Optics and Photonics: Background

• Harnessing Light: Optical Science and Engineering for the 21st Century, published in 1998 (NRC)
• Optics and Photonics: Essential Technologies for Our Nation (“Harnessing Light II”), published in 2013 (NRC)
• MPSAC Subcomittee on Optics and Photonics formed and charged in late 2012 / early 2013 (Tony Heinz, Columbia University, subcommittee chair); MPSAC approved and published report in July 2014
• OSTP/NSTC FTAC on O&P chartered in April 2013 report conveyed to OSTP in September 2013; recommendations report published in April 2014
• Joint MPS-ENG-CISE DCL on O&P prepared and published in July 2014
FTAC-OP: Background

- NSTC/CoS/PSSC chartered the FTAC-OP to respond to the National Research Council’s (NRC) report, Optics and Photonics, specifically “to identify opportunities for Federal investment and interagency cooperation in basic and early applied research.”
- FTAC-OP members represented NIST, DOD (many parts), DOE, NASA, HHS (NIH and FDA), and NSF
- FTAC-OP
  - met weekly between May and September
  - hosted subject matter experts within the Federal Government, from academe, and from the private sector
  - final guests were the five sponsoring societies of the National Photonics Initiative (NPI): SPIE, OSA, LIA, IEEE/Photonics, and APS
- Committee recommendations fell into two broad categories:
  - Research Opportunities
  - Capability Opportunities
Mapping of the FTAC-OP recommendations the NRC’s Grand Challenge Questions (top) and national priorities (bottom). The relative sizes of the boxes indicate the FTAC-OP prioritization, and the relative thickness of the connecting lines indicates the strength of the relationship.
FTAC-OP Prioritized Research Recommendations

- **(A1) Biophotonics to Advance Understanding of Systems Biology and Disease Progression**
  - Support fundamental research in innovative biophotonics to enable advances in quantitative imaging, systems biology, medicine, and neuroscience; in vivo validation of biomarkers that advance medical diagnostics, prevention, and treatment; more efficient agricultural production

- **(A2) From Faint to Single Photonics**
  - Develop optics and photonics technologies that operate at the faintest light levels

- **(A3) Imaging through Complex Media**
  - Advance the science of light propagation and imaging through scattering, dispersive, and turbulent media

- **(A4) Ultra-Low-Power Nano-Optoelectronics**
  - Explore the limits of low energy, attojoule-level photonic devices for application to information processing and communications
FTAC-OP Prioritized Capabilities Recommendations

• (B1) Accessible Fabrication Facilities for Researchers
  - Determine the need of academic researchers and small business innovators for access to affordable domestic fabrication capabilities to advance the research, development, manufacture, and assembly of complex integrated photonic-electronic devices

• (B2) Exotic Photonics
  - Promote research and development to make compact, user-friendly light sources, detectors, and associated optics at exotic wavelengths accessible to academia, national laboratories, and industry

• (B3) Domestic Sources for Critical Photonic Materials
  - Develop and make available optical and photonic materials critical to our Nation’s research programs, such as infrared materials, nonlinear materials, low-dimensional materials, and engineered materials
Subcommittee Membership

David Awschalom
Liew Family Professor in Molecular Engineering, University of Chicago

James Beletic
Vice President, Space and Astronomy, Teledyne Scientific and Imaging Corporation

Philip Bucksbaum
Marguerite Blake Wilbur Professor in Natural Science, Stanford University

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Professor of Chemistry and Physics, University of Michigan
Scientific Frontiers of Optics and Photonics (MPSAC SC)
Priorities and Research Directions

1. Plasmonics and nanophotonics: controlling optical fields and propagation on the nanoscale
2. Coherent electromagnetic fields: attosecond time scales and x-ray photon energies electromagnetic
3. Optomechanical interactions: from single-molecule mechanics to macroscopic quantum states
4. Seeing beyond the diffraction limit and new imaging modalities
5. Creating and controlling quantum coherence with light
6. Controlling molecules with light and light with molecules
7. Observing the universe: optics and photonics for astronomy and astrophysics
NSF Dear Colleague Letter on Optics and Photonics

• Published on July 16, 2014
• Partnership among MPS, ENG, and CISE
• Identifies two subtopics of special interest to NSF
  – light-matter interaction at the nanoscale... plasmonics, and quantum phenomena
  – novel terabit/second and faster communication systems