U.S. DEPARTMENT OF ENERGY | Office of Science

High Energy Physics Research Status

HEPAP Meeting
July 9, 2019

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Research & Technology Division Director
Office of High Energy Physics
Office of Science, U.S. Department of Energy

Overview

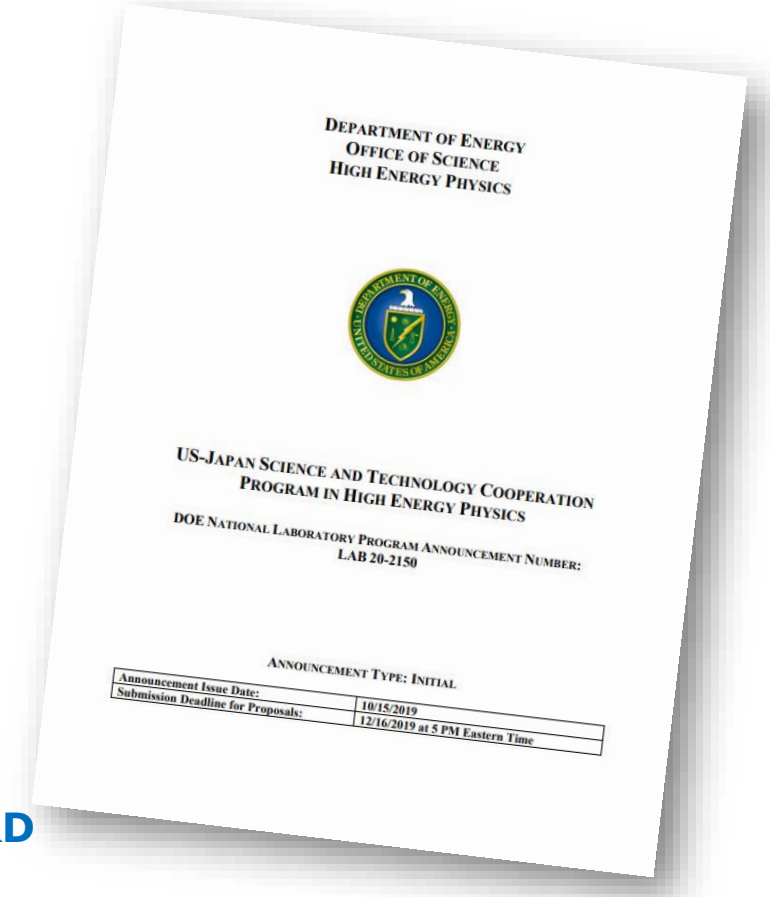
- COVID impacts on HEP Research Program
- Status Reports on HEP Funding Opportunities and Lab Calls:
  - US-Japan programs
  - HEP Comparative Review (including AI/ML)
  - Early Career Research (including AI/ML)
  - HEP-QIS
  - Accelerator Stewardship
  - SBIR/STTR
- Other Research support:
  - Small projects
  - SCGSR and Workforce Development programs
- Comings and Goings

COVID-19 HEP Research Program Impacts

- We are doing everything we can to ensure continuity of research programs:
  - Additional DOE flexibility in awards (see Harriet Kung's presentation)
  - Support for staff on ongoing awards continues, subject to university policy
  - Proposal submission, review, awards continue (remotely)
  - Lab research reviews (Energy, Cosmic) deferred to FY21
  - Experiment operations reviews (e.g., Mu2e, Belle II, DESI) delayed ~few months and made virtual
  - **Prioritized funding for continuing junior research staff**
- Some delays, but still expect 200+ award actions, as in a normal year
- Planning for FY 2021 is starting
- HEP Program staff have done an outstanding job!

FY 2020 U.S.-Japan Program

- National Lab Program Announcement (NLA), "US-Japan Science and Technology Cooperation Program in High Energy Physics" [LAB 20-2150], for the FY 2020 US-Japan cooperative R&D program was issued October 15, 2019
  - Marked the 4th round of joint US-Japan call for proposals
- Research areas supported:
  - R&D to enhance the physics yield of current or future HEP experiments
  - Accelerator Science and Technology R&D
  - Detector R&D for HEP
  - Workshops, conferences and/or travel to incubate and develop new concepts
- NOT supported:
  - ILC cost-reduction R&D (there is a separate funding mechanism for this)
  - Proposals that do not involve significant U.S.-Japan collaboration
  - Theoretical research, except via workshops as noted above
  - Scientific staff. Support for engineering or technical staff ok.
- 2020 Results:
  - Received 29 proposals on U.S.-side (8 Japan-only)
  - **Funded 23 proposals, totaling nearly $1.9M: 14 GARD, 5 IF, 4 Det. R&D**



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HIGH ENERGY PHYSICS

US-JAPAN SCIENCE AND TECHNOLOGY COOPERATION PROGRAM IN HIGH ENERGY PHYSICS

DOE NATIONAL LABORATORY PROGRAM ANNOUNCEMENT NUMBER: LAB 20-2150

ANNOUNCEMENT TYPE: INITIAL

Announcement Issue Date:	10/15/2019
Submission Deadline for Proposals:	12/16/2019 at 5 PM Eastern Time

US-Japan Student Exchange Program

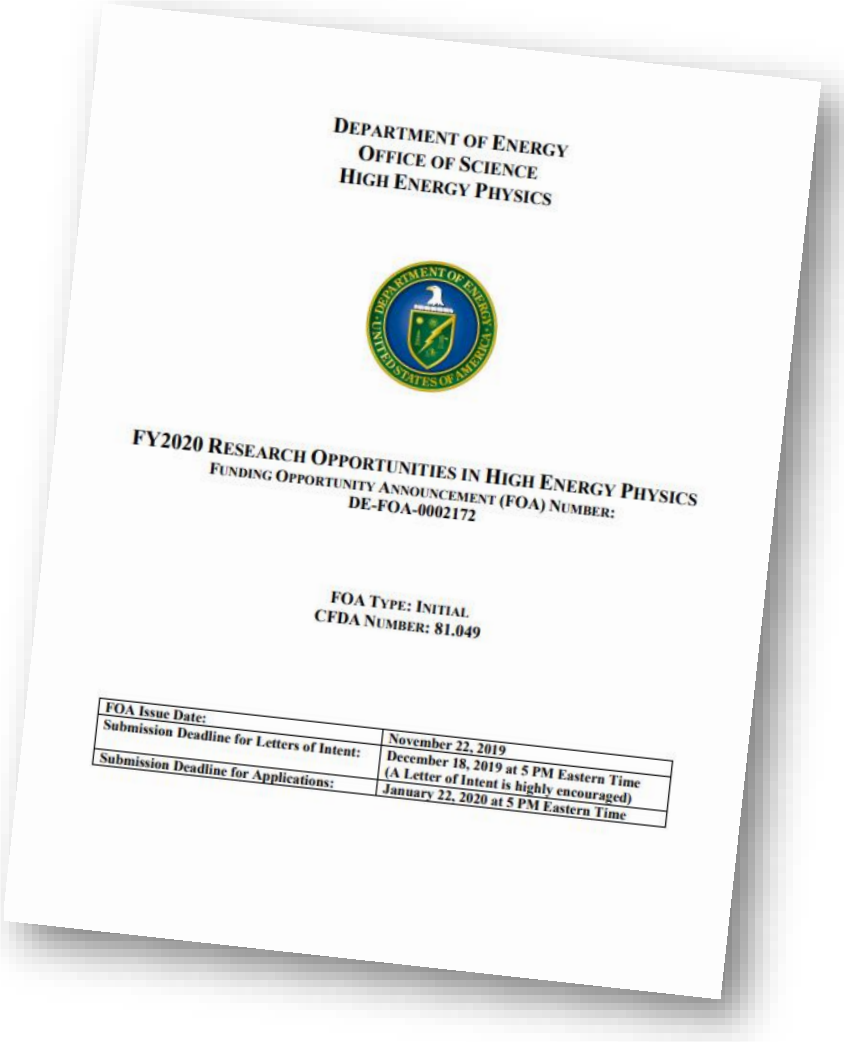
- Strengthens US-Japan scientific collaboration by facilitating greater cooperation in projects of mutual benefit to Japan and the U.S. in the areas of accelerator and particle physics. Each year, up to five proposals will be selected in the U.S. and up to five in Japan.
  - Graduate students enrolled in US Physics PhD programs are eligible to submit a proposal to conduct HEP research or technology R&D in Japan
  - The duration of the award is for a three- to twelve- month period
  - The award will provide travel, housing and cost of living expenses stipend for the stay in Japan. Tuition will be the responsibility of the students and their home institution

