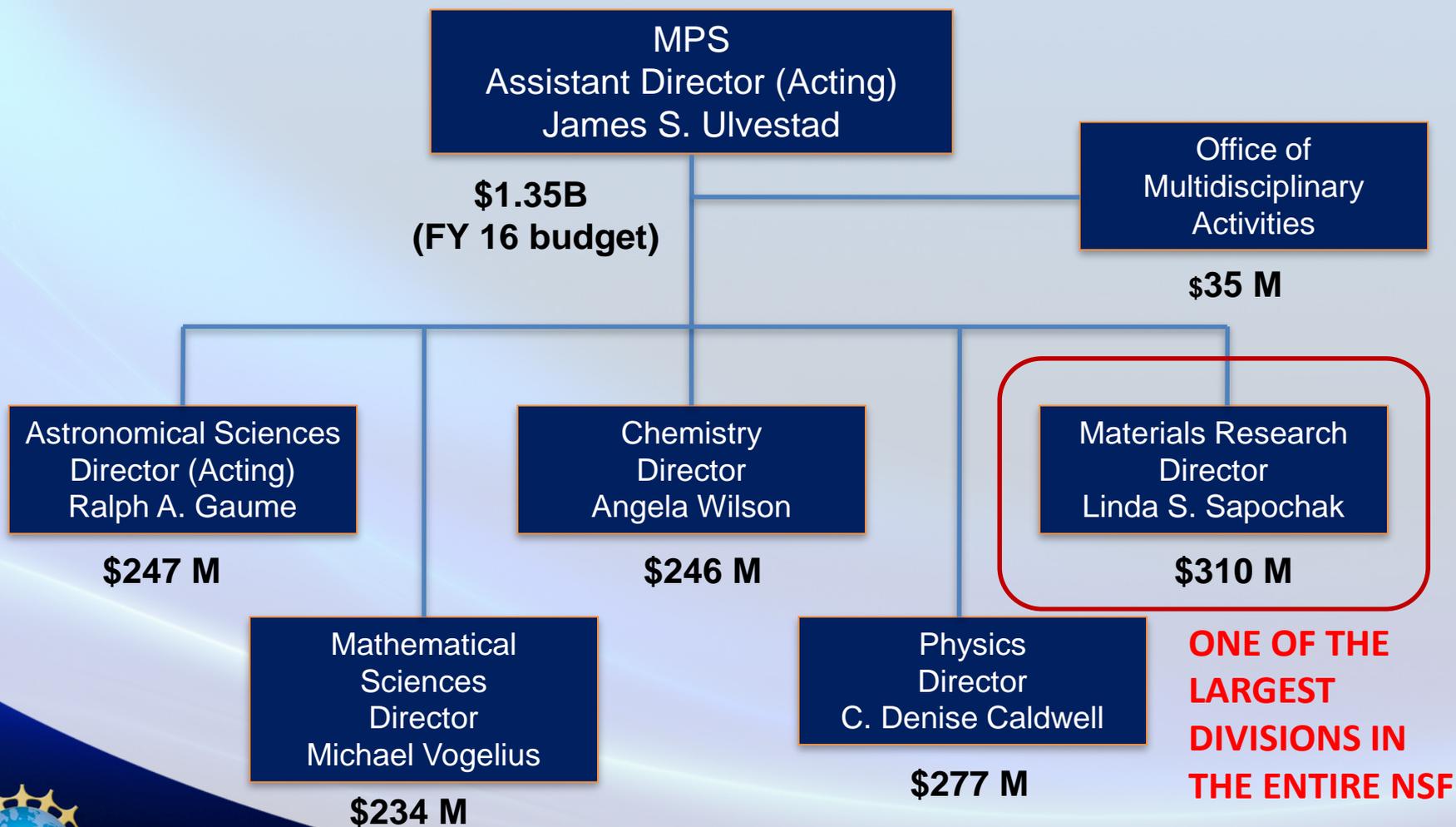
- NSF Organization and Changing Leadership
- DMR Staff, Programs, Budget
- Program Updates
- Program Highlights
- Strategic Research Directions
- DMR “Partnership” Activities



National Science Foundation



Mathematical and Physical Sciences





Division of Materials Research (DMR)

OFFICE OF THE DIVISION DIRECTOR



Linda Sapochak
Division Director



Sean L. Jones
Acting Deputy Division Director



Nelia Odom-Jefferson
Operations Specialist



Velma Lawson
Program Support Manager

ADMINISTRATIVE UNIT



Meghan Ackerman
Program Specialist



Benita Fair
Program Specialist



Renee Ivey
Program Specialist



Claudia Johnson
Contractor



Allison Smith
Program Specialist



Kelsey Smith
Student Program Assistant



Aubrie TenEyck
Contractor



Elaine Washington
Program Specialist



Denese Williams
Program Analyst



Program Directors

Materials Instrumentation & National Facilities



Leonard Spinu



Guebre X. Tessema



Charles Ying

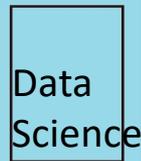
Designing Materials to Revolutionize and Engineer our Future



Susan Dexheimer



John Schlueter



Materials Research Science & Engineering Centers



Daniele Finotello



Birgit Schwenzer



PREM



Jose Alfredo Caro

Condensed Matter Physics



Tomasz Durakiewicz



Paul Sokol

Electronic & Photonic Materials



Miriam Deutsch



Tania Paskova

Condensed Matter & Materials Theory



Daryl W. Hess



Alex Klironomos

Solid-State & Materials Chemistry



Birgit Schwenzer



Eugene Zubarev

Ceramics



Lynnette Madsen

Polymers



Andrew J. Lovinger

Biomaterials



Joseph A. Akkara



Alex Simonian

Metals & Metallic Nanostructures



Diana Farkas

Expert



Freddy Khoury

50:50
Permanent:Rotator

DMR Budget

FY15 \$307M
 FY16 \$310M
 FY17E \$310M
 FY18 ????????



Initiatives Relevant to DMR

CIF21 - Cyberinfrastructure Framework for 21st Century

UtB - Understanding the Brain

SusChEM - Sustainable Chemistry, Eng, and Materials

INFEWS - Innovation at the Nexus of Food, Energy, and Water

MGI - Materials Genome Initiative

Advanced Manufacturing

Mid Scale Instrumentation

OP - Optics & Photonics

BioMaps - Interface of the Biological, Mathematical and Physical Sciences & Eng



Program Updates





DIVISION OF MATERIALS RESEARCH (DMR)

Topical Materials Programs

Biomaterials
Ceramics
Electronic & Photonic Materials
Metals and Metallic Nanostructures
Polymers

Condensed Matter & Materials Theory
Condensed Matter Physics
Solid State and Materials Chemistry

Cross-Cutting Activities

Diversity
International
Education

Centers & Teams

Materials
Research
Science &
Engineering
Centers
(MRSEC)

Partnerships in
Research &
Education in
Materials (PREM)

Designing Materials
to Revolutionize &
Engineer our Future
(DMREF)

National Facilities & Instrumentation Program

Cornell High Energy Synchrotron Source
(CHESS)

National High Magnetic Field Laboratory
(NHMFL)

Center for High Resolution
Neutron Scattering (CHRNS)

National Nanotechnology
Coordination Network (NNCI)

Materials Innovation Platforms **(MIP)**

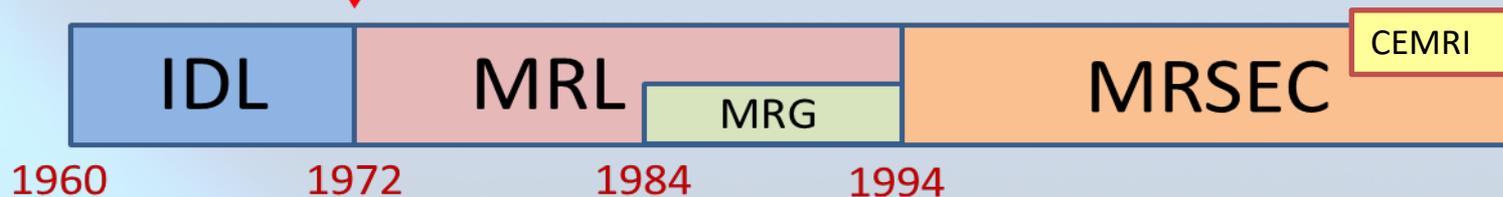


MRSEC & Other NSF Centers

NSF established DMR



2011



IDL/MRL University	Year Initiated
Cornell	1960
Pennsylvania	1960
Northwestern	1960
Chicago	1961
Harvard	1961
MIT	1961
Pennsylvania State	1974
Ohio State	1982

