Guide to FY2013 Basic Research Funding at the Department of Defense (DOD)

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Summary and Index

This document provides insights into the various DOD funding agency opportunities for University basic research and for a few more salient applied research (6.2) efforts, with special attention to changes anticipated in FY2013. More extensive information is provided at the Central Desktop "Mission Agency Program Summary" (MAPS) website.

DOD depends heavily on technological advantage. Research and engineering must be marshaled to meet tomorrow's defense challenges. Given today's globalized access to knowledge and the rapid pace of technology development, innovation, speed, and agility have taken on greater importance to DOD efforts. The Department has identified seven priorities: Autonomy, Counter Weapons of Mass Destruction, Cyber Sciences, Data-to-Decisions, Electronic Warfare, Engineered Resilient Systems, and Human Systems. The major basic research funding opportunities originate in the three service research offices, the Defense Advanced Research Project Agency (DARPA), the Defense Threat Reduction Agency (DTRA), and the Congressionally Directed Medical Research Program (CDMRP), which is managed by DOD. Large-scale opportunities arise from periodic Center competitions and the annual Multidisciplinary University Research Initiatives. Applied research and development are also funded by the Services, DARPA, DTRA, and other agencies with guidance from the Department of Defense Research and Engineering (DDR&E).

The change in basic research investment relative to the FY12 President's Budget Request is projected to be essentially zero. The Navy and DARPA budget request shows a ~5% increase, with no change or decline for the other agencies.

Central Desktop Mission Agency Program Site (MAPS) for additional information:
contact NLWalker@usc.edu for user name and password

Overview

DOD funds research that is relevant to its mission, predominantly drawing on engineering, computer/information science, and physical sciences. However, DOD also funds some limited basic social science, medical, and life science research. In addition to basic research (labeled 6.1, or BA1), DOD funds applied research (6.2, or BA2) and advanced technology development (6.3, or BA3). Universities get about 50% of the 6.1, 15% of the 6.2, and 10% of the 6.3 funding. But the 6.2 and 6.3 funding at Universities is dominated by University Affiliated Research Centers and other entities that are structured to handle greater deadline, security classification and reporting requirements. On 6.2/6.3 projects, it is not unusual for a University professor to be a collaborator with industry, a university affiliated organization (such as ISI and ICT at USC), or a DOD lab.

Funding for basic research is distributed among several DOD agencies, each having its own particular focus:

- ARO (Army Research Office): soldier, ground force mission oriented (6.1)
- AFOSR (Air Force Office of Scientific Research): pilot, aerospace mission oriented (6.1)
- ONR (Office of Naval Research): sailor, marine, ship, ocean mission oriented (6.1 - 6.3)
- DARPA (Defense Advanced Research Projects Administration): defense-wide technology innovation oriented (6.1 – 6.3)
- DTRA (Defense Threat Reduction Agency): weapons of mass destruction (6.1 – 6.3)
- CBDP (Chemical Biological Defense Program): chem/bio warfare defense (6.1 - 6.3)
- CDMRP (Congressional Directed Medical Research Program): medical research (6.1)
- OSD (Office Secretary of Defense): overarching Defense issues

For the Army and Air Force, their 6.2 and 6.3 funds are managed out of their Laboratories and Commands.

Single Investigator Efforts

The majority of DOD basic research funding is invested in single investigator efforts, and advertised through relatively generic Broad Area Announcements (BAAs). The funding for these efforts typically ranges between $100-200K/yr for three years; continuation is possible. Approximately 20% of continuing programs will be turned over annually. New programs occur periodically - the Navy has Basic its Research Challenges and the Air Force has its Basic Research Initiatives. For more information see the DOD Charts 37-87 that are parsed by funding agency and/or Charts 23-36 that are parsed by academic discipline.

While peer review is used to differing degrees by the various DOD agencies, the program officers have far greater latitude than do NSF program officers. So it is <u>essential</u> to contact a program officer and explore mutual interests (you can use the discipline organized Charts 23-36 and/or the MAPS database to identify the appropriate program officers). A white paper is very useful (sometimes required). Proposals to the long-range programs may be submitted at any time, but spring is when many tentative initial decisions are made for new starts in the coming fiscal year (starting 1 Oct). There is no standard DOD proposal format; each agency/office has its own proposal requirements. Guides to interacting with the program officers and preparing proposals are in Charts 155-158.

Special Announcement Programs
During the year, DOD agencies may announce special program opportunities. These range from large, center efforts (e.g., UARCs, Collaborative Technology Alliances, Centers of Excellence) to single investigator programs (e.g., ONR's Basic Research Challenges, AFOSR's Discovery Challenge Thrusts, DARPA's Mathematical Challenges). These opportunities can be found by monitoring the funding agency sites and grants.gov for new solicitations; the DC Office of Res. Advancement does this and provides alerts to pertinent USC investigators.

Teaming Efforts
The multidisciplinary university research initiative (MURI) program has topics announced in the June – Sept time frame each year, with white papers due about a month later and proposals due about three months later. These require multidisciplinary teaming efforts; the funding is up to $1.5M/yr for five years (presuming acceptable performance). A record of prior winners for the past five years is available from the DC office, including the successful USC efforts. Successful proposals have typically had 2-4 Universities engaged, but single University efforts can be successful. For more information see Charts 103-104.

Instrumentation
The Defense University Research Instrumentation Program (DURIP) is competed each summer. The awards range from $50K to $1M; matching funds are not required, but very useful for the high priced instruments. While anyone may submit, there is a strong preference for instrumentation in support of funded DOD research efforts (for more information see Chart 105). ARO also has a research instrumentation program (for more information see Chart 43).

Young Investigators
Each of the three services, DTRA, and DARPA have young faculty programs. The eligibility typically is within five years of Ph.D. or equivalent degree [DARPA (ONR) is six (five) years from initial tenure-track appointment]. US Citizenship or "green card" status is required by the Services, not by DARPA and DTRA. The available funding ranges from $50K/yr (Army) to $170K/yr (Navy). Submission deadlines vary. For more information see Charts 139-145; a compendium of the awardees/topics is available from the DC office.

National Security Science and Engineering Faculty Fellowship (NSSEFF)
DOD has a special program to support faculty with a degree awarded in the last 25 years (awardees have averaged ~20 yrs) and an established outstanding research record in areas of interest to DOD. About 30 awards of $850K/yr for five years were initiated in 2008-10; none in 2011-12. For more information see Chart 154.

Human Social, Cultural, and Behavioral Modeling (HSCB)
In addition to the Service core HSCB programs, OSD has created S&T programs to address understanding and modeling of human behavior in social and cultural contexts. The basic research component is entitled Minerva and in the past has been administered partly by DOD and partly by NSF (http://minerva.dtic.mil/funding.html). For more info see Charts 19, and 136-7.

Medical
Congress typically adds funds to the DOD budget for support of medical research; these total to ~$400M/yr in recent years. The funds are for specific topics and are competed

openly through the Congressionally Directed Medical Research Program (CDMRP), which is managed by USAMRMC. For more information see Charts 106-116 and/or visit the website http://cdmrp.army.mil. USAMRMC has a generic BAA that lists its current interests (but little monies for extramural work). There is the Guidance for the Development of the Force (GDF) program that now has mostly applied monies (see Charts 129). There is the Armed Forces Institute of Regenerative Medicine (AFIRM), which periodically funds consortia; see Chart 45. DARPA has a Basic Operational Medical Science (6.1) and Biomedical Technology (6.2) budget line.

University Centers of Excellence (COE)
Both the Army and Navy support University Affiliated Research Centers that address more applied research and development (DOD chart 138). The Air Force supports University Centers of Excellence (~5yr lifetime) that are associated with a specific technical directorate (laboratory) and 1) perform research in a high priority AF interest area; 2) educate US students in critical technology areas; 3) frequent professional interchanges between AFRL and University personnel; and 4) strengthen AFRL in-house technical capabilities. (DOD chart 55) The Army has similar University COE (DOD chart 47).

DOD Laboratories, Centers, and Schools
The DOD has an extensive intramural research program at various laboratories and centers. Those entities do have limited opportunities to fund University-based efforts. One example is the Naval Postgraduate School, which annually solicits research initiatives in support of its efforts (DOD chart 73).

Education/Training
In addition to funding research itself, there are DOD programs in support of postdoctorates (National Defense Science and Engineering Graduate (NDSEG) - $47M/yr) and education (National Defense Education Program (NDEP) - $62M/yr). Each of the Services also has a STEM education effort. In addition there are many programs to support faculty working at the various DOD laboratories. For more information on these efforts see Charts 146-154.

Non-DOD Security Related Opportunities
In addition to the DOD, the Intelligence Community and the Department of Homeland Security have some limited S&T opportunities. For more information see Charts 9-16.

Resources
For access to the Research Advancement **Mission Agency Program Site (MAPS)** information on the Central Desktop website, contact NLWalker@usc.edu for user name and password. The file labeled "USC DOD Funding Revised 'XX' " at the Central Desktop MAPS website provides a compilation of numbered charts with detailed information on the various DOD funding agencies; the various program interests; the program managers, their research interests and contact information; and how to best navigate the agency websites. Chart numbers in the text above reference that file. In addition, at the website there are other useful reports/presentations, a database to identify program officer interests, and program officer data sheets (see illustration in Appendix 2). If you are interested in exploring an opportunity, contact with the appropriate DOD program officer is strongly recommended; see MAPS and/or Murday for Program Officer data sheets.

Assistance in Locating Funding and Preparing Proposals

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Table 1: FY2008 and FY2010 DOD Research Funding ($M)
Obligations at Universities/Colleges

	2008			2010		
	Basic	Applied	Total	Basic	Applied	Total
TOTAL	**869.28**	**690.53**	**1559.81**	**1000.59**	**611.80**	**1612.39**
Physical Sciences	**156.87**	**71.27**	**228.14**	**194.61**	**78.62**	**273.23**
Astronomy						
Chemistry	50.14	17.96				
Physics	90.33	26.82				
Other	16.40	26.49				
Environmental Sciences	**101.91**	**24.67**	**126.58**	**105.53**	**20.14**	**125.67**
Atmospheric	7.03	7.30				
Geological	3.96	2.36				
Oceanology	89.97	12.67				
Other	0.94	2.34				
Mathematics and Computer	**147.61**	**74.26**	**221.87**	**151.00**	**87.64**	**238.64**
Computer Sciences	102.39	50.51				
Mathematics	38.16	18.02				
Other	7.06	5.73				
Engineering	**350.86**	**369.94**	**720.80**	**425.41**	**314.38**	**739.79**
Aeronautical	13.37	31.32				
Astronautical	0.18	6.68				
Chemical	2.89	7.83				
Civil	0.58	4.82				
Electrical	79.45	72.50				
Mechanical	32.99	23.14				
Metal/Materials	55.15	69.07				
Other	166.26	154.59				
Life Sciences	**107.68**	**143.39**	**251.07**	**106.56**	**101.50**	**208.06**
Agriculture	0.04	1.93				
Biological	42.88	7.77				
Environmental	10.33	0.02				
Medical	25.34	125.81				
Other	29.09	7.63				
Psychological	**4.34**	**5.51**	**9.85**	**8.47**	**8.03**	**16.50**
Social Sciences	**0.01**	**1.49**	**1.50**	**9.01**	**1.49**	**10.50**

From NSF "Federal Funds for Research and Development: FY2008-2010"
NSF 12-308, April 2012

Basic Research	2008	Tables 68-71
Applied Research	2008	Tables 76-79
Basic Research	2010	Table 67
Applied Research	2010	Table 75

Table 2: Projected DOD Basic Research Funding ($M) for FY2013

Discipline / Agency	Army	AF	Navy	DARPA	DTRA	CBDP	OSD
Biology / Life Sciences	8	24		40			
Human Systems			21				
Biology / Medical			21	40			
Chemistry	10		xx	xx			
Propulsion		36					
Physics	12	51	xx	xx			
Electronics/Photonics	11	61	49	53			
Materials	7	46	64	76			
Mechanics	6						
Mechanics Structural		20	xx				
Mechanics Fluid		27	xx				
Environment							
Ocean			87				
Atmosphere and Space		xx	27				
Environmental Science	4						
Computer, Information Sciences, Mathematics			47	68			
Mathematics and Computing Sciences	13	19					
Information Sciences		42		26			
Networks	7	34					
Air/Ground/Sea Vehicles			72				
Weapons			29				
Counter IED Devices			19				
Science Education Career and Outreach	10	21	37				
Transformative				47			
Chemical/Biological Warfare Defense						50	
Weapons of Mass Destruction Defeat					45		
High Energy Laser Multidisciplinary Research Initiative		13					
Multidisciplinary University Research Initiatives (MURI)	59	78	88				
Defense University Instrumentation Program (DURIP)	14	16	19				
National Defense S & E Graduate Program		47					
National Defense Education Program (NDEP) - STEM							62
Social / Cultural / Human - MINERVA, HSCB	3	xx	xx	xx			16
National Security S&E Faculty Fellow (NSSEFF)							27
Medical							
Total	164	535	580	350	45	50	105

Since the projected budgets are parsed differently than the organization program taxonomies, clear assignment of funds is not always possible. The Table should be considered a best estimate. In some cases the amount of funding in a discipline is included under other headings and is thereby unknown – indicated by "xx" in the cell.

