THE HSB/LSB GALAXIES NGC 2403 AND UGC 128

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Abstract. We have decomposed the rotation curves of the high surface brightness (HSB) galaxy NGC2403 and the low surface brightness (LSB) system UGC128. Both galaxies have a similar baryon content and rotational velocities but have very different disk scale lengths and angular momentum contents. On a linear scale, the rotation curve of the HSB galaxy rises much steeper than that of the LSB galaxy but once scaled with the scale lengths of the stellar disks, the rotation curves are practically indistinguishable. The inferred stellar M/Ls from maximum-disk decompositions are reasonable for the HSB galaxy but are excessively high for the LSB galaxy. Assuming both galaxies are embedded in a similar halo results in more acceptable stellar M/Ls for both galaxies with the HSB galaxy being close to a maximum-disk situation while the LSB galaxy is dark matter dominated.

Knowing the properties of dark matter halos around spiral galaxies with a similar baryon content but with very different distributions of their luminous masses, is of great importance for understanding the process of galaxy formation. In particular, one may wonder whether the distribution of the dark matter is somehow related to the distribution of the luminous matter. HI rotation curves provide a powerful kinematic measure to address this issue and here we present some results of a comparative study of the kinematics of the nearby HSB galaxy NGC 2403 at 3.6 Mpc and the distant LSB galaxy UGC 128 at 64 Mpc.

Existing WSRT HI data of N2403 were reanalyzed and a rotation curve was derived by fiting tilted rings to the HI velocity field. U128 was observed with the VLA-C and the data were analyzed in a similar fashion. A wide field I-band CCD image of N2403, kindly made available by Van Zee, was calibrated with photometric Gunn-r and -i images by Frei *et al.* An I-band image of U128 was obtained by De Blok.

Both galaxies have a similar rotational velocity of 130 km s^{-1} in the outer disk, comparable I-band magnitudes of -20.7 and -20.2 and HI masses of 3.8×10^9 and 7.5×10^9 $M_\odot$ respectively for N2403 and U128. Correcting for the Helium fraction and assuming $M_*/L_{\rm I} = 1$ for both galaxies, we find total baryonic masses of 1.3×10^{10} $M_\odot$ for N2403 and 1.5×10^{10} $M_\odot$ for U128. The main intrinsic difference

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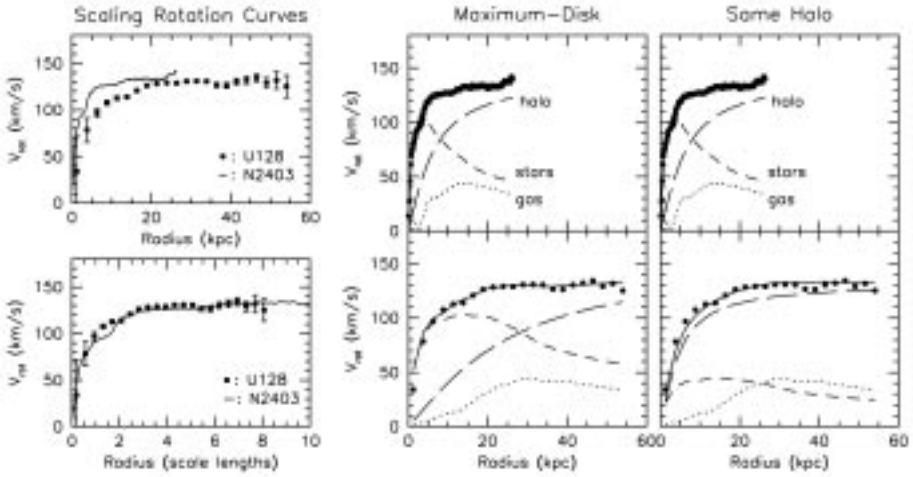

Figure 1. Left panels show a comparison of both rotation curves in kpc and in disk scale lengths. Decompostions in the middle panels assume a maximum-disk situation and those on the right assume that both galaxies are embedded within the same halo.

between these two galaxies is their central disk surface brightness; $\mu_0^{\rm i}({\rm I}) = 19.6$ and $h_{\rm disk} = 2.1$ kpc for N2403 while $\mu_0^{\rm i}({\rm I}) = 22.7$ and $h_{\rm disk} = 6.7$ kpc for U128.

The left panels of Figure 1 show the measured HI rotation curves of N2403 (solid line) and U128 (dots). In the upper left panel, the radial scale is in kpc and it is obvious that the LSB rotation curve rises more slowly than the HSB curve. The radial scale in the lower left panel is in disk scale lengths and the shapes of both rotation curves are nearly identical. Small deviations ($\approx$ 10 km s^{-1}) in the inner regions can easily be attributed to slight non-circular motions. From this scaling exercise one might conclude that the distributions of luminous and dark matter are intimately related and that the central density and core radius of the dark halo relate directly to the scale length of the stellar disk.

However, the four right panels show the rotation curve decompositions for both galaxies under the assumption of a maximum-disk situation (middle panels) and a situation in which both galaxies are embedded in the same isothermal halo which roughly corresponds to the maximum-disk halo of N2403. The corresponding stellar M/Ls in the I-band are 1.8 for N2403 and 9.4 for U128 in the maximum-disk case and 1.6 respectively 1.7 for the same-halo decomposition.

Based on the quality of the fits and the degeneracy of the decompositions, no convincing distinction can be made between a maximum-disk or a same-halo situation. Based on stellar population models, the inferred stellar M/Ls seem to favor the same-halo situation. Obviously, scale-invariant rotation curves do not necessarily imply that the dark matter distribution is closely related to that of the luminous mass.