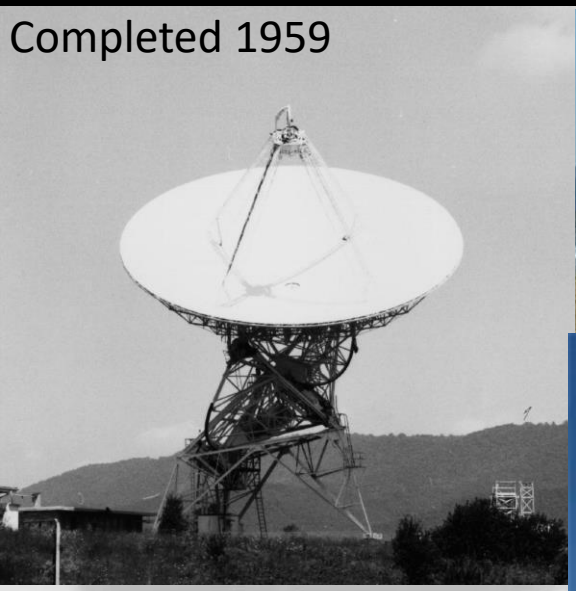
Welcome to Green Bank!

(virtually)

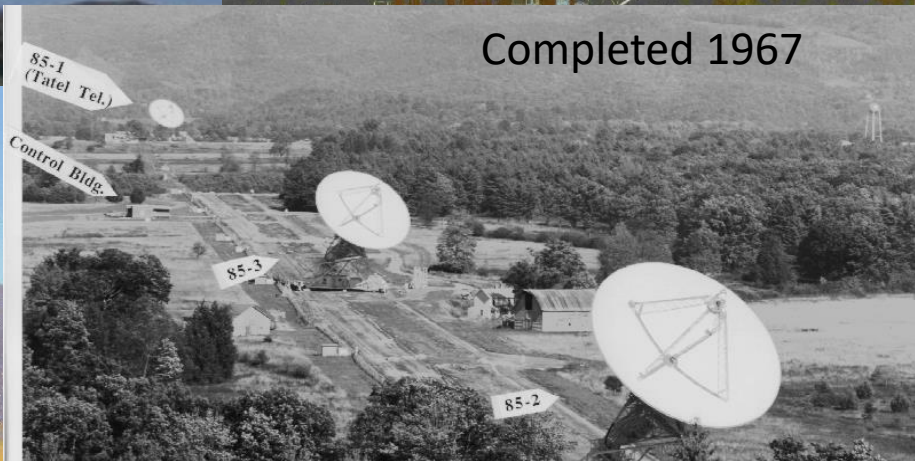
Welcome to Green Bank!

Green Bank Observatory enables leading edge research at radio wavelengths by offering telescope, facility and advanced instrumentation access to the astronomy community as well as to other basic and applied research communities. With radio astronomy as its foundation, the Green Bank Observatory is a world leader in advancing research, innovation, and education.

Original National Radio Astronomy Observatory, with world class telescopes for 60 years

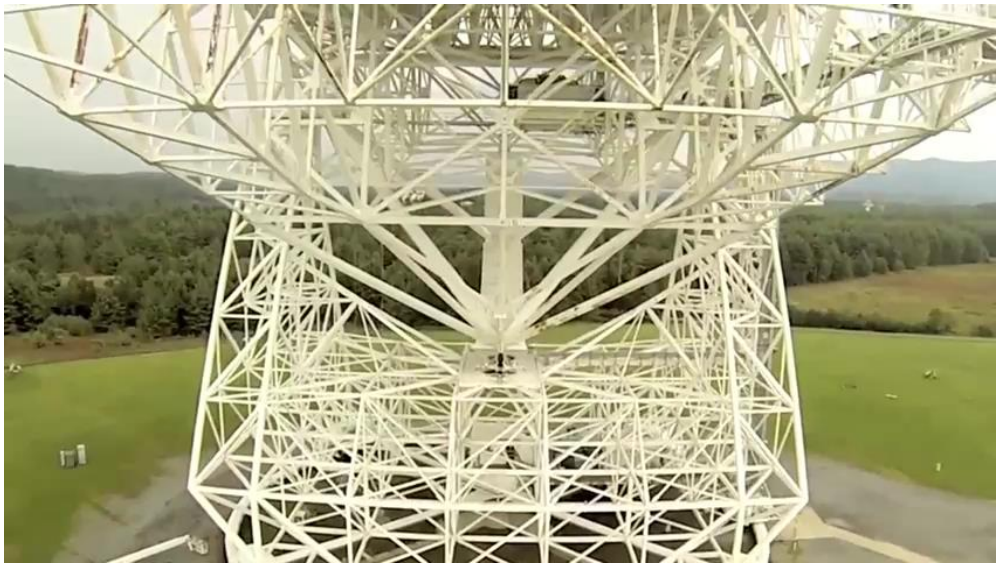


Completed 1962



The GBT

A World Class Facility for Science Research



- 85% sky coverage
- 0.2 – 116 GHz range
- Unblocked aperture
- Phenomenal sensitivity (μJy)
- 30% aperture eff. at 100 GHz
- 6800 hours available annually

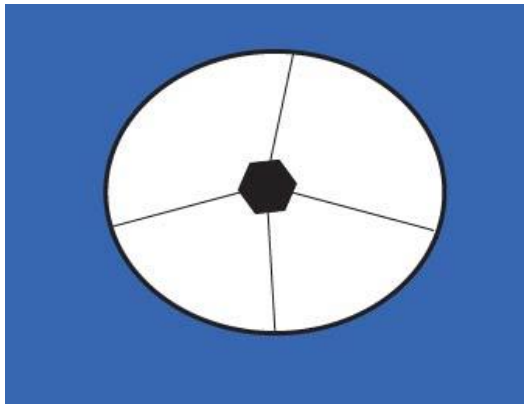
User Community :

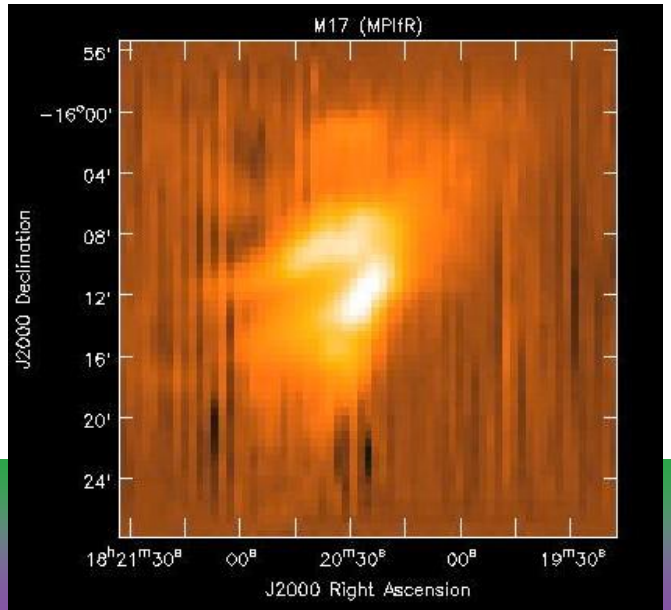
- >3000 individual scientists proposed to use the GBT in past 5 years*
- Span range of disciplines from planetary science to chemistry and physics
- Roughly 20% of proposers are new each semester

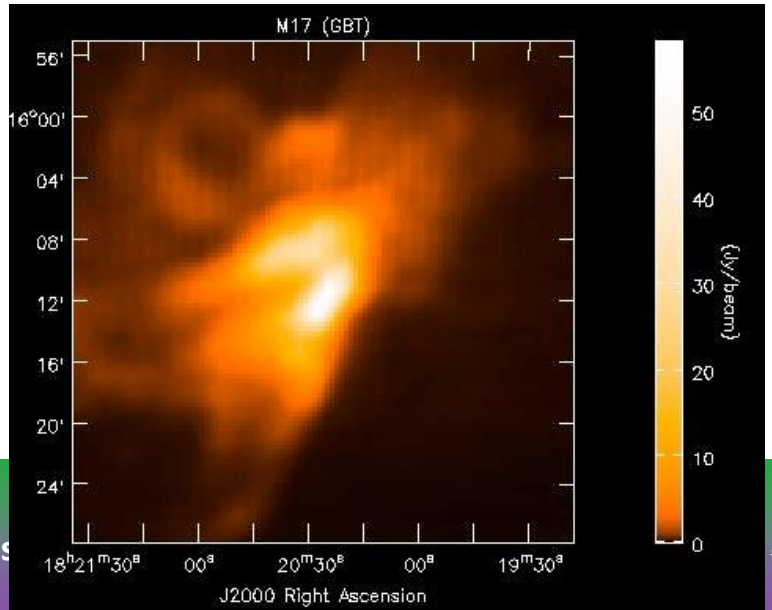
*Based on number of individual email addresses

The GBT:

