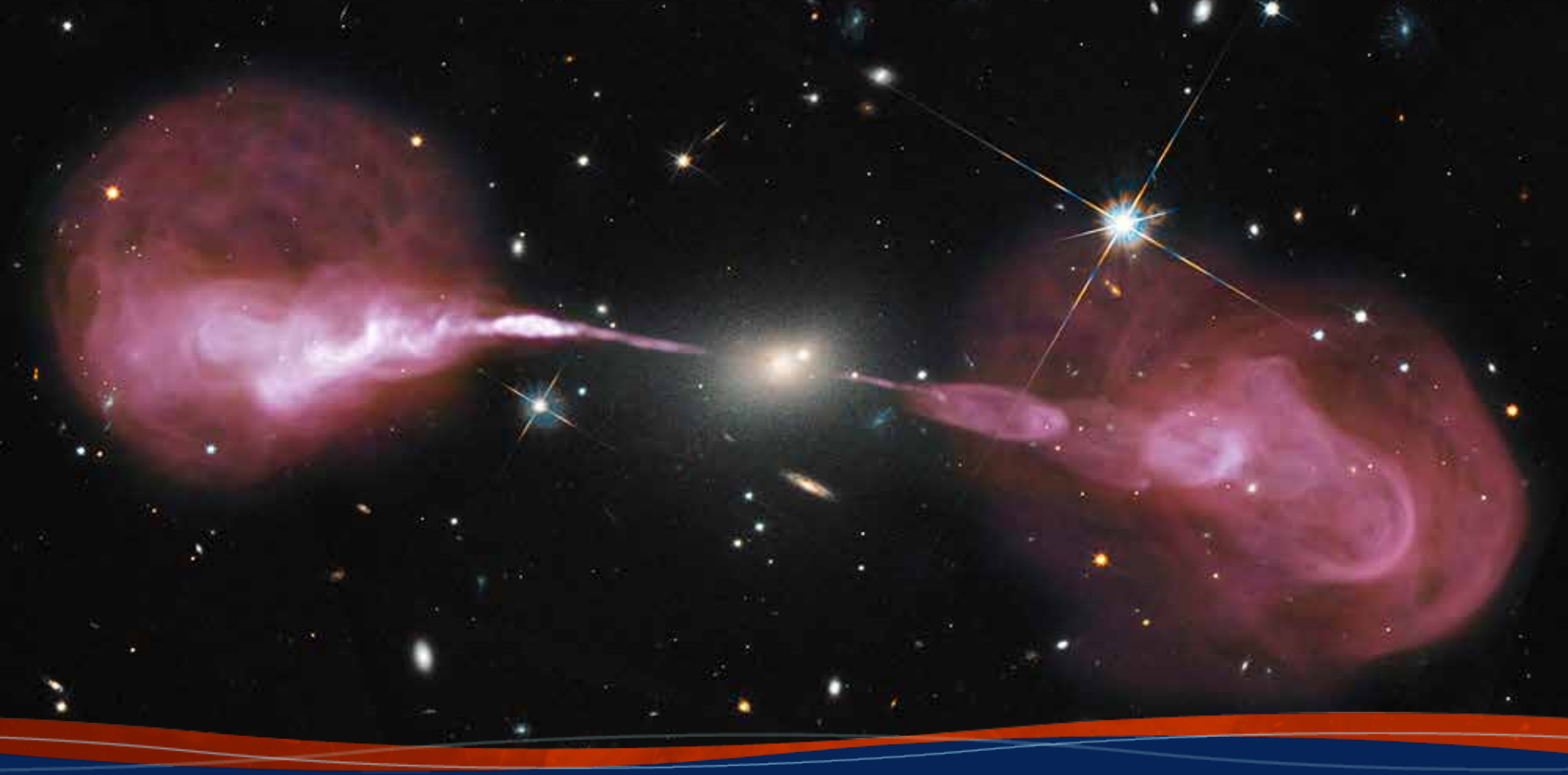

cm Radio Astronomy Technology

Tony Beasley

History

- Long-term interest @ NRAO – thermal imaging on milliarcsecond scales (bridging non-thermal/thermal science)
- EVLA Phase II, NAA, ….
- ALMA – immediate growth in cm/mm science

