



Opportunities to Engage on Basic Research at the DoD

Dr. Bindu Nair, PhD

Director of the Basic Research Office

Office of the Under Secretary for Research and Engineering

Unclassified



Agenda

- Overview of OSD's Basic Research Office (BRO)
- How to Engage with BRO
- Overview of Selected BRO Programs
- Questions for You, the Academic Research Community



OSD Basic Research Office: Overview



Research Policy

- Talent Retention
- Scientific Integrity
- Represent the DOD in NSTC
- Grants



STEM

- Program Management
- SMART
- Policy and Oversight
- Evaluation, Assessment, and Capability



Diversity

- HBCU/MI program
- Centers of Excellence
- DEPSCoR



Technical and International Programs

- Minerva
- Vannevar Bush Faculty Fellowship
- Laboratory-University Collaboration Initiative
- Future Direction Workshops
- International MURI
- BARI



Basic Research Oversight

- MURI
- NDSEG
- Service programs and budgets

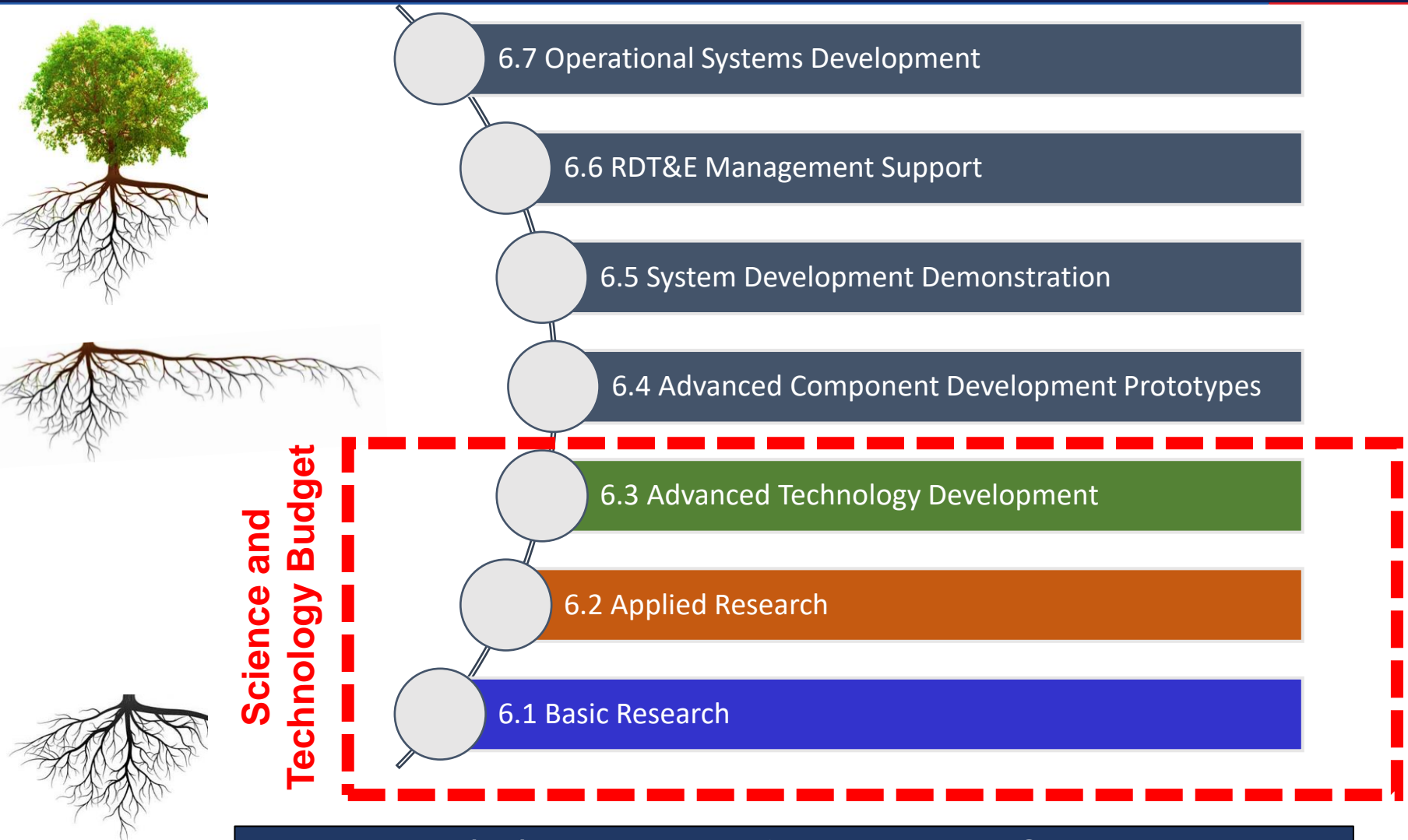


How Does DoD Define Basic Research?

DoD policy states that basic research is the
*“systematic study directed toward greater knowledge
or understanding of the fundamental aspects of
phenomena and of observable facts...”*



