Karl G. Jansky Very Large Array

National Radio Astronomy Observatory

VLA – Science Machine

The VLA is a powerful telescope that observes the Universe, night and day. Our 27 dish-shaped antennas are tuned to a kind of light that eyes cannot see. This invisible light is in the form of radio waves.

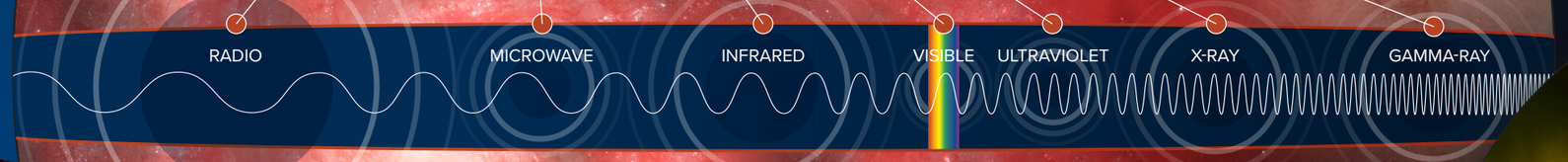
Radio waves reveal previously unseen activities of stars, galaxies, and planets and map the chemical workings of the gas and dust clouds that create them. Optical telescopes cannot see into these places, because those same clouds block their view.

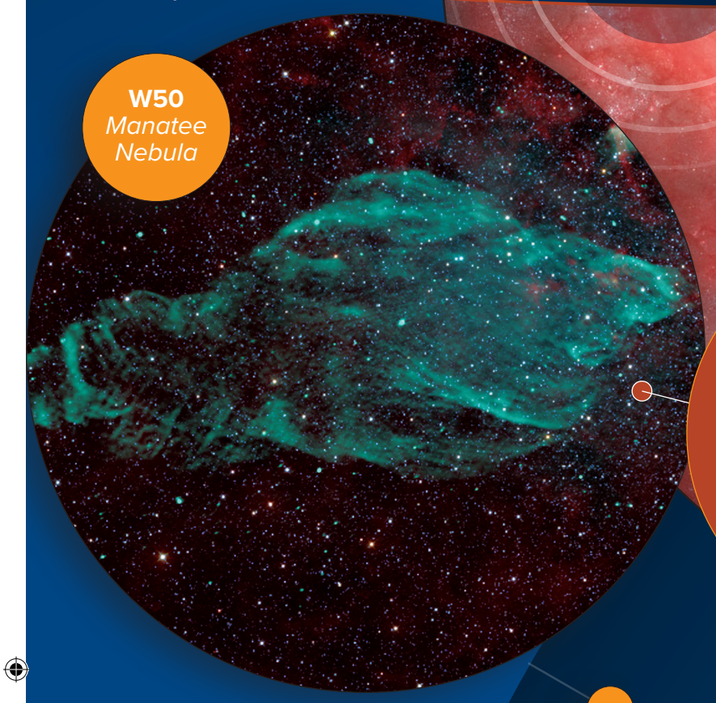
Unhindered radio waves can travel for billions of years across the vastness of space. They provide the VLA with data that help us construct a time line of the Universe – from its ancient past to its possible future.

Since it first began watching the skies back in 1976, the VLA has observed nearly 43,000 different cosmic objects.

The Invisible Universe

Visible light, the light our eyes and optical telescopes can see, is only a tiny fraction of the light given off by normal matter in the Universe. Since Karl G. Jansky discovered natural radio waves coming from space in the 1930s, scientists have designed special telescopes to detect a full range of once-invisible light types across the cosmos, from weak radio waves to high-energy Gamma-rays.





W50
Manatee Nebula

Radio waves find monsters in the mist. This gas cloud was once a large star that exploded. The crushed, dense remnant of that star still causes havoc within: it yanks gas off a nearby star and, like a spinning lawn sprinkler, hurls tons of charged gas outward in powerful jets that blast corkscrew-like arcs into this cloud.

Radio waves help us picture the future. They give us a peek through the dusty blankets that hide newly-forming stars and planets from our eyes and optical telescopes. When we plot these hidden stellar nurseries with the VLA's radio eyes, we are charting the next generation of stars that our own eyes will someday see shining there.

M82
Cigar Galaxy

VLA – Engineering Marvel

Each of the 27 white dishes of the VLA gathers faint, natural radio waves traveling through distant space from objects such as galaxies, black holes, and baby stars.

Each dish is 82 feet (25 meters) across and made from smooth aluminum panels fitted carefully onto a steel basket. (Experience the true size of a dish at Stop #7.)

