NSF Astronomy Update

Richard Green (AST Division Director) and

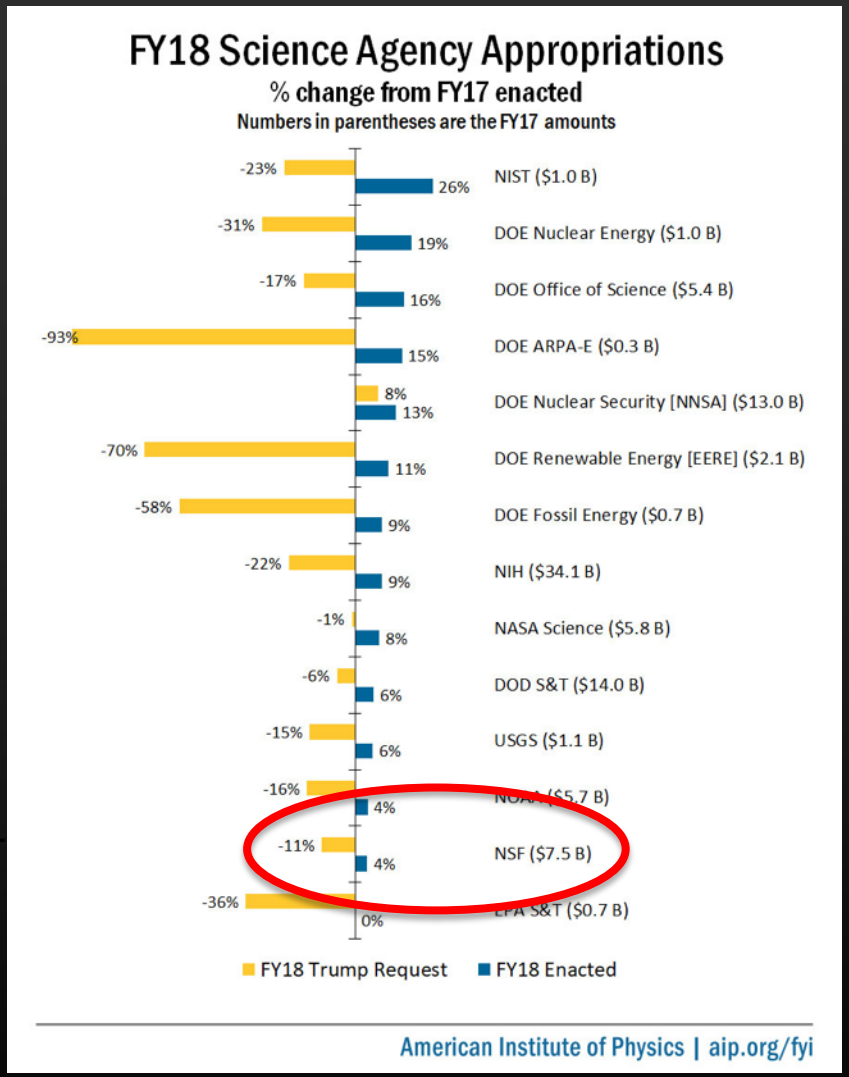
Dave Boboltz (Program Director, NSO/DKIST)

Committee on Solar and Space Physics (CSSP)

October 16, 2018

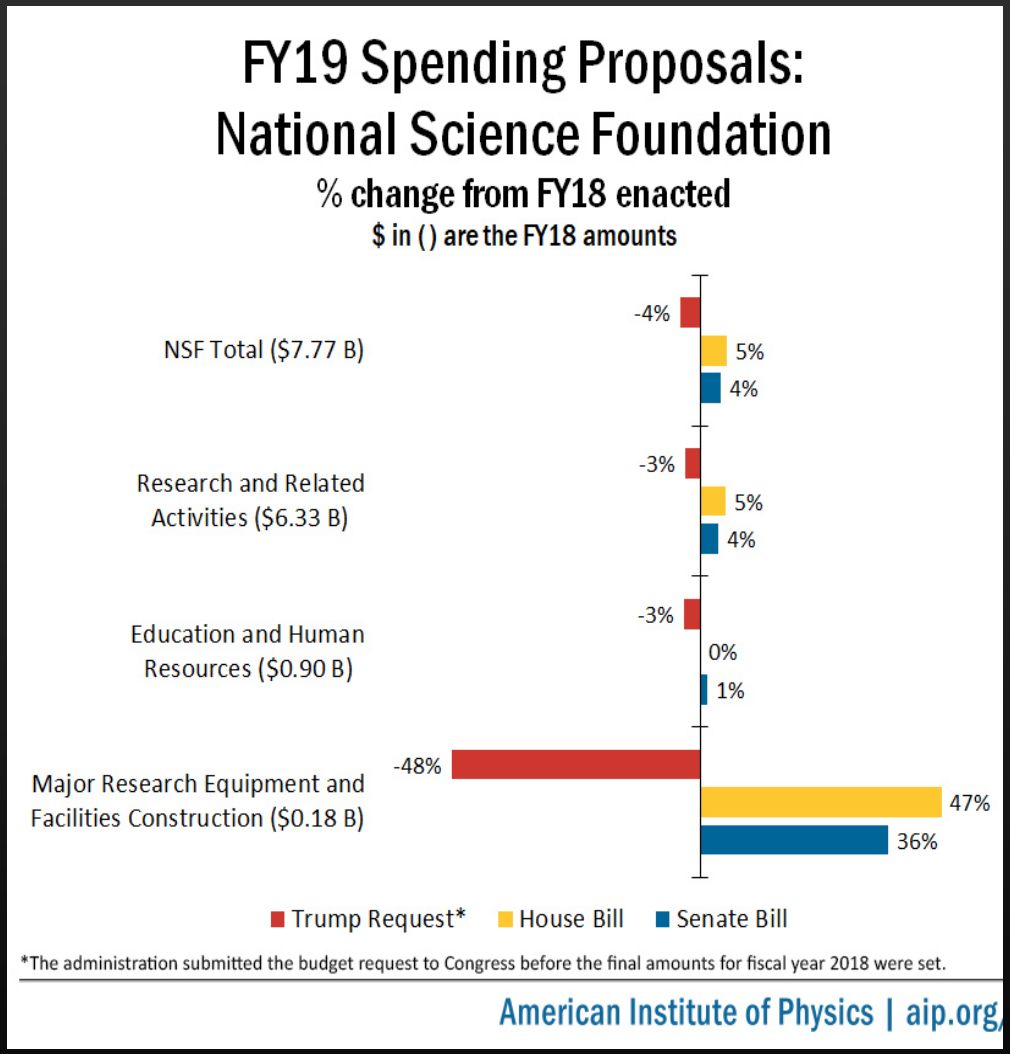
FY 2018 Appropriation Enacted

- NSF top line ~$7.5B
  - up ~4%; ~$295M
- Good outcome for AST
  - Total $307M
  - Up ~22% from $252M in FY17
- Much of the additional funding went to one-time specific projects (some dependent on FY19 availability of funds to complete).
  - MSIP
  - Multi-messenger Astrophysics grants
  - DKIST ops forward-funding
  - DKIST Leve-2 Data Products
  - Center infrastructure upgrades