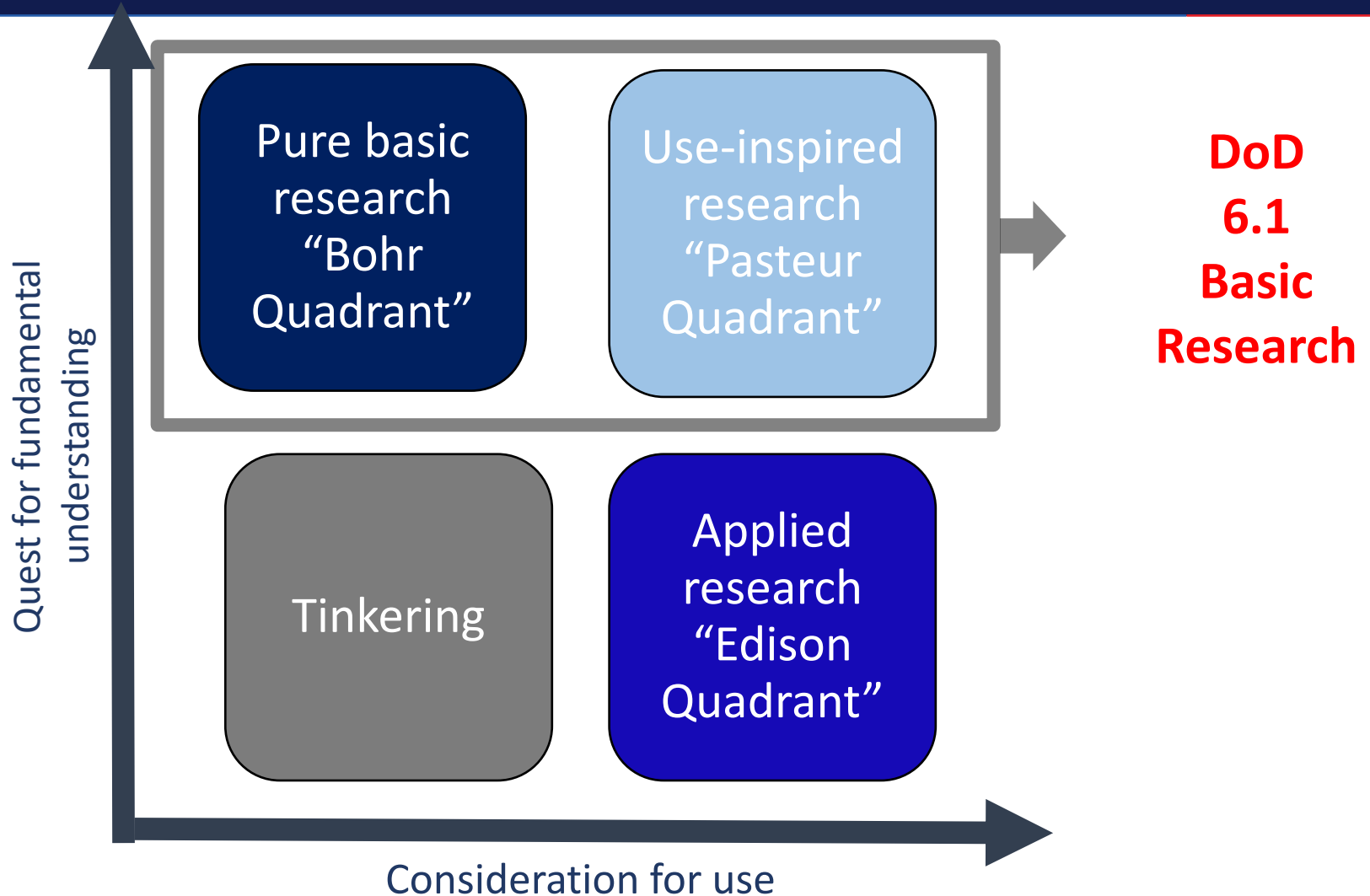
DoD's Research and Development, Test and Evaluation (RDT&E) Structure



The entire RDT(&E) budget ranges from 6.1-6.7. The S&T budget is 6.1-6.3.



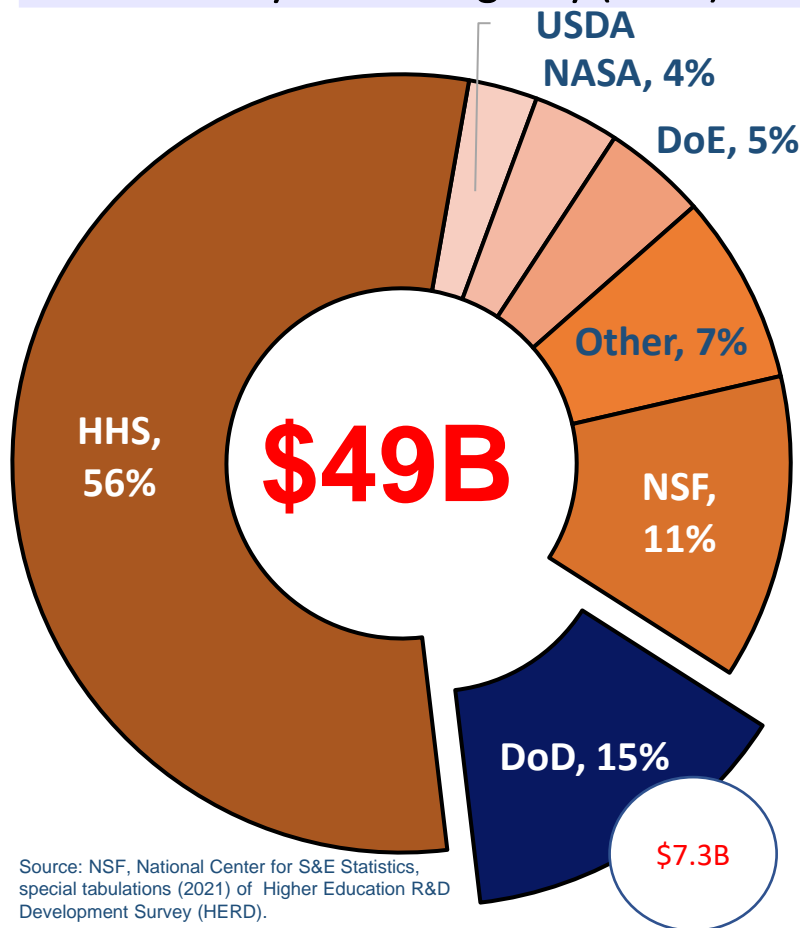
Why DoD Funds Basic Research?





