

Breakout Session 2: DARPA 101: Engaging with DARPA & DSO

Dr. Stefanie Tompkins, DSO Director

DSO Proposers Day

June 22-23, 2016





Stellar program managers

Technology leadership

Adventurous spirit

Conviction and drive to change the world

Active engagement with technology community

Universities

Labs

Companies small and large

Military services and agencies

DARPA Culture

Off-scale impact

Risk taking

Honor in public service



Wide range of national security challenges: evolving nation states, shifting networks

Powerful, globally available technologies set a fast pace

Military systems' cost, pace, and inflexibility limit our operational capabilities



DARPA Technical Offices

BTO	DSO	I2O	MTO	STO	TTO
BIOLOGICAL TECHNOLOGIES OFFICE	DEFENSE SCIENCES OFFICE	INFORMATION INNOVATION OFFICE	MICROSYSTEMS TECHNOLOGY OFFICE	STRATEGIC TECHNOLOGY OFFICE	TACTICAL TECHNOLOGY OFFICE
<ul style="list-style-type: none">• Biological Complexity at Scale• Neurotechnologies• Engineering Biology• Restore, Maintain and Improve Warfighter Abilities	<ul style="list-style-type: none">• Math, Modeling & Design• Physical Systems• Human-Machine Systems• Social Systems	<ul style="list-style-type: none">• Empower the Human within the Information Ecosystem• Guarantee Trustworthy Computing and Information	<ul style="list-style-type: none">• Electromagnetic Spectrum• Tactical Information Extraction• Globalization	<ul style="list-style-type: none">• System of Systems (SoS)• Battle Management/Comm and Control (BMC2)• Communications and Networks (C&N)• Electronic Warfare (EW)• Intelligence Surveillance, and Reconnaissance (ISR)• Positioning, Navigation, and Timing (PNT)	<p>System Focus Areas:</p> <ul style="list-style-type: none">• Ground• Maritime• Air• Space <p>Crosscutting Themes:</p> <ul style="list-style-type: none">• Agile development• Cooperative Autonomy• Unmanned Systems• Power and Propulsion

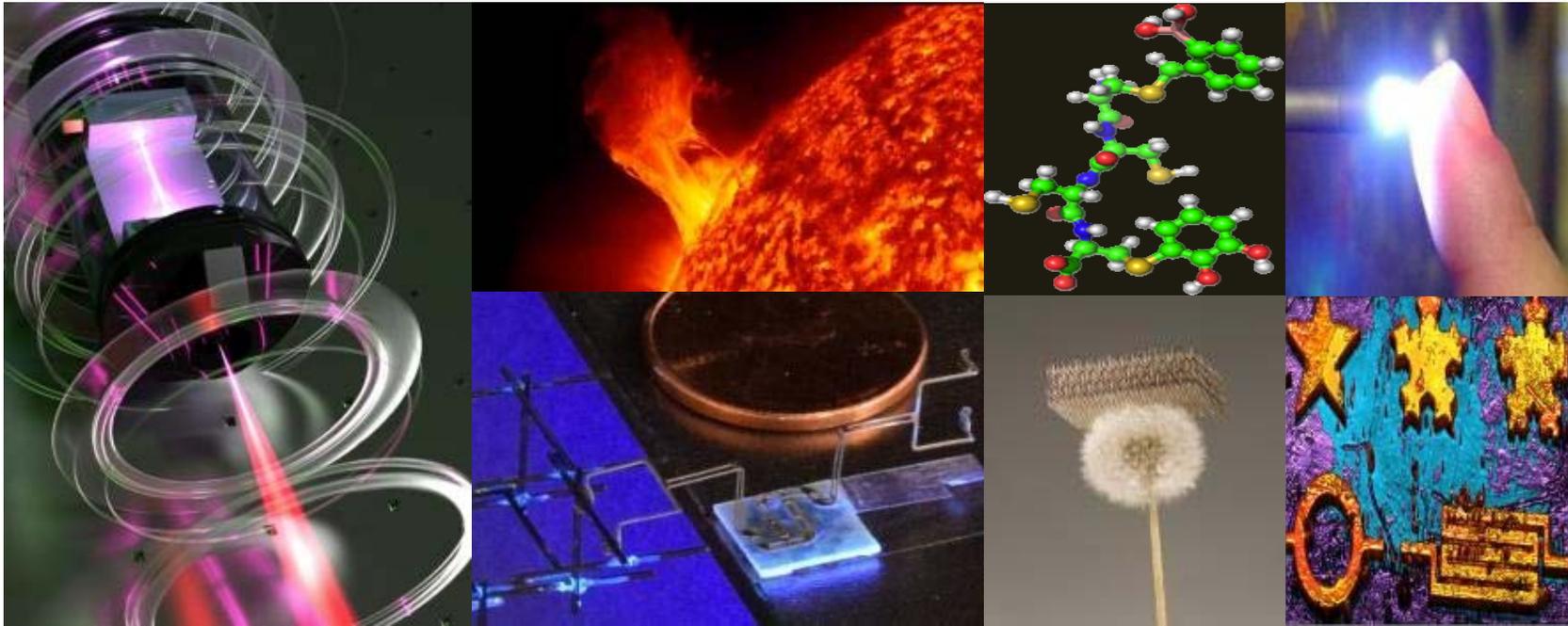


DARPA Technical Offices





DSO is "DARPA's DARPA"