FY 2019 Budget

- President's Budget Request down from FY18 levels
- Congressional subcommittee levels are higher
- ~$300M reserved for Big Ideas
  - Potential ~8% reduction to AST core programs
- NSF is currently under a continuing resolution until Dec. 7, 2018



Big Ideas Where MPS/AST Can Compete

RESEARCH IDEAS

Harnessing Data for 21st Century Science and Engineering

Work at the Human-Technology Frontier: Shaping the Future

Navigating the New Arctic

Windows on the Universe: The Era of Multi-messenger Astrophysics

The Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life: Predicting Phenotype

PROCESS IDEAS

Mid-scale Research Infrastructure

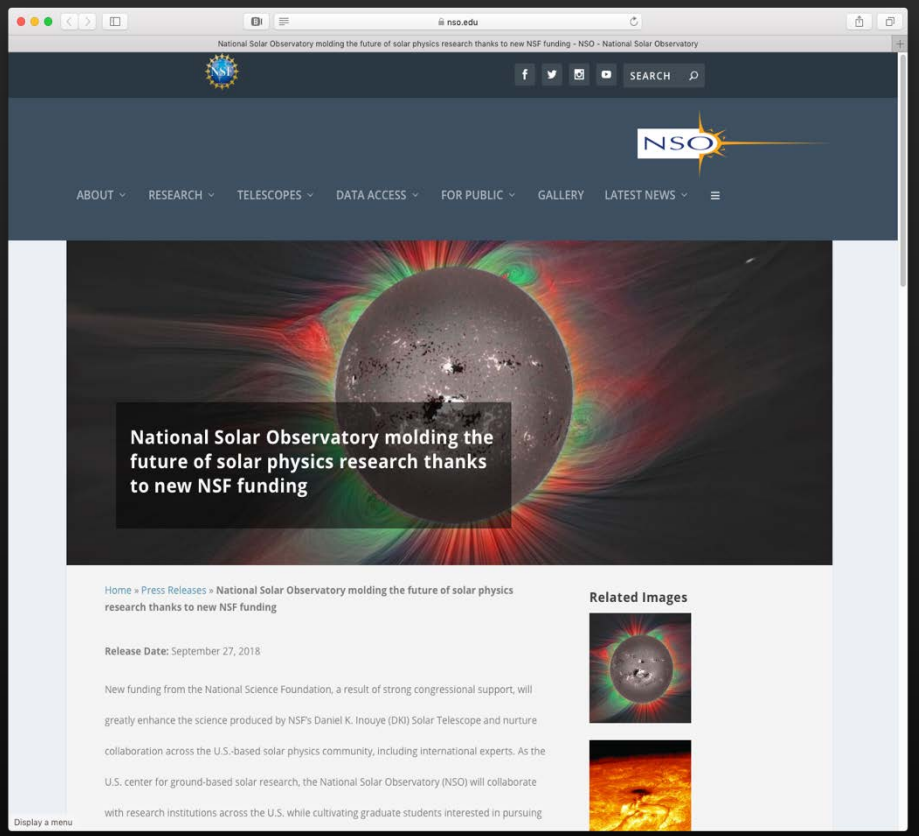
NSF 2050

Convergent Research at NSF

NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

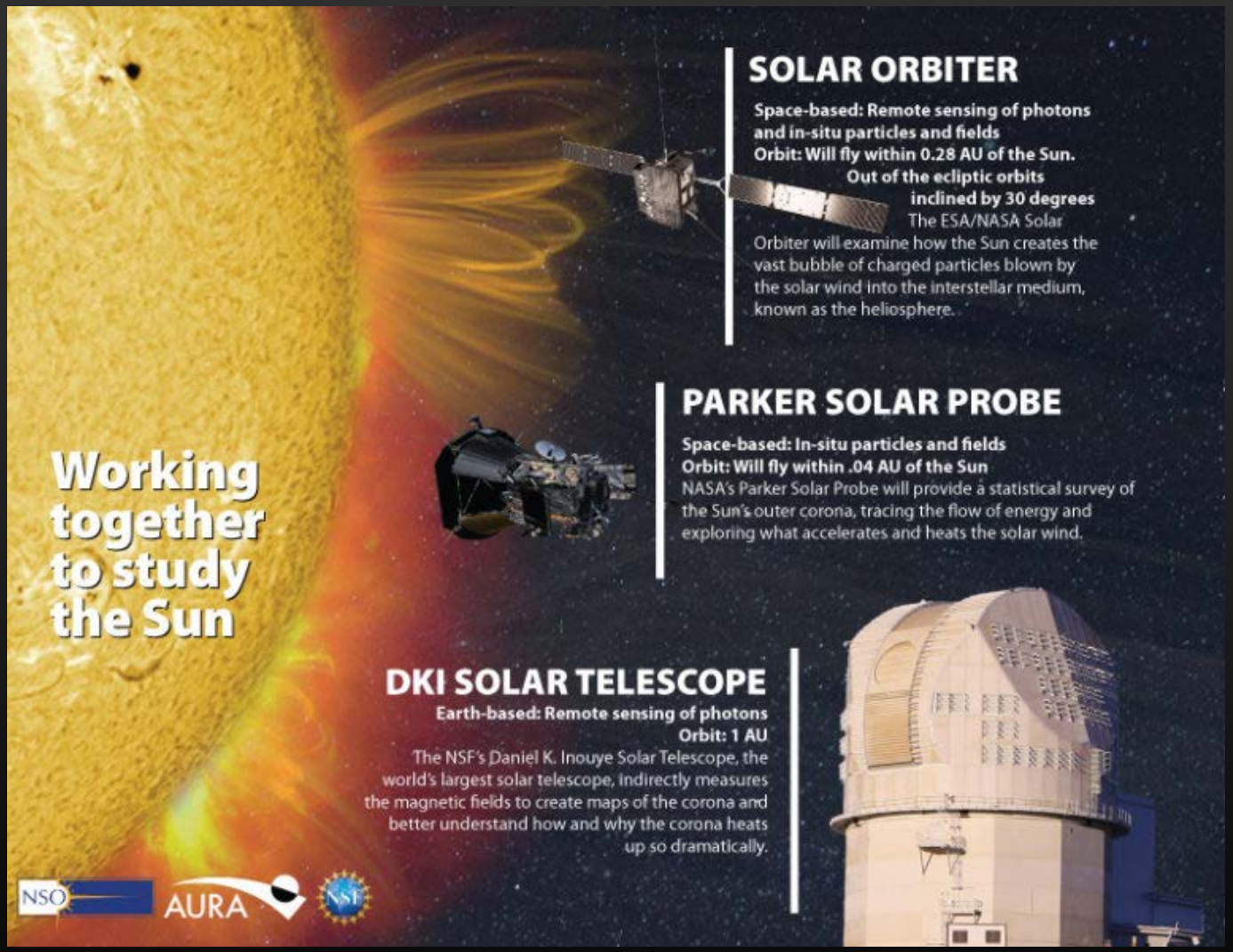
Harnessing the DKIST Data Revolution

- $8.0M forward-funding of FY19 DKIST ops to ensure Data Center development is not restricted by availability of funds
- $3.5M supplemental award made to NSO for the production of DKIST Level-2 Data Products
  - NSO proposal has a substantial community engagement component
  - Additional $3.5M in FY19 contingent upon availability of funds



