Office of High Energy Physics (HEP) Program and Budget Report

Astronomy & Astrophysics Advisory Committee (AAAC)

February 24, 2021

Kathy Turner, Cosmic Frontier Program Manager

Cosmic Frontier group members:
- Karen Byrum (Detailee), Drew Baden (IPA),
Science & Project Updates since the Jan. 2021 meeting
- SPT-3G
- DESI
- LSST Camera New Opportunities
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.

**SUPPORTED RESEARCHERS**
1,115 PH.D SCIENTISTS (325 POST-DOCS)
595 GRADUATE STUDENTS

**2,215 USERS AT 3 HEP FACILITIES**
FERMILAB ACCELERATOR COMPLEX, SLAC FACET-II, BROOKHAVEN ATF

**$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

**OVER 300 ACTIVE AWARDS**

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

**20 NOBEL PRIZES IN PHYSICS**

**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.

**$390 MILLION RESEARCH BUDGET**
$25M SBIR/STTR, $118M UNIVERSITIES, $247M DOE LABS

**PRESIDENTIAL EARLY CAREER AWARDS FOR SCIENTISTS AND ENGINEERS (PECASE)**
15
Science goals:
- dark energy constraints from CMB lensing & galaxy clusters
- constraints on neutrinos and other light particles
- with BICEP/Keck, potential measurement of primordial gravitational waves.

Survey started 2018; continues to operate smoothly with high observing efficiency
- Cumulative map depths for the main 1500-square-degree survey are on track to achieve unprecedented deep levels, 3.0/2.2/8.0 μK-arcmin at 95/150/220 GHz by the end of 2023.
South Pole Telescope (SPT-3G) -- Science Highlights

- First SPT-3G science publication
- Measurement of TE/EE power spectra with 2018 data set
- Most sensitive measurements made to-date with SPT over the multipole ranges $300 \leq \ell \leq 1400$ for EE and $300 \leq \ell \leq 1700$ for TE.
- Maps from 2019+ are already 3-4x deeper than this 2018 data. Will be used to constrain $H_0$ & effective number of relativistic species

Dutcher et al.  
https://arxiv.org/abs/2101.01684  
Submitted to Physical Review D
The 4-month survey validation (SV) phase started Dec. 2020
- 1044 science exposures through mid-February (each with ~5,000 spectra). Analysis so far indicates DESI will achieve TDR in performance and survey depth/parameters.
- Sky map of where DESI is observing target classes during SV
**NSF (AURA) and DOE (SLAC) partnership**
- Project: DOE responsible for the Camera fabrication & commissioning

**Camera Fabrication:**
- Only remaining scope for the Major Item of Equipment (MIE) Project is the completion of the last 2 filters (out of 6).
- Camera planned to complete early June 2021

**Commissioning (on HEP program funds):**
- Camera assembly and verification at SLAC
- Camera is expected to ship to Chile in Feb. 2022 and be ready for installation on telescope ~ July 2022
LSST Camera

Picture of the mass simulator being loaded in its container

Camera body with the filter exchange system and shutter being installed for a dry fit (no cryostat). In front is what we call the manual loader used to load the filter exchange system with the filters.

ComCam being assembled on the summit
Rubin Observatory: Facility Operations Planning

The Rubin Observatory will conduct a 10-year deep, wide, fast, optical imaging Legacy Survey of Space and Time (LSST) using DOE’s LSST Camera & the Simonyi Survey Telescope

**DOE & NSF will provide 50/50 support**

DOE-supported efforts are primarily:
- Camera maintenance and operations
- US Data Facility (USDF) \(\rightarrow\) SLAC selected to be the managing organization

\(\rightarrow\) DOE/SLAC will carry out all the planned functions for the US Data Facility
  - The Data Facility is fully integrated into the NOIRLab and SLAC partnership to carry out the Rubin Operations plan and deliver all the data products to all the researchers and collaborations.