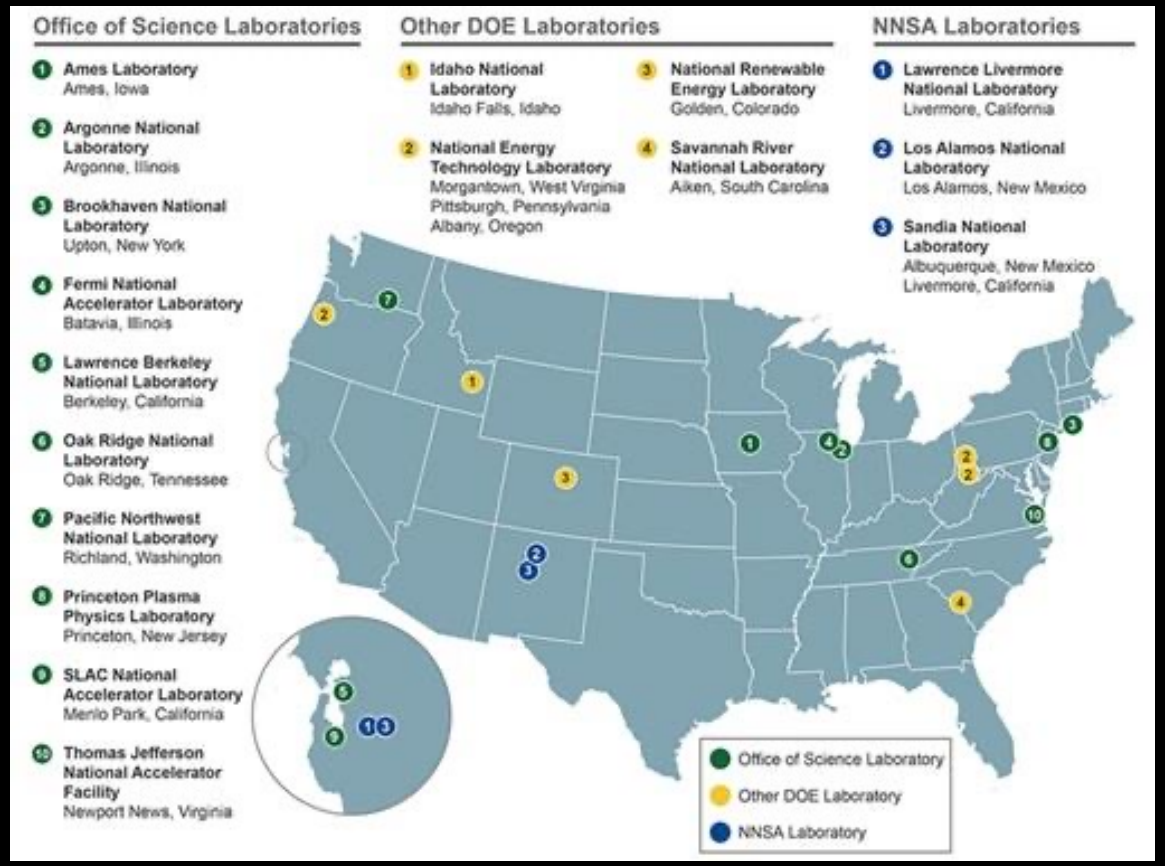
DETECTOR R&D in the US

Daniela Bortoletto

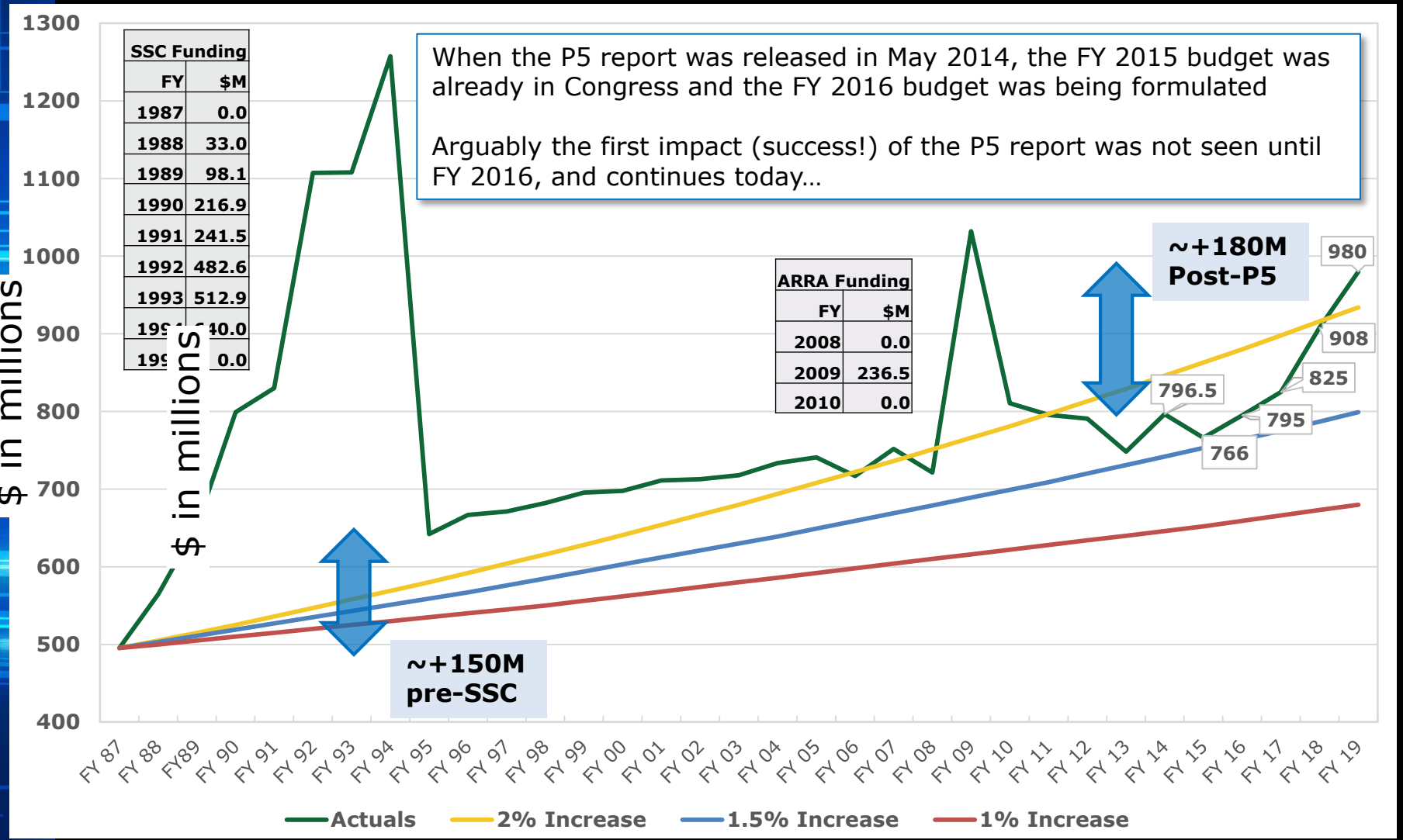
PP funding in the US

- Supported by two funding agencies DOE and NSF
- DOE
  - "to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions."
  - Manages seventeen national laboratories
  - Supporting most universities doing PP in the US
  - DOE budget $38 billion FY20
    - Office of science $7 billion FY20
    - HEP $1.04 billion FY20
- NSF EPP: $17.3 M in FY19 + MREFC funding for ATLAS and CMS upgrades