1985 Engineering Res Centers

1989 Science & Tech Centers

2001 Nanoscale Science & Engineering Centers NSEC

2002 Physics Frontier Centers PFC

2004 Centers for Chemical Innovation CCI



MRSEC Evaluation

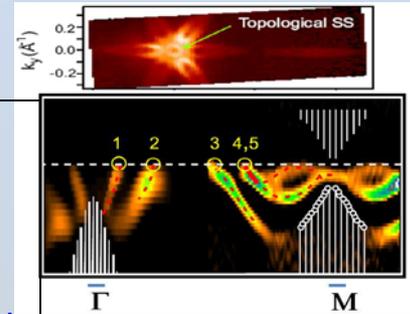
- **COV is deeply concerned** regarding the **sizes of awards**.It was also commented that the buying power of awards has diminished to the point where most **graduate students are partially supported on multiple grants**.
- **National Research Council (NRC) Report (The National Science Foundation's Materials Research Science and Engineering Program, Looking Back, Moving Forward)**, noted that the effectiveness of MRSECs was reduced in recent years as a result of increasing requirements without a commensurate increase in resources. The report continued by stressing that **increasing the mean grant size is necessary** to allow the program to fulfill its important mission goals.
- **COV encourages DMR to consider exploring ways to level the playing field for new MRSEC proposals** while maintaining the highest quality scientific standards and expectations on broader impact.
- Strategic planning in the **MRSEC program** office should help guide the **portfolio development**.

DMR's RESPONSE

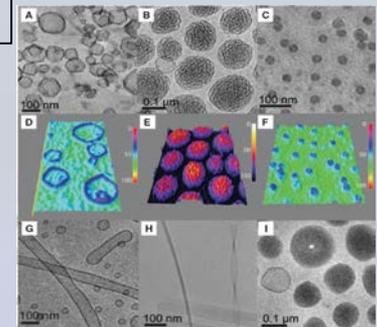
- **Limit IRGs to a maximum of 3; increase funding per IRG.**
- Suggested research areas of interest that would broaden the DMR/MRSEC research portfolio.
- Removed sections of the proposal that could only be completed by existing re-competing.
- Better emphasized/focused the role of research and the potential societal benefits at the Preliminary proposal stage.



Materials Research Science & Engineering Centers (MRSEC)

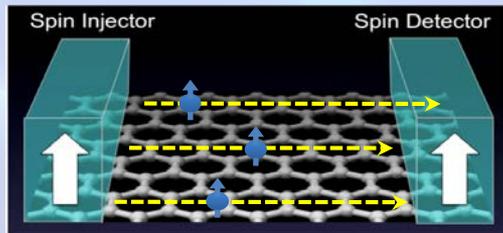


Princeton MRSEC: 3D Topological Dirac Insulator with a Quantum Spin Hall Phase



U Penn MRSEC: Self-assembly of Janus-dendrimers into Uniform Dendrimersomes

- FY17 competition began EARLY.
- Pre-proposals received on **7/1/2016**. *75 pre-proposals (206 IRGs)*
- Full proposals (by invitation) due **12/2/2016**. *18 full proposals (43 IRGs)*
- Reverse Site Visit Invitations sent out **2/14/2017**. *10 with 26 IRGs*
- **RSVs start April-May, 2017.**



Ohio State MRSEC: World Record Performance of Graphene Spin Valves

Dan Finotello



Birgit Schwenzer



Miriam Deutsch



Susan Dexheimer



STC: CIQM

Center for Integrated Quantum Materials

Harvard, MIT and Howard
Director: Robert Westervelt

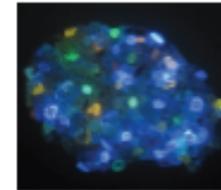
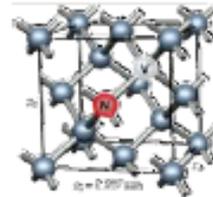
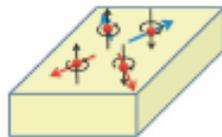
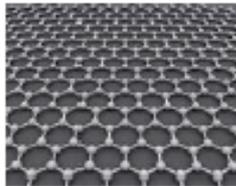
Mission

Transform electronics and photonics using 2D atomic layers,
electron surface states and single-atom devices in
Quantum Materials:

Atomic Layers: Graphene, BN, MoS₂ - *ultrafast devices*

Topological Insulators – *topologically protect data*

Nitrogen Vacancy Center Diamond – *atomic memory*



PO: Dan Finotello



STC on Real-Time Functional Imaging

<http://strobe.colorado.edu>

Director: Margaret Murnane

Vision: Transform imaging technology of functioning systems

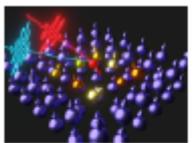
Frederic Ives Medal / Quinn Prize

highest award of the Optical Society:

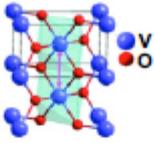
“for pioneering and sustained contributions to ultrafast science ranging from femtosecond lasers to soft x-ray high-harmonic generation to attosecond studies of atoms, molecules and surfaces.”

imaging
X-rays and
methods to
windows into
important
al challenges

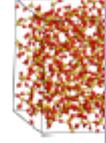
New windows into functional materials



Energy materials

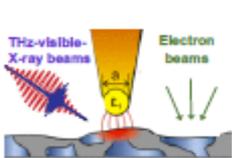


Quantum materials



Disordered materials

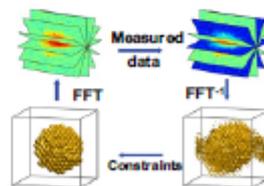
Advance and integrate dynamic imaging techniques



