

# DOE HEP Status

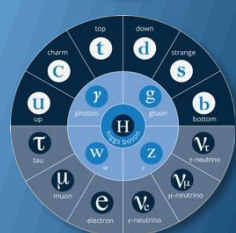
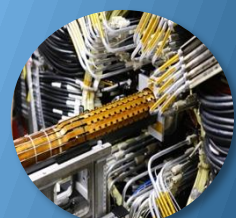
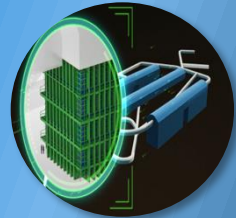
APS Division of Particles and Fields  
2021 Meeting  
July 12-14, 2021

- ▶ Glen Crawford
- ▶ Director, Research and Technology R&D
- ▶ DOE High Energy Physics



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# FY 2021 HEP University Comparative Review

- ▶ DE-FOA-00002424: FY 2021 Research Opportunities in High Energy Physics
  - ▶ FOA published on November 17, 2020
  - ▶ Proposals due on January 26, 2021
  - ▶ Reviews completed by April 1, 2021
  - ▶ Decisions by DOE/HEP to recommend proposals for funding by June 1, 2021
  - ▶ Grant award paperwork still in-process through the DOE system
- ▶ **148 proposals; 145 reviewed; 93 funded**
- ▶ Many thanks to reviewers and panelists for the time and hard work in evaluating this year's HEP research proposal

# FY 2022 HEP Comparative Review

- ▶ FY 2022 Comparative Review FOA:
  - ▶ **Currently under review at DOE and expected to be issued this summer**
  - ▶ Proposals currently expected to be due in September/October
  - ▶ Reviews should be completed by end of calendar year 2021/early 2022
  - ▶ Planned (not-yet-approved) format changes for Bio-sketches, C&P, COIs, Mentoring and Recruitment – including an explicit merit review criteria question on the subject, Budget material, ...
- ▶ More information at the August 2021 Virtual HEP PI Meeting
- ▶ See the FOA for complete details once published

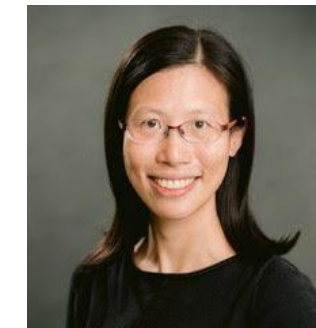
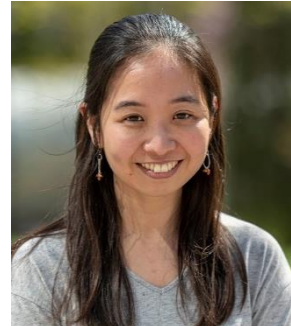
# 2021 Virtual HEP PI Meeting

- ▶ To brief and guide the HEP community on the FY 2022 Comparative Review and provide a status and overview of the DOE-supported HEP program, a virtual DOE-HEP Principal Investigators (PI) Meeting will be held on August 9-12, 2021.
- ▶ **All interested investigators invited, including existing and future investigators, laboratory staff, and interested postdoctoral researchers considering new faculty or staff positions**
- ▶ **Registration Deadline: August 6, 2021; Registration Fee: None**
  - ▶ <https://www.ornl.gov/heppi2021/> (*encouraged to register for logistical planning*)
- ▶ **Draft Agenda posting Today**
- ▶ General presentations during a plenary Zoom session
- ▶ Parallel Zoom sessions led by individual DOE-HEP Program Managers
- ▶ Additional sessions targeted at special topics
  - ▶ for e.g., Early Career research and related concerns; diversity, equity and inclusion in HEP; impacts of COVID-19 on university and laboratory research
- ▶ Opportunities to schedule separate 1:1 or small group remote sessions between PIs and DOE PMs across the different HEP program areas during the course of the event