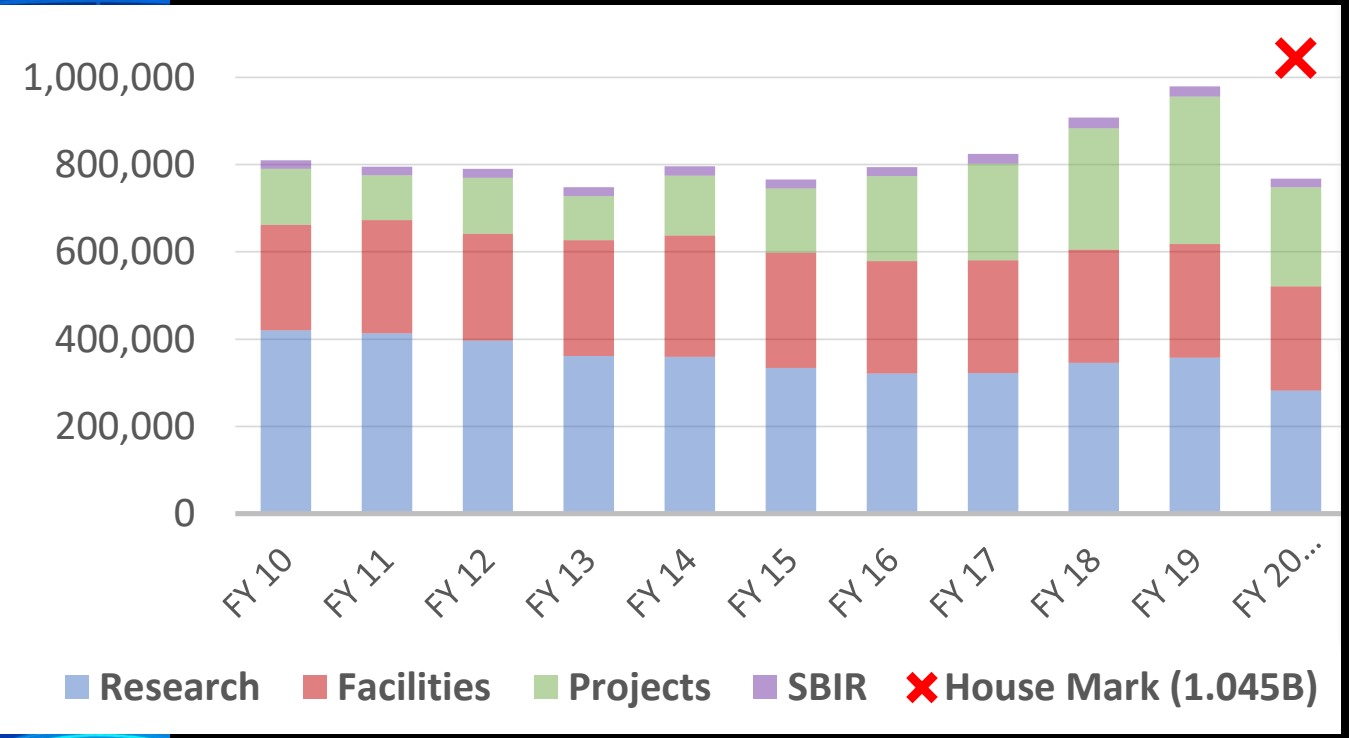
Evolution of HEP DOE Budget

P5 Report



Muon g-2, CMS Upgrade, ATLAS Upgrade, LSSTcam, Mu2e, LZ, SuperCDMS-SNOLAB, DESI

Challenges



- Since P5 report, profiles for high-priority projects recommended by P5 continue to ramp up
- Research funding facing pressure even if overall HEP budget rises
- Detector R&D
  - "Generic R&D" funded by KA25 about $25M/year (~2.5% of DOE HEP budget)
  - Project specific directed R&D

Sources of instrumentation funding

- Universities
  - Funding opportunity announcements (FOAs) for KA25
  - Project funding
  - Early Career Awards (~5 $5M/5 years)

- Labs
  - Field Work Proposals for KA25
  - Project funding
  - Early Career Awards
  - Laboratory Directed Research and Development (LDRD- 2% of lab base funds)

- Companies
  - Small Business Innovation Research (SBIR)
  - Small Business Technology Transfer (STTR)
- *Phase I.* Establish technical merit, feasibility, and commercial potential of R&D $50,000 - $250,000
- *Phase II.* Continue the R/R&D - $750,000 for 2 years.
- *Phase III.* Small business pursues commercialization objectives. The SBIR/STTR programs do not fund Phase III.