- In 2019:
  - 2 students were selected from Japan to visit U.S.
  - 4 students were selected from U.S. to visit Japan
- 2020 Program:
  - 8 applications to U.S. side, 5 recommended
  - 3 applications to Japan side, 3 recommended
  - **All recommended applications were approved at the Joint selection meeting in January 2020**

FY 20 HEP Comparative Review Outcomes

FY 2020 Research Opportunities In High Energy Physics [DE-FOA-0002172] closed on 1/22/2020

- 158 proposals submitted, 137 reviewed
  - 15 non-compliant, 6 duplicates
  - 14 Non-compliant proposals are "New" proposals
- 83 proposals funded through 78 awards
  - Includes 5 merged into other awards and 14 funded in FY 2021
  - 54 declined; ~60% success rate
- Additional award statistics:
  - 23 new awards
  - 20 multi-thrust (umbrella) awards
  - 60 different institutions in 28 states
  - 20% of award PIs are women
- Numbers of funded research thrusts (by sub-program):
  - 22 Cosmic, 22 Energy, 24 Intensity, 8 GARD, 13 Detector, 33 Theory
  - PI counts of individual research thrusts range from 1-10
- **Total funding $132 M, including $43.1M in FY 2020**



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FY2020 RESEARCH OPPORTUNITIES IN HIGH ENERGY PHYSICS
FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER:
DE-FOA-0002172

FOA TYPE: INITIAL
CFDA NUMBER: 81.049

FOA Issue Date:	November 22, 2019
Submission Deadline for Letters of Intent:	December 18, 2019 at 5 PM Eastern Time (A Letter of Intent is highly encouraged)
Submission Deadline for Applications:	January 22, 2020 at 5 PM Eastern Time

Artificial Intelligence & Machine Learning in SC

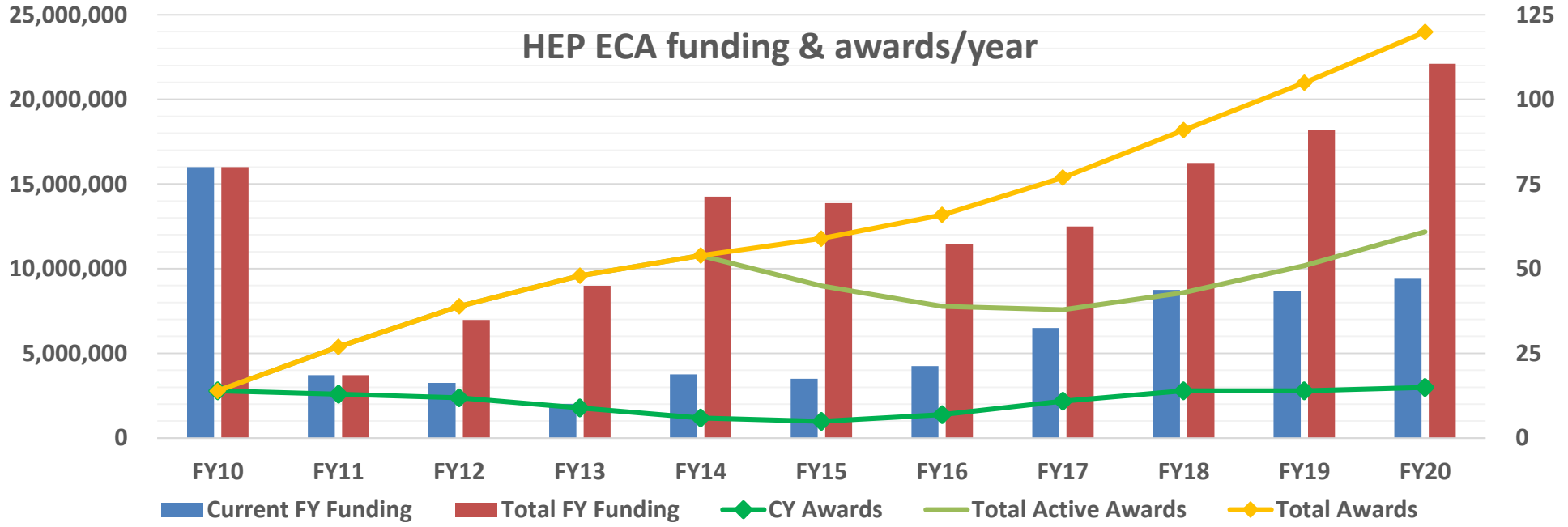
- The President has placed a high priority on American leadership in the Industries of the Future (IOTF):
  - artificial intelligence (AI), quantum information science (QIS), advanced manufacturing, biotechnology, and 5G/advanced wireless technologies
- As part of the AI initiative, the FY20 appropriation included $71M in AI funding for SC
  - SC has prioritized investments in AI/ML for user facilities focusing on accelerator optimization, control, prognostics, and data analysis
- On March 9, 2020, SC released a lab funding announcement on Data, Artificial Intelligence, and Machine Learning at DOE Scientific User Facilities
  - The application deadline was May 1, 2020
  - The proposals are under review; awards expected to be announced in August 2020
  - HEP is participating in this lab call with BES and NP

