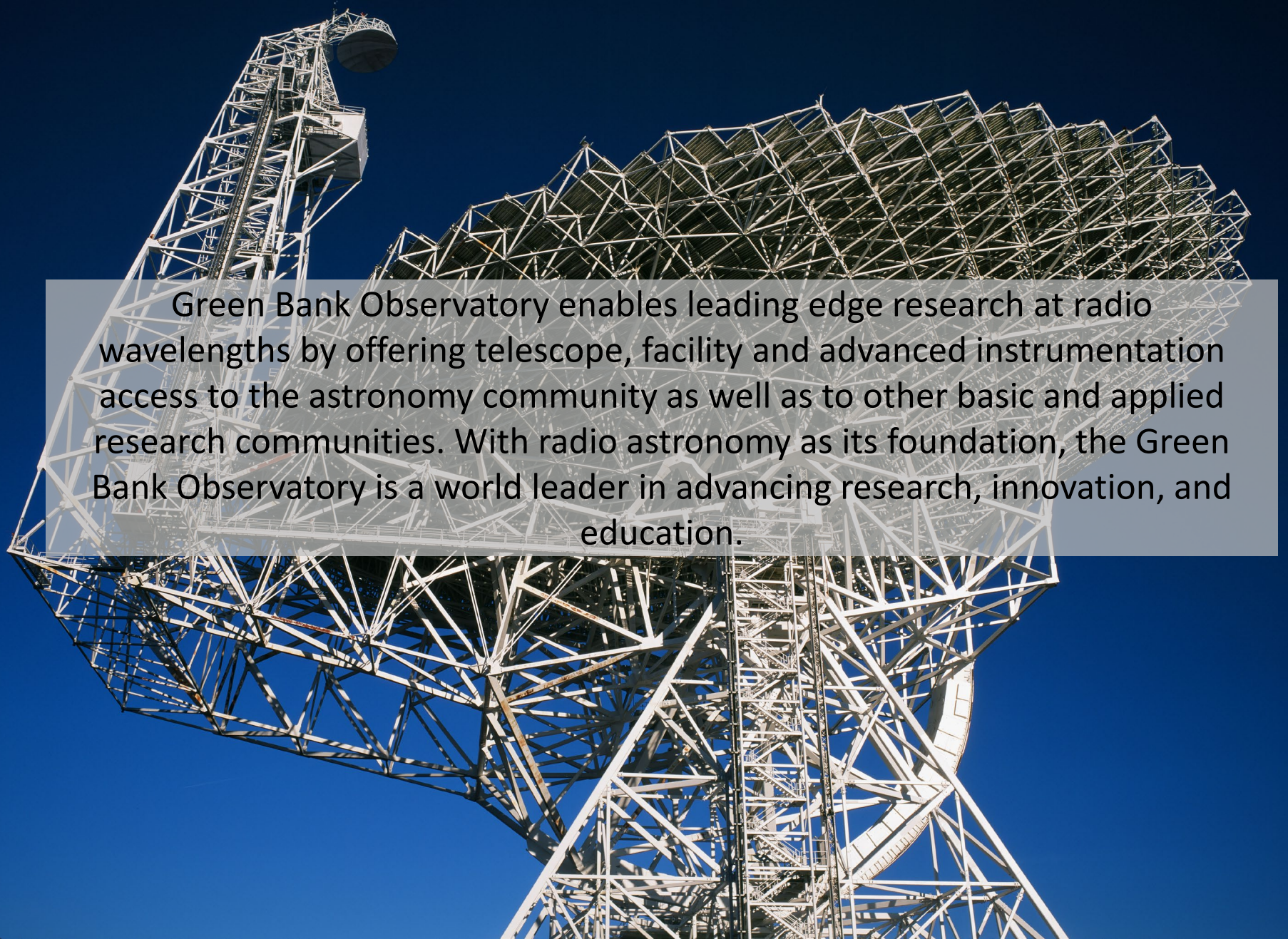
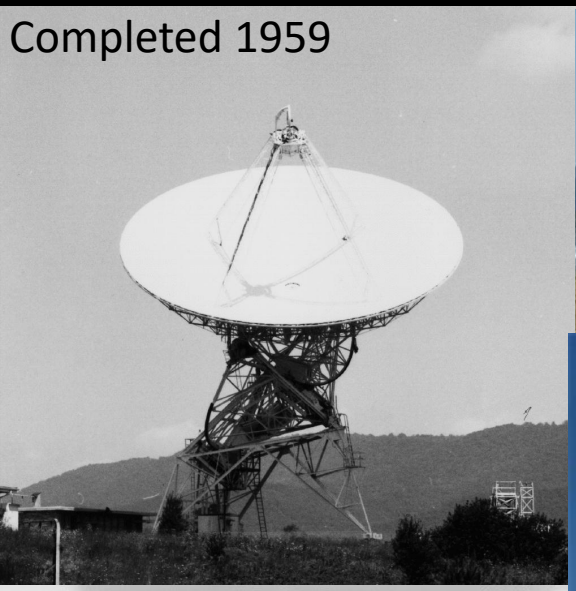
Welcome to Green Bank!

Welcome to Green Bank!

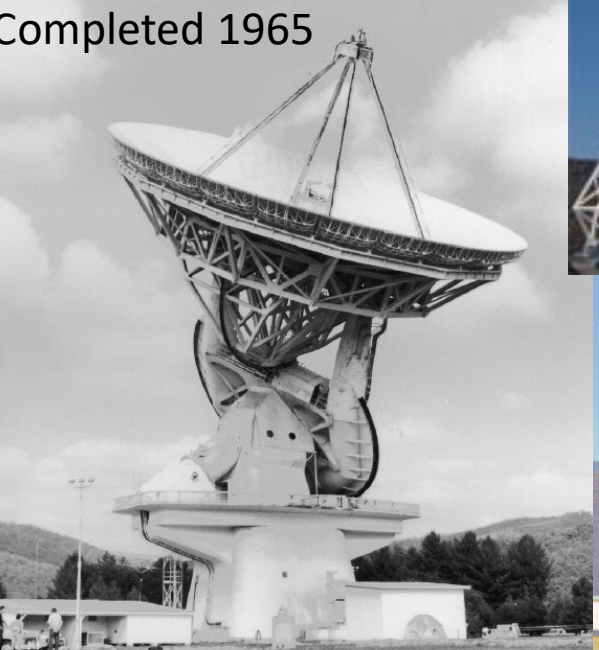


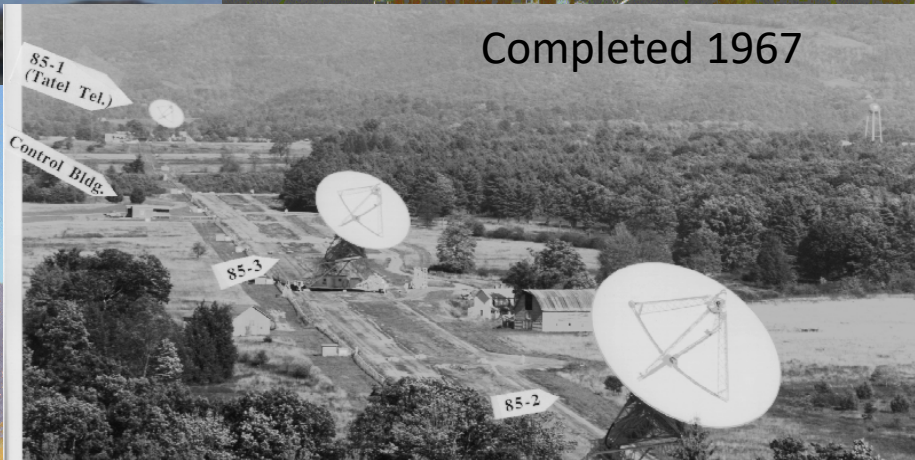
Green Bank Observatory enables leading edge research at radio wavelengths by offering telescope, facility and advanced instrumentation access to the astronomy community as well as to other basic and applied research communities. With radio astronomy as its foundation, the Green Bank Observatory is a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