Motorized drives steer these 100-ton dishes around, dip them up and down, and keep them pointed exactly on the cosmic radio source for several hours at a time to collect enough radio waves from each object they observe. (Get up close to an antenna at Stop #11.)

The radio waves are funneled on to supersensitive, cryogenically-cooled receivers.

The views from each of the 27 active antennas in the array are sent down fiber optic cables to a supercomputer housed in the Control Building. (Learn more at Stop #14.) The supercomputer mathematically merges the 27 views, uniting the array into a single, powerful telescope.

To change the level of detail the VLA can see, we increase or decrease the distances between the antennas along the Y-shaped rail tracks to change the level of detail the VLA can see. At the widest antenna separation, the merged observations of the VLA have the qualities of a giant telescope with an eye 22 miles across!

VLA – Everyday

Although most of our staff are in Socorro, a core of 50 staff members (including 24-hour security) work on-site to keep up with the VLA's operational needs. Most of the astronomers who are awarded observing time on the VLA are located elsewhere around the globe. Our telescope operators control the VLA on their behalf as it observes the radio sky for 5,000 hours every year, both day and night.

We adjust the VLA's science capabilities every four months. Our specially-trained crew operate the unique Transporters to carefully lift and relocate each 230-ton antenna to one of 72 new positions along the Y-shaped railroad tracks. (View the historic tracks from Stop #12.)

On regular timetables, our tradespeople perform critical maintenance tests and upgrades on the antennas, Transporters, and the 82 miles of railroad tracks, while our engineers update the supercomputer, software, and antenna receiver equipment as needed.

Antenna Assembly Building, aka the Antenna Barn. (Drive over to Stop #18 for a view inside.)

EACH OF THE 27 ANTENNAS IN THE ARRAY WEIGHS OVER 230 TONS, IS 82 FEET ACROSS, AND OVER 90 FEET HIGH.

VLA – Rich History

In the early 1960s, we began planning a "very large array" of radio antennas that would function as one giant telescope. The United States Congress authorized this "VLA" project in 1972, and site work began on the Plains of San Agustin in New Mexico two years later. In 1975, the first VLA antenna was assembled on site, inside the

With only two antennas, the VLA began observing the radio skies in 1976. The VLA became a full-time telescope in 1977 when six antennas were operational. By January 1981, all 27 antennas of the new array (plus its spare 28th) were completed. In 2012, after decades of planning and retrofitting, the VLA was transformed by a new suite of receivers, a supercomputer, and the replacement of its old wiring with nearly 3,000 miles of fiber optics. It was rededicated in honor of one of the founding figures of radio astronomy, Karl G. Jansky (Learn more about Jansky at Stop #2).

Please:

- **Please ensure all electronic devices are in airplane mode and powered off (phones, computers, tablets, watches, or anything else that utilizes wireless connections including cellular service, WiFi, and Bluetooth). If you plan to use your phone or tablet to take photographs, you may briefly turn them on (while in airplane mode) to take pictures and then power them off again once you've done so.**
- Keep in mind the VLA is a scientific observatory and an active work place. Visitors should conduct themselves accordingly by being mindful of their surroundings, their children and pets, and **obeying all posted signs.**
- Do not leave the designated visitor path and exhibit areas. Be alert for trucks and cars at all crosswalks. **Do not walk on roads.**
- Do not enter the fenced enclosures or any buildings other than the Visitor Center.
- Leashed pets are allowed on the tour path (but not inside the Visitor Center with the exception of service animals). Leashes must be no longer than 6 feet.
- You may encounter snakes or other wildlife here at the VLA. Be aware of your surroundings and watch your step on the unpaved surfaces and uneven ground.
- Dispose of all trash responsibly using the receptacles provided at the Visitor Center and picnic areas.
- Be aware! You are at 7,000 feet elevation. It's higher than it looks! Stay hydrated and use sun protection.
- Take as many photographs as you like from the public areas and share them with us on your social media sites when you get home.
- **The use of drones is strictly prohibited!**

Always check VisitVLA.com before visiting! We are sometimes forced to close the site during inclement weather, severe storms, and major site construction.