Artificial Intelligence & Machine Learning in HEP

- FY 2020 HEP budget includes $15M for AI/ML as part of Theoretical, Computational, and Interdisciplinary Physics to:
  - Tackle the challenges of managing increasingly high volumes and complexity of experimental and simulated data across the HEP experimental frontiers, theory, and technology thrusts
  - Address cross-cutting challenges across the HEP program in coordination with DOE investments in exascale computing and associated AI efforts
- Since AI/ML techniques are already widely used in many areas of HEP, for FY20 HEP has prioritized identifying key AI/ML activities in:
  - Ongoing DOE lab research programs ($9.7M, including some existing Early Career)
  - New and renewal applications under its standard FOAs and lab calls, including HEP Comparative Review ($3.7M), and new Early Career Research awards ($1.6M)

Increasing Investments to Early Career Research Program

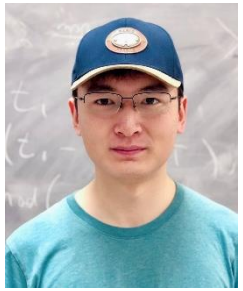
- Launched in FY 2010 with ARRA funding https://science.osti.gov/early-career
- Established Program to Stimulate Competitive Research (EPSCoR) supported 1 Theory ECA in FY 2011, 1 Intensity ECA in FY 2013, and 1 Cosmic in FY 2020
- Funding nadir was FY 2013, the first year impacted by sequestration
- Full-funding requirement took affect in FY 2014 (awards < $1M)
- 120 total HEP awards to date: 71 University and 49 National Labs
- **In FY 2020, 15 awards (10 Univ, 5 Lab) is the largest cohort in a single year**



FY 2020 HEP Early Career Awards: Univ.

- Jonathan Asaadi, U. Texas Arlington^
  - Discovery Science with New Multi-modal Pixel-based Noble Element Time Projection Chambers
- Javier Duarte, U. California San Diego*
  - Real-Time Artificial Intelligence for Particle Reconstruction and Higgs Physics
- Heather Gray, U. California Berkeley*
  - Probing the Flavor Dependence of Higgs Couplings with Charm Tagging
- Luchang Jin, U. Connecticut*
  - Lattice Calculation of the QED Corrections to Meson Leptonic Decay
- Hugh Lippincott, U. California Santa Barbara
  - HydroX: Using Hydrogen Doped in Liquid Xenon to Search for Dark Matter




*** First HEP Early Career Awards at these Institutions**

^ First HEP Early Career Award in Detector R&D at a University

FY 2020 HEP Early Career Awards: Univ.

