The Green Bank Telescope

NATIONAL RADIO ASTRONOMY OBSERVATORY GREEN BANK, WEST VIRGINIA

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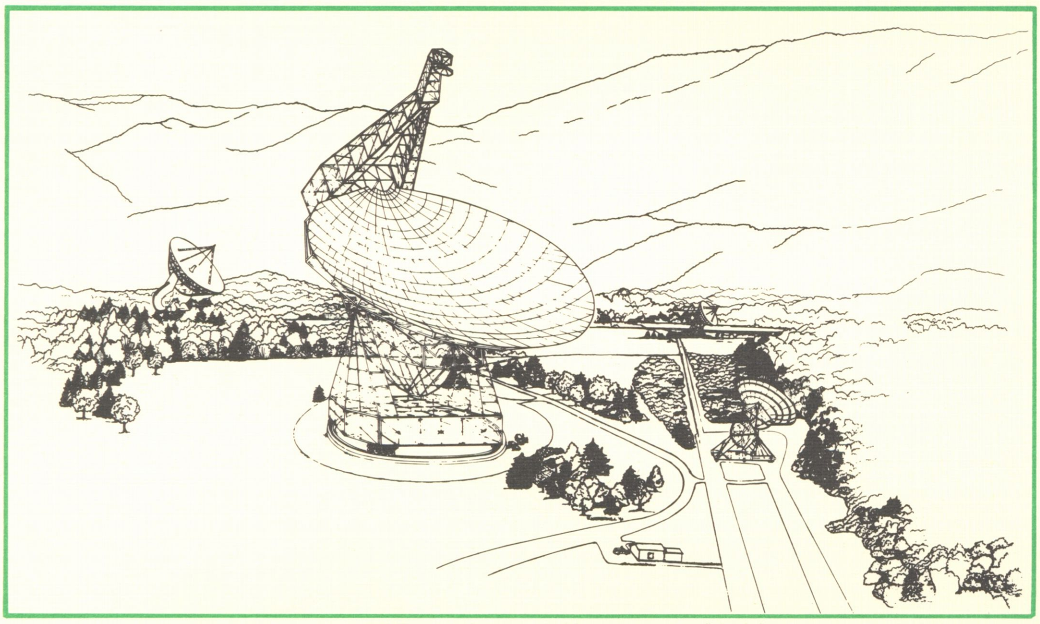

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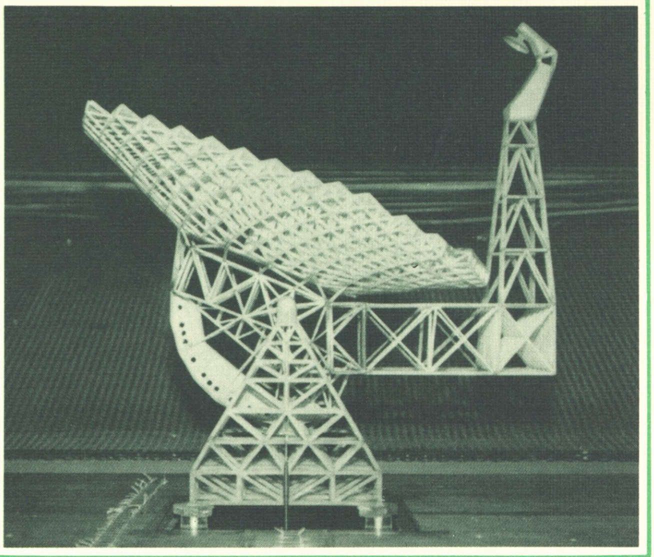
The Green Bank Telescope (center) when completed in 1995, will be the instrument for pioneering research in radio astronomy in the 21st century. It will tower over the 26 meter telescopes (right edge) and the 43 meter telescope (left background) presently used to investigate quasars, pulsars, galaxies, stars, planets and Milky Way gas clouds.

The National Radio Astronomy Observatory in Green Bank, West Virginia has been a center for radio astronomy research since 1958. The Green Bank Telescope, or GBT, introduces a new era for such research. Since most of the Telescope's lifetime will be in the 21st century, its precise scientific mission cannot be predicted. Accordingly, the emphasis of its design is on versatility: the GBT will be capable of continuous improvement throughout its lifetime.