Accelerating breakthrough discoveries to create new enabling technologies for national security



Program Managers



Fariba Fahroo
Mathematics



Michael Maher
Materials & Manufacturing



James Gimlett
Physics



Jan Vandenbrande
Math, Design, & Production Automation



John Paschkewitz
Systems, Design, & Materials



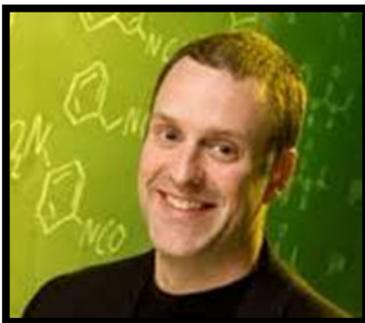
John Main
Material System Innovation



Prem Kumar
Quantum & Nonlinear Optics



Adam Russell
Behavioral/Social Sciences



Tyler McQuade
Chemistry



Predrag Milojkovic
Imaging & Optics
Distribution Statement "A" (Approved for Public Release, Distribution Unlimited)



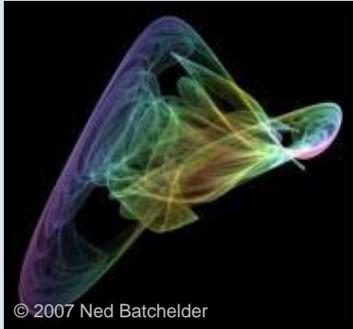
Reza Ghanadan
Complexity Science



Vincent Tang
Applied Physics



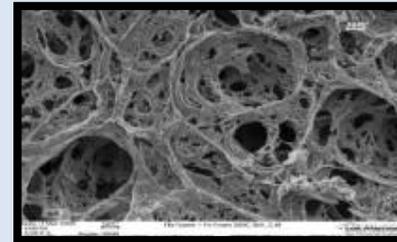
Focus Areas



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Math, Modeling & Design

Physical Systems



Human-Machine Systems



Credit: Detroit Institute of Arts

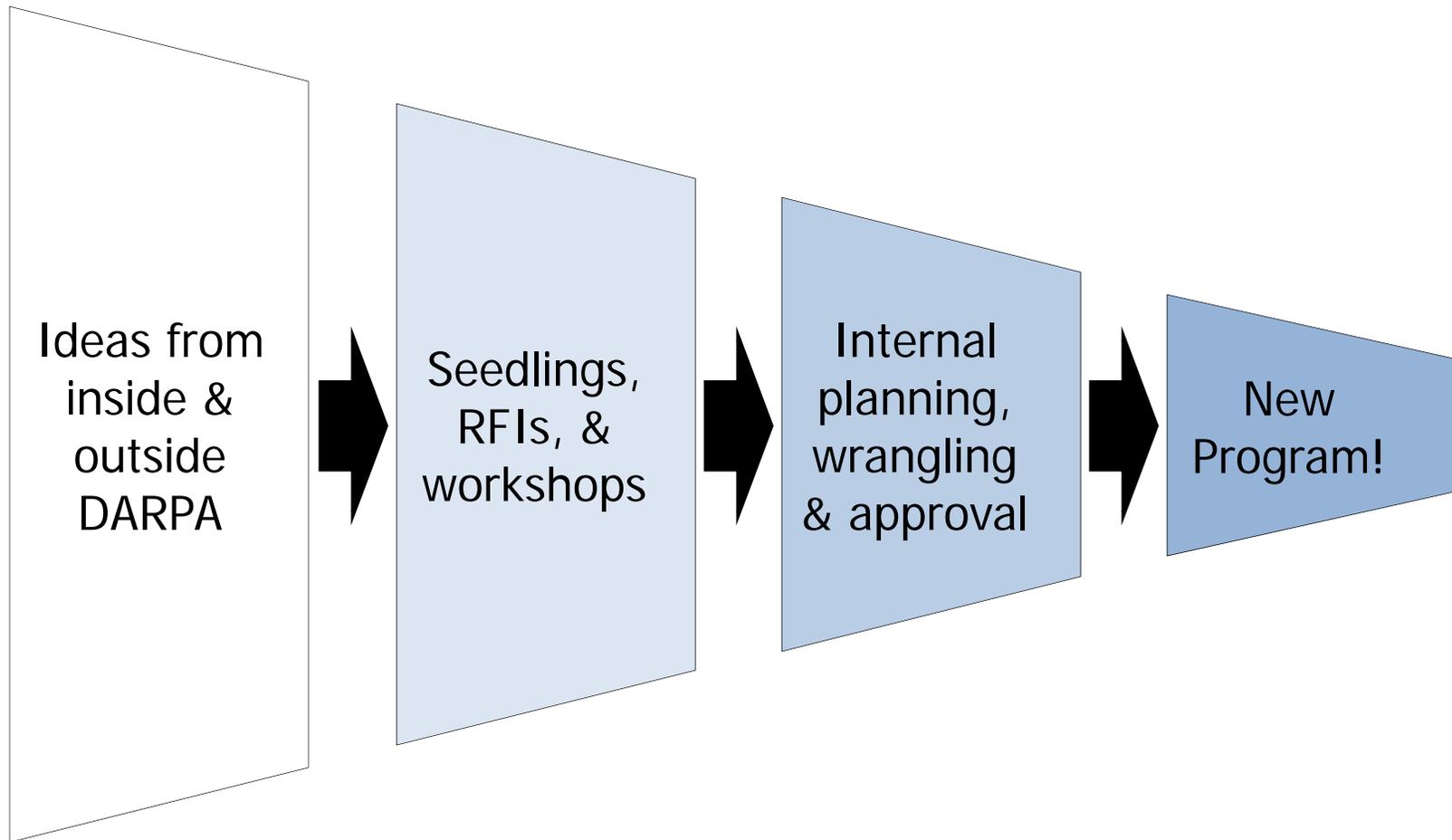
Social Systems



The Economist, April 2012



DARPA Program Gestation





Seedlings vs. Programs



Seedlings

- Usually submitted through DSO Office-Wide BAA
- Small short duration (6-9 months) projects
- Move concepts from “disbelief” to “mere doubt”
- May lead to the next generation of program ideas

Programs

- Proposals solicited through specific DSO program BAAs
- Often multi-year, multi-disciplinary efforts
- Technology development to move from “possibility” to “capability”



Types of Programs



Foundations	Tools	Integrated Demonstrations
<ul style="list-style-type: none">• Monitor and explore scientific frontiers across multiple disciplines to create new communities and capabilities• Mostly measurement and theory	<ul style="list-style-type: none">• Exploit discoveries to develop tools• Translate capability from within a research community to outsiders• Increased focus on use cases and potential CONOPS	<ul style="list-style-type: none">• Bring together multiple lines of research into a new capability, outside the laboratory• Often opportunistic, and/or driven by specific DoD needs



How we think: The Heilmeier Catechism



Important questions to consider when approaching DARPA with ideas:

- What are you trying to do? (no jargon!)
- How does this get done today?
- What is new about your approach?
- If you succeed, what difference do you think it will make?
