High velocity HI in the inner 5 KPC of M31

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1. INTRODUCTION

New observations made with the Westerbork Synthesis Radio Telescope of M31 in the line of neutral hydrogen (Brinks, this volume) show the presence of high-velocity HI in the inner 4-5 kpc of the galaxy. There were indications from previous 21-cm line studies that HI gas is moving with peculiar velocities (Whitehurst and Roberts, 1972; Unwin, 1979) but the new maps, made with a resolution of $\Delta\alpha \times \Delta\delta \times \Delta V = 24'' \times 36'' \times 8.2$ km s^{-1} and sufficient sensitivity show for the first time the distribution of this material.

2. RESULTS

Figure 1 shows three position-velocity maps made parallel to the minor axis at +6', 0' and -6' distance from the nucleus. These maps were constructed after smoothing to twice the original beamsize. For all three cross-cuts, we would expect the HI to be distributed more or less in a narrow band around systemic velocity if the gas clouds were moving around the nucleus in circular orbits in the plane of the galaxy. Figure 1 shows that this is clearly not the case. At 1.2 kpc North of the nucleus, roughly on the major axis, HI gas with a radial velocity exceeding 250 km s^{-1} with respect to systemic velocity is found (see figure 1a). Figure 1c shows that at the same distance South of the nucleus the velocity is about 200 km s^{-1} lower than expected from the circular rotation situation. On the minor axis (figure 1b) there is a steep velocity gradient on both sides of the nucleus. The feature labeled "a" lies outside the central region at about 5 kpc and coincides with the prominent dust arm North-East of the nucleus. This arm has already been discussed by Bajaja and Shane (1982) and is also detected in CO by Stark (1979).

3. DISCUSSION

The high-velocity HI features inside 4-5 kpc show the same signature as the high velocities measured in the optical by Rubin and Ford (1970,

E. Athanassoula (ed.), Internal Kinematics and Dynamics of Galaxies, 27–28.

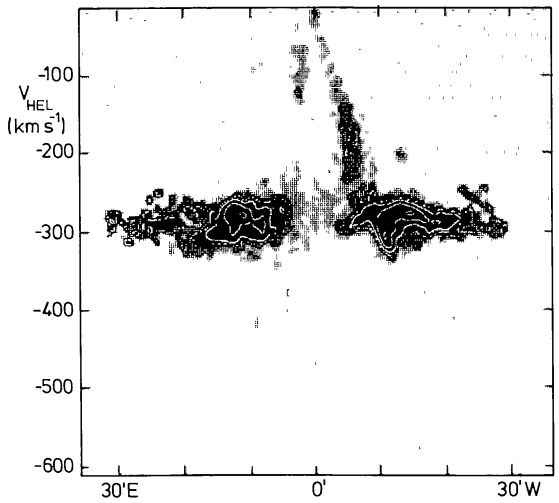

Figure 1a: position-velocity map, 6'N of the minor axis. Contour levels are 2.5, 5, 10 and 25 K.

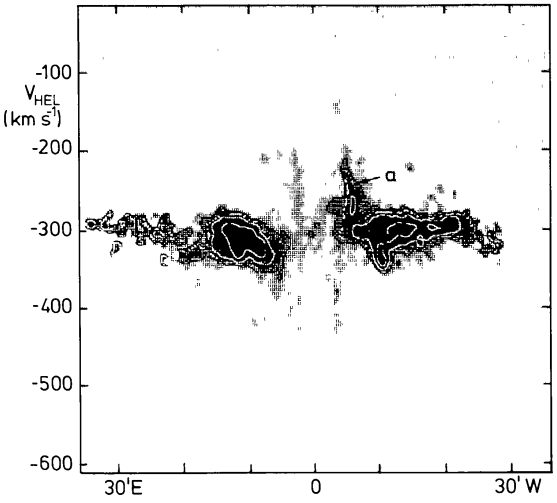

Figure 1b: as figure 1a, along the minor axis.

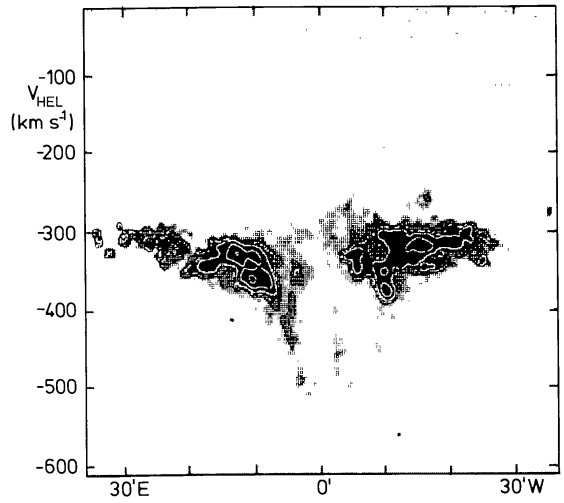

Figure 1c: 6'S of the minor axis.

1971). We have not detected any HI inside 500 pc corresponding with their measurements, perhaps because gas inside 500 pc is mostly in ionised form. The position-velocity maps support the idea that the high velocities are due to rotation rather than produced by infall of material or ejection from the nucleus. This idea is strengthened by the fact that the central radio source in M31 is intrinsically weak and shows no evidence for recent activity. From figure 1 it is clear that the gas does not move in circular orbits in the plane of the galaxy. It has been shown that the isophotes of the bulge show a gradual change in position angle and ellipticity (Matsumoto et al, 1977; Lindblad, 1956), so it is quite possible that the gas moves along elliptical streamlines, perhaps even tilted out of the plane, much like the distribution proposed for the central region of our own galaxy.

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