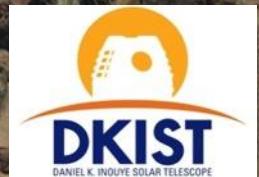


# NSF Astronomy Update: The National Solar Observatory (NSO) and the Daniel K. Inouye Solar Telescope (DKIST)

**Dave Boboltz (Program Officer, NSO/DKIST)**

**Committee on Solar and Space Physics (CSSP)**

**October 5, 2016**



# AST Budget within MPS and NSF

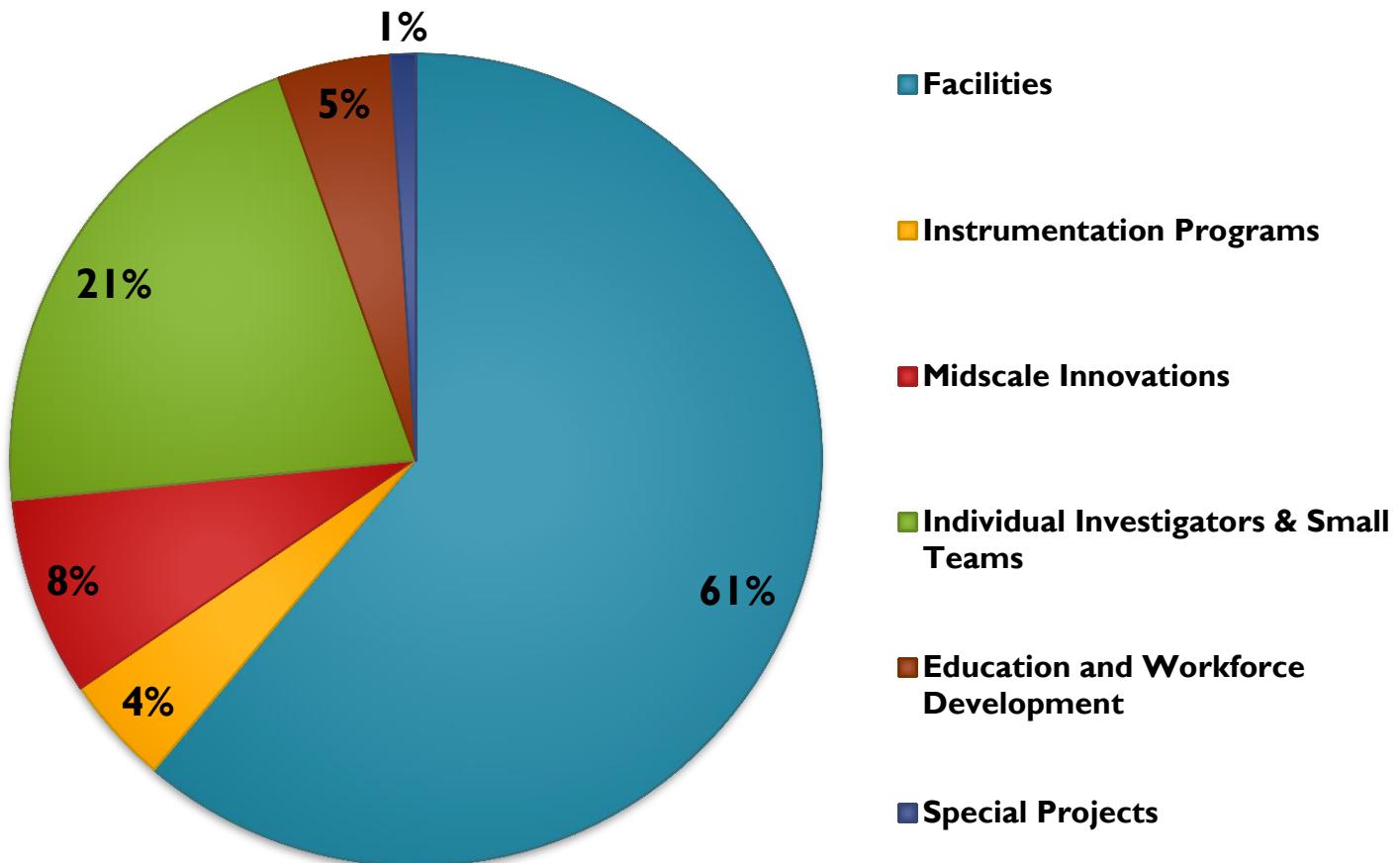
- FY 2017 Request Released on February 9, 2016
- DKIST Construction from MREFC line
- NSO/DKIST Operations funding from AST line

\$M	FY15 Actual	FY16 Request	FY16 Approp.	FY17 Request Total	FY17 Request Disc.
NSF Total	7344	7724	7463	7964	7564
NSF R&RA	5934	6186	6034	6425	6079
MPS	1337	1366	1349	1436	1355
AST	245.2	246.5	246.7	262.6	247.7
MREFC	200.8	200.3	200.3	193.1	193.1

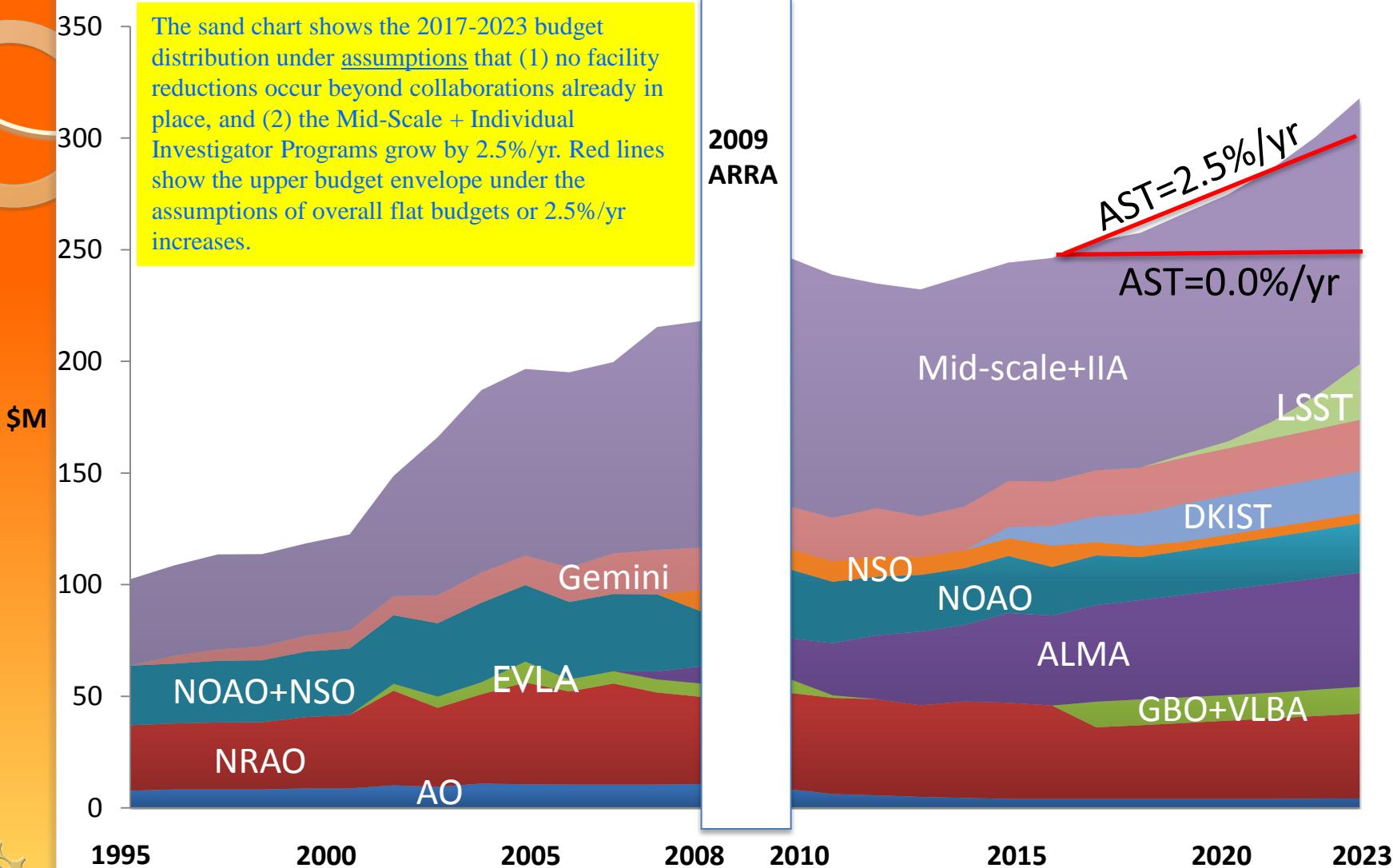


# Research Support Within AST

**Modes of Support FY 2016**

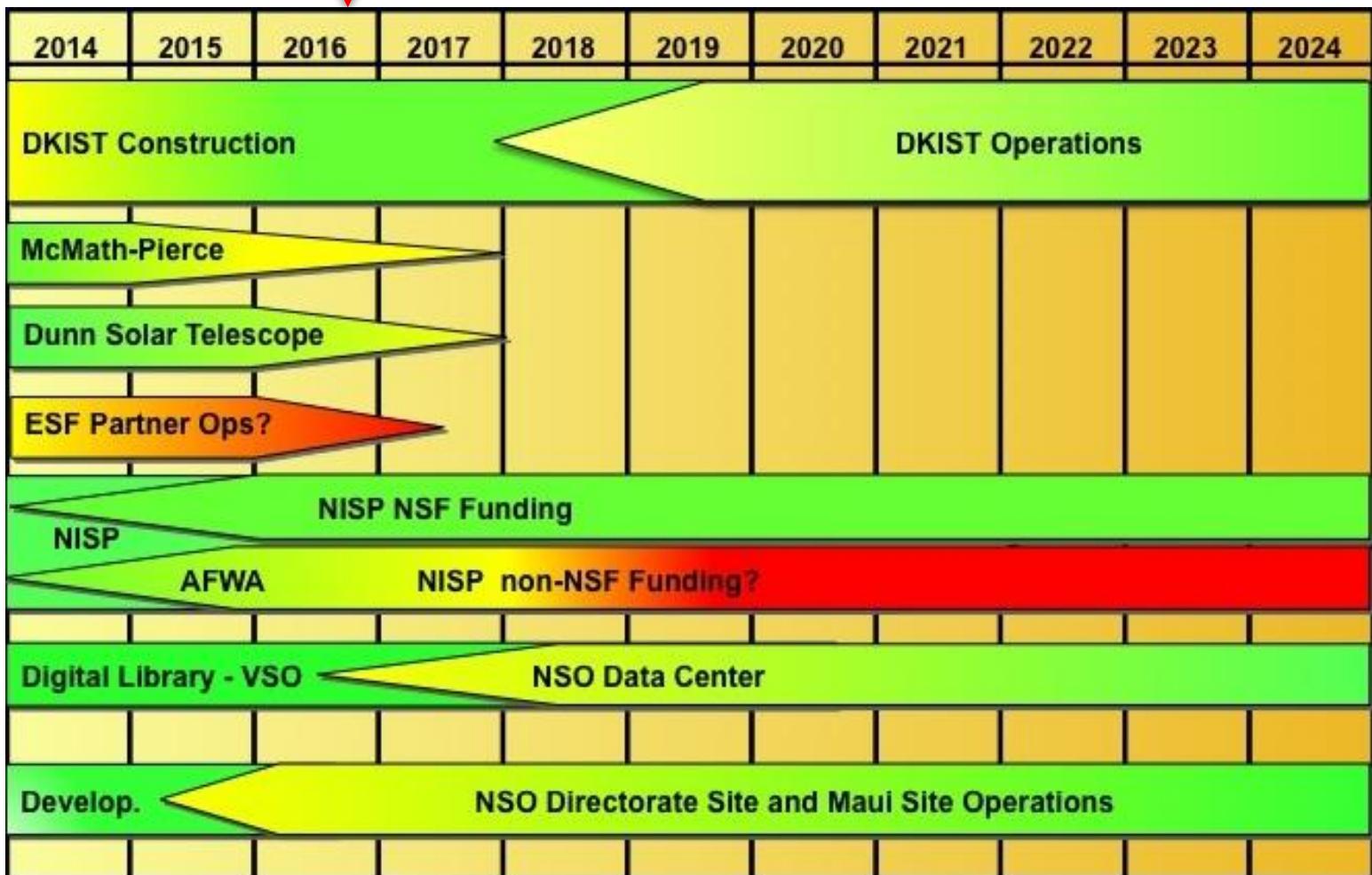


# Hypothetical Budget Run-outs



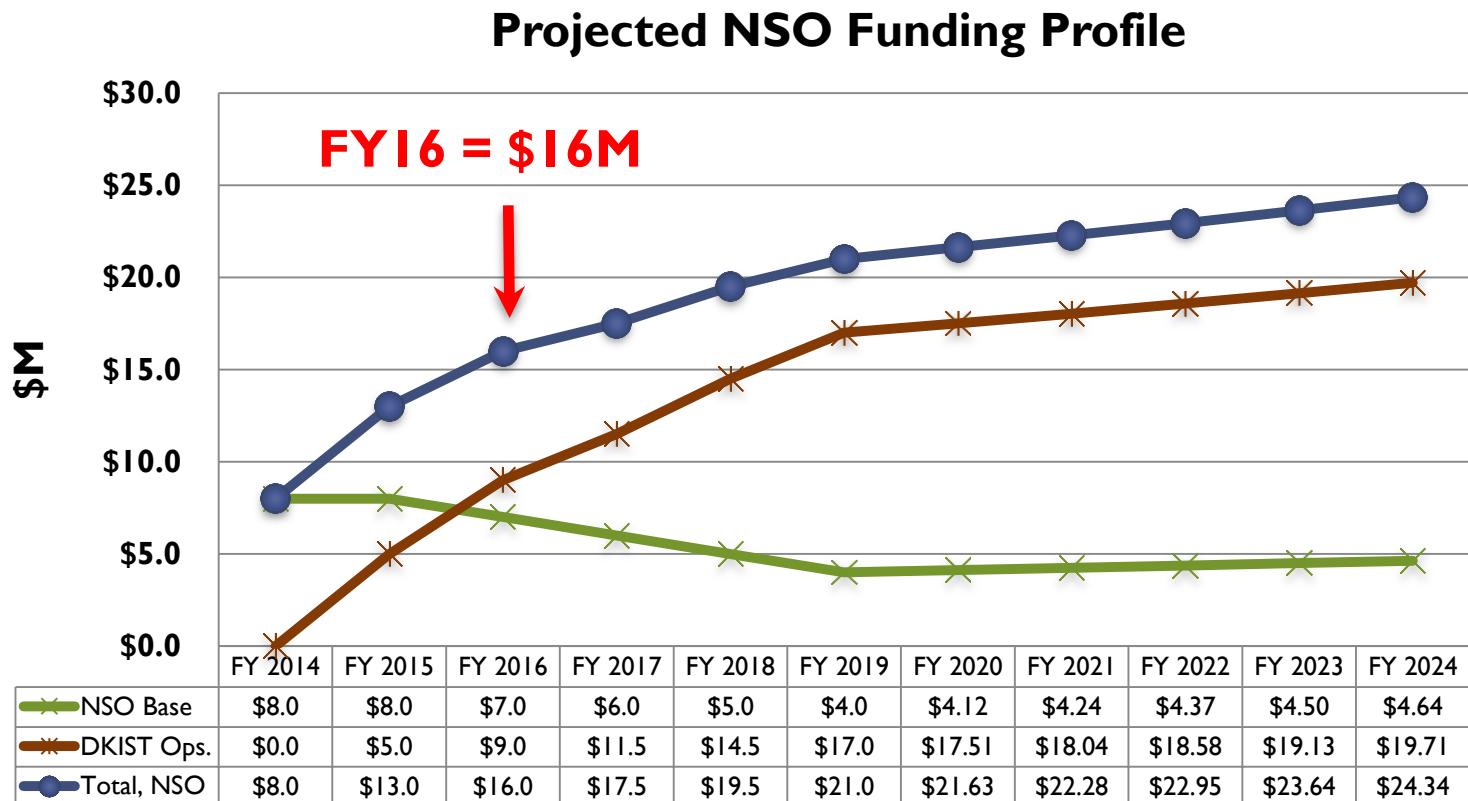
# NSO Transition to DKIST Era

We are here



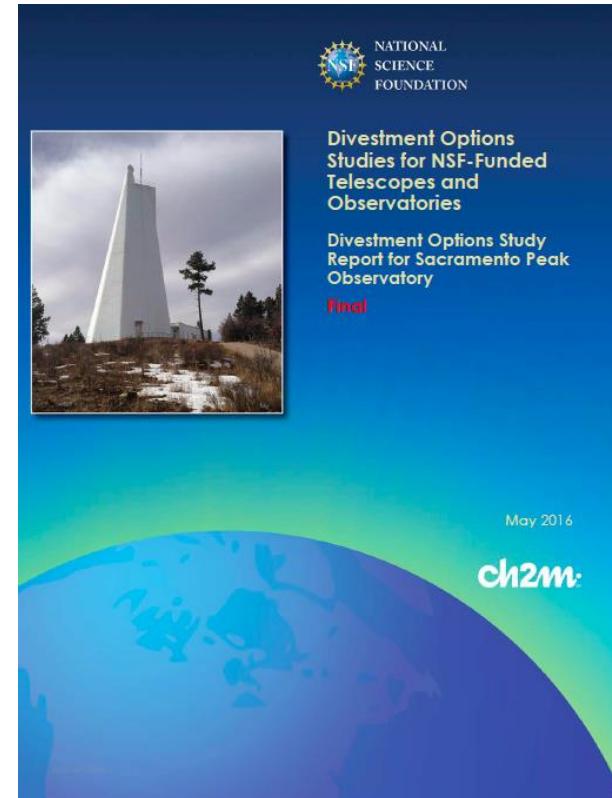
# NSO Operations & Maintenance

- Total R&RA through FY 2024 = \$201.84M
- FY 2016 appropriation = \$16M + \$2.5M (GONG refurb.)



# NSO Facilities on Sacramento Peak

- Recommended for divestment by the 2012 AST Portfolio Review
- NSF funding to NSO for Sac Peak operations projected to ramp down to the **end of 2017**
- Engineering feasibility study (CH2M Hill) completed **May 19, 2016**
- Environmental Impact Statement (EIS)/Section 106 process started
  - Notice of Intent, **July 5, 2016**
  - Public scoping meeting, **July 21, 2016**
  - End of public comment, **Aug. 5, 2016**
  - Draft EIS expected **Dec. 2016**



# Bridge to the Sunspot Solar Observatory Consortium (SSOC)

- Met with National Solar Observatory (NSO) and representatives of universities seeking to create a consortium to operate Sac Peak, **May 2015**
- NM State Legislature failed to fund highly rated NMSU request for funds to enable consortium, **Feb. 2016**
- NMSU submitted a proposal to AST for funding to bridge the gap between NSO and SSOC, **May 2016**
- Proposal awarded **Sept. 2016**
- Still looking for SSOC members



The screenshot shows a news article on Senator Tom Udall's website. The headline reads: "Udall, Heinrich, Pearce Announce \$1.2 Million to Upgrade Dunn Solar Telescope in Sunspot, NM, Transition Operation to NMSU Consortium". The article is dated September 22, 2016. It includes a "SIGN UP FOR THE UDALL UPDATE" form and a "STAY CONNECTED" section with social media links. The text of the article discusses the upgrade of the Richard B. Dunn Solar Telescope at the National Solar Observatory in Sunspot, New Mexico, and the transition of its operation to New Mexico State University (NMSU) through a consortium.

