U.S. DEPARTMENT OF ENERGY | Office of Science

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),*

OUTLINE

→ 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.

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

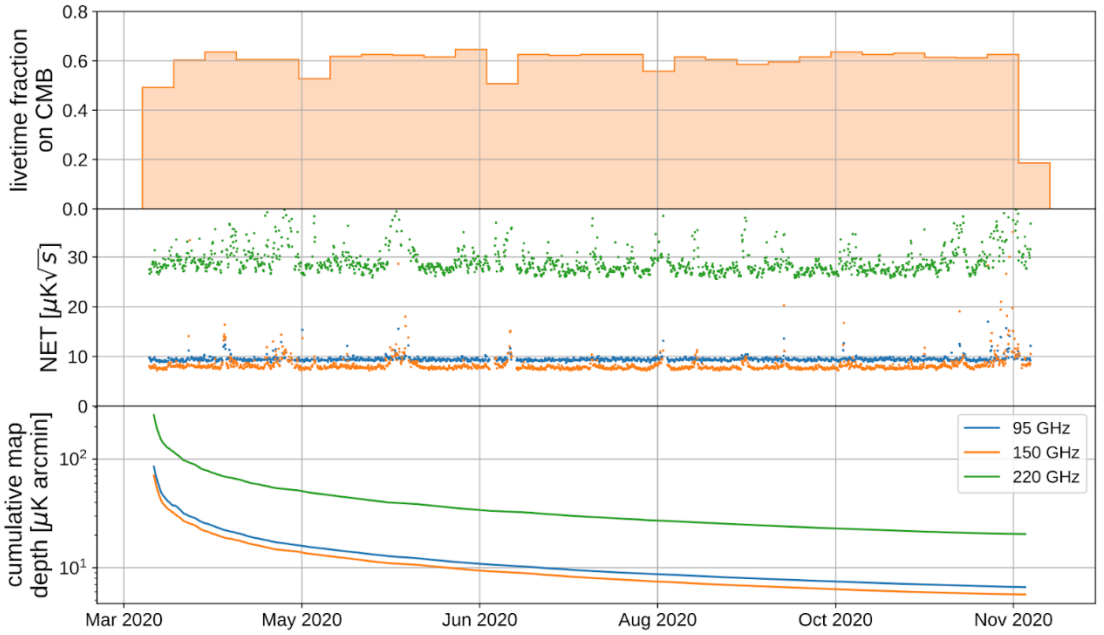
LBNF/DUNE, PIP-II, HL-LHC-ACCELERATOR, HL-LHC-ATLAS, HL-LHC-CMS, CMB-S4, ACORN

South Pole Telescope (SPT-3G)

NSF & DOE partnership
HEP supported major upgrade: fabrication of the 16,000-detector focal plane, greatly increasing sensitivity.

Science goals:

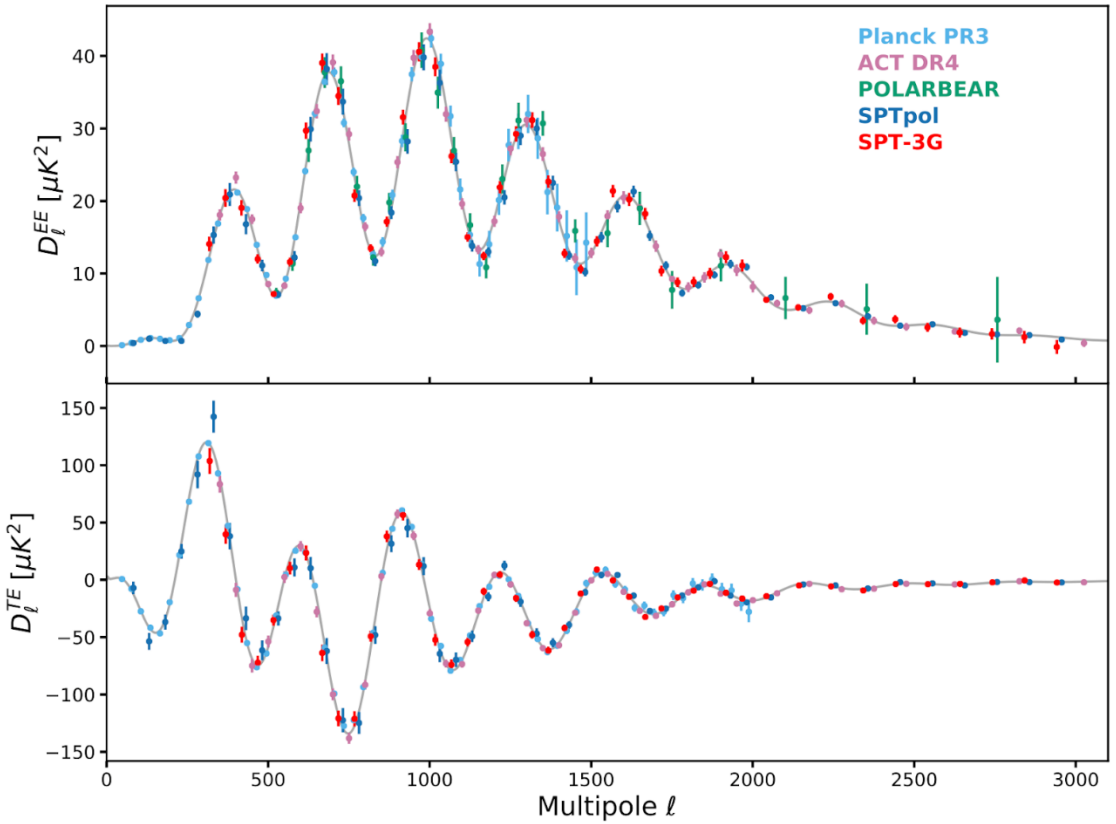
- dark energy constraints from CMB lensing & galaxy clusters
- constraints on neutrinos and other light particles
- with BICEP/Keck, potential measurement of primordial gravitational waves.