History

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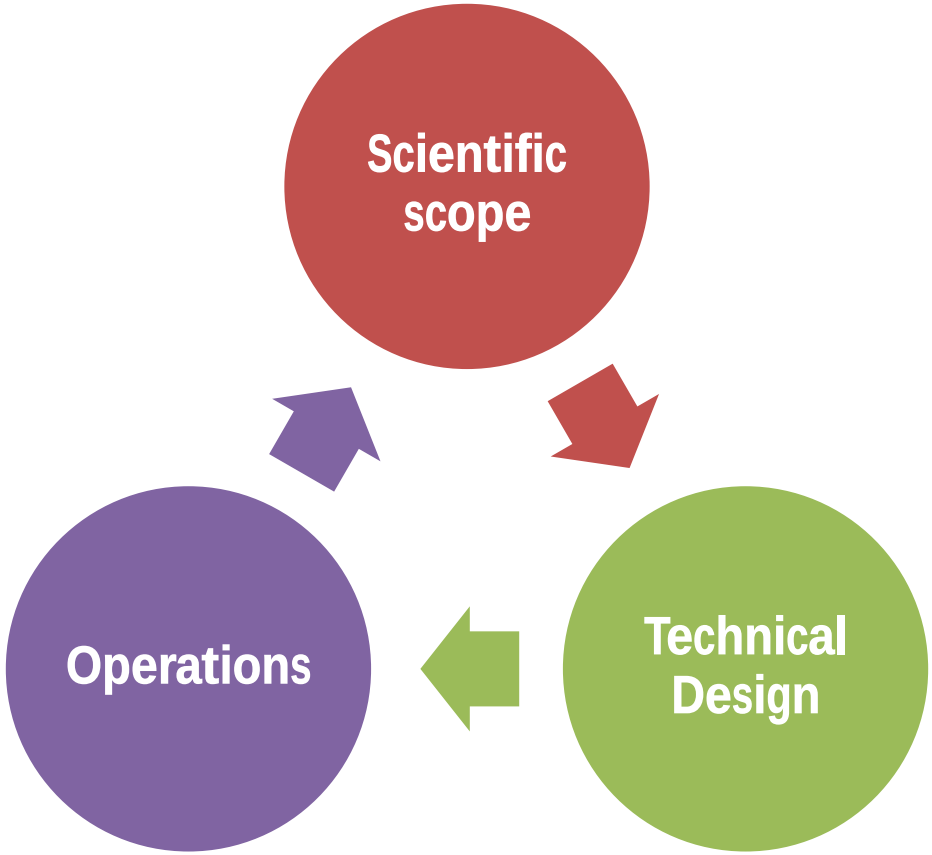
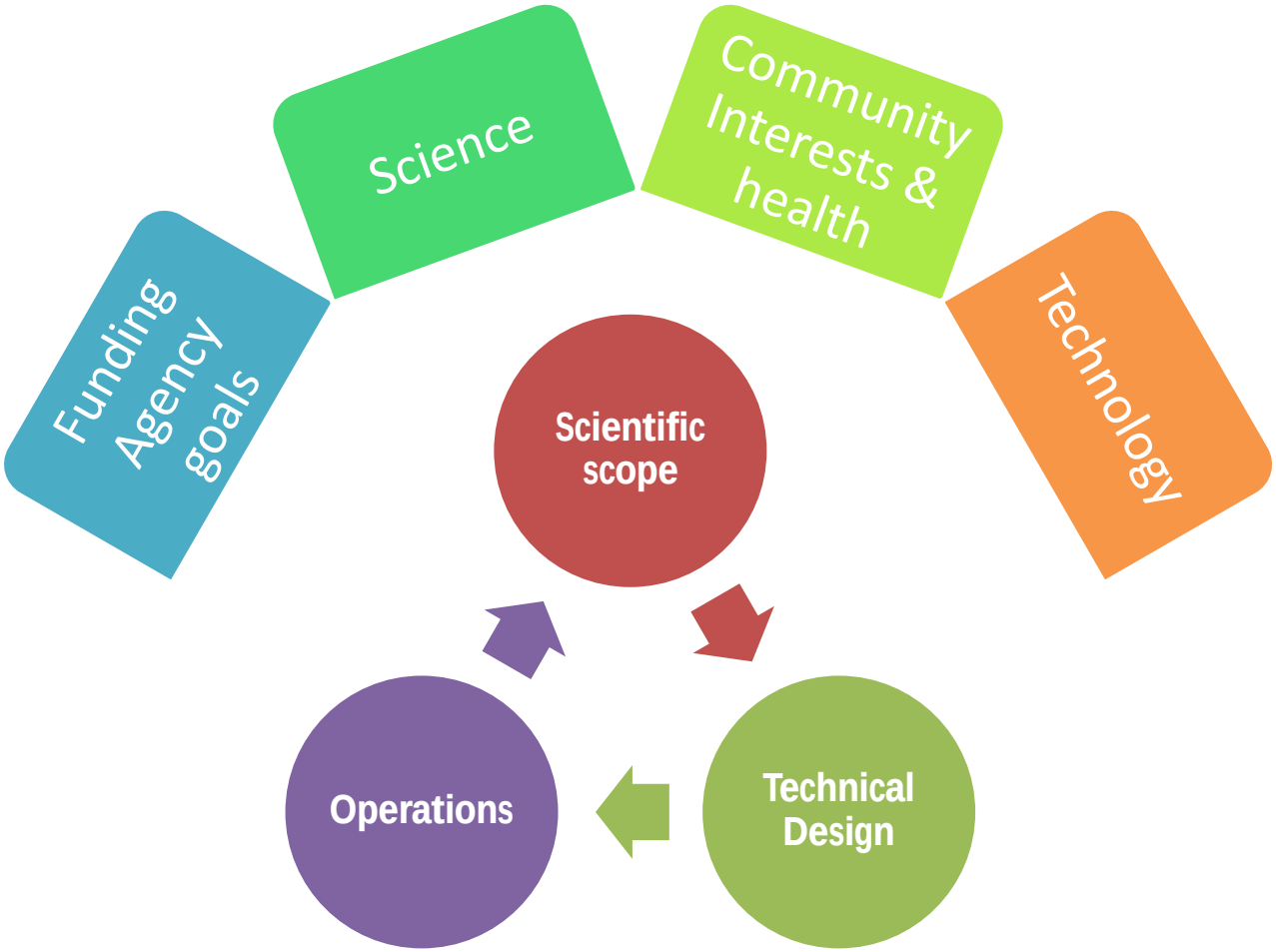
- EVLA Phase II, NAA, ….
- ALMA – immediate growth in cm/mm science
- University Radio community in US – in decline
- Mixed ASTRO2010 outcome, SKA project not ready

