DYNAMICS OF THE FORNAX DWARF SPHEROIDAL GALAXY

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The mass to light ratio of the inner parts of the Fornax system is 3.2 ± 1.1. Its major axis rotation is only 3.4 ± 2.4 km s^{-1} over ± 1 kpc, which argues against its origin as a stripped dwarf irregular.

INTRODUCTION

To estimate the M/L ratio of the Fornax system, we need (i) the surface density profile, which gives the structure and lengthscales, and (ii) the velocity dispersion. New star counts, from UK Schmidt plates, are in excellent agreement with those of Hodge (1971): from a King model fit, the derived core radius is 17.7 arcmin, and the log of the ratio of tidal to core radii R_t/R_c is 0.5.

THE ROTATION OF THE FORNAX SYSTEM

Fornax appears elongated on the sky; its apparent axial ratio is about 0.67. Say it was once a dwarf irregular. These are disklike rotating systems. Fornax itself could then still be a disklike rotating system after the stripping event. Assume it is disklike and has an intrinsic axial ratio of 0.2. Then its inclination to the line of sight is 49° (zero is face on). What would be its rotational velocity ? This depends on the dynamics of the stripping event. We considered several possibilities. As a typical example, say (with hindsight) that the M/L ratio for Fornax is now about 3, and was about 1 as a dwarf irregular. We can then estimate its rotation rate from the Tully Fisher relation. Assume also that it lost half of its total mass and angular momentum in the stripping event, and then readjusted into equilibrium. Then the total rotational velocity difference that we would now observe over ±17 arcmin along the major axis is about 10 km s^{-1}. (The ±17 arcmin is set by the size of the AAT fiber field: 17 arcmin is about 1 core radius).

T. de Zeeuw (ed.), Structure and Dynamics of Elliptical Galaxies, 447–448.

THE OBSERVATIONS

The stars are K giants, chosen from our photographic photometry of the Fornax galaxy. Their mean V magnitude is about 18.5. The stars were chosen in two regions, 17 arcmin SW (17 stars) and 17 arcmin NE (22 stars) from the center and along the major axis. Their velocities were measured with the AAT fiber system. This took an entire night.

THE RESULTS

The velocity difference between the two regions is 3.4 ± 2.4 km s^{-1}, which is significantly less than our estimate of the expected rotation if Fornax was once a dwarf irreegular. The velocity dispersion at a radius of one core radius is 5.0 ± 0.9 km s^{-1} (corrected for the measuring error, which was itself well determined from repeated measurements throughout the night). This dispersion is slightly smaller than previously reported measurements (Seitzer and Frogel 1985, Aaronson and Olszewski, 1986) for carbon stars and globular clusters; however most of the difference results from the different radii at which the measurements were made. Our observed V/σ value is then about 0.34 ± 0.25: for an isotropic oblate system with the apparent axial ratio of Fornax, the V/σ value is about 0.7.

To estimate the mass, we represent Fornax by the King model fitted to the star counts (see above). By projecting the King model on the sky, we can estimate the characteristic velocity dispersion of the King model from our measured velocity dispersion at 17 arcmin radius. The resulting mass to (V) light ratio is 3.2 ± 1.1. This is fairly similar to the M/L value of 2.6 for the globular cluster ω Cen (Freeman and Seitzer, in preparation).

REFERENCES

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