Techniques



Detectors, Big Data



Advanced Algorithms



FORT LEWIS COLLEGE
DURANGO, COLORADO



PO: Charles Ying

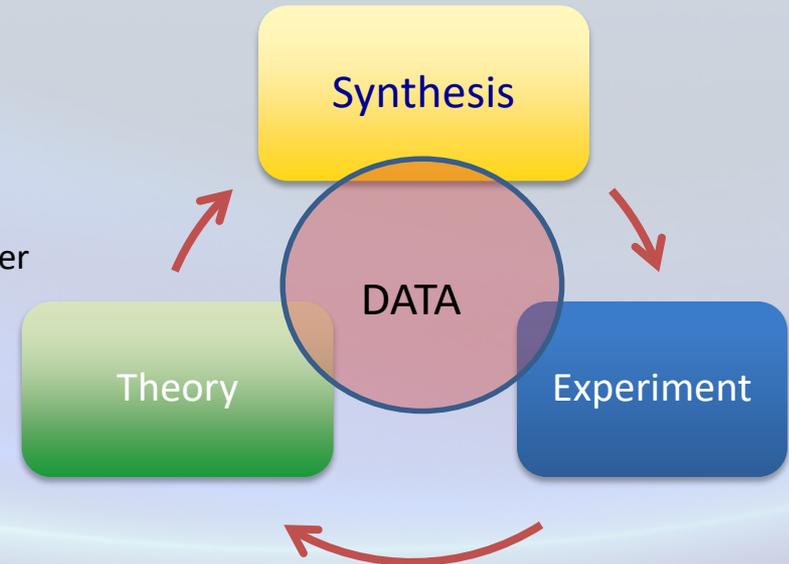
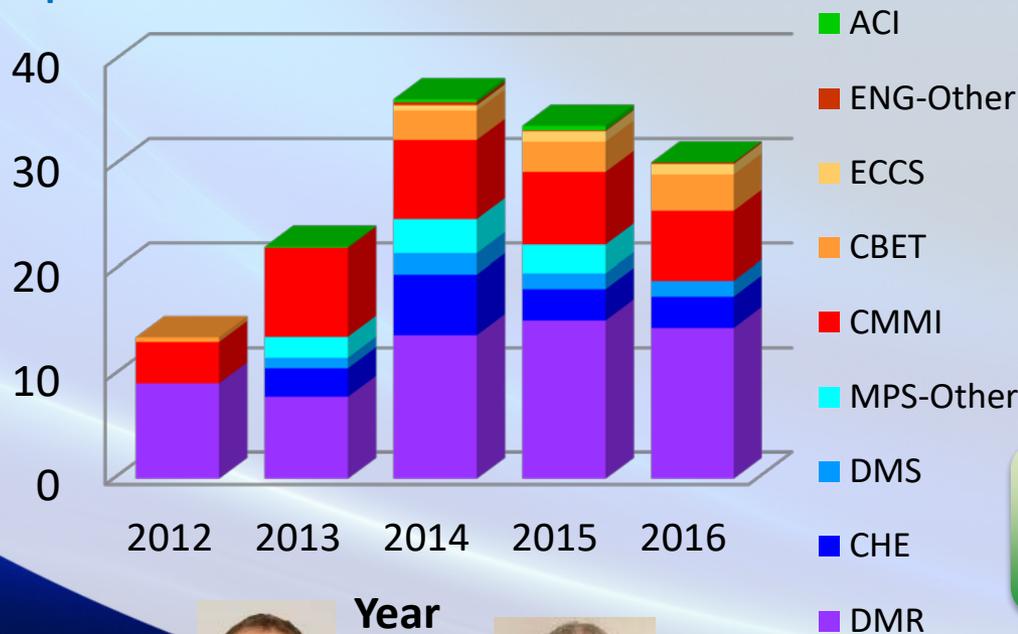


Designing Materials to Revolutionize & Engineer our Future (DMREF)



- Build the fundamental knowledge base needed to progress towards designing and making a material with a specific and desired function or property from first principles.
- Accelerate materials discovery and development.
- Collaborate and iterate “close the loop” between theory and experiment.
- **Aspire to enable “data-driven” materials research.**

Funding in Million \$



Funding rate is ~12%.



John Schlueter

Year



Susan Dexheimer

FY17 DMREF Solicitation Goes Biennial

NSF Solicitation 16-613

Major Changes: Biennial, Guidelines for Renewals, Target Areas

Submission Window: January 3-17, 2017

Awards are expected to range from \$250,000 - \$400,000 per year for a duration of 3 or 4 years, totaling \$750,000 to \$1,600,000.

Estimated number of awards: 20 - 25, depending on availability of funds

Total anticipated funds: \$29.4 M

GOALI proposals may be submitted to the DMREF Solicitation



NSF's Big Ideas

Proposals that align with NSF's Big Ideas are encouraged, but not required.

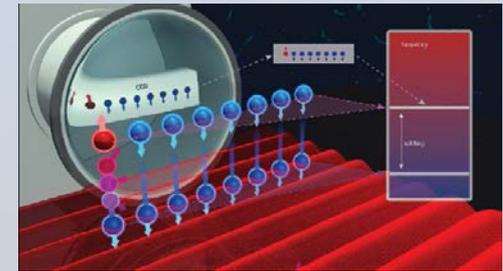
Harnessing Data



Shaping the New Human Technology Frontier



Quantum Leap



Understanding the Rules of Life



Navigating the New Arctic



Windows on the Universe

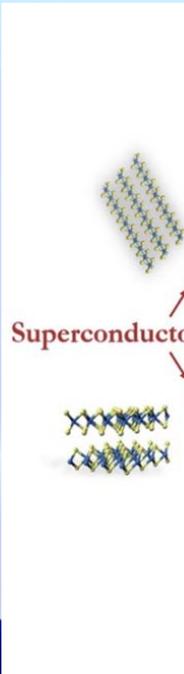




Director: Joan Redwing

2D chalcogenide monolayers, surfaces and interfaces are emerging as a compelling class of systems with transformative new science that can be harnessed for novel device technologies in next generation electronics.

Focus: 2-dimensional chalcogenide materials for future electronics
e.g., Can theory model growth kinetics and guide materials synthesis?

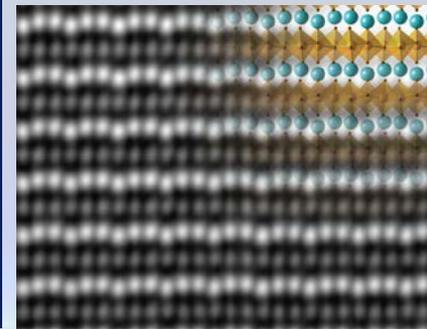
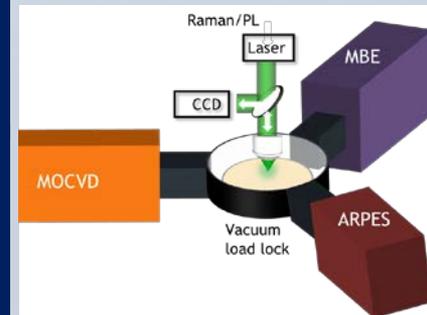
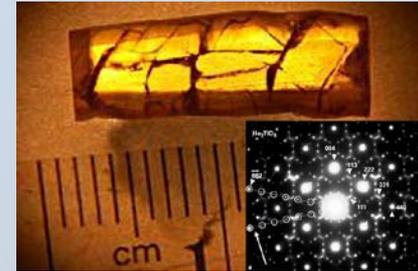


Find the 2DCC at www.mip.psu.edu

Oxide-based **multi layer structures** with a range of 2D material systems s
electronic **effort.**

Focus: interfacial materials, combining oxides & 2D materials, for valleytronics & spintronics

e.g., Can we design and create new interfacial materials by “breaking” Gibbs’ & Pauling’s rules?



Topical Materials Research Programs

Biomaterials

Ceramics FY17 (51 proposals), previous 3-yr. ave. (147)

Electronic & Photonic Materials

Metals and Metallic Nanostructures

Polymers

Condensed Matter & Materials Theory FY17 (202), previous 3-yr. ave. (287)

(Computational & Data-Driven Materials Research)

Condensed Matter Physics

Solid State and Materials Chemistry

**FY2017 Solicitations
for “open”
unsolicited
proposals windows**

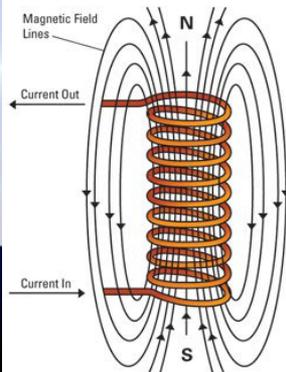
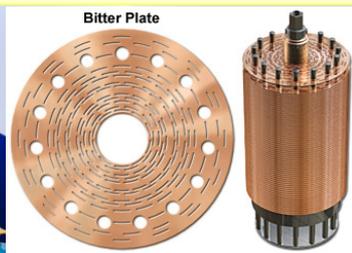
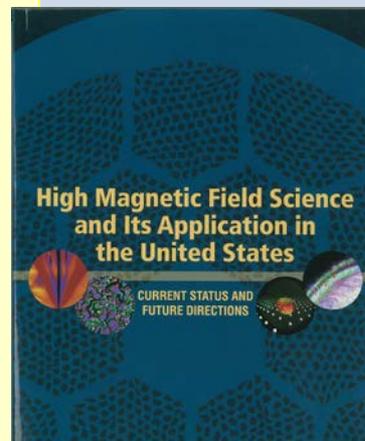
Submission constraints

- 3 strikes and “out” on resubmissions.
- Reduce multiple submissions in DMR .
- CMMT includes **CDMR**, with more emphasis on programs working together.
- Encouraging the best ideas rather than all the “reviewable ones” .



