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The Australia Telescope National Facility

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The Australia Telescope National Facility (ATNF) is owned and operated by Australia's national science agency, CSIRO. The ATNF supports research in radio astronomy and is used by the international astronomy community. It also supports space-related activities, such as spacecraft tracking and communication, bistatic interplanetary radar and passive radar. CSIRO's engineering technologies group develops radio astronomy receivers, digital signal processing systems and software to keep ATNF telescopes at the cutting edge and to enhance observatories around the world.

The ATNF currently offers merit-based access to the Australian Square Kilometre Array Pathfinder (ASKAP), the Australia Telescope Compact Array (ATCA), the Parkes Murriyang 64-m radio telescope, and the Long Baseline Array—a network of telescopes utilising the technique of Very Long Baseline Interferometry (VLBI).

ASKAP is CSIRO's newest radio telescope and is undertaking a five-year program of continuum and spectral line projects, including all-sky and transient surveys. Located at Inyarrimanha Ilgari Bundara, the CSIRO Radio-astronomy Observatory in Western Australia, ASKAP is a high resolution, rapid survey instrument. ASKAP consists of 36, 12-metre diameter dishes spread over 6 km, and provides a 30 square degree field of view. ASKAP is fitted with CSIRO's phased array feed (PAF) receivers. Effectively digital cameras, but for a radio telescope, PAFs enable ASKAP to take snapshots of the sky over an area 100 times the size of the full moon.

ATCA is a versatile and responsive imaging instrument with high sensitivity to fine- and broad-scale angular structure. ATCA comprises six, 22-metre dishes on railway tracks allowing for variable baselines from 30 m to 6 km. System temperatures of ~20 K are achieved over most of the range 1-11 GHz; receivers are available up to 100 GHz. These capabilities are complementary to instruments in other countries, providing unique opportunities for follow up observations. ATCA has also been used for space tracking and as the receiving station for bistatic radar. A new correlator ("BIGCAT") based on GPU technology is under construction. BIGCAT will improve sensitivity, reliability, and provide new modes for spectral line and time varying phenomena.

At 64 m, the Parkes Murriyang radio telescope is the largest, steerable, single-dish radio astronomy telescope in the southern hemisphere. It has world leading capability in pulsar, fast radio burst and spectral line astronomy. Parkes has recently been equipped with an ultra-wideband receiver operating over the range 0.7-4.2 GHz. A cryogenically cooled PAF receiver based on ASKAP technology will be installed during 2023 and a broadband high frequency receiver is under development. These receivers replace a much larger fleet of narrow-band receivers, significantly easing operational impacts while increasing overall frequency coverage.

ATNF telescopes and antennas of the CSIRO-operated NASA facility, the Canberra Deep Space Communication Complex, and CSIRO's Mopra Telescope, are combined with other radio telescopes in Australia and overseas to form the Long Baseline Array: a continental-scale VLBI telescope that provides the highest angular resolution imaging capability for the southern sky.

CSIRO's radio astronomy instrumentation group collaborates with observatories around the world seeking advanced instrumentation for their telescopes. This group develops some of the world's largest, high performance multibeam receivers, ultra-wideband receivers and next-generation PAFs, alongside advanced digital systems and software for data handling and analysis.

This paper describes the capabilities of these instruments, recent science results and technical developments.

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