U.S. DEPARTMENT OF ENERGY | Office of Science

Office of High Energy Physics (HEP) Funding Opportunities for Universities

CMB-S4 Collaboration Meeting (zoom)

March 9, 2021

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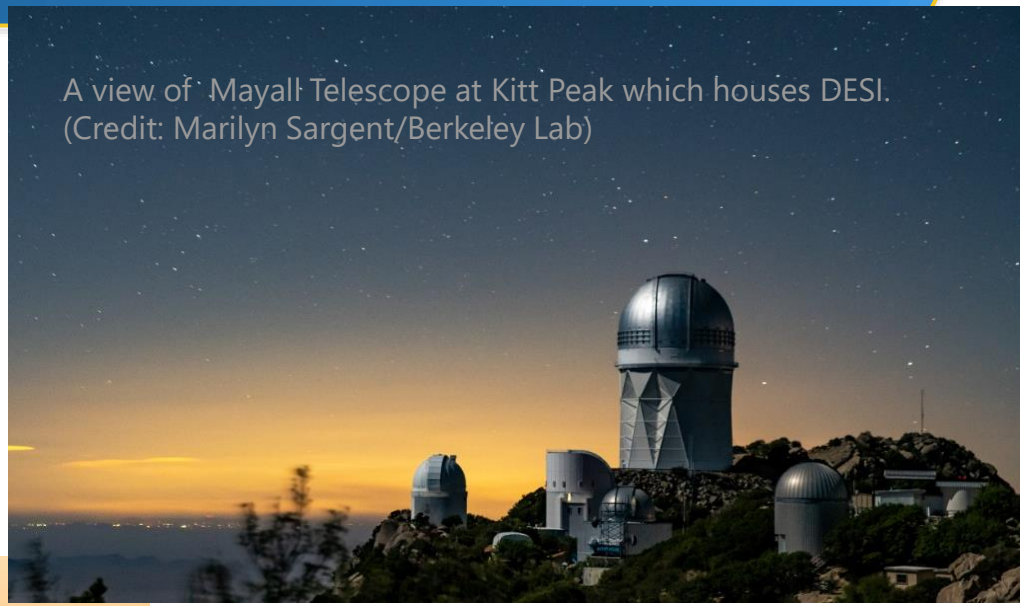
Cosmic Frontier group members:

- *Karen Byrum (Detailee), Drew Baden (IPA)*

OUTLINE

- HEP & Cosmic Frontier intro
- Scientific funding considerations
- Funding Opportunities



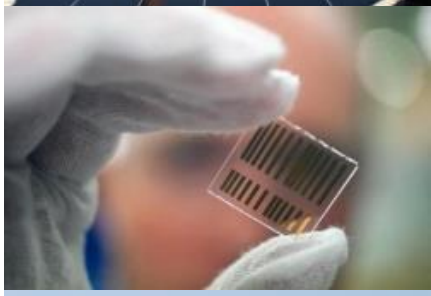
A view of Mayall Telescope at Kitt Peak which houses DESI. (Credit: Marilyn Sargent/Berkeley Lab)

Mission of the US Department of Energy (DOE)

The mission of DOE is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.

- Catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.
- **Maintain a vibrant U.S. effort in science and engineering as a cornerstone of our economic prosperity with clear leadership in strategic areas.**
- Enhance nuclear security through defense, nonproliferation, and environmental efforts.
- Establish an operational and adaptable framework that combines the best wisdom of all DOE stakeholders to maximize mission success.

➔DOE grew out of the Manhattan Project effort to develop the atomic bomb during World War II, and various energy-related programs that were dispersed throughout various Federal agencies.



