

EXERCISE 2A

Determining the directional characteristic and effective aperture of the antenna RT15

Theoretical basis:

The main lobe width of the directional characteristic $P(\alpha, \delta)$ of the antenna at half power expresses the antenna angular resolution.

The directional characteristic of the antenna can be obtained by scanning of a radio source with a small angular size compared with the antenna angular resolution (a point source).

The effective aperture A_{eff} can be determined by observation of a point radio source of well known flux density i.e. the calibrator:

$$kT_A = \frac{1}{2} A_{eff} S_\nu$$

where S_ν is the known flux density of the radio source at frequency ν .

Before the exercise:

Prepare the hour angle and declination of the radio source Cas A for the moment of observations (using e.g. OOD program).

Tasks:

Perform a measurement of the shape of the antenna directional characteristic's main lobe in two perpendicular planes by doing scans of a point source along hour angle and declination. At the beginning and at the end of the observation make measurements of the noise signal for cases with the noise generator switched on and off.

Report (coverage):

1) Present the antenna directional characteristic measured in two planes in graphs. Determine the width of the antenna directional characteristic's main lobe at half power, so the antenna angular resolution (at observed wavelength) in both planes in units of degrees. Remember about including "cos(δ)".

2) Determine the flux density of the radio source Cas A (using: Baars et al. 1977, AA 61, 99 or OOD program). Find effective aperture A_{eff} of the antenna at observed wavelength (equation above) and aperture efficiency:

$$\eta = \frac{A_{eff}}{A_{geom}}$$

3) Determine the sensitivity of the telescope $\Gamma = A_{eff}/(2k)$ in units of K/Jy.

4) Determine the beam solid angle Ω_A of the antenna (using: $A_{eff}\Omega_A = \lambda^2$) and directive gain of the antenna $G = 4\pi A_{eff}/\lambda^2$.

5) Determine the main beam solid angle and the main beam efficiency.