National Facilities and Instrumentation (NaFI): National High Magnetic Field Laboratory

- Renewal proposal received in June 2016.
- Site-visit review in October 2016.
- **Quantum Materials and Magnet Development** major science drivers influenced by user community and NAS study.
- High Priority, but budget cuts will impede sufficient investment.
- **2022 MRFEC opportunity**; threshold lowered to \$70M. Workshop being planned – need for ultra-high magnetic fields for a “quantum leap”. (Led by Phuan Eng/Princeton for Fall 2017).
- **France Córdoba will visit MagLab this month!**



Leonard
Spinu



Charles
Ying

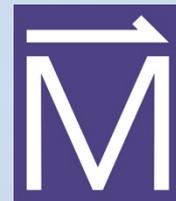


Program Highlights

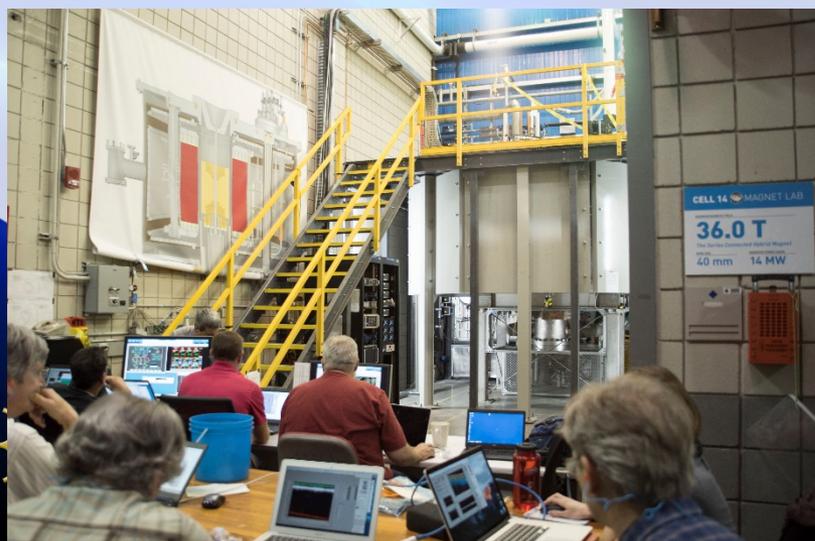




DMR-Supported MagLab Makes New World Record!

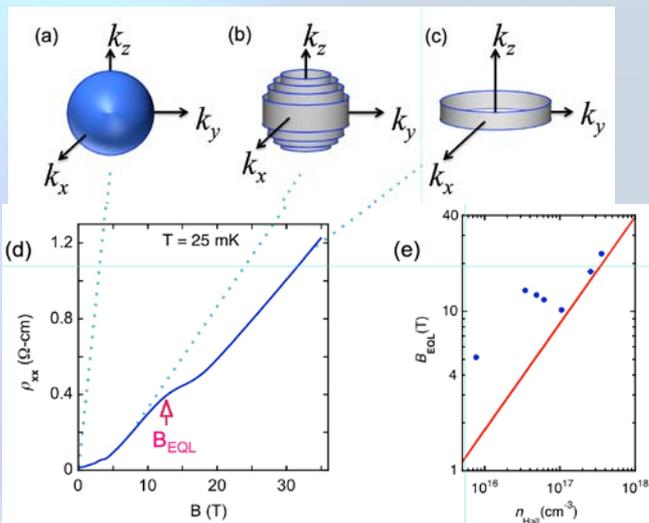


- ❑ **Strongest** magnet (36 T) in the world for NMR spectroscopy.
- ❑ **Decade** of planning, designing and building through DMR - *Mid-Scale Instrumentation Program* investments of \$14.8M.
- ❑ **Revolutionary Technology Development** - series connected hybrid magnet reaches very high magnetic fields which remain stable and homogeneous.
- ❑ **Boosted NMR sensitivity** for study of a wider range of elements.
- ❑ **“Opens a door of discovery”** making the highest magnetic fields available to not only physicists, but to chemists and biologists.





Extreme Quantum Limit of Electrons in Strontium Titanate

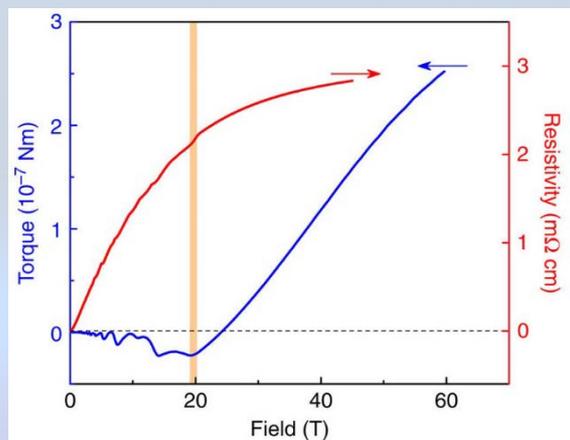


A. Bhattacharya¹, B. Skinner^{1,2},
G. Khalsa³, A. Suslov⁴

1. Argonne National Laboratory; 2. MIT;
3. NIST; 4. MagLab

Nature Commun. 7, 12974 (2016). DOI:
10.1038/ncomms12974.

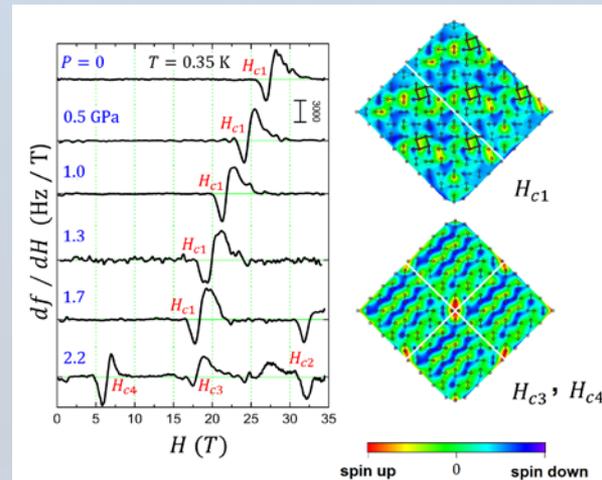
Magnetic Torque Anomaly in the Quantum Limit of Weyl Semimetals



P. J.W. Moll¹, A.C. Potter¹, N. L. Nair¹,
B. J. Ramshaw^{2,3}, K. A. Modic^{2,3}, S.
Riggs^{2,3}, B. Zeng^{2,3},
N.J. Ghimire², E.D. Bauer², R.
Kealhofer¹, F. Ronning², J.G. Analytis¹

1. UC-Berkeley, 2. LANL, 3. MagLab
Nature Commun. 7, 12492 (2016),
doi:10.1038/ncomms12492

Crystallization of Spin Superlattices with Pressure and Field



S. Haravifard¹, D. Graf², A.E. Feiguin³,
C.D. Batista⁴, J.C. Lang⁵, D.M.
Silevitch⁶, G. Srajer⁵, B.D. Gaulin⁷,
H.A. Dabkowska⁷, T.F. Rosenbaum⁶
Duke Univ.; 2. MagLab and FSU; 3.
Northeastern Univ.; 4. Univ. of Tenn.;
5. ANL; 6. California Inst. of Tech.;
7. McMaster Univ.

Nat. Commun. 7, 11956 (2016).
doi:10.1038/ncomms11956.



Defects in 2-D ceramic nanosheets quantified using synchrotron radiation

Scott T. Mixture, Alfred University, DMR 1409102

Outcome: Partial reduction of MnO_2 nanosheets yields intentionally-formed defects that increase the electrical charge storage capacity by a factor three (to 320 F/g) vs. H_xMnO_2 .

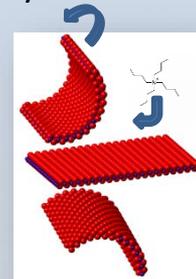
1st quantitative link of defects to electrochemical charge storage, where the **improved capacitance** is a result of **“surface Frenkel” defects** that form in the MnO_2 nanosheets.

Impact: Demonstrates that **defect engineering is feasible**, thus enabling design of properties at two levels: nanoscale for surface area and quantum confinement, and atomic scale defects for functionality.