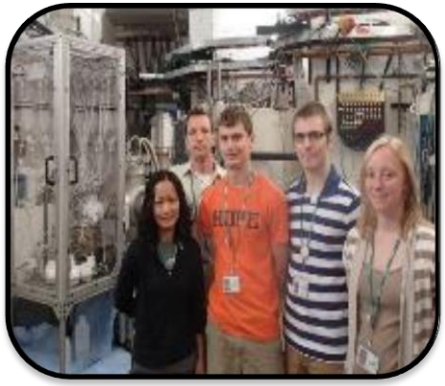
Mission of the DOE Office of Science (SC)

- A research funding agency and a steward of national research infrastructure.

The mission is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the US.

Largest Supporter of Physical Sciences in the U.S.

Funding at >300 Institutions, including 17 DOE Labs



Over 23,000 Researchers Supported

Over 33,000 Users of 28 SC Scientific Facilities

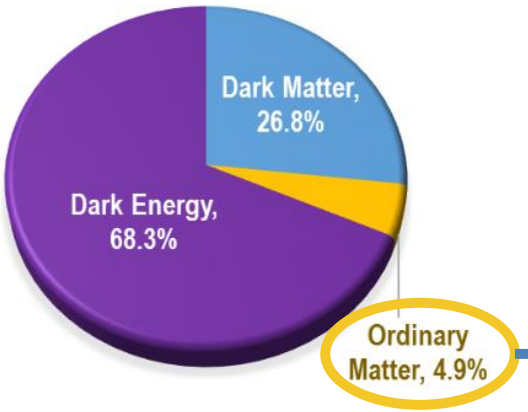
SC is the nation's largest federal sponsor of basic research in the physical sciences and is a major supporter of research in such key scientific fields as physics, materials science, and chemistry. SC is also the lead federal agency supporting fundamental scientific research related to energy. Six offices: Advanced Scientific Computing, Basic Energy Sciences, Biological Energy Research, Fusion Energy, **High Energy Physics**, Nuclear Physics

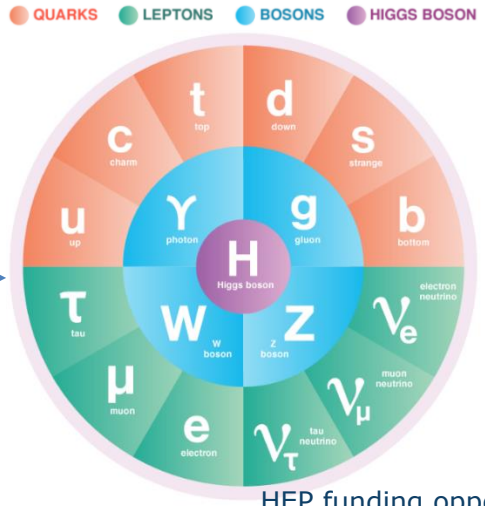
Office of High Energy Physics (HEP) →Program Mission

… is to understand how the universe works at its most fundamental level:

- Discover the elementary constituents of matter and energy
- Probe the interactions between them
- Explore the basic nature of space and time

- The DOE-HEP fulfills its mission by:
  - Building **projects** that enable discovery science
  - Operating **facilities** that provide the capability for discoveries
  - Supporting a **research** program that produces discovery science





