MASS DISTRIBUTION OF THE E0 GALAXY NGC 6703 FROM ABSORPTION LINE PROFILE KINEMATICS

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1. Introduction

Absorption line velocity profiles (VPs) contain important information on the anisotropy and mass distribution of elliptical galaxies (e.g., Gerhard 1993, Merritt 1993). Here we briefly present results of an extensive analysis of the E0 galaxy NGC 6703 (Gerhard *et al.* 1997). This work is part of an observational and theoretical program aimed at understanding the orbit structure and dark matter content of ellipticals at intermediate radii (a preliminary account is given in Saglia et al. 1997).

2. Data and Analysis

NGC 6703 is an E0 galaxy at a distance $D=36h_{50}^{-1}$ Mpc ