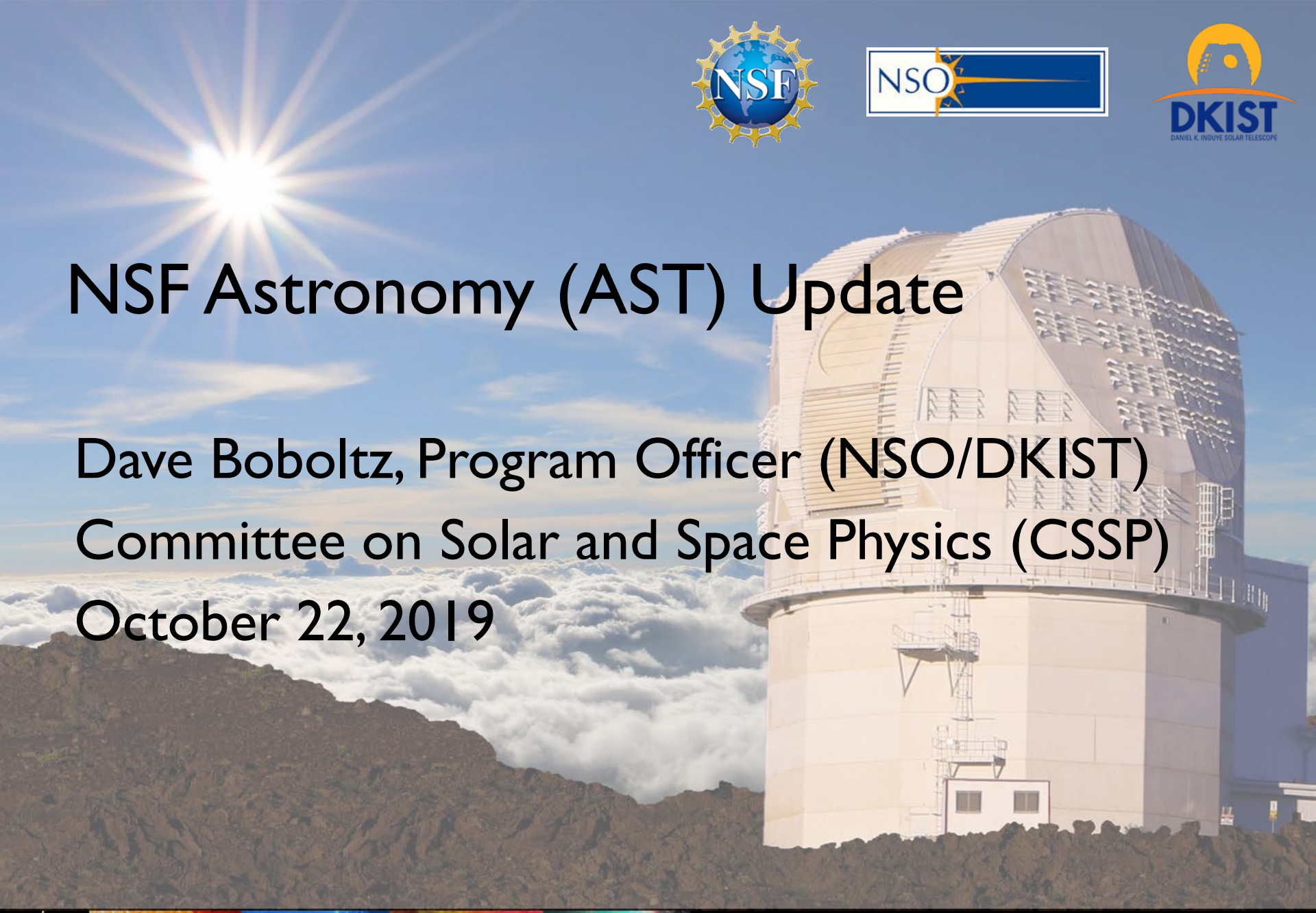


NSF Astronomy (AST) Update

Dave Boboltz, Program Officer (NSO/DKIST)

Committee on Solar and Space Physics (CSSP)