- Five years from ASTRO2020 … what are our science goals? What instrument/facility opportunities can be defined? How do we lead/complement the broader domestic/global astronomy communuity?

Projects



Start with Science…. Explore technology…. Then strategy…. End w/ Project
Avoid project cost estimates, parametric relationships, etc.
NRAO: bring RMS community together, consider options, produce credible ASTRO2020 entry



Environment

NSF MREFC Funding Projection

	FY 2013 Actual	FY2014 Estimate	FY 2015 Request	FY 2016 Estimate	FY 2017 Estimate	FY 2018 Estimate	FY 2019 Estimate	FY 2020 Estimate
AdvLIGO	$15.18	$14.92	-	-	-	-	-	-
ALMA	0.51	-	-	-	-	-	-	-
DKIST[1]	25.00	36.88	25.12	20.00	20.00	20.00	16.13	-
LSST	-	27.50	79.64	99.67	67.12	55.80	47.89	45.75
NEON	90.80	93.20	96.00	80.64	-	-	-	-
OOI[1]	65.00	27.50	-	-	-	-	-	-
MREFC Total	$196.49	$200.00	$200.76	$200.31	$87.12	$75.80	$64.02	$45.75

Totals may not add due to rounding, ***$113*** ***$125*** ***$136*** ***$155***

[1] DKIST, the Daniel K. Inouye Solar Telescope, is the new name for the Advanced Technology Solar Telescope (ATST). DKIST received $146.0 million and OOI received $105.93 million in ARRA funds in FY 2009.

TMT/GMT ?($300M) 2022 ®

- **($200M) Empty wedge late in decade – access for D&D?**
- **Major construction money – no earlier than mid/late next decade**
- **Construction money hard, Operations funding – harder…..**

NRAO & Community Futures

- Community: Kavli Meeting Series – "US RMS Interests in 2020s"
  - Science Opportunities ® several options
  - Science case refinement, technical considerations ® few options
  - Planning, Prototyping, Presentation ® community options
- NRAO
  - Next-generation VLA – 5-10x collecting area on few hundred-km baselines, 1-120 GHz, 32 GHz BW, one dewar & low cost high efficiency antennas
  - AAS workshop – highly successful, ngVLA science case emerging, white papers in production
  - ALMA2030 complete (archive, BW, baselines, FOV)

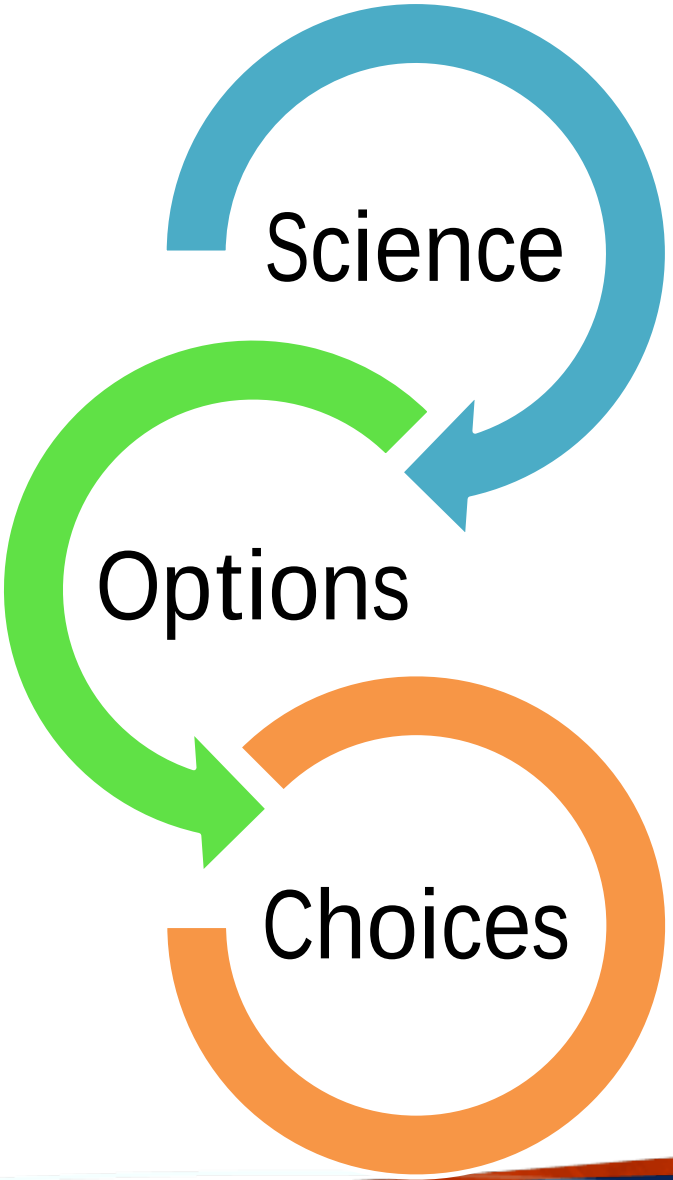
https://science.nrao.edu/science/meetings/2015/aas225/next-gen-vla/program