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



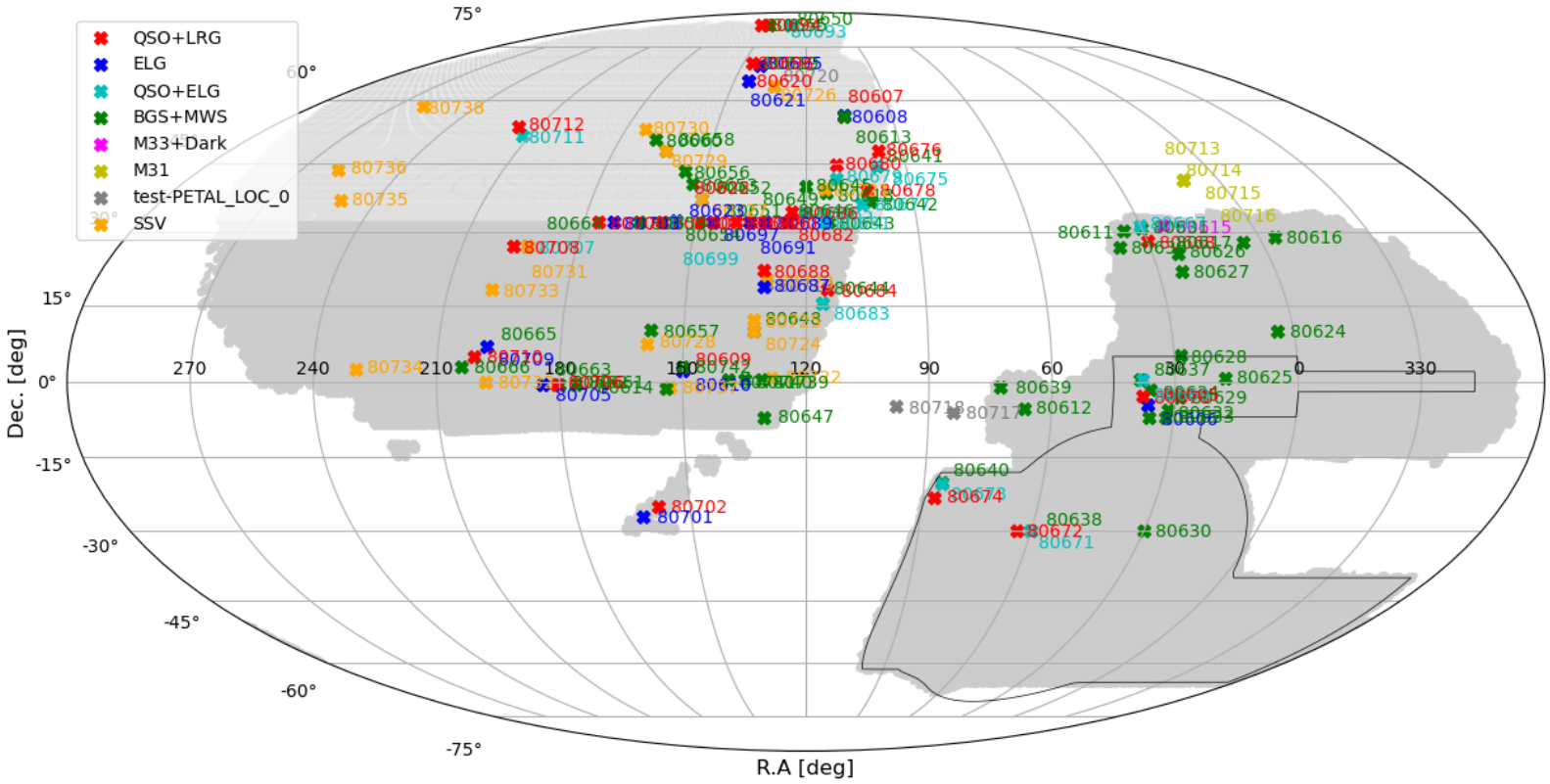
Dutcher et al.
https://arxiv.org/abs/2101.01684
Submitted to Physical Review D

- 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

Dark Energy Spectroscopic Instrument (DESI) – Taking Data!