October 22, 2019

Programs within AST

Research

Technology/ Instrumentation

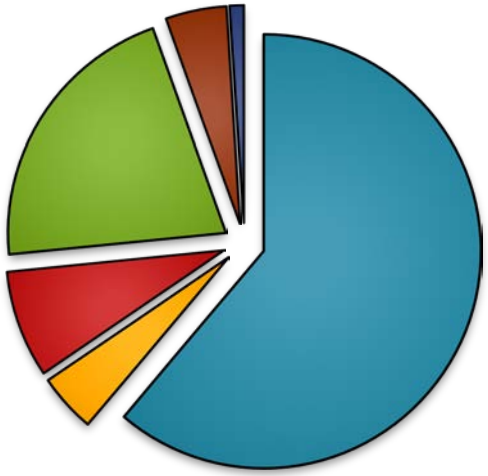
Education and Special Programs

Individual Investigator

- AAG
- CAREER
- AAPF
- ATI
- MRI
- REU
- PAARE

Mid-scale

- MSIP

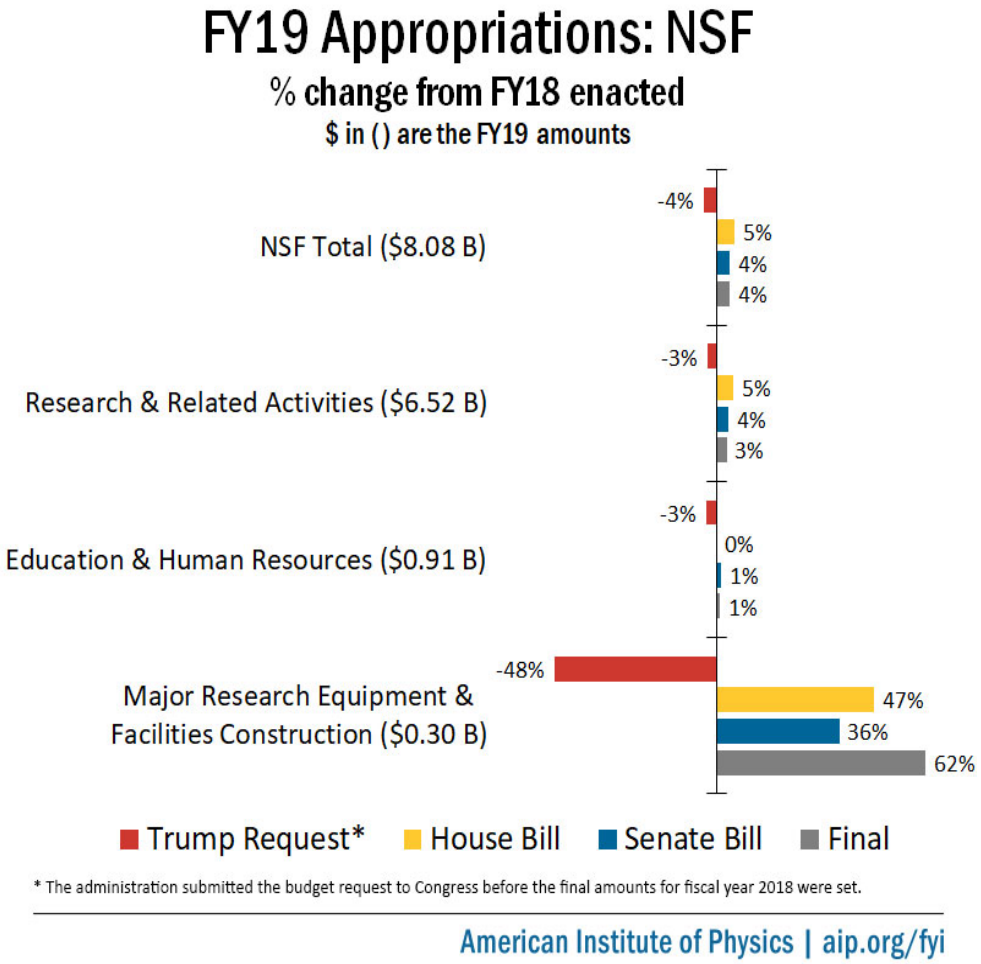


Facilities

- ALMA
- NRAO
- Gemini
- NOAO
- LSST
- Arecibo
- NSO
- GBO

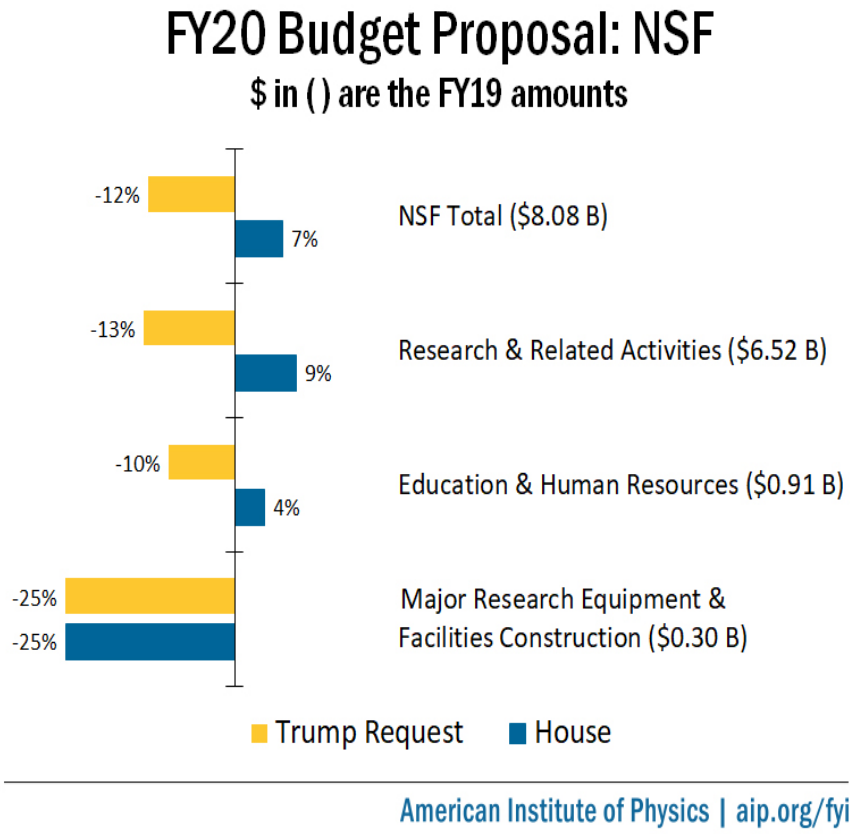
FY 2019 Appropriation Enacted

- NSF top line $8.08B
  - up 8% ($580M) from FY18
- AST
  - Up some from $306.9M in FY18
  - Final numbers not yet available

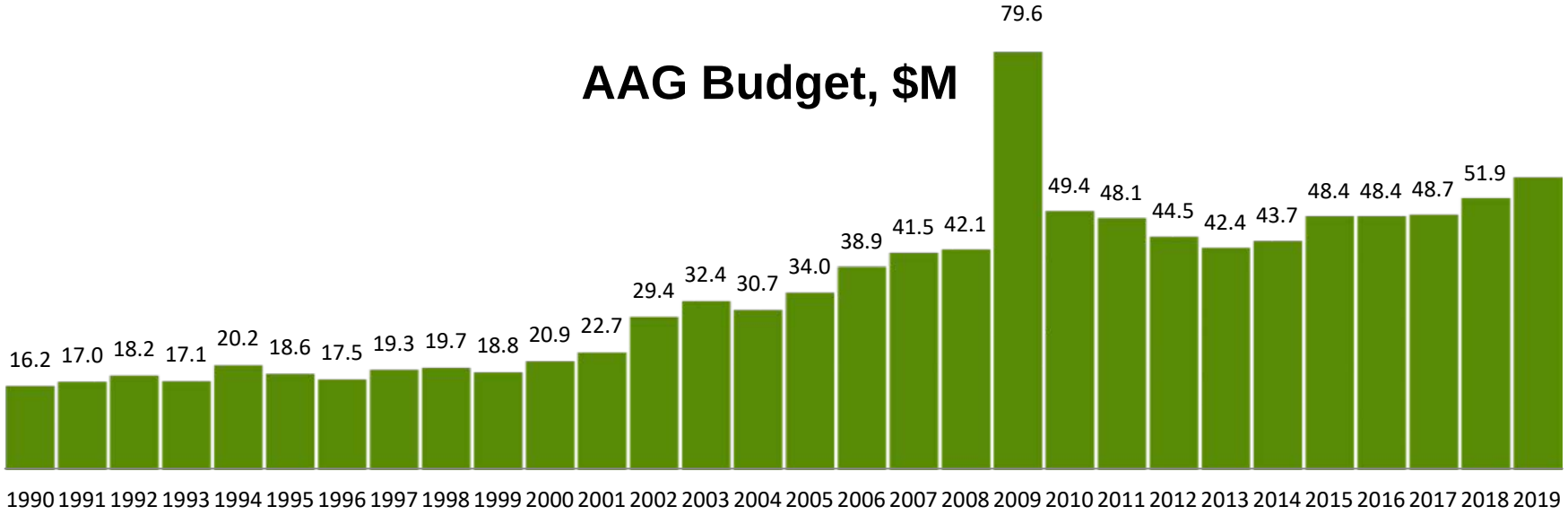


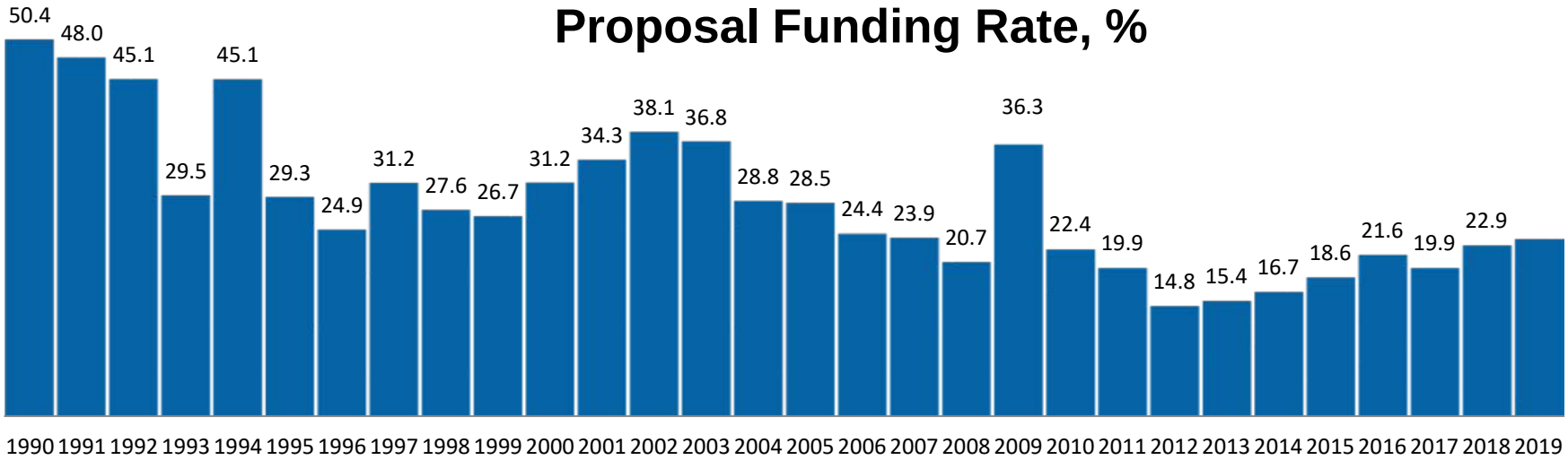
FY 2020 Budget Request

- Currently operating under a CR until Nov. 21, 2019
- President's Budget Request down from FY19 PBR levels
- AST Request
  - Total $212.9M
  - Down from FY19 PBR
- Preliminary Congressional markups up from PBR



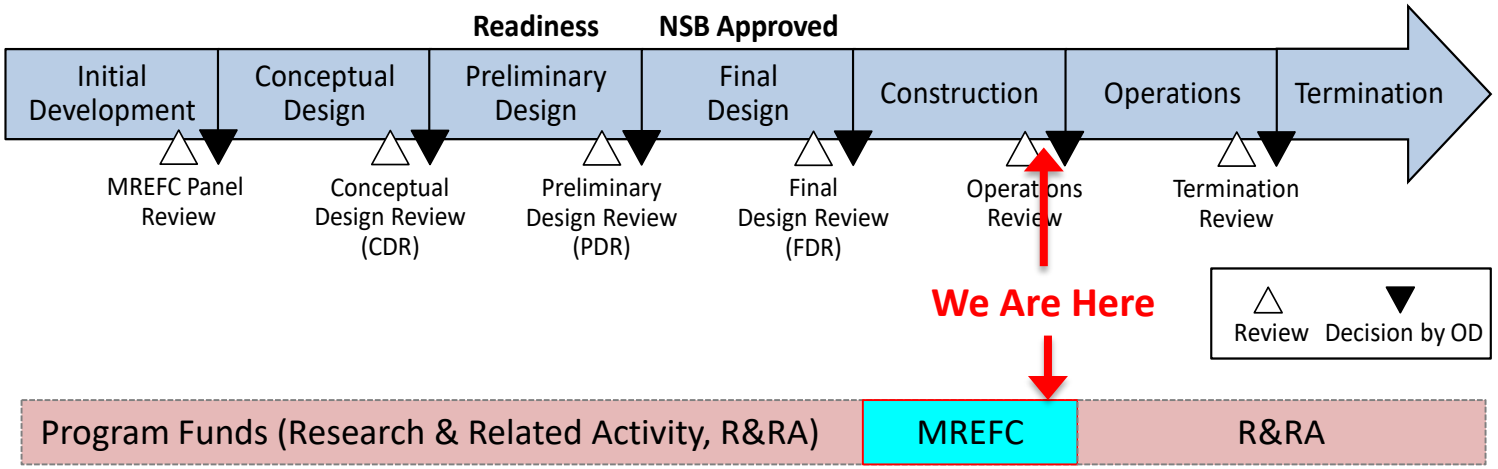
Grants Program (AAG; includes Solar)



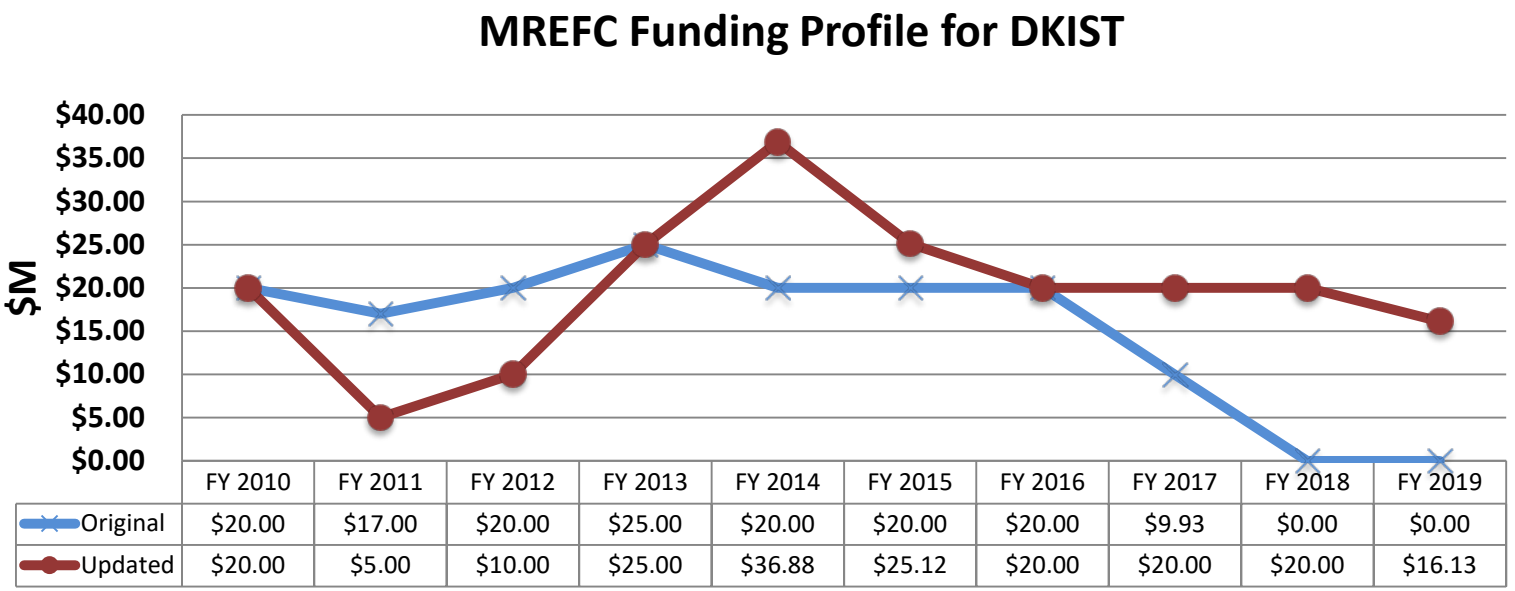


AST Forefront Facilities

DKIST in the NSF Facility Lifecycle



DKIST Construction Funding (MREFC)



	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Original	$20.00	$17.00	$20.00	$25.00	$20.00	$20.00	$20.00	$9.93	$0.00	$0.00
Updated	$20.00	$5.00	$10.00	$25.00	$36.88	$25.12	$20.00	$20.00	$20.00	$16.13

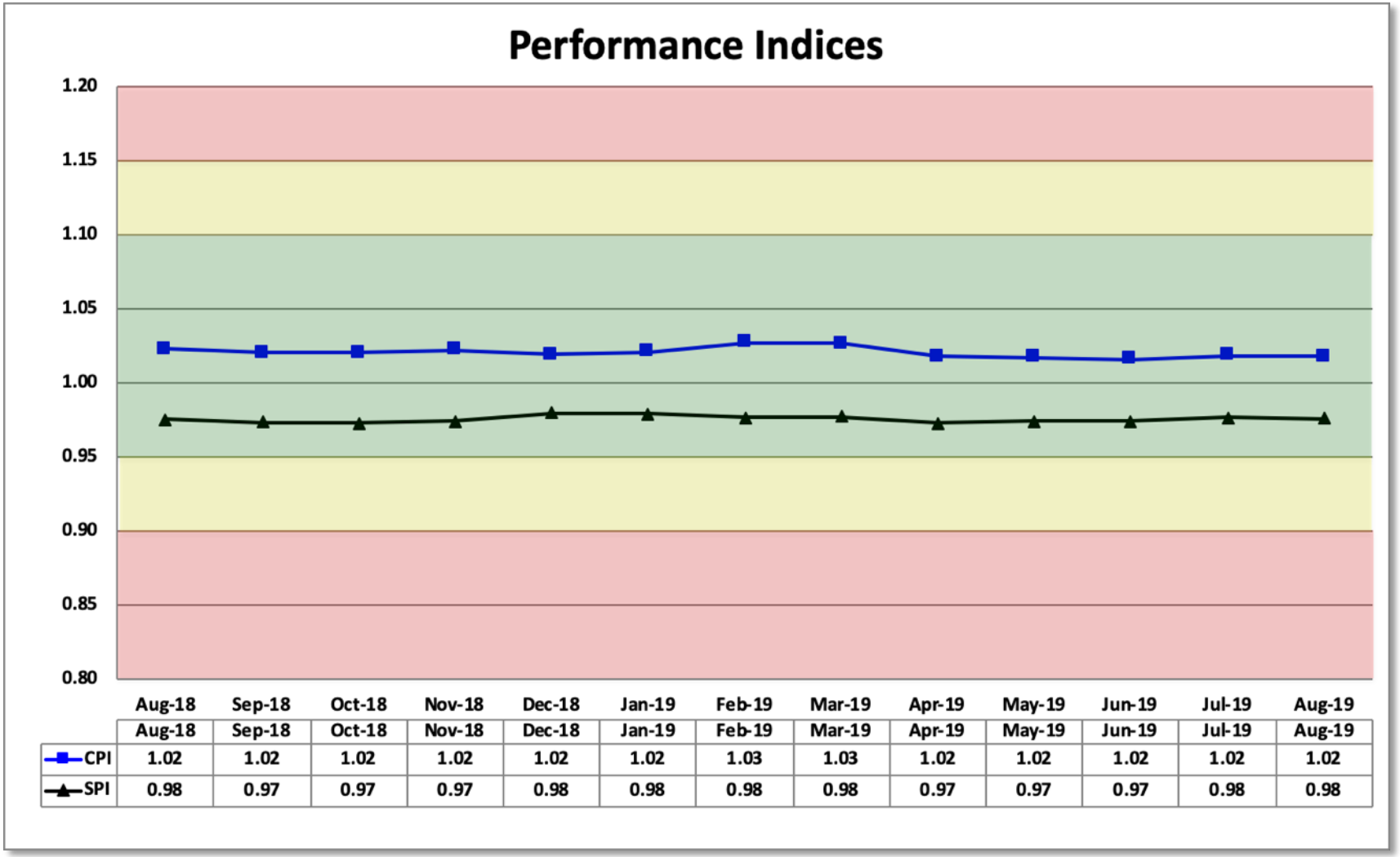
- DKIST Re-baselined Total Project Cost = $344.13M
- Total MREFC awarded $344.13M (DKIST fully funded)
- DKIST Project received $344.05M
  - $60.4K USAF for mirror coating
  - $22.5K 2013 re-baseline review travel costs