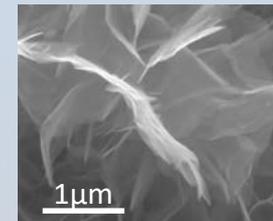
Explanation: Alkali-ion intercalation is improved dramatically, as is the charge transfer and cycling fade, when defects are introduced.

P. Gao, et al., *Nat. Commun.* 8, 14559
doi:10.1038/ncomms14559 (2017).

Exfoliation of layered oxides



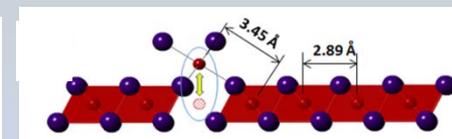
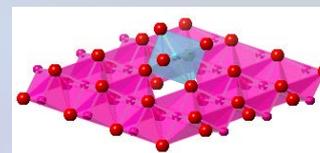
Bottom-up assembly



+



Introduce controlled defects



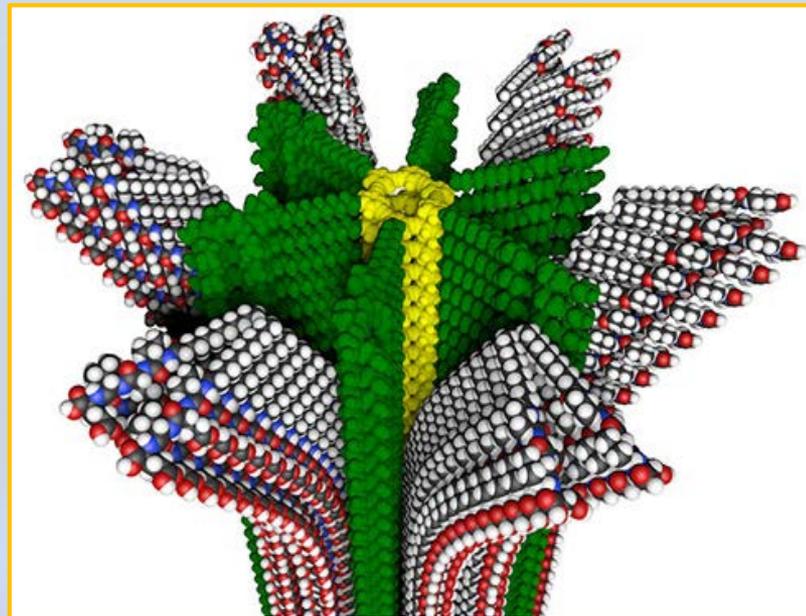
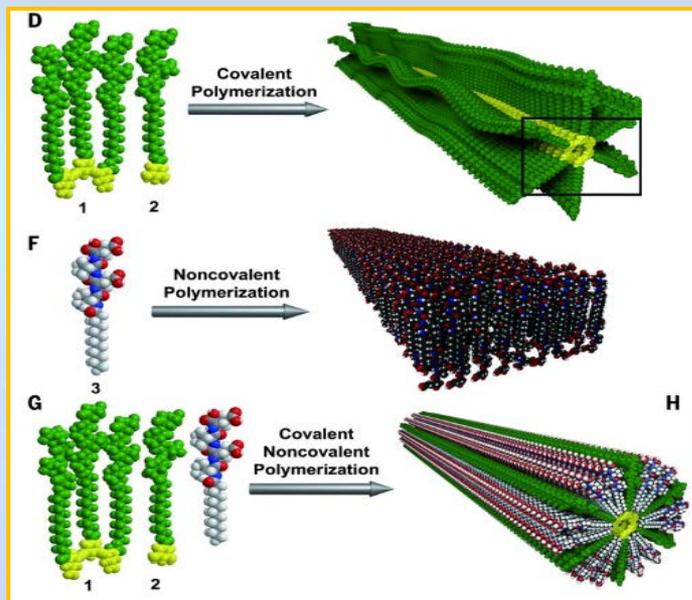
Quantify Mn defects:

- **Charge of Mn defect:** X-ray absorption studies at **CHES**
- **Geometry of defects:** X-ray pair distribution functions using **APS**



UNIQUE KIND OF POLYMER WITH REMOVABLE SUPRAMOLECULAR COMPARTMENTS

Sam Stupp (Northwestern U.), DMR-1508731



Science 351, 497 (2016). <https://news.northwestern.edu/stories/2016/01/new-polymer.html>

- First-ever combination of covalent and non-covalent polymerizations leading to reversibly self-assembled hybrid materials.
- The polymer has internal compartments -- one rigid, the other soft.
- The soft material can respond to stimuli and be repeatedly removed and regenerated.
- **APPLICATION POTENTIAL:** Delivery of chemicals/drugs followed by regeneration; smart patches; polymer fibers that contract and expand the way muscles do; self-repairing constructs; dynamically responsive materials.



(Machine) Learning From Failure



Can we predict synthesis routes to new crystals?

- Created database 3995 failed reactions

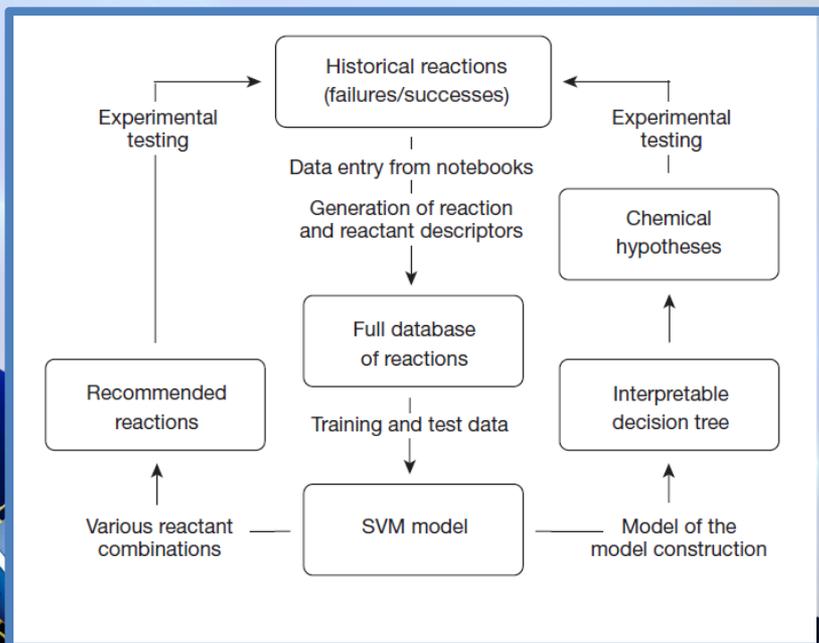
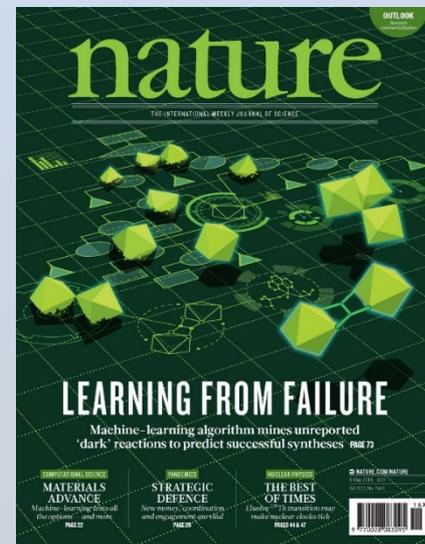
<http://darkreactions.Haverford.edu>

- Trained an SVM (support vector machine) model

- Success rate advantage

model vs. human → 8%

Collaboration between solid-state chemist, theoretical chemist and computer scientist.



PI: Alex Norquist, Haverford College

- Developed a “decision-tree” model of the SVM model

- “Rules” for reaction formation
- Insights into the chemistry

A kind of “Closing the loop”

Text Extraction and Data Mining at Scale

Elsa A. Olivetti

Massachusetts Institute of Technology Award #1534340

Developed an **automated**, large scale platform to **extract desired text** from scientific journal articles.

