Agenda

• COVID-19 Impacts
• AST Personnel
• NSF Personnel
• Science Highlights from AST Facilities
• Satellite Mega-Constellations
• Looking Forward
COVID-19 Impacts

• AST facilities
  • Observing: NRAO (VLA, VLBA), GBO, Arecibo, GONG, Gemini (N).
  • Restarted Construction/Commissioning: DKIST.
  • Idle: Gemini (S), CTIO, Rubin Obs., ALMA, KPNO.
  • Restart risks/costs, replan of MREFC programs.
COVID-19 Impacts

• AST facilities
  • Observing: NRAO (VLA, VLBA), GBO, Arecibo, GONG, Gemini (N).
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  • Restart risks/costs, replan of MREFC programs.

• NSF: *NSF Implementation of OMB Memo M-20-17.*
  • Includes (but not limited to):
    • Allowability of salaries and other project activities.

  *Recipients are authorized to continue to charge salaries, stipends, and benefits to currently active NSF awards consistent with the recipients’ policy of paying salaries (under unexpected or extraordinary circumstances) from all funding sources, Federal and non-Federal.*

• Decadal Survey:
  • Possible Delays in release of the decadal survey may impact funding for large ground-based programs.
COVID-19 Impacts: NSF Staff

• March 16: NSF implemented up to 100% telework policy.
  • NSF building essentially closed to staff.
  • Flexible work schedules for staff, flexible dependent care.
  • *Return to work?* NSF never stopped working.

• Work-related travel cancelled.

• All NSF meetings/panels 100% video conference.
  • AST was in middle of panel season.
  • AST has successfully run all panels after mid-March remotely, 2 POs per panel plus Admin support, AST continued as scheduled.
DKIST in the NSF Facility Lifecycle

<table>
<thead>
<tr>
<th>Readiness</th>
<th>NSB Approved</th>
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<tr>
<td>Initial Development</td>
<td>Construction</td>
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<td>Conceptual Design</td>
<td>Operations</td>
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<td>Preliminary Design</td>
<td>Termination</td>
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<tr>
<td>Final Design</td>
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- MREFC Panel Review
- Conceptual Design Review (CDR)
- Preliminary Design Review (PDR)
- Final Design Review (FDR)
- Operations Review
- Termination Review

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

MREFC

- We Are Here

Review Decision by OD
DKIST Restart

• March 17, 2020: site construction was halted.

• May 29, 2020: NSO held a restart review. DKIST site construction approved for Phase I restart.

• June 4, 2020: DKIST site construction restarted.
  • Phase 1 entails:
    - Telework. Some high-priority activities allowed on site.
    - Directorate approval and scheduling required for high-priority activities.
    - PPE & social distancing strictly enforced.
    - On-site workforce split into two teams/shifts to reduce worker density and enable continuity of construction activities.

• The DKIST Project Management office is in the process of estimating cost/schedule impacts of the site construction stoppage.
LSST: Opening a Window of Discovery on the Dynamic Universe
Chile Base Facility nearly complete

Moved fully into the new offices during the quarter.

Rubin Obs. delivered new buildings to COS OIR Lab for operation, officially became a tenant.

Rubin Lab Space included in final remodeling phase started Oct. 1.
Tough first quarter in Chile (Pre-COVID)

Political unrest caused significant turmoil

- 1 day of no summit access
- 4 days of “emergency” staff only – No bus
- 6 days of late arrival / early return
- DOE personnel travel authorizations declined by Embassy
- Significant increase in staff tension (reduced over time)
- Individual disruptions
- Non-critical work was delayed
Current State of the Facility

Telescope mount tarped

M1M3 Cell, coating facility, M2 system, Hexapods, all secured and shutdown

Electrical boxes, equipment and materials tarped in dome

Construction paused: **Day for day** schedule slip plus start up and decreased efficiency delays
Personnel
Directorate for Mathematical and Physical Sciences (MPS)

- Anne Kinney, Assistant Director (AD) for MPS, left NSF May 1, to become the GSFC Deputy Director in May 2020.

- Sean Jones, Deputy AD, is acting AD.

- Tie Luo, Deputy Division Director of the Division of Mathematical Sciences is acting Deputy AD.
NSF Office of the Director

• France Córdova ended a 6-year term as NSF Director March 31.

• Sethuraman Panchanathan nominated by President to be 15th NSF Director (07 Jan. 2020).

• Kelvin Droegemeier named as Acting NSF Director on April 1. Current Director of OSTP and former member of the National Science Board.
Facility Highlights
NSF’s National Optical-Infrared Astronomy Research Laboratory

NOIRLab
The Inouye Solar Telescope sees large bubbling cells the size of Texas but can also see tiny features as small as Manhattan Island. This is the first time these tiny features have ever been resolved. The Inouye Solar Telescope is showing us three times more detail than anything we’ve ever seen before. For more information about this telescope, visit www.nso.edu.
Gemini-N Lucky Imaging of Jupiter

- Gemini-N has collected some of the highest resolution images of Jupiter obtained from the ground.
- Images are part of a multi-year joint program with the Hubble Space Telescope in support of NASA’s Juno mission.
- The facilities combined observe Jupiter’s atmosphere as a system; revealing winds, gases, heat, and weather phenomena.
- Images reveal that lightning strikes, and some of the largest storm systems that create them, are formed in and around large convective cells over deep clouds of water ice and liquid.
- Observations confirm that dark regions in the Great Red Spot are gaps in the cloud cover and not due to cloud color variations.
Cosmic Bubbles Reveal the First Stars

- Astronomers using the infrared imager NEWFIRM on the Mayall telescope on Kitt Peak have identified several overlapping bubbles of hydrogen gas ionized by some of the first stars formed after the cosmic dark ages, a mere 680 million years after the Big Bang.
- Stars contained in EGS77 Galaxy group.
- used to discover the two fainter galaxies in the group discovered via NEWFIRM narrow-band imaging.
Barnard’s Galaxy

• Barnard’s Galaxy, a dwarf galaxy neighboring the Milky Way, is revealed in this stunning image from the Blanco 4-m telescope.