Sources of instrumentation funding

- Universities
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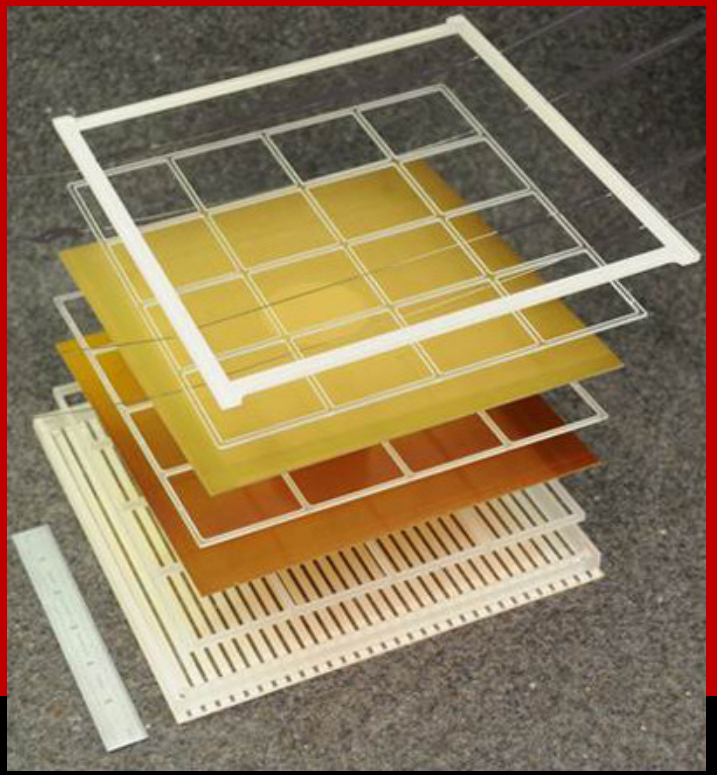
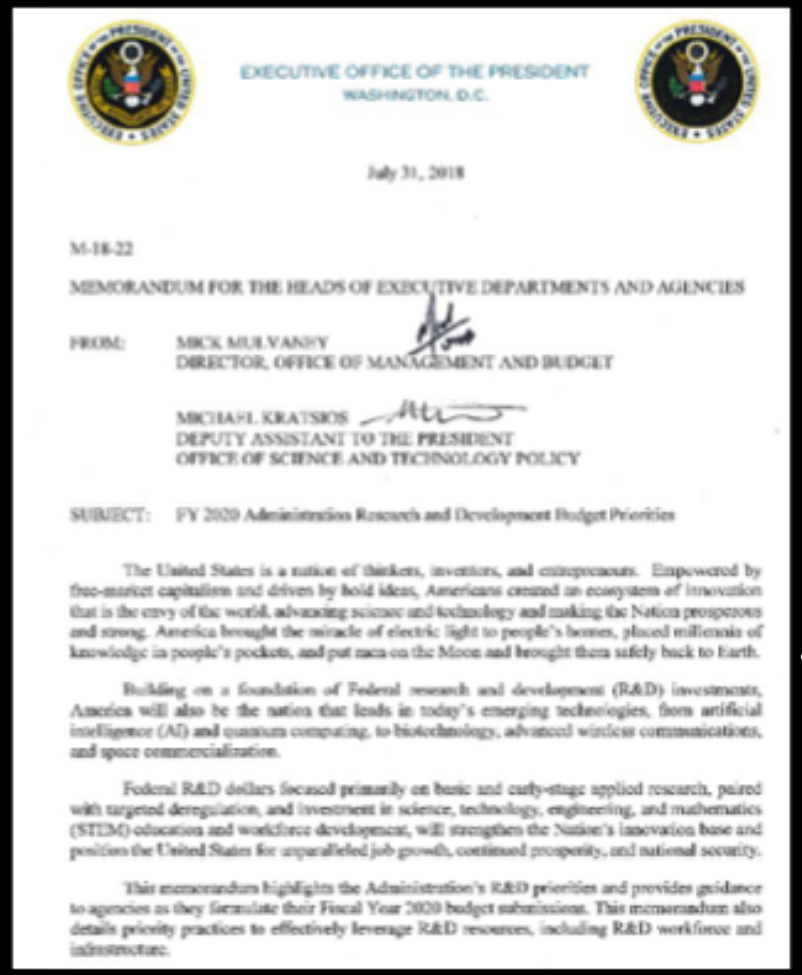
- Labs
  - Field Work Proposals for KA25
  - Project funding
  - Early Career Awards
  - Laboratory Directed Research and Development (LDRD- 2% of lab base funds)
- Development of large area photodetectors LAPD (Arradiance, Argonne, Incom Inc etc.)