- How long do you think it will take?
- Can your work transition (to the DoD or others)?
- How much will it cost?



DSO Recent Programs



Materials for Transduction (MATRIX)	Integrate transduction modeling, design and validation into unified R&D approach with applications focus	BAA release: 1/23/2015
Revolutionary Enhancement of Visibility by Exploiting Active Light-fields (REVEAL)	Comprehensive theoretical framework to enable maximum information extraction from complex scenes by using all photon pathways and leveraging light's multiple degrees of freedom	BAA release: 5/22/2015
Make-It	Automated chemical synthesizer that can produce, purify, characterize and scale a wide range of small molecules	BAA release: 6/9/2015
Tailorable Feedstock and Forming (TFF)	Rapid manufacturing of small aerospace composite parts at costs competitive with metal	BAA release: 9/11/2015
Complex Adaptive System Composition And Design Environment (CASCADE)	Design system of systems architectures for resilient response to unexpected situations	BAA release: 11/23/2015
Fundamental Limits of Detection (Detect)	Establish the first-principles limits of photon detection by developing new models, and by testing those models in proof-of-concept experiments	BAA release: 1/21/2016
Improv	Scope emerging threats to military personnel, technology, and operations posed by commercially available technology and products	BAA release: 3/11/2016
Next Generation Social Science (NGS2)	New experimental methods, models, and practices for conducting research into complex social systems	BAA release: 3/18/2016
Intense and Compact Neutron Sources Phase Two (ICONS2)	Revolutionary increases in neutron source intensity and reductions in device size, weight, and power (SWaP) for in-the-field neutron radiography and analytical techniques.	BAA release: 4/28/2016
Accelerated Computation for Efficient Scientific Simulation (ACCESS)	Computational architectures that will achieve the equivalent of petaflops performance in a benchtop form-factor and be capable of what traditional architectures would define as "strong" scaling for predictive scientific simulations of interest	BAA release: 5/6/2016
Transformative Design (TRADES)	Develop/exploit new mathematics to incorporate advanced materials and manufacturing techniques into the design of solid parts and structures	BAA release: 5/11/2016



