

The Australia Telescope Compact Array – Fast Facts

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CSIRO's Australia Telescope Compact Array (ATCA) is a set of six 22-m diameter parabolic dishes used for radio astronomy. The ATCA is located about 24 km west of the town of Narrabri, NSW (which is 540 km north-west of Sydney). It is operated by CSIRO Astronomy and Space Science (CASS), a business unit of CSIRO. CASS also operates the Parkes radio telescope near Parkes, NSW, and the Mopra radio telescope near Coonabarabran, NSW, and is developing the Australian SKA Pathfinder (ASKAP) telescope in Western Australia.

The telescope

Radio astronomers want dishes that are as large as possible because the larger the dish, the clearer (the higher in resolution) the radio picture. However, building steerable dishes more than 100 m in diameter is expensive and difficult, and so astronomers use a number of small dishes linked together instead. A telescope that combines signals in this way is called an interferometer.

The Compact Array consists of six dishes. Five of the dishes sit on a 3-km stretch of rail track running east-west; the sixth is three kilometres further west. There is also a 214-m track running north-south.

The rail track allows the dishes to be moved into different arrangements ("configurations"), with different distances between them. This produces better radio pictures.

The dishes are not moved long the track while observations are taking place, but in between observations—every few weeks or so. They are self-powered, and move at 4 km/hr, a fast walking pace.

When in location, the dishes are plugged into "stations" along the track, which are the outlets for power and signal cables. The cables carry signals to and from the control building.

At the control building, the signals from each antenna are combined with those

from every other antenna, in a series of pairwise comparisons, to build up a picture of cosmic radio sources.

DID YOU KNOW?

- ◆ The telescope can be pointed with an accuracy of better than two arcseconds—about the width of a finger seen 1 km away.
- ◆ The telescope can receive radio waves from 3 mm to 20 cm long.
- ◆ The telescope only receives signals from space, never sends them.
- ◆ The Compact Array opened in 1988. Equipment changes since then have allowed it to receive much fainter radio signals, over a wider range of wavelengths.



Signal processing boards built by CSIRO for a recent upgrade of the Compact Array.
Photo: Tim Morison.



CSIRO's Australia Telescope Compact Array.
Photo: David Smyth



Particles emitting radio waves stream millions of light-years into space from the heart of the galaxy Centaurus A in this picture made by CSIRO. Data for the image was gathered with CSIRO's Australia Telescope Compact Array and Parkes radio telescope.

Ilana Feain, Tim Cornwell & Ron Ekers (CSIRO/ATNF). ATCA northern middle lobe pointing courtesy R. Morganti (ASTRON), Parkes data courtesy N. Junkes (MPIfR).

Using the telescope

The Compact Array is one of the most advanced telescopes of its kind (of which there are about a dozen in the world). It operates 24 hours a day, seven days a week, throughout the year. Support staff are always on hand.

About 80% of all time each year is scheduled for observing. Less than 4% of that is lost because of high winds, bad weather, or equipment problems. The rest of the time each year is used for maintenance and testing.

Astronomers can operate the telescope from the control room or from another location, over the Internet. There is always an astronomer present on site if the telescope is being used remotely.

Scientists from around the world can apply to use the telescope. Each year CSIRO's radio telescopes (the Compact Array, the Parkes telescope, and the Mopra telescope near Coonabarabran) are used by more than 400 astronomers from more than 130 institutions in Australia and overseas.

Radio astronomy

The radio waves from objects in space are extremely weak by the time they reach Earth. The power received from a strong cosmic radio source by the telescope is about a hundredth of a millionth of a millionth of a watt (10^{-14} W). If you wanted to heat water with this power it would take about 70 000 years to heat one drop by one degree Celsius.

Galaxies contain stars, gas and dust. The gas—mostly hydrogen—is the raw material from which stars form. It emits radio waves, at a frequency of 1420 MHz. Radio astronomers spend a lot of time studying this gas, learning where it is and how it is moving.

Astronomers don't look through the telescope. Instead, signal processing systems and computers take the radio waves the telescope collects and turns them into pictures (like photographs) of objects in space.

Space tracking

In 2007 the Compact Array was outfitted with receivers that allow it to receive radio waves 7 mm long. This will allow it to be used from time to time to help NASA track spacecraft.

TV roles

The Compact Array was the setting for a television series, "Sky Trackers", produced in 1994.



Vital statistics

Diameter of each dish

22 m

Mass of each dish

270 tonnes

Focal length

7 m

Maximum tilt

78° from the vertical

Time to maximum tilt

4 minutes

Time for 360° rotation

9 minutes

Surface accuracy

0.2 mm rms difference from ideal surface

Pointing accuracy

2 arcseconds rms

Speed of travel along track

4 km per hour.

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