AAS 235: NSF Town Hall


Ralph Gaume

Division Director, MPS/AST

January 6, 2020





NSF Town Hall Outline

- AST Personnel
- AST Program
- AST Facility Highlights
- AST Grants
- AST Program Funding
  - FY 2019
  - FY 2020 appropriation and prospects
- Astro 2020
- Broader Impacts (Dr. James Neff)
- NSF Spectrum Management (Dr. Ashley Zauderer)

AST Personnel

Division of Astronomical Sciences (AST)

Management Team

Ralph Gaume
Division Director

James Neff
Deputy Division Director (Acting)

Craig McClure
Program Support Manager

Donna O'Malley
Financial & Operations Specialist

Administration

Elizabeth Pentecost
Project Administrator

Matthew Viau
Program Analyst

Allison Farrow
Program Analyst

Renee Adonteng
Program Analyst (Pathways Student)

Individual Investigator Programs (IIP)

James Neff
Program Director
IIP Coordinator

Richard Barvainis
Program Director
Extragalactic Astronomy & Cosmology (EXC)

Glen Langston
Program Director
Galactic Astronomy

Harshal Gupta
Program Director
Astronomy & Astrophysics Postdoctoral Fellowships

Nigel Sharp
Program Director
AAG; CDS&E; cross-NSF programs

Hans Krimm
Program Director
Stellar Astronomy & Astrophysics

Peter Kurczynski
Program Director
Advanced Technologies & Instrumentation; EXC; MRI

Matthew Benacquista
Program Director
REU; EXC; ESP

Kenneth Johnston
Expert
CAREER; AAG

Sarah Higdon
Program Director
AAG

Zoran Ninkov
Program Director
Advanced Technologies & Instrumentation

Facilities, Mid-Scale, & MREFC Projects

Christopher Davis
Program Director
AstroLab Ops. MSO, CSDC. Gemini Observatory

Joe Pesce
Program Director
National Radio Astronomy Obs.; ALMA

David Boboltz
Program Director
AstroLab Transition, National Solar Observatory; DKIST

Edward Ajhar
Program Director
Large Synoptic Survey Telescope

Ashley Zauderer
Program Director
Arecibo Observatory

Richard Barvainis
Program Director
Mid-Scale Innovations Program (MSIP)
MSRI-1, MSRI-2

Luke Sollitt
Program Director
Planetary Astronomy

Harshal Gupta
Program Director
Green Bank Observatory

Martin Still
Program Director
Gemini Observatory

ESM

Jonathan Williams
Program Director

Ashley Zauderer
Program Director

AST Program

AST Division Programs

Individual Investigators
(Lead: J. Neff, H. Krimm)

Mid-scale
(Lead: Rich Barvainis)

Facilities Ops

Facilities MREFC or Reorg.

Research

- AAG
- CAREER
- AAPF

Technology/ Instrumentation

- ATI
- MRI

Education and Special Programs

- REU
- Misc.

Mid-scale

- MSIP
- MSRI

Facilities Ops

- ALMA
- NRAO
- Gemini
- MSO/CSDC
- NSO
- Arecibo
- GBO

Facilities MREFC or Reorg.

- DKIST
- LSST
- OIR Lab

AST Facility Highlights

AAS 235: AST Facility related events

- Friday – Monday (sorry if you missed it)
  - Other: NSF Postdoctoral Fellow Symposium
  - Session 119: LIGO-Virgo 3rd Observing Run and Plans for the Future.
  - Session 141: Town Hall – NSF's OIR Lab.
  - Session 181: Town Hall – DKIST Commissioning and Start of Operations.
  - Other: New Science Opportunities with the next generation Gemini North Adaptive Optics facility.

- Monday
  - Session 255: Breakthrough Science with the Atacama Large Millimeter/Submillimeter Array.
  - Other: Large Synoptic Survey Telescope Open House.

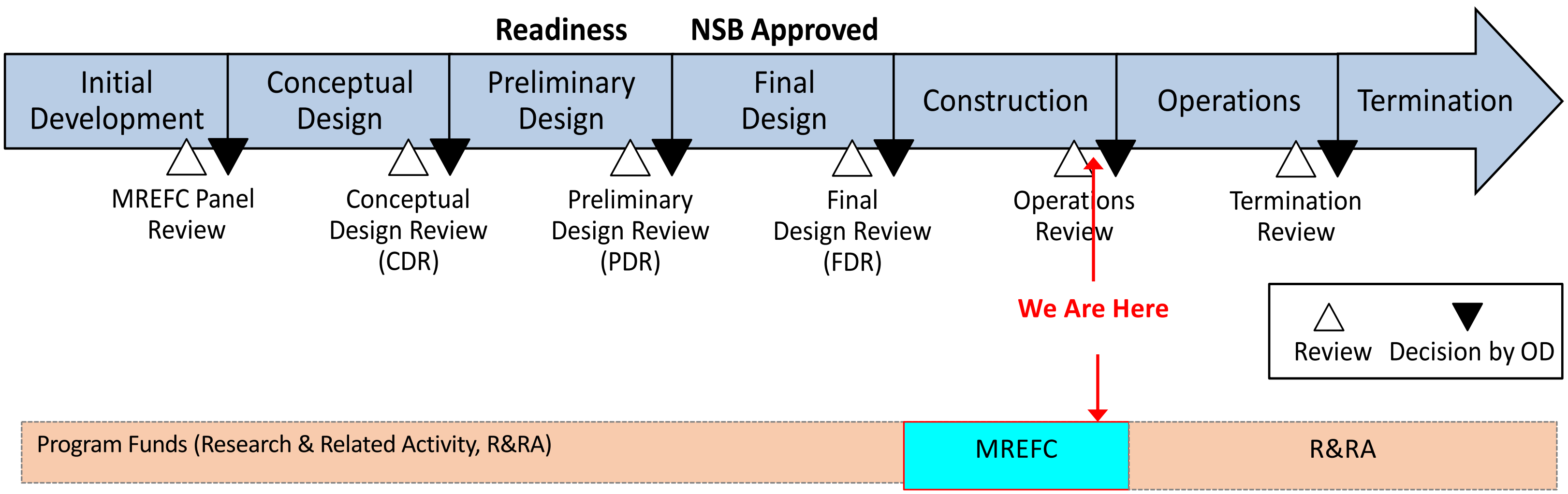
AAS 235: AST Facility related events

- Tuesday
  - Session 338: New Results from the Dark Energy Survey.
  - Other: The Advanced Green Bank Telescope: Planning for the Next Decade.
  - Other: Planets, exoplanets, and planet formation with the Gemini large and long programs (LLPs).
  - Other: Arecibo Observatory Open House.
  - Other: MSO/CSDC Open House NOAO's Transition to NSF's OIR Lab.
  - Other: Gemini Open House.
  - Session 383: NRAO Town Hall.

- Wednesday
  - Session 422: Town Hall – Multi-Messenger Astrophysics at NASA and NSF.
  - Session 446: DESI Imaging and First Light Spectroscopy.

DKI Solar Telescope

DKIST in the NSF Facility Lifecycle



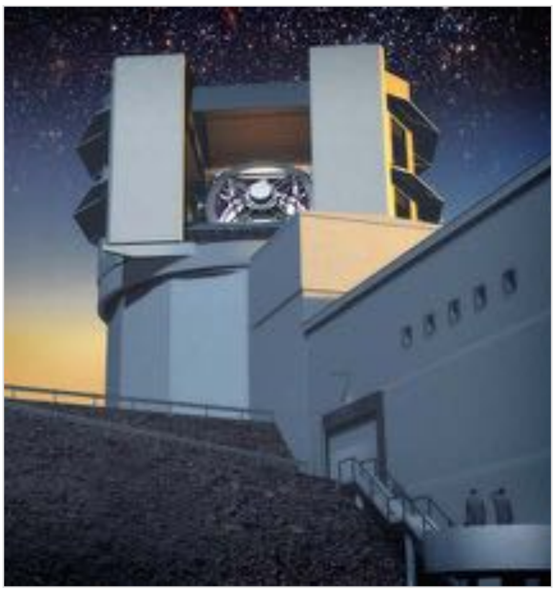
DKIST Telescope

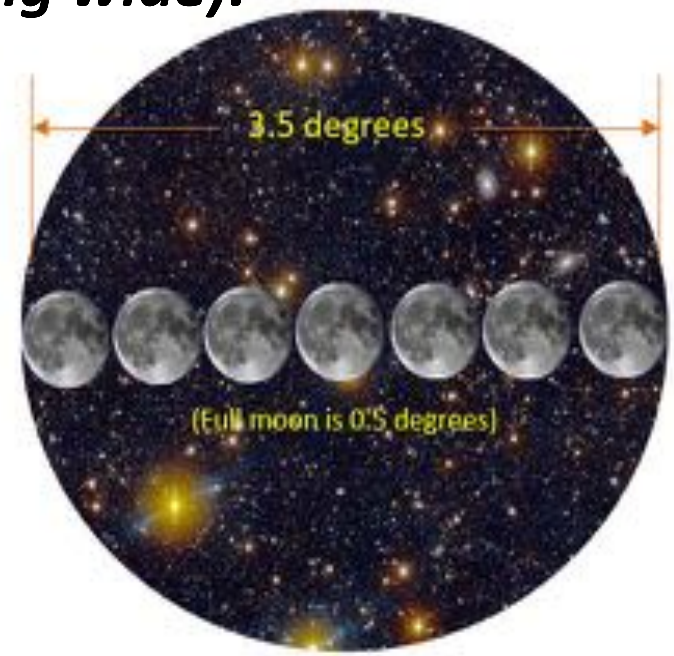
- Telescope optics in place, M1 & M2 aligned.
- Current challenges largely with instrument completion and delivery, as well as data policy.
- Commissioning of thermal control loops also a significant task.
- Still on schedule and within budget contingency.

LSST: Opening a Window of Discovery on the Dynamic Universe

What Makes LSST a Discovery Engine?