- Michael Mooney, Colorado State U.*
  - Constraining the Electromagnetic Shower Energy Scale at LArTPC Neutrino Detectors Near and Far
- Lado Samushia, Kansas State U.#
  - Robust Dark Energy Constraints with Dark Energy Spectroscopic Survey
- Louise Skinnari, Northeastern U.
  - Exploring the Energy Frontier through Precision Tests and Fast Tracking with the CMS Detector
- Douglas Stanford, Stanford U.
  - Quantum Black Holes and Wormholes
- Michael Troxel, Duke U.
  - Accurate Dark Energy Constraints via the Precise Characterization of Galaxy Intrinsic Alignment Coupled with Shear and Redshift Interference

*** First HEP Early Career Awards at these Institutions**

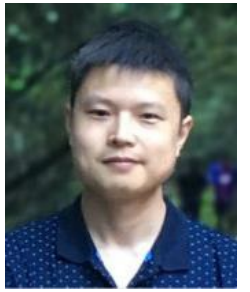
 # Also funded by DOE Established Program to Stimulate Competitive Research

FY 2020 HEP Early Career Awards: Labs

- Robert Ainsworth, FNAL*
  - Ensuring Bunch Stability in Multi-MW Beams
- Laura Fields, FNAL
  - Precision Neutrino Fluxes for LBNF/DUNE
- Jonathan Jarvis, FNAL*
  - Next-Generation Beam Cooling and Control with Optical Stochastic Cooling
- Brendan O'Shea, SLAC*
  - Improving Accelerators with Diagnostics Optimized for Artificial Intelligence
- Tong Zhou, LBNL*
  - Multi-kHz Laser-plasma Accelerator Driven by Spectrally Combined Fiber Laser







*** 4 Accelerator R&D awards (also a record!)**

Quantum Information Science (QIS)

- HEP QIS budget in FY20 ($38.5M) supports:
  - Multidisciplinary SC Quantum Information Science (QIS) Research Centers in support of the National Quantum Initiative
  - HEP QIS research program, Quantum Information Science Enabled Discovery (QuantISED)
- QuantISED topics are aligned to OSTP QIS categories
  - QuantISED is coordinated with and reports to SC, DOE, and OSTP
- HEP competed QuantISED in FY18 and FY19 and seeded HEP-QIS interdisciplinary research at Labs and Universities
  - FY20 Lab plan: Consolidate FY18-initiated programs for three-year efforts through peer-reviewed renewal proposals, totaling about $14M/year for three years. The Lab programs engage multiple university collaborators.
  - FY20 University consortia renewal proposals focused on the subcategories identified in research above; HEP recommended five university awards totaling about $3M/year for three years
  - We expect FY19 awards to apply for renewals next year
- The SC QIS PI meeting that was planned for March 2020 has been postponed to 2021 and will include the SC QIS Research Centers, once they are announced