Funding Opportunity Announcements

- Top-down



EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C.

July 31, 2018

M-18-22

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: MICK MULVANEY
DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

MICHAEL KRATSIOS
DEPUTY ASSISTANT TO THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: FY 2020 Administration Research and Development Budget Priorities

The United States is a nation of thinkers, inventors, and entrepreneurs. Empowered by free-market capitalism and driven by bold ideas, Americans created an ecosystem of innovation that is the envy of the world, advancing science and technology and making the Nation prosperous and strong. America brought the miracle of electric light to people's homes, placed millennia of knowledge in people's pockets, and put men on the Moon and brought them safely back to Earth.

Building on a foundation of Federal research and development (R&D) investments, America will also be the nation that leads in today's emerging technologies, from artificial intelligence (AI) and quantum computing, to biotechnology, advanced wireless communications, and space commercialization.

Federal R&D dollars focused primarily on basic and early-stage applied research, paired with targeted deregulation, and investment in science, technology, engineering, and mathematics (STEM) education and workforce development, will strengthen the Nation's innovation base and position the United States for unparalleled job growth, continued prosperity, and national security.

This memorandum highlights the Administration's R&D priorities and provides guidance to agencies as they formulate their Fiscal Year 2020 budget submissions. This memorandum also details priority practices to effectively leverage R&D resources, including R&D workforce and infrastructure.