Unblocked Optics, High Dynamic Range

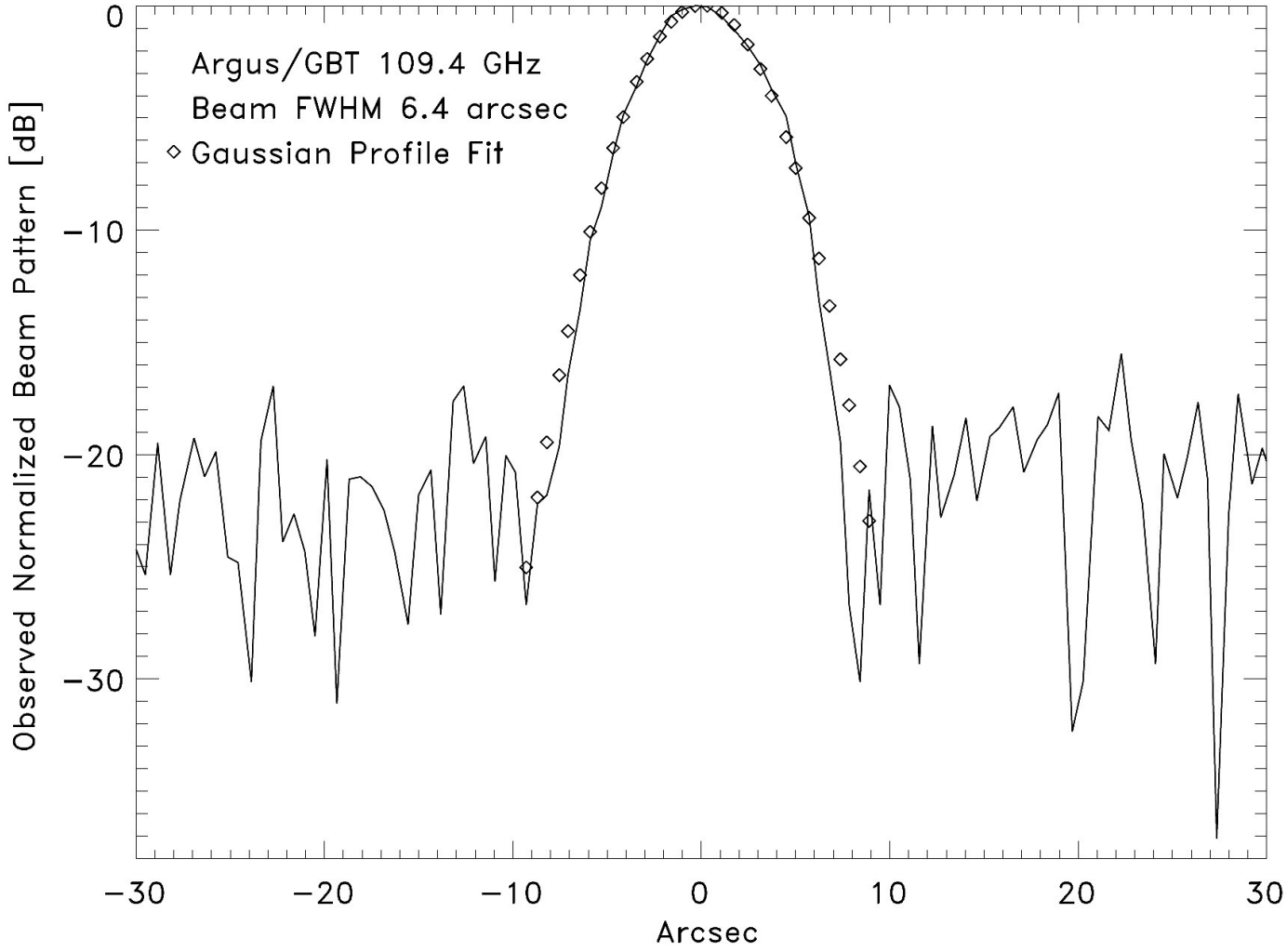






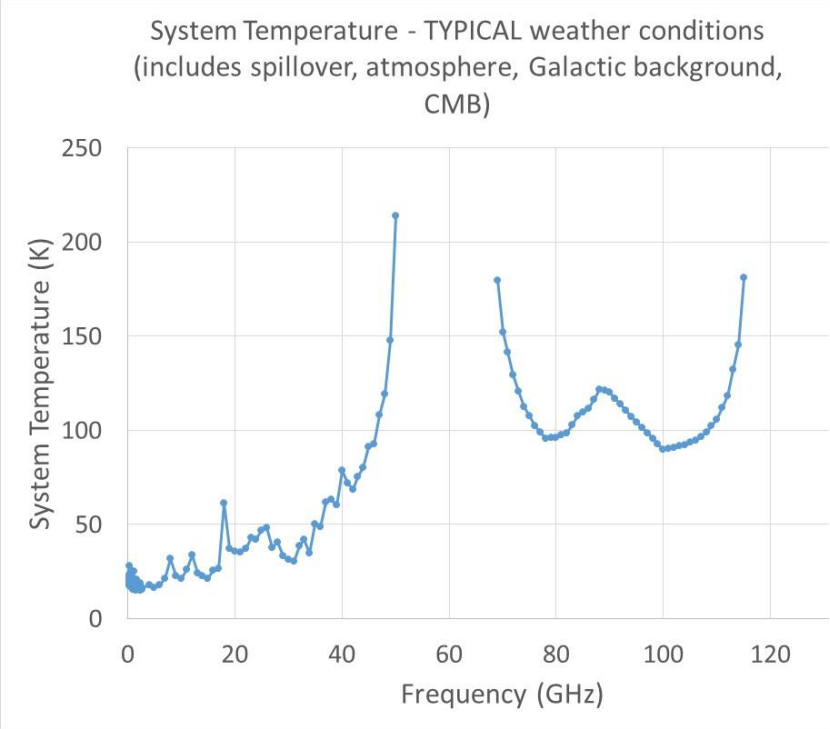
The GBT:

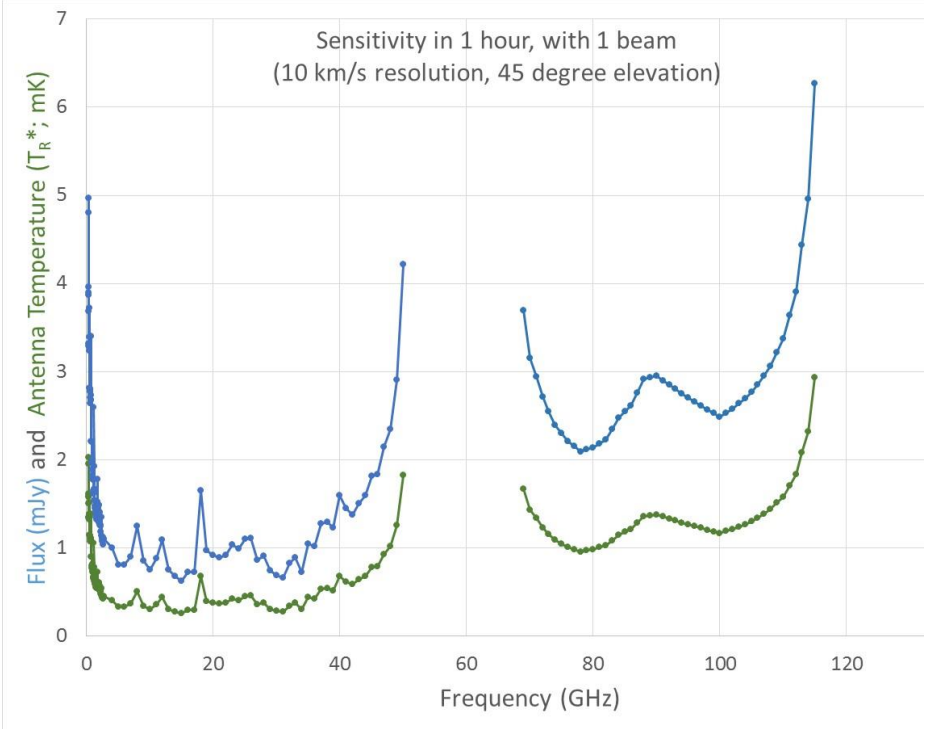
GBT Beam at 109 GHz; 6.4”



The GBT:

Frequency Coverage from 0.2-116 GHz



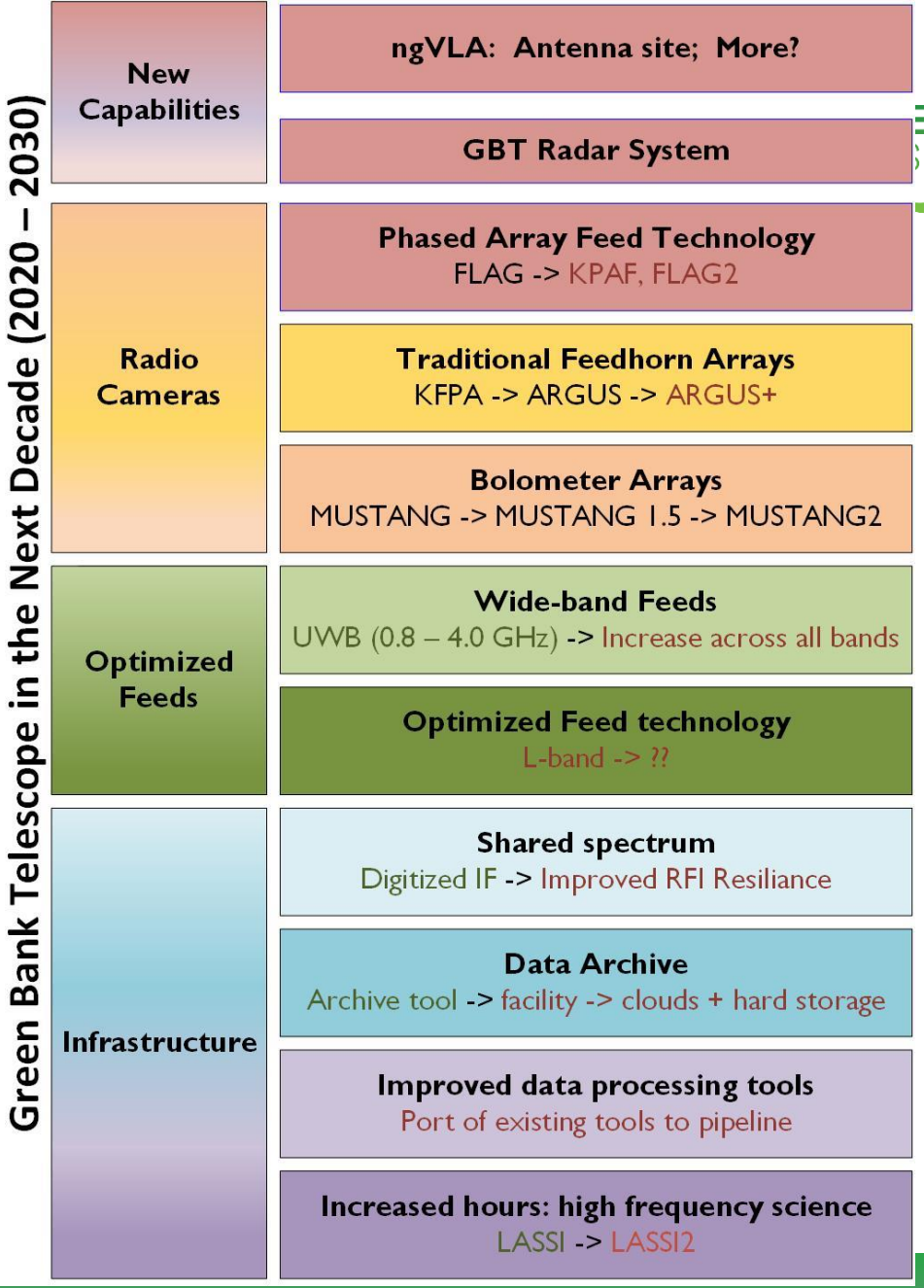


- Most receivers are single/dual pixel, however…
  - Three multi-pixel ‘cameras’ now available on the GBT
- Primary backend is FPGA/GPU system

The Future

Meeting the scientific needs of the next decade:

The Advanced GBT



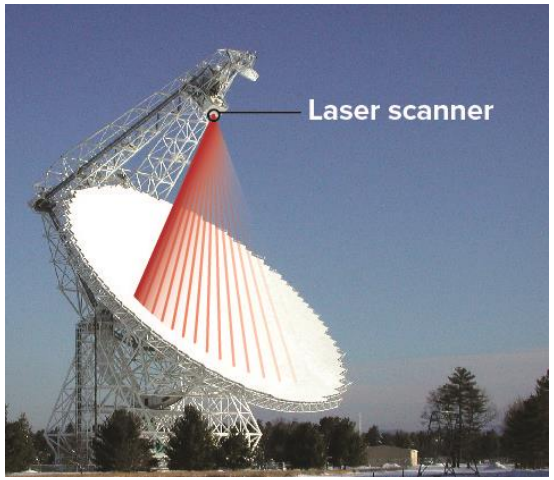
The Future

LASSI: Laser Active Surface Scanning Instrument

$1.3M grant from NSF MSIP

- Place Terrestrial Laser Scanner on GBT to provide real time surface corrections

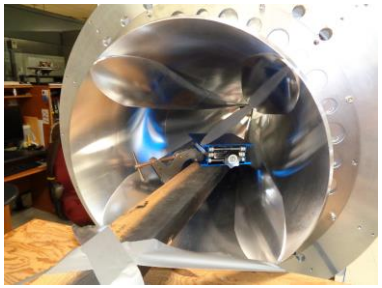
- Allows for high frequency observing during the day
- Minimize time needed for OOF Holography
- **Increase high frequency hours available to GBT**
- Will ease scheduling issues, benefit all science