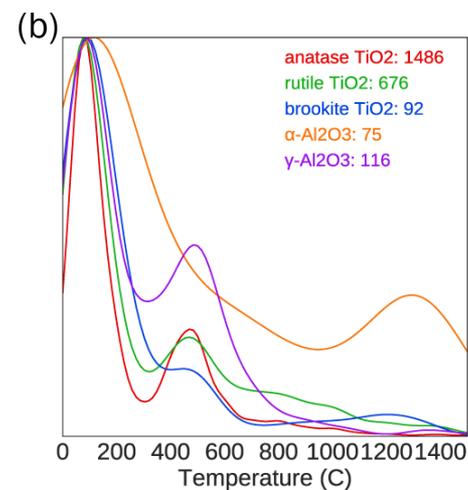
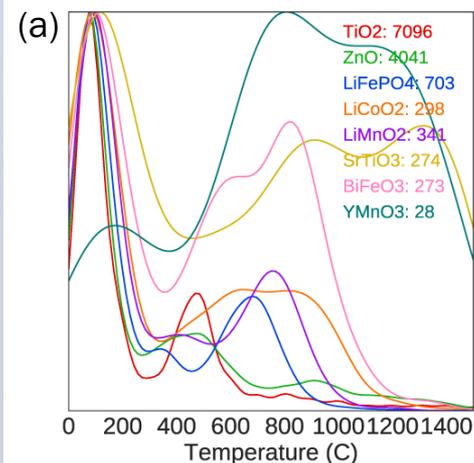
From a corpus of ~400,000 inorganic materials science papers -**extracted and analyzed synthesis recipes**.

High throughput data mining of the obtained synthesis features subsequently enables us to investigate large scale trends in materials synthesis across thousands of papers at once.

Correlate insights with intrinsic and extrinsic materials properties.

Formulate robust relationships between synthesis conditions and the materials they produce.

Ultimately-correlations will allow development of novel recipes for the synthesis of current and emerging materials.



DMREF: GOALI: High Temperature Alloys



Matt Begley (UCSB)
Mechanical Engineering
Materials



Frederic Gibou (UCSB)
Computer Science
Mechanical Engineering
Mathematics



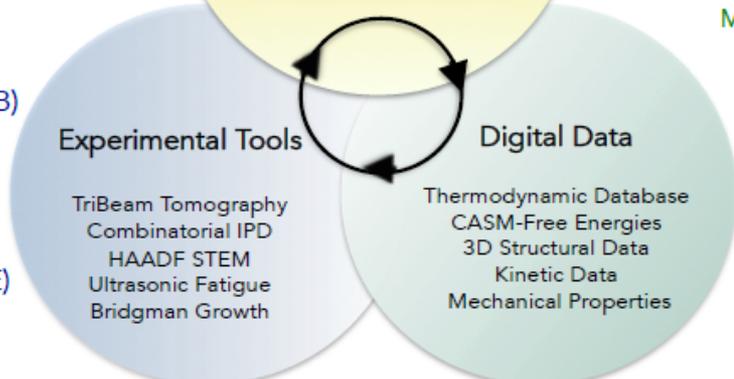
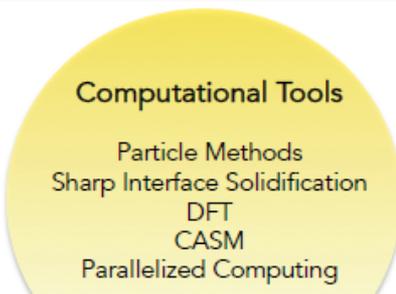
Anton Van der Ven (UCSB)
Materials



Carlos Levi (UCSB)
Materials



Akane Suzuki (GE)
Materials
Industry
Collaborator



Tresa Pollock (UCSB)
Materials (PI)



Gunther Eggeler
(Rühr Univ Bochum)
Materials
International
Collaborator



**SCIENCE
NATION**

<https://www.youtube.com/watch?v=deKomQdWd9Y>

Search: "materials ready for take off"



Strategic Research Directions



DMR – Looking Forward

Sustainable Material Development



Andy
Lovinger



Alex
Klironomos

MGI & Advanced Manufacturing Programs and Activities



John
Schlueter



Susan
Dexheimer

Quantum Leap



Daryl Hess



Tomasz
Durakiewicz



Susan
Dexheimer



Miriam
Deutsch



Tania
Paskova

Materials Information Platforms



Charles
Ying

Soft matter/
biomaterials?

Cyberinfrastructure and Data-Driven Materials Research



Daryl Hess



Alex
Klironomos



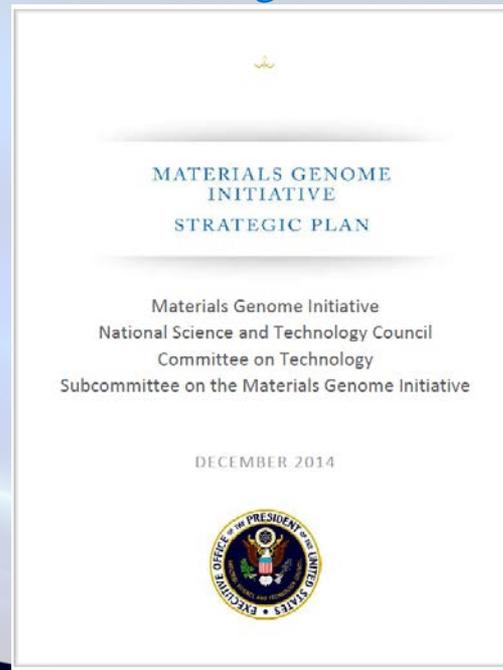
MGI: Key Challenges

- Leading a culture shift in materials research to encourage an integrated team approach.
- Integrating experiment, computation, and theory.
- Making digital **data** accessible.
- Creating a world-class materials workforce that is trained for careers in academia or industry.

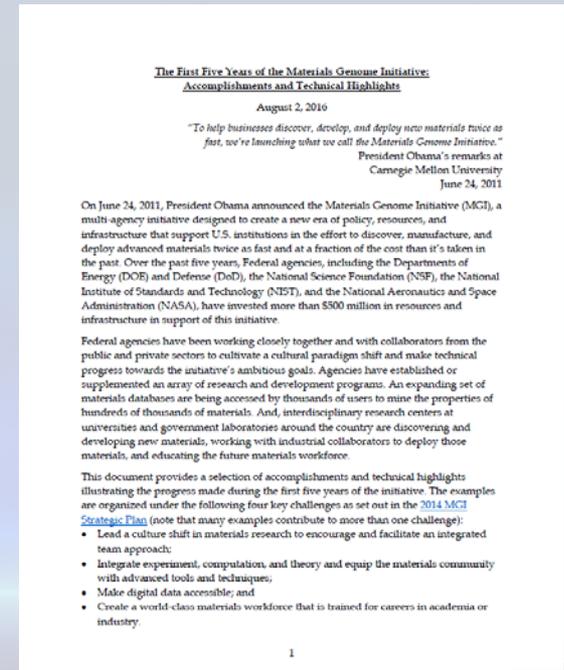
Whitepaper



Strategic Plan



5-year Highlights



MGI Fifth Anniversary

White House - August 2, 2016



The First Five Years of the Materials Genome Initiative: Accomplishments and Technical Highlights

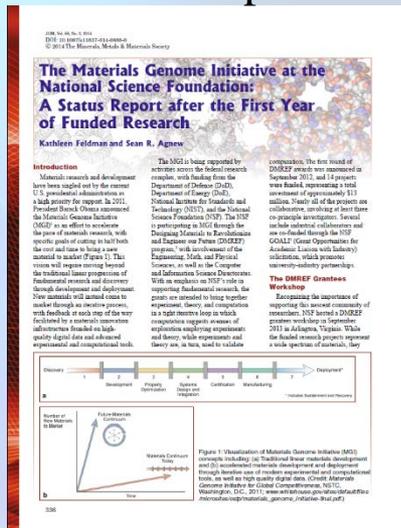
The Materials Genome Initiative (MGI) has sparked a paradigm shift in the way that materials are discovered, developed, and deployed. By emphasizing computationally-led and data-driven research, MGI is accelerating the pace at which fundamental discoveries are made and transitioned to American manufacturing.