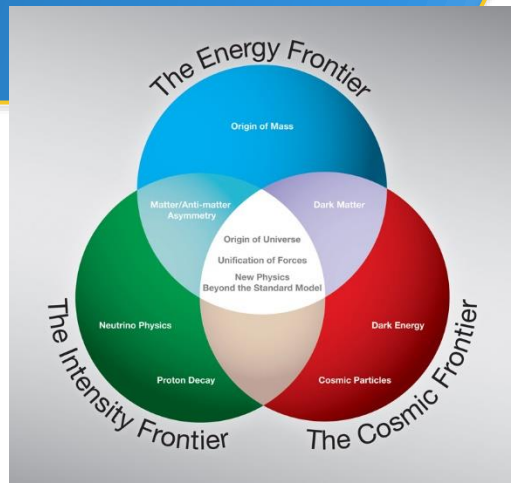
HEP Program Layout

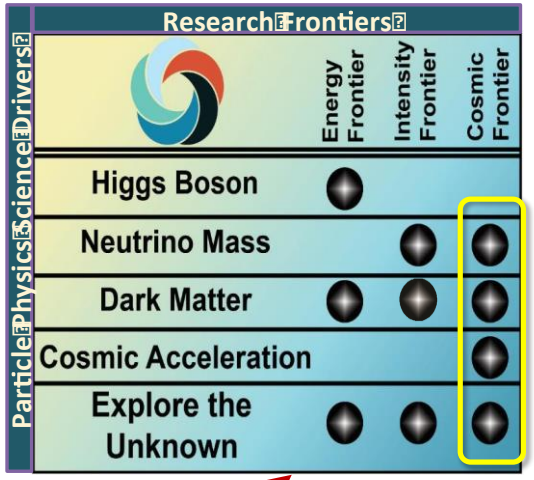
Mission – fundamental nature of matter, energy, space & time.

HEP programs:

- **Energy & Intensity Frontiers (accelerator-based)**
- **Cosmic Frontier - using data from natural sources is an increasingly important area for discovery.**
- Theoretical research, Detector and Accelerator technology development, Quantum Information Science (QIS), Artificial Intelligence/Machine Learning

Many interagency and international partnerships.





Guidance & Community Input from:

- **FACA panels: HEPAP, AAAC**
- Natl. Academy of Sciences, other community studies

➔HEP continues to follow HEPAP's **2014 "P5" strategic plan**.

Other HEP and Office of Science areas to fully carry out the program:

- High Performance Computing → Exascale

HEP by the Numbers

HEP RESEARCH SPANS

MORE THAN **160** ACADEMIC, NONPROFIT, AND INDUSTRIAL INSTITUTIONS

12 DOE NATIONAL LABORATORIES | **42** STATES AND WASHINGTON, D.C.

13 CORE RESEARCH THRUSTS

OVER **400** ANNUAL HEP PUBLICATIONS IN PEER-REVIEWED SCIENTIFIC JOURNALS

SUPPORTED RESEARCHERS

1,115 PH.D SCIENTISTS *(325 POST-DOCS)*

595 GRADUATE STUDENTS

HEP BY THE NUMBERS (FY 2020)

HEP's mission is to understand how the universe works at its most fundamental level by discovering the elementary constituents of matter and energy, probing the interactions between them, and exploring the basic nature of space and time.

20 NOBEL PRIZES IN PHYSICS

$390 MILLION RESEARCH BUDGET

$25M SBIR/STTR, $118M UNIVERSITIES, $247M DOE LABS

2,215 USERS AT **3** HEP FACILITIES

FERMILAB ACCELERATOR COMPLEX, SLAC FACET-II, BROOKHAVEN ATF

PRESIDENTIAL EARLY CAREER AWARDS FOR SCIENTISTS AND ENGINEERS (PECASE) **15**

OVER **300** ACTIVE AWARDS

$317 MILLION SCIENTIFIC USER FACILITIES AND EXPERIMENTAL OPERATIONS BUDGET

LHC, SURF, RUBIN/LSST, DESI, LZ, AMS, TEST FACILITIES, ETC.

$338 MILLION LINE-ITEM CONSTRUCTION PROJECT AND MAJOR-ITEM OF EQUIPMENT BUDGET

LBNF/DUNE, PIP-II, HL-LHC-ACCELERATOR, HL-LHC-ATLAS, HL-LHC-CMS, CMB-S4, ACORN

DOE/SC Policies, Procedures → Diversity, Equity, Inclusion

The DOE Office of Science (SC) is fully committed to fostering safe, diverse, equitable, and inclusive work, research, and funding environments that value mutual respect and personal integrity.

As President Obama said in 2011, "*We are at our best when we draw on the talents of all parts of our society" (Executive order 13583).*

➔In recent years, it has become obvious how far we still have to go.

DOE has long had policies in place prohibiting discrimination and harassment by institutions that we fund (at academic institutions, small businesses, and DOE national labs), and by employees. A new www site is in place to consolidates DOE's policies and procedures:

- https://science.osti.gov/sc-2/Research-and-Conduct-Policies/Diversity-Equity-and-Inclusion

- SC's effective stewardship and promotion of diverse and inclusive workplaces that value and celebrate a diversity of people, ideas, cultures, and educational backgrounds is foundational to delivering on our mission.
- Discrimination and harassment undermine SC's ability to achieve its mission by reducing productivity, discouraging or inhibiting talent retention and career advancement, and weakening the integrity of the SC enterprise overall.

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Research Support Considerations

Research Support – Focus & Method

DOE is a science *mission* oriented agency. The **projects** are selected for the (P5) strategic plan that will provide significant leaps in science. Then we **support the community to carry out** these projects/experiments.

- **Priority is to support projects & experiments in our program, where we have responsibilities**

"Cosmic Frontier" is Experimental Research at the Cosmic Frontier.

- Cosmic Frontier theoretical efforts should be proposed to the HEP Theory program.
- Cosmic Frontier detector development that is not part of a particular experiment can be proposed to the HEP Detector Development program.

Balance & Priorities, aligned with P5

→ Distribution of efforts across areas will necessarily change to support changing priorities

→ Balance support of scientist efforts on operating experiments, with efforts on designing and building the new experiments.

Research Support - Priorities

Research budgets: Support scientists on all phases of an experiment

Priority is to support research efforts directly in line with planning & carrying out the:

- **DOE/HEP roles & responsibilities on our projects & operating experiments**
- **DOE/HEP priority science topics that were the basis for our participation**

HEP Collaboration Model:

- Sufficiently support the researchers that are part of the Collaboration to carry out experiment in all phases - project's design, fabrication and operations & to plan and carry out data analyses to deliver the best science.

➔Review panels look to see **close engagement (significant roles & responsibilities) by the scientists in our** experimental projects & collaborations.

Cosmic Frontier Priority Areas:

- Dark Matter (direct detection) generation 2 experiments & planning new initiatives
- Dark Energy: complete DES analysis; Operate and data analysis for DESI; complete construction of LSST camera for Rubin Observatory, carrying out experimental operations, Dark Energy science studies.
- CMB: complete SPT-3G operations and analysis; Design & build CMB-S4 & carry out HEP related science topics
- Not funded in our program: gravitational waves (LIGO), dark matter maps, astronomy, planet searches, heavy ion physics, AMO physics, etc.

Research Support – Activities

➔**What DOE supports**

- Research efforts (mainly scientists) on R&D, experiment design, fabrication, data-taking, analysis-related activities
- Funding efforts that are in direct support of our programs

Faculty support

We support faculty and their groups of students & postdocs. Limited Research Scientist support is available.

- Typically, the *full* research time of the faculty member throughout the whole year is supported by providing 2 months summer salary and support for the group.
- Summer support should be adjusted according to % time the faculty is on research effort

Research Scientists as part of the Faculty group:

- Efforts are related towards research; not long-term operations and/or project activities
- Consider case-by-case on merits: could the research be fulfilled by a postdoc?

- In Cosmic Frontier: Funding for theory/simulations/phenomenology/computational efforts in direct support of our experiments; otherwise should be proposed to the Theory program.

× **What's not supported by research grants**

- Engineering, major items of equipment, consumables for prototyping or production – for the Projects or Experimental Operations; get these funds from the Project Office
- Non-HEP related efforts

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Research Funding Opportunities

HEP Provides Funding for Scientists to work on HEP Experiments & Theoretical Studies

https://science.osti.gov/hep/Funding-Opportunities

Annual Funding Opportunity Announcements (FOA) are geared primarily towards PhD scientists employed as a researcher at US laboratories or professors at US universities.