The reported Army funding reflects only the ARO budget available for University proposal submission, not the total basic research funding. For the Navy, about 25% of the reported total basic research funding is provided to the Naval Research Laboratory and is not available for University proposal submission. For the Air Force, about 30% is provided to the AF Research Laboratories.

Acronym Glossary

AFOSR	Air Force Office of Scientific Research
AFRL	Air Force Research Laboratories
ARL	Army Research Laboratories
ARO	Army Research Office
BA	Budget Activity (new designation for the R&D accounts)
BAA	Broad Agency Announcement
CBDP	Chemical/Biological Defense Program
COTS	Commercial Off-the-Shelf (products)
CSI	Congressional Special Interest (also known as budget "adds")
CTA	Collaborative Technology Alliance
CWMD	Combating Weapons of Mass Destruction
DARPA	Defense Advanced Research Projects Agency
DDR&E	Director, Defense Research and Engineering
DHP	Defense Health Program
DMRDP	Defense Medical Research and Development Program
DOD	Department of Defense
DTRA	Defense Threat Reduction Agency
DURIP	Defense University Research Instrumentation Program
GDF	Guidance for the Development of the Force
GPS	Global Positioning System
HSCB	Human Social Cultural and Behavior Modeling
IED	Improvised Explosive Devices
MAPS	Mission Agency Program Site found at the Central Desktop website
MEMS/NEMS	Micro- Nano-ElectroMechanical Systems
Minerva	Name of DOD program engaging the social science community
MOVINT	The ability to track moving things on land and sea (Movement Intelligence)
MURI	Multidisciplinary University Research Initiative
NDEP	National Defense Education Program
NDSEG	National Defense Science and Engineering Graduate Fellowships
NSF	National Science Foundation
NRL	Naval Research Laboratory
NSSEFF	National Security Science and Engineering Faculty Fellowship
PBR	President's Budget Request (submitted to Congress)
STEM	Science, Technology, Engineering, Mathematics
TBA	To be Announced
ONR	Office of Naval Research
OSD	Office of the Secretary of Defense
UARC	University Affiliated Research Center
USAMRMC	United States Army Medical Research and Materiel Command
YIP	Young Investigator Program

Appendix 1: FY2013 DOD Basic Research Programs

Service		Actual* FY 11	Estimate* FY12	PBR FY12	PBR FY13	% inc PRB FY12-13
Navy	Basic Research	539	605	577	605	4.8
Air Force	Basic Research	476	530	519	516	-
Army	Basic Research	389	456	437	444	1.6
	ARO (H57)	71	78	78	78	-
	ICT (J08	7.6	8	8	8	-
	Minerva (V72)	8	3.3	3.3	3.3	-
DARPA	Basic Research	288	329	327	349	6.7
DTRA	Basic Research	46	48	48	45	(6)
CBDP	Basic Research	49	53	53	51	(4)
OSD	NDEP	91	84	116	88	
	MINERVA	0	5	15	16.5	10
DHP	GDF Basic Research	29	0	0	3	

* The FY11-12 numbers may include Congressional Adds (CA, sometimes labeled Congressional Special Interest, CSI) which do not appear in the President's Budget Request (PBR).

Dr. Zack Lemnios, Assistant Secretary of Defense (R&E) has identified the following as his high priority research topics: a) metamaterials and plasmonics, b) quantum information science, c) cognitive neuroscience, d) nanoscience and nanoengineering, e) synthetic biology, and f) computational modeling of human and social behavior.

Dr. Robin Staffin, Director of Research for DDR&E. has identified the following as his priority topics: a) quantum information sciences; b) synthetic biology and synthetic genomics; and c) nanomanufacturing. Other topics in which he is interested include cognitive neuroscience, engineered materials, and modeling human behavior.

Dr. Randy Avent, Director of Basic Science for DDR&E, has identified the following as his personal topics of interest: a) nano-enabled technology (will impact many technologies); b) synthetic biology / panomics; c) quantum technology (second IT revolution); d) cognitive neuroscience; e) engineered materials – plasmonics; f) computational models of human behavior.

Each of the Services has a strategic S&T plan which provides guidance into priorities; these can found at the Research Advancement's MAPS Central Desktop website. In addition to the budget growth elaborated below, approximately 20-30% of the projects in a DOD program are turned over each year. So there are opportunities in most programs even in the absence of budget growth.

Office of the Secretary of Defense (OSD)

P010 Basic Research Initiative (6.1, MINERVA) From $5M in FY2012 to $16.5M

Support endowed faculty chairs for Minerva Research Fellows at defense education institutions such as war colleges and service academies. Support new university-led research initiatives.

P209 Systems 2020 Applied Research (6.2) From 0 in FY2012 to $7.9M

-Conduct Systems 2020 research projects, coordinate with the Services' science and technology leadership and the Service's research, development and engineering centers. Integrate Services' pilot project results and data.
-Perform applied research to enable implementation of candidate Systems 2020 tools, technologies and methods in an integrated laboratory demonstration and evaluation of initial capabilities to accelerate delivery of complex adaptive systems.
-Perform applied research to enable implementation of candidate Systems 2020 systems analysis and design engineering tools in an integrated laboratory demonstration that performs within a wide range of architectures and design drivers in the context of dynamic mission and threat conditions.
-Perform applied research to enable implementation of Systems 2020 tools that mature a concept-engineering and integrated modeling environment that enables rapid assessment of new material, increases productivity of engineering, design and production processes, and readily incorporates a wide range of mission data for generation of design alternatives.

P266 Data to Decisions Applied Research (6.2) From 4.1M in FY2012 to $13.8M

• Continue to research methods to discover and identify threat signatures in complex, incomplete, imprecise and potentially contradictory large MOVINT data sets.
• Continue to research activity-based modeling methods node to enable faster and more efficient detection of social networks in wide-area persistent data streams.
• Continue to research methods to discover and provide contextual information about MOVINT data to the analyst such as scene location, object movement, and object proximity.
• Continue to research methods to reduce uncertainty and reduce the solution space in motion imagery data.
• Continue to research new methods to enable rapid development of new motion imagery processing systems.
• Continue to identify processing and machine translation gaps and conduct research to reduce these technical shortfalls.
• Continue to identify gaps in social network discovery and link entity mining tools and conduct research to reduce technical limitations.
• Research information representation methods to enable faster and more efficient detection of social networks in complex, incomplete, imprecise and potentially contradictory large data sets.
• Research methods to enable analysts to operate more efficiently, leverage non-traditional data sources, and more effectively identify objects of interest.

P003 Cyber Applied Research (6.2) From $4.6M in FY2012 to $19M

INFORMATION ASSURANCE AND COMPUTER NETWORK DEFENSE (IA/CND):

-Investigate impact of cognitive radio technology to increase network resiliency by enabling cross-layer communications.
-Define hardware/software interface logic language for many-core processors and

systems on a chip to integrate security into automated design flows and run time systems.

-Develop improved security framework for optical transport layers in critical infrastructure fiber-optic telecommunications devices to ensure reliability and availability of critical communications networks to both DoD and commercial operators and users.

-Develop techniques to employ non-signature-based monitoring and validation methods to make trust decisions on information systems.

COMPUTER NETWORK OPERATIONS (CNO):

-Decouple programming language-dependent constructs in existing CNO software frameworks to allow for development of clients developed in different languages to operate within the SW architecture.

-Investigate and test a hybrid time of arrival and phased array system for wireless localization.

-Construct wireless environments for implementing authentication and information hiding schemes at the physical later of wireless networks.

-Demonstrate malicious code delivery through audio and video content vulnerabilities new implementations of common web browsers

-Develop techniques to address adversarial botnets in real-time.

CYBER METRICS AND EXPERIMENTATION:

-Optimization of a composite trust metric and application for risk management and mission performance tradeoff analysis for multiple-objective missions in coalition networks.

DARPA (http://www.darpa.mil/)

DARPA has a 3-5 year tenure for its program officers (PO). As a critical component of their job, new POs must develop new programs. Those new program topics are not fully anticipated in the budget material below. It is highly beneficial to participate in that development since it enhances the chances for funding when a BAA is released.