<https://mgi.nist.gov/sites/default/files/uploads/mgi-accomplishments-at-5-years-august-2016.pdf>



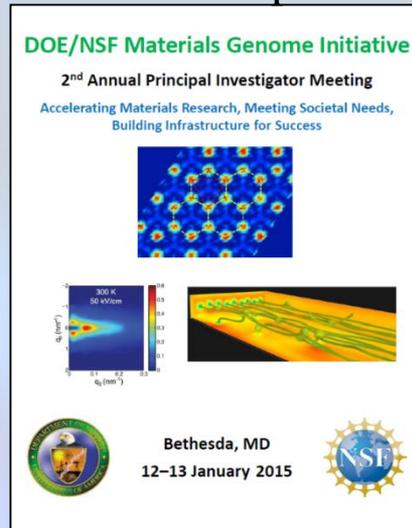
Annual MGI PI Meeting

September 8-9, 2013
NSF PIs
45 Participants



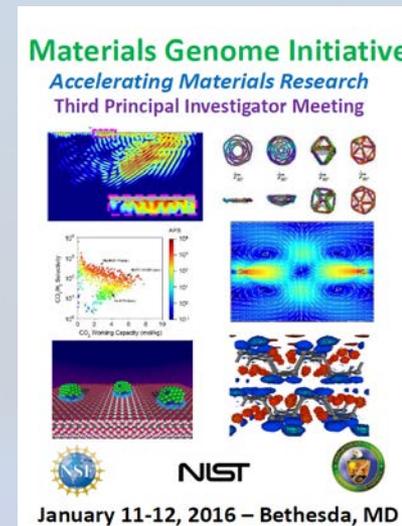
JOM 2014, 66(3), 336

January 12-13, 2015
DOE & NSF PIs
160 Participants



www.orau.gov/mgi2016

January 11-12, 2016
DOE, NSF, NIST PIs
192 Participants



www.orau.gov/mgi2016

The next MGI PI meeting is tentatively scheduled for January 2018.

- Inclusion of more federal agencies.
- Representation from industrial partners.
- Educational session for students and post-docs.



MGI-II Workshop

Current Opinion in Solid State and Materials Science 18 (2014) 99–117



Contents lists available at ScienceDirect

Current Opinion in Solid State and Materials Science

journal homepage: www.elsevier.com/locate/cossm



The Materials Genome Initiative, the interplay of experiment, theory and computation



Juan J. de Pablo^{a,*}, Barbara Jones^b, Cora Lind Kovacs^c, Vidvuds Ozolins^d, Arthur P. Ramirez^e

^a Institute for Molecular Engineering, University of Chicago, 5747 S. Ellis Ave., Chicago, IL 60637, United States

^b IBM Research – Almaden, 650 Harry Road, San Jose, CA 95120, United States

^c Department of Chemistry and Biochemistry, The University of Toledo, 2801 W. Bancroft, Toledo, OH 43606, United States

^d Department of Materials Science and Engineering, University of California – Los Angeles, Los Angeles, CA 90095, United States

^e Jack Baskin School of Engineering, University of California – Santa Cruz, Santa Cruz, CA 95064, United States

- MGI-I Workshop held Dec 13-15, 2012 (NSF)
- De Pablo et al., Current Opinion in Solid State and Materials Science (2014) 18, 99.
- **May 18-19, 2017** workshop being overseen by **Daryl Hess/CMP/DMR**.





FY 17 Opportunities in Computation & Data for Materials Research

*Building and using a materials innovation
cyberinfrastructure*

Data Infrastructure
Building Blocks
(DIBBs)

Data-centric
cyberinfrastructure to
accelerate collaborative
and interdisciplinary
Research

Computation and Data
Enabled Science and
Engineering (CDS&E)

Adventurous and
Innovative Research
Using Computation and
Data

Software Infrastructure
for Sustained
Innovation (SI2)

Scientific Innovation
Transformed into
Sustainable and
Reusable Software

*Opportunities to Revolutionize How Materials Research is Done
to Accelerate Discovery and Innovation*

*Collaboration → Computational Materials Scientists, Chemists,
Cyberinfrastructure Experts, Engineers, Physicists, ...*



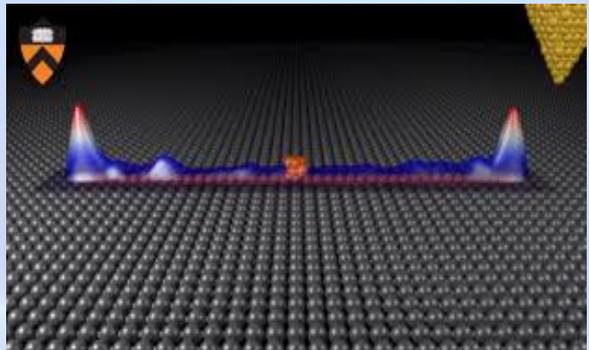


QUANTUM LEAP

Leading the Next Quantum Revolution



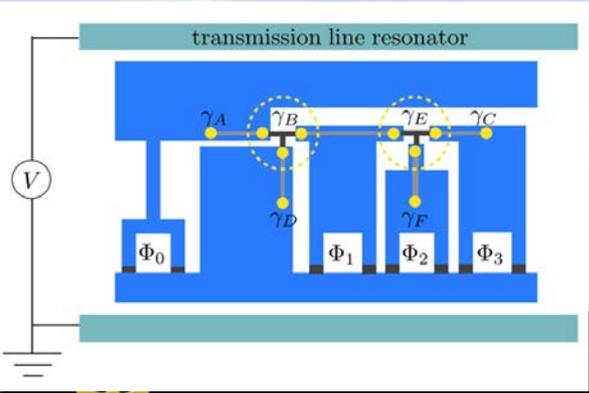
One of 10 Big Ideas announced by NSF in March 2016:
A plan to build on the First Quantum Revolution in early 20th century and prepare for the Second one exploiting quantum phenomena like superposition, entanglement, and squeezing to enable the next wave of precision sensors and more efficient computation and simulation and communication



EU, Netherlands, UK, China, Japan, Canada... investing in development of quantum technologies.



NSF would support research that addresses the manipulation of quantum states and the control of material light interactions involving physicists, mathematicians, and engineers. There will be strong connections to industry, other federal agencies, and international partnerships.