- **Commissioning for instrument underway!**
- PI: Lockman

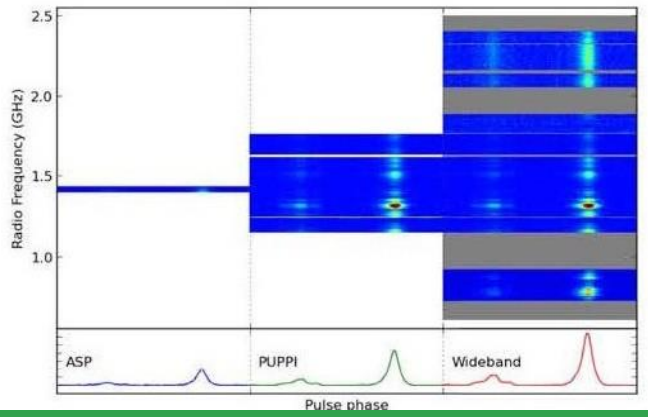
The Future

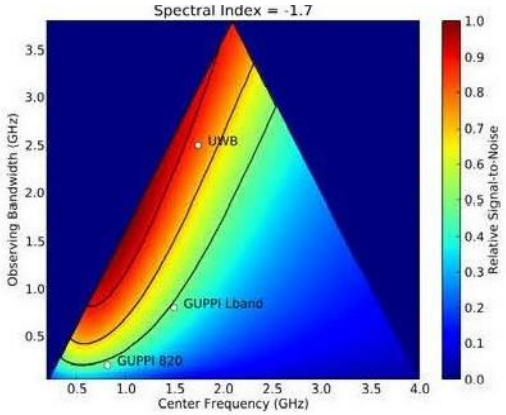
Ultra Wideband Feed



Moore Foundation award (PI: Ransom – NRAO/NANOGrav)

- 0.7 – 4.0 GHz feed optimized for pulsar work
- Aim is T_{sys} ~30 K
- Doubles the sensitivity for most pulsar timing observations
- Under construction;





Left: Pulse profile versus frequency for J2214+ 3000 as observed by ASP, PUPPI, planned UWB

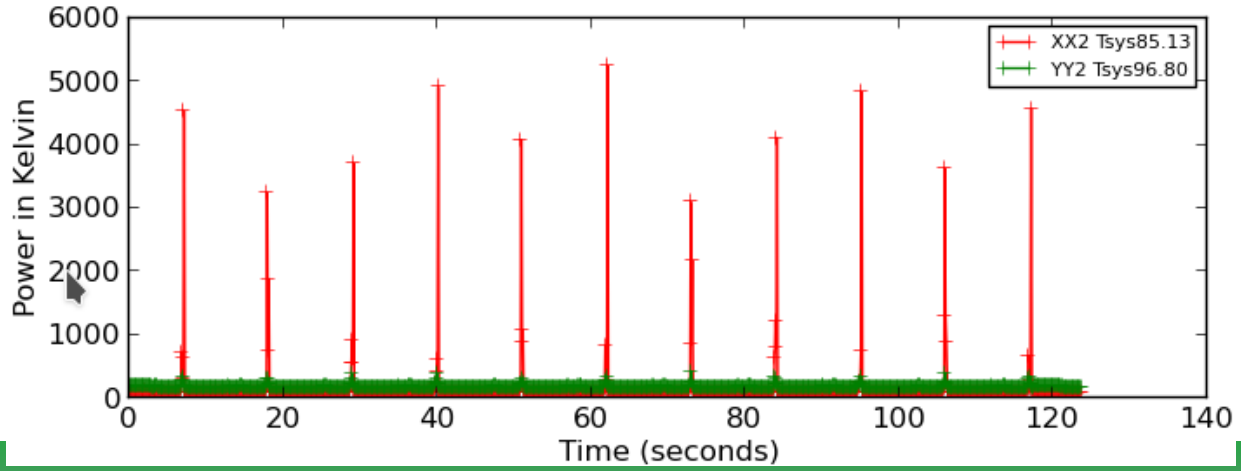
Right: Relative SNR as a function of observing bandwidth and center frequency for uniformly-weighted data and a typical pulsar spectral index of -1. 7

The Future

Digitizing the RF

NSF ATI award (R.Lynch, PI)

- Designed for wide-band digital systems
- Increase the range of frequencies detected at any instant
- Allows for active RFI mitigation;
- Improves dynamic range, baselines
- Development underway; Goal is t deplot on UWBR



Data from the GBO 20-m telescope demonstrating our new, real-time robust recursive power estimation excision technique.

The Future

Data Archive Center

NSF WoU award

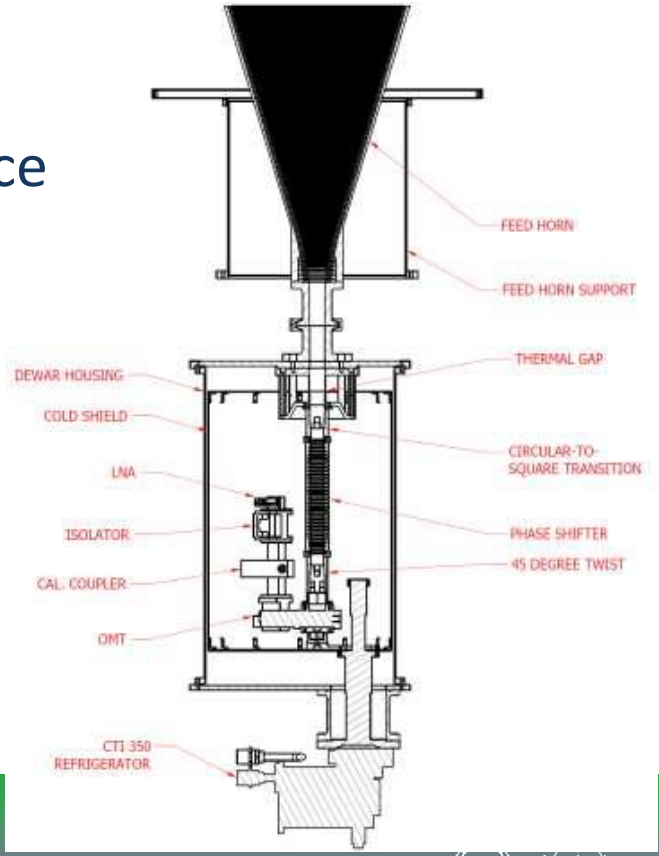
- Allow for onsite archiving of **all** GBT open skies data
- Data will be accesses through the NRAO AAT
- Cost effective means for data storage