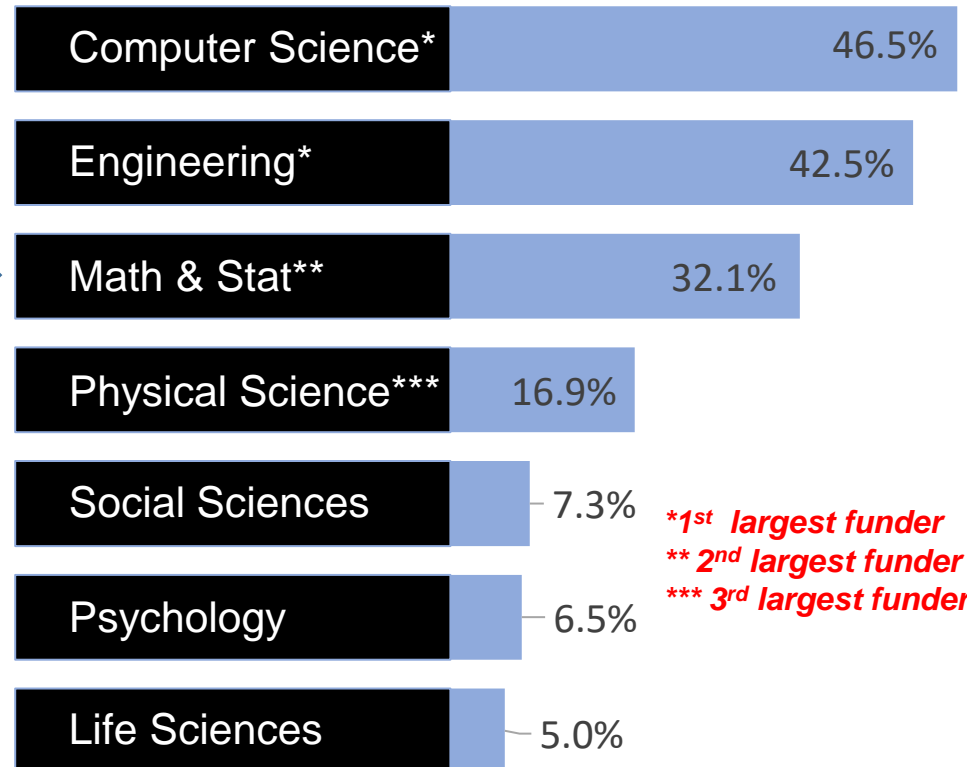
Federal Academic R&D Expenditures Across the USG

Academic R&D Expenditures by Federal Agency (2021)



Top Field Areas *funded by DoD* (% of total federal R&D expenditures)

Major funder of basic research in math, physics, and engineering



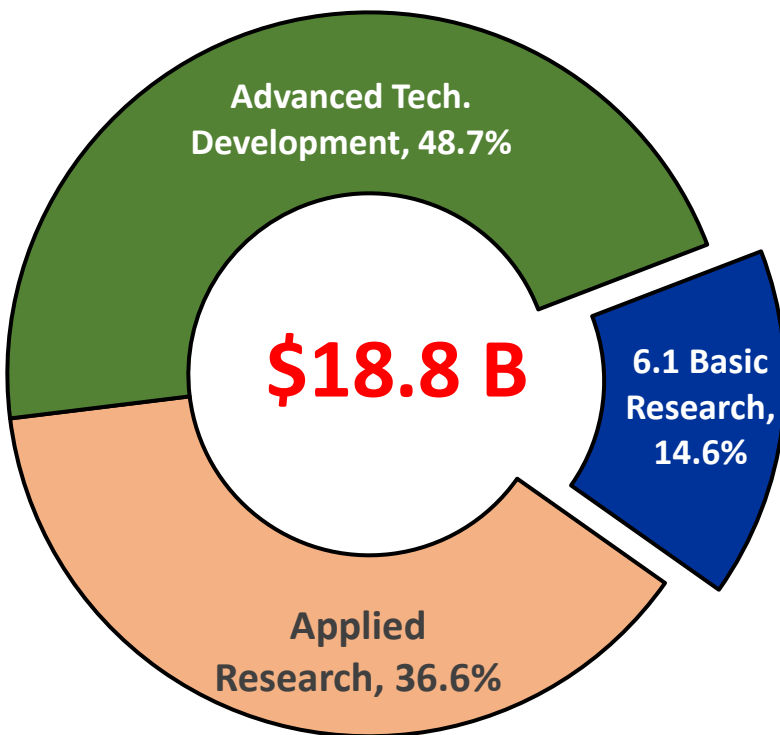
In 2021, DoD had the second largest Academic R&D Expenditures and prioritized funding areas like math and physical sciences.

Source: NSF, National Center for S&E Statistics, special tabulations (2021) of Higher Education R&D Development Survey (HERD).