# NSO Facilities on Kitt Peak

- Recommended for divestment by the 2012 AST Portfolio Review
- NSF minimal operations funding ramping down to 2017
- NSF engineering feasibility study (CH2M Hill) completed **July 2016**
- Recent negative developments
  - Tohono O'odham Community College voted against any participation
  - Northrop-Grumman StarShade proposal not funded by JPL
- Still open to collaborations

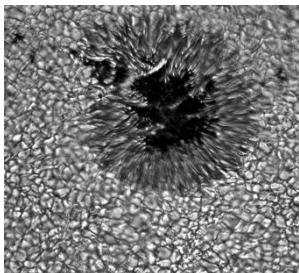


# NSO Integrated Synoptic Program

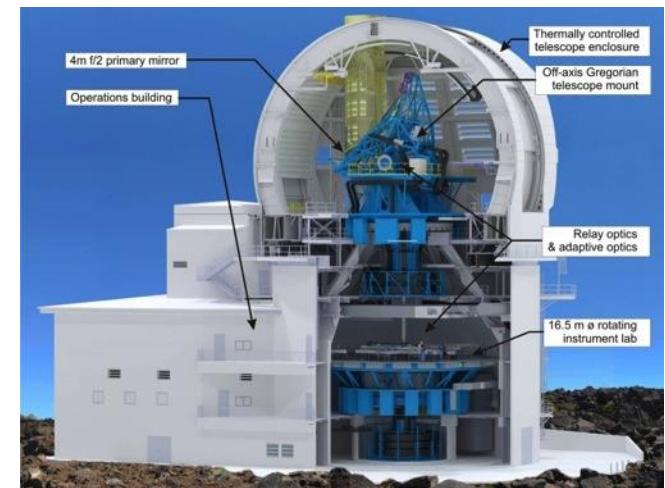
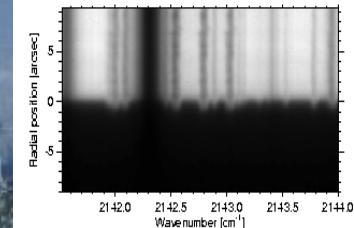
- Consists of SOLIS and GONG
- Recommended for 50% (\$2M/year) divestment by the 2012 AST Portfolio Review
- External Federal stakeholders: NOAA-SWPC, AFWA, NASA
- Increased Federal awareness (i.e. NSWS and NSWAP) of space weather assets like GONG
- Result: program to “operationalize” GONG in the **FY2016 appropriation**
  - **\$2.5M** addition to NSF (through AST) for refurbishment
  - **\$1M/year** addition to NOAA for operations
- **August 2016: Interagency Agreement NSF-NOAA signed!**

# DKIST Will Replace Current National Solar O/IR Facilities

**Dunn Solar Telescope**  
**Evans Solar Facility**  
**Sacramento Peak, NM**

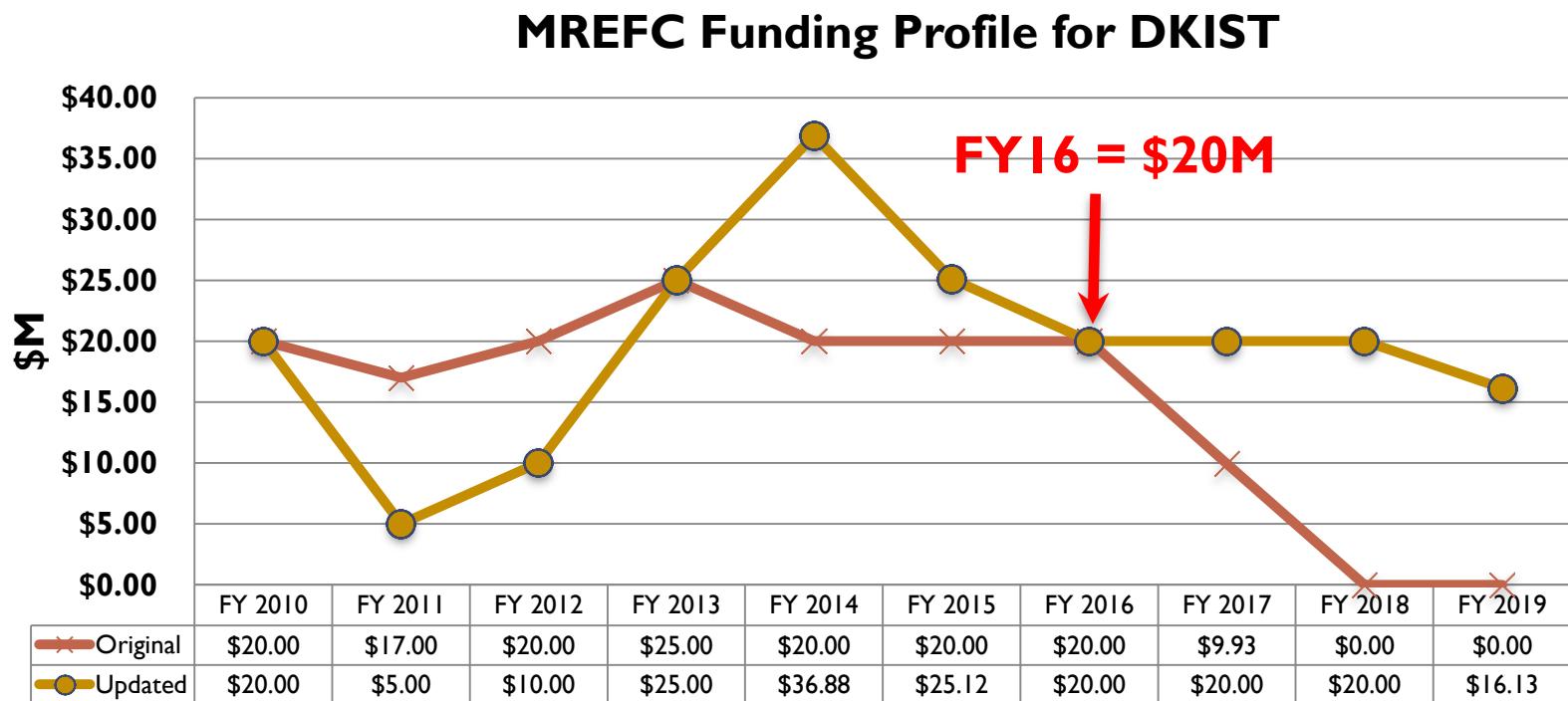


**McMath-Pierce, Kitt Peak, AZ**

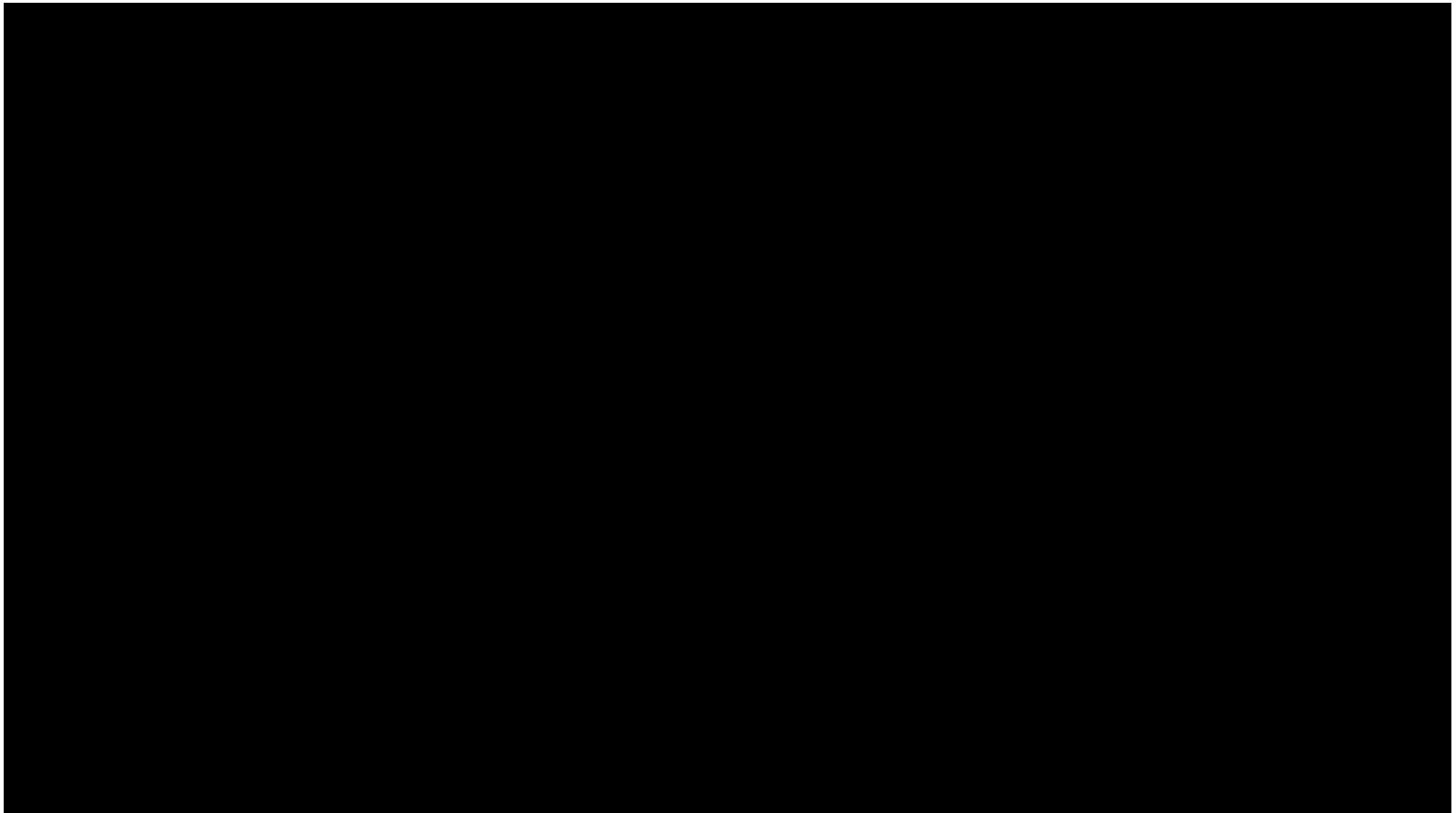


# DKIST Construction Funding

- DKIST Re-baselined Total Project Cost = **\$344.13M**
- ARRA **\$146M** awarded FY 2010
- MREFC FY 2016 = **\$20M** awarded