DSO Recent RFIs



Design of Dynamically Composed System of Systems (RFI)	Analysis and design frameworks for dynamically composed networked system of systems (SoS) architectures	Released 5/26/2015
Extreme Challenges in Optics and Imaging (RFI)	Extreme challenges encompass systems, components, devices, processing schemes, or design/optimization tools that drastically outperform the current state of the art, and expand the limits of what is typically deemed possible using conventional design methodologies	Released 8/24/2015
New Capabilities for Experimental Falsifiability in Social, Behavior, and Economic (SBE) Sciences (RFI)	Develop novel methods, including new tools, platforms, techniques, and/or approaches, that could contribute to the development of unprecedented capabilities for testing the experimental falsifiability of (i.e., disconfirming) models, theories, and hypotheses in SBE sciences	Released 9/1/2015
Design for Advance Materials and Manufacturing (RFI)	Revolutionize design of complex engineered objects, from multifunctional components to entire products (e.g., air, space, marine and transport vehicles)	Released 10/8/2015
Fabrication Technologies for Scalable Production of Extended Solids (RFI)	Scalable techniques for the synthesis of extended solid materials characterized by extensive covalent bond networks	Released 11/16/2015
Open Manufacturing Transition Study (RFI)	Qualification for Additively Manufactured Aircraft Components	Released 3/23/2016
Theoretical Foundations for the Design of Collective Human-Machine Systems (RFI)	Foundational, quantitative theories for the analysis and design of human-machine systems	Released 4/15/2016
Nanoweaving (RFI)	Assessing the state of the art in nanoweaving and nanobraiding	Released 5/11/2016
Fundamental Limits of Learning (RFI)	What are the fundamental limitations inherent in machine learning systems?	Released 5/12/2016



Some Recent Seedlings



Understanding Dynamical Systems in High-Dimensional Parameter Spaces

Extended Transport of Long Wavelength Radiation in Air Waveguides

Data-driven Inverse Design Paradigm for Part Qualification in Additive Manufacturing

High-Speed Plasma Science to Enable Advanced Radiation Devices

Engineering Self-Organizing Systems

Investigating Novel Geometric Representations for Computational Fabrication

Maximizing Direct Electrical Power Generation from Ionizing Radiation

New Strategies for Prediction and Data Assimilation for Turbulent Dynamical Systems

Mitigating the Curse of Dimensionality Using Sparse Grids

Ultrasonic Fourier Computing for Ultrafast Solver for the Vlasov Equation

Biologically Inspired Automata



Three Ways to Engage with DSO

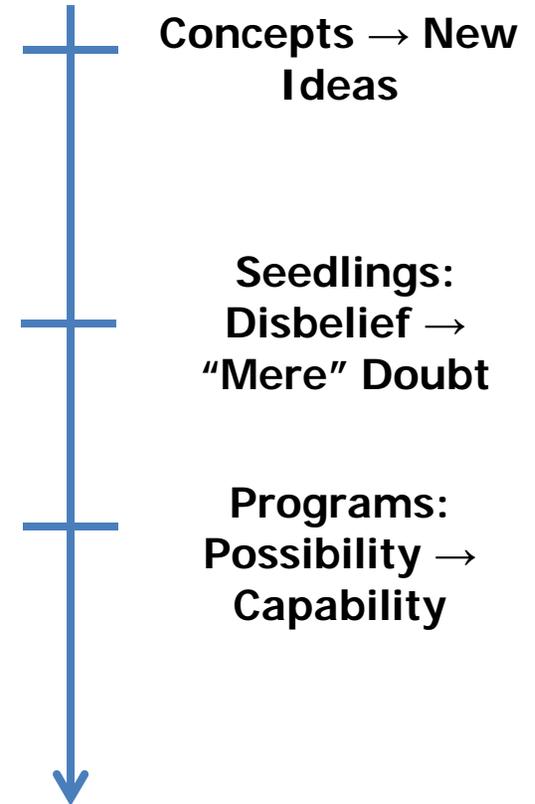


Talk to a Program Manager (PM)

- PMs here today and tomorrow
- Email/phone/face to face throughout the year

Submit ideas to the DSO Office-Wide BAA (BAA-16-46)

Respond to DSO program BAAs



Find DARPA announcements at www.darpa.mil, www.fedbizopps.gov
and www.grants.gov



We look forward to your ideas



www.darpa.mil