Multi-Messenger Astrophysics of the Sun

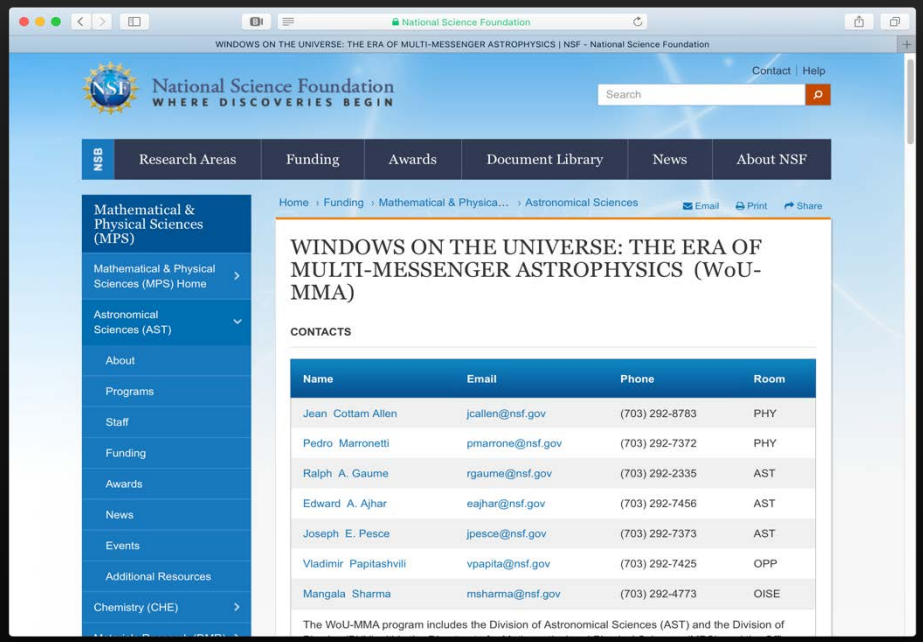
From the NSO Director's Blog



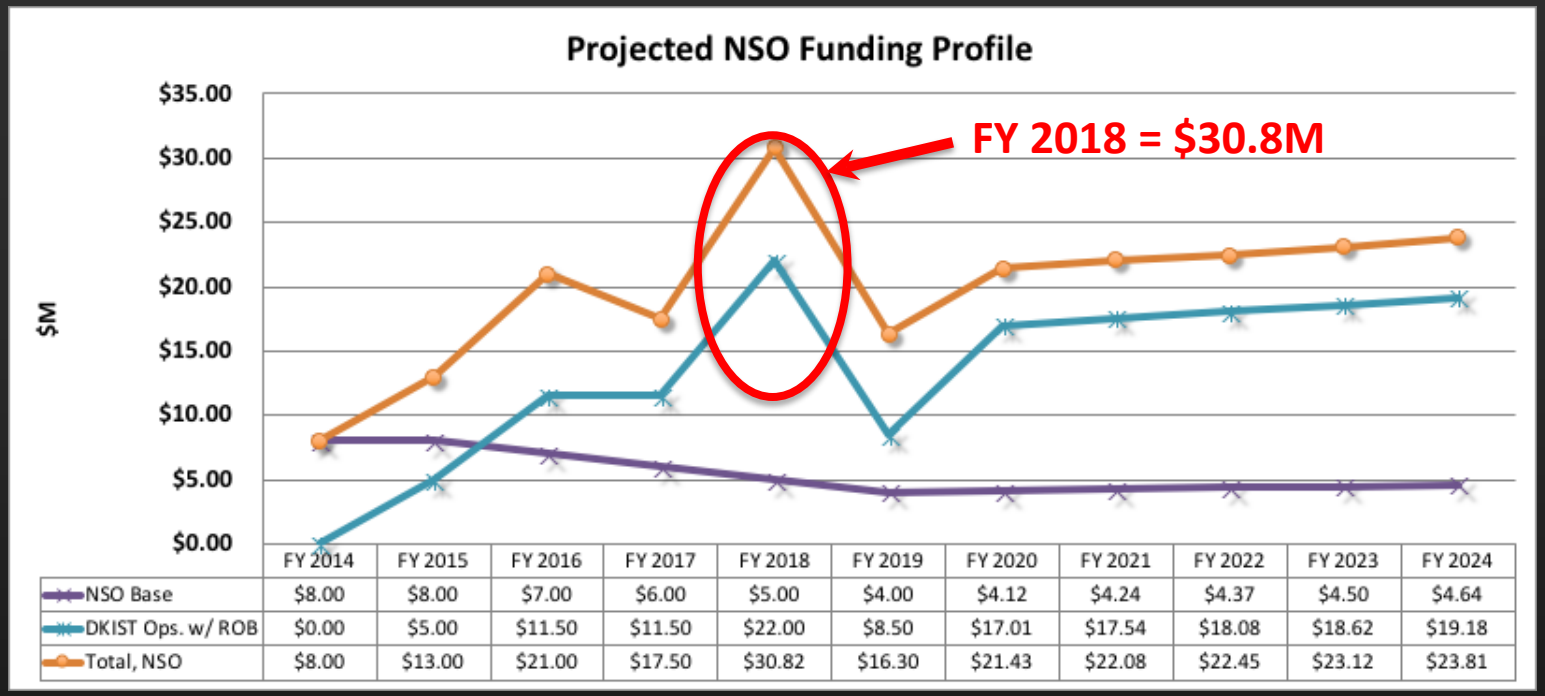
AST Program Changes and Opportunities

- No-deadline SPG pilot program ended Oct. 1, 2018
- Solar Physics proposals will now be submitted to the AAG program (due Nov. 15, 2018)

- NSF Dear Colleague Letter for WoU-MMA
  - $30M allocated to this NSF-wide program
  - Apply to the program through AAG