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



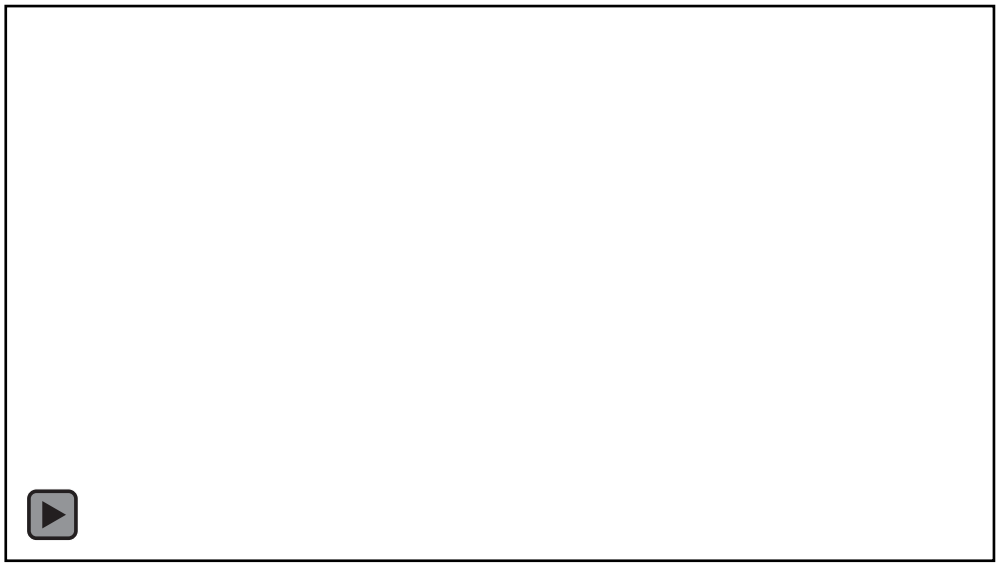
Completed 1962





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

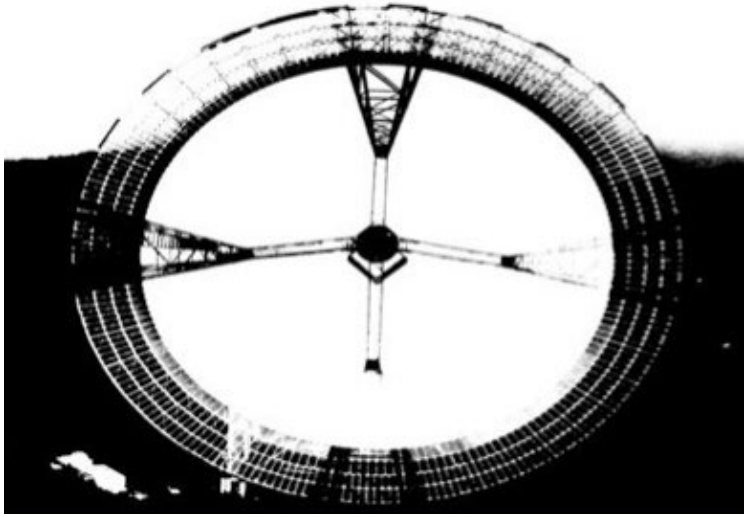
User Community :

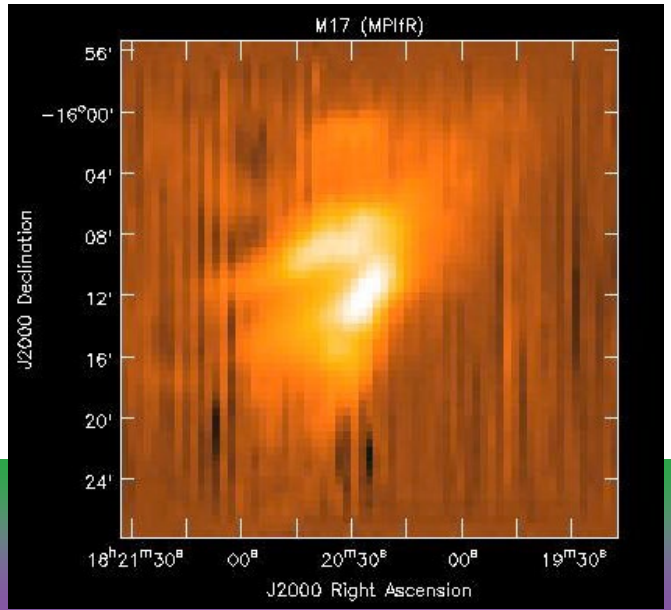
- >3000 individual scientists proposed to use the GBT in past 5 years*
- Span range of disciplines from planetary science to chemistry and physics
- Roughly 20% of proposers are new each semester

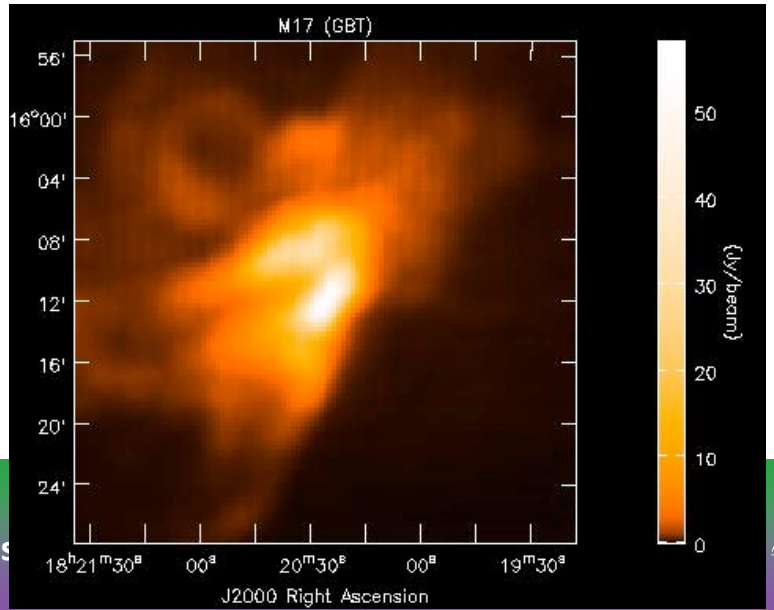
*Based on number of individual email addresses

The GBT:

Unblocked Optics, High Dynamic Range

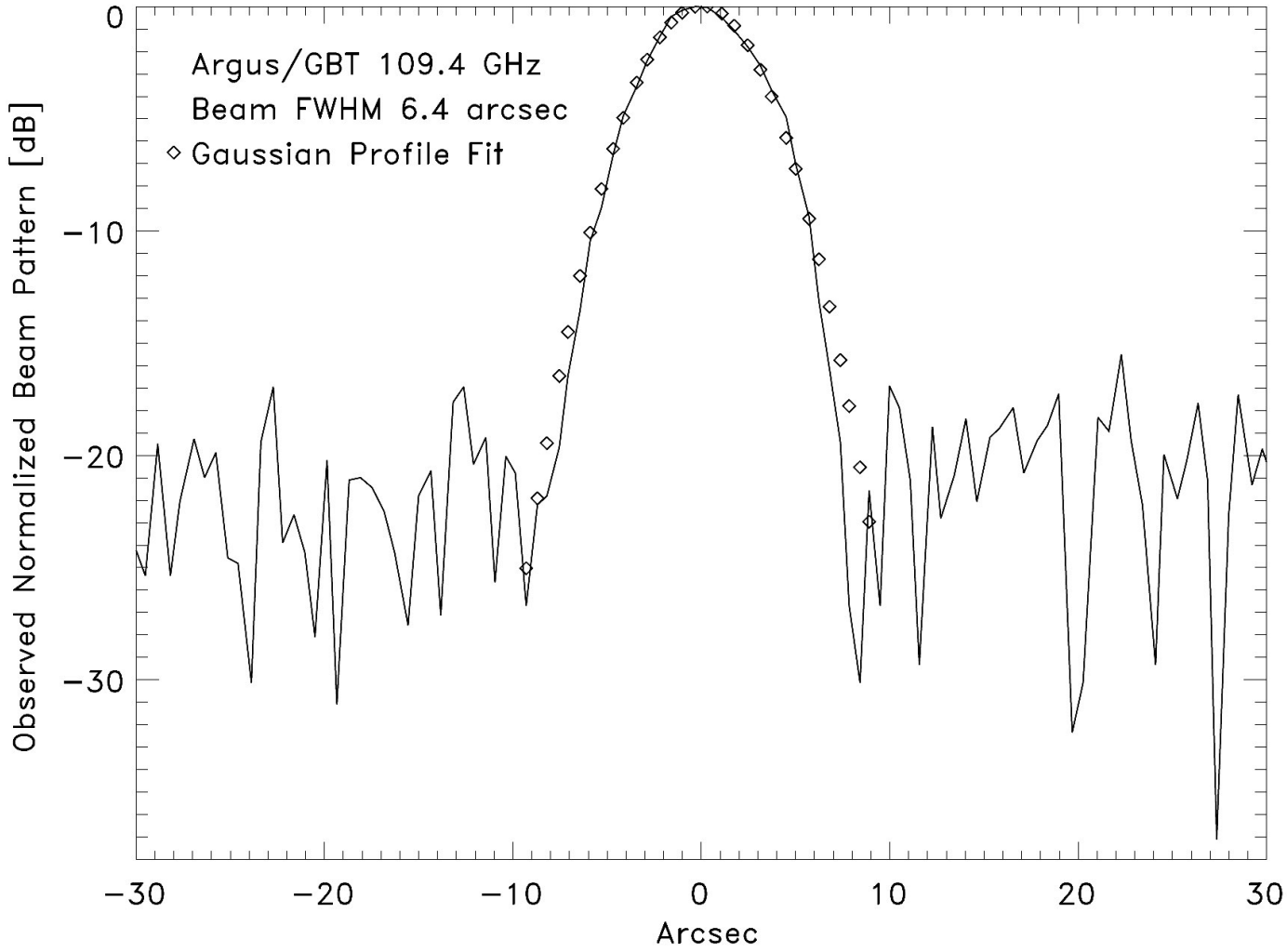






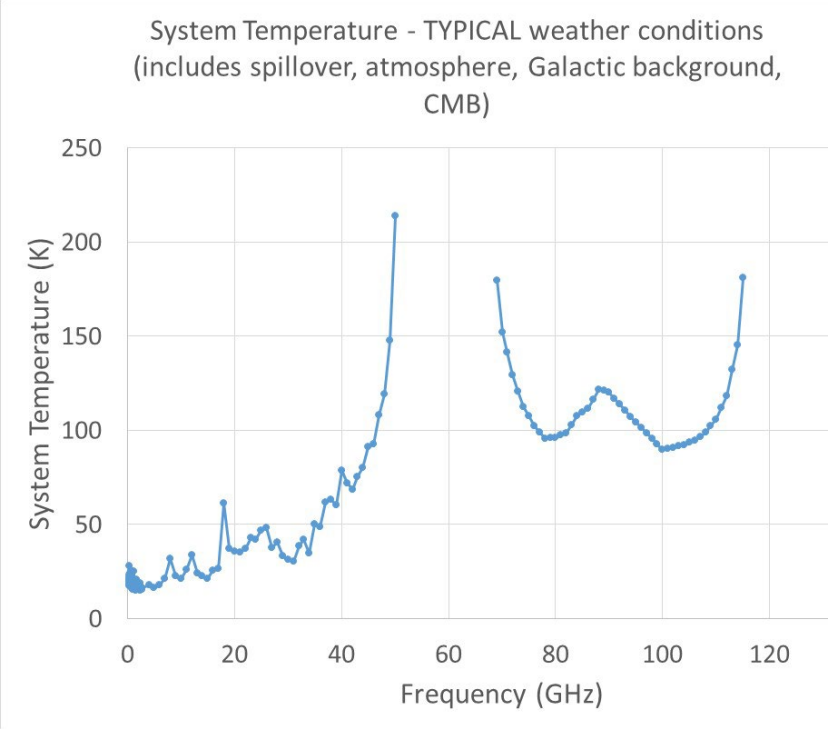
The GBT:

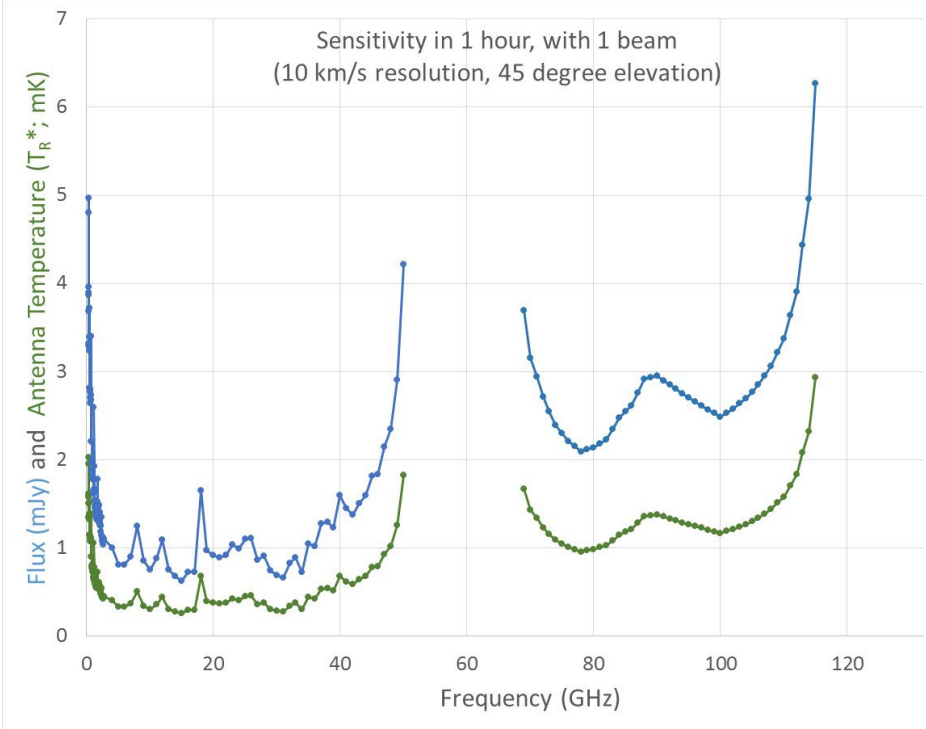
GBT Beam at 109 GHz; 6.4”



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

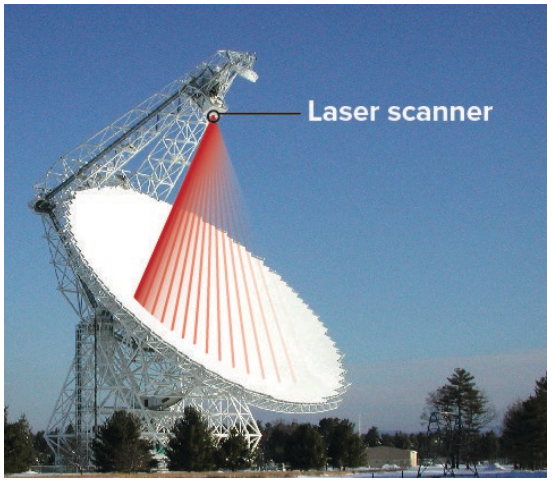
The GBT – Coming Up

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 by 1,000/year**
- Will ease scheduling issues, benefit all science



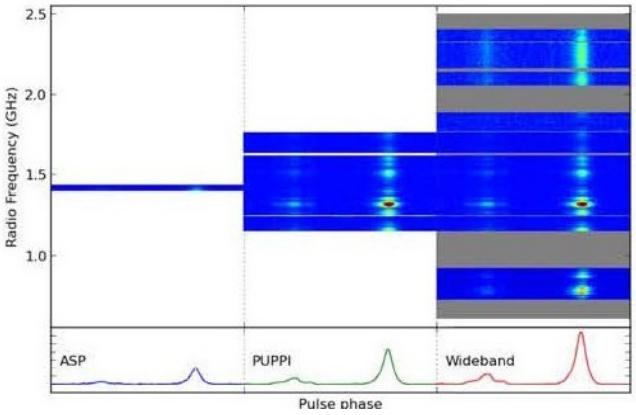
- Three year project, started Oct 1.
- PI: Lockman

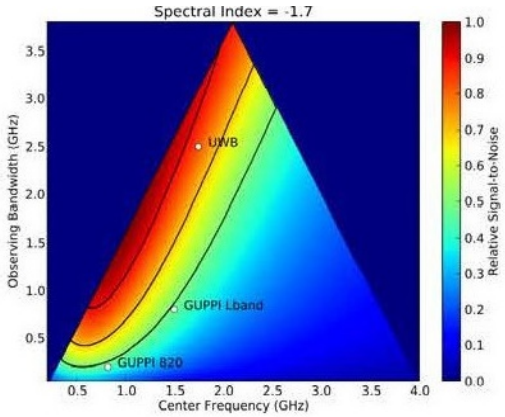
The GBT – Coming Up

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 of the GBT for most pulsar timing