# FY 2021 HEP Early Career Awards – Congrats!

- Lindsey Bleem, *ANL*
- Chihway Chang, *U. Chicago*
- Netta Engelhardt, *MIT*
- Farah Fahim, *FNAL*
- Philip Harris, *MIT*
- Tongyan Lin, *UC San Diego*
- Xueying Lu, *Northern Illinois U.*
- Brian Nord, *FNAL*
- Simone Pagan Griso, *LBNL*
- Diana Parno, *Carnegie Mellon U.*
- Kiersten Ruisard, *ORNL*
- Daniel Scolnic, *Duke U.*
- Indara Suarez, *Boston U.*
- Caterina Vernieri, *SLAC*
- Hao-Yi Wu, *Boise State U.*



# HEP Budget Request – FY 2022 Highlights

- ▶ **Research funding increases by \$21.4M or 5.4% over FY 2021 Enacted, with increases targeted to program and Administration priorities (+\$32M).**
  - ▶ Core Research activities increase (+\$0.2M) -> flat, no growth
  - ▶ *Accelerator Stewardship subprogram moves to the ARDAP (-\$10.8M)*
- ▶ **Artificial Intelligence/Machine Learning (\$35.8M) – On-chip AI/ML to enable edge computing** for winnowing particle events to the most important data. **Real-time control of both accelerator and quantum systems** to meet the increasing demands of future particle physics experiments.
- ▶ **Integrated Computational and Data Infrastructure for Scientific Discovery (\$4.1M) –** Data storage innovation to **manage tens of exabytes of data/year** from future experiments. Investments in software development to improve interface with SC exascale systems and ASCR-supported middleware



# HEP Budget Request – FY 2022 Highlights (cont'd)

## ▶ **Quantum Information Science (\$26.6M)**

- ▶ **Quantum optimization and quantum machine learning** applications for HEP numerical problems: Event generators, event reconstruction, data analysis, quantum data from emerging quantum sensors.
- ▶ R&D efforts in quantum devices, system performance and integration, and architecture development: Goal to achieve high-rates, operational robustness, and high-fidelity **quantum teleportation utilizing photonic qubits** at telecommunication wavelengths, over the **same type of optical fibers used by the telecommunication industry**
- ▶ **QIS Research Center (\$25.0M)**: HEP will continue support for multi-disciplinary Fermilab-led Superconducting Quantum Materials and Systems (SQMS) Center, which brings together **20 partners from national labs, academia, and industry** to develop, construct, and deploy a **quantum computer prototype in the largest millikelvin refrigerator ever built**



# HEP Budget Request – FY 2022 Highlights (cont'd)

- ▶ **Accelerator Science and Technology Initiative (\$17.4M):** Increase support for mid- to long-term R&D in high-field magnet and SRF accelerator technology
- ▶ **Microelectronics (\$7.0M)**
  - ▶ Ultra-sensitive analog front-end readout, integrated with high speed digital logic to create low noise, low-power, high-performance readout electronics
  - ▶ 5G high-bandwidth, low latency millimeter-wave wireless technology. Possible applications include antenna designs for Accelerator tunnels, and directed or autonomous 5G-enabled robots operating in tunnels and high radiation areas
- ▶ **Reaching a New Energy Sciences Workforce (RENEW) (\$4.0M):** Leverages SC's unique national laboratories, user facilities, and other research infrastructures to provide undergraduate and graduate training opportunities for students and academic institutions not currently well represented in the U.S. S&T ecosystem.





# Reaching a New Energy Sciences Workforce (RENEW)



- Outreach
- Listening tours and round tables to:
- Gain understanding about challenges
- Develop evidence-based solutions



- Identify unique Office of Science Lab opportunities
- Partner with Minority Serving Institutions and professional societies
- Implement action plan

- Competitively support new traineeship awards resulting in:
- “Hands on” experiences, mentoring, enhanced workforce diversity, equity, and inclusion



- Track post-traineeship outcomes
- Assess program effectiveness

# Research Traineeships to Broaden and Diversify Nuclear Physics

- ▶ <https://science.osti.gov/-/media/grants/pdf/foas/2021/DE-FOA-0002456.pdf>
- ▶ The DOE SC Nuclear Physics (NP) program ... for Research Traineeships to Broaden and Diversify Nuclear Physics (TBD-NP) ... This pilot program is intended to support training and research experiences for members of underserved communities with the goal of increasing the likelihood that participants from underrepresented populations, such as those present at minority serving institutions (MSIs) , will pursue a career in a Science, Technology, Engineering or Math (STEM) related field, particularly in Nuclear Physics.
- ▶ ...informed and influenced by the recommendations in recent reports including the American Institute of Physics TEAM-UP report
- ▶ HEP is partnering with NP to fund 4 selected Traineeship awards in FY21-22:  
<https://www.energy.gov/science/articles/departments-energy-announces-285-million-support-undergraduate-research>



# HEP - FY 2022 President's Request

(Dollars in thousands)

	FY 2019	FY 2020	FY 2021	FY 2022	FY 2022 Request vs		FY 2022 Request vs	
	Enacted	Enacted	Enacted	Request	FY 2021 Enacted	FY 2020 Enacted	FY 2021 Enacted	FY 2020 Enacted
<b>High Energy Physics</b>								
Energy Frontier, Research	76,530	71,125	68,000	71,833	3,833	5.64%	708	1.00%
Energy Frontier, Facility Operations and Experimental Support	52,000	52,650	53,650	49,850	-3,800	-7.08%	-2,800	-5.32%
Energy Frontier, Projects	105,000	100,000	72,500	40,000	-32,500	-44.83%	-60,000	-60.00%
Energy Frontier, SBIR/STTR	5,390	4,663	...	...	...	...	-4,663	-100.00%
<b>Energy Frontier Experimental Physics</b>	<b>238,920</b>	<b>228,438</b>	<b>194,150</b>	<b>161,683</b>	<b>-32,467</b>	<b>-16.72%</b>	<b>-66,755</b>	<b>-29.22%</b>
Intensity Frontier, Research	61,646	58,871	63,082	65,994	2,912	4.62%	7,123	12.10%
Intensity Frontier, Facility Operations and Experimental Support	155,035	177,122	166,785	176,845	10,060	6.03%	-277	-0.16%
Intensity Frontier, Projects	16,000	5,494	3,000	8,000	5,000	166.67%	2,506	45.61%
Intensity Frontier, SBIR/STTR	8,299	8,747	...	...	...	...	-8,747	-100.00%
<b>Intensity Frontier Experimental Physics</b>	<b>240,980</b>	<b>250,234</b>	<b>232,867</b>	<b>250,839</b>	<b>17,972</b>	<b>7.72%</b>	<b>605</b>	<b>0.24%</b>
Cosmic Frontier, Research	50,741	48,072	47,091	49,012	1,921	4.08%	940	1.96%
Cosmic Frontier, Facility Operations and Experimental Support	20,076	41,358	44,500	42,500	-2,000	-4.49%	1,142	2.76%
Cosmic Frontier, Projects	27,350	2,000	6,000	5,000	-1,000	-16.67%	3,000	150.00%
Cosmic Frontier, SBIR/STTR	2,869	3,471	...	...	...	...	-3,471	-100.00%
<b>Cosmic Frontier Experimental Physics</b>	<b>101,036</b>	<b>94,901</b>	<b>97,591</b>	<b>96,512</b>	<b>-1,079</b>	<b>-1.11%</b>	<b>1,611</b>	<b>1.70%</b>
Theoretical, Computational, and Interdisciplinary Physics, Research	86,611	111,434	136,362	157,422	21,060	15.44%	45,988	41.27%
Theoretical, Computational, and Interdisciplinary Physics, SBIR/STTR	3,223	4,093	...	...	...	...	-4,093	-100.00%
<b>Theoretical, Computational, and Interdisciplinary Physics</b>	<b>89,834</b>	<b>115,527</b>	<b>136,362</b>	<b>157,422</b>	<b>21,060</b>	<b>15.44%</b>	<b>41,895</b>	<b>36.26%</b>
Advanced Technology R&D, Research	72,141	64,391	72,833	75,344	2,511	3.45%	10,953	17.01%
Advanced Technology R&D, Facility Operations and Experimental Support	27,625	39,232	43,262	40,200	-3,062	-7.08%	968	2.47%
Advanced Technology R&D, Projects	10,000	...	...	...	...	...	...	...
Advanced Technology R&D, SBIR/STTR	3,740	3,783	...	...	...	...	-3,783	-100.00%
<b>Advanced Technology R&amp;D</b>	<b>113,506</b>	<b>107,406</b>	<b>116,095</b>	<b>115,544</b>	<b>-551</b>	<b>-0.47%</b>	<b>8,138</b>	<b>7.58%</b>
HEP Accelerator Stewardship, Research	9,083	10,788	10,835	...	-10,835	-100.00%	-10,788	-100.00%
HEP Accelerator Stewardship, Facility Operations and Experimental Support	6,067	6,067	6,100	...	-6,100	-100.00%	-6,067	-100.00%
HEP Accelerator Stewardship, SBIR/STTR	574	639	...	...	...	...	-639	-100.00%
<b>HEP Accelerator Stewardship</b>	<b>15,724</b>	<b>17,494</b>	<b>16,935</b>	<b>...</b>	<b>-16,935</b>	<b>-100.00%</b>	<b>-17,494</b>	<b>-100.00%</b>
<b>Program Subtotal</b>	<b>800,000</b>	<b>814,000</b>	<b>794,000</b>	<b>782,000</b>	<b>-12,000</b>	<b>-1.51%</b>	<b>-32,000</b>	<b>-3.93%</b>
18-SC-42 Proton Improvement Plan II (PIP-II), FNAL	20,000	60,000	79,000	90,000	11,000	13.92%	30,000	50.00%
11-SC-40 Long Baseline Neutrino Facility/Deep Underground Neutrino Exper, FNAL	130,000	171,000	171,000	176,000	5,000	2.92%	5,000	2.92%
11-SC-41 Muon to Electron Conversion Experiment, FNAL	30,000	...	2,000	13,000	11,000	550.00%	13,000	...
<b>Construction Subtotal</b>	<b>180,000</b>	<b>231,000</b>	<b>252,000</b>	<b>279,000</b>	<b>27,000</b>	<b>10.71%</b>	<b>48,000</b>	<b>20.78%</b>
<b>Total High Energy Physics</b>	<b>980,000</b>	<b>1,045,000</b>	<b>1,046,000</b>	<b>1,061,000</b>	<b>15,000</b>	<b>1.43%</b>	<b>16,000</b>	<b>1.53%</b>

