$q = 2\pi/\theta$, the units of $q$ in our Fig. 13 is $\mathrm{rad}^{-1}$. For example, when $\theta = 100$ arcmin $= 0.029$ rad, $q = 216.7\ \mathrm{rad}^{-1}$.

From the EQ. 35, $k = q/r$ and at $z = 6$ we have $r \approx 8400$ Mpc, so $k = 0.026\ \mathrm{Mpc}^{-1}$. From Fig. 13, at $k = 0.026\ \mathrm{Mpc}^{-1}$ the $k^3/(2\pi^2)P_{\mathrm{3D}}(k) \approx 2.2\times10^4\ (\mathrm{Jy/sr})^2$. So $P_{\mathrm{3D}} = 2.5\times10^{10}\ (\mathrm{Jy/sr})^2\mathrm{Mpc}^3$.

Since for $\delta\nu_0 = 1$ GHz and $\nu_0 = 271.5$ GHz, $\delta r \approx 11$ Mpc at $z = 6$, we get $P_{\mathrm{2D}} = 32\ (\mathrm{Jy/sr})^2\mathrm{sr}$ from EQ. 35, and $q^2/(2\pi)P_{\mathrm{2D}} = 2.4 \times 10^5\ (\mathrm{Jy/sr})^2$. This is consistent with the Fig. 12.

The 2D power spectrum DO depends on the projected thickness along the line-of-sight, because when you stack the thin slices together, the small-scale fluctuations along the line-of-sight would cancel out each other somewhat, leaving only the fluctuations larger than the thickness at the radial direction.

EQ. 35 is just a very simple approximation, to get the accurate 2D power spectrum, a formula like EQ. 10 in Loeb & Zaldarriaga (2004) is much better.