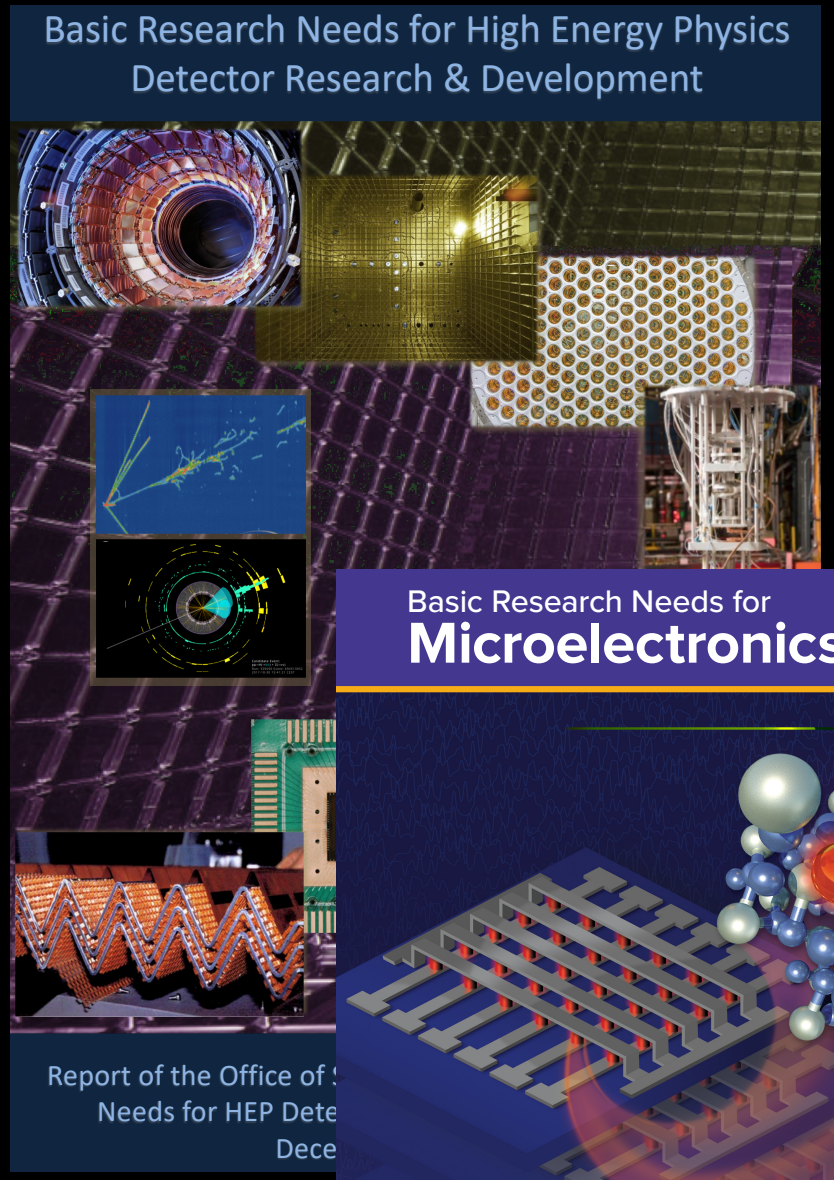
- **Priority R&D Areas**
  - "Security for the American people" — emphasizing military superiority, cyber security, border surveillance and weather prediction;
  - **Artificial intelligence, quantum information sciences and strategic computing;**
  - Communications connectivity and autonomy of driving and unmanned vehicles;
  - **Next generation manufacturing, including digital manufacturing, robotics, industrial Internet of Things, machine learning and AI;**
  - Space exploration, including research into long-duration spaceflight, in-space manufacturing, cryogenic fuel storage, space-related power and propulsion;
  - "American Energy Dominance";
  - Medical innovation — personalized medicine, disease prevention, health promotion and translation, veteran health care and aging populations; and,
  - Agriculture, including precision agriculture, aquatic technologies and input minimization and yield maximization.
- **Priority R&D Practices:**
  - **Support educating & training workforce in STEM fields**
  - **Managing and modernizing the R&D infrastructure**
  - Improve interagency coordination and cross-disciplinary collaboration
  - Increase technology transfer
  - **Facilitate industry-academia partnerships.**

Quantum Information Science (QIS)

- **HEP-QIS Sub Program**
  - Forge new routes to scientific discovery along the HEP mission and P5 science drivers invoking interdisciplinary advances in QIS
  - Contribute to QIS using expertise, techniques, and technology developed in HEP community
  - Develop effective interdisciplinary consortia that positively impact both HEP and QIS fields
- **Quantum Information Science Enables Discovery (QuantISED) for HEP FOA**
  - FY18 specific HEP awards (~ $18M)
  - FY19 QIS funds ~ $27M

Funding Opportunity Announcements

- Bottom up through Basic Research Needs (BRN) studies as start of process to develop new HEP initiatives
  - DOE Basic Research Needs Study on High Energy Physics Detector Research and Development (HEP instrumentation BRN)
  - Basic Research Needs Workshop for Dark Matter Small Projects New Initiatives
  - Basic Research Needs Workshop for Microelectronics
- The 2020 Updated Roadmaps for the U.S. Magnet Development Program
- Quantum Sensors at the Intersections of Fundamental Science, Quantum Information Science & Computing



Impact of the HEP Instrumentation BRN

Lab Microelectronics initiative: Multiple SC program offices issued a joint DOE National Laboratory Program Announcement focused on multi-disciplinary co-design approaches to basic research that could enable transformative innovation in microelectronic technologies for sensing, communication, and computing.