The Green Bank Telescope will be the largest fully steerable radio telescope in the world. It will also be useful over a much greater band of radio wavelengths than any telescope of comparable size—wavelengths from several meters (a few feet) to several millimeters (about one tenth of an inch). It will point, under laser control, to an accuracy approaching a second of arc, approximately the angle subtended by a dime when seen from a distance of one mile.



GBT Wind Tunnel Model

The users of the Green Bank Telescope will come from universities and laboratories around the world. Their scientific proposals will be carefully reviewed by their peers, whose ratings will determine which proposals compete successfully for the available telescope time. The GBT will be in use at all hours, day and night, every day of the year. If radio astronomy's past is a valid predictor of its future, the Green Bank Telescope will discover objects and phenomena no one today can predict.

Specifications

Primary Reflector: 100 x 110 meters, unblocked

Focal Length: 60 meters

Subreflector: 7.55 x 7.95 meters

Azimuth Range: −270° to +270°

Elevation Range: 5° to 95°

Phased Performance Development:

Phase	Surface Accuracy	Pointing Accuracy
I	1.25mm	7″
II	0.42mm	3″
III	0.22mm	2″

Moving Weight: 14,000,000 pounds

First signals in 1995

Goals for the Green Bank Telescope

Sensitivity An immense collecting area, a clean beam and low-noise electronics combine to produce unprecedented ability to detect weak signals.

Wavelength Range The primary mirror can be continuously adjusted to maintain a parabola accurate enough for receiving radio waves only millimeters in length.

Sky Coverage Full steerability gives access to eighty-five percent of the sky.

Versatility A stable of receivers and detectors can, in minutes, be interchanged in response to prioritized scientific opportunities and to weather changes.

Discrimination Against Interference No structures block the main reflector. Their absence eliminates scattering of signals from interfering sources into the path of the incident radiation.

Resolving Power Electronic and computer links can connect the telescope to others, including to those in orbit, to sharpen the angular detail that can be revealed.

Unique Features of the Green Bank Telescope

Unblocked Aperture The arm supporting receivers at the focal point is completely outside the path of the incoming radiation. Few extraneous signals get scattered into the receivers; most of the energy they accept comes only from the astronomical objects of interst.

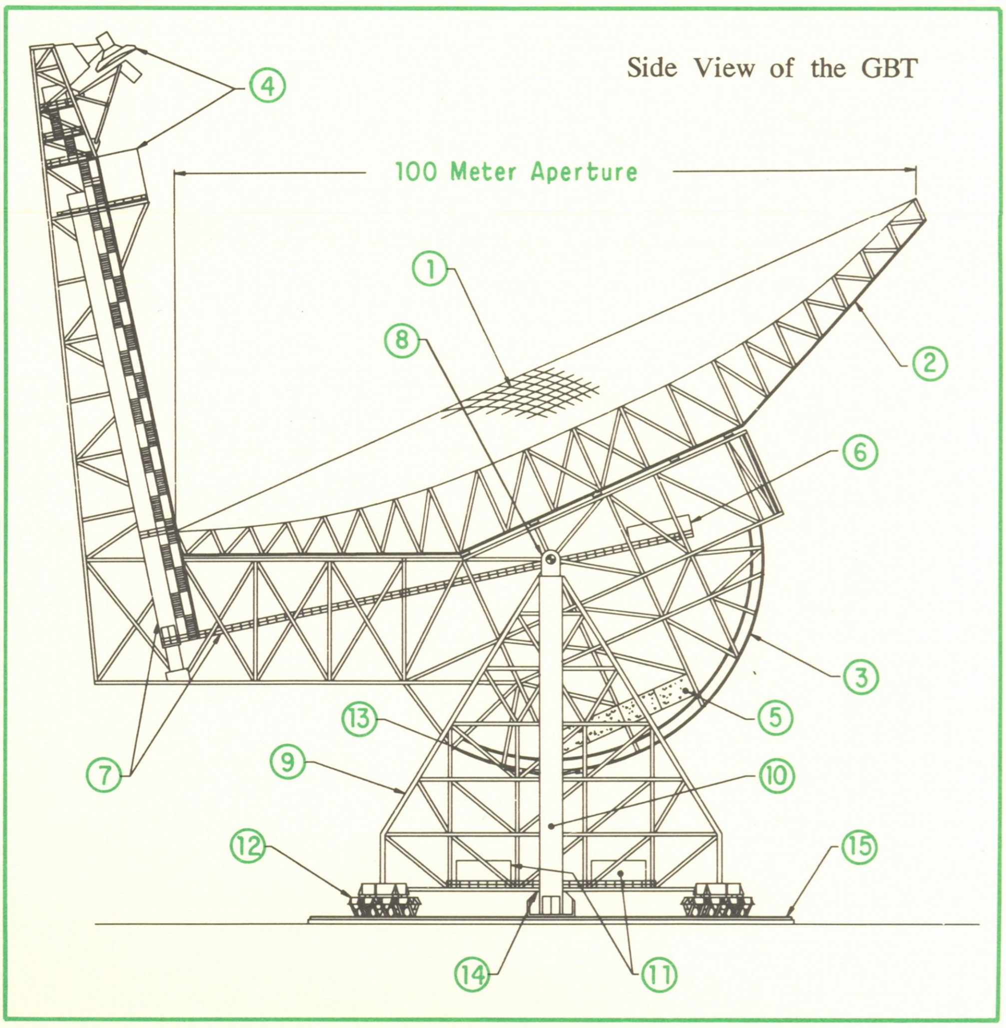
Adjustable Surface Each of the 2204 panels can be moved in or out by computer controlled actuators, so that distortions of the surface can be eliminated.

