INTERFEROMETRIC OBSERVATIONS OF THE SMALL-SCALE STRUCTURE OF GALACTIC NEUTRAL HYDROGEN

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The small-scale structure of galactic neutral hydrogen may be statistically described by the spatial power spectrum of the 21-cm line. This latter may be readily observed by interferometer arrays since it is the squared modulus of the visibility function. We have observed the $l=52.^{\circ}5$, $b=0.^{\circ}0$ region with the Westerbork Synthesis Radio Telescope (Crovisier and Dickey, 1983). Brightness fluctuations of the 21-cm line were detected in this region on scales as small as 1.7 arcmin (corresponding to less than 5 pc). The Westerbork observations, combined with single-dish observations made at Nançay and Arecibo, allow determination of the spatial power spectrum over a dynamic range of about 10^6 in intensity. The spectrum follows roughly a power law with indices ~ -3 to -2. An interpretation in terms of the turbulence spectrum is proposed by Dickey (1985).

Another way to investigate galactic HI structure over very small scales is to measure, with an interferometer, 21-cm absorption profiles toward the components of double continuum background sources. The simple source structure allows an easy reduction by model fitting. Previous observations (Dickey, 1979) with the NRAO 3-element interferometer revealed only marginal optical-depth variations except toward the components of Cyg A. We recently made more sensitive observations with the WSRT toward 7 double extragalactic sources with angular separations ranging from 0.7 to 6 arcmin. Significant absorption differences were found between the components of each pair ($\Delta\tau$ = 0.05 to 0.3). Some of them correspond to linear scale-lengths as small as 0.2 pc, when the relevant clouds are placed at their kinematic distances. As an example, Figure 1 shows the spectra obtained toward 3C 69 ($l=136.^{\circ}26$, $b=-0.^{\circ}88$), whose components are separated by θ = 42 arcsec. These absorption differences may be attributed to optical-depth variations and/or velocity gradients within the HI clouds.

Interpretation of these interferometric observations will be done in the future in terms of HI distribution models.

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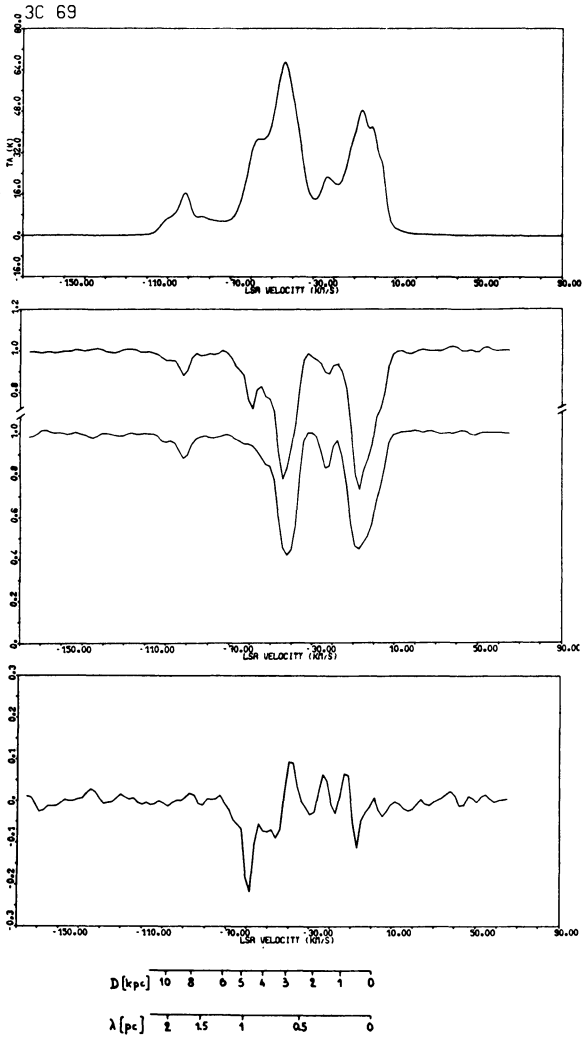

Figure 1. From top to bottom: a) the mean 21-cm emission spectrum in the 3C 69 direction observed with the Nançay radio telescope; b) the absorption profiles observed toward the south and north components of 3C 69 with the WSRT; c) the difference between the two absorption profiles; d) the relationship between velocity, kinematic distance D and linear separation $\lambda = D\theta$.

REFERENCES

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