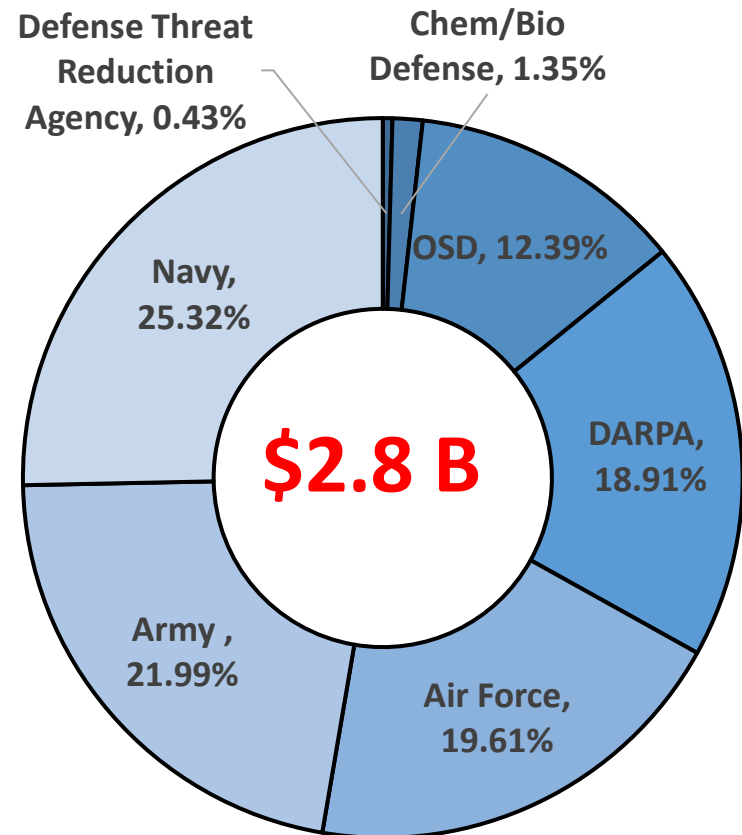


DoD's S&T Budget (FY2022 Enacted)

DoD S&T Budget (6.1-6.3)



DoD Basic Research Budget (6.1)



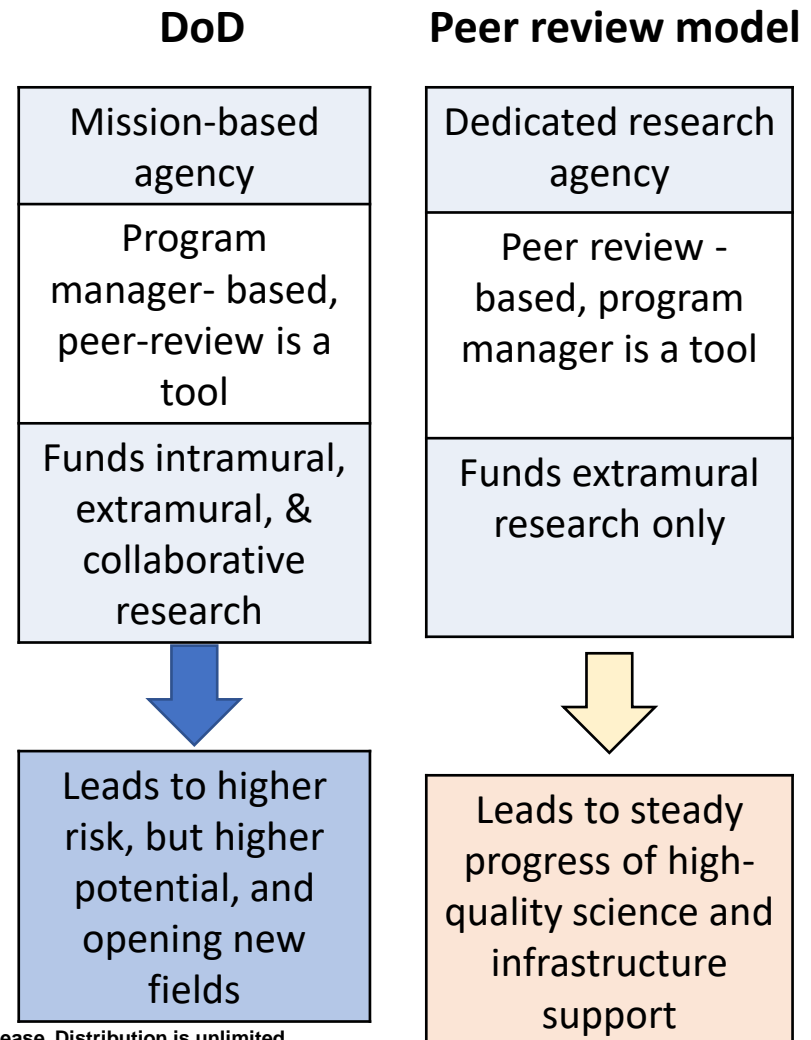
DoD's S&T Budget (6.1-6.3) is \$18.8 B. Basic Research (6.1) primarily funds extramural programs (over two-thirds). Some Applied Research (6.2) funds are also allocated for academia through programs like UARCS.



What Makes Applying to DoD Special: DoD's Program Manager-Centered Model

- The DoD model of funding basic research relies on program managers who have insight into DoD future needs and a vision of the scientific community.
- This model results in some incredibly important investments
 - Program manager see beyond academic trends to grow new fields, sustain fields of interest, and make early investments in leading researchers, and
 - Program managers can have incredible long lasting impact – Harold Bright

Different research funding models





The DoD's Model of Blue-sky Research

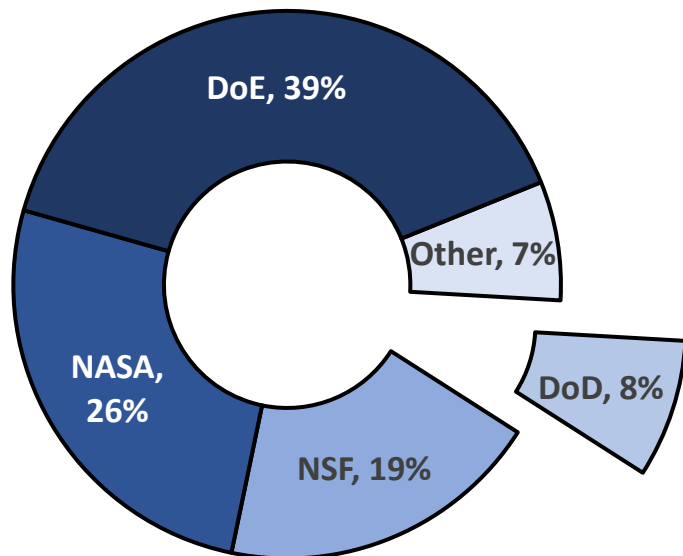
- Beyond even the model, DoD basic research expectations are only for technical excellence, not to realize specific impacts
- We understand the nonlinear nature of research
- This is not what you will find at the NSF, or even DARPA