• The image reveals regions of intense star formation and a scattering of immense cosmic bubbles.

• Glowing red regions of star formation distributed throughout Barnard’s Galaxy indicate that star formation is widespread.
GBT Detects Faint Repeating Fast Radio Burst

• Fast Radio Bursts (FRBs) are mysterious energetic flashes of radio emission originating from unknown extragalactic sources, and most were thought to be non-repeating

• GBT follow-ups detected a very faint signals from FRB 171019 – some 9 and 20 months after brighter bursts were found by the Australian Square Kilometre Array Pathfinder (ASKAP) – showing that this FRB repeats in time

• The very high sensitivity of the GBT allowed detection of ~600x fainter signals

GBT and ASKAP detections of FRB 171019 (Kumar et al. 2019, ApJL, 887, L30)

• More repeating faint FRBs missed by less sensitive observations may be detectable with the GBT, helping to elucidate the nature of FRBs

NSF’s Arecibo Observatory

• Critical scientific observations continued during challenging past few months
• Detected “mask-shaped” asteroid
• Expected to be largest asteroid to fly by Earth this year
• Distance ~16 times Earth-moon distance

AO radar image of the potentially hazardous object, asteroid 1998 OR2.

AO Management Team led by the University of Central Florida

(Arecibo Observatory/NASA/NSF)
ALMA Discovers Massive Rotating Disk in Early Universe

- Observations by the Atacama Large Millimeter/submillimeter Array (ALMA) show a massive disk galaxy, similar to our Milky Way, but at ~12.3 billion light years (the most distant rotating galaxy ever observed).

- The unprecedented resolution of ALMA allowed measurement of the galaxy’s disk, indicating a rotation velocity of 272 km/sec (comparable to the Milky Way).

- Follow-up observations by the Very Large Array and the Hubble Space Telescope show a star formation rate 10x more than that of the Milky Way.

- Such big, fully formed, galaxies are not expected so early in the history of the universe – only 1.5 billion years after the Big Bang.

- The results appear in *Nature*, 20 May 2020

Top Right: An artist’s impression of the Wolfe Disk
Bottom Right: The ALMA radio image of the disk galaxy.
Credit: NRAO/AUI/NSF, S. Dagnello (top) and ALMA (ESO/NAOJ/NRAO), M. Neeleman; NRAO/AUI/NSF, S. Dagnello (bottom)
Satellite Mega-Constellations
Satellite Constellations:

Impact to Optical and Infrared Ground-Based Astronomy
Internet Satellites and Optical Sensors

• About 7,000 satellites in CelesTrak catalog

• Internet satellites: SpaceX Starlink, OneWeb, Amazon, etc.
  • SpaceX: permission for 12,000, filed for another 30,000
    • ~300 launched to date, plan to launch in batches of 60, twice per month.
  • Amazon: ~3600
  • OneWeb: 648-2,500 (?)
  • Samsung: ~4,600

• Internet satellites typically will be in LEO, up to ~1,000 km altitude.
Satellite Constellations - Update

- NSF funded workshop: “Satellite Constellations 1 Workshop” June 29-July 2
  - Goal: *Work collectively toward effective solutions to mitigate impacts*
  - Four working groups currently examining
    - Synthesizing observational results and identifying future observing program needs
    - Examining the current status of simulations
    - Exploring mitigation through satellite ground measurements, detector performance, ops strategies
    - Developing metrics for Optical/IR.
  - Day 1-2: broader discussion
  - Day 3-4: Working Groups work on final white paper

- NSF working within the Federal Government to:
  - Understand specific impacts on Rubin Observatory.
  - Identify mitigation opportunities.
  - Identify good practices/policies for satellite vendors.

- NSF/Rubin Observatory continues to work closely with companies launching satellites to understand causes of optical brightness and to find mutually acceptable solutions.
Looking Forward
## FY 2021 Programs and Deadlines

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<th>Deadline</th>
<th>Program Lead</th>
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<tr>
<td>CAREER*</td>
<td>Faculty Early Career Development Program</td>
<td>27 Jul 20</td>
<td>Higdon</td>
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<tr>
<td>REU Sites*</td>
<td>Research Experiences for Undergraduates</td>
<td>28 Aug 20</td>
<td>Benacquista</td>
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<td>AAPF</td>
<td>Astronomy &amp; Astrophysics Postdoctoral Fellowships</td>
<td>15 Oct 20</td>
<td>Gupta</td>
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<tr>
<td>AAG</td>
<td>Astronomy &amp; Astrophysics Research Grants</td>
<td>16 Nov 20</td>
<td>Sharp (EXC), Langston (GAL), Krimm (SAA), Sollitt (PLA)</td>
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<tr>
<td>ATI</td>
<td>Advanced Technology and Instrumentation</td>
<td>16 Nov 20</td>
<td>Ninkov</td>
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<tr>
<td>MRI*</td>
<td>Major Research Infrastructure</td>
<td>19 Jan 21</td>
<td>Ninkov</td>
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* NSF-wide solicitations
Questions/Discussion?