US RMS Process

Kavli Community Meetings

Design/Prototype

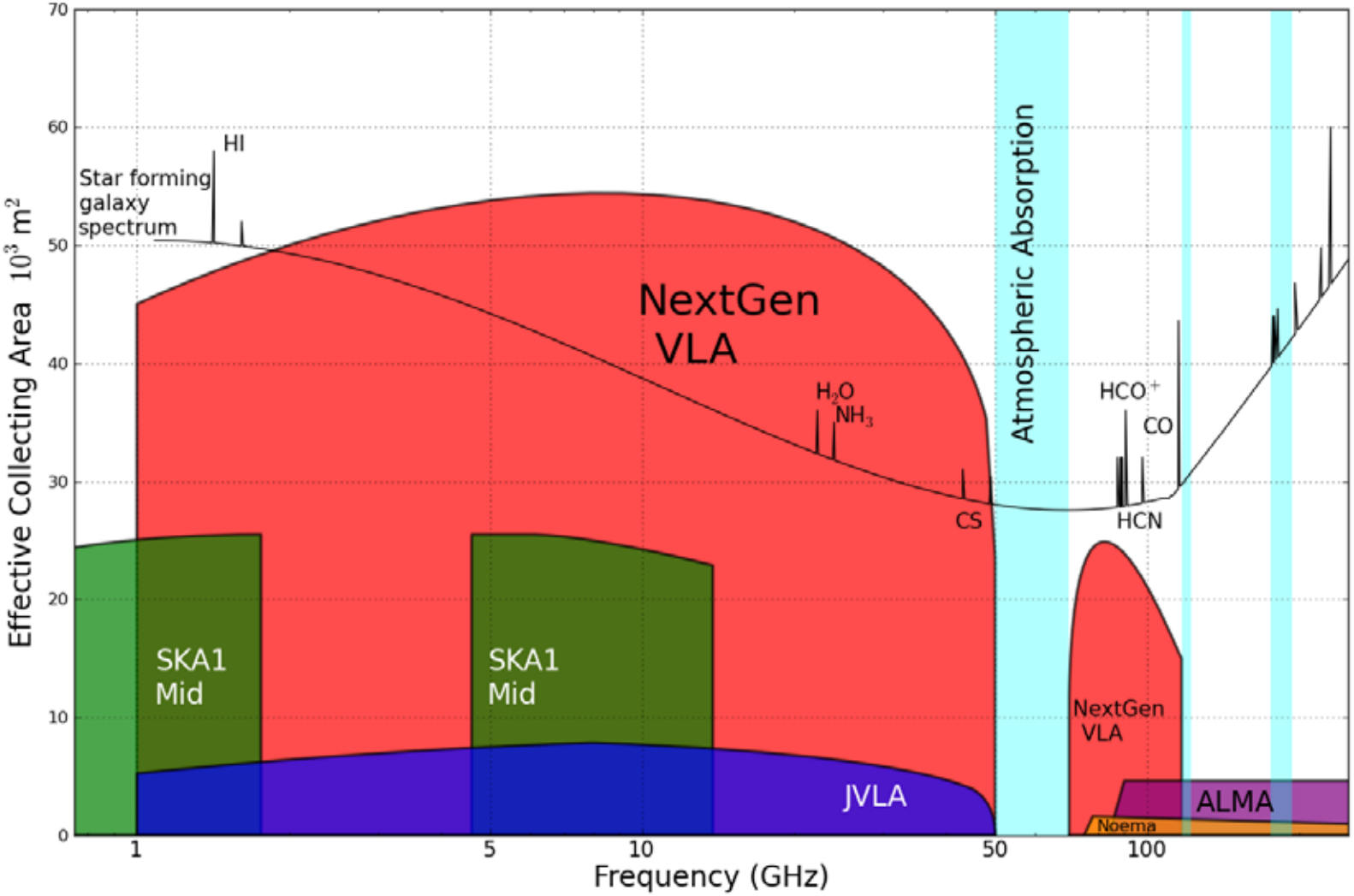
Proposals

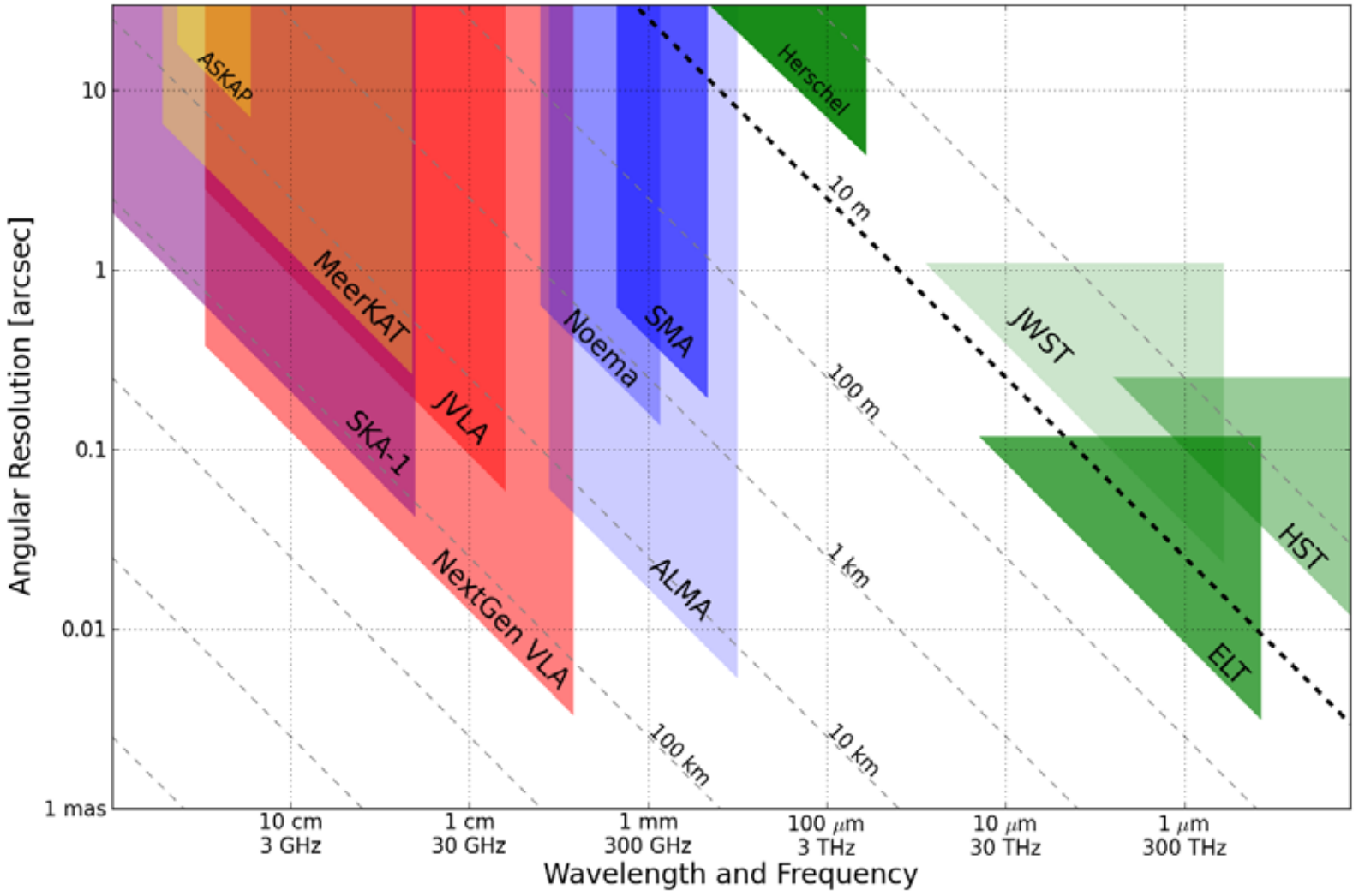


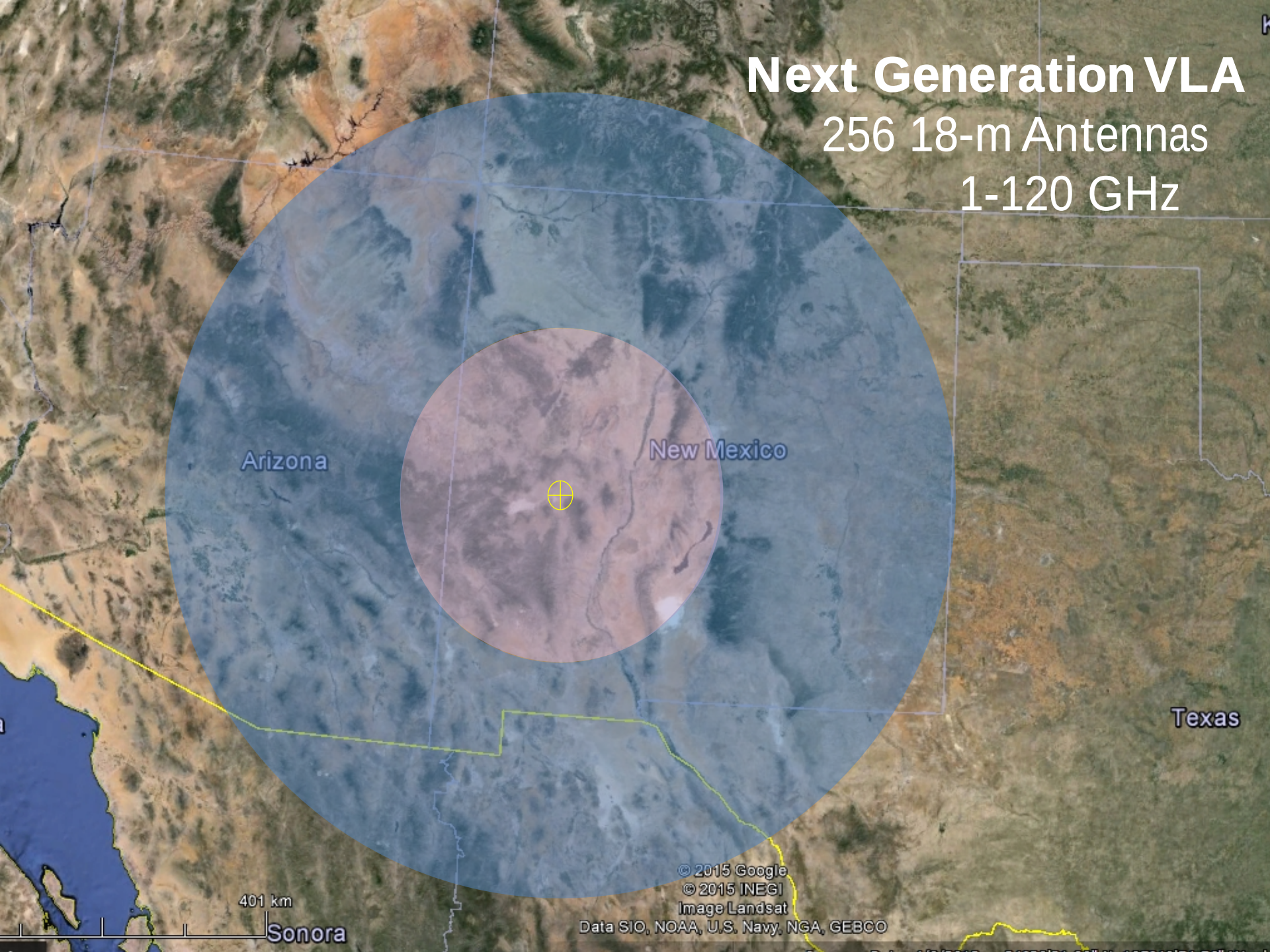
2015

2017

2020


Effective Collecting Area 10^3 m^2
Frequency (GHz)
HI
Star forming galaxy spectrum
NextGen VLA
H_2O
NH_3
CS
Atmospheric Absorption
HCO^+
CO
HCN
SKA1 Mid
SKA1 Mid
JVLA
NextGen VLA
ALMA
Noema


Angular Resolution [arcsec]
10
1
0.1
0.01
1 mas
10 cm
3 GHz
1 cm
30 GHz
1 mm
300 GHz
100 μm
3 THz
10 μm
30 THz
1 μm
300 THz
Wavelength and Frequency
ASKAP
MeerKAT
SKA-1
JVLA
NextGen VLA
Noema
SMA
ALMA
Herschel
JWST
HST
ELT
10 m
100 m
1 km
10 km
100 km


Next Generation VLA
256 18-m Antennas
1-120 GHz
Arizona
New Mexico
Texas
Sonora
401 km
© 2015 Google
© 2015 INEGI