→Investigators submit a proposal for a grant provided by the HEP program to support their research.

→FOAs

- Research Opportunities in High Energy Physics
- Early Career Research Program
- Quantum Information Science
- Traineeship in Accelerator Science & Technology

The proposals are all subject to competitive peer review.
Universities: Typically the funds pay for the professor's time, for salaries for postdocs and students and for expenses (computers, travel etc).

University Grants – Working in the Program

Typical HEP researcher:

- Has an experimental program that may involve analysis on one experiment while designing & constructing the next project.
- Makes **long term commitments** to our experiment/project/science as a **closely integrated** member of the collaboration.
- He/she has **specific commitments (service work) & responsibilities** for our projects/experiments that may include analyzing data with one experiment while constructing or planning the next one – in addition to the science analysis. These responsibilities may evolve over time as the experiment progresses through phases.

  -- Not funded for one particular study or effort here and there

In your proposal:

• Explain your long term program (past 3 years), how it progresses over time & how pieces fit together. Describe your past accomplishments.

• Details on what you're doing the next 3 years, your responsibilities and efforts, why they're important to the project/experiment and why they're important and a priority NOW.

• Explain what fraction of time you're working on each effort (whether or not HEP funded)

• DOE regards 2 months summer salary as 100% of research time throughout the year.

University Grants – New Efforts

Universities: Model for starting to work in the field & get a grant:

• Get involved in experiment/science and take on responsibilities for the project & collaboration and then submit proposal.

• Have involvement in the community so that you are part of the HEP community! (e.g. DPF meetings)

• Lot of science topics may be in the projects, e.g., Rubin Observatory carries out non-HEP related science topics; for HEP support, need to think of what is the priority & main efforts needed and which are needed now!

• Have responsibilities for the experiment – not just your own science simulations & analysis.

• Many people have program working on a series of experiments (e.g.) DES operations/analysis while participating in Rubin/LSST planning and construction. Not all has to be funded by HEP!

• Show track record and have responsibilities before funding starts.

• Transitioning to a new project/field requires a lot of work to get up to speed.
- best for faculty member to take the time to really learn the field and take on responsibility first

Comparative Merit Review Criteria

[Criteria Questions are provided in Section V of FOA and to merit reviewers/panel to evaluate Proposal and PI(s)]

1) **Scientific and/or Technical Merit of the Proposed Research**
   e.g., What is the scientific scope and impact of the proposed effort? What is the likelihood of achieving valuable results? How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research? How does the proposed work compare with other efforts in the field, both in terms of scientific and/or technical merit and originality? Is the Data Management Plan suitable for the proposed research and to what extent does it support the validation of research results? *Please comment on each investigator.*

2) **Appropriateness of the Proposed Method or Approach**
   e.g., How logical and feasible are the research approaches? Does the proposed research employ innovative concepts or methods? Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions? Does the applicant recognize significant potential problems and consider alternative strategies?

3) **Competency of Research Team and Adequacy of Available Resources**
   e.g., What is the past performance and potential of the team, including the dissemination of results? How well qualified is each senior investigator and the team, and what is the likelihood of success in carrying out the proposed work? Are the research environment and facilities adequate for performing the research, including any synergistic opportunities, institutional support, and/or infrastructure? Does the proposed work take advantage of unique facilities and capabilities? Are any plans proposed for recruiting additional scientific and/or technical personnel including new senior staff, students and postdocs reasonable, justified, and appropriate? Are the senior investigator(s) or any members of the research group that are being reviewed leaders within the proposed effort(s) and/or potential future leaders in the field? For senior investigator(s) proposing to work across multiple research thrusts, are the plans for such cross-cutting efforts reasonably developed and will the proposed activities have impact?