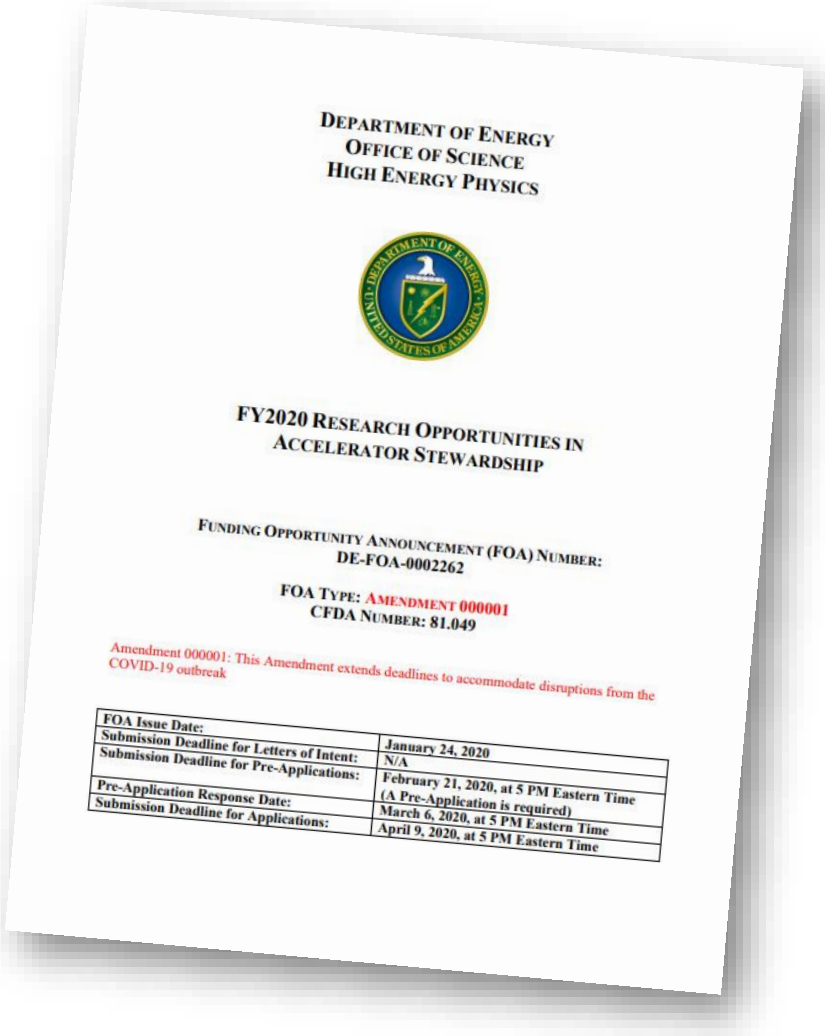
QuantISED Topics

QuantISED Research
- Cosmos & Qubits & Foundational HEP-QI-QC
- Quantum Computing for HEP Experiment
- QIS Based Experiments for P5 Science Drivers

QuantISED Res Technology
- Quantum Sensors
- Quantum Communications
- Quantum Controls, readouts, FPGAs

Accelerator Stewardship

- FY2020 Research Opportunities in Accelerator Stewardship [DE-FOA-0002262, LAB 20-2262]
  - Amendment extended deadline to accommodate disruptions from the COVID-19 outbreak; Proposals were due April 9, 2020
- This year's FOA included new topics from the 2019 Compact Accelerators BRN, which received a strong community response
  - Track 1: Accelerator Stewardship Topical Areas
    - a) Particle Therapy Beam Delivery Improvements
    - b) Ultrafast Laser Technology Program
    - c) High Power Electron Accelerator Technology for Industrial Applications
    - d) Compact Accelerator Technologies for Security and Medicine
  - Track 2: Long-Term Generic Accelerator R&D
  - Track 3: Accelerator Stewardship Test Facility Program
- 14 programs participated as stakeholders this year from DOE, DOD, DHS, NIH, and NSF
- **FY 2020 Accelerator Stewardship FOA is under review with decisions expected by August—stay tuned!**



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FY2020 RESEARCH OPPORTUNITIES IN ACCELERATOR STEWARDSHIP

FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER:
DE-FOA-0002262

FOA TYPE: AMENDMENT 000001
CFDA NUMBER: 81.049

Amendment 000001: This Amendment extends deadlines to accommodate disruptions from the COVID-19 outbreak

FOA Issue Date:	January 24, 2020
Submission Deadline for Letters of Intent:	N/A
Submission Deadline for Pre-Applications:	February 21, 2020, at 5 PM Eastern Time (A Pre-Application is required)
Pre-Application Response Date:	March 6, 2020, at 5 PM Eastern Time
Submission Deadline for Applications:	April 9, 2020, at 5 PM Eastern Time

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Program

- FY 2020 Phase I (R2) closed 2/24/2020
  - FY 2019 decrease in awards due to an increase in maximum award amount from $150K to $200K
  - Proposal volume trends with number of published subtopics
  - Number of awards depends on budget (statutory)
- FY 2020 Phase II (R2) closed 4/21/2020
  - Phase II proposal volume fluctuates; number of sequential proposals unpredictable
  - FY 2020 proposal decrease due to decreased FY19 Phase I awards; also option to defer Phase II proposals one year
  - Number of awards depends on budget (statutory)

FY 2020 HEP Topic Areas:

- Advanced Concepts and Technology for Particle Accelerators
- Radio Frequency Accelerator Technology
- Laser Technology R&D for Accelerators
- Superconductor Technologies for Particle Accelerators
- High Energy Physics Electronics
- High Energy Physics Detectors and Instrumentation
- Quantum Information Science (QIS) Supporting Technologies

Phase I

FY	Proposals	Awards	Award %
2016	208	30	14.4%
2017	179	37	20.7%
2018	164	40	24.4%
2019	165	30	18.2%
2020	131	37	28.2%

Phase II ***(* indicates preliminary decisions)***

FY	Proposals	Awards	Award %
2016	34	15	44.1
2017	39	17	43.6
2018	45	18	40.0
2019	47	18	38.3
2020	37	16*	43.2*