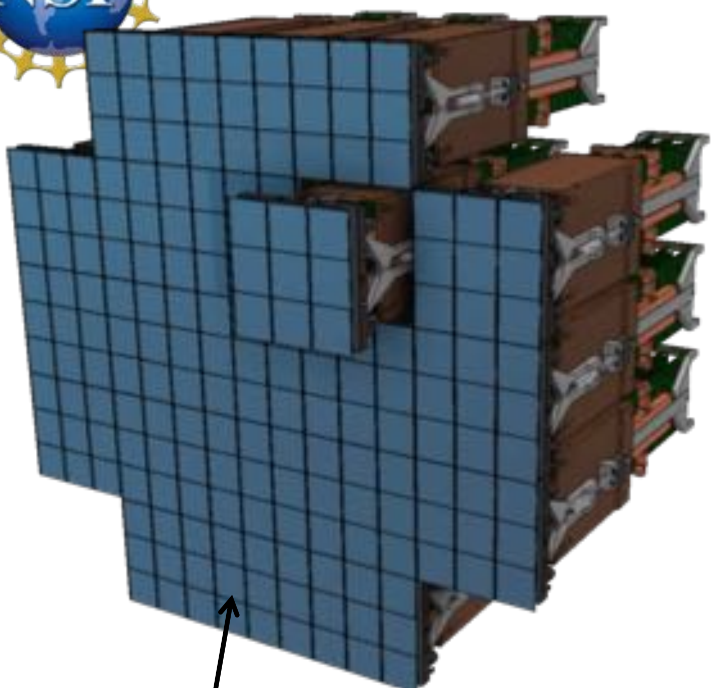
Large primary mirror allows ***going deep (faint)***.
Large Field of View allows rapid surveying of the entire sky every few nights ***(going wide).***

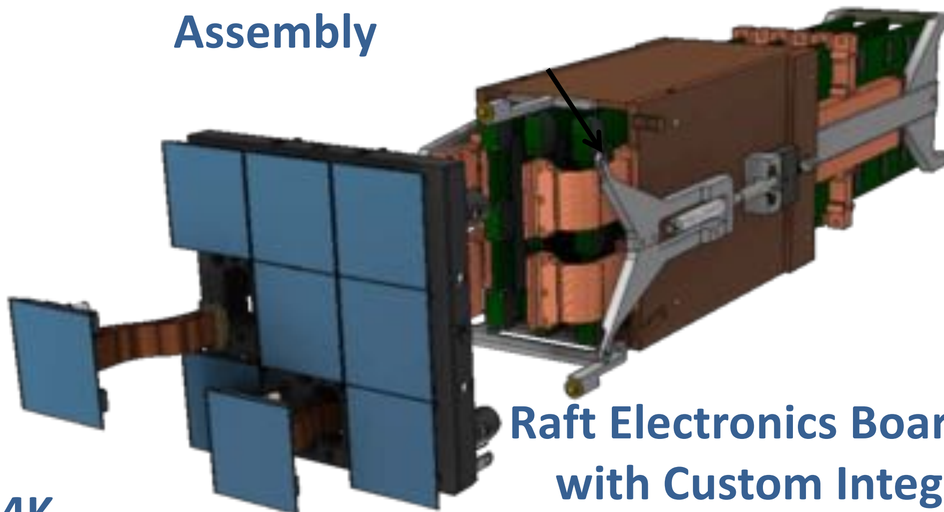




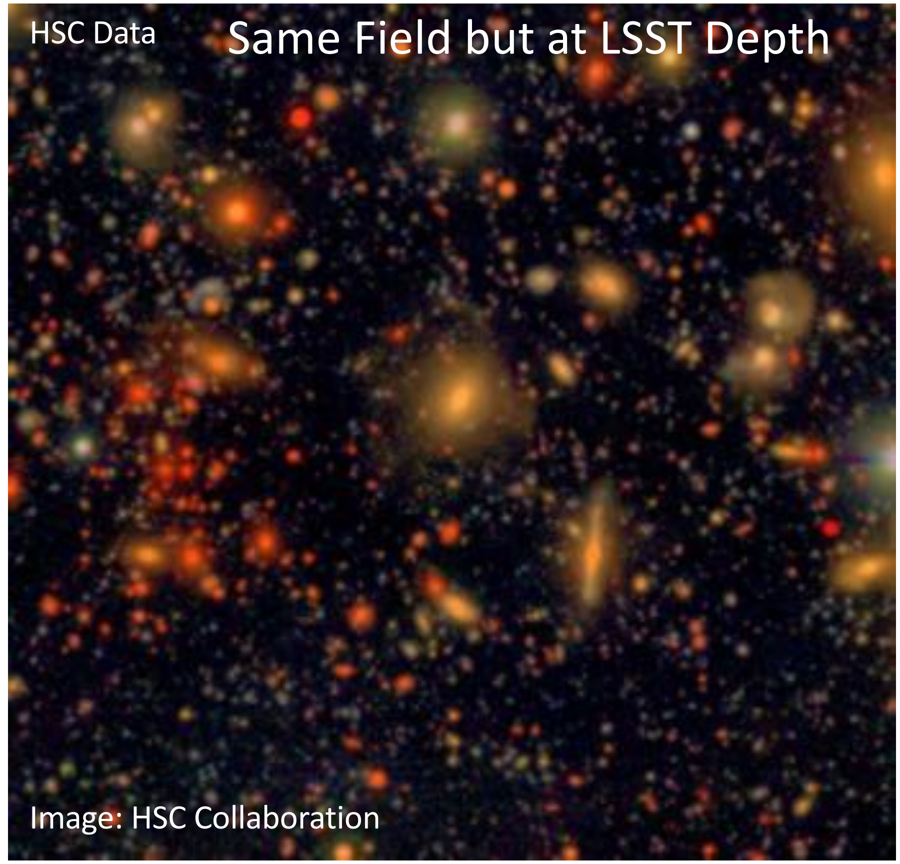
What Makes LSST a Discovery Engine?

Exquisite sampling of the Field of View with World's Largest Astronomical Camera





LSST Going Wide and Deep



Four Science Goals

Dark Matter, Dark Energy

Mapping Galaxies
through space and time

Cataloging the Solar System

Potentially Hazardous
Asteroids

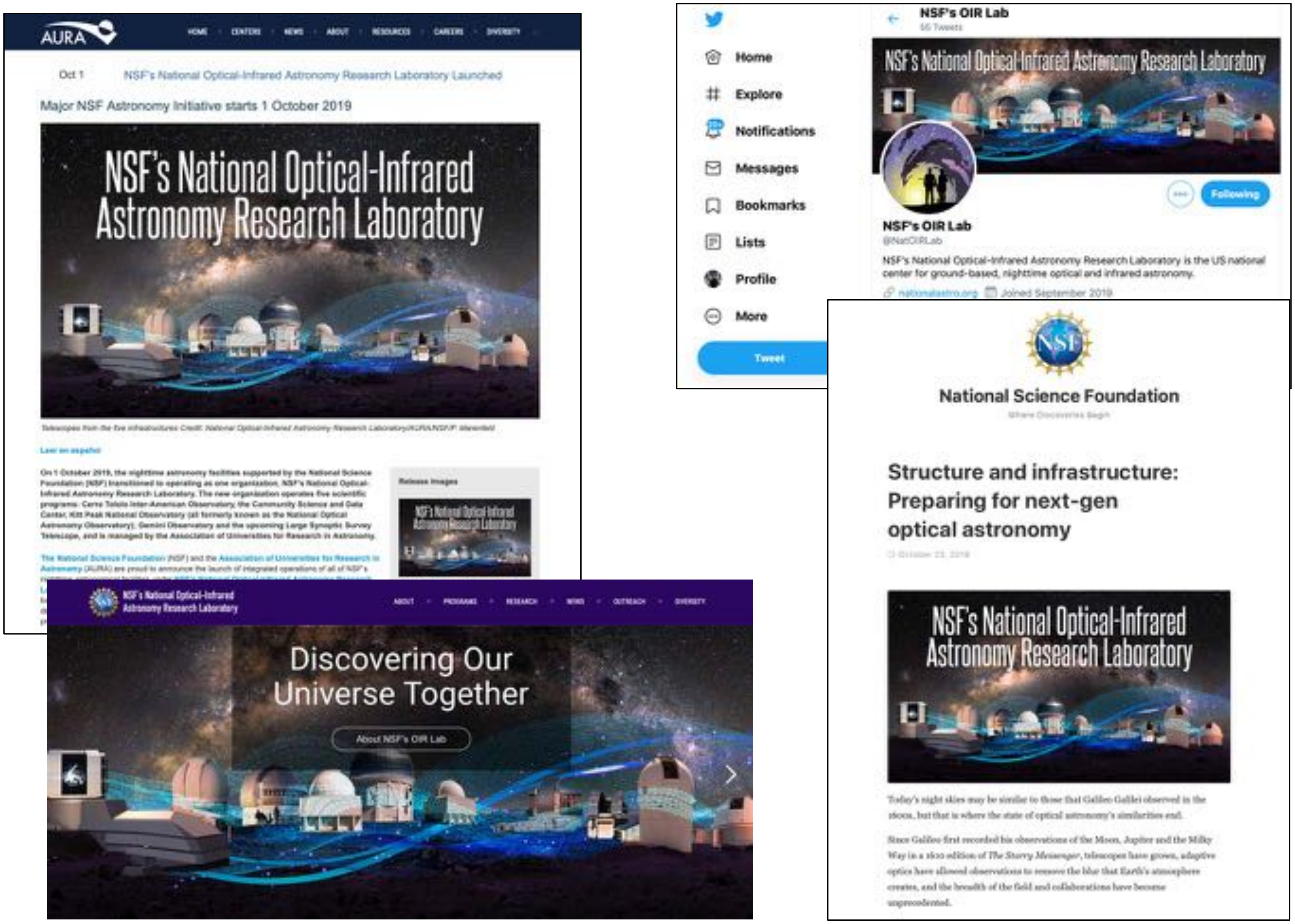
Milky Way Structure & Formation

Understanding our
home galaxy

Exploring the Transient sky

Revolutionizing time
domain astrophysics

LSST Fall 2019


AURA
HOME · CENTERS · NEWS · ABOUT · RESOURCES · CAREERS · DIVERSITY
Oct 1
NSF's National Optical-Infrared Astronomy Research Laboratory Launched
Major NSF Astronomy Initiative starts 1 October 2019
NSF's National Optical-Infrared Astronomy Research Laboratory
Release Images
NSF's OIR Lab
Home
Explore
Notifications
Messages
Bookmarks
Lists
Profile
More
Tweet
Following
NSF's OIR Lab
@NatOIRLab
NSF's National Optical-Infrared Astronomy Research Laboratory is the US national center for ground-based, nighttime optical and infrared astronomy.
noirlab.edu
Joined September 2019
National Science Foundation
Structure and infrastructure: Preparing for next-gen optical astronomy
NSF's National Optical-Infrared Astronomy Research Laboratory
ABOUT · PROGRAMS · RESEARCH · NEWS · OUTREACH · DIVERSITY
Discovering Our Universe Together
About NSF's OIR Lab