DKIST Cost and Schedule Status (Aug. 31, 2019)

- Project 93% complete
- Budget
  - TPC = $344.13M
  - NSF Funding to date = $344.13M ($146M ARRA)
  - Actuals + Commitments = $316.4M
  - Earned Value = $312.8M
  - Budget Contingency = $7.9M (33.5% of remaining estimate to complete)
- Schedule
  - CSA Expiration Date = June 30, 2020
  - Project Baseline Completion date = April 30, 2020
  - Estimated Project Completion date = June 4, 2020
  - Schedule Contingency = ~0.9 months

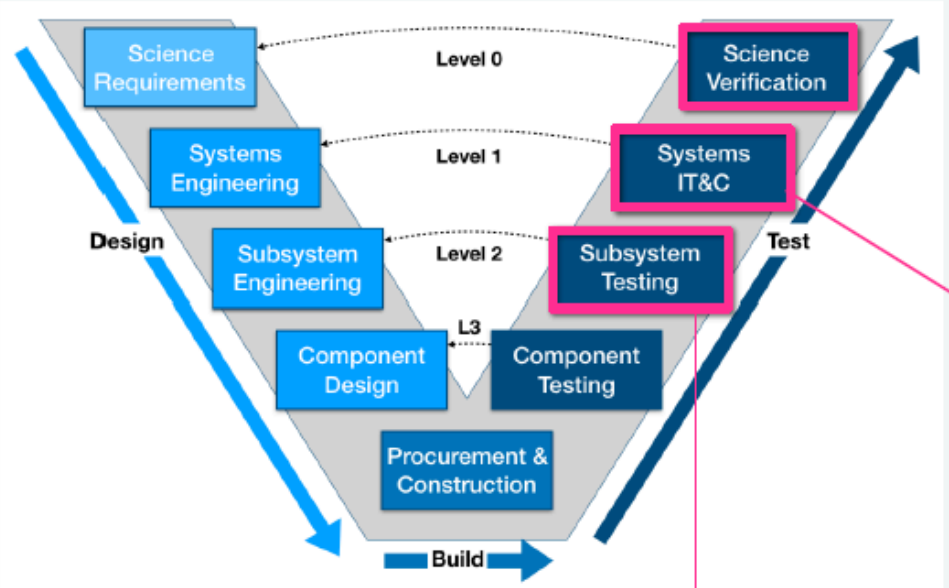
This is a push of about 1.5 months from the last CSSP due to weather and technical issues

Performance Indices



	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19
	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19
CPI	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.02	1.02	1.02	1.02	1.02
SPI	0.98	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.98	0.98

DKIST Project Scope – Principal Remaining Work



- TI Fit/Finish, FTS, Site Closeout
- M8 Assembly
- FIDO Optics (Beamsplitters)
- Wavefront Correction System
- Visible Broadband Imager
- PA&C / GOS
- Partner Instruments:
  - Cryo-NIRSP
  - DL-NIRSP
  - ViSP
  - VTF
- Visible Cameras (VTF)

Remaining Subsystems to be Delivered

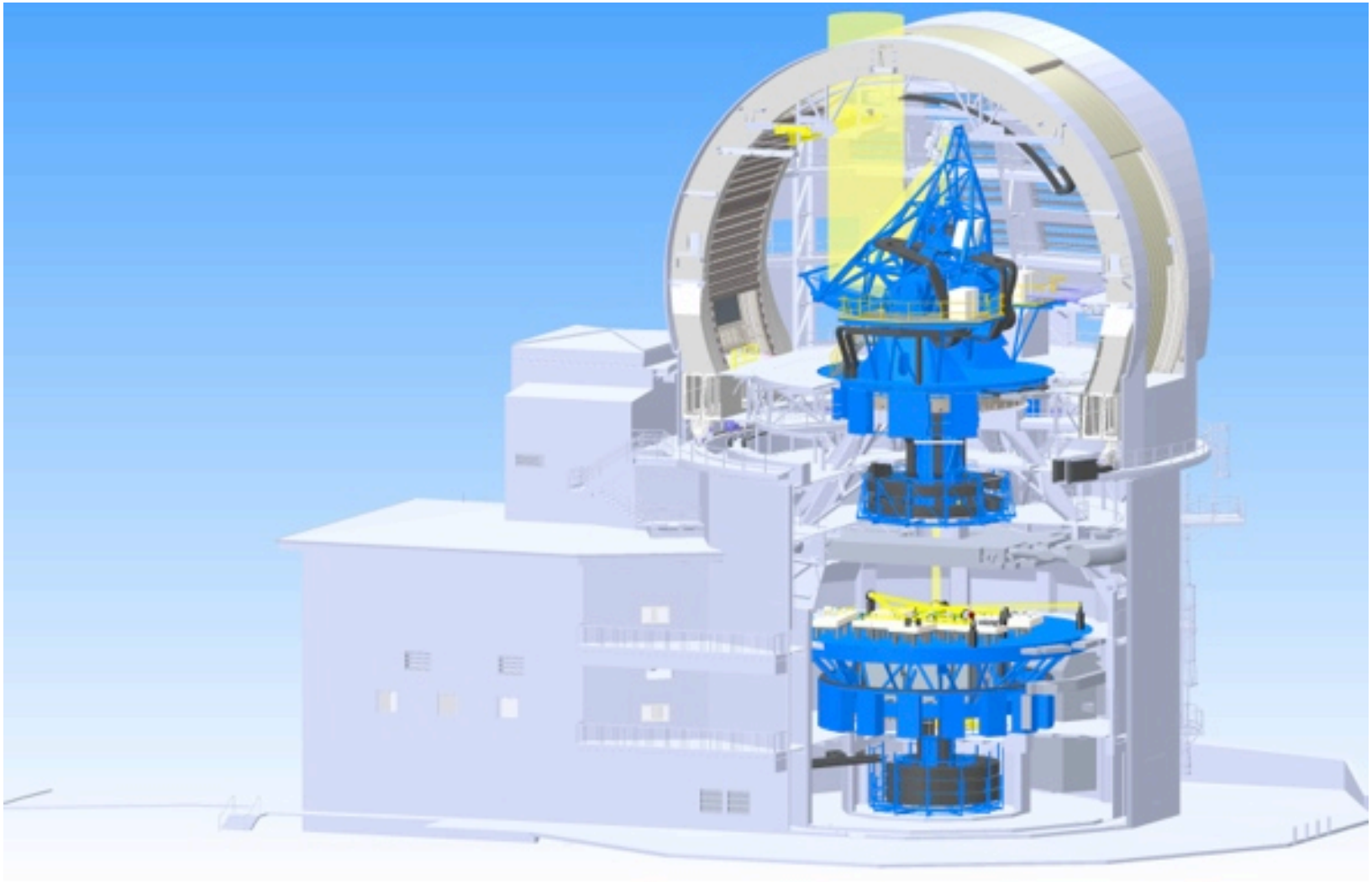
- ~~SIM 1 - Telescope Pointing Map~~
- ~~SIM 2 - M1 Integration~~
- ~~SIM 3 - M1 and M2 Integration~~
- ~~SIM 4 - M1 M6 Integration~~
- ~~SIM 5 – Coude Optics + FIDO~~
- ~~SIM 6a - VBI Integration –~~
- ~~SIM 6b - WFC Integration~~
- SIM 7 - First Light Initiative
- ~~SIM 8 - GOS Integration~~
- SIM 9a - Cryo-NIRSP Integration
- SIM 9b - DL-NIRSP Integration
- SIM 9c - ViSP Integration
- SIM 9d - VTF Integration
- SIM 10 - Polarization Calibration
- SIM 11 - Commissioning & Verification