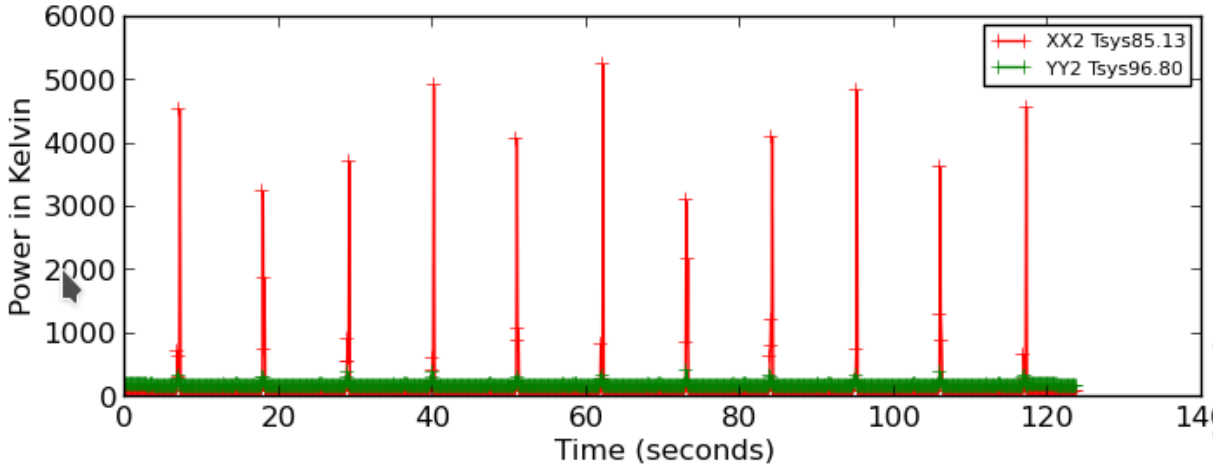
Left: Pulse profile versus frequency for J2214+ 3000 as observed by ASP, PUPPI, planned UWB
Right: Relative SNR as a function of observing bandwidth and center frequency for uniformly-weighted data and a typical pulsar spectral index of -1. 7

The GBT – Coming Up

Digitizing the RF

NSF ATI award

- Wide-band digital systems
- Increase the range of frequencies detected at any instant
- Allows for active RFI mitigation;
- Improves dynamic range, baselines