NSO Operations & Maintenance



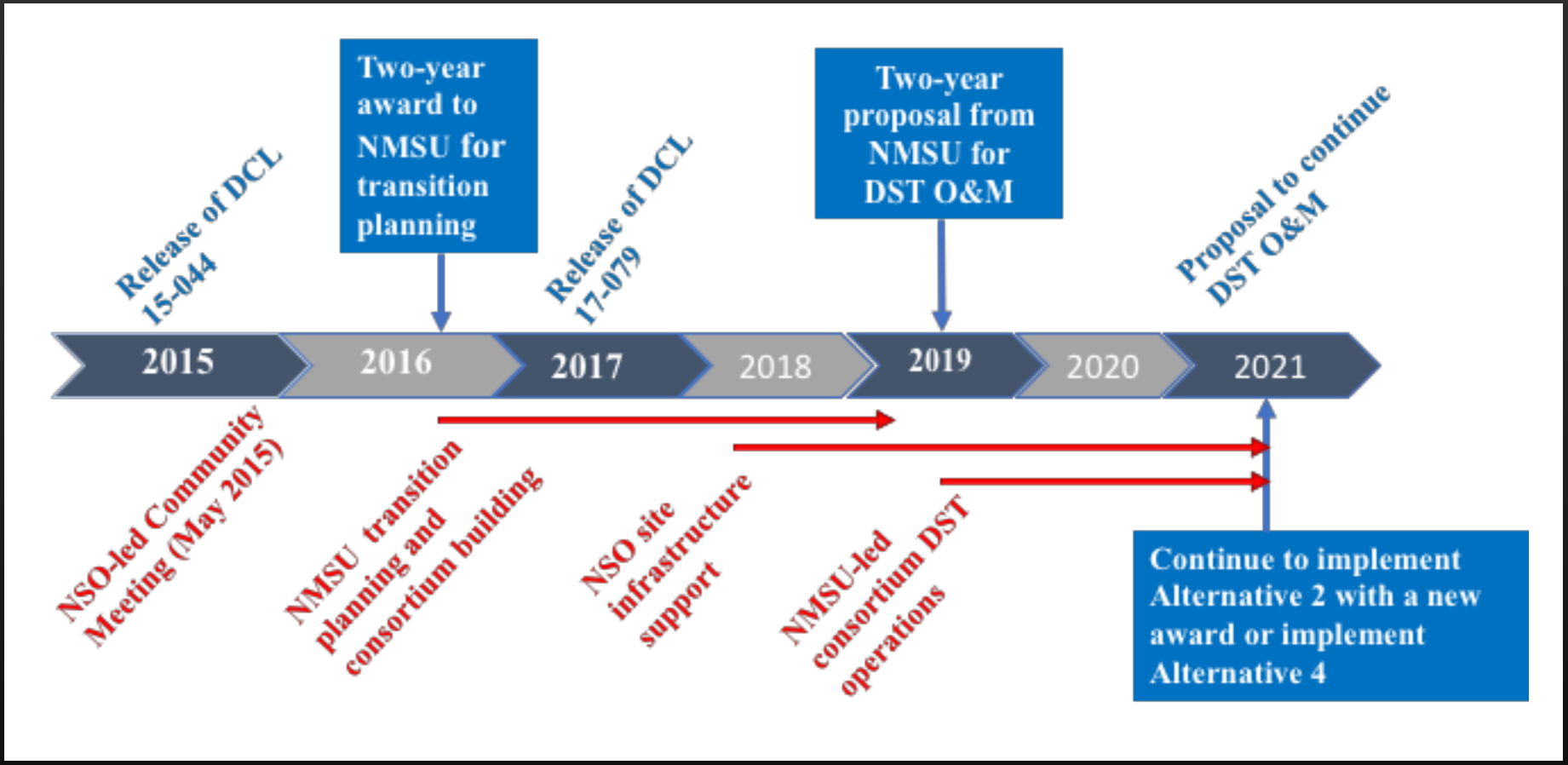
	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
NSO Base	$8.00	$8.00	$7.00	$6.00	$5.00	$4.00	$4.12	$4.24	$4.37	$4.50	$4.64
DKIST Ops. w/ ROB	$0.00	$5.00	$11.50	$11.50	$22.00	$8.50	$17.01	$17.54	$18.08	$18.62	$19.18
Total, NSO	$8.00	$13.00	$21.00	$17.50	$30.82	$16.30	$21.43	$22.08	$22.45	$23.12	$23.81

- FY 2018 awarded = $30.8M includes:
  - DKIST ops forward-fund from FY19 = $8.0M
  - DKIST Level-2 Data Products = $3.5M
  - Sac Peak Infrastructure = $325K
- FY 2019 O&M estimated = $16.3M

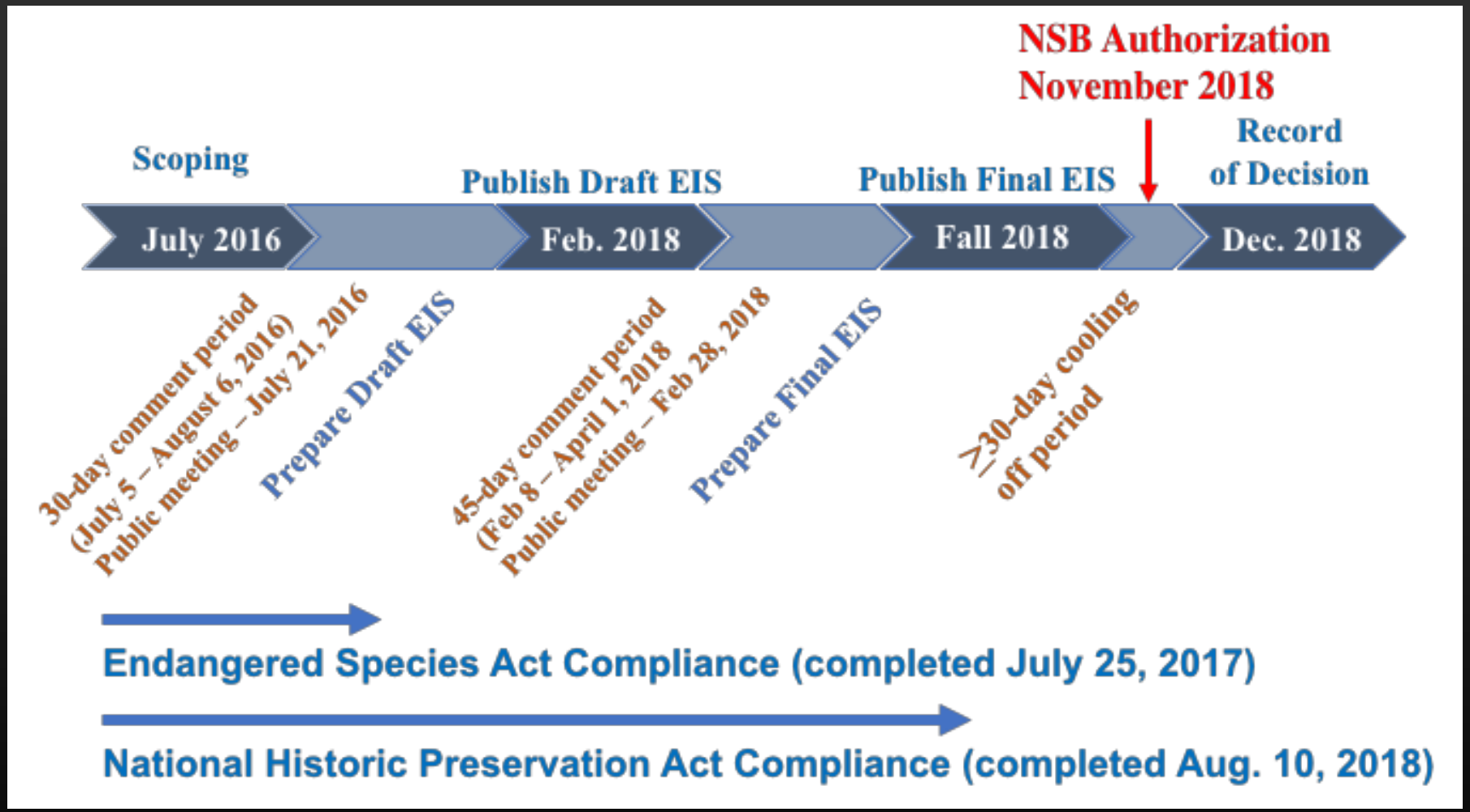
Transition of NSO Facilities on Sac Peak