SIM Status

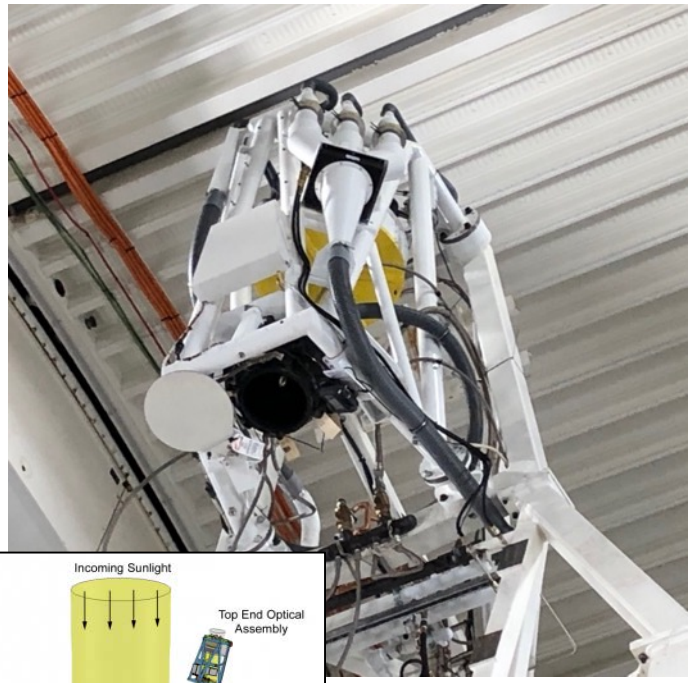
Current Construction Site

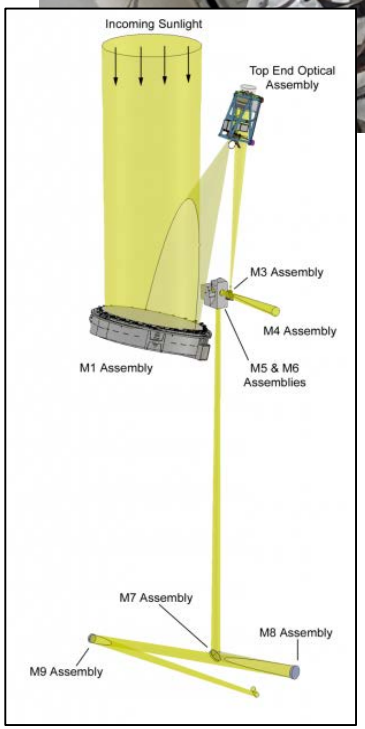
Facility Thermal Systems (FTS)

