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An Active Dual-Polarized Antenna for Fast Radio Burst Monitor

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Fast radio bursts (FRBs) are transient events that last only a few milliseconds and can originate from any direction in the sky. To maximize the chance of detection, an all-sky monitor is needed, which can be constructed using an array of small wide-beam antennas [1]. The development of antennas with low gain towards the horizon and a wide field of view (FoV) is critical for enhancing the performance of large all-sky arrays used in radio astronomy. Low gain towards the horizon minimizes radiation losses outside the desired reception area, reducing ground noise and radio frequency interference (RFI) thereby improving the signal-to-noise ratio, which is critical for sensitive astronomical applications. A wide FoV enables a single antenna element to capture signals from a broad section of the sky, making it highly efficient for large-scale array deployments. Together, these attributes ensure that each small antenna contributes effectively to the overall array, enabling detailed and high-quality sky surveys while minimizing array complexity and system noise.

This paper presents a dual-linearly polarized cavity-back cross-dipole antenna designed to operate over a frequency range of 550 to 750 MHz, achieving a peak gain of approximately 12 dBi. This frequency range is specifically selected to avoid strong RFI, a critical factor in radio astronomical applications where high sensitivity is required. The antenna consists of a printed-circuit board crossed dipole suspended above an aluminum cavity to allow for a symmetrical beam with low back radiation. A key feature of the antenna is its integrated low-noise amplifier (LNA). By integrating the LNA into the antenna we avoid transmission losses, which would otherwise increase the system noise. With the entire system exhibiting a noise temperature below 20 K, the antenna system provides exceptional low-noise performance. The gain and noise performance of the antenna make it particularly suitable for large-scale radio frequency observatories.

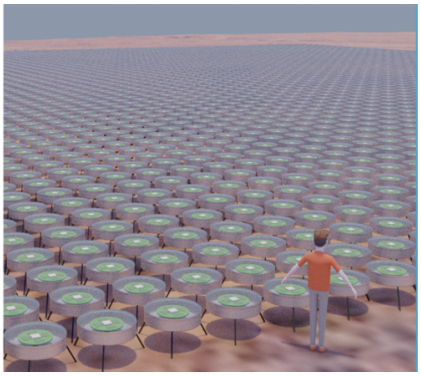

Figure 1. A perspective view of the Coherent All-sky All The Time Array (CASATTA)

References

[1] R. S. Dixon, "Argus: a next-generation omnidirectional powerful radio telescope," *Acta Astronautica*, vol. 35, no. 9-11, pp. 745–752, 1995.