- Recommended for divestment by the 2012 AST Portfolio Review
- State of New Mexico recently awarded a $273K grant to NMSU July 2018
- 3-year NSF-NMSU-NSO plan
  - NMSU to lead consortium; operate Dunn Solar Telescope and Visitor Center ~$200K/year
  - NSO to operate site infrastructure ~$300K/year

Timeline to Sunspot Solar Observatory



Sac Peak Compliance Schedule



Transition of NSO Facilities on Kitt Peak

- Recommended for divestment by the 2012 AST Portfolio Review
- McMath-Pierce
  - NSF award $4.5M ($3.3M FY18) proposal to the NOAO Visitor Center
  - Will become the Windows on the Universe Center for Astronomy Outreach
  - Plans include exhibit of McMath's contributions to solar physics and NSF astronomy virtual control room
- Vacuum (SOLIS) tower
  - Request for Bids (RFB) to demolish issued Sept. 12
  - Bids due Oct. 19

National Optical Astronomy Observatory NEWS

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A nine-hour exposure of the McMath-Pierce Solar Facility on Kitt Peak. The normally white building appears red due to high altitude haze following the 1991 eruptions of Mount Pinatubo. No filters or multiple exposures were used. Credit: Bill Livingston & NOAO/AURA/NSF.

The sun rises behind the McMath-Pierce Solar Telescope on Kitt Peak. Credit: P. Marenfeld & NOAO/AURA/NSF.

McMath-Pierce and NSF's

National Science Foundation to Fund New Windows on the Universe Center for Astronomy Outreach at Kitt Peak National Observatory

A new $4.5 million grant from the National Science Foundation (NSF) has been awarded to the Association of Universities for Research in Astronomy (AURA) for the development of a new "Windows on the Universe Center for Astronomy Outreach" at NSF's Kitt Peak National Observatory. Located in the McMath-Pierce Solar Telescope facility, an iconic structure that was once the world's largest solar observatory, the center will provide the public with a new way to experience the cutting-edge research being carried out at Kitt Peak and NSF's other astronomy facilities around the globe, including ground-based optical, radio, solar, and gravitational wave facilities.

New Windows on the Universe for the Public

The grant will fund the renovation and transformation of the McMath-Pierce into an astronomy visualization and presentation center with potentially global reach. The center will feature data visualization systems, interactive exhibits, and a simulated telescope control room, which will give visitors the virtual experience of being at a telescope and participating in research carried out at NSF facilities around the world, including those in Hawaii, Chile, and the South Pole.

To highlight its location in the McMath-Pierce facility, the Center will feature special exhibits on the history of solar astronomy. The grant will also fund public programs, including educational programs to be developed in collaboration with the Tohono O'odham Nation. Kitt Peak National Observatory, which is located in the Schuk Toak district on Tohono O'odham Nation land, 56 miles west of Tucson, Arizona, is part of the National Optical Astronomy Observatory (NOAO), which is operated by the AURA under an agreement with NSF.

Visitors to the center will explore the wide variety of research carried out at NSF's astronomy facilities, including Kitt Peak, Cerro Tololo Inter-American Observatory, Gemini Observatory, the Large Synoptic Survey Telescope, and the Daniel K. Inouye Solar Telescope—all managed by AURA—as well as the Very Large Array, Atacama Large Millimeter Array, South Pole Telescope, and Laser Interferometer Gravitational-Wave Observatory.

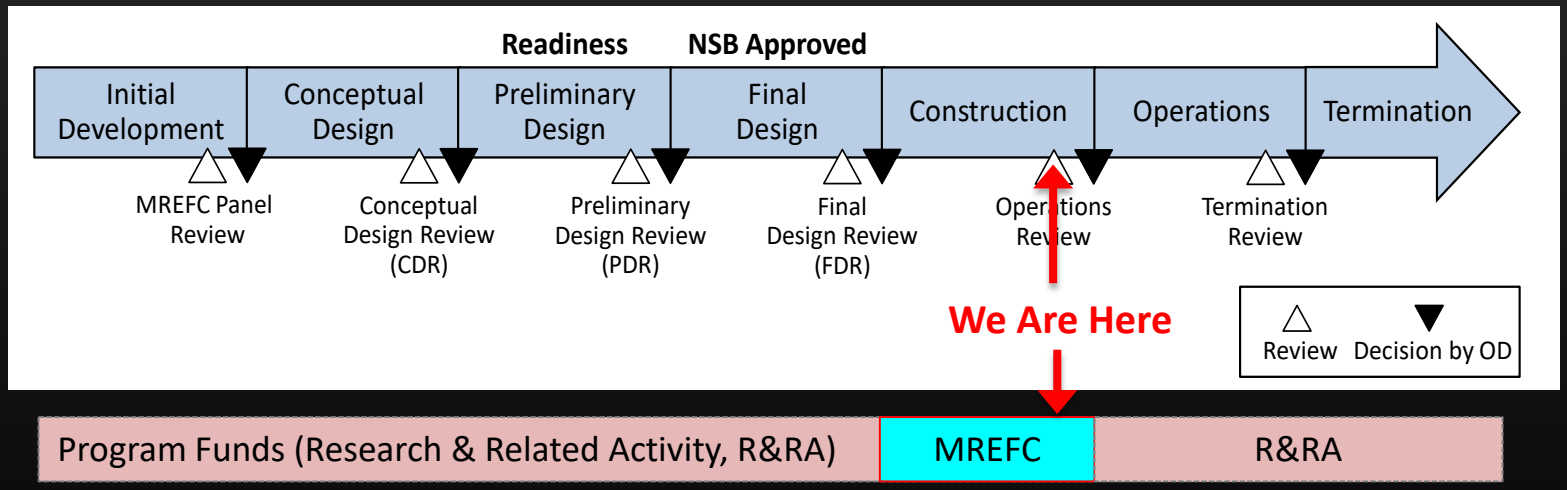
The visualizations created for Windows on the Universe will feature imagery from these NSF facilities and will be designed for export to compatible visualization centers around the world, expanding the center's reach.