NSF's National Optical-Infrared Astronomy Research Laboratory-- *National Optical Astronomy Observatory (NOAO), Gemini Observatory, and Large Synoptic Survey Telescope (LSST) operations -- under a single organizational framework, managed by one management organization as an FFRDC.*

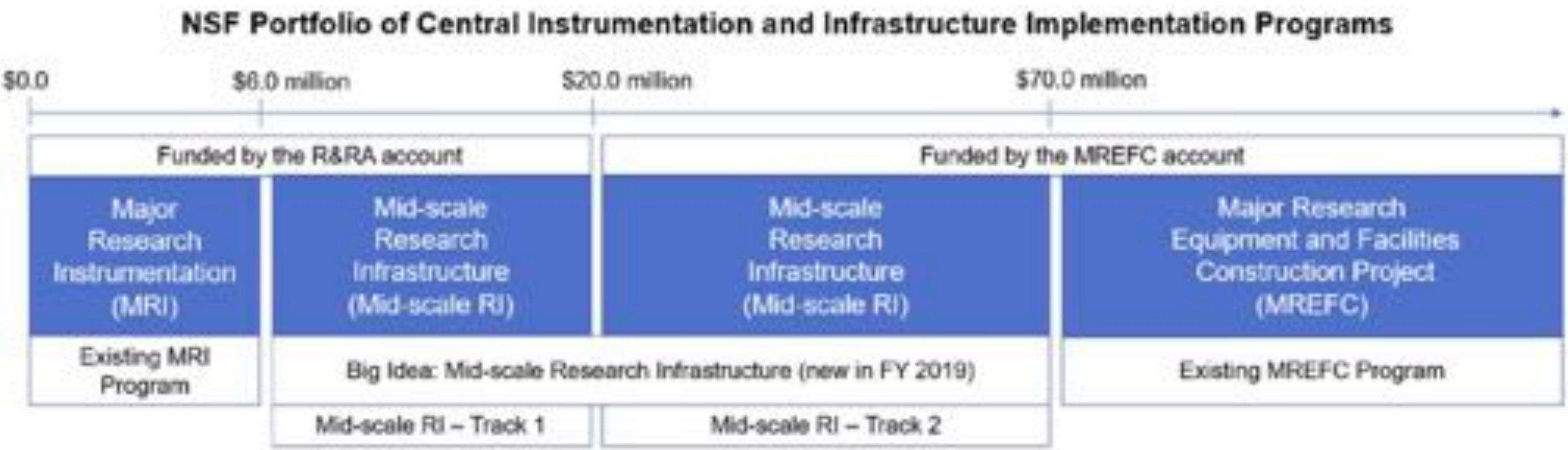
- Inauguration/kick off on 1 Oct 2019.
- Joint NSF/AURA press release to mark the event.
- LSST operations received initial funding in FY 2019.
- Pat McCarthy, Director

AST Grants

AST Grants program

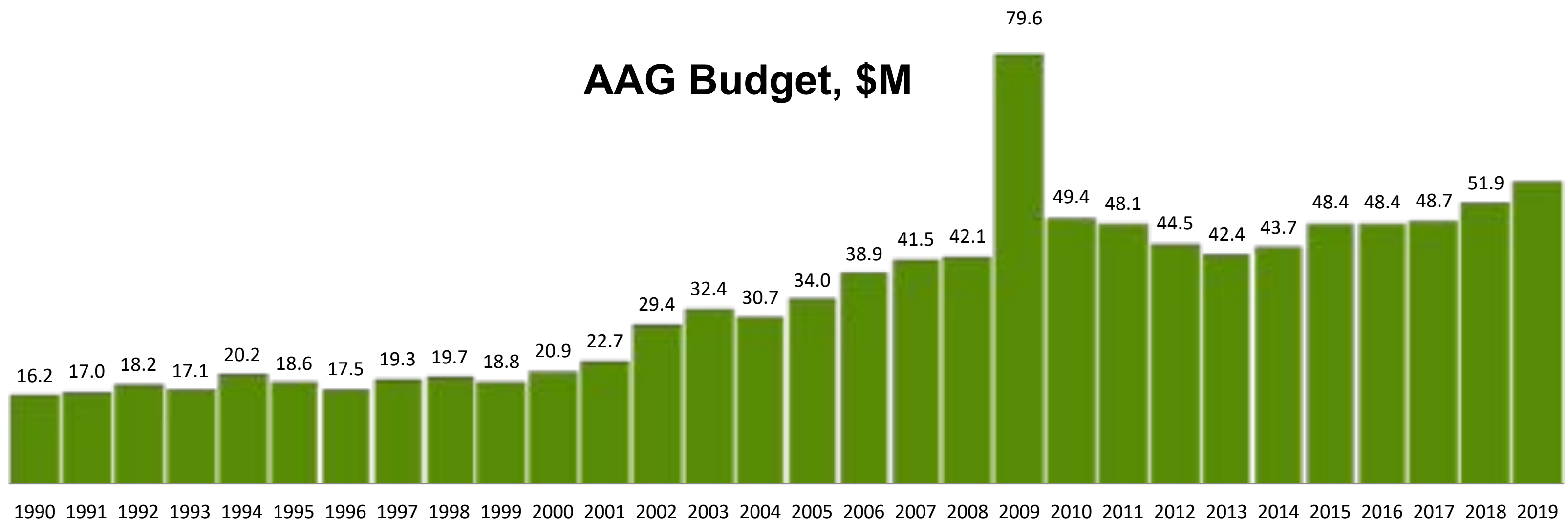
- FY 2018 was a good year:
  - Astronomy and Astrophysics Grants program funded at $51.9M, with a success rate of 22.9%.
  - Mid-scale Innovation Program (MSIP) year: funded at ~$50M level (FY 2018/2019).
- FY 2019 also a good year:
  - AAG program: see AAG funding histogram.
  - MSIP (not offered this year) but funding for 2nd year of awards FY 2018 awards fully provided.
  - Mid-scale Research Infrastructure (MSRI-1): < $20M, inaugural year, 2 astro. awards
  - ATI program: good year.
  - Windows on the Universe (NSF Big Idea) $30M stewardship funding was planned.
    - MPS/AST, MPS/PHY, GEO/OPP
- FY 2020 prospects:
  - AAG, may be another good year.
  - MSIP year, could be a good year.
  - Mid-scale RI-2: awards planned for projects in the $20M - $70M range.

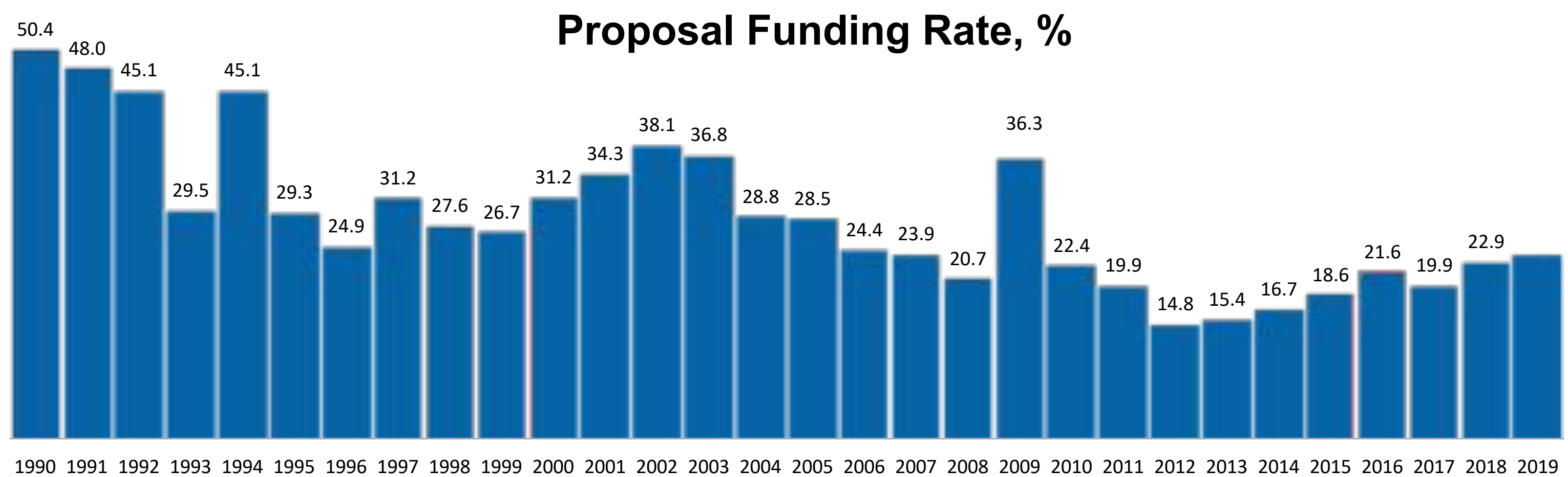
NSF-wide Mid-scale Opportunities



10 Awards made in FY 2019
2 to astronomy programs:
EHT and CMB-S4

50 pre-proposals received,
awards to be made in FY 2020


AAG Budget, $M
16.2 17.0 18.2 17.1 20.2 18.6 17.5 19.3 19.7 18.8 20.9 22.7 29.4 32.4 30.7 34.0 38.9 41.5 42.1 79.6 49.4 48.1 44.5 42.4 43.7 48.4 48.4 48.7 51.9
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019


Proposal Funding Rate, %
50.4 48.0 45.1 29.5 45.1 29.3 24.9 31.2 27.6 26.7 31.2 34.3 38.1 36.8 28.8 28.5 24.4 23.9 20.7 36.3 22.4 19.9 14.8 15.4 16.7 18.6 21.6 19.9 22.9
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

AST Program Funding

FY2019/FY2020 Enacted levels

NSF FY 2019 Budget

- Enacted Foundation appropriation increases R&RA account by 3% (to $6,520M).
- MREFC line re-incorporates Antarctic infrastructure; DKIST (final year, Ops begin June 2020) and LSST at requested levels.
- NSF's bill was not under consideration for passage before the end of FY 18, so operations after October 1, 2018 were under a Continuing Resolution until Dec 21st.
- Major 35-day shutdown challenge for NSF was maintaining flow of funds to facilities awardees, particularly those with Chilean labor contracts. OMB allowed cash draws for previously allocated funding, unlike the 2013 shutdown.
- FY 2019 detailed AST budget will be released and made public in the President's FY 2021 Budget Request to Congress (nominally February 2020).

