ROTATION CURVE AND MASS MODEL FOR THE EDGE-ON GALAXY NGC 5907

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The rotation curve of the edge-on disk galaxy NGC 5907 can be interpreted in terms of a two-component model, consisting of a truncated exponential disk and of a spherical halo. About 60% of the total mass inside the edge of the disk turns out to be in the halo. Indicative masses for disk and halo are 9 and $13.5 \cdot 10^{10}$ solar masses respectively.

The photometric study by van der Kruit and Searle (1981 a, b) of some edge-on galaxies has indicated that their exponential disks are probably truncated. The rotation curve of a galaxy with a truncated exponential disk shows (Casertano 1982) a characteristic shape, the "signature" of the truncation being a step-like decrease of velocity at the cut-off radius (see Fig. 1).

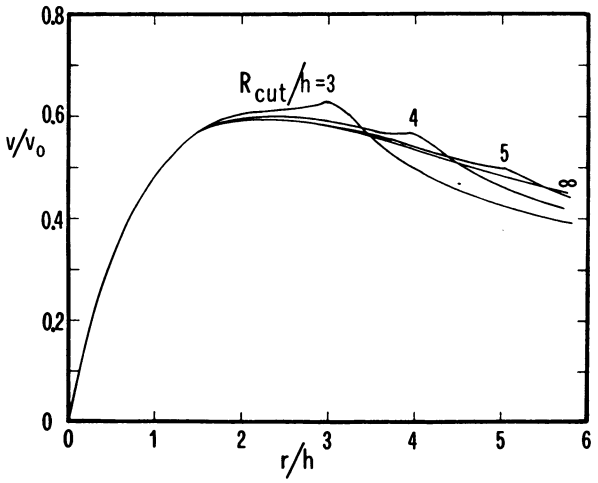

Fig. 1: Rotation curve for truncated exponential disks with different values of the cut-off radius R.

The rotation curves available for two of these galaxies, NGC 4565 and NGC 5907, extend beyond the optical cut-off radius. They both show the expected velocity decrease at the optical truncation. Moreover, at

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the same radius the warping of the galactic plane begins. The two facts indicate that the mass in the disk should also decrease, following the behaviour of the light emission, and therefore support the view that the mass-to-light ratio in the disk is approximatively constant in the outer part of the disk itself.

On the other hand, the velocity decrease observed at the cut-off radius is in both cases smaller than it would be if all the mass were in the disk. Therefore it is natural to assume that part of the mass is smoothly distributed in a different component, such as a spherical halo. The combination of a truncated exponential disk and of a spherical halo with mass density proportional to r^{-2} gives a satisfactory reproduction of the observed rotation curve of NGC 5907 (see Fig. 2). The model has two free parameters, the total mass M_h+M_d and the ratio M_h/M_d (here M_d and M_h are the disk and halo masses inside the disk cut-off radius). The total mass is related to the total rotation velocity, the ratio of the masses to the shape of the rotation curve. The resulting best-fitting values of M_d and M_h are 9 and $13.5 \cdot 10^{10}$ solar masses respectively. The corresponding value of M/L (light in the J band) for the disk is 11, in solar units. The uncertainty on the above figures, in the framework of the present model, is about 20%.

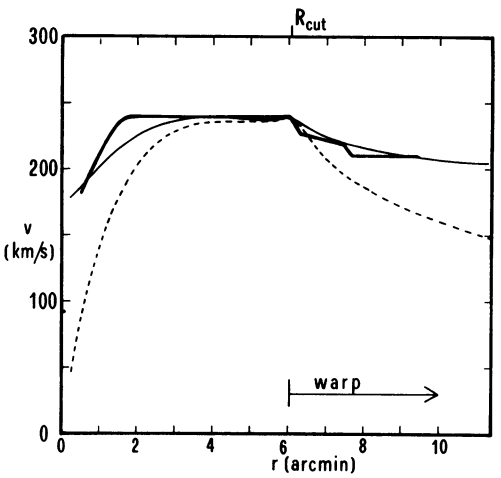

Fig. 2: Observed and model rotation curves for NGC 5907. The observed curve is the thick solid line, the model curve for the disk is dashed and the thin solid line represents the best-fitting disk-halo model.

A similar modelling has not been attempted for NGC 4565, since the uncertainties in the rotation curve are comparatively too large. The best value for the parameter M_h/M_d should lie between 2 and 5.

REFERENCES

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