NSO Integrated Synoptic Program

- GONG engineering site relocation to Boulder completed
- $2.5M upgrade ongoing

- SOLIS relocation to BBSO experiencing permitting difficulties

DKIST in the NSF Facility Lifecycle

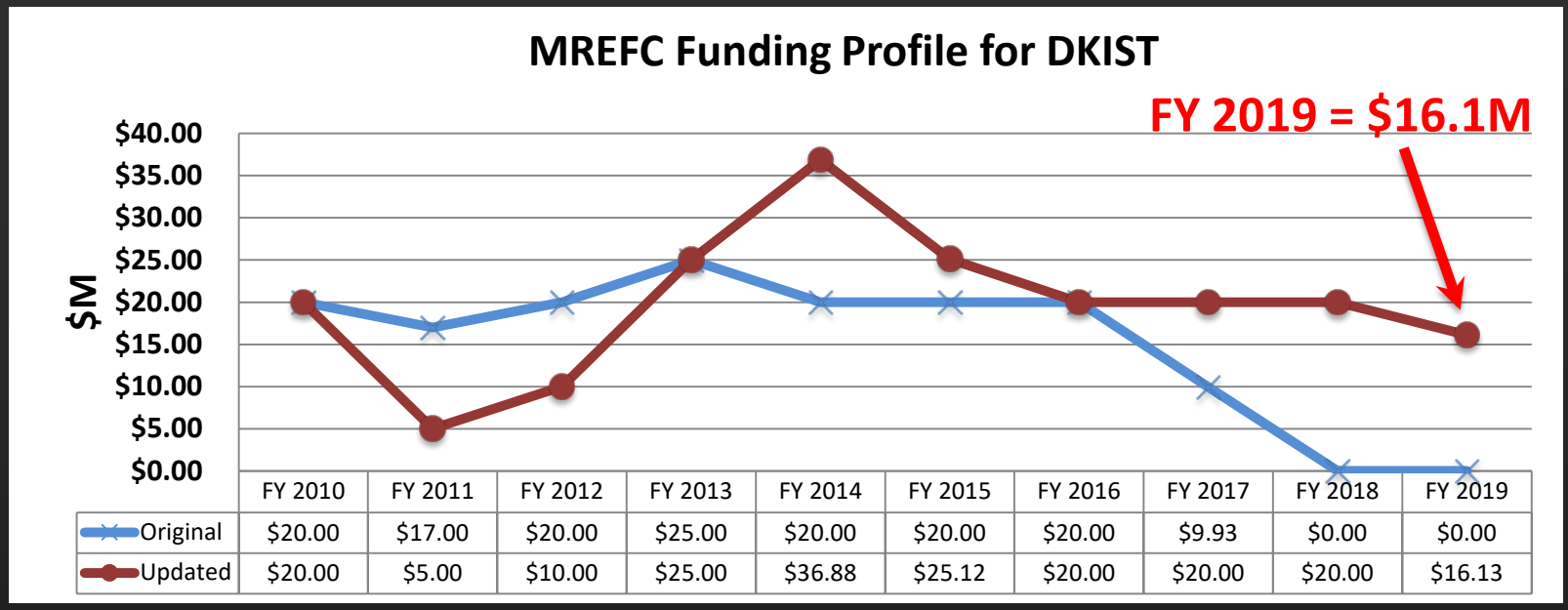


Program Funds (Research & Related Activity, R&RA)	MREFC	R&RA

R&RA funds also support scientific research

Major Research Equipment and Facilities Construction (separate appropriation)

DKIST Construction Funding (MREFC)

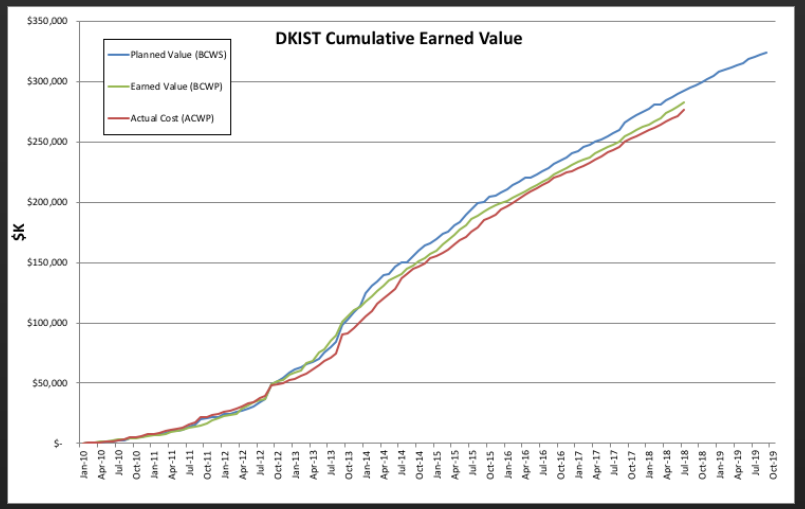


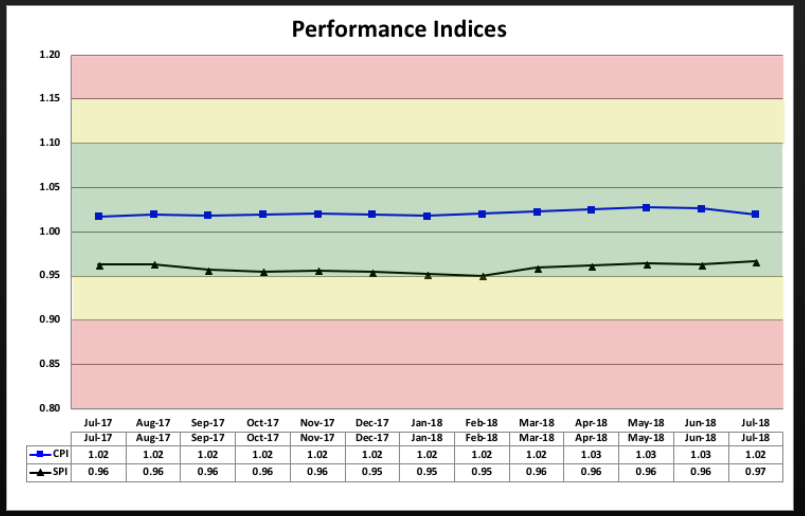
	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Original	$20.00	$17.00	$20.00	$25.00	$20.00	$20.00	$20.00	$9.93	$0.00	$0.00
Updated	$20.00	$5.00	$10.00	$25.00	$36.88	$25.12	$20.00	$20.00	$20.00	$16.13