# Planned Construction



# Enclosure: CSSP, October 2015



October 2015



CSSP Meeting

# Enclosure: CSSP, March 2016

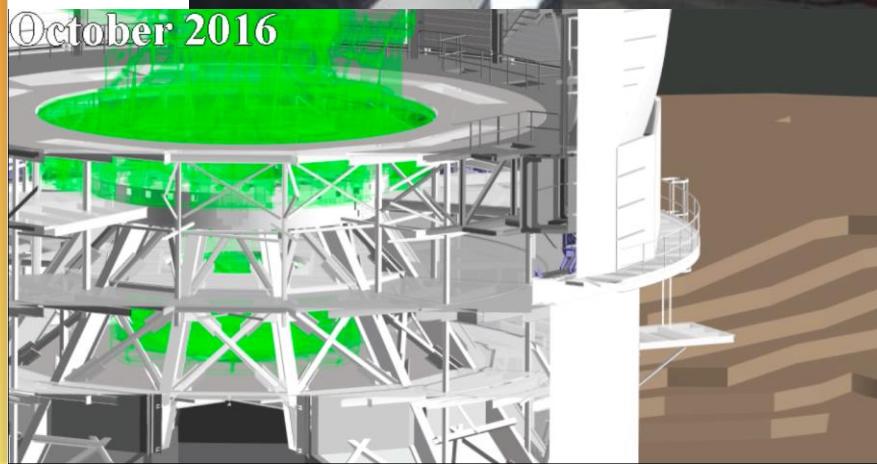


March 2016

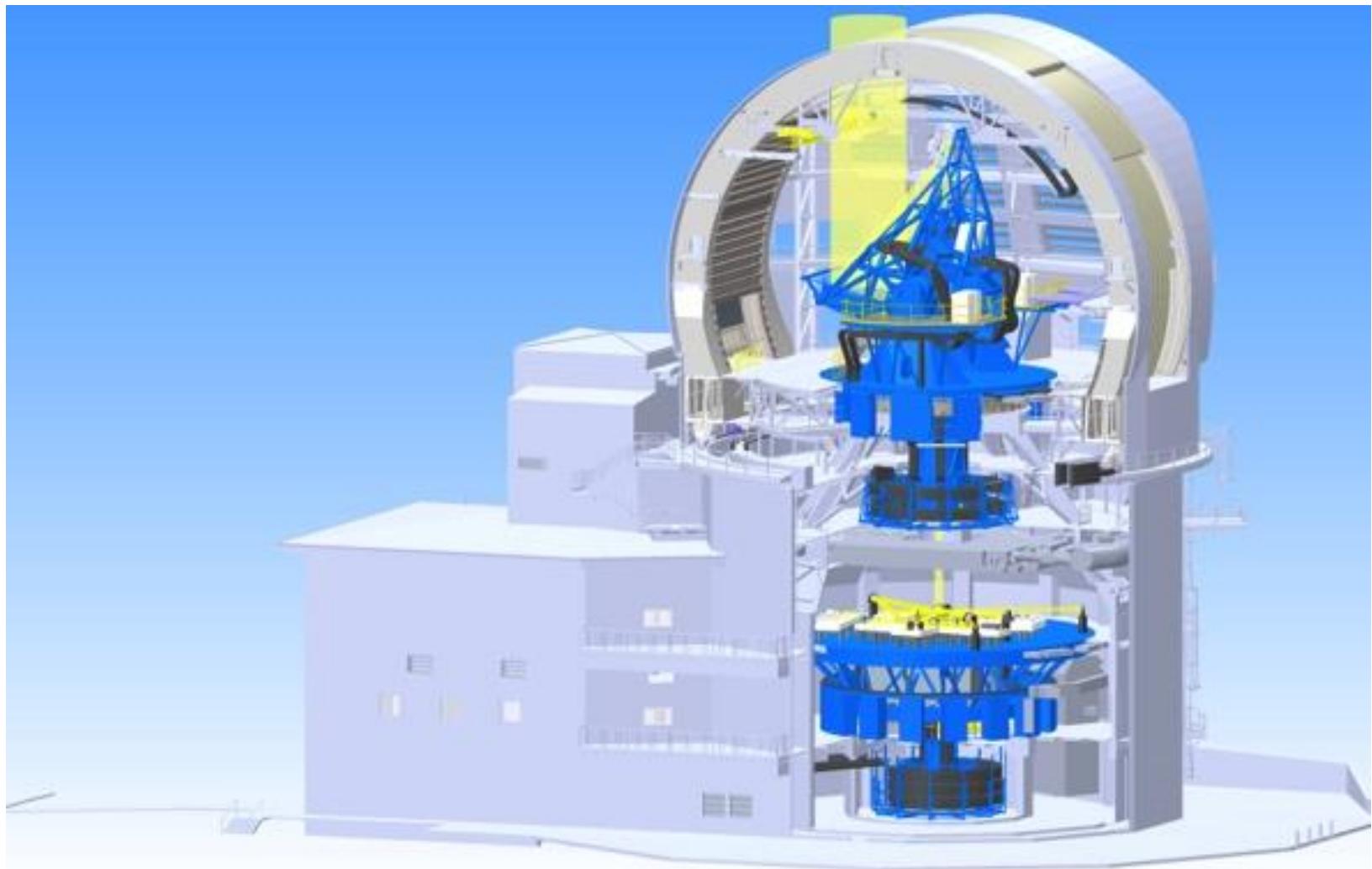


CSSP Meeting

# Enclosure: CSSP, October 2016



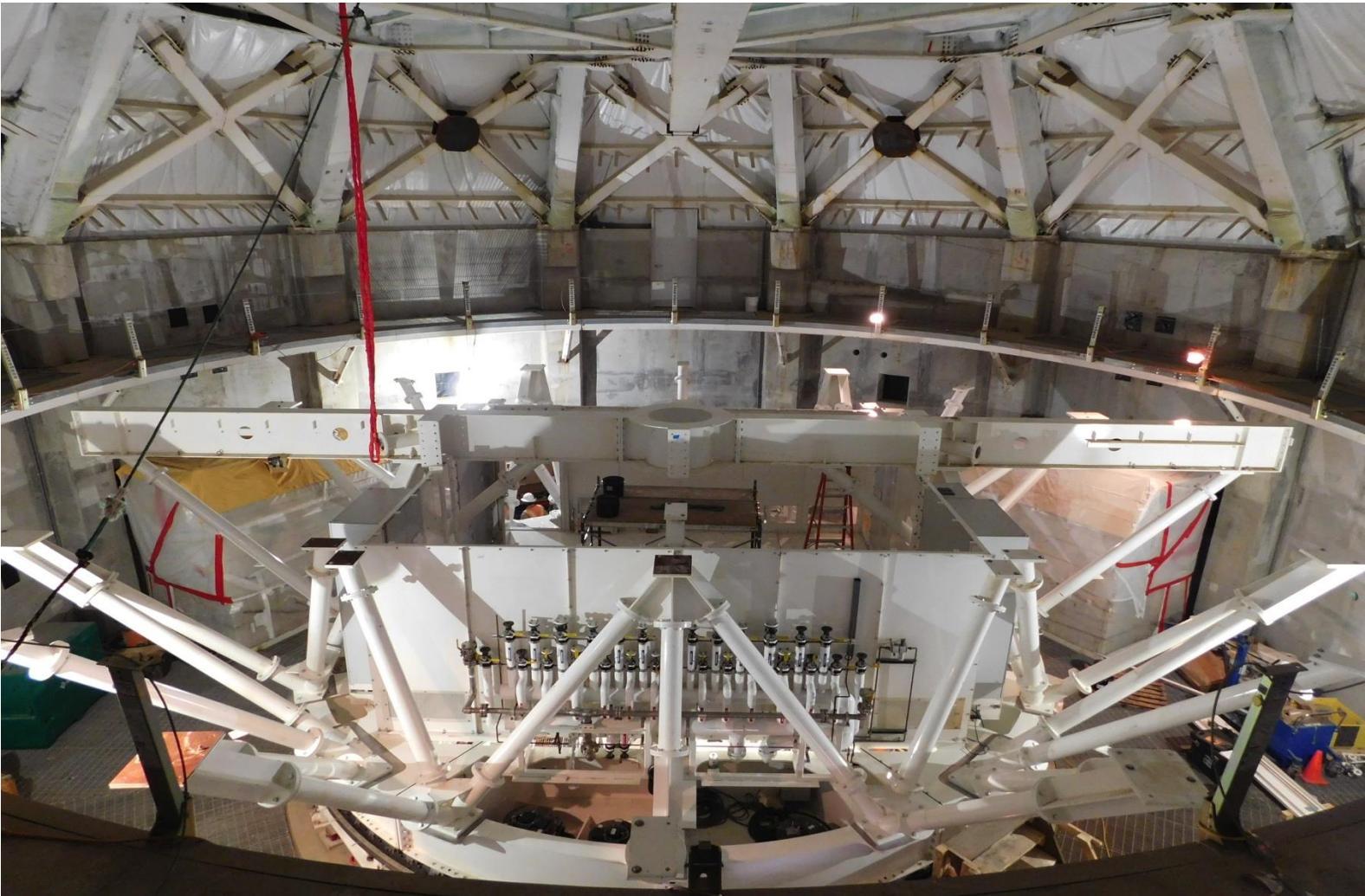
# DKIST Cutaway View



# Coudé Rotator: CSSP, March 2016



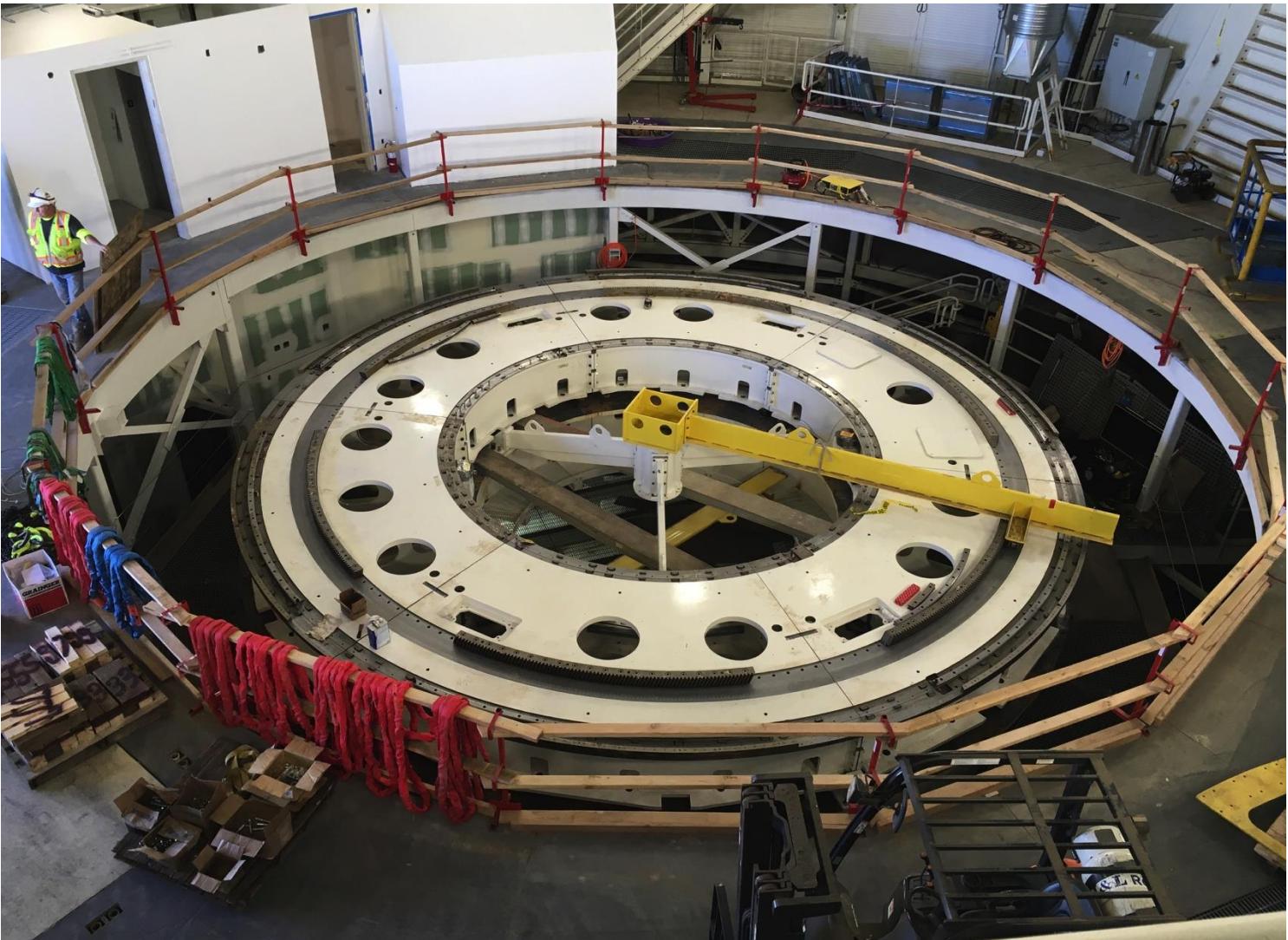
# Coudé Rotator: July 2016



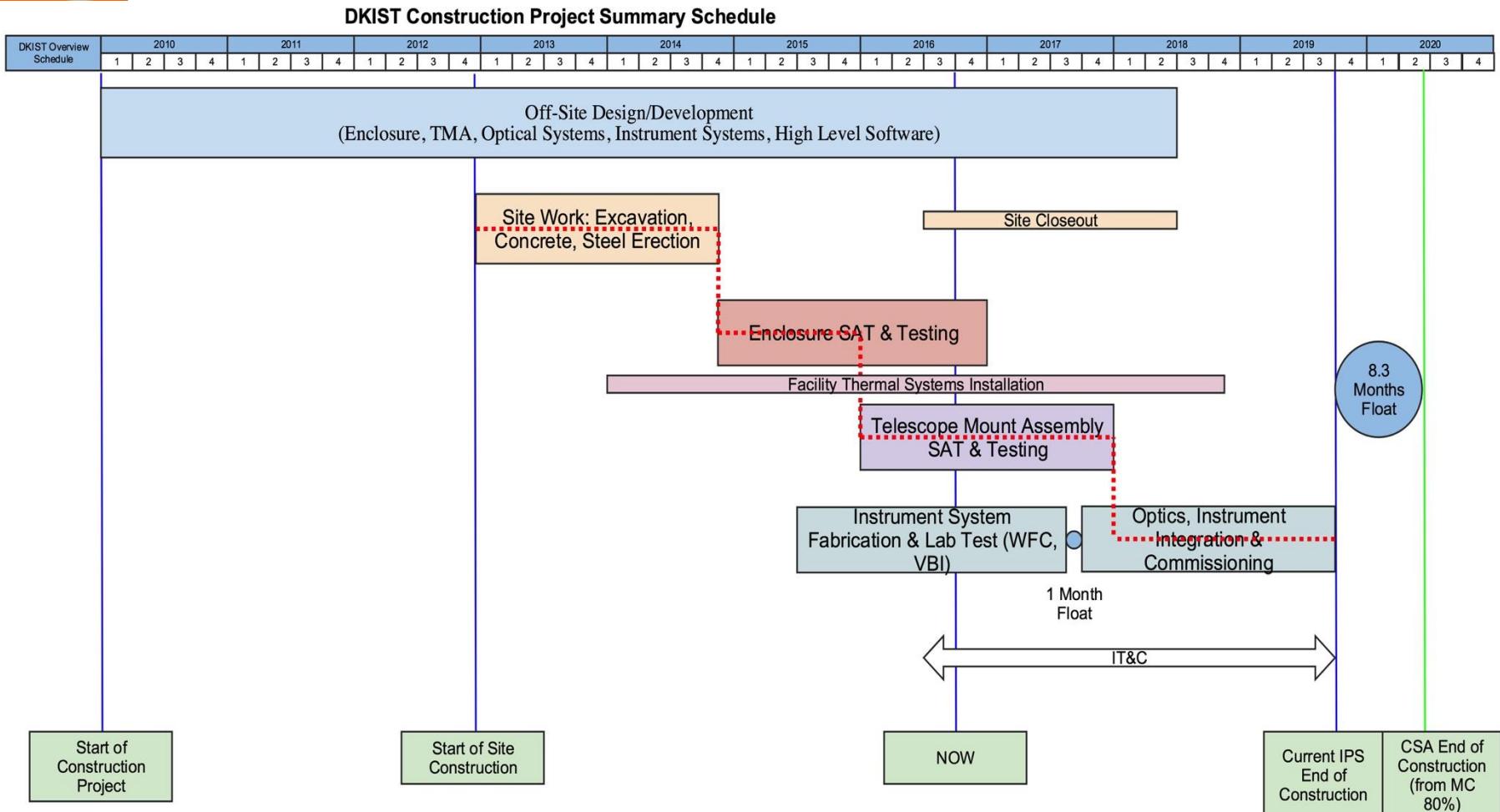
# Coudé Rotator, CSSP October 2016



# TMA Base Ring: September 2016



# DKIST Summary Schedule



# DKIST Site Construction



ATST Construction Webcam 2013-01-01 09:00:42



# DKIST Critical Science Plan (CSP)

- <http://dkist.nso.edu/CSP>
- The CSP aims to define critical science goals for the first year of DKIST operations
- DKIST Science Working Group (SWG) headed by Mark Rast (CU)
- Next SWG meeting Oct. 11-13, 2016 at NMSU

The DKIST is developing a Critical Science Plan (CSP). This will define some of the early science that the DKIST will focus on during early operations. More specifically, the CSP aims to define critical science goals for the first year of DKIST operations, and in the process help determine data handling procedures and further develop science operations. The aim is to engage community, instrument, and NSO scientists in defining the scientific goals, further developing efficient observational strategies, analyzing the forthcoming data, and publishing the first critical science results. This web page along with a series of workshops will provide the collaborative environment within which to accomplish that.

It is important to note that the CSP observations will be conducted in **Service Mode**. Along with standalone DKIST projects, coordinated observations with other observing facilities or platforms are encouraged and will be supported if needed to meet the science goals.

As scientific goals are expected to evolve between now and DKIST first light, we anticipate that the development, implementation and execution of the CSP will be an iterative process subjected to adjustment and revision, through different phases and steps:

Phase A:

- Definition of Research Topics and identification of contact personnel for each Research Topic: the contact will act as an interface to the DKIST project to help and support the development of the individual Science Use Cases, as needed.
- Submission of Science Use Cases: these will include a statement of the scientific goals, a definition of the required instrument suite to be employed supplemented by an assessment of the beam-splitter configuration to ensure instrument compatibility, a description of the basic data needs (image or spectra, wavelengths, cadences, and photometric, spectroscopic and polarimetric precisions), and a summary of the observing strategy and any joint facility coordination needs.

Phase B:

- Coordination of Science Use Cases: this will include self organization into teams and identification of team leads where applicable (subsequently to serve as observing proposal PIs). The coordination effort will be facilitated as needed by Research Topic contact personnel via forum discussion, and will aim to avoid too much overlap of the individual Science Use Cases. The end goal is the formation of a complimentary set of PI lead Science Use Cases (team or individual efforts) under each Research Topic.

Phase C:

- Conversion and translation of Science Use Cases into DKIST Observing Proposals.

# CSP Research Areas

**DANIEL K. INOUYE SOLAR TELESCOPE** NSO

**Research Areas**

[Search](#)

- [Building the DKIST](#)
- [News](#)
- [Employment](#)
- ▼ [DKIST in Hawaii](#)
  - [Cultural](#)
  - [Educational](#)
  - [Environmental](#)
- ▼ [Media](#)
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  - [Videos](#)
- ▼ [Science](#)
  - [Critical Science Plan](#)
- [Engineering](#)
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**DKIST Critical Science Plan**

▼ [Research Areas](#)

- [Magnetohydrodynamics and Dynamo Processes](#)
- [Flares and Eruptive Activity](#)
- [Magnetic Connectivity, Mass and Energy Flows in the Solar Atmosphere](#)
- [Long-Term Studies of the Sun](#)
- [Special Topics](#)
- [Service Mode](#)

The DKIST will be the largest solar ground-based resource for high-resolution studies of the Sun's magnetic activity leading to sunspots, flares, coronal mass ejections (CME's), the solar wind and solar variability. Polarimetric accuracy and sensitivity at high-spatial resolution on the disk, and far into the solar atmosphere (corona) is a high priority. The flexible and versatile first-light instrument suite in conjunction with the active optics and a high-order adaptive optics system will allow to obtain observations that can address a variety of scientific questions of which many will fall into the following Research Areas:

• [Magnetohydrodynamics and Dynamo Processes](#).

• [Flares and Eruptive Activity](#).

• [Magnetic Connectivity, Mass and Energy Flow in the Solar Atmosphere](#).

• [Long-Term Studies of the Sun](#).

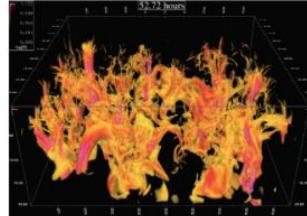
• [Special Topics](#).