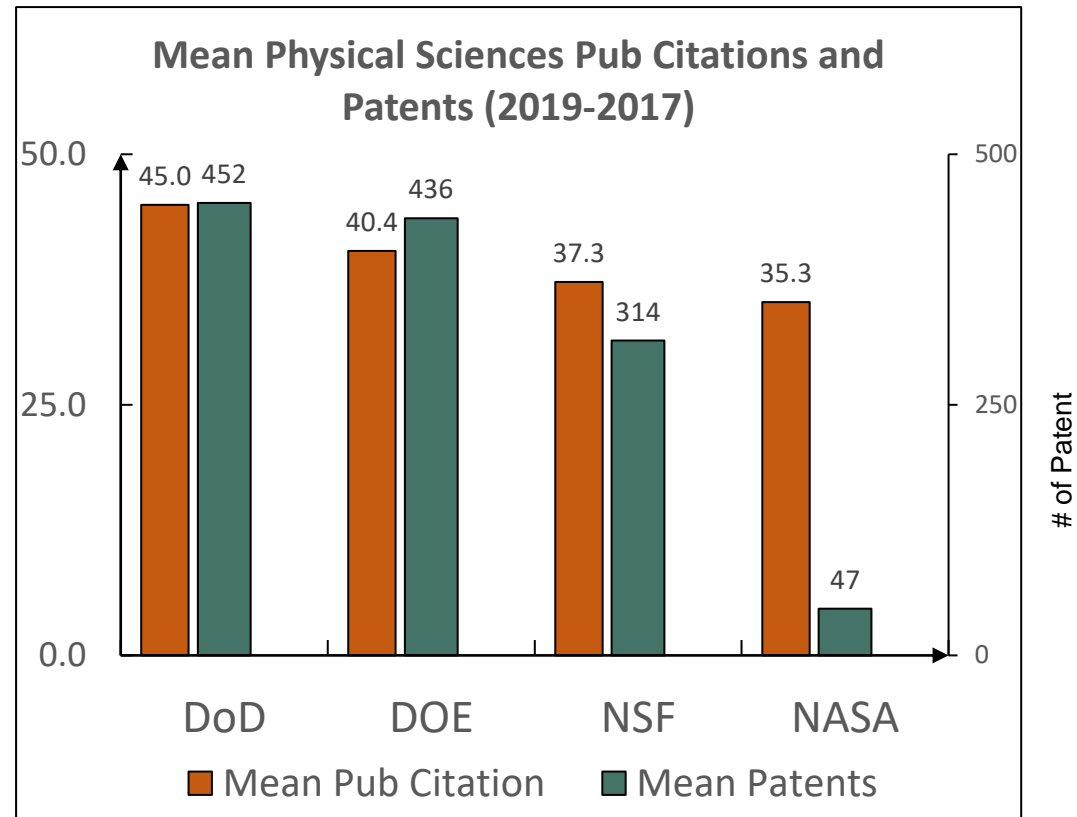


Revealing Indicators of DoD Innovation

Average % Federal Obligations in Physical Sciences 2015-2013



Other DoD NSF NASA DoE



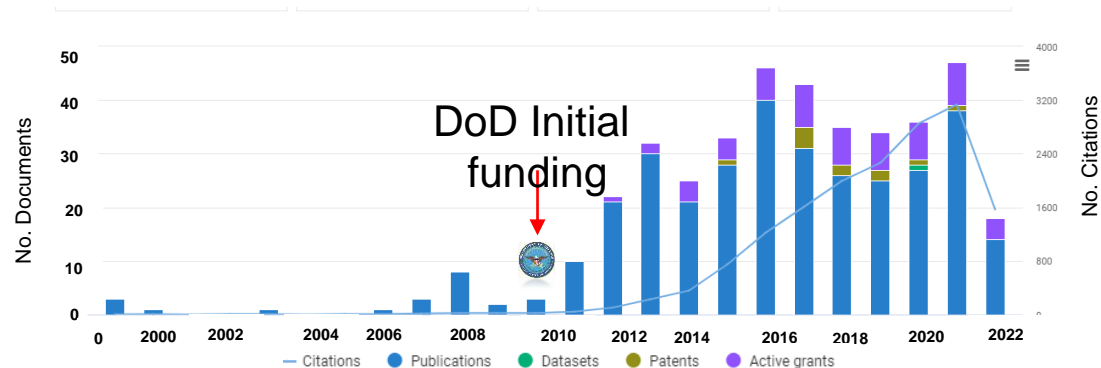
DoD is < 10% of the Federal Physical Science Budget, but is leading in cited research and patents



Long-term U.S. DoD Funding Allows Scientific Ideas to Evolve and Mature

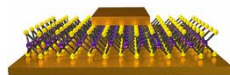
U.S. DoD's initial investments in Prof. Deji Akinwande propelled research career and funded one of the biggest discoveries in the field of memristors of the decade!

*Top 10 cited paper in physical sciences in 2019



2010-2014

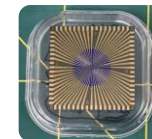
- **2010** ONR Young Investigator Award
- **2011** ARMY Young Investigator Award
- **2012** NSF Career
- **2013** DTRA Young Investigator Award



Basic Research Discovery: YIP investments led to the development of the "atomristor", a memory sandwich based on molybdenum sulfide (MoS₂).

2015

- **PECASE Award:** "Outstanding research accomplishments in nanomaterials, graphene device physics, and opto-electronics, and for dedication to the education of future scientists and engineers."



Technology Transitions:
A sensor that can test for COVID-19 and the flu simultaneously (NSF Funding)

Current



Technology Transitions:
Switches for future 6G devices
Nature Electronics



How to Engage with the DoD



Typical Project Development Process

PRE-

RESEARCH MENU

- Engage with program officer
- Submit any time via email

Evaluation: Individual tri-Service Program Officers

WHITEPAPER

- Provide a well-written scientific question and proposes a novel approach
- Describe the level of risk associated with the effort.
- Identify the resources required to pursue the research (rough order of magnitude).
- Provide a short bibliography positioning the research in the body of knowledge.