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



Vera C. Rubin Observatory

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

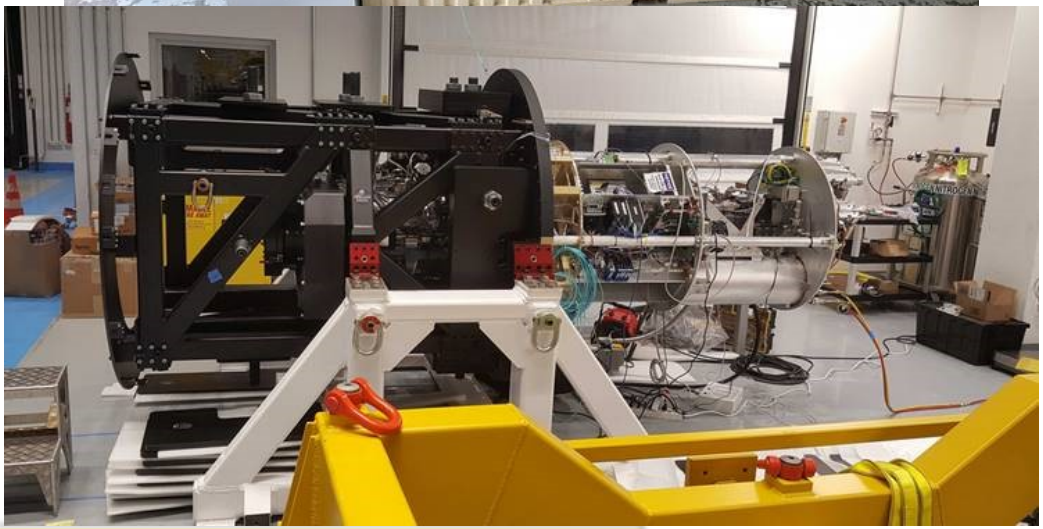
Commissioning (on HEP program funds):

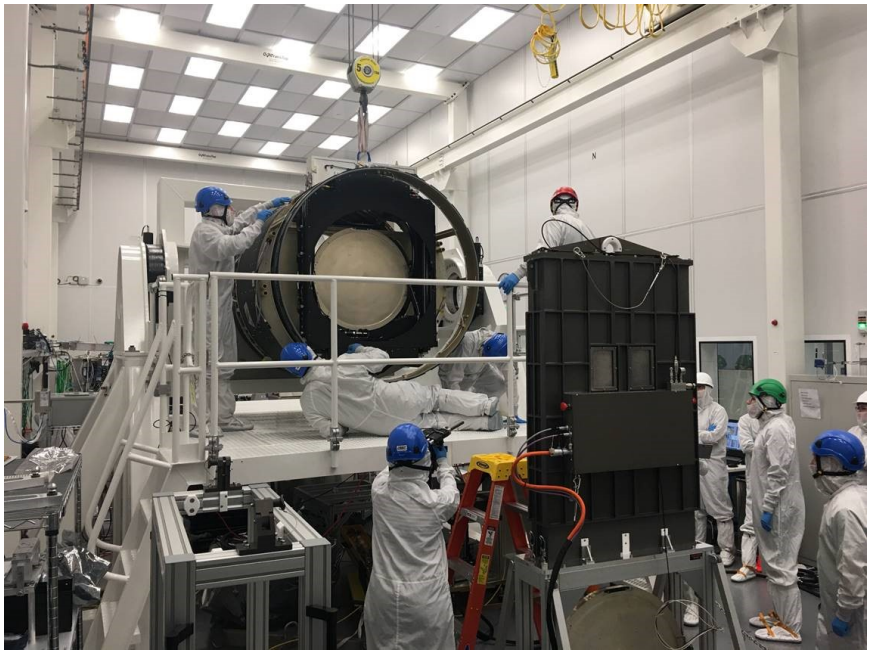
- Camera assembly and verification at SLAC
- Camera is expected to ship to Chile in Feb. 2022 and be ready for installation on telescope ~ July 2022

r-band filter with its plastic protective cover

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) → SLAC selected to be the managing organization

➔ 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.

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