NSF FY 2020 Budget

- Enacted Foundation appropriation increases R&RA 3% (to $6,737M).
- MREFC line fully funds LSST at requested levels.
- NSF's bill was not under consideration for passage before the end of FY 19, so operations after October 1, 2018 were under Continuing Resolutions until Dec 20th.
- Relevant FY2020 Congressional Report and Explanatory language (paraphrased for brevity):
  - House: NASA should maintain current funding levels for NSF facilities wrt Planetary Defense, and determine if additional funds are required.
  - Senate: Within 180 days NASA shall conduct cost and tech. eval. of installing a transmitter at Green Bank Observatory.

NSF FY 2020 Budget

- Relevant FY2020 Congressional Report and Explanatory language (paraphrased for brevity) continued:
  - House: allocate funding no less than FY 2019 levels for astronomy assets.
  - House: Committee concerned about NSF planning for the construction and development of next generation of large scale facilities, including ground-based telescopes.
  - Senate: expects NSF to continue to support astronomy facilities and instrumentation while preliminarily preparing for upgrades and activities associated with Astro 2020. Continue to explore partnerships.
  - House & Senate: fully supports LSST construction budget request.
  - Senate: supports DKIST operations, and encourages support for existing ancillary academic partnerships that made construction successful.
  - Senate: WoU-MMA Big Idea: encouraged to support ongoing operations of existing and future astronomy and physics facilities within this budget.
  - House/Senate/Conference: MSRI-2 funded at $45M/$75M/$65M in MREFC account.

Astro 2020

NSF Perspective

Astro 2020 decadal survey

- Planning is now well underway for input to the next Astronomy & Astrophysics Decadal Survey.
- NSF/AST and NASA Astrophysics Division are the primary sponsors of the survey. DOE Cosmic Frontier in the Office of Science is also a sponsor.
- NSF is including all ground-based astrophysics (i.e., gravitational wave detection and astro-particle detection) for scientific consideration, not limited to AST.
- Pending receipt of the survey NSF had exercised due diligence by providing preparatory funding for several candidate large decadal projects, including NRAO for ngVLA, NSF's OIR Lab for US-ELT, and CMB-S4. Does not imply commitment.
    - Congressional Report language: *preliminarily preparing for facility upgrades and activities associated with supporting the next Astrophysics decadal. (FY 2019, similar language for FY 2020).*
- AST does not explicitly support preparation of mid-scale proposals for Decadal submission via a dedicated solicitation, but may support this through the AST MSIP solicitation and/or the MSRI program.

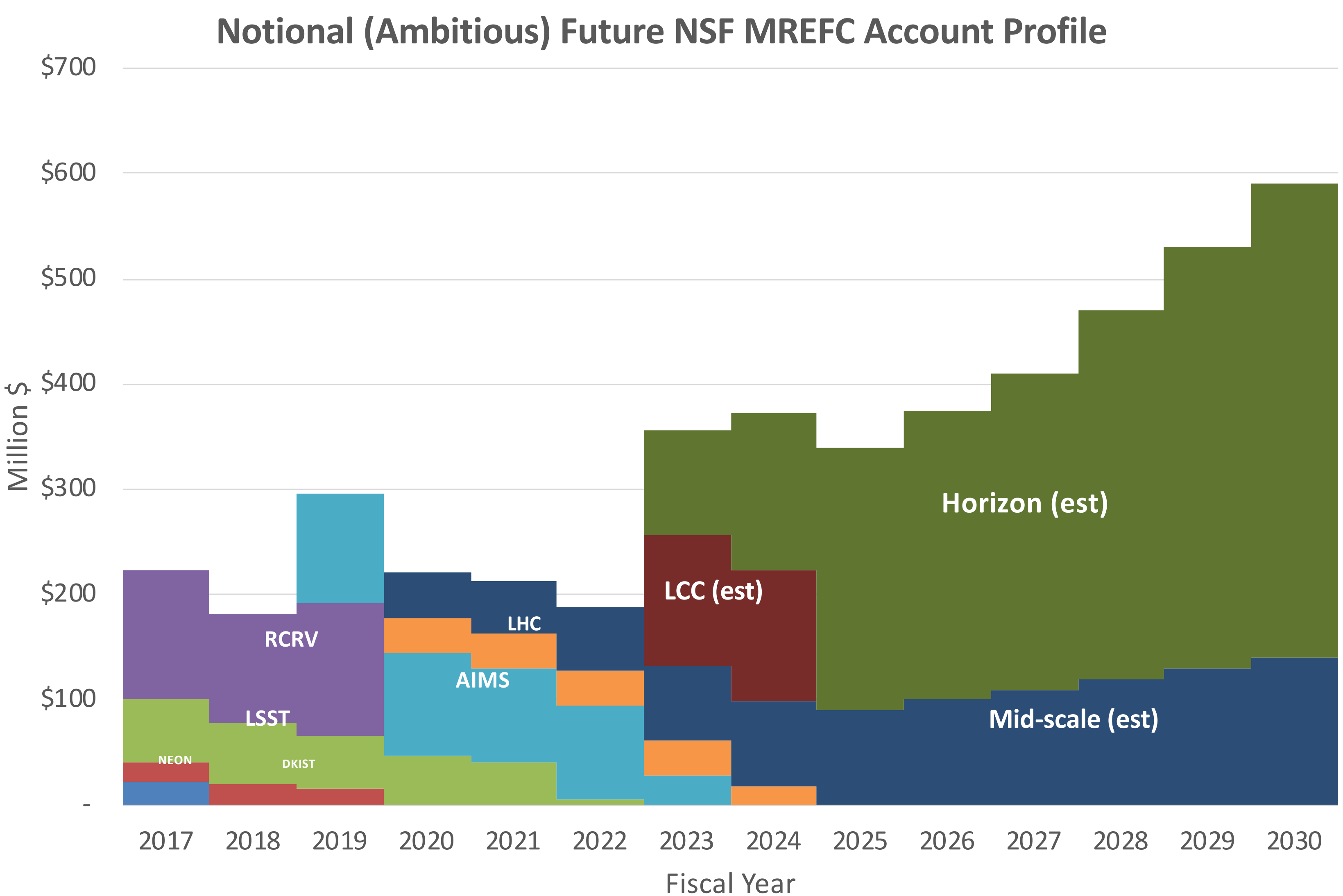
NSF Goals for Astro2020

- Astro2020 will be most effective if it is *aspirational, inspirational,* and *transformative.*

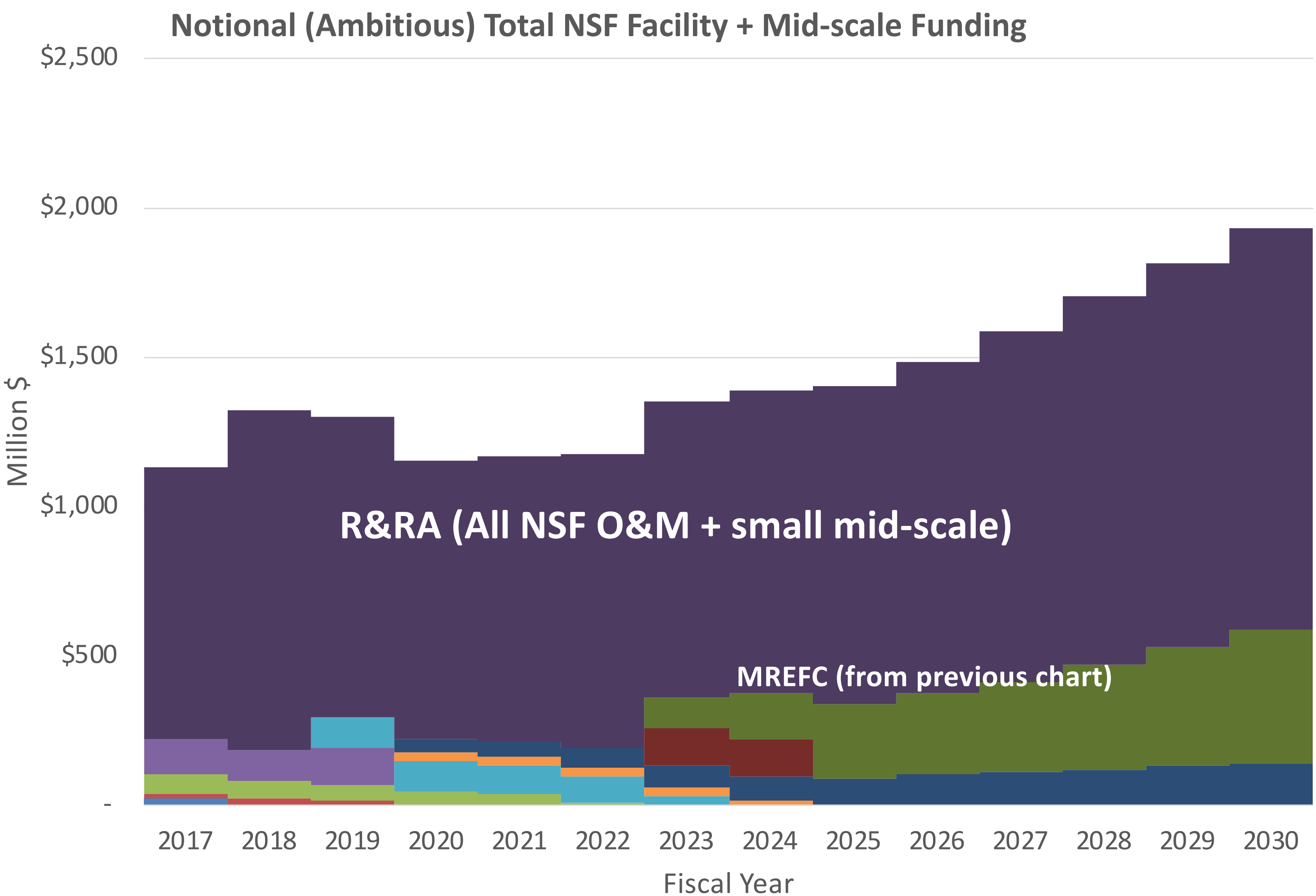
- Astro2020 will be most effective if it is based on *community consensus science priorities*.