BLS-01 BioInterfaces From $6.5M in FY12 to $12M

The Bio Interfaces program supports scientific study and experimentation, emphasizing the interfaces between biology and the physical and mathematical/computer sciences. This unique interaction will develop new mathematical and experimental tools for understanding biology in a way that will allow its application to a myriad of DoD problems. These tools will help exploit the advances in the complex modeling of physical and biological phenomena. It is also expected that understanding the fundamentals of biology will aid in developing tools to understand complex, non-linear networks and force structures.

CCS-02 Strategic Social Interaction Modules (SSIM) From $10.7M in FY12 to $14.1M

The Strategic Social Interaction Modules (SSIM) program will improve military training to include the social interaction skills and abilities warfighters need for successful engagement with local populations. In the current operational environment, it is imperative to develop rapport with local leaders and civilians as their cooperation and consent will be necessary for successful operations. SSIM will emphasize the foundational social skills necessary to achieve cultural understanding in any social setting and the skills necessary for successful interactions across different social groups.

CCS-02 Unconventional Computation From 0 in FY2012 to $5M
The Unconventional Computation program is a broad-based effort to develop new methods of computing by investigating, exploiting, and advancing novel computation models - such as those found in neuro-biological systems – that are currently unavailable in conventional microprocessors and can theoretically boost processing efficiency by three orders of magnitude for certain important classes of DoD-critical applications. The program will require cross-disciplinary collaboration to exploit and advance unique computational models and connectivity architectures which minimize power, processing time, and/ or instruction complexity in DoD-critical applications such as image/pattern detection, signal filtering/data reduction, and change detection.

CYS-01 Active Authentication From $5.5M in FY2012 to $10.2M
The Active Authentication program will develop more effective user identification and authentication technologies. Current authentication approaches are typically based on long, complex passwords and incorporate no mechanism to verify the user originally authenticated is the user still in control of the session. The Active Authentication program will address these issues by focusing on the unique aspects of the individual (i.e., the cognitive fingerprint) through the use of software-based biometrics that continuously validate the identity of the user. Active Authentication will integrate multiple biometric modalities to create a system that is accurate, robust, and transparent to the user.

CYS-01 Automated Anal for Cybersecurity (APAC)* From $11.2M in FY12 to $14.8M
Automated Program Analysis for Cybersecurity (APAC) is developing automated program analysis techniques for mathematically validating the security properties of mobile applications. This will involve creating new and improved type-based analysis, abstract interpretation, and flow-based analysis methods with a far greater ability to accurately demonstrate security properties without false alarms than is possible today. APAC technologies will enable developers and analysts to identify mobile applications that contain hidden malicious functionality and bar those applications from DoD mobile application marketplaces.

ES-01 Advanced X-Ray Integrated Sources (AXIS) From $5M in FY2012 to $11M
The objective of the Advanced X-Ray Integrated Sources (AXIS) program is to develop tunable mono energetic Xray sources that are spatially coherent with greatly reduced size, weight and power while dramatically increasing their electrical efficiency through application of micro-scale engineering technologies such as MEMS and NEMS. Such X-ray sources will enable new versatile imaging modalities based on phase contrast which are 1000X more sensitive than the conventional absorption contrast imaging.

MS-01 Nanoscale/Bio-inspired and MetaMaterials From $10M in FY2012 to $14.1M
The research in this thrust area exploits advances in nanoscale and bio-inspired materials, including computationally based materials science, in order to develop unique microstructures and material properties. This area also includes efforts to develop the underlying physics for the behavior of materials whose properties have been engineered at the nanoscale level (metamaterials) and materials exhibiting a permanent electric charge (charged matter).

MS-01 Enabling Quantum Technologies From $9.2M in FY2012 to $15.7M
This thrust emphasizes a quantum focus on technology capabilities including significantly

improved single photon sources, detectors, and associated devices useful for quantum metrology, communications, and imaging applications. In addition, this thrust will examine other novel classes of materials and phenomena such as plasmons or Bose-Einstein Condensates (BEC) that have the potential to provide novel capabilities in the quantum regime, such as GPS-independent navigation via atom interferometry and communications, and ultrafast laser technologies.

TRS-01 Social Media in Strategic Comms (SMISC)* From $8.3M in FY12 to $16.7M
The Social Media in Strategic Communication (SMISC) program will develop techniques to detect, classify, measure and track the formation, development and spread of ideas and concepts (memes) in social media. This will provide warfighters and intelligence analysts with indications and warnings of adversary efforts to propagate purposefully deceptive messaging and misinformation.