HEP Small Projects

- Several new small HEP projects were initiated in FY20:
  - T2K upgrade
  - NA61 upgrade
  - Dark Matter New Initiatives (R&D awards) for LDMX and TESSERACT
  - Sector 30 beamline AIP Phase I at SLAC

"Small" projects currently HEP-supported (incl. new since P5):

Intensity Frontier:

- **ANNIE**
- **COHERENT**
- **Heavy Photon Search**
- **KOTO**
- **LArIAT**
- **NA61 Upgrade**
- **PROSPECT**
- **SBN Program**
- **WATCHMAN**
- **T2K Upgrade**

Cosmic Frontier:

- **ADMX-G2**
- **eBOSS**
- **HAWC**
- **SuperCDMS-SNOLAB**
- **SPT-3G**

Dark Matter New Initiatives (see backup):

- **ADMX Extended (2-4GHz)**
- **OSCURA (Skipper CCD detector)**
- **DM-Radio axion search**
- **TESSERACT (Multiple detectors, w/TES readout)**
- **Beam Dump exp at LANL**
- **Light Dark Matter Experiment (LDMX)**

DOE SC Graduate Student Research Fellowships

- DOE SC Graduate Fellowship program has 2 calls per year, supporting student internships with DOE lab mentors in the summer (deadline previous Fall) and during the school year (deadline previous Spring).
- Spring 2020 solicitation closed, next solicitation opens August 2020 for interns starting June 2021 or later. Internship period is flexible: 3-12 months
- This program has supported 15-20 HEP graduate students per year and HEP has had a strong success rate for eligible applications. You can view the solicitation at https://science.osti.gov/wdts/scgsr/
- Recent addition: Convergence Research Topical Areas, for research of interest to 2 or more SC offices and are treated somewhat differently in review. Please encourage likely candidates.
  - Convergence Research Topical Areas
    - (a) Microelectronics (ASCR, BES, HEP)
    - (b) Data Science (ASCR, BES, BER, FES, HEP, NP)
    - (c) Fundamental Symmetries (BES, HEP, NP)
    - (d) Accelerator Science (ASCR, BES, BER, FES, HEP, NP)

SC Workforce Development for Teachers and Scientists (WDTS)

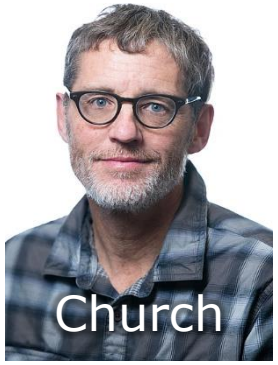
- Science Undergraduate Laboratory Internships (SULI)
  - Summer 2020 SULI just closed (Applications due May 28, 2020)
- Community College Internships (CCI)
  - Fall 2020 CCI just closed (Applications due May 28, 2020)
- Visiting Faculty Program (VFP)
  - Summer 2020 VFP closed Jan. 2020, notifications in April
- Office of Science Graduate Student Research Program (SCGSR)
  - Two annual solicitations with May and November deadlines
- Albert Einstein Distinguished Educator Fellowship
  - 2020-2021 cycle closed on November 14, 2019
- More information and key dates for all programs at:
  - https://science.osti.gov/wdts

HEP PI Meeting: August 24-26, 2020

- We invite all current PIs, co-PIs, those interested in applying to future HEP FOAs, and interested national laboratory staff
- Meeting will be fully online using Zoom and will include:
  - General presentations during a plenary session covering the overall DOE-HEP program, budgetary issues, and different HEP FOAs at DOE which PIs may apply to
  - Parallel sessions led by individual DOE-HEP PMs for each research program thrust area
    - Energy, Intensity, and Cosmic Frontiers, Theoretical HEP, Acc. R&D, Detector R&D, Comp. HEP, QIS
  - Additional special topics sessions may be added as time permits, if there is an interest
    - Early Career research; diversity, equity and inclusion in HEP; impacts of the COVID-19 pandemic
  - Opportunities for separate 1-on-1 or small group sessions between PMs and PIs across the different HEP program areas during the course of the 2-3 days
- Please register online at: https://www.orau.gov/heppi2020/
- For questions, contact:
  - Christie Ashton christie.ashton@science.doe.gov
  - Abid Patwa abid.patwa@science.doe.gov