- The agencies are the *customers*. Astro2020 will be conducted independently of the customer, but must provide *recommendations, clear priorities,* and *actionable advice* to the customer.
  - Let the agencies will sweat implementation details.

Notional NSF Budgets: Construction and Operations



Notional (Ambitious) Future NSF MREFC Account Profile
$700
$600
$500
$400
$300
$200
$100
-
Million $
RCRV
LSST
NEON
DKIST
AIMS
LHC
LCC (est)
Horizon (est)
Mid-scale (est)
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Fiscal Year



Notional (Ambitious) Total NSF Facility + Mid-scale Funding
$2,500
$2,000
$1,500
$1,000
$500
-
Million $
R&RA (All NSF O&M + small mid-scale)
MREFC (from previous chart)
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Fiscal Year

Broader Societal Impact

NSF Mission Statement & Broader Societal Impact

- Dual nature of NSF's mission: to advance the progress of science while benefitting the nation

  "to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense; and for other purposes"

- Dual Merit Review *criteria*:

  Intellectual Merit – the potential to *advance knowledge*

  Broader Impacts – the potential to *benefit society* and contribute to achieving specific, desired societal outcomes

- https://www.nsf.gov/bfa/dias/policy/merit_review/

Current AST Guidance to Panelists…

- Read the guidance on the *Panelist Functions* web page in Fast Lane.

- Evaluate *separately* and *explicitly* the Intellectual Merit and Broader Impacts. Provide a brief narrative assessment for each in the boxes provided.

- A *single* grade (Excellent, Very Good, Good, Fair, Poor) that reflects your *overall* assessment based on both review criteria, solicitation-specific criteria, and fit to the AAG program.

From the Pre-Panel Briefing…

- *"Broader impacts may be accomplished*
  - *through the research itself,*
  - *through activities that are directly related to [the proposed research],*
  - *or through activities that are supported by, but are complementary to the project."*
- Evaluate how well the proposal *explains* the societal benefit of funding this research program.
- In astronomy, these impacts are most commonly manifested in education, educational infrastructure, public outreach, enhanced public literacy, citizen science, and broadening participation.
- Other societal impacts are possible, so keep an open mind

What We Ask of You

- PROPOSERS
  - Carefully read the PAPPG and the Solicitation
  - Think deeply about the 3 ways BI may be accomplished; identify both direct and indirect impacts.
  - Clearly and convincingly articulate your case!
- REVIEWERS
  - *Evaluate* the proposal; do not just apply minimum threshold, a qualifying checklist, or invent new criteria.
  - Apply the same professional rigor as your evaluation of intellectual merit.
- AWARDEES
  - Include broader impact in your Annual and Final reports

Electromagnetic Spectrum Management

Ashley Zauderer, Program Director
MPS/AST
January 7, 2020 – AAS Winter Meting

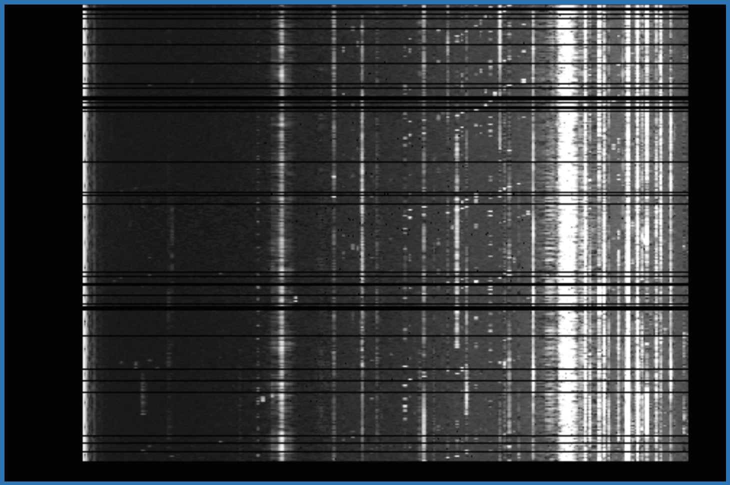
2020:
A decade with
new opportunities

LSST

Credit: almaobservatory.org

2020:
A decade with
new opportunities
and
new challenges

optical interference



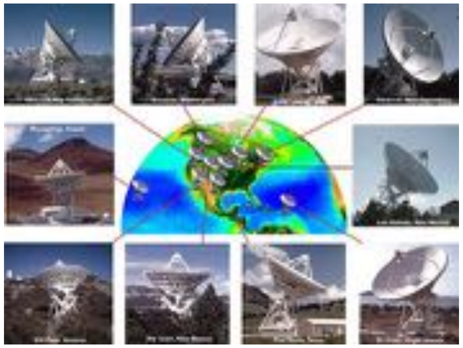
radio interference

Astronomy research relies on access to electromagnetic spectrum

ESM resides in MPS/AST because historically spectrum usage has been focused primarily around the needs of <u>a few large radio facilities</u> and <u>the National Radio Quiet Zone.</u>

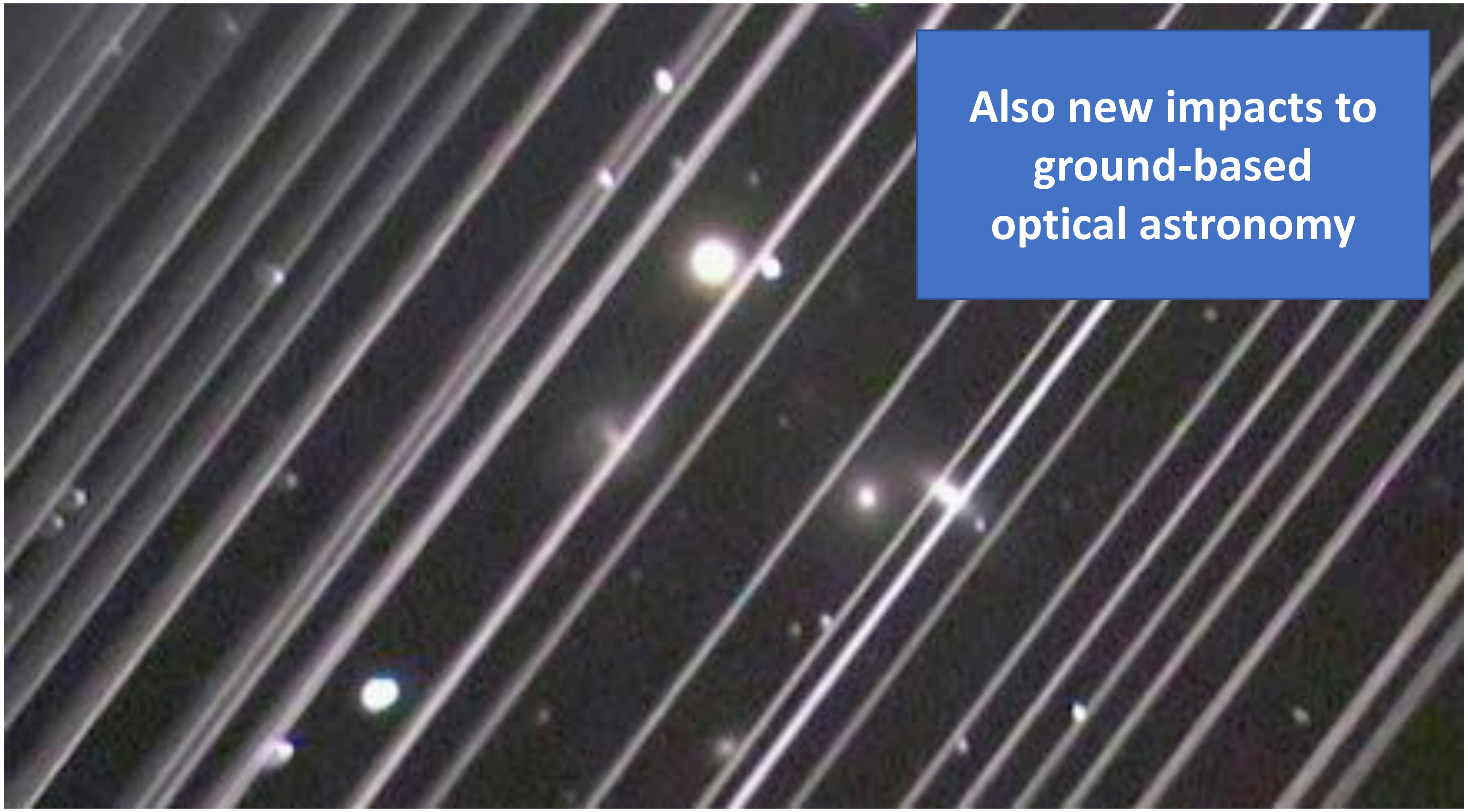
Arecibo Observatory, Puerto Rico

Very Large Array, NM



Very Long Baseline Array

Green Bank Observatory
National Radio Quiet Zone



Optical image of NGC 5353/4 galaxy group (25 May 2019)