MICROELECTRONICS CO-DESIGN RESEARCH

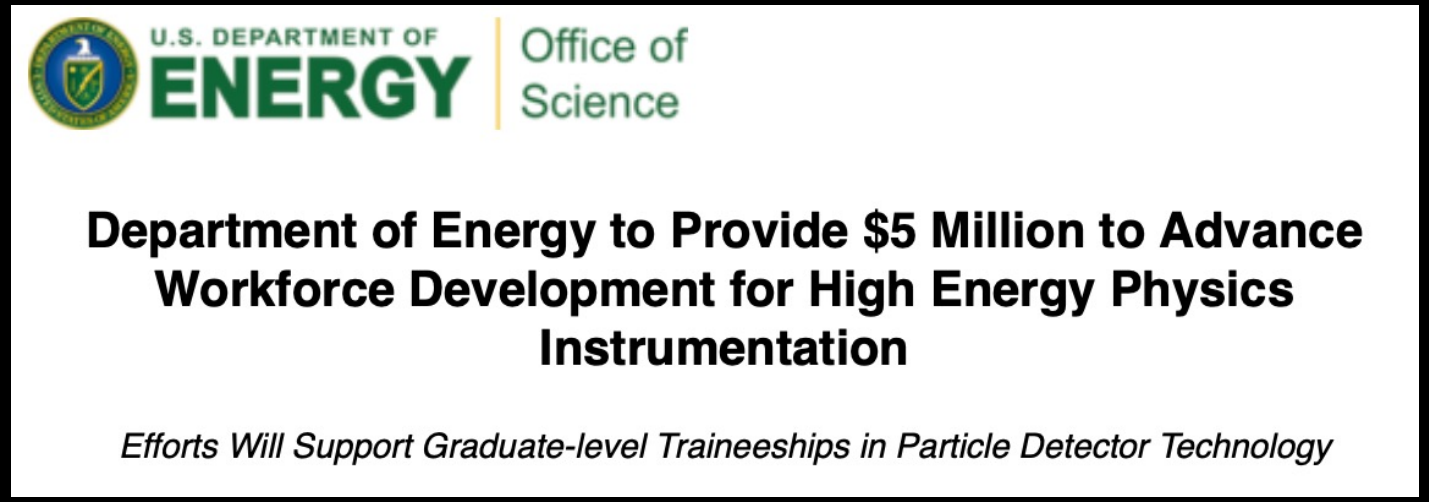
DOE NATIONAL LABORATORY PROGRAM ANNOUNCEMENT NUMBER: LAB 21-2491

24 March, 2021

HEP BRN shaped OHEP participation in the Lab Microelectronics initiative with some of the research areas called out, driven by the findings of the BRN.

Impact of the HEP Instrumentation BRN

Following the recent HEP Instrumentation BRN (and the 2014 HEPAP Workforce report) HEP issued an Instrumentation Traineeship FOA to support graduate student training in the areas of sensors, front-end electronics and data acquisition, and systems design and engineering; modeled closely after the Accelerator Traineeship FOA.



1 April, 2021

https://science.osti.gov/hep/Funding-Opportunities?utm_medium=email&utm_source=govdelivery

The report has already been influential inside the Office of Science. To further increase the impact of the report we are preparing a BRN brochure, will organize a community letter writing campaign (with APS), and work with the FNAL-UEC to carry the report message to Washington.

R&D coordination in the US

- Loosely organized through the DPF Coordinating Panel for Advanced Detectors (https://cpad-dpf.org)
  - Yearly workshops
  - DPF Instrumentation Award
  - DPF Instrumentation Early Career Award

- Very envious in the US about a dedicate R&D programme like AIDA.
- I joined AIDA-2020 as soon as I moved to the UK!