TRS-01 Bits to Behavior via Brains (B3) From 0 in FY2012 to $6.5M
The Bits to Behavior via Brains (B3) program extends recent work indicating avatar activity in virtual worlds can result in measurable differences in real-world behavior on the part of users. One example of this observation is an increase in physical exercise undertaken by humans when their virtual avatar begins an exercise regimen. Understanding the neural mechanisms that govern the transfer of virtual behavior into actual behavior will enable optimization of virtual resources to train and educate soldiers, and could lead to therapeutic and preventative capabilities. B3 will examine how virtual world interactions influence neural mechanisms of learning (both one-shot and traditional) and executive function (especially judgment).

BOMS Autonomous Diagnostics (ADEPT) From $17.5M in FY12 to $24.5M
The Autonomous Diagnostics to Enable Prevention and Therapeutics (ADEPT) program will develop the underlying technologies to rapidly respond to a disease or threat, and improve individual readiness and total force health protection by providing centralized laboratory capabilities at non-tertiary care and individual settings. ADEPT will develop and exploit synthetic biology for the in vivo creation of nucleic acid circuits that continuously and autonomously sense and respond to changes in physiologic state and for novel methods to target delivery, enhance immunogenicity, or control activity of vaccines, potentially eliminating the time to manufacture a vaccine ex vivo.

AF Office of Scientific Research
(www.wpafb.af.mil/library/factsheets/factsheet.asp?id=8976)
The AFOSR budget submission shows no significant changes in S&E programmatic funding from FY2012 to FY2013.

Education and Outreach From $5.1M in FY2012 to $11.2M
Increase awareness of Air Force research needs and opportunities throughout the civilian scientific community, while simultaneously identifying, recruiting, and increasing opportunities for new young investigators to participate in critical Air Force research.

Army Research Office (http://www.arl.army.mil/www/default.cfm?Action=29&Page=29)
The ARO budget submission shows no significant changes in programmatic funding from FY2012 to FY2013

University and Industry Research Centers: VS3 Center for Advanced Research
In FY2015 the budget shows $2.1M for the start of a Center for Quantum Science Research.

Office of Naval Research (http://www.onr.navy.mil/)

Air Ground Sea Vehicles **From $58.3M in FY2012 to $71.7M**

- Initiate pressure-shear experiments at ultra high loading rates of explosion resistant coating (ERC) in combination with light weight composites including glass, acrylics, Poly(methyl methacrylate) (PMMA) and develop computational simulation capability for understanding the behavior and failure effect of ERC on the materials.
- Initiate computational methods for simulation of fragmentation including tracking interactions of fragments and their interactions with composites of various materials (and fluid fragment interaction).
- Initiate development of the Centers for Innovative Naval Technology (CINT), which will expand and apply the Center for Innovative Ship Design (CISD, at the Naval Warfare Systems Center -Carderock) approach to other Navy facilities to dramatically expand participation and the breadth of naval technologies covered

Human Systems **From $17.5M in FY2012 to $21.5M**

- Initiate research on brain-inspired intelligent systems to enable high-level interaction between warfighters and autonomous systems.
- Initiate research to explore the development of algorithms to automate assessment of the information value of Command and Control (C2) related data for next generation C2 systems.
- Initiate research to explore to dynamically provide decision support in support of rapid mission planning, re-planning and execution at command and combatant echelons. Research thrust to include dynamic mapping of decision space and decision based dynamic task allocation algorithms.
- Initiate research to explore concepts of operations for the management of information in hybrid autonomous systems.
- Initiate research on social neuroscience of Trust.
- Initiate research on data collection and processing for health surveillance and medical assistance.

Mathematics, Computor and Information Sciences **From $35.7M in FY12 to $47.5M**

- Initiate research on mathematical and computational building blocks for machine reasoning and intelligence.
- Initiate multidisciplinary research efforts on knowledge representation and reasoning for decentralized autonomy.
- Initiate research efforts on algorithmic solutions and explicit measurement schemes for networks inference and monitoring.
- Initiate research on novel techniques for interference mitigation.
- Initiate efforts to develop computer sciences foundation for quantum information sciences leading to new ways of computing and communication.