DKIST Cutaway View

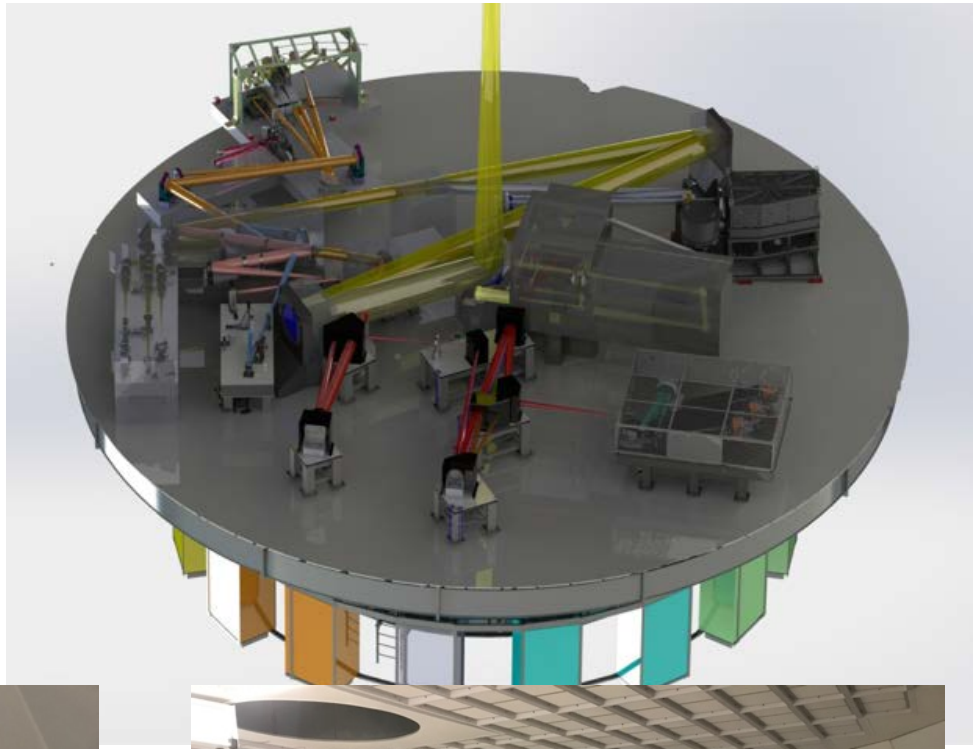


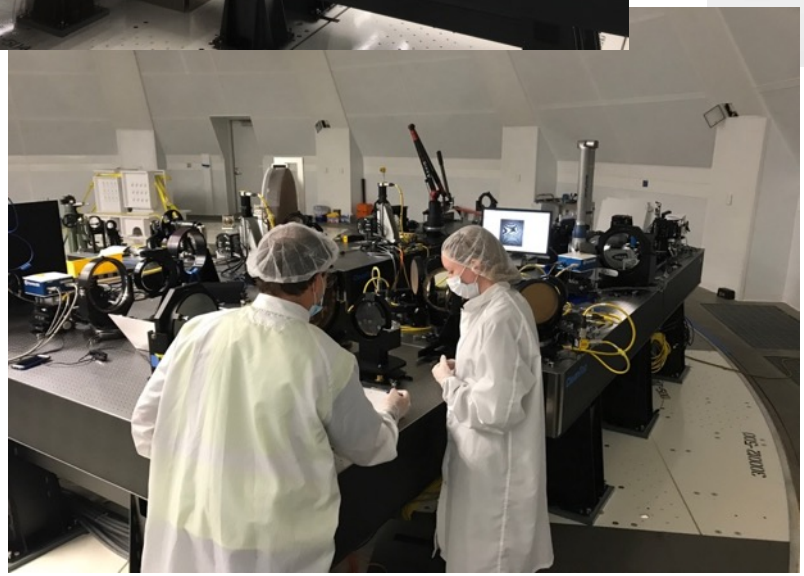
Telescope Level



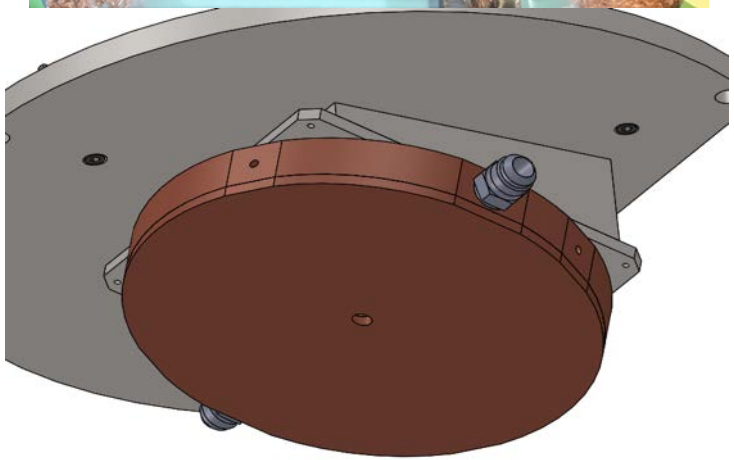


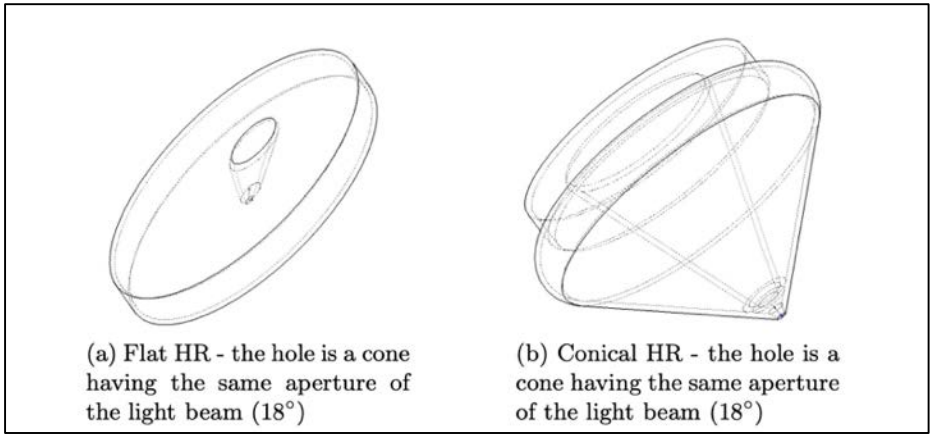
Coudé Rotator Lab





Heat Stop

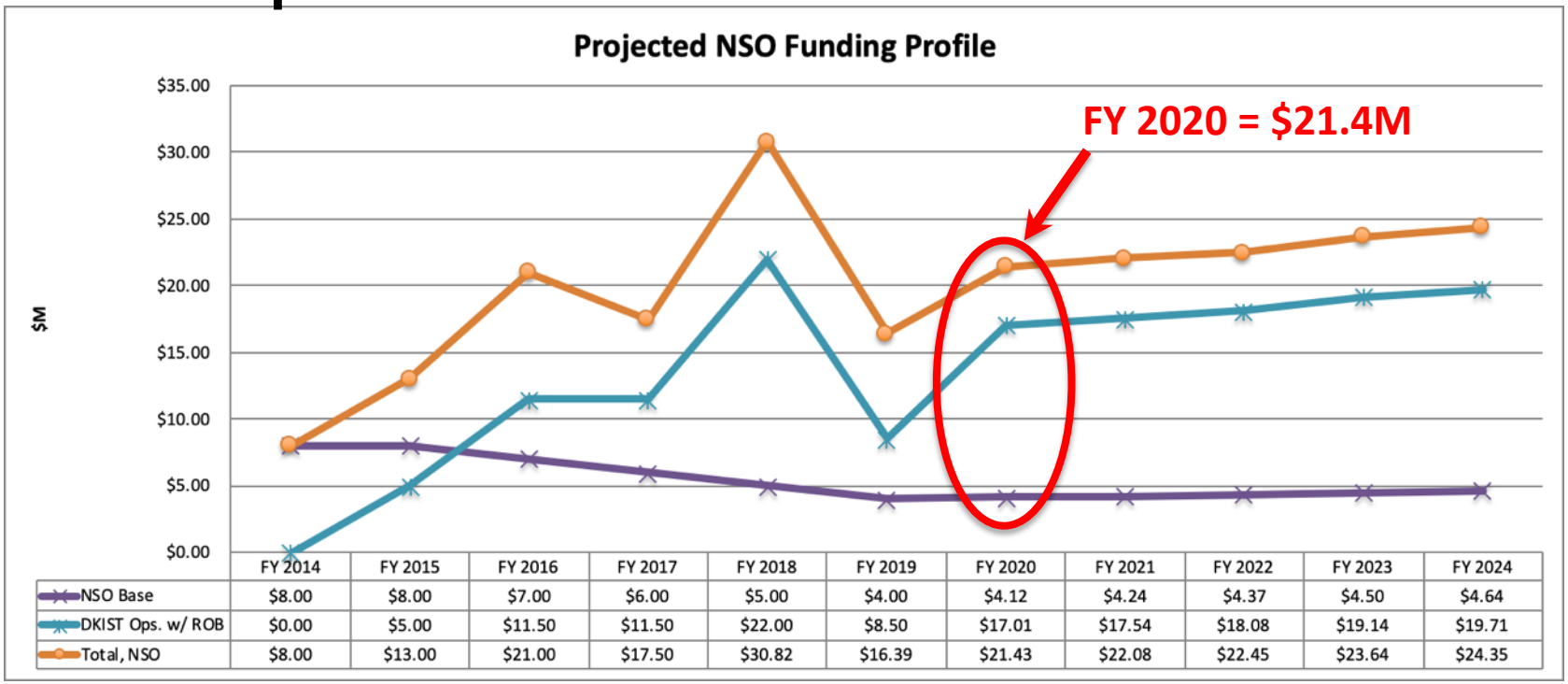




(a) Flat HR - the hole is a cone having the same aperture of the light beam (18°)

(b) Conical HR - the hole is a cone having the same aperture of the light beam (18°)

NSO Operations & Maintenance

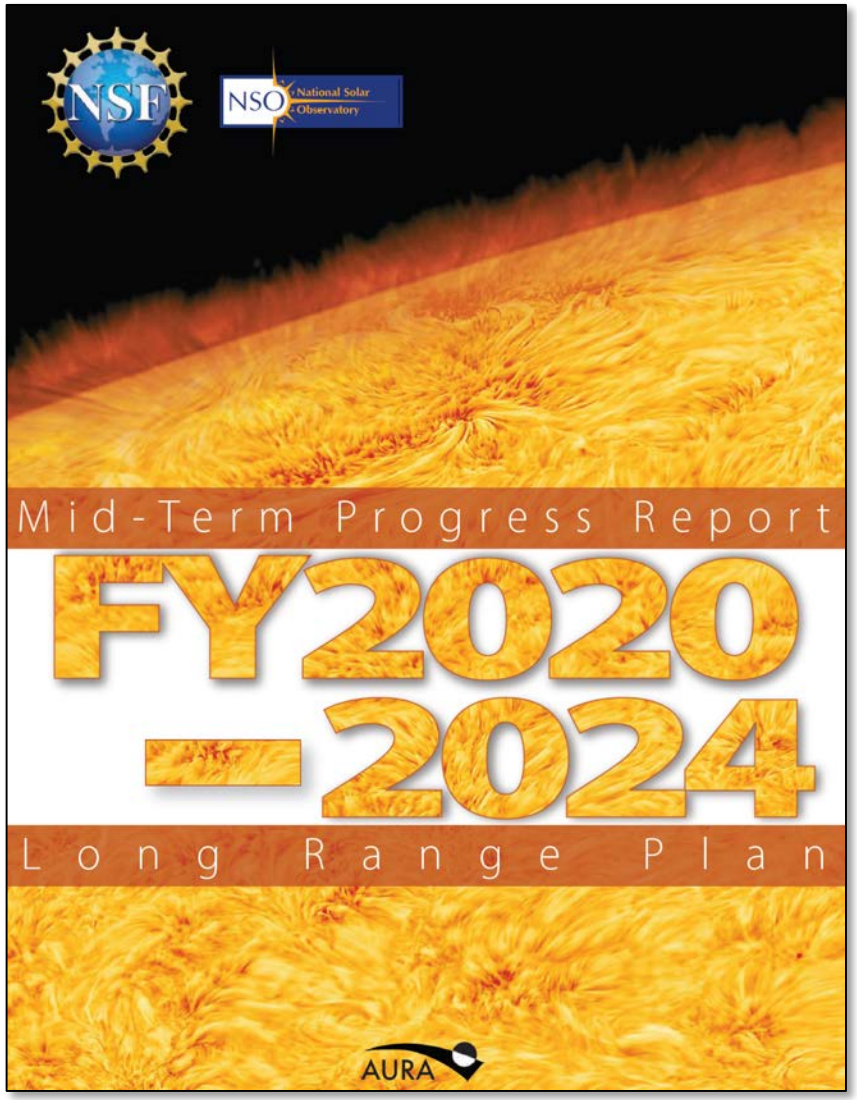


	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
NSO Base	$8.00	$8.00	$7.00	$6.00	$5.00	$4.00	$4.12	$4.24	$4.37	$4.50	$4.64
DKIST Ops. w/ ROB	$0.00	$5.00	$11.50	$11.50	$22.00	$8.50	$17.01	$17.54	$18.08	$19.14	$19.71
Total, NSO	$8.00	$13.00	$21.00	$17.50	$30.82	$16.39	$21.43	$22.08	$22.45	$23.64	$24.35

- FY 2019 O&M = $16.4M (prelim. execution)
  - DKIST Level-2 Data Products = $3.5M
  - Legacy facilities = $400K

NSO Comprehensive Mid-term Review

- Review conducted:
  - July 30–Aug. 1, 2019
- Review material:
  - NSO Mid-term Progress Report (MPR) and FY2020 - FY2024 Long Range Plan (LRP)



Review Panel Charge (summary)

In assessing the performance of AURA/NSO as described in the MPR and LRP, the review panel should consider the criteria described in each of the four broader areas below, as well as the integration of these elements into a coherent and viable plan for the National Solar Observatory in the era of the Daniel K. Inouye Solar Telescope.

