# INTENSITY MAPPING TECHNIQUES

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**BEAM PATTERN**

Beamforming is a general signal processing technique that is used in radio astronomy to observe radio signals from a defined area of the sky. The technique is applicable to either radiation or reception of energy. In this report, we discuss the formation of beam patterns for reception. The report presents images of the beam pattern for the KAT-7 antennas generated from OSKAR Simulator at Stokes parameters (I, Q, U, V).

The KAT-7 antennas were simulated with OSKAR by treating each dish as a 12m aperture array and placing a bunch of dipoles in a 12m circle. Mathematically, we can express this using the general equation of a circle as:

$$(x - a)^2 + (y - b)^2 = r^2 \tag{1}$$

Assuming there is no phase shift during observation, equation (1) becomes

$$x^2 + y^2 = r^2 \tag{2}$$

where, $x = r\cos\theta$, $y = r\sin\theta$, $\theta = (0, 2\pi)$ and $r = (0, n)$ with $n$ being the number of antennas.

The telescope model for the simulation is developed by generating the dipoles from equation (2).
The images at various intensities in Figure 1 are the primary beam responses for KAT-7 forming a dish-like beam at the zenith. The image field-of-view is 30 degrees with pixel dimension of 256 by 256. The dish-like beam at the zenith clearly describes the field strength received by the aperture array.
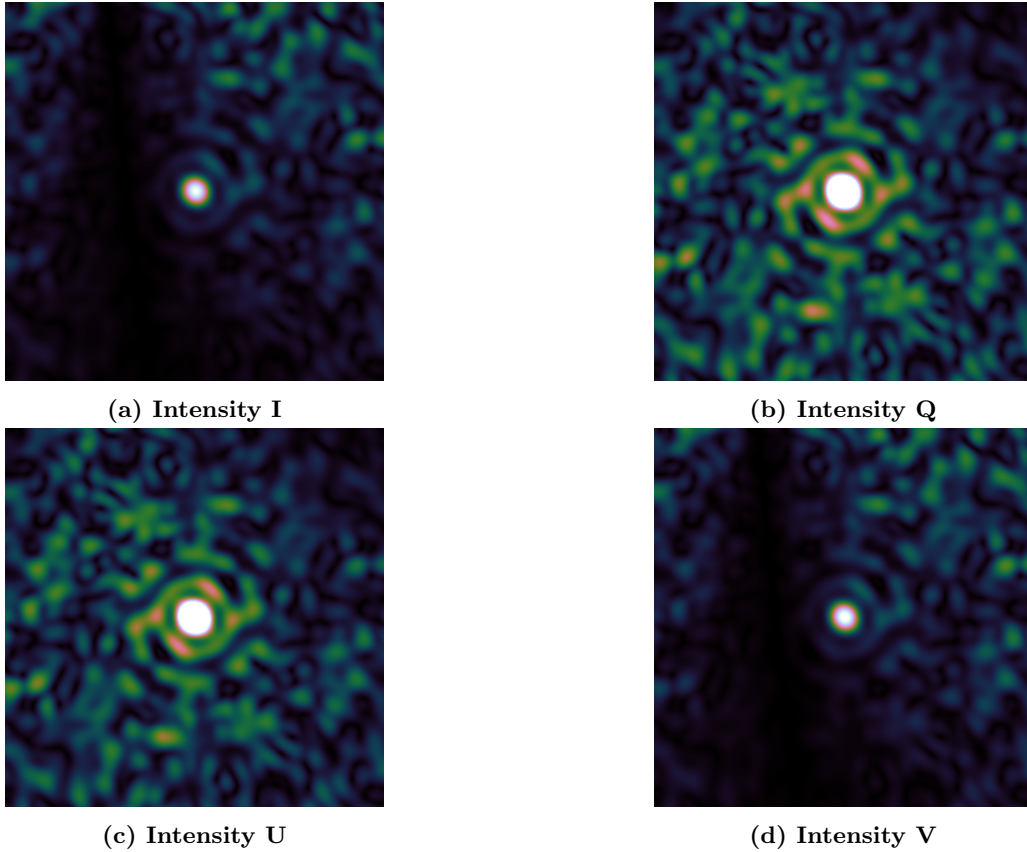


(a) Intensity I

(b) Intensity Q

(c) Intensity U

(d) Intensity V

**Figure 1:** Beam Patterns of Polarised Map