MASS MODELS OF THREE SOUTHERN LATE-TYPE DWARF SPIRALS

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Although rotation-curve studies of spiral galaxies have unambiguously established the presence of dark matter, and theoretical studies have shown that its location is likely to be in a separate spheroidal halo component (Binney, 1978; Tubbs and Sanders, 1979; Monet, Richstone and Schechter, 1981), very little is known about its spatial distribution and its nature. Recently, Faber and Lin (Faber and Lin, 1983; Lin and Faber, 1983) have shown that, if one can get a rough idea of fundamental parameters like the halo scale length and the halo-to-disk ratio, it is also possible to put strong constraints on the nature of non-luminous matter.

One way to determine its spatial distribution, is to try to probe the gravitational potential as far out as possible through rotation velocities, and then, by using mass models, to subtract the contribution of the luminous matter to the potential. Assuming a constant M/L for the luminous disk, this can be done since the light distribution can then be transformed directly into a mass distribution. However, high-sensitivity HI observations are necessary, since optical velocities rarely extend past the disk-dominated region (e.g. see Kalnajs, 1983 for NGC 7217 and NGC 4378).

Late-type dwarf spirals are ideal candidates for determining the basic halo parameters for these galaxies. The contribution by dark matter to the total mass in the region that can be surveyed by 21-cm line emission is an order of magnitude larger than that of luminous matter. Moreover, since these systems have almost no bulge, one can, in principle, trace the distribution of dark matter over almost the entire galaxy; when a bulge component is present, it will tend to make V(r) flat in the inner regions, and it is difficult to determine reliably the contribution of the disk and of the bulge to the potential field, since each component has different M/L and mass distribution.

One-component models (Kalnajs, 1983) using Carignan's photometry (1983) and two-component disk-halo models (exponential disk and iso-

H. van Woerden et al. (eds.), The Milky Way Galaxy, 95–96.

https://doi.org/10.1017/S0074180900242125 Published online by Cambridge University Press

thermal halo) are presented for the three Sculptor Group Sd galaxies NGC 7793, NGC 247 and NGC 300.

Only in the case of NGC 7793 does a one-component disk model with M/L = 2.5 (mass = 5.5×10^9 $M_\odot$) fit the observed rotation curve reasonably well. However, only optical velocities (Davoust and de Vaucouleurs, 1980) are available, and no conclusion can be reached before we get HI data to greater radii.

On the other hand, the two-component disk-halo models fit the three observed rotation curves fairly well with the following parameters: M/L_B = 2.0, 5.0, 2.5 for the luminous disk, core radius r_c = 2.5, 3.0, 4.0 kpc and one-dimensional velocity dispersion σ_h = 75, 80 and 60 km/sec for the dark halo of NGC 7793, NGC 247 and NGC 300 respectively. The mass of the luminous disk is almost identical for the three systems, at about 5.0×10^9 $M_\odot$. In these calculations, we have assumed distances of 3.13, 2.10 and 1.85 Mpc for NGC 7793, NGC 247 and NGC 300.

These models yield interesting quantities such as halo-to-disk mass ratios which at the Holmberg radii are 1.8, 3.3 and 0.8, and halo-to-disk scale-length ratios of 2.5, 1.3 and 2.0 in the same order.

More details on these models will be published elsewhere (Carignan and Freeman, 1983) and other pure-disk galaxies are being observed in HI at Westerbork.

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