# Comments on Budget Process

- ▶ The budget process for the last several years has been unusual.
  - ▶ Budget Requests and final Appropriations for DOE Office of Science have not been closely aligned
  - ▶ Requesting HEP Project funding at the level of the approved baseline(s) would have forced larger cuts into Research.
    - ▶ Experience has shown Congress is more likely to respond to project shortfalls than research shortfalls.
  - ▶ **In particular, in FY2018-21 Congress added significant funding (above Request) to HEP projects.**
    - ▶ This has been critical to staying on the P5 plan and encouraging international partnerships
    - ▶ Strong and consistent community support for P5 have also been critical
    - ▶ But not all projects received similar increases

# Fiscal Year 2022

- ▶ The budget process for FY22 was different due to transition to the new Administration (which happened late in the budget process)
- ▶ The FY 22 President's Request Budget for DOE/HEP is down \$1.5 million for projects (Line Item Construction + Major Items of Equipment) compared to the FY 21 Appropriation.
  - ▶ The PIP II request is below the approved baseline.
  - ▶ LBNF/DUNE is below the planned level.
  - ▶ HL-LHC projects took larger cuts on a percentage basis.



# Mitigations (what we are doing)

- ▶ Reaffirm our commitment to the P5 plan and priorities therein:
  - ▶ Talk to CERN management about our ongoing commitment to and priority for HL-LHC.
  - ▶ Talk to international partners about plans for LBNF/DUNE and PIP-II
  - ▶ Respond to questions from Congress on impacts.
  - ▶ All of these have been started and are ongoing.
- ▶ Wait for the markups from the Senate and the House
  - ▶ **House Mark** is slightly below Request for DOE/SC (-1.6%), but +4.2% above FY21. No details on individual SC programs yet.

# Mitigations (what the community can do)

- Don't panic.
- Maintain strong and consistent community support for P5
- Start-up (restart) Snowmass process in 2021 building on P5





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