The Future

X-band Receiver Replacement

Internally funded

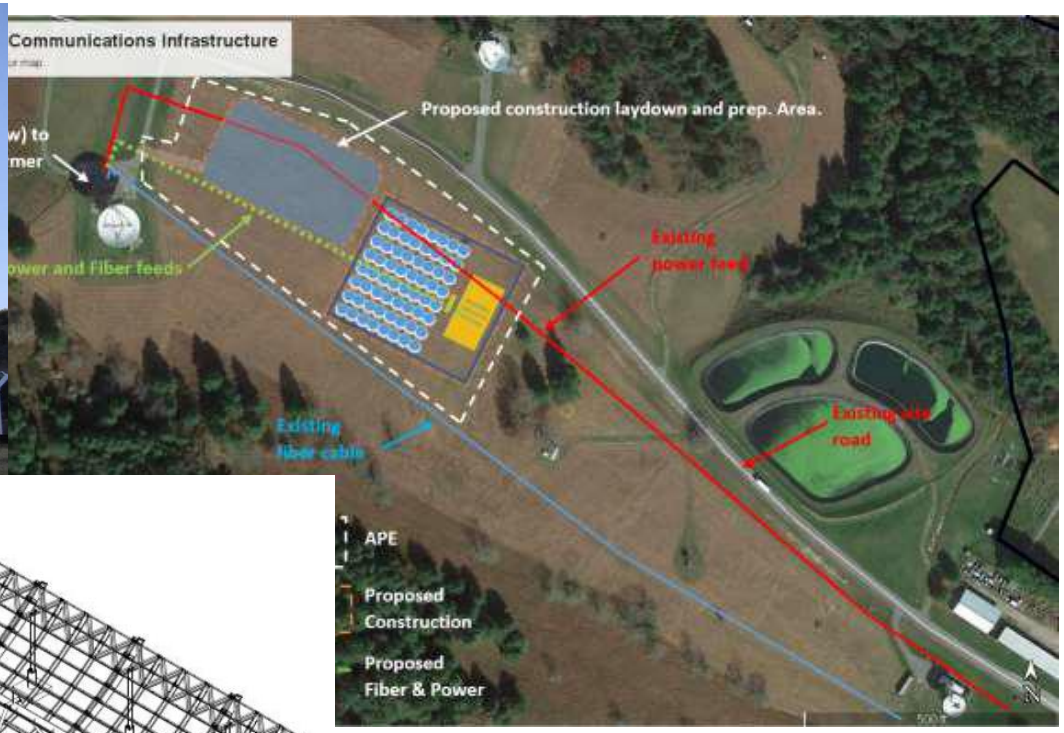
- Replaces the current GBT X-band receiver at the Gregorian focus
- Increased frequency range
  - 8-12 GHz instead of 8-10.1 GHz
- Higher cooling capacity = less maintenance
- Improved baseline stability
- Commissiong planned for 2021

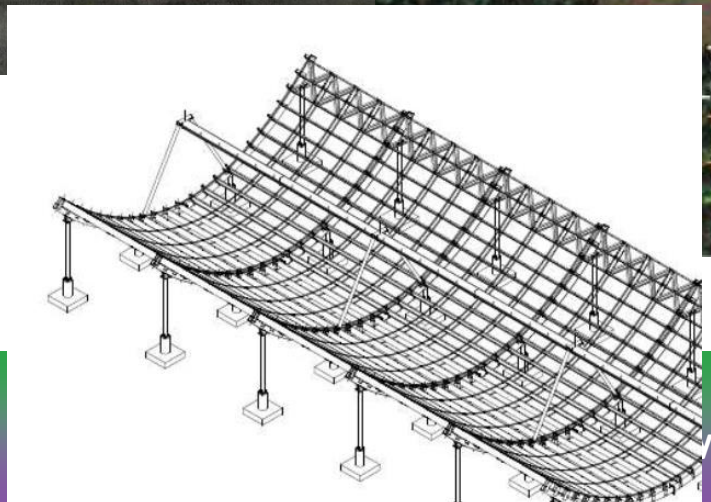


The GBT – Looking Ahead

CHIME Outrigger

- Proposed CHIME outrigger antenna on site
- Planned construction to start as soon as weather allows