Comings & Goings

- Incoming:
  - Clayton Hollowell – SURF Program Manager (DOE; in Lead, SD) [April 2020]
  - Eric Church – Computational HEP & QIS (Detailee) [April 2020]
  - David Cinabro – Intensity Frontier (IPA) [June 2020]
- Outgoing:
  - Bill Wisniewski – LBNF/DUNE (Detailee) [April 2020]
- DOE Federal Position for HEP Intensity Frontier
  - Brian Beckford (currently U. Michigan) will start in August!
- DOE Federal Position for HEP Communications & Strategic Planning
  - Anticipate an announcement in the future—all qualified candidates encouraged!
- Always looking for candidates to help with critical tasks
  - Interested parties should contact HEP Management!
  - Investigating alternate hiring opportunities beyond IPAs and Detailees



Summary

- DOE/HEP Research Program rolls on, despite some delays, including notably COVID-19:
  - HEP staff have done outstanding work to make sure the normal processes for lab and university research awards continued
  - Awards are being made at the ~usual rate in a reasonably timely fashion
  - HEP prioritized support for continuing grad students and postdocs
  - Largest HEP Early Career cohort ever!
  - We plan to continue in this fashion into FY21
    - New staff coming on board. Additional help always welcome!
    - More details and info at HEP PI virtual meeting in August

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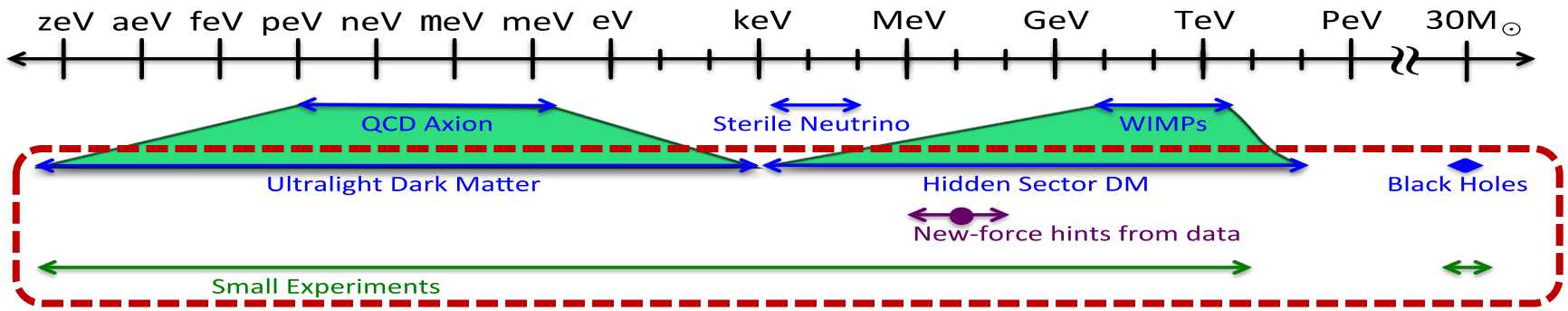
Dark Matter New Initiatives (DMNI)

- P5 recommended the search for Dark Matter particles as a high priority & also that the program should include small projects
  - Recent theoretical advances and development of new technologies opened new avenues to explore dark matter



- 2017 Community Workshop https://arxiv.org/abs/1707.04591
- 2018: Basic Research Needs (BRN) study; https://science.energy.gov/hep/community-resources/reports
- 2019: Funding Opportunity Announcement (FOA); Six selected to develop concept and execution plans for potential small projects, funding started in FY19 or FY20

Following completion of Concept & Execution plans, small projects will be reviewed before advancing to fabrication phase.

- **Cosmic Frontier:**
  - ADMX Extended (2-4GHz) – A. Sonnenschein (FNAL)
  - OSCURA (Skipper CCD detector) – J. Estrada (FNAL)
  - DM-Radio axion search – K. Irwin (SLAC)
  - TESSERACT (Multiple detectors, w/TES readout) – D. McKinsey (LBNL)
- **Intensity Frontier (accelerator based)**
  - Beam Dump experiment – R. van der Water (LANL)
  - Light Dark Matter Experiment (LDMX) – T. Nelson (SLAC)