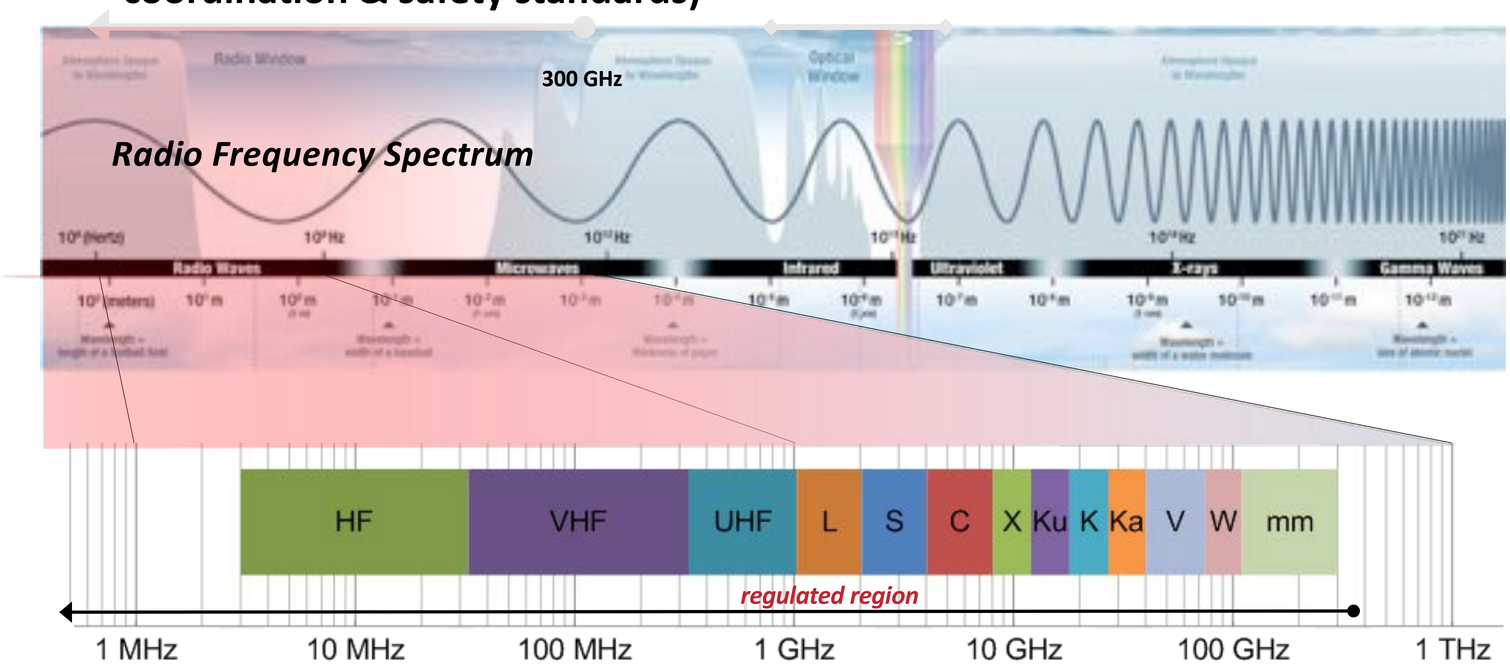
Image Credit: Victoria Girgis / Lowell Observatory
https://www.iau.org/public/images/detail/ann19035a/

- Constellations of thousands of satellites (10-50+ GHz regime) such that from any location you would always "see" at least one and up to 3 or 4 satellites or more!

Scientists use *the entire spectrum* but only *8.3 kHz to 275 GHz is regulated*:

- ***Radio Frequency Spectrum***: frequency region of the EM Spectrum that is managed via international and national laws and regulations

- Limited regulations in the near-infrared and optical region (e.g., laser coordination & safety standards)



Terminology used with portions of the radio frequency domain

Slide Credit: NASA

Frequency Allocations

- Radio Regulations:
  - (1) International (ITU-R Radio Regulations; www.itu.int)
  - (2) Regional
  - (3) National (USA: NTIA - www.ntia.doc.gov; FCC - www.fcc.gov)

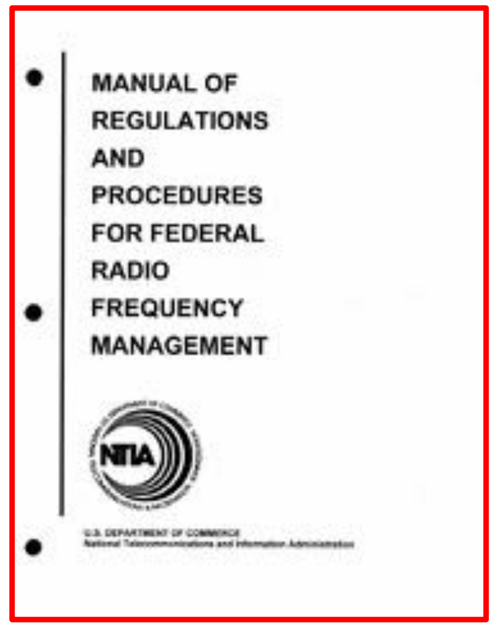
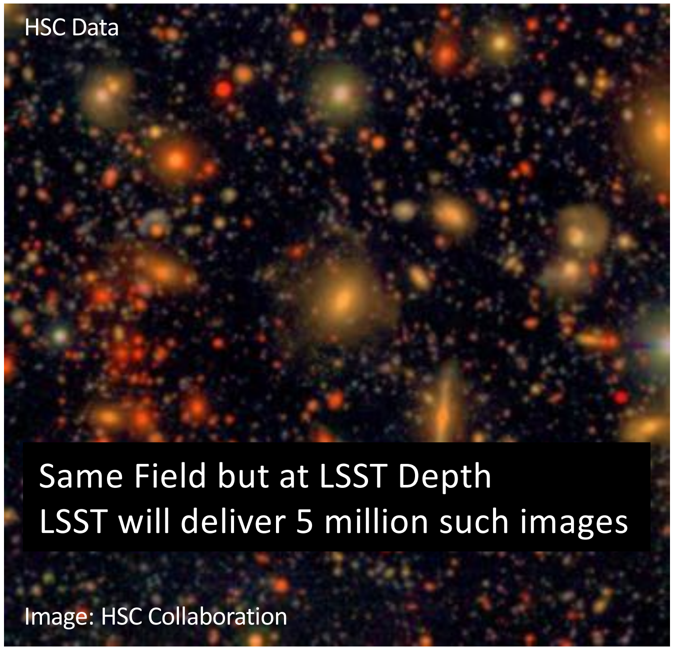


Table 1: Overall EVLA Performance Goals

Parameter	VLA	EVLA	Factor
Continuum Sensitivity (1-σ, 9 hr)	10 μJy	1 μJy	10
Maximum BW in each polarization	0.1 GHz	8 GHz	80
Log (Frequency Coverage over 1–50 GHz)	22%	100%	5

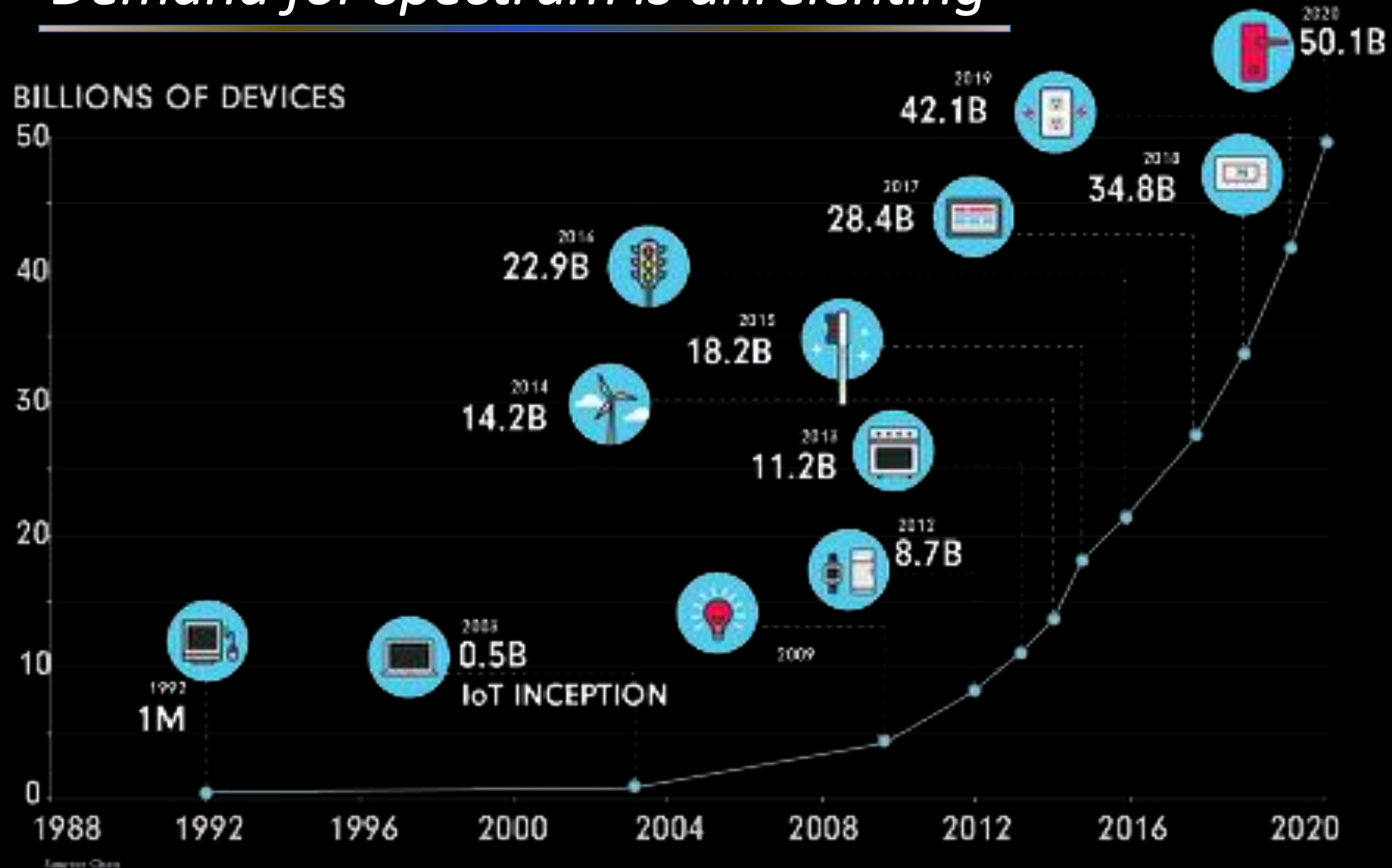
At the same time there are large improvements in radio astronomy capabilities…

Table and Image Credit: NRAO



And large improvements in optical astronomy capabilities…

Demand for spectrum is unrelenting



How much of your science case and your calculated sensitivity assumes access to full bandwidths or the status quo?

The RFI environment as we know it is changing… *rapidly*.