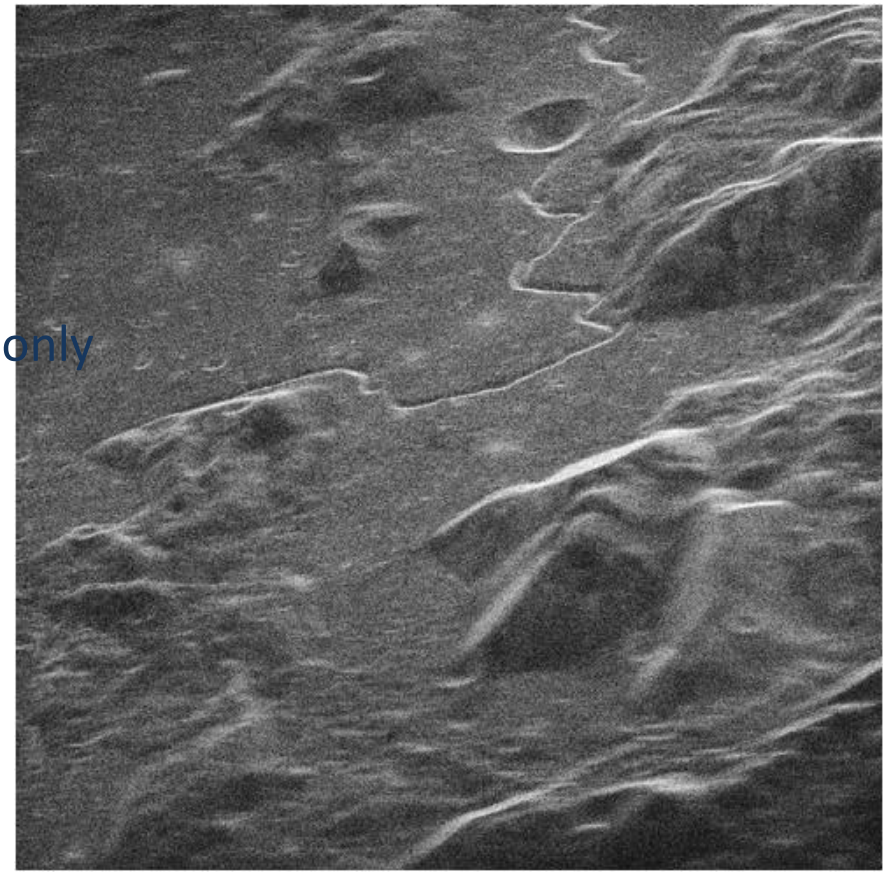
The Future

Radar Systems

Planning for new high power radar system on GBT

Phase I: low power demonstration

- Test system: 700W, 14 GHz
- Images Apollo 15 landing site
- Image show receive with Hancock VLBA only



Phase II: high power system

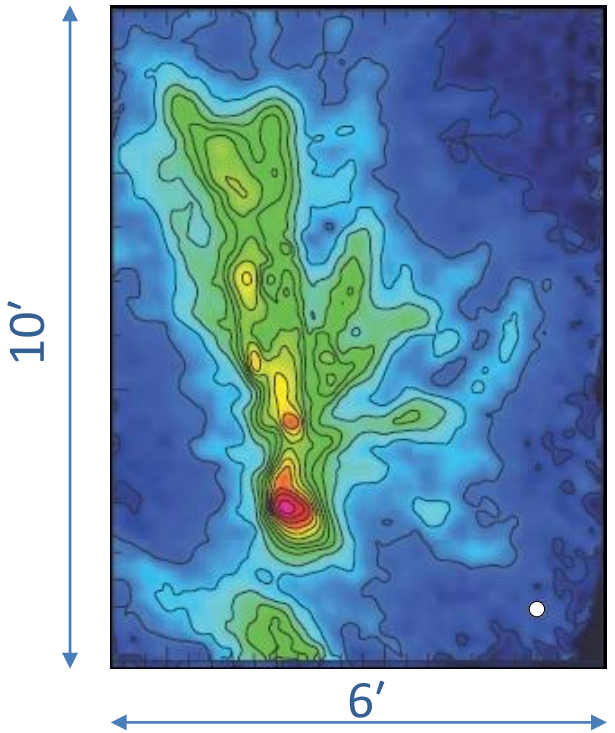
- 50-100s kW transmit on GBT
- VLBA then ngVLA as receive
- Project planning underway
- Not yet funded

The Future

The GBT – Radio Cameras

ARGUS 144

- Planned instrument
- 10 x 10 pixels; 85-116 GHz
- Pixel spacing 26.7” ; Footprint: 4’x4’
- T_{sys}: 50-60K
- FWHM: 8” at 89 GHz; 6.5” at 110 GHz
- ≥ 1 GHz instantaneous bandwidth
- ≥ 2 spectral windows of 100 MHz each
  - Frequency resolution ~60 kHz (0.2 km/s)
- Project not yet funded
- Have applied to NSF MSIP program