Each of those Research Areas is further divided into individual Research Topics. Please select one of the above areas and then a topic underneath that is most applicable to the Science Use Case you have in mind and submit your Science Use Case under that topic once it is prepared.

---

**Magnetohydrodynamics and Dynamo Processes**

Magnetic fields pervade the solar atmosphere, both giving rise to large scale phenomena like active regions and sunspots, as well as modifying solar convection on the smallest spatial scales. These fields are most likely not only advected from the deepest layers of the solar convection zone, after being generated by the global dynamo, but are also generated locally by a surface dynamo, although it is not clear to what relative degree. To distinguish between the two scenarios and determine their relative contributions will require the detailed comparison between physical parameters derived from high-resolution spectro-polarimetry, and (radiative-)MHD simulations of equal resolution. To measure the weakest, more horizontal, intranetwork fields will require interpretation of polarimetric data via the subtle Hanle effect, in addition to the traditional Zeeman effect, which is more suitable for stronger, vertical fields. Observations with high temporal cadence are required to determine the energy of waves that, guided by the magnetic field, transfer energy from the convectively dominated photosphere to the magnetically dominated chromosphere, where radiative losses balance the energy that is



# DKIST Instrumentation

**NSO** DANIEL K. INOUYE SOLAR TELESCOPE **DKIST**  
DANIEL K. INOUYE SOLAR TELESCOPE NSO

**DKIST Instrumentation Suite and Configuration**

**Instrumentation Suite Overview**

The DKIST will offer a combination of state-of-the-art instruments with imaging and/or spectropolarimetric capabilities covering a broad wavelength range. This first-light instrumentation suite will include:

- **Cryogenic Near-InfraRed Spectro-Polarimeter (Cryo-NIRSP)** : a cryogenic slit-based spectropolarimeter for coronal magnetic field measurements and on-disk observations up to 4.7 microns.
- **Diffraction-Limited Near-InfraRed Spectro-Polarimeter (DL-NIRSP)** : a fiber-fed two-dimensional spectropolarimeter.
- **Visible Broadband Imager (VBI)** : a rapid broadband filtergraph for high-spatial and -temporal resolution imaging.
- **Visible Spectro-Polarimeter (ViSP)** : a slit-based dual-beam spectropolarimeter for sensitive and accurate multi-line spectropolarimetry.
- **Visible Tunable Filter (VTF)** : a double Fabry-Pérot based imaging instrument for high-spatial resolution spectroscopy and spectropolarimetry.

**DKIST Critical Science Plan**

**DKIST Instrumentation Suite and Configuration**

- **Cryo-NIRSP**
- **DL-NIRSP**
- **VBI**
- **VTF**
- **ViSP**
- **First Light Coudé Beamsplitter Configuration**

**Combining Individual Instruments**

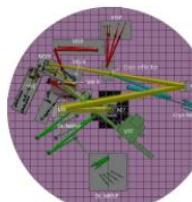
The individual instruments can be combined and operated in parallel with the exception of the Cryo-NIRSP, which can only be operated as stand-alone during early operations. For early operations, the DKIST will be equipped with an initial set of beam splitters allowing to feed specific wavelength ranges to the individual instruments.

In order to avoid any conflicts in the light distribution when combining individual instruments for your Science Use Case, please study the following information:

- **Coudé Beamsplitter Configuration**

and if necessary cross-check your Coudé configuration and combination of instruments by using the following tool (IDL procedure):

- **Beamsplitter configuration tool** (zip file containing the IDL tool and user instruction file).



# Science Use Cases

NSO

DANIEL K. INOUYE SOLAR TELESCOPE

DKIST

Science Use Case Online Submission Form

Building the DKIST

News

Employment

DKIST in Hawaii

- Cultural
- Educational
- Environmental

Media

- Images
- Videos

Science

- Critical Science Plan

Engineering

Meetings

Library

Contact Us

Add content

DKIST Critical Science Plan

Research Areas

Service Mode Operations

DKIST Instrumentation Suite and Configuration

Science Use Case Online Submission Form

User menu

My account

Log out

Search

View Revisions

Log in successful for *Mark Rast*.

Please fill out the complete form. If you have any questions, please get in contact with the contact person for the specific research topic under which you intend to submit the Science Use Case.

### 1. General Information

Principal Investigator's Name (Last, First)

Affiliation

Address

Primary Email

### Co-Investigators

Please enter last name, first name, affiliation, and email address for all Co-I's.

Program Type

Synoptic

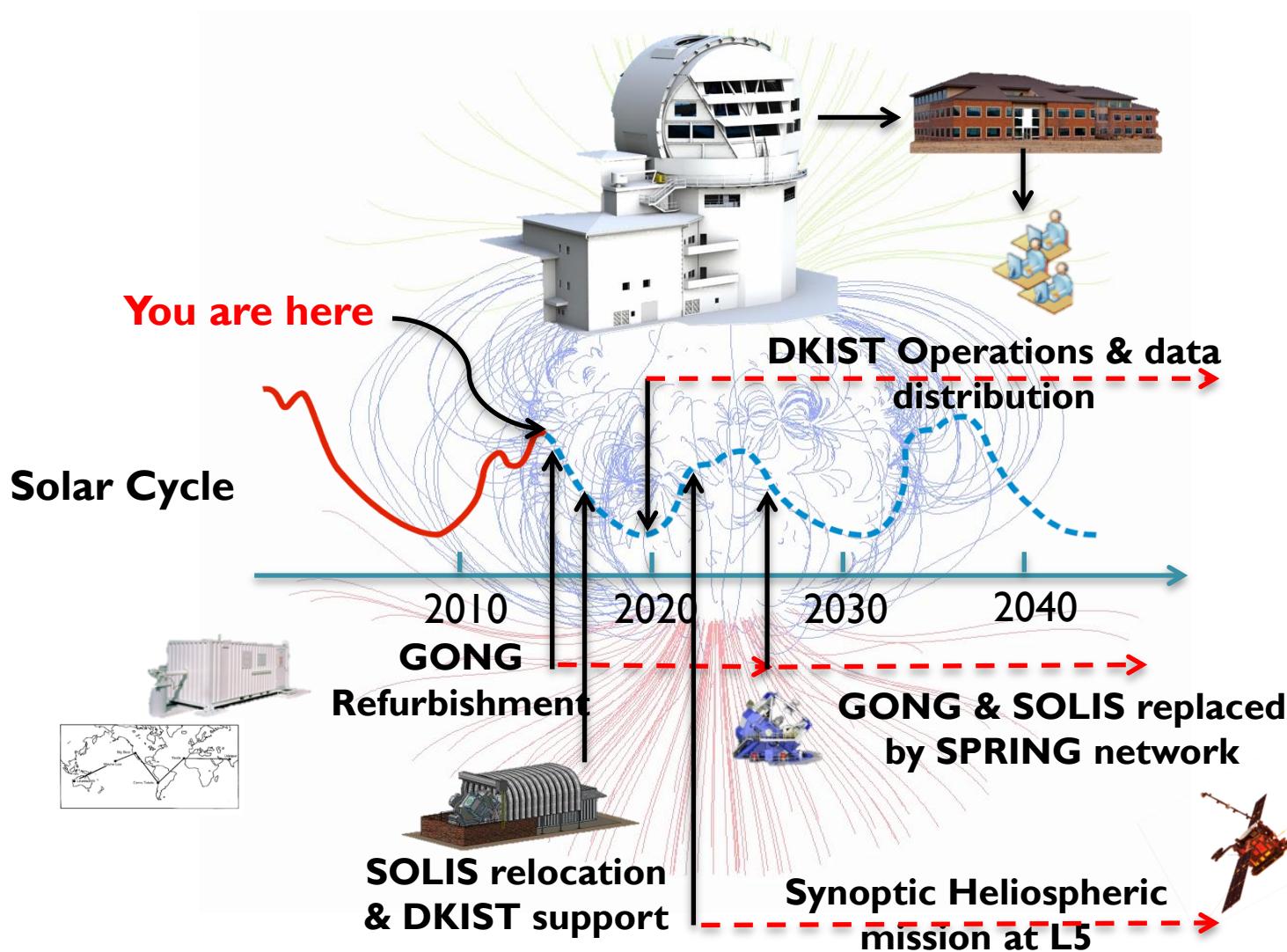
Coordinated

Please select from the above list if applicable.

### 2. Science Justification

Title

# Transformation of NSO



# Individual Investigator Opportunities

- AST runs several grants programs
- **Workforce Development:** CAREER and AAPF
- **Instrumentation:** ATI and MRI (NSF-wide)
- **Midscale Innovations:** MSIP
- **Research:** Astronomy and Astrophysics Grants (AAG)
  - AST's largest program (**\$48.4M** FY2015)
  - Four major categories: EXC, GAL, SAA and PLA

**Astronomical Sciences (AST)**

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[Publications](#)  
[Career Opportunities](#)  
[AST Presentations](#)  
[Astronomy & Astrophysics Advisory Committee \(AAAC\)](#)  
[AST Portfolio Review](#)  
[See Additional AST Resources](#)  
[View AST Staff](#)

**Astronomy and Astrophysics Research Grants (AAG)**

**Note about FY16 AAG Proposals**

AST continues to be concerned about the burden placed on the community in the writing and reviewing of proposals, especially in light of low funding rates. Guided by this, AST is seriously considering placing a limit on the number of proposals submitted by an individual principal investigator (PI) or co-PI at the November 2016 AAG deadline. Other divisions of the NSF Directorate for Mathematical and Physical Sciences already have taken similar steps with varying levels of restrictions. In preparation for this possible change, AST encourages members of the community to be responsible when considering whether or not to submit multiple proposals at the November 2015 deadline.