Evaluation Panel: Subject Matter Experts in the tri-Services

PROPOSAL

- Consult the solicitation for full details on requirements.
- Expand on the discussion in the whitepaper to adequately describe the proposed effort.
- Provide a reasonably self-contained description; expert reviewers should not have to heavily consult the literature or supplementary material to understand the question and the approach.
- Submit via grants.gov.

Evaluation Panel: Subject Matter Experts in the tri-Services



Ways To Engage with Service Program Officers



Email preferred for most POs



Phone (hit or miss due to travel)

	AFOSR	ARO	ONR
Program Officers	<i>Grants.gov</i> BAA (Research Interests of the Air Force Office of Scientific Research)	<i>Grants.gov</i> BAA (Broad Agency Announcement for Fundamental Research Department of Defense)	https://www.nre.navy.mil/our-research/our-program-officers
FOA			https://www.nre.navy.mil/work-with-us/funding-opportunities/announcements



DoD Academic Funding opportunities



Pre-doctoral Fellowships

- **NDSEG**
- Minerva Training Grants
- SMART



Research Funding to University Laboratories

- VBFF
- Minerva projects
- **MURI**
- Single-Investigator Awards
- Young Investigator Program



Expanding the Research Base at Universities

- DEPSCoR Research Collaboration
- HBCU/MI



Equipment and Facility Funding

- **DURIP**
- DEPSCoR Capacity Building



Transition to DoD

- Minerva transition to Professional Military Schools
- LUCI
- **UARCS**



Technology Transfer

- STTR/SBIR
- Manufacturing Institutes

Service Programs **green**

OSD Programs **purple**

Cross- Service Programs **orange**



DoD Interests in Biological Sciences

Today's biological sciences basic research will advance tomorrow's operational capabilities across multiple DoD domains: material & systems, military medicine, warfighter performance, and chem-bio defense....



Discovering new functional materials using biology
(ARL)



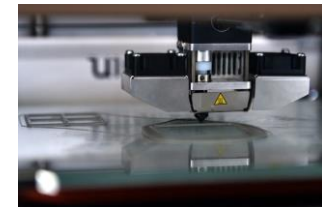
Innovating bioinspired autonomous systems
(NRL)



Improving warfighter performance through Biomedicine
(ONR)



Revolutionizing biofabrication of prosthetics
(DARPA)



Advancing precision in bioprinting
(ARL)

Broad DoD Basic Research Areas in Biological Sciences

- Biomaterials
- Synthetic Biology
- Biomimetics
- Quantum Biology
- Bioinspired autonomous systems
- Bio-sensing
- Bioelectronics
- Biofabrication
- Epigenetics
- Bio-energy



OSD versus Services versus Components

- “Core” grants by OXR (AFOSR, ONR, ARO):

- Single-Investigator (SI), typically \$200 – 400K/year; 3 years
- Designed for exploration, proof-of-concept
- Proposals address broad research directions, set by DoD PMs

- MURI:

- Small Teams, multiple Universities: \$1.5M/year; 5 years
- Designed to solve hard multi-disciplinary problems
- New topics each year, written by POs; cross-service collaboration

“Large teams develop, and small teams disrupt science and technology”

<https://doi.org/10.1038/s41586-019-0941-9>



VBFF:

- Single-Investigator: \$600K/year; 5 years
- Exploring far-reaching, high-risk, and very innovative ideas by top (tenured) faculty
- Broad topics, covering all scientific areas of DOD interest



Selected Programs



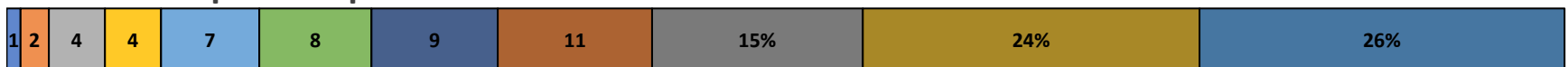
Vannevar Bush Faculty Fellowship: Overview

Defense Department's largest single-investigator program: 5-year fellowship with up to \$3M for research with potentially extraordinary outcomes

Program Goals:

- VBFF supports transformative, high-risk, basic research
- Attract distinguished, productive, and creative candidates and sustain career-long association between Fellows and DoD
- Establish a group of experts that can study and advise DoD on emerging scientific and technical challenges