- DKIST Re-baselined Total Project Cost = $344.13M
- Total MREFC awarded thus far $324.5M
  - $3.5M of contingency withheld for future allocation
- FY 2019 MREFC $16.13M estimated

DKIST Cost and Schedule Status (July 31, 2018)

- Project 87% complete
- Budget
  - TPC = $344.1M
  - NSF Funding to date = $324.5M ($146M ARRA)
  - Actuals + Commitments = $289.4M
  - Budget Contingency = $19.2M (44.5% of remaining estimate to complete)
- Schedule
  - 80% MC CL end date = June 10, 2020
  - Current IPS end date = Jan. 31, 2020
  - Schedule Contingency = 4.3 months
- Performance Indices
  - CPI = 1.02
  - SPI = 0.97





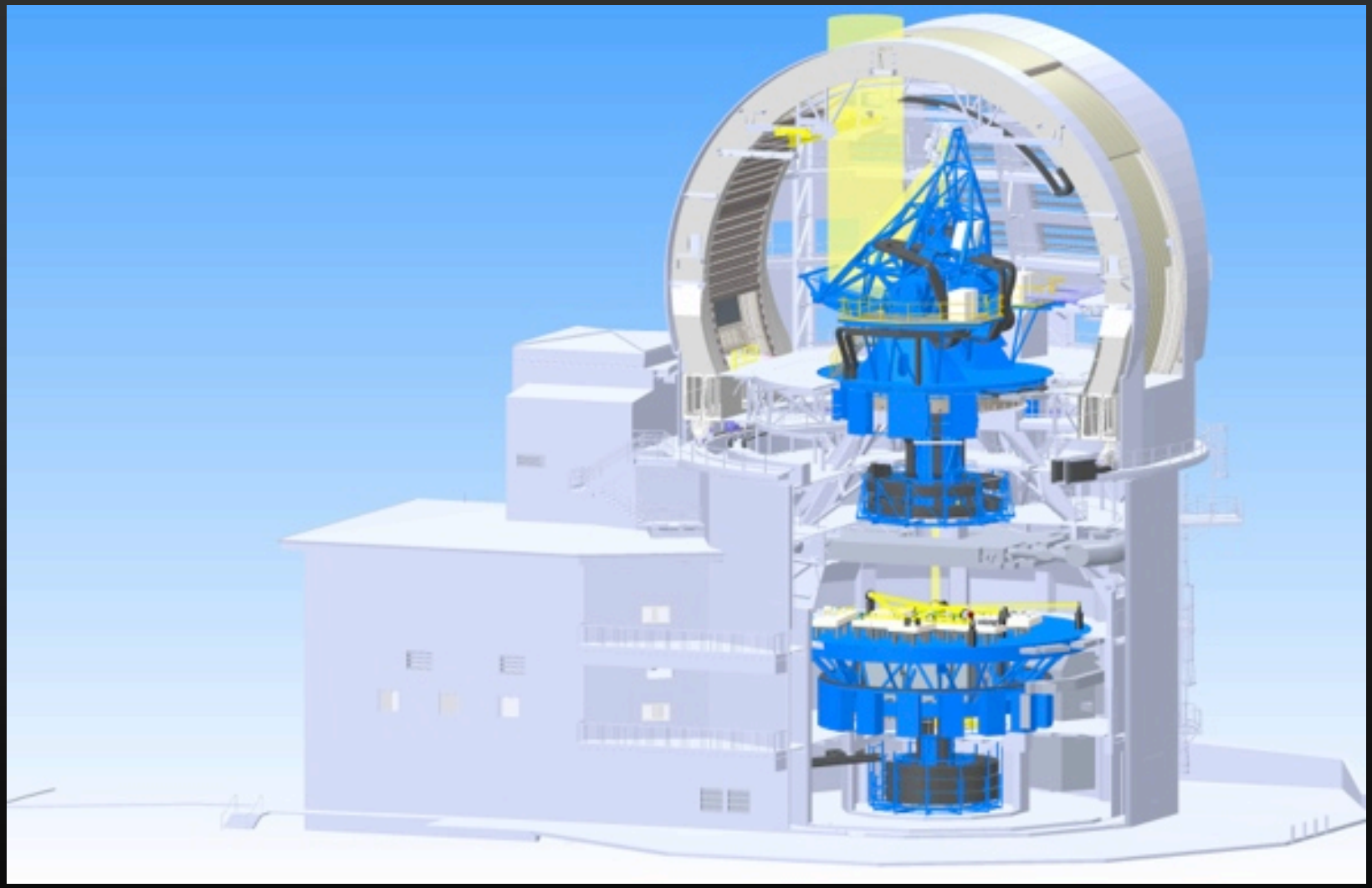
Current Construction Site

Recent Weather Impacts to Construction

Hurricane Lane, Aug. 23-24

Hurricane Olivia, Sept. 11-12

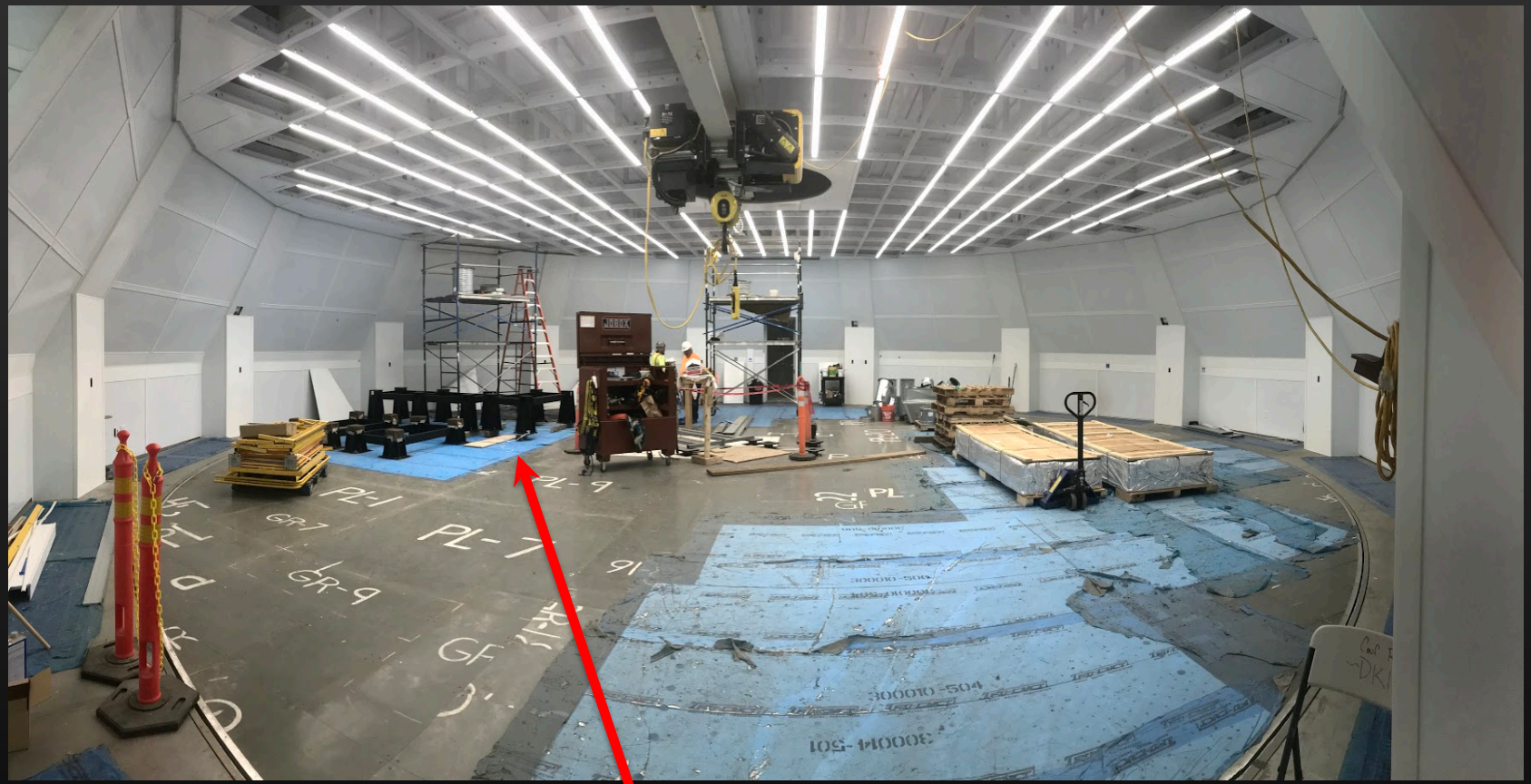
DKIST Cutaway View



Telescope Mount, Sept. 2018

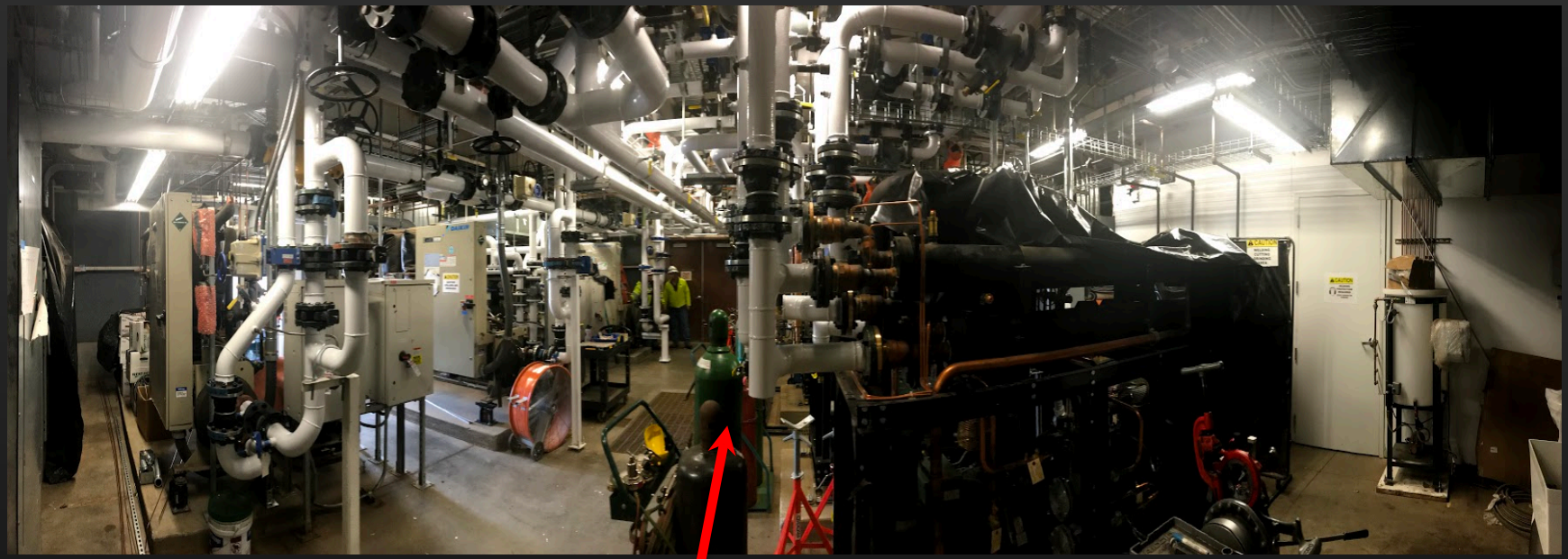
CO_2 "snow" cleaning of the M1 primary mirror

Coudé Laboratory, Sept. 2018



Installation of the first optical bench

Facility Thermal Systems (FTS), Sept. 2018



Primary FTS coolant loops in the Utility Building. First system start-up expected this month.

DKIST Remote Office Building (ROB)

- Located in Pukalani, Maui, HI next to UH-IfA
- NSF approved the purchase of land by AURA (July 31, 2015)
- AURA closed on the land purchase (Aug. 21, 2015)