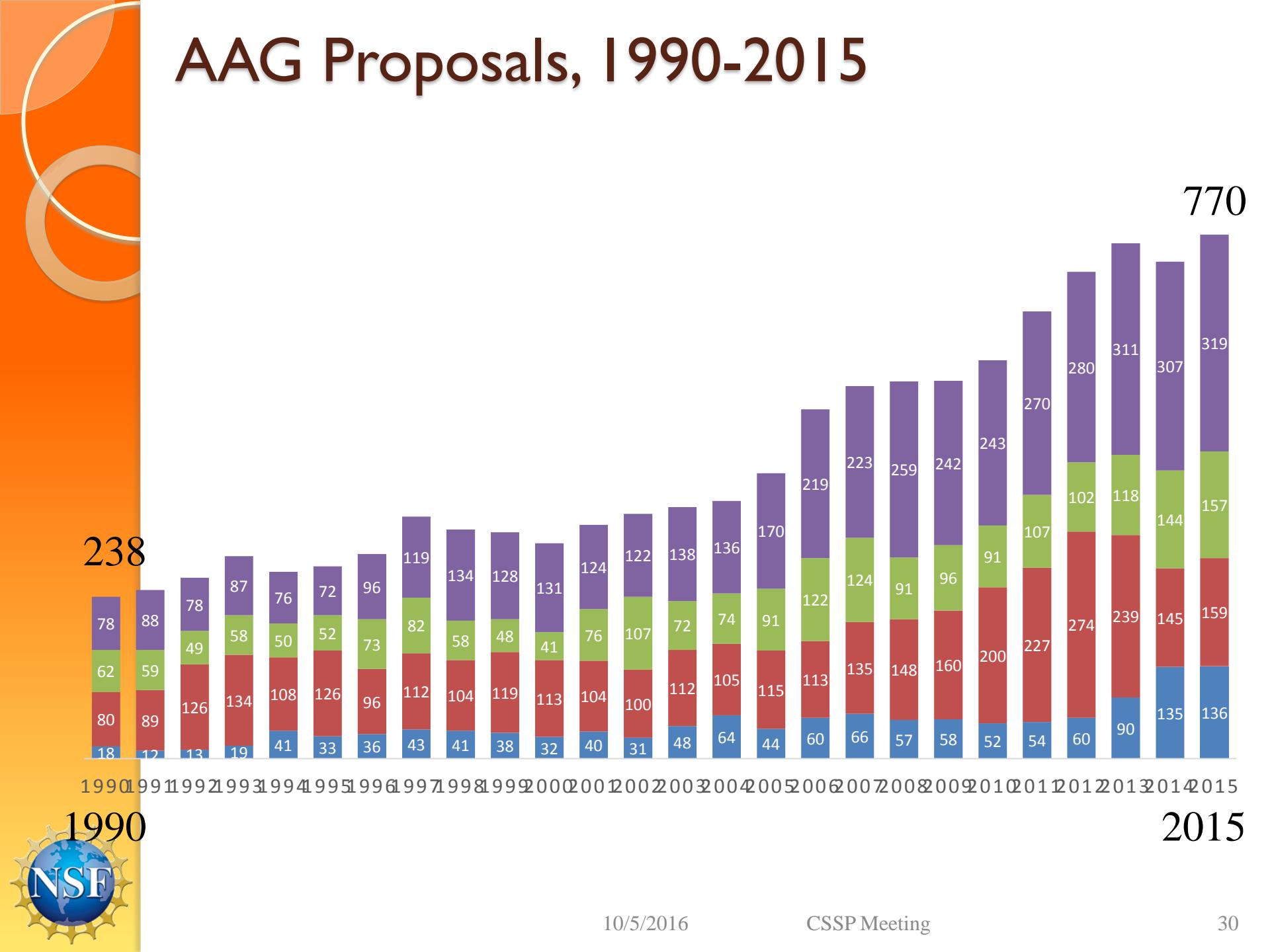
**CONTACTS**

Name	Email	Phone	Room
James E. Neff, Lead	jneff@nsf.gov	(703) 292-2475	1045 S
Richard E. Barvalinis	rbarval@nsf.gov	(703) 292-4891	1045 S
Glen Langston	glangsto@nsf.gov	(703) 292-4937	1045 S
Nigel A. Sharp	nsharp@nsf.gov	(703) 292-4905	1045 S

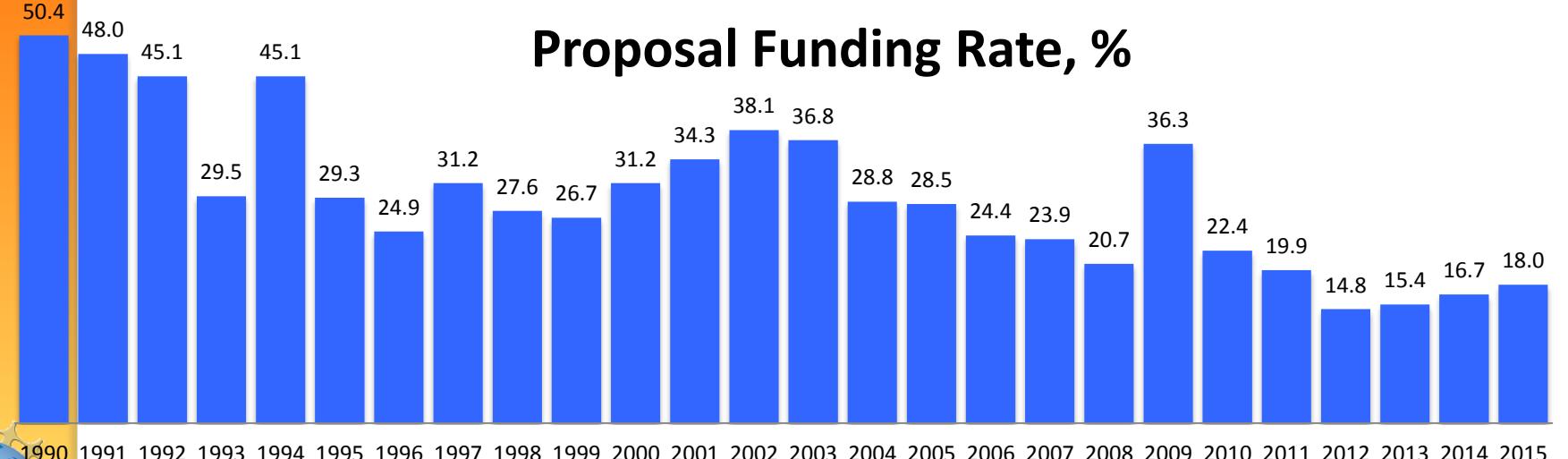
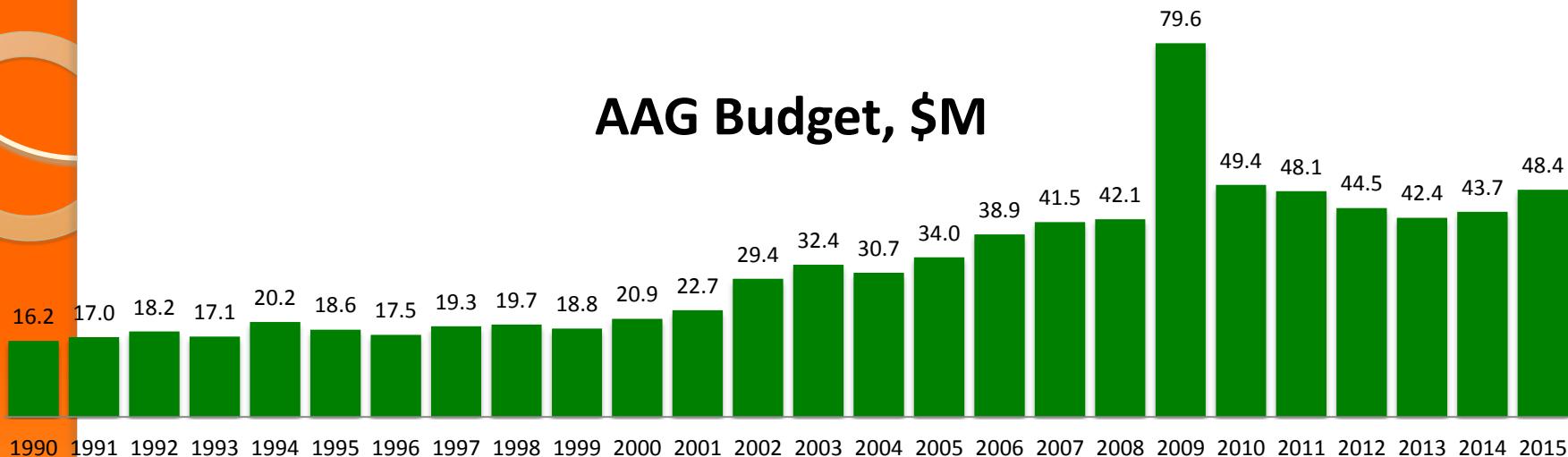
**PROGRAM GUIDELINES**

Solicitation 12-589

# AAG Proposals, 1990-2015



# AAG Funding History, 1990-2015



# Solar Research Opportunities

- AAG open to all astronomical research including solar, however AST not a traditional home for solar research
- Getting the word out in advance of DKIST
  - Multiple talks in 2015: TESS/SPD, IRIS 4 workshop, IAU, etc.
  - **Mark Rast (CU) on behalf of DKIST SWG:** Coordinated submission of solar proposals to FY 2016 AAG program
- Results:
  - Critical mass (21 proposals) for panel
  - **More proposals with DKIST in the title than ALMA**
  - **First-ever solar physics panel (SAA-SUN) in AST!**
  - 19% success rate consistent with the rest of AAG



# NSF/GEO Pilot Program Eliminating Proposal Deadlines

No pressure: NSF test finds eliminating deadlines halves number of grant proposals | Science | AAAS  
www.sciencemag.org/news/2016/04/no-pressure-nsf-test-finds-eliminating-deadline

No pressure: NSF test finds eliminating deadlines halves number of grant proposals | Science | AAAS

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5K 12



Roger Wakimoto, assistant director for geosciences at the National Science Foundation, reports a new approach to relieving grant proposal pressure is working.

Sandy Schaeffer/National Science Foundation

## No pressure: NSF test finds eliminating deadlines halves number of grant proposals

By Eric Hand | Apr. 15, 2016, 12:30 PM

In recent years, the National Science Foundation (NSF) in Arlington,

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**Tweets** by @ScienceInsider

@UTHSCSA\_GSBS

@FYIscipolicy Great quote--Mediocre science is not in anyone's interest via @scienceinsider @science

10h

ScienceInsider Retweeted

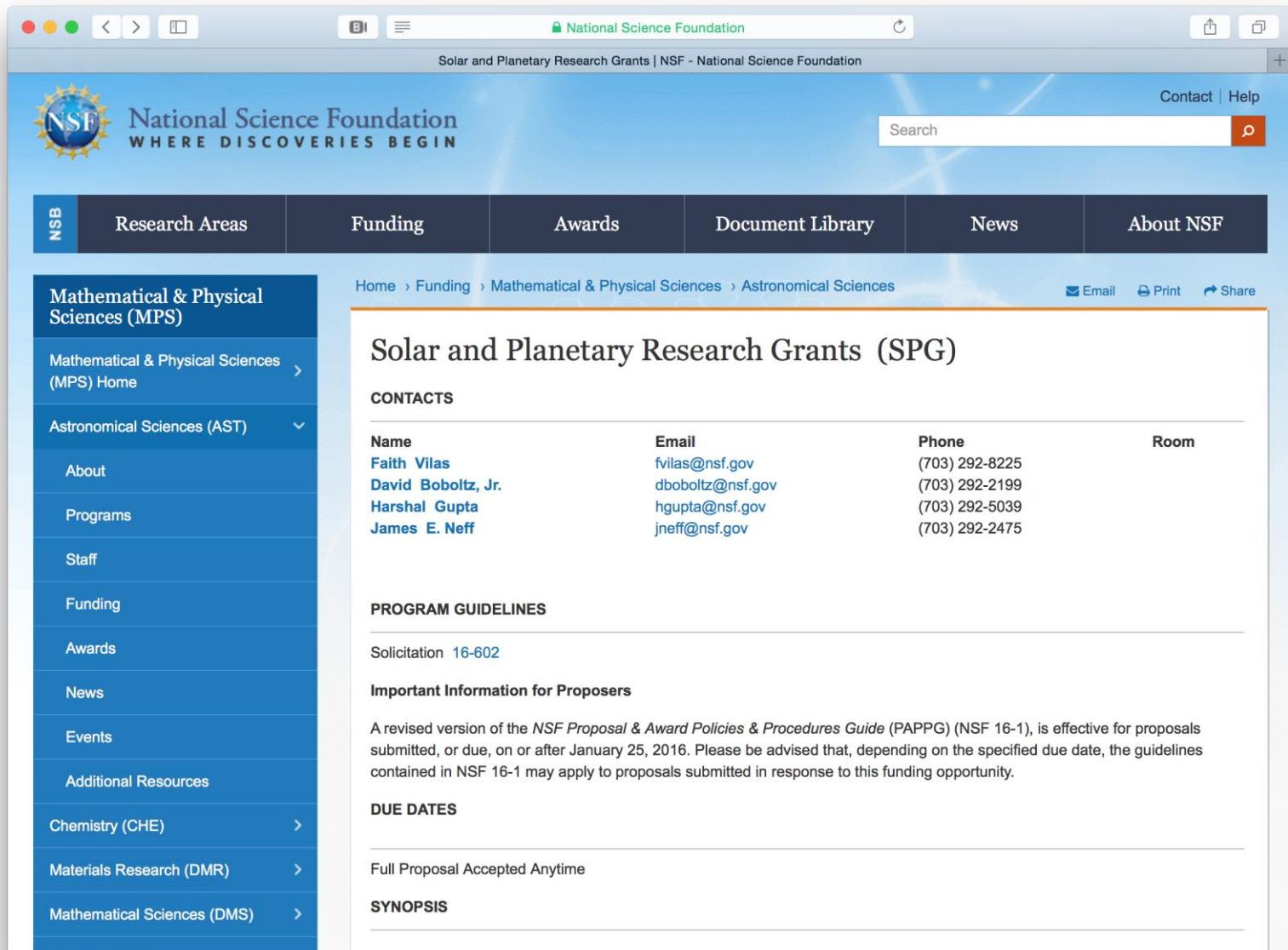
GWIS Northern CO @NoCoGWIS

New U.S. overtime rules will bump up postdoc pay, but could hurt research budgets @ScienceInsider goo.gl/43ZC1F



Embed View on Twitter

# AST No-deadline SPG Pilot Program



The screenshot shows the NSF website with a blue header bar. The header includes the NSF logo, the text "National Science Foundation WHERE DISCOVERIES BEGIN", a search bar, and links for "Contact | Help" and a magnifying glass icon. Below the header is a navigation bar with links for "Research Areas", "Funding", "Awards", "Document Library", "News", and "About NSF". The "Research Areas" link is currently selected, indicated by a blue background. The main content area shows the "Solar and Planetary Research Grants (SPG)" page. The page title is "Solar and Planetary Research Grants (SPG)". Below the title is a "CONTACTS" section with a table of names, emails, and phone numbers. The table has four columns: Name, Email, Phone, and Room. The contacts listed are: Faith Vilas (fvilas@nsf.gov, (703) 292-8225), David Boboltz, Jr. (dboboltz@nsf.gov, (703) 292-2199), Harshal Gupta (hgupta@nsf.gov, (703) 292-5039), and James E. Neff (jneff@nsf.gov, (703) 292-2475). Below the contacts is a "PROGRAM GUIDELINES" section with a link to "Solicitation 16-602". The next section is "Important Information for Proposers", which contains a note about the revised NSF Proposal & Award Policies & Procedures Guide (PAPPG) (NSF 16-1). The following sections are "DUE DATES", "Full Proposal Accepted Anytime", and "SYNOPSIS". The sidebar on the left lists various research areas: Mathematical & Physical Sciences (MPS), Mathematical & Physical Sciences (MPS) Home, Astronomical Sciences (AST), About, Programs, Staff, Funding, Awards, News, Events, Additional Resources, Chemistry (CHE), Materials Research (DMR), Mathematical Sciences (DMS), and Plant Sciences (PLS). The "Mathematical & Physical Sciences (MPS)" link is currently selected, indicated by a blue background.

# Summary

- DKIST will transform the ground-based solar community
- NSF (through AST) investing in ground-based solar physics via NSO, DKIST and SPG Program
- AST supported the NSO move to the campus of the University of Colorado, Boulder
- AST will continue to work with our colleagues in GEO/AGS to find synergies and potential projects for co-funding
- AST will continue its involvement in Federal space weather forums (NSWS, NSWAP)
- AST encourages conversations and proposals from the solar physics community



# Back-up Slides

## Daniel K. Inouye Solar Telescope (DKIST)



A New Universe of Discoveries



# NSO and the NSWS/SWAP

- NSF's National Solar Observatory can contribute to the National Space Weather Strategy and Action Plan through:
  - space weather observations (5.3)
  - forecasting improvement (5.4)
  - enhancing fundamental understanding of space weather (5.5)
  - international cooperation (6.2)
- See NSO White Paper at:
  - <http://www.nso.edu/node/1290>

## NATIONAL SPACE WEATHER STRATEGY

PRODUCT OF THE

National Science and Technology Council



October 2015

## NATIONAL SPACE WEATHER ACTION PLAN

PRODUCT OF THE

National Science and Technology Council

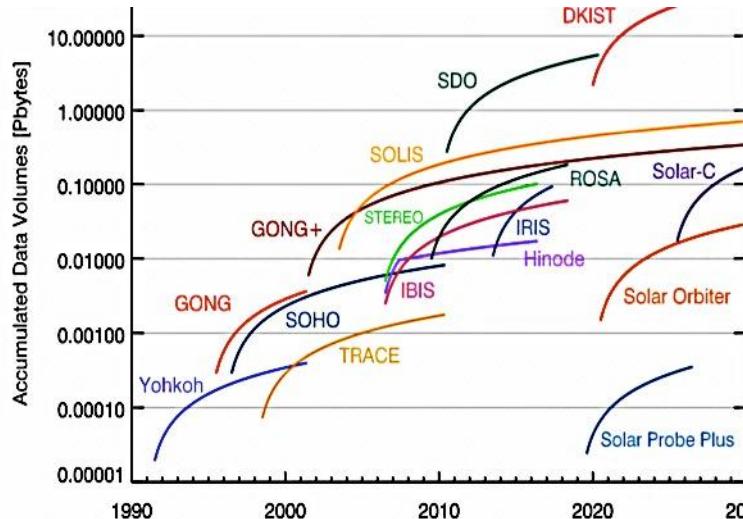


October 2015



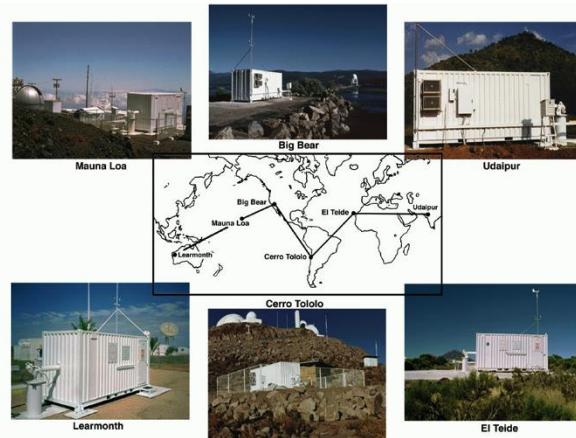
# DKIST: SWAP 5.3.9, 5.4.2, 5.5.2, 6.2.2

- The Daniel K. Inouye Solar Telescope (DKIST) will host **new sensor technologies** (5.3.9, 5.4.2) and support **basic research opportunities** (5.5.2) through **international partnerships** (6.2.2)
- Key challenges:
  - Construction completion
  - Transition to operations
  - Big Data



# NISP: SWAP 5.3.4

- The NSO Integrated Synoptic Program (NISP) contributes to a sustained or enhanced ground-based solar imaging including solar magnetic field and H-alpha data (5.3.4)
- Key challenges:
  - 2012 Portfolio Review recommended partial divestment
  - U.S. Air Force withdrawal of support for GONG operations
  - Need to integrate SOLIS vector-magnetograms into space weather models
- NSF – NOAA partnership for robust GONG operations



# SPRING: SWAP 5.3.9, 5.4.2, 6.2.2

- NSO will contribute to the development and deployment of new operational space weather assets (5.3.9) and novel sensor technologies (5.4.2) leveraging international partnerships (6.2.2).
- Key challenges:
  - The Solar Physics Research Integrated Network Group (SPRING) is an international project currently led by the Kiepenheuer Institut für Sonnenphysik (KIS) in Germany, where science requirements are being written and instrument concepts being developed
  - The U.S. participation is through the NSO as a consultant on the European-led project
  - SPRING is in the conceptual stage and currently has no Federal funding.