% of Awards per Discipline



Remote sensing

Physics

Photonics

Nanoscience

Fluid Dynamics

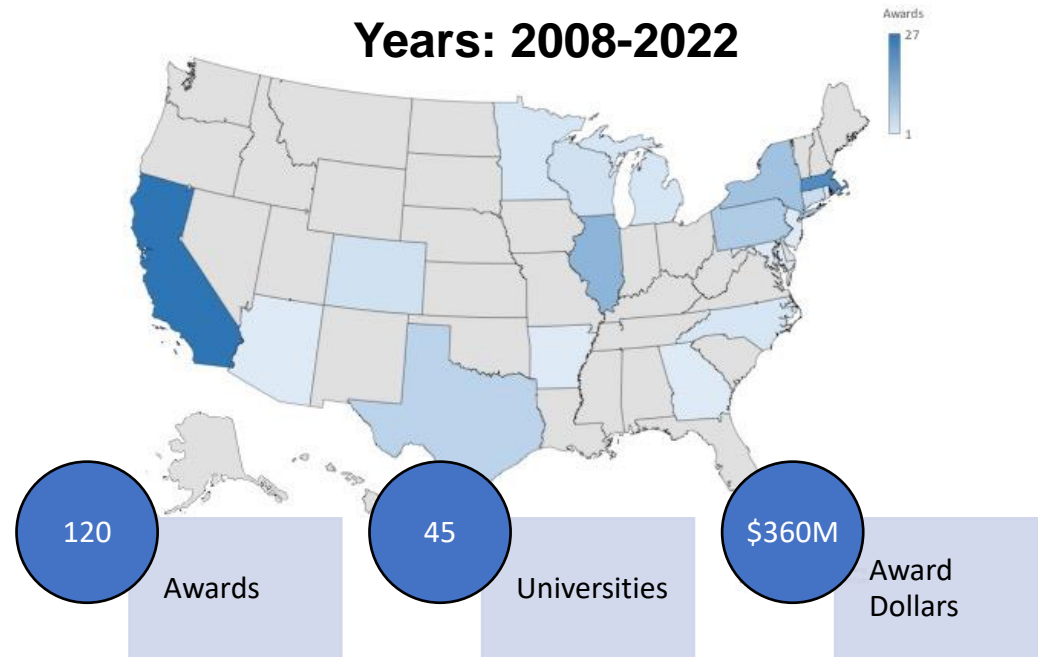
Bio-Engineering

Networks/ AI

Cognitive Sciences

US Map of VBFF Awards

Years: 2008-2022





Vannevar Bush Faculty Fellowship: Continued

2023 Class

Ana Maria Rey



Quantum
University of
Colorado at
Boulder
Qimiao Si

Charbel Farhat



AI
Stanford University

Michael Crommie



**Quantum
Materials**
University of
California, Berkeley
Jeffrey Tabor

Michael Fischbach

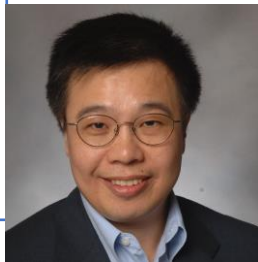


Bioengineering
Stanford University

Lek-Heng Lim



Applied Math
University of Chicago



**Quantum
Materials**
Rice University

Rebecca Schulman



Bioengineering
John Hopkins
University



Bioengineering
Rice University

Tuomas Sandholm



Applied Math
Carnegie Mellon
University

Wolfgang Ketterle



Quantum
Massachusetts Institute
of Technology

FOA posted by
ONR
Late Summer



White papers
due
Fall



~15%

Full proposals
due
Winter



~25%

Selection of
2024 Class
Spring

Informational webinar, project descriptions available on website
<https://basicresearch.defense.gov/Programs/Vannevar-Bush-Faculty-Fellowship/>



Minerva Research Initiative

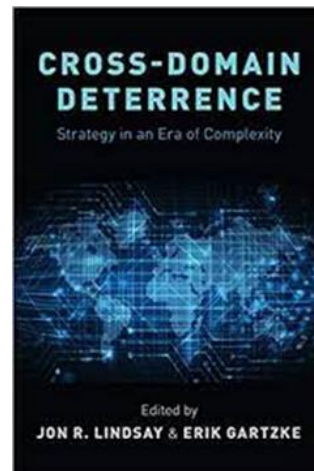
Success Story: Prof. Eric Gartzke

Looking back at Prof. Eric Gartzke's impact in the National Defense Strategy....

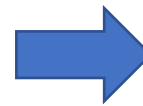
Minerva researcher Eric Gartzke's book, *Cross-Domain Deterrence: Strategy in an Era of Complexity* (Oxford University Press, 2019) has become a vital reference for the team formulating the National Defense Strategy. Gartzke's work (alongside other Minerva researchers) has proven relevant to Sec. Austin's message on "integrated deterrence" as put forth in his recent Washington Post opinion piece: "The Pentagon must prepare for a much bigger theater of war."



Gartzke's Minerva project "Deterring Complex Threats: The Effects of Asymmetry, Interdependence, Multipolarity on International Strategy."



Sec Austin expresses "Under what I call 'integrated deterrence,' the U.S. military isn't meant to stand apart, but to buttress U.S. diplomacy and advance a foreign policy that employs all instruments of our national power".



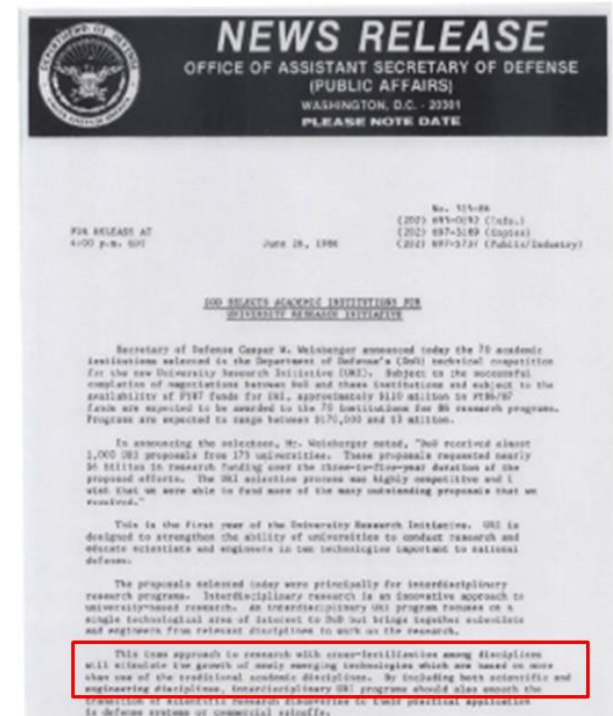
Source: https://www.washingtonpost.com/opinions/lloyd-austin-us-deter-threat-war/2021/05/05/bed8af58-add9-11eb-b476-c3b287e52a01_story.html



Multidisciplinary University Research Initiative: Program Overview

Tri-service program that supports basic research teams intersecting with more than one traditional science and engineering discipline

- Promote rapid technology transition directly to Service applications
- Complement other DoD programs that support university research through the single-investigator awards.
- Educate scientists and engineers in the interdisciplinary areas important to national defense



1986 Press Release: “This team approach in research with cross-facilitation among disciplines will stimulate the growth of newly emerging technologies....