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

- Low-cost High Efficiency Antenna (ANTENNAS)
- Manufacturability !!!!
- Operations cost !!!!!!!
  - One dewar, three cartridges? (RECEIVERS)
  - Plug n Play components (feed to edge of property)
  - Power-efficient processing (CORRELATOR)

- Need to build a prototype – real cost # into ASTRO2020?
- Partners !!! Domestic and foreign
- ENABLING TECHNOLOGIES – this meeting

Immediate Future

- Assemble ngVLA development consortium,
- NRAO project office – Mark McKinnon PM, Proj Sci
- Interface to growing list of interested international partners (Canada, Mexico, Japan, China) – Northern Hemisphere Array?
- Interface to industry (several areas..)
- Develop political advocacy
- Quick (funded) ramp into community-based D&D would provide immediate relief to key community resources (about to be lost…)
- NSF: put our name in hat for MREFC slot early 2020s
- Continue SKA liaison role, in-kind support.
- Issue: community health, alignment….. Strategy needed

SKA

- Rebaselining unfolding … major changes anticipated (needed..)
- Recent US outreach push … end-run NRAO, Decadal Survey
- Continued broad unfunded US participation across several areas – scientific/technical/advisory
- Overlap between SKA-High & ngVLA – minor concern (Band 5-)
- At this point – not seeing a US buy into SKA low/mid to enable phase 2 as an ASTRO2020 option .. open to debate
- Watch and learn, not direct competition – US interests differ.
- Our PI-driven Object-driven broader capability more relevant?

- Next up: Data Management, transmission – key issue (w/ some relief from SKA, MWA/VLA etc..)

- Goal of this meeting: explore the state of the art in critical technology areas
- Assess interest/opportunities of the broader community

For the uninitiated…

- Surrounded by unmatched world leaders in one particular endeavor – stating opinions as facts… (fact?)

- Translations
  - "I know" ® "I believe…."
  - "That's a terrible idea" ® That's now my idea…
  - "What you said is wrong, your design will never work" ® I love you, we should continue this marvelous discussion in the break
  - " I hate you all and want you dead" ® N

- Thanks to Sandy for organizing the meeting

www.nrao.edu
science.nrao.edu

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