- Final EA and Finding of No Sig. Impact (FONSI) (Apr. 6, 2016)
- AURA issued RFP to build the ROB (June 30, 2016)
- Bids received (Sept. 6, 2016)
- Project's Selection approved by NSF (Dec. 2, 2016)
  - Contractor Arisumi Bros.
  - $8.321M
- Construction completed (May 2018)

From ROB to DKIST Science Support Center (DSSC)

- Occupancy (June 2018)
- Fully furnished (August 2018)

Recent DKIST Critical Science Plan Workshops

- Flares & Eruptive Phenomena; Houston, TX; May 15-17, 2018
- Coronal Science Frontiers; Maui, HI; June 27-29, 2018
- Broader Implications; Bozeman, MT; July 18-20, 2018
- Long-term Studies; Boulder, CO; Oct. 9-10, 2018
- Wave Generation and Prop.; Las Cruces, NM; Dec. 6-8, 2018

Over 200 Science Use Cases!

Astronomy & Astrophysics Decadal Survey

- NSF/AST and NASA Astrophysics Division are the primary sponsors of the survey. DOE Office of Science also a sponsor
- Agencies provided a charge to the National Academies for implementation of the Decadal
  - The NASEM proposal for NSF's share has been awarded
  - NSF is including all ground-based astrophysics (i.e., gravitational wave detection and astro-particle detection) for project prioritization, not limited to AST
  - The call for science white papers was issued (due Jan. 18 2019)
- Special session at June SPD meeting organized by NSO
  - AST Division Director gave presentation and answered questions