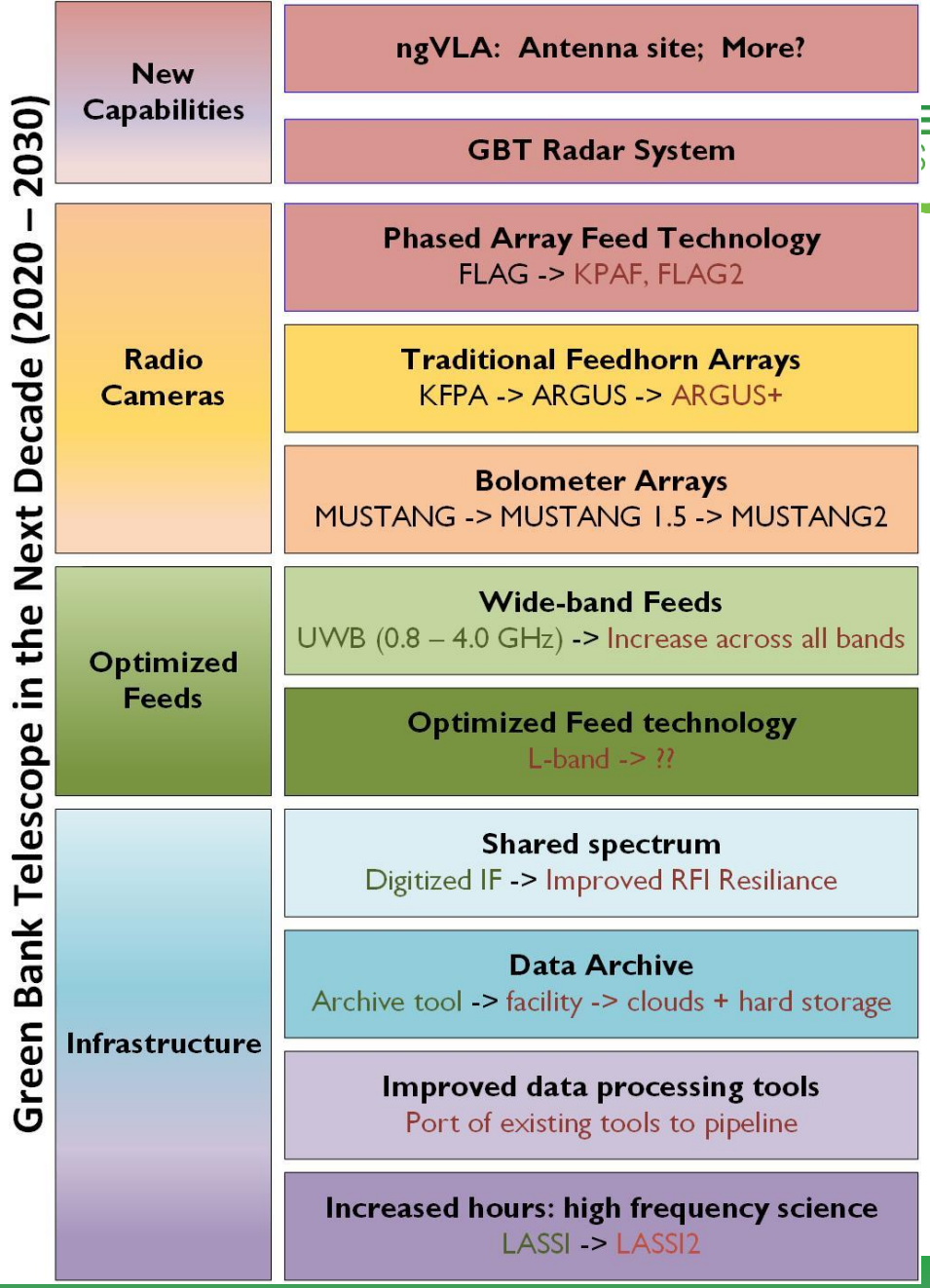


Part of OMC-1 mapped by Argus in HNC(1-0). This map took 4.5 hours, including pointing, surface setting and calibration. The white circle (lower right) shows the Argus beam. With Argus+ and the planned GBT metrology improvements spectral lines images with identical sensitivity over a somewhat larger area will be acquired in <30 min.
(Figure courtesy of Alvaro Hacar).

The Future

Meeting the scientific needs of the next decade:

The Advanced GBT



The Future

Meeting the scientific needs of the next decade:

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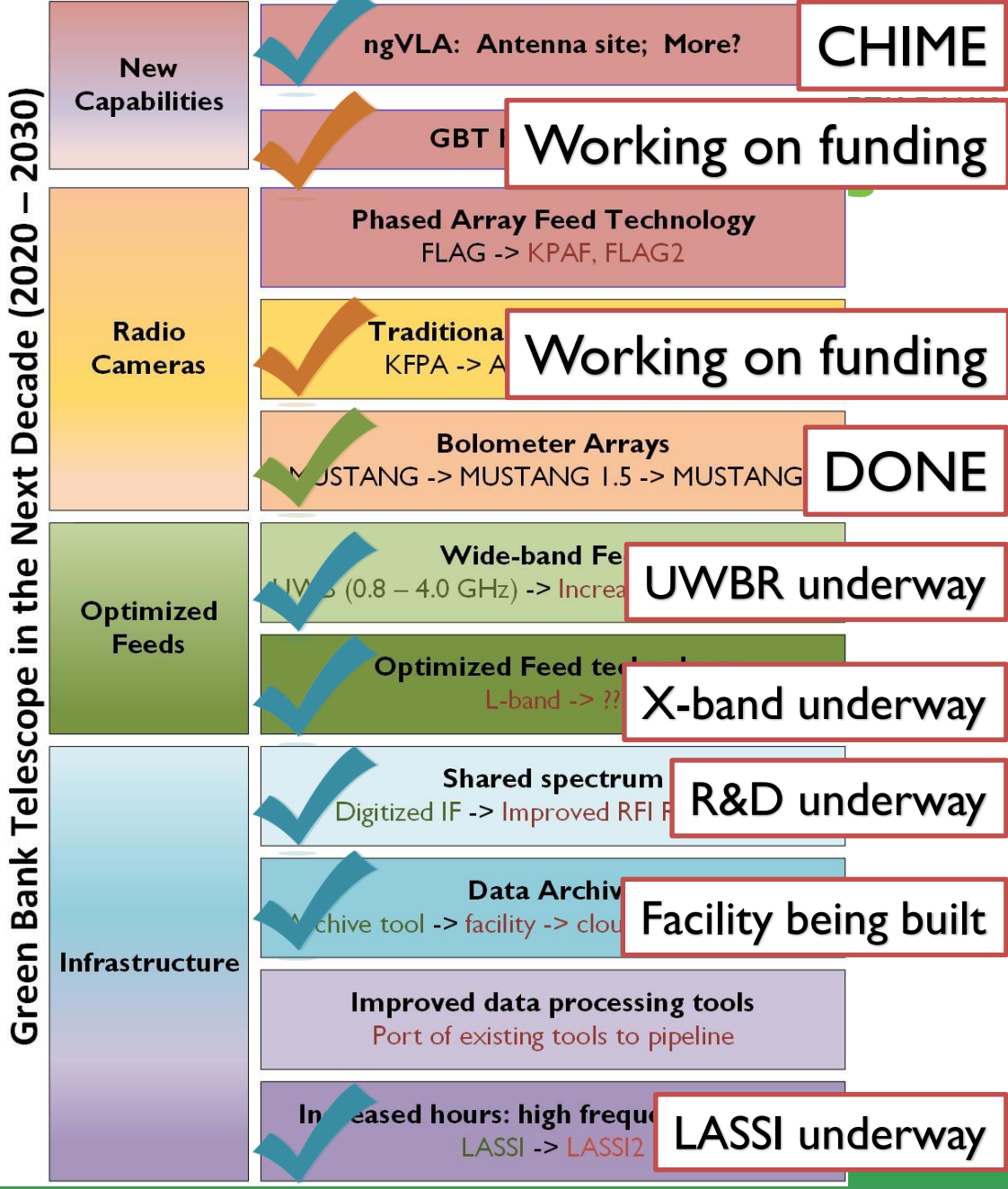

The Future

What is next?

- Numerous new instruments and capabilities under development
- GBT will see many new capabilities within the decade
- After that?
  - Working to define GBT/GBO's role in the era of the ngVLA
    - ngVLA antenna site; Role for GBT with zero spacing, high sensitivity?
  - Operational plans for radar system may also play into GBT+ngVLA plans
- But the long term GBT future is also up to you!
  - The GBT was built for the astronomy community
  - Community input is **the** basis for our long term goals and instrumentation

Welcome to Green Bank!

GREEN BANK
OBSERVATORY