

Green Bank lies in the National Radio Quiet Zone. Radio transmissions in this area are controlled, to avoid interfering with the operations of the observatory.

### Shhhhhh!

If you tune to a typical AM radio station 60 miles away, the signal you receive is pretty weak (about one-ten-millionth of a Watt per square meter). But the telescope receives radio waves from space that are a billion billion times weaker!

Radio astronomy started in 1932. If you added up the energy of all the radio waves collected by all radio telescopes since then, it would be less than that of a falling raindrop.

### Cosmic radio waves - "weak whispers"

- Galaxies - swarms of billions of stars
- Molecules in space - water, ammonia and many others, even carbon-based molecules associated with life!
- Forming stars - stars in the earliest phases of their lives
- Pulsars - tiny spinning stars that give off regular "pulses" of radio waves
- Solar System objects - planets and asteroids

### What the telescope studies

Created in 1956, NRAO operates these major radio facilities:

- the Green Bank Telescope and other instruments at Green Bank
- the Very Large Array, near Socorro, New Mexico
- the Very Long Baseline Array, a group of ten dishes that work together as one telescope. The dishes are spread across the United States, from the Virgin Islands in the east to Hawaii in the west.

### The National Radio Astronomy Observatory (NRAO)

About 200 scientists come to Green Bank each year, from all over the world.

### Who uses the telescope?

Wind, heat and cold can distort the dish. And as the telescope tilts, gravity tends to pull the dish out of shape. To correct for these effects a system of 2,209 pistons ("actuators") adjusts the exact positions of the surface panels from underneath. The shape of the dish is being monitored all the time, by laser beams shone down from the large "feed arm" onto reflectors on the dish's surface.

### Adjusting the telescope

To make a picture of an object such as a galaxy, the telescope "stares" at a tiny point in the object for a while, which amplifies them. From the receiver, the signals pass to *backend* equipment, which can analyze them in a number of ways.

### How the telescope works

Cosmic radio waves hit the surface of the dish and reflect up to the *subreflector* at the dish's focal point. From there they are reflected down into a *feedhorn* located on the large arm of the dish.

The feedhorn channels the weak signals into a receiver. The feedhorn channels the weak signals into a receiver, which amplifies them. From the receiver, the signals pass to *backend* equipment, which can analyze them in a number of ways.

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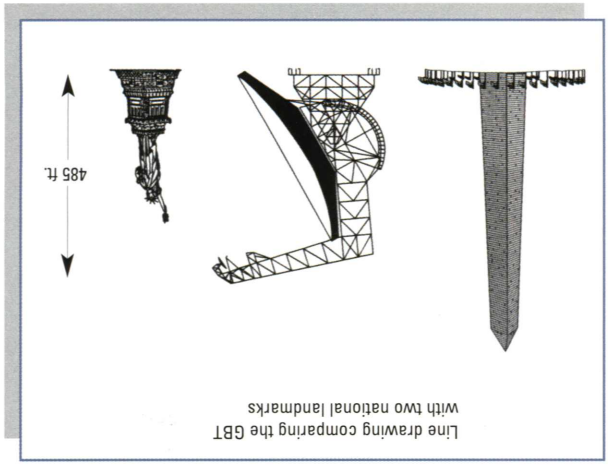
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Line drawing comparing the GBT with two national landmarks. 485 ft.

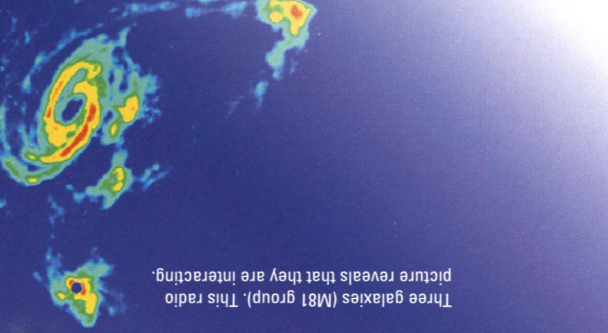
waves, all over the sky.

- the Universe started with a Big Bang. Today, the radiation from this event appears as a background of radio waves, all over the sky.
- gas clouds in space are laced with molecules, some associated with life
- it's a very violent place - some galaxies blast giant jets of particles billions of light-years into space

Radio telescopes have discovered some of the most important facts about the Universe:

### What has radio astronomy found?

NRAO is a facility of the National Science Foundation, operated under cooperative agreement by Associated Universities, Inc.

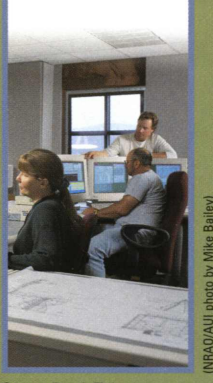


Three galaxies (M81 group). This radio picture reveals that they are interacting.

### Fast facts

- The telescope helps us learn about stars, galaxies and other objects in the Universe, by collecting the radio waves they emit.
- Astronomers don't look through the telescope. Instead, electronic detectors and computers take the radio waves the telescope collects and turn them into pictures of the objects in space, or some other kind of information.
- The telescope is 485 ft (148 m) tall - taller than the Statue of Liberty and nearly as tall as the Washington Monument.
- It weighs 16 million lbs (7.3 million kg) - the same as 19 Boeing 747s.
- Despite its weight, the telescope can be pointed with an accuracy of one arcsecond. That's equivalent to the width of a human hair seen six feet (2 m) away.
- The telescope's surface is made up of 2004 metal panels, and is almost two acres (8000 m<sup>2</sup>) in extent - one and a half times the size of a football field.
- To measure the positions of the panels, laser beams are shot down from the telescope's tall "feed arm" and reflected off small targets on the dish surface. The panels' positions are adjusted precisely with motor-driven pistons.
- To keep track of exactly where the telescope is pointing on the sky, laser beams are sent up from the ground and reflected from targets on the underside of the dish.
- The telescope works both night and day - the radio waves it collects are not 'drowned out' by the Sun.
- The telescope is designed to handle a great range of wavelengths, from 9 ft (3 m) long down to 1/8" (3 mm).
- The telescope only receives signals from space, never sends them.

GBT:  
Precise  
Sensitive  
Versatile



Green Bank Telescope Control Room



### Visit us!

Green Bank is located in Pocahontas County on Route 92/28, about 25 miles north of Marlinton.

- Tour Center** - The Green Bank Tour Center has exhibits and an audio-visual show on radio astronomy. It is open 9 am - 4 pm every day June through August, and on weekends September and October. For information, call (304) 456-2150.
- Guided tours** - We offer guided tours for the general public each day from Memorial Day weekend through to Labor Day, and on weekends in September and October. We can arrange tours for private groups any time of the year. For information and reservations please contact the Tour Director at [crose@nrao.edu](mailto:crose@nrao.edu) or call (304) 456-2164.
- Self-guided walking or bicycling tours** - These can be taken any time of year.
- Education programs** - We run a wide variety throughout the year. For details, contact our Education Programs Manager at [sheather@nrao.edu](mailto:sheather@nrao.edu) or call (304) 456-4008.

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The Robert C. Byrd

Green Bank  
Telescope



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# The Green Bank Telescope