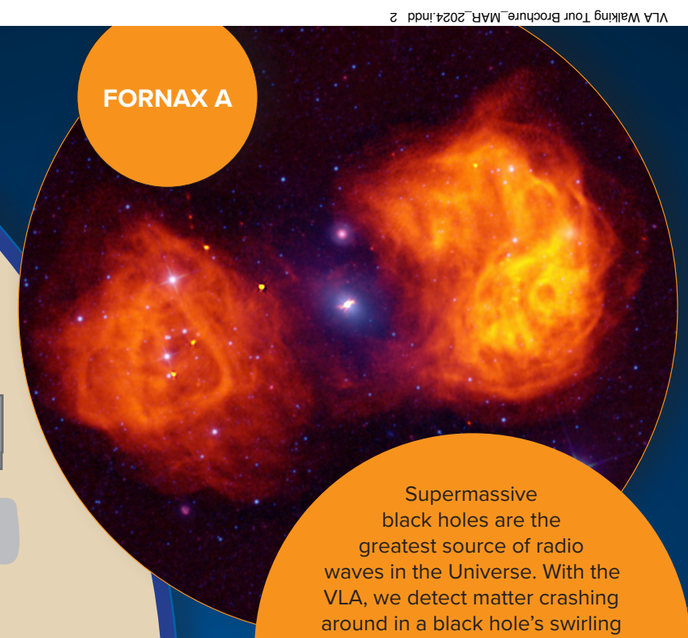
Walking Tour Stops:

1. Welcome to the Karl G. Jansky Very Large Array Walking Tour
2. What is the Very Large Array?
3. Bracewell Sundial
4. Are those antennas part of the VLA?
5. How does a VLA antenna work?
6. How big is a VLA dish?
7. Who keeps the VLA running?
8. What are radio waves?
9. What does the VLA do? Radio Universe Gallery
10. Why is the VLA out here?
11. What is inside a VLA antenna?
12. Why is the VLA so very large?
13. What happens in this building?
14. Why do we need a supercomputer?
15. The next generation Very Large Array (ngVLA)
16. Shiva: Shiwana
17. What happens in this barn?

Follow the instructions on the Solar Radio Telescope sign and make your own discoveries!

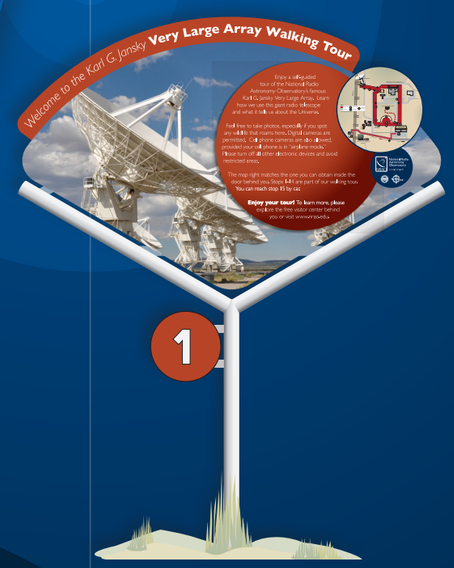
Come back again! The Visitor Center and tour paths are open from 9am to 4pm every day except Thanksgiving, Christmas Eve, Christmas Day, and New Year's Eve Day. No public access outside of these hours.

REMEMBER:
NO CELL PHONES
NO DRONES
Switch your phone to airplane mode and turn it off when you are not taking pictures.



Supermassive black holes are the greatest source of radio waves in the Universe. With the VLA, we detect matter crashing around in a black hole's swirling neighborhood. We also see material shot away as bright jets that eventually slow into huge, glowing pools.

See more spectacular images from the VLA at Stop #10.



MAR2024

ALMA

VLA photo by Knate Myers.

SAGITTARIUS A

The VLA has seen clear into the dust-shrouded center of our galaxy, 26,000 light years away – that's over 150 quadrillion miles from here! With its radio eyes, the VLA captured a stunning view of material spiraling around the supermassive black hole anchored in the heart of our galaxy.

VLA WALKING TOUR MAP

Karl G. Jansky
Very Large Array

The National Radio Astronomy Observatory is a facility of the National Science Foundation operated by Associated Universities, Inc. Since 1956, we have designed and operated Earth's most powerful radio telescopes for use by scientists around the world.

In addition to running the VLA, NRAO also leads the North American partnership in the Atacama Large Millimeter/submillimeter Array (ALMA), 66 complex, high-frequency radio antennas observing at the loftiest elevation of any in the world – 16,500 feet high in the Chilean Andes.

Take a virtual tour of these facilities!

public.nrao.edu/explorer/vla
public.nrao.edu/explorer/alma

Welcome to the self-guided walking tour at the National Science Foundation's Karl G. Jansky Very Large Array (VLA). Run by the National Radio Astronomy Observatory (NRAO), the VLA is the most adaptable, hardest-working telescope in the world.

This souvenir map shows you where we have installed exhibit signs that explain what we do here. Use it to guide yourself along the marked walkways to explore the cutting-edge science and engineering of our working astronomical observatory.

National Radio Astronomy Observatory

public.nrao.edu • VisitVLA.com