- **Overall Management Concept**
  - Strategic Vision, Management, Organizational Structure, Business Services, Staffing & Workforce Development
- **Operations, Science and Programs**
  - Scientific Resources, Technical Capabilities, Service to the Stakeholder Community, NISP, NCSP, DKIST
- **Education and Public Outreach**
  - Community Engagement, Public Engagement, STEM Outreach, Broadening Participation
- **DKIST Transition to Operations**
  - Operations Concept, Implementation Plan, Data Center and Data Products, Staffing

Panel's Final Report

- Delivered – Sept. 2, 2019
- Overall panel findings very positive!
- 30 Findings/Recommendations
  - 17 DKIST related
- Report transmitted to NSO – Sept. 16, 2019
  - NSO will respond
- Results to be presented to the NSB

NSO Mid-Term Review Panel Report

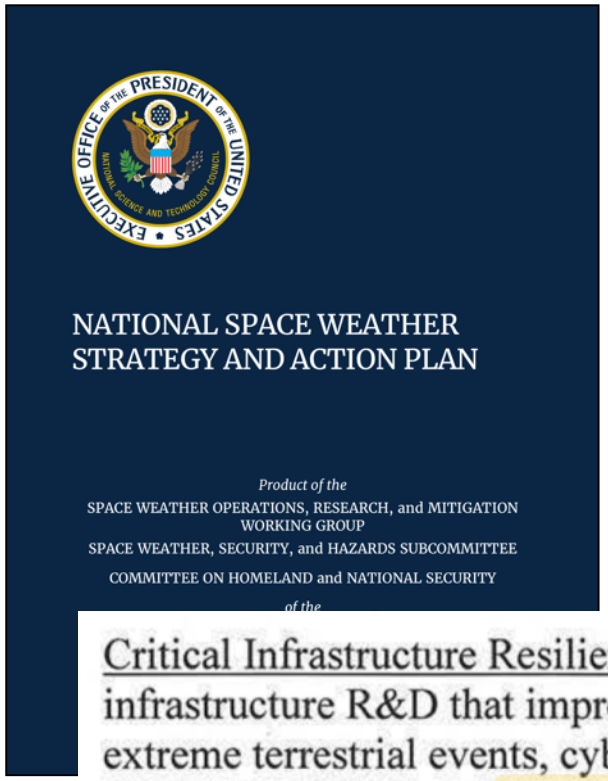
September 2, 2019

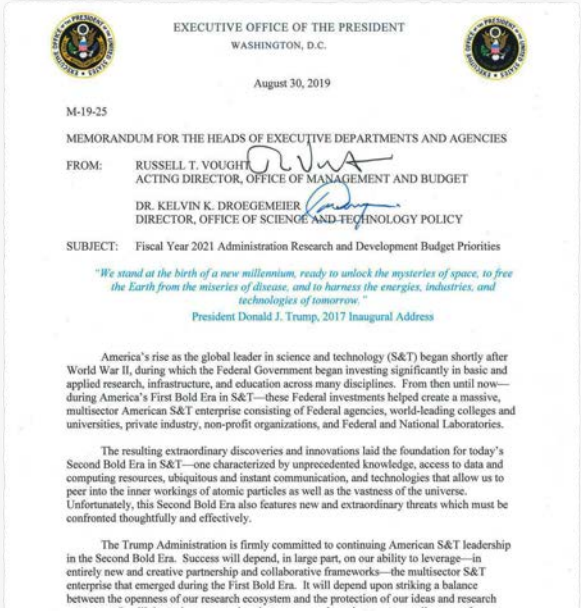
Philip R. Jewell[1] (Chair), David Alexander[2], Christophe Dumas[3], Nicole Duncan[4], Craig Foltz[5], Manolis Georgoulis[6]

[1] National Radio Astronomy Observatory; [2]Rice University; [3]TMT Organization; [4]Ball Aerospace; [5]Gettysburg College; [6]Academy of Athens, Greece & Georgia State University.

Space Weather R&D

OMB FY21 R&D PRIORITIES





EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C.

August 30, 2019

M-19-25

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: RUSSELL T. VOUGHT
ACTING DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

DR. KELVIN K. DROEGEMEIER
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

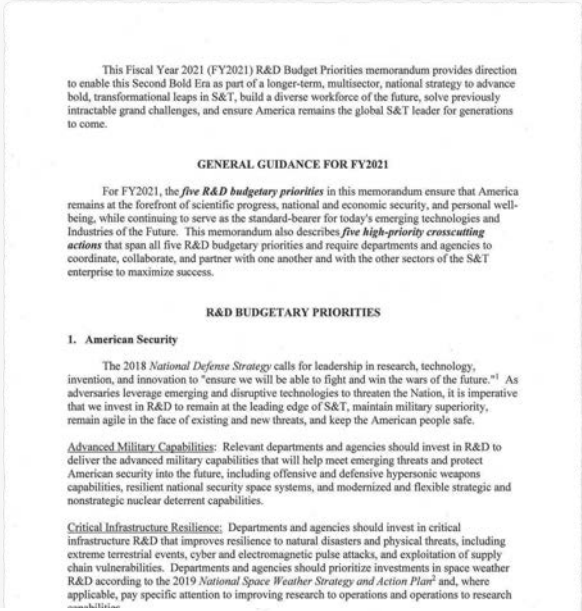
SUBJECT: Fiscal Year 2021 Administration Research and Development Budget Priorities

"We stand at the birth of a new millennium, ready to unlock the mysteries of space, to free the Earth from the miseries of disease, and to harness the energies, industries, and technologies of tomorrow."
President Donald J. Trump, 2017 Inaugural Address

America's rise as the global leader in science and technology (S&T) began shortly after World War II, during which the Federal Government began investing significantly in basic and applied research, infrastructure, and education across many disciplines. From then until now—during America's First Bold Era in S&T—these Federal investments helped create a massive, multisector American S&T enterprise consisting of Federal agencies, world-leading colleges and universities, private industry, non-profit organizations, and Federal and National Laboratories.

The resulting extraordinary discoveries and innovations laid the foundation for today's Second Bold Era in S&T—one characterized by unprecedented knowledge, access to data and computing resources, ubiquitous and instant communication, and technologies that allow us to peer into the inner workings of atomic particles as well as the vastness of the universe. Unfortunately, this Second Bold Era also features new and extraordinary threats which must be confronted thoughtfully and effectively.

The Trump Administration is firmly committed to continuing American S&T leadership in the Second Bold Era. Success will depend, in large part, on our ability to leverage—in entirely new and creative partnership and collaborative frameworks—the multisector S&T enterprise that emerged during the First Bold Era. It will depend upon striking a balance between the openness of our research ecosystem and the protection of our ideas and research



This Fiscal Year 2021 (FY2021) R&D Budget Priorities memorandum provides direction to enable this Second Bold Era as part of a longer-term, multisector, national strategy to advance bold, transformational leaps in S&T, build a diverse workforce of the future, solve previously intractable grand challenges, and ensure America remains the global S&T leader for generations to come.

GENERAL GUIDANCE FOR FY2021

For FY2021, the ***five R&D budgetary priorities*** in this memorandum ensure that America remains at the forefront of scientific progress, national and economic security, and personal well-being, while continuing to serve as the standard-bearer for today's emerging technologies and Industries of the Future. This memorandum also describes ***five high-priority crosscutting actions*** that span all five R&D budgetary priorities and require departments and agencies to coordinate, collaborate, and partner with one another and with the other sectors of the S&T enterprise to maximize success.

R&D BUDGETARY PRIORITIES

1. American Security

The 2018 *National Defense Strategy* calls for leadership in research, technology, invention, and innovation to "ensure we will be able to fight and win the wars of the future."[1] As adversaries leverage emerging and disruptive technologies to threaten the Nation, it is imperative that we invest in R&D to remain at the leading edge of S&T, maintain military superiority, remain agile in the face of existing and new threats, and keep the American people safe.