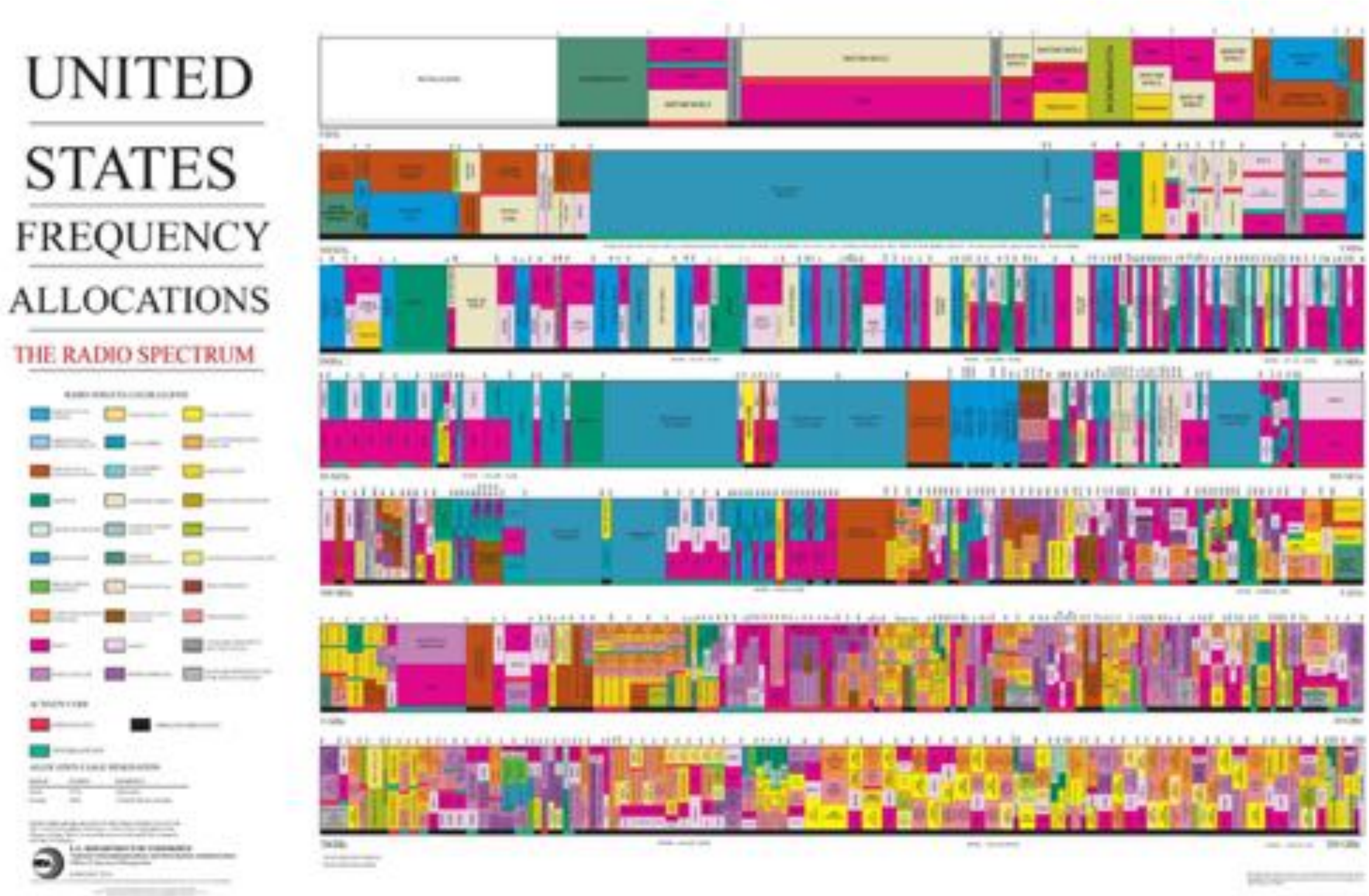
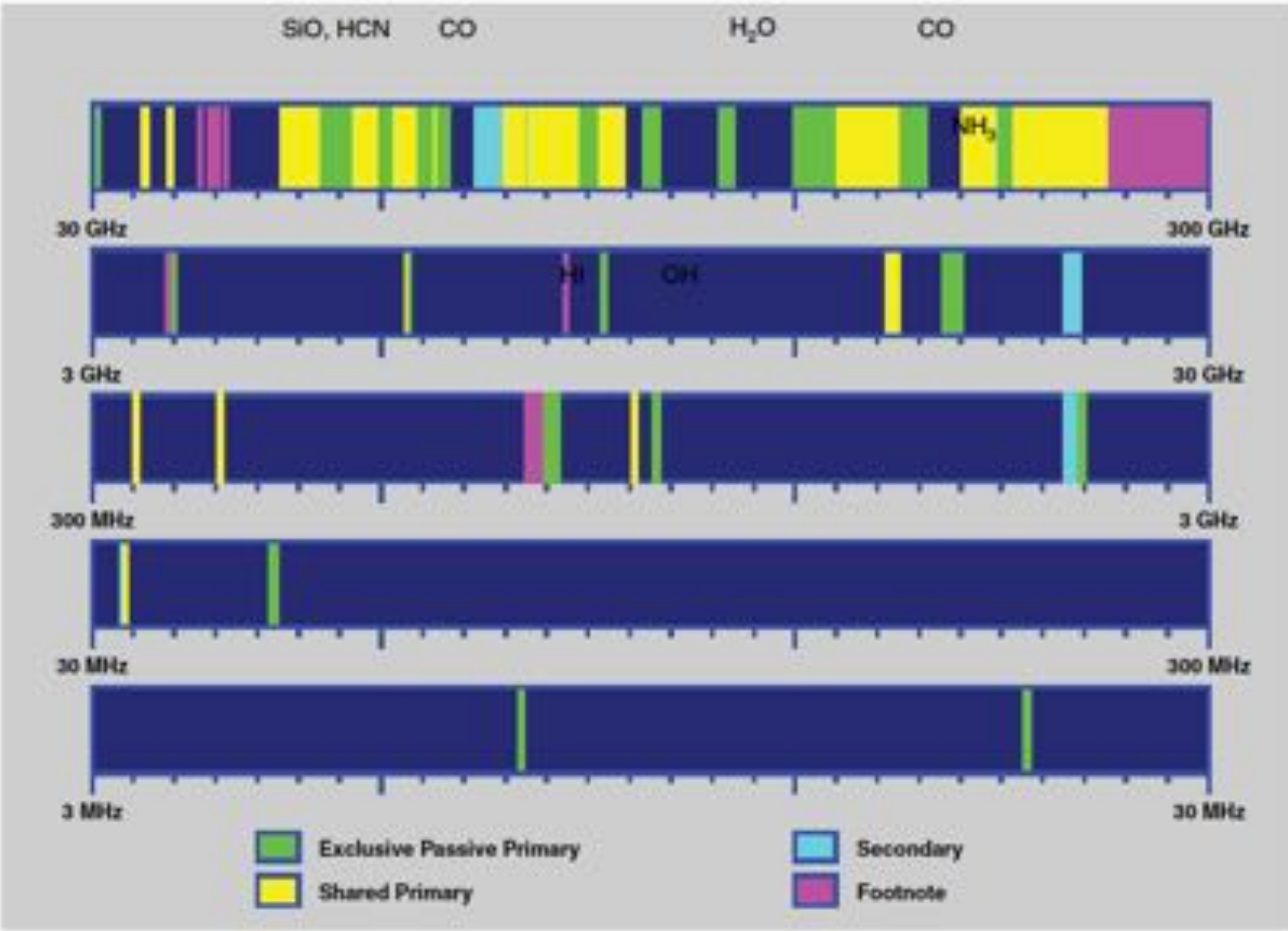


Image Credit: www.ntia.doc.gov

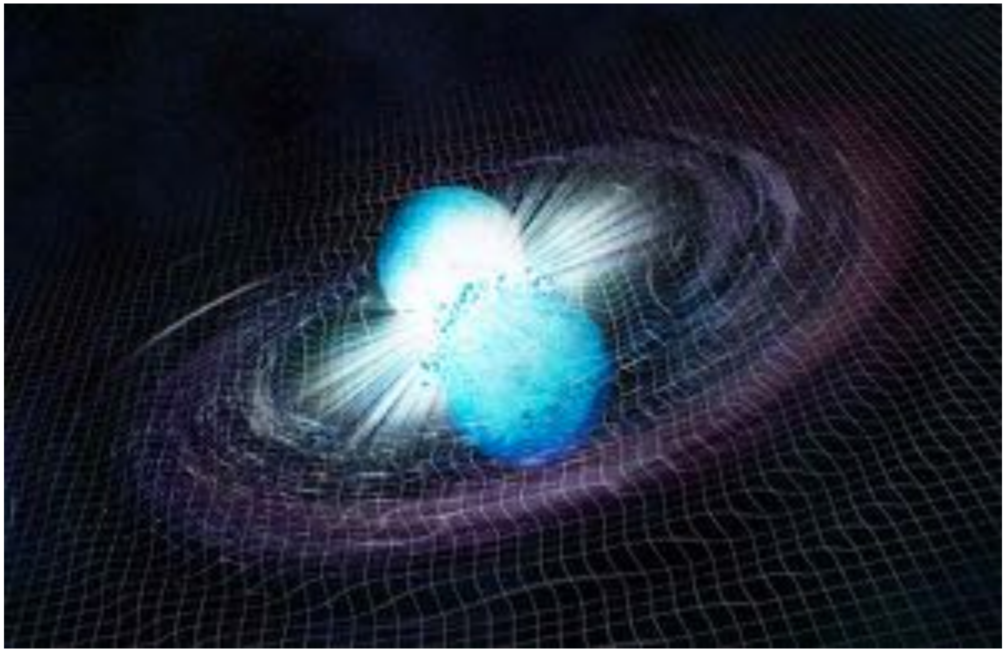


Radio Astronomy Frequency Allocations in the United States

<2 % below 3 GHz is allocated to Radio Astronomy as primary

Why does access to the radio spectrum matter?

GW170817



Artist's illustration of the merger of two neutron stars. A new study suggests that the neutron-star merger detected in August 2017 might have produced a black hole.
NASA/CXC/M.Weiss

A radio counterpart to a neutron star merger

G. Hallinan[1,*,†], A. Corsi[2,†], K. P. Mooley[3], K. Hotokezaka[4,5], E. Nakar[6], M. M. Kasliwal[1], D. L. Kaplan[7], D. A. Frail[8], S. T. Myers[8], T. ...

+ See all authors and affiliations

Science 22 Dec 2017:
Vol. 358, Issue 6370, pp. 1579-1583
DOI: 10.1126/science.aap9855

Article Figures & Data Info & Metrics eLetters PDF

GROWTH observations of GW170817

The gravitational wave event GW170817 was caused by the merger of two neutron stars (see the Introduction by Smith). In three papers, teams associated with the GROWTH (Global Relay of Observatories Watching Transients Happen) project present their observations of the event at wavelengths from x-rays to radio waves. Evans *et al.* used space telescopes to detect GW170817 in the ultraviolet and place limits on its x-ray flux, showing that the merger generated a hot explosion known as a blue kilonova. Hallinan *et al.* describe radio emissions generated as the explosion slammed into the surrounding gas within the host galaxy. Kasliwal *et al.* present additional observations in the optical and infrared and formulate a model for the event involving a cocoon of

Why does access to the radio spectrum matter?