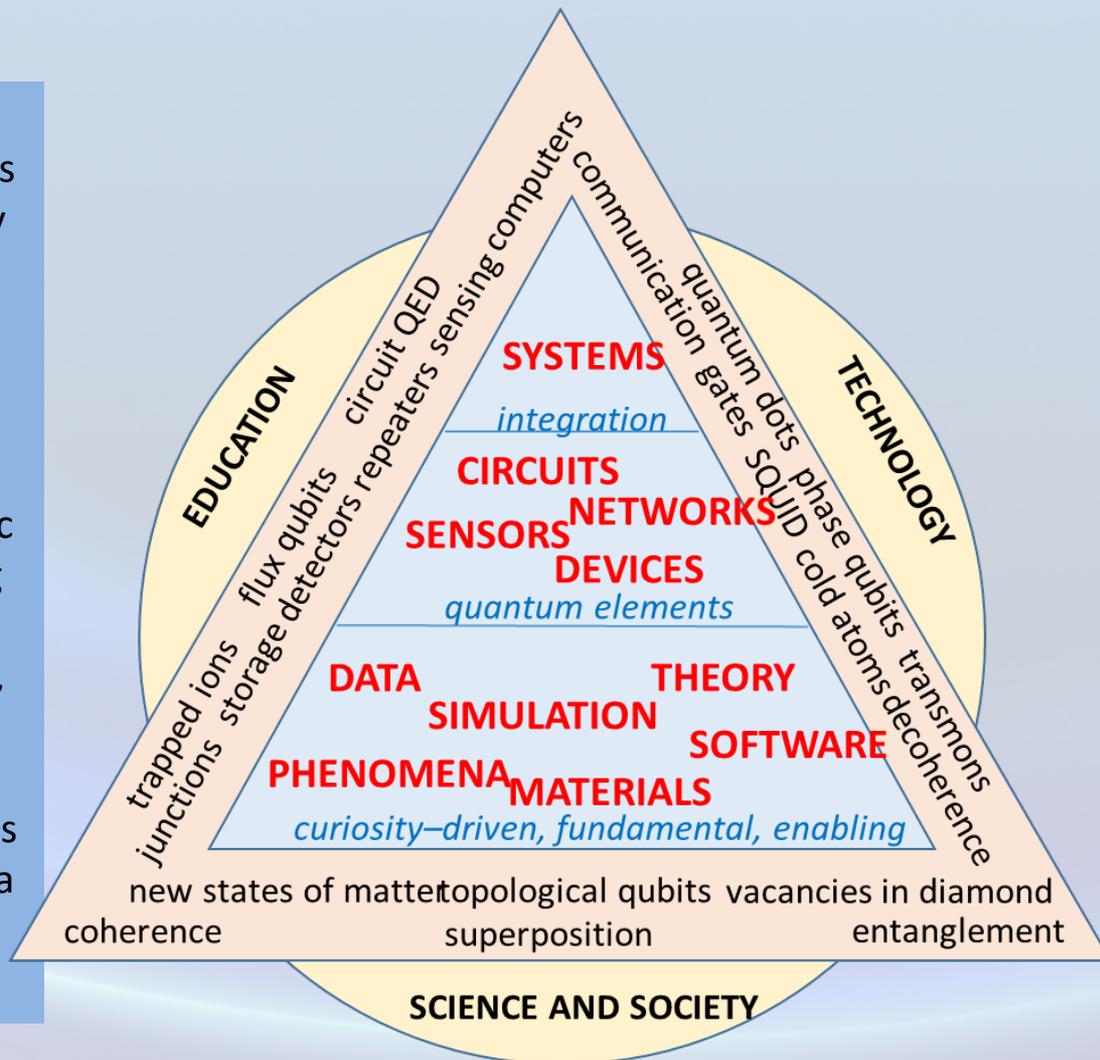


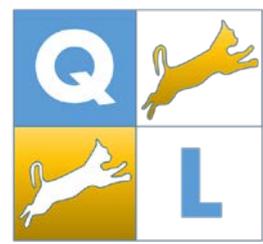
QUANTUM LEAP

Leading the Next Quantum Revolution

Quantum Leap Strategies:

- **Beyond Core** – Development of programs for high-risk/high-payoff interdisciplinary projects that promote convergence
- **Transformative Midscale Projects and Infrastructures** – Empower U.S. researchers to significantly advance the Quantum Leap.
- **Strategic Partnership** - Promote strategic mutually productive partnerships among academia, the private sector, other U.S. Government agencies and National Labs, and international researchers and organization.
- **Mentored Workforce** - Develop programs that grow, educate and train, and retain a new generation of well-mentored workforce.





QUANTUM LEAP

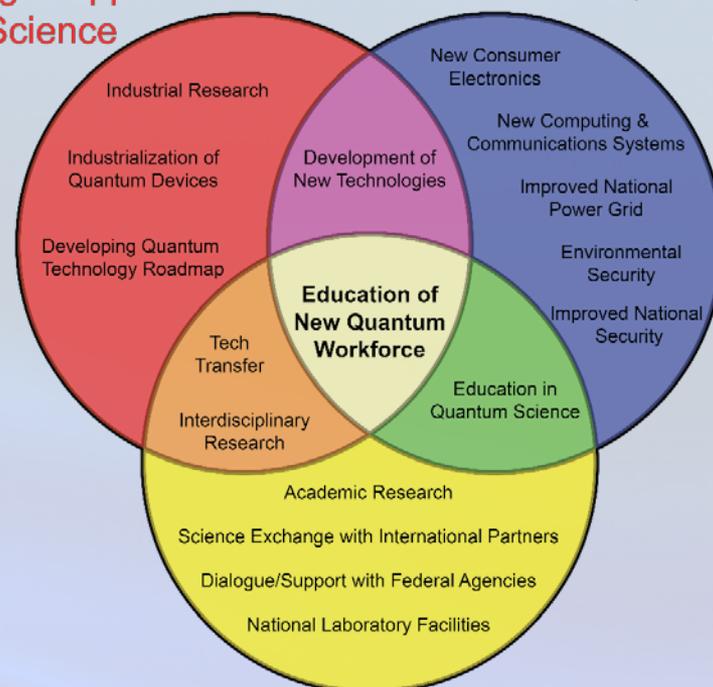
NSF/DOE Summer School on Quantum Science

Summer School, FY17

Sources of funding	NSF: \$700k DOE/BES: \$300k
Organizing Team	Joe Checkelsky (MIT) Natalia Drichko (JHU) Liang Fu (MIT) Kyle Shen (Cornell) Jun Zhu (Penn State)
Locations and Dates	Tentative Location and Dates JHU: June 5-16, 2017 Cornell : June 18-30, 2018 Penn State: June 9-21, 2019 University of Colorado: 2020
Rationale	Train transdisciplinary workforce for the second quantum revolution driven by convergence of multiple disciplines
Participants	50 Graduate Students and early-career Postdocs

Engineering & Applied
Quantum Science

Quantum Science
and Society



Fundamental
Quantum Science



QUANTUM LEAP

Dear Colleague Letter NSF 17-053



Funding Opportunity – A “Quantum Leap” Demonstration of Topological Quantum Computing

Goal: To challenge researchers to propose transformative research leading to the successful experimental demonstration of a topological qubit based on braiding anyon world lines or other known or creative new mechanisms enabling viable topological quantum computing.

Mode: whitepaper leading to EAGER proposal

Level of support: up to 300k\$ over 2 years

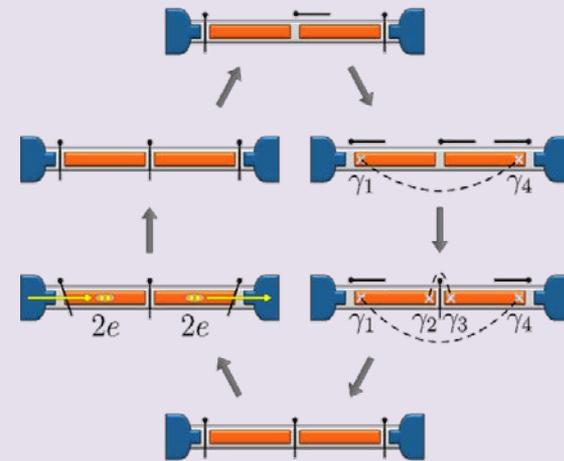
Key contacts:

CMP: Tomasz Durakiewicz, tdurakie@nsf.gov

CMMT: Daryl Hess, dhess@nsf.gov

EPM: Miriam Deutsch, mdeutsch@nsf.gov

Announced: Feb 6, 2017



Example of proposed experiment to demonstrate Majorana “fusion” – A key ingredient for fault-tolerant quantum computations; D. Aasen et al., Phys. Rev. X 6, 031016 (2016)
Shown: sets of semiconducting wires coated with a superconducting island and bulk superconductor that are bridged by a gate-tunable “valves.”



DMR “Partnership” Activities

“DMR takes very seriously our mission in serving the U.S. public to advance materials research frontiers and develop the workforce for our nation. **This is an important job which is not possible without a strong partnership with all of you from the research communities.**” L. Sapochak, DMR Newsletter 2017

Professional Society Conference Activities.

Special presentations
Speed Coaching

DMR Website.

Continual improvement

Webinars.

In Discussion.

DMR Newsletter.

Going out this week!

Division Workshops.

e.g. Ultra-high magnet field
needs for quantum leap.

Division Studies.

e.g. *Frontiers of Materials Research: A Decadal Survey*, is being supported by the DMR and the Department of Energy, Office of Basic Energy Sciences *to help us understand the changing landscape and future needs of materials research in the context of the U.S. and international efforts in important emerging research areas.*



THANK YOU!

lsapocha@nsf.gov

Ideas? Questions?

Concerns?

Please feel free to contact
me directly!