Weapons **From $24.8M in FY2012 to $29.1M**

- Initiate research and development for hypersonic propulsion system technologies for increased range and speed, improved stealth and maneuverability, reduced emissions and

signatures, lower noise, wider operational envelopes and turn-down ratio.
- Initiate research into coulombic explosives via unique electronic and structural properties of atomic clusters not observed in bulk.
- Initiate development of a new methodology coordinating both theoretical and synthetic chemistry to maximize molecular design and predicted molecule stabilities. This will facilitate insight into the next generation of energetic materials.
- Initiate research to develop ability to synthesize and quantitatively predict energetic material performance from first principles of quantum chemistry.
- Initiate research and development on aircraft, fuels and rocket propulsion system technologies for: increased range and speed, improved stealth and maneuverability, reduced emissions and signatures.
- Initiate an investigation that focuses both theoretical and synthetic processes to maximize molecular design and crystal morphology for new insensitive munition (IM)-compliant commodity energetic material ingredients.
- Initiate a Vehicle Autonomy effort focused on unmanned and autonomous systems to displace the operator from hazardous conditions/environments, lighten the load of individual Marines, and provide greater warfighting capability.
- Initiate assessment of theoretical constructs for directed energy (DE) systems detection and geolocation.
- Initiate investigation into the susceptibility of critical naval electronic components to electromagnetic radiation.
- Initiate development of suitable metamaterial samples, which provide electromagnetic shunting and conduct laboratory testing with laser and microwave systems.

Science and Engineering Education **From $32.1M in FY2012 to $36.7M**
- Initiate support for SciGirls, Navy GEMS (Gains in the Education of Mathematics and Science), SeaPerch 4H, STEM Literacy for Navy recruits, Business-Higher Education Forum (BHEF), and the Gulf Coast Initiative.
- Initiate new projects to further teacher development and Grades 13/14 STEM degree retention.

Defense Threat Reduction Agency (http://www.dtra.mil/)
The FY2013 budget submission indicates no significant changes in S&E programmatic funding as compared to FY2012. Specific DTRA topics are announced in solicitations, the most recent of which is: HDTRA1-11-16-BRCWMD-BAA, Amendment 1 in December 2011

Chemical/Biological Defense Program (http://www.acq.osd.mil/cp/)
Chemical/Biological Defense **From $31M in FY2012 to $45M**
Investigate and evaluate systemic biological responses following exposure of living systems to CB agents. Improve understanding of polymicrobial interactions influencing response to or course of disease. Exploit advances in systems biology to mine "omics" experimental designs involving agents and hosts to provide new biomarkers, targets and options. "omics" informally refers to a field of study in biology ending in -omics, such as genomics or proteomics. Explore materials in biotic/abiotic interface and biomimetics to enable functional molecular development (such as robust synthetic enzymes).

Appendix 2: Illustration of a Program Officer Datasheet

Dr. David M. Stepp
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Biosketch:
Dr. David Stepp serves as the Chief of the Materials Science Division of the U.S. Army Research Office. Also, he is Adjunct Assistant Professor in the Department of Mechanical Engineering & Materials Science, Pratt School of Engineering, Duke University.

Education

PhD	Duke University	1998	Mechanical Engineering and Materials Science
MS	Duke University	1995	Mechanical Engineering and Materials Science
BS	Harvey Mudd College	1993	Engineering

Program: Mechanical Behavior of Materials
http://www.arl.army.mil/www/default.cfm?page=183
The Mechanical Behavior of Materials program seeks to establish the fundamental relationships between the structure of materials and their mechanical properties as influenced by composition, processing, environment, and loading conditions. The program emphasizes research to develop innovative new materials with unprecedented mechanical, and other complementary, properties. ……

Recent MURI Topics:
FY11 Flex-Activated Materials
FY10 Ion Transport in Complex Heterogeneous Organic Materials
FY09 Tailored Stress-Wave Mitigation
FY09 Disruptive Fibers for Flexible Armor

Illustrative Papers Reflecting Personal Research Interests:
A theory of amorphous viscoelastic solids undergoing finite deformations with application to hydrogels
Korchagin Vladimir; Dolbow John; Stepp David INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES 44(11-12), 3973-3997 JUN 1 2007

Damage mitigation in ceramics: Historical developments and future directions in army research
Stepp DM
CERAMIC TRANSACTIONS 134, 421-428 2002

High-resolution study of water trees grown in silver nitrate solution
Stepp, D.,King, J.A., Worrall, J., Thompson, A., and Cooper, D.E.
IEEE Transactions on Dielectrics and Electrical Insulation, 3(3), 392 - 398 1996