Precision Pointing Lasers on the telescope beamed at reflecting cubes on its surface determine the surface's shape to a tenth of a millimeter. Lasers on the ground circling the telescope determine where it is pointing to within a few seconds of arc.

Selectable Receivers One receiver can be swung into position at the prime focal point; or any of several on a turntable at the secondary focal point can be swiftly rotated into position.

Key to Diagram

1. Primary Reflector Surface
2. Reflector Support Structure
3. Feed Support Arm
4. Secondary Reflector
   Receiver Room
5. Counterweight
6. Active Surface Control Room
7. Access Way to Focal Point
8. Elevation Bearing
9. Alidade
10. Elevator
11. Equipment Rooms
12. Azimuth Trucks and Drives
13. Elevation Drives
14. Pintle Bearing
15. Azimuth Track

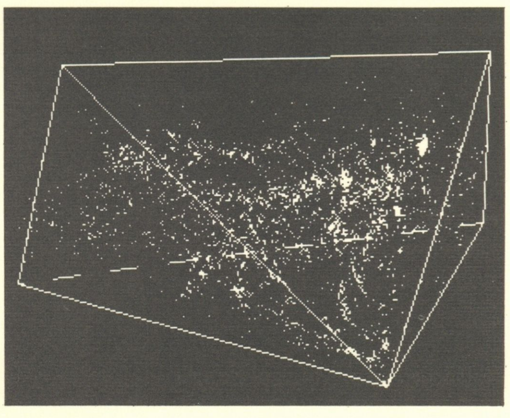


Fundamental Science with the Green Bank Telescope

Structure of Space
Surveys of hydrogen emission from distant galaxies can map the distribution of matter in the universe.

Nature of Time
Precision timing of rapidly spinning pulsars can test predictions of Einstein's General Theory of Relativity.

Chemistry of Space
The many molecules that occupy the spaces between stars in the Milky Way and in other galaxies can be studied by the sharp signal each radiates.



Filaments hundreds of millions of light-years long bound voids of comparable size to define a frothy distribution of matter in the universe.

Origin of Space Time
The radio hiss filling space since the beginning of time can be mapped for hints of the seeds of galaxies.

Energy Sources
Violent activity at the hearts of galaxies and quasars can be monitored and probed in search of evidence for black holes.

Census of the Radio Universe
The telescope can rapidly scan the sky, detecting hundreds of thousands of radio sources, most several billion light-years from our Galaxy.

NRAO
The National Radio Astronomy Observatory is operated by Associated Universities, Inc., under cooperative agreement with the National Science Foundation.