



The ATCA “BIGCAT” Upgrade

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The Australia Telescope Compact Array (ATCA) has been a cornerstone of Australian radio astronomy for over 30 years, enabling groundbreaking studies across a broad range of astrophysical topics. The ATCA is an interferometric array consisting of six 22-meter Cassegrain telescopes and operates from 1 to 105 GHz, with a maximum baseline length of 6 km. To ensure ATCA remains at the forefront of radio astronomy, the Broadband Integrated GPU Correlator for ATCA (BIGCAT) upgrade is currently underway. This project represents a complete modernization of the telescope's backend, replacing all components of the signal processing chain except for the antennas and receivers. Once fully implemented, BIGCAT will double the instantaneous processed bandwidth from 4 to 8 GHz, significantly enhance spectral line flexibility, and improve overall system reliability.

BIGCAT encompasses the replacement of the intermediate frequency (IF) conversion system, digitizers, and correlator. This upgrade will enable more flexible spectral line configurations, facilitating a broader range of scientific applications. By making ATCA more adaptable to evolving project needs, BIGCAT will ensure that the observatory remains a competitive instrument in the era of next-generation radio facilities.

The first phase of BIGCAT was installed in April 2025. A second phase, involving an RF system upgrade to support wider bandwidths, will take place in the second half of 2025.

The new digitizer for BIGCAT is based on the Xilinx RFSoc chips, which integrate eight wideband (4 Gsps) ADCs into an FPGA fabric. The RFSoc chip is mounted on a board called "Jimble," custom-designed by CSIRO engineers. The same Jimble digitizer will be used on the Murriyang (Parkes) telescope CryoPAF receiver and wideband receivers. In addition to digitizing the analogue signal, the Jimble performs coarse channelization using a polyphase filterbank and sends the data to the correlator using commodity 100 Gbps Ethernet.

The new BIGCAT correlator is a small cluster of 16 Nvidia graphical processing units (GPUs). The GPU system performs all the astronomical data processing, including geometric corrections, fine channelization, cross-correlation, and averaging. As the digital processing code is software-based, it will allow highly flexible configuration changes for modes such as spectral resolution, phased-array beams, and nonstandard modes for bespoke experiments.

In this talk, we will present an overview of the BIGCAT upgrade, its technical advancements, and the commissioning plans that will guide ATCA into its next era of scientific discovery.