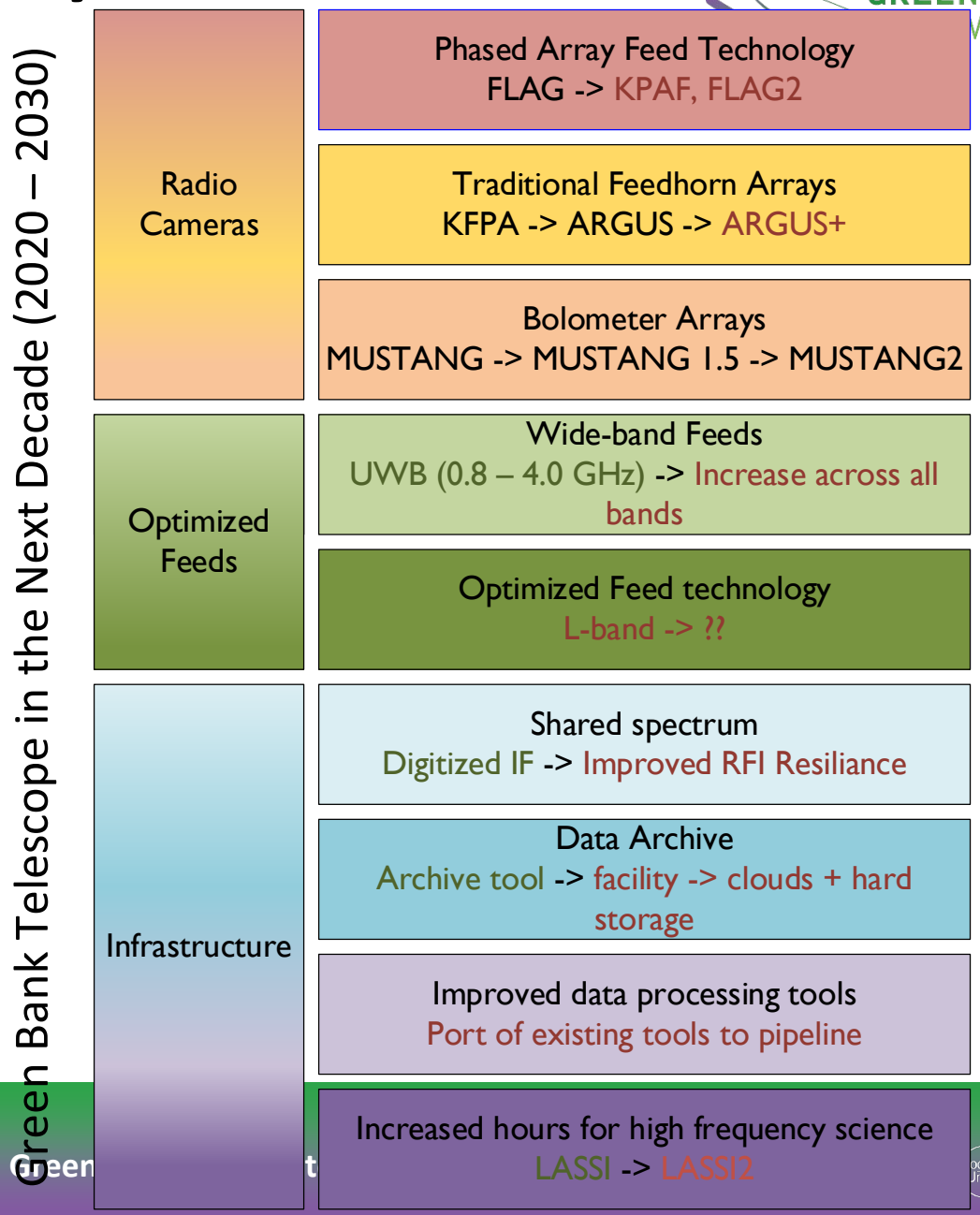


Data from the GBO 20-m telescope demonstrating our new, real-time robust recursive power estimation excision technique. T

The GBO – 2025 & Beyond

Meeting the scientific needs of the next decade:

The Advanced GBT

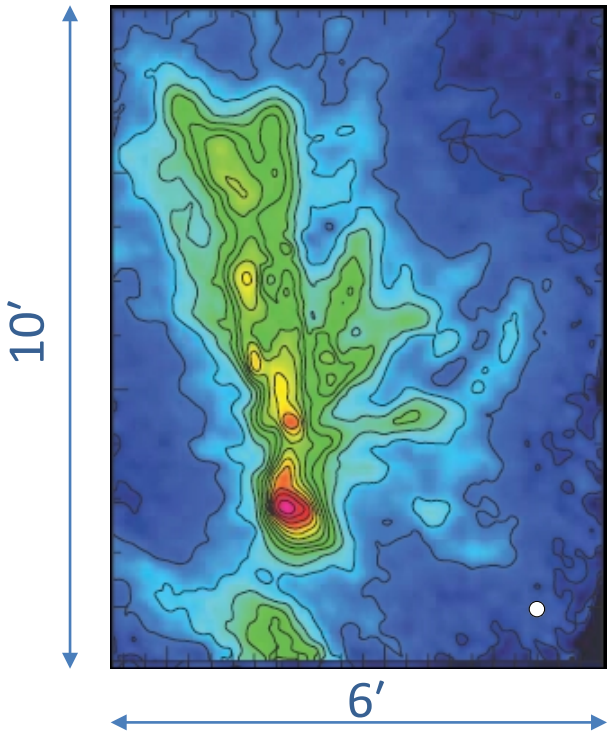


The GBO – 2025 & Beyond

The GBT – Radio Cameras

ARGUS+

- 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)



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 GBO – 2025 & Beyond

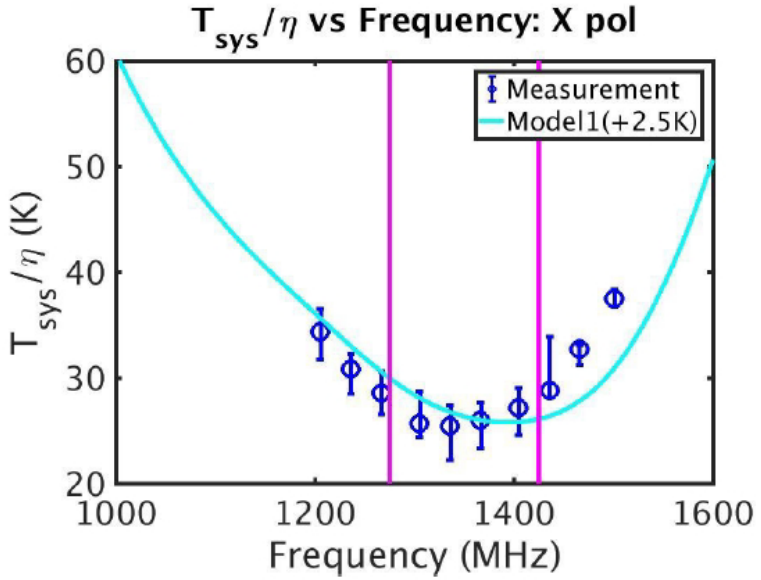
The GBT – Radio Cameras

FLAG: World's most sensitive phased array feed

- 19 elements; 1.2-1.7 GHz
- Prototype!
- Collaboration: NRAO, GBO, BYU, WVU

Next generation - KPAF

- 50-100 elements
- Wider bandwidth
- 18-30 GHz (approx.)