Comparative Merit Review Criteria

[Criteria Questions are provided in Section V of FOA and to merit reviewers/panel to evaluate Proposal and PI(s)]

4) **Reasonableness and Appropriateness of the Proposed Budget**
e.g., Are the proposed budget and staffing levels adequate to carry out the proposed work? If multiple research thrusts are proposed, is the balance of proposed efforts reasonable and well-matched to the proposed research goals? Is the budget reasonable, appropriate for the scope?

5) **Alignment of Proposed Research to the Priorities Established in the P5 Strategic plan**
e.g., How does the proposed research of each senior investigator specifically contribute to the mission, science goals, and programmatic priorities of the subprogram in which the application is being evaluated? Is the proposed research consistent with priorities and strategic plan described in the P5 report? For multi-thrust proposals, does the scope of the full proposed program provide synergy or additional benefits within HEP's Congressionally-authorized mission-space beyond the individual thrusts? How likely is the research to impact the direction of the overall HEP program? For applications proposing work and/or a transition across multiple research thrusts during the project period, will the overall efforts add value in the broader context of the program goals described in the P5 strategic plan?

Other Research Funding Opportunities

Workforce Development (WDTS) programs:
https://science.osti.gov/wdts

- **Office of Science Graduate Student Research fellowships (SCSGR)**
  - Supports grad student research at a DOE lab, 3 to 12 months, 2 calls per year
- **Science Undergraduate Laboratory Internships (SULI)**
  - Supports undergraduate research at a DOE lab, 10 to 16 weeks; 3 calls per year
- **Visiting Faculty Program (VFP)**
  - Summer research support for faculty/students from historically underrepresented institutions
- **Community College Internships (CCI)**
- **Albert Einstein Distinguished Educator Fellowship (AEF)**
- **National Science Bowl (NSB)**

HEP funding opportunities, plus from other Office of Science programs:

- **Research Opportunities in HEP (closes 1/26/21)**

https://science.osti.gov/-/media/grants/pdf/foas/2021/SC_FOA_0002424.pdf

- **Early Career Research (closes 2/16/21)** https://science.osti.gov/early-career
- **SC "Open Call"** [DE-FOA-0002181]
  - HEP uses this primarily for conferences and supplements

STEM Career Planning and Internship/Fellowship Opportunities

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION
Shaping the Future of Science

ORISE provides various resources to address the **career planning and professional development** needs of all research and non-research participants.

At all levels, including undergraduates, graduate students, postdocs, early-career professionals, as well as K-12 teachers.

ORISE connects the most talented and diverse college students, recent graduates, postdocs, and faculty to programs closely aligned with the interests of a variety of research facilities, including those managed for the U.S. Department of Energy and more than a dozen other federal agencies.

zintellect
climb higher

Find opportunities via Zintellect, a searchable database of research and non-research internships and fellowships administered by ORISE.

Research Support during covid-19

- Faculty PI's have been notified that they have significant flexibility within existing grant awards to re-plan their scope of work to accommodate research tasks that have been cut short or delayed by the pandemic, including extending support for junior scientists, which is one of our highest priorities.

- We have been working with PIs on a case-by-case basis to address these issues as needed.

- The need to continue support for existing students and postdocs may impact the availability of funds for new proposals and/or new personnel on renewal proposals.

Cosmic Frontier - HEP FOA Statistics (Universities)

PASAG criteria applied to Research; priority for critical HEP roles & science goals.

- Work as part of an HEP-style collaboration w/leadership & critical contributions to project, operations and data planning & analysis.

HEP uses merit review and then folds in programmatic factors of priorities for support, funding availability: Ensure PI's with near-term, critical roles/responsibilities are supported; Support all phases of project, operations, and data analysis.