Defense University Research Instrumentation Program: Overview

Funding mechanism for purchasing research instrumentation and equipment so that university labs can conduct high-quality research

DURIP awards are made to research institutions with current DoD basic research grants

Range: \$50,000 to \$1,500,000

Submission Closes: Feb 16, 2024

Fiscal Year 20 Competition (announced Nov. 2019)

172

Awards

91

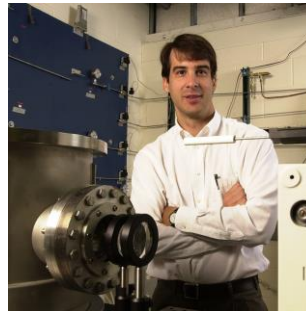
Universities

\$48.9M

Budget

Three DURIP Awardees

Nick Glumac



University of Illinois
Flash X-Ray System
ONR

Claudia Fajardo-Hansford



Western Michigan University
Plasma-Assisted
Combustion Diagnostics
AFOSR

Suzanne Shontz



University of Kansas
Graphics Processing Unit (GPU)
Infrastructure
ARO

More Information:

ONR: <https://www.onr.navy.mil/en/Education-Outreach/Sponsored-Research/University-Research-Initiatives/DURIP>

ARO: <https://www.arl.army.mil/business/broad-agency-announcements/>

AFOSR: <https://www.afrl.af.mil/About-Us/Fact-Sheets/Fact-Sheet-Display/Article/2282120/afosr-funding-opportunities-university-research-initiative-uri/>



Laboratory University Collaboration Initiative: Success Story

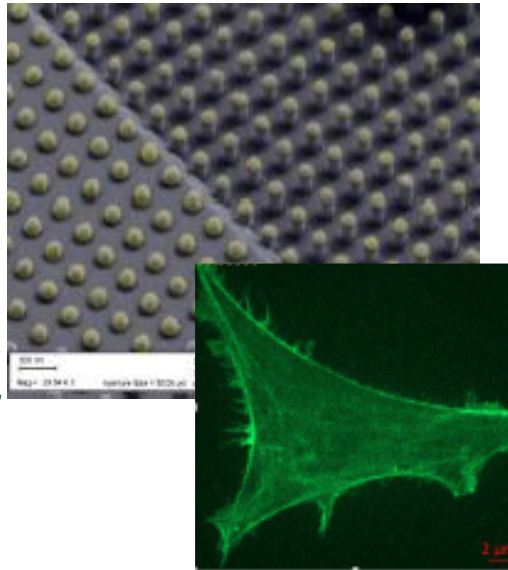
LUCI encourages collaboration to support high-risk basic science and build stronger relationships between universities and DoD labs

VBFF Fellow: Norbert Scherer, U. of Chicago
LUCI Fellow: Marc Raphael, U.S. Navy research Laboratory

How Does Cellular Navigation Systems Enable Wound Healing?

Accomplishment:

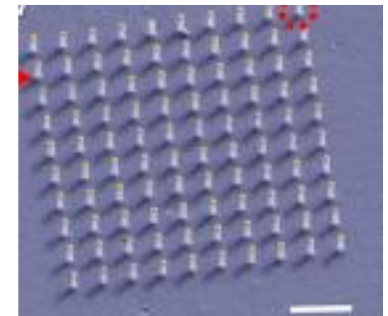
Fabricated multi-functional chips for eukaryotic and prokaryotic cell adhesion, division and migration experiments



Transition into
Application



Nanoplasmonic Imaging Chip



Wound healing application:
senses secretions at the injury
site

U.S and Int'l Patents and Applications:
9,791,368, 2014-0093977 A1; US14039326,
US15186742, WO2014052759A1,
WO2014159847A1, WO2016205775A1

Awards of **\$600K** awarded over 3 years

<https://basicresearch.defense.gov/Pilots/Laboratory-University-Collaboration-Initiative/>



Investing in the Next DoD Workforce Generation: DoD STEM Program - Overview



DoD STEM is inclusive of Department-wide efforts that aim to *inspire, cultivate, and develop* a diverse and exceptional STEM talent through a continuum of meaningful STEM learning opportunities across the Pre-K-Postdoc continuum. The **National Defense Education Program (NDEP)** is one of the largest STEM efforts in the Department. DoD STEM website – www.dodstem.us & on social media @DoDSTEM.



Investing in the Next DoD Workforce Generation Continued...

The Department has several workforce development programs that engage with the next generation of scientist and engineers.

SMART

SCIENCE, MATHEMATICS,
AND RESEARCH FOR
TRANSFORMATION

PART OF THE NATIONAL
DEFENSE EDUCATION PROGRAM



SMART Scholarship	NDSEG Fellowship	HBCU/MI
<p>The Science, Mathematics, and Research for Transformation (SMART) Scholarship-for-Service Program, funded by the DoD, is a combined educational and workforce development opportunity for STEM students.</p> <p>https://www.smartscholarship.org/</p>	<p>The NSDEG fellowship supports graduate students in science and engineering disciplines of military importance.</p> <p>http://www.ndsegfellowships.org</p>	<p>Aimed to foster workforce diversity and entry of underrepresented minorities into STEM disciplines important to national defense.</p>



Now let's hear from you



Questions for the Scientific Community



Infrastructure

What type of resources or facilities are needed?



New Directions and Concepts

What are you all most excited about from a conceptual perspective?



Recruiting and Fostering Collaborations

What is your perspective on recruiting talent and maintaining/fostering collaborations



Next Generation of Scientists

How do we prepare the next generation of researchers in material science and engineering



<http://basicresearch.defense.gov>



[@DoD_STIx](https://twitter.com/DoD_STIx)



<https://www.linkedin.com/company/dod-basic-research-office>