The GBO – 2025 & Beyond

The GBT – Other

<u>Upgraded Receivers</u>

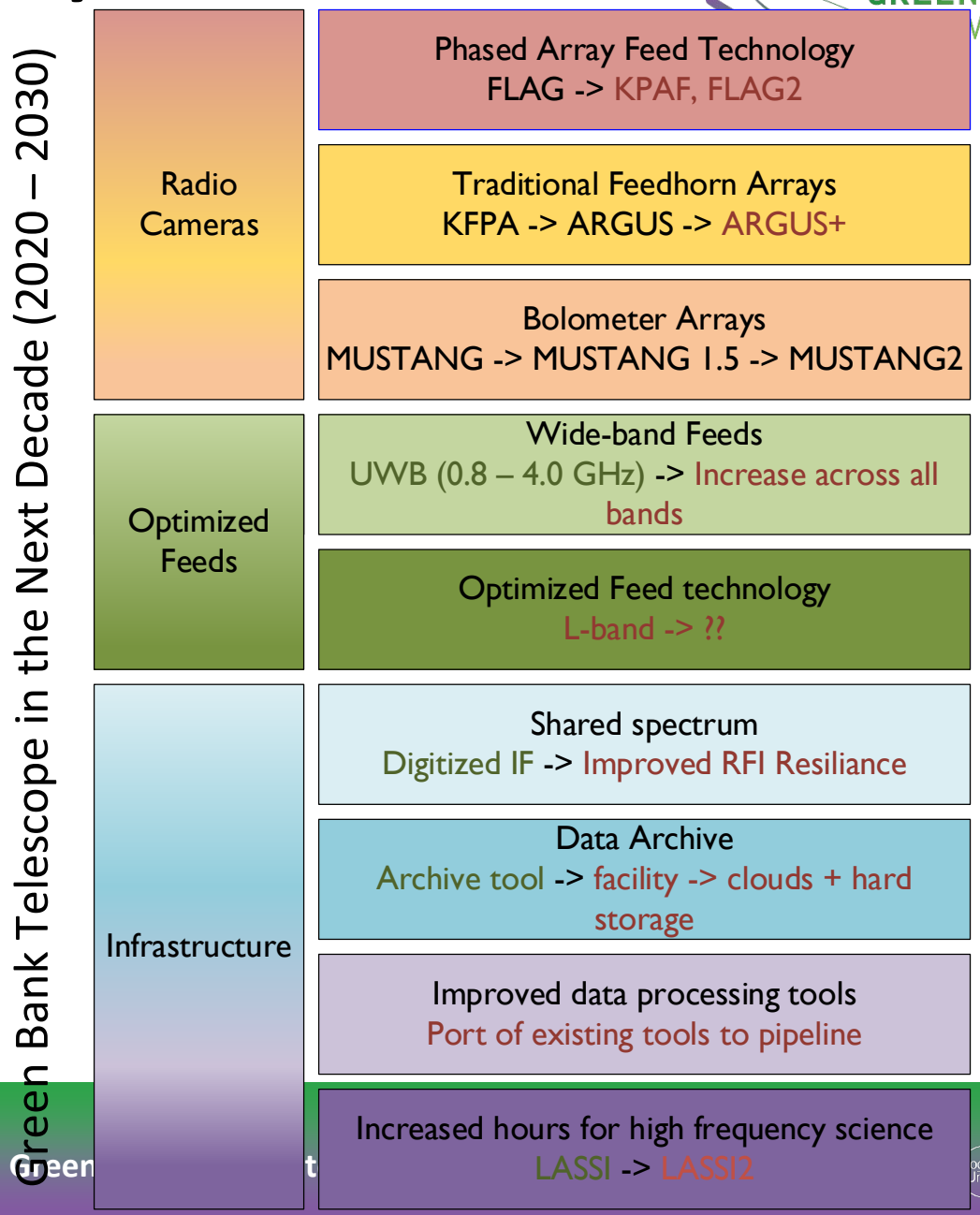
- L band Rx (1.15-1.73 GHz) is ~20 years old
  - Could reduce T_{sys} by 4K (to 14K); Reduce on-sky time significantly

- 3mm Point Source Receiver
  - Dual-polarization receiver, optimized signal and reference pixels
  - Maximum sensitivity for observations of small radio sources (≤ 3”)
  - Increase observing speed by 2x

The GBO – 2025 & Beyond

Meeting the scientific needs of the next decade:

The Advanced GBT



The GBO – 2025 & Beyond

Other Research

- Large site, radio quiet, with significant infrastructure
- Looking at possibility of small (10 element) array based on ngVLA design
- Could work independently and with the GBT
- Valuable for: FRBs, Pulsar, VLB, Star formation, etc

Educational Programs

- The primary training grounds for radio astronomy
- Increase number of student training workshops to quarterly
- Increase number of undergrad/secondary students reached annually

Welcome to Green Bank!

GREEN BANK OBSERVATORY