Advanced Military Capabilities: Relevant departments and agencies should invest in R&D to deliver the advanced military capabilities that will help meet emerging threats and protect American security into the future, including offensive and defensive hypersonic weapons capabilities, resilient national security space systems, and modernized and flexible strategic and nonstrategic nuclear deterrent capabilities.

Critical Infrastructure Resilience: Departments and agencies should invest in critical infrastructure R&D that improves resilience to natural disasters and physical threats, including extreme terrestrial events, cyber and electromagnetic pulse attacks, and exploitation of supply chain vulnerabilities. Departments and agencies should prioritize investments in space weather R&D according to the 2019 *National Space Weather Strategy and Action Plan*[2] and, where applicable, pay specific attention to improving research to operations and operations to research

Critical Infrastructure Resilience: Departments and agencies should invest in critical infrastructure R&D that improves resilience to natural disasters and physical threats, including extreme terrestrial events, cyber and electromagnetic pulse attacks, and exploitation of supply chain vulnerabilities. Departments and agencies should prioritize investments in space weather R&D according to the 2019 *National Space Weather Strategy and Action Plan*[2] and, where applicable, pay specific attention to improving research to operations and operations to research capabilities.

Space Weather: Opportunities for Agency Collaboration

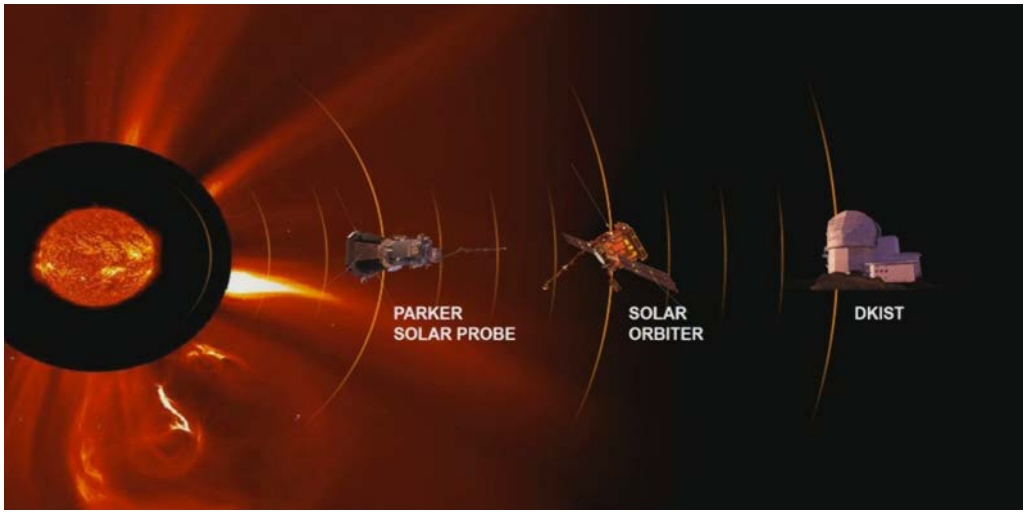
Senate Report 116-127 on CJS Appropriations Bill

In the NASA Heliophysics section of the report

Space Weather Science Applications.—In response to the Space Weather Action Plan and the recommendations of the Decadal Survey, the Committee recommendation provides no less than $20,000,000 for space weather science applications to support innovation in observational capabilities and advance research-to-operations, operations-to-research, and computational aspects of space weather mitigation. NASA should coordinate with NOAA, NSF, and the Department of Defense to ensure that NASA is focused on research and technology that enables other agencies to dramatically improve their operational space weather assets and the forecasts they generate using data from those assets, including current and future ground-based telescopes and instruments that are expected to come on line, such as the Daniel K. Inouye Solar Telescope. In addition, the Committee recognizes the diversity of activities within Living With a Star [LWS] that contribute to our understanding of the societal impact of the Sun-Earth system and encourages the Administrator to ensure that future budget proposals support missions that are currently operating and enable the formulation and development of future missions, including the next LWS mission.

New Collaboration Opportunities

Particles, fields, and photons



SOLAR PHYSICS IN THE 2020s: DKIST, PARKER SOLAR PROBE, AND SOLAR ORBITER AS A MULTIMESSENGER CONSTELLATION[1]

Valentin Martinez Pillet, NSO, USA;
Alexandra Tritschler, NSO, USA;
Louise Harra, PMOD/WRC, Switzerland;
Vincenzo Andretta, INAF/OACN, Italy;
Angelos Vourlidas, JHU/APL, USA;
Nour Raouafi, JHU/APL, USA;
Ben Alterman, UMich, USA;
Luis Bellot Rubio, IAA-Spain;
Gianna Cauzzi, NSO/INAF, Italy;
Steve Cranmer LASP/CU, USA;
Sarah Gibson, HAO/NCAR, USA;
Anik de Groof, ESA, EU;
Shadia Habbal, IfA/UH, USA;
Yuan-Kuen Ko, NRL, USA;
Sue Lepri, UMich, USA;
Jon Linker, PSI, USA;
Sarah Matthews, MSSL/UCL, UK;
Susanna Parenti, IAS, France;
Daniele Spadaro, INAF/OACT, Italy;
Ignacio Ugarte-Urra, NRL, USA;
Harry Warren, NRL, USA;
Reka Winslow, UNH, USA.

[1] Based on the discussions at the DKIST Critical Science Plan Workshop 4: "Joint Science with Solar Orbiter and Parker Solar Probe". JHU/APL, 13 – 15 March 2018, Laurel, MD, USA

PARKER SOLAR PROBE — A MISSION TO TOUCH THE SUN

NASA

solar orbiter

esa

NSF

DKIST
DANIEL K. INOUYE SOLAR TELESCOPE

DKIST, PSP, AND SOLAR ORBITER AS A MULTIMESENGER CONSTELLATION

Next Generation GONG (ngGONG)

- GONG was designed to measure flows. Space Weather was an **R2O evolution.**
- ngGONG will be designed with Space Weather requirements from its inception.
  - Vector Spectromagnetograph
  - Multi-wavelength Doppler instrument for helioseismology
  - Full-disk intensity images
  - Coronagraphs
- NSF – NOAA – USAF
- Decadal survey white papers

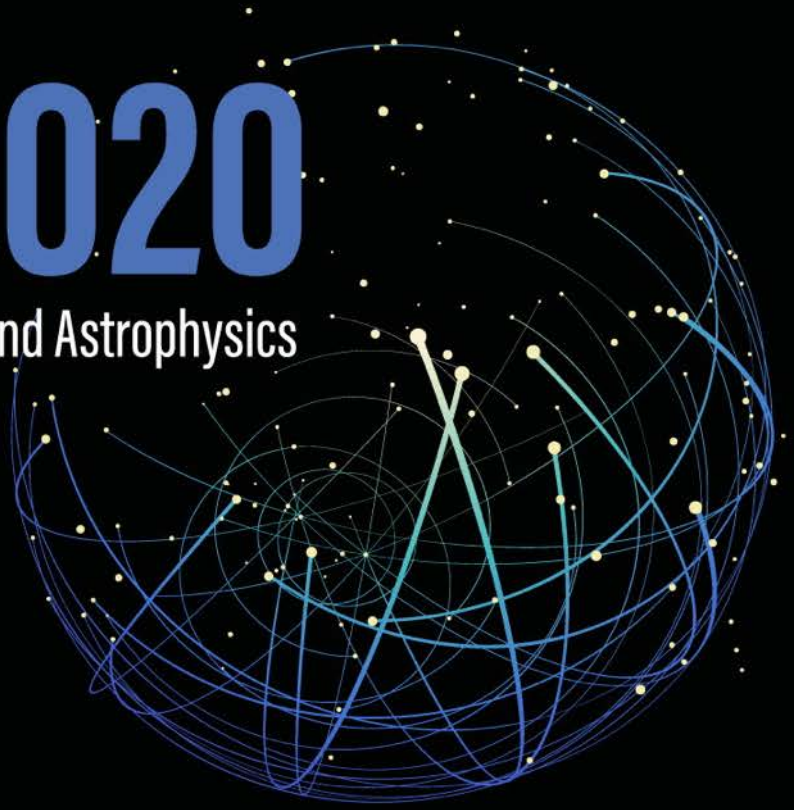
- Forecaster's perspective:

  SHINE 08/09 afternoon
- Researcher's perspective:

  HAO & NSO 09/26-27
- PSTEP 2020 (Nagoya)

Astro 2020

Decadal Survey on Astronomy and Astrophysics



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