10 uJy at 3 GHz ~2 weeks

2 GHz BW (~1.4 GHZ after RFI excision)

<50 MHz is RAS primary

Image Credits: Hallinan et al., Science (16 Oct 2017)

To achieve 2 uJy RMS (5-sigma detection) requires integration time on source of:

2 GHz bandwidth:
5.5 hours

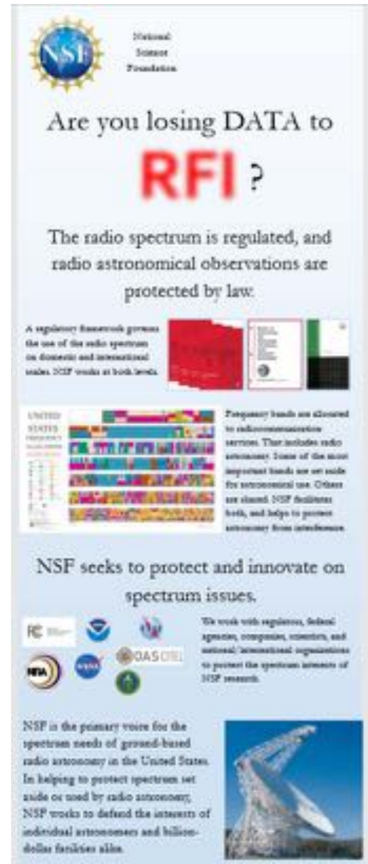
1.4 GHz bandwidth:
6 hours

50 MHz bandwidth:
185 hours (more than one week)

Exposure is too long
That is a lot of VLA time on one source. You may want to change your values for noise and bandwidth.

What is coming…

- NGSO constellations
- Mobile telecommunications, 5G
- High Altitude Platform Systems
- Commercial technologies in mm, sub-mm and THz regimes



What is coming…

- Increasingly congested spectrum everywhere

RFI at K-Band (18-26.5 GHz)

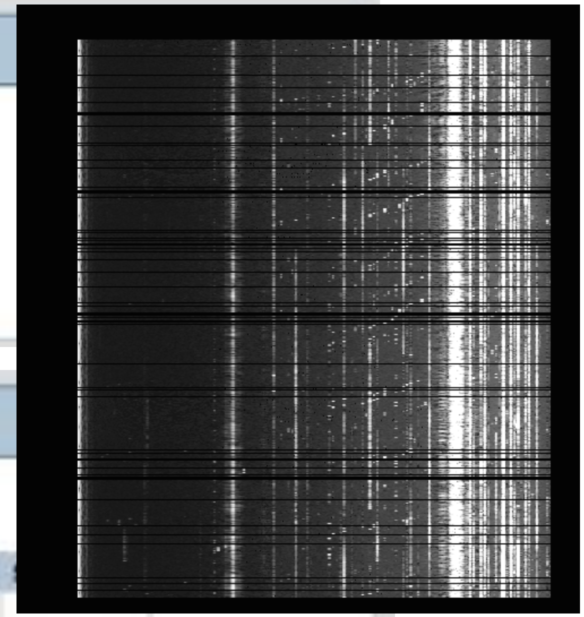
by Emmanuel Momjian — last modified Jul 07, 2011

Frequency (MHz)	Description	Origin	Classification	Spectrum
17800-20200	Satellite downlink	Clarke Belt	continuous	

RFI at Ka-Band (26.5-40 GHz)

by Emmanuel Momjian — last modified Mar 15, 2013 by Heidi Medlin

Frequency (MHz)	Description	Origin	Classification	S
29500-30000	local Wildblue VSAT	Local residences	Intermittent	
34875	Internal (June 2 to Oct. 8, 2010)	Antenna EA10	Continuous	plot
36286	Internal (June 2 to Oct. 8, 2010)	Antenna EA10	Continuous	plot



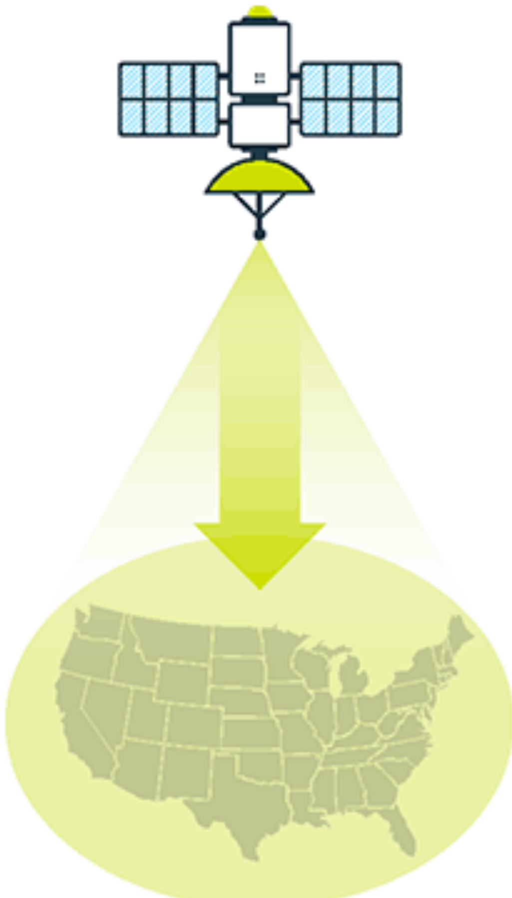
https://science.nrao.edu/facilities/vla/observing/RFI

Remote locations only help to a point…

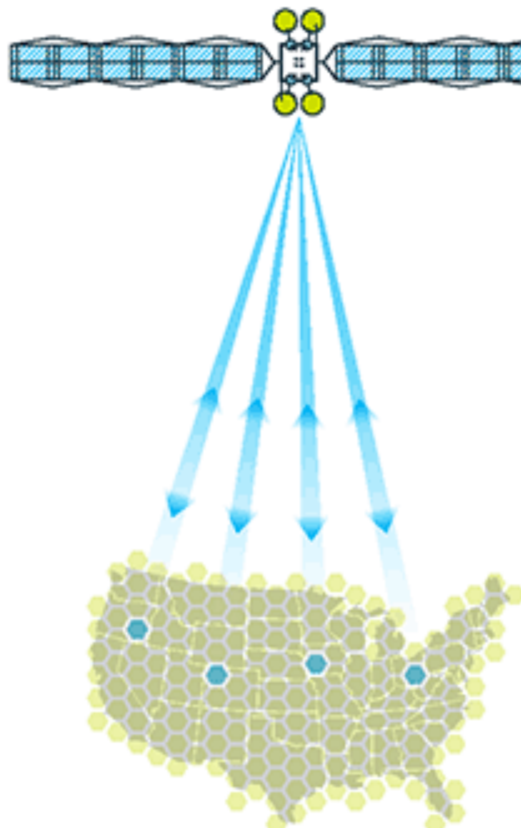
Band 1:
35 – 50 GHz
Band 2:
67 – 90 GHz

Image credits: almaobservatory.org, LSST

Radio and Optical Observatories tend to be in geographically remote sites, but radio and optical emission from <u>moving emitters will be an increasing challenge.</u>



Single beam,
one-way video broadcast



Spot beams for
satellite internet

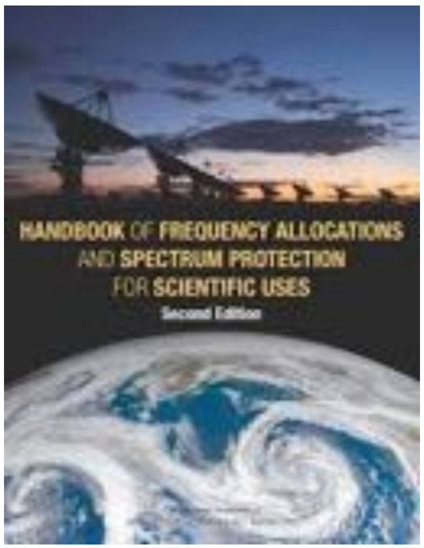
https://corpblog.viasat.com/how-it-works-the-technology-behind-satellite-internet/

Impact and Challenge is Widespread

- Ground based radio astronomy
- High energy astrophysics & Space Research (via Deep Space Network)
- Optical astronomy
- Space weather / solar physics
- Big data needs

Spectrum is an issue for the entire Scientific community, not just a small subset of radio astronomers.

What can we do?



- **Keep protected allocations as RFI-free as possible**
  - *Emissions may be prohibited at certain frequencies, out-of-band emissions can still be problematic*

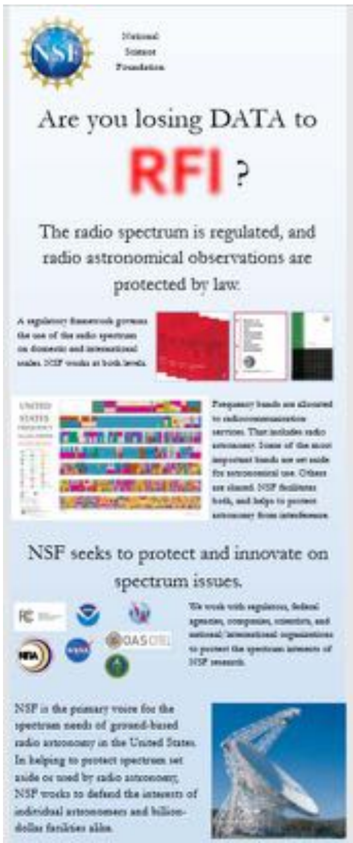
- **Utilize technology developments and advancements to increase spectrum availability, esp. in strategic geographic locations**
  - *Research in RFI excision techniques and receiver technology*

- **Coordination –**
  - *Study and Develop recommendations for emission levels at frequencies higher than 275 GHz, including optical*
  - *Work with industry to collaborate on solutions*

SESSION 410. Special Session - Challenges to Astronomy from Satellites

January 8, 2020, 10:00 AM - 11:30 AM | HCC - Ballroom AB

Questions and Comments



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