	FY 2016		FY 2017		FY 2018		FY 2019		FY 2020	
Y1 request, available	$7.8/$4.3M		$7.6/$4.7M		$14.3/$5.4M		$5.2/$3.4M		$9.1/$4.9M	
	# Prop.	# PI's	# Prop.	# PI's	# Prop.	# PI's	# Prop.	# PI's	# Prop.	# PI's
# Received	43	62	31	49	30	49	23	36	30	51
Reviewed	36	55	26	43	28	47	20	33	30	51
Funded	21	25	18	26	23	33	18	26	23	36
Success Rate (%)	58%	45%	69%	60%	82%	70%	90%	79%	77%	71%

Cosmic Frontier
➔ Early Career Award Statistics (Univ + Lab)

Cosmic Frontier - Early Career awards	FY16	FY17	FY18	FY19	FY20
#Proposals Received	**13**	**13**	**16**	**17**	**16**
Proposals Reviewed Univ	7	8	11	13	11
Proposals Reviewed Lab	6	5	5	4	5
Funded Univ	**1**	**1**	**2**	**3**	**3**
Funded Lab	**0**	**1**	**0**	**0**	**0**

FY16:

Eduardo Rozo
Dark Energy

Anja von der Linden
Dark Energy

FY17:

Michael Schneider
Dark Energy

FY18:

Alexie Leauthaud
Dark Energy

Hee-Jong Seo
Dark Energy

FY19:

Tim Eifler
Dark Energy

Scott Hertel
Dark Matter

Elisabeth Krause
Dark Energy

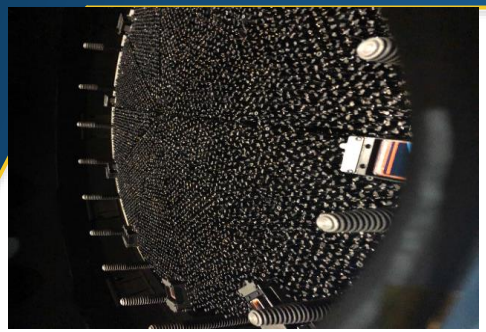
FY20:

Hugh Lippincott
Dark Matter

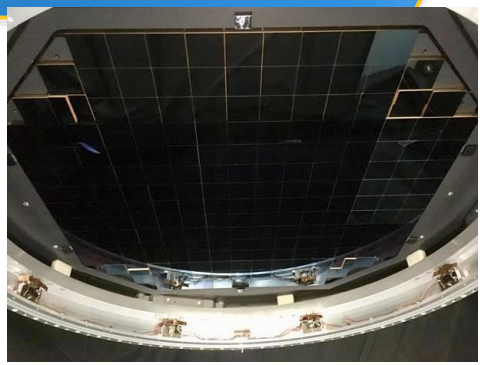
Lado Samushia
Dark Energy

Michael Troxel
Dark Energy

Summary

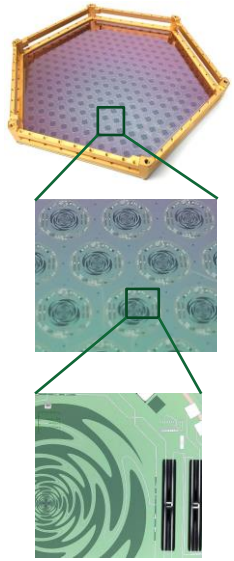


HEP continues to carry out the 2014 P5 strategic plan.
→ Many important interagency and international partnerships.



Cosmic Frontier:

- Continues to produce excellent, world-leading science results
- **DESI** has started it science survey operations
- **LZ** (dark matter) fabrication complete, now in commissioning
- **LSST Camera** nearly complete, Commissioning ongoing
- **Rubin Observatory** Facility Ops planning is ramping up: Google Interim Data Facility, SLAC US Data Facility, International in-kind contributions
- **CMB-S4** – LBNL selected as lead DOE lab; Approved as a fabrication project for DOE in the FY2021 budget; working towards planning for next decision points.
- **DOE/NASA RFI** to collect information on focused, potentially collaborative areas.
- **Future Planning** – Astro2020 and beyond



University funding opportunities – priority is to carry out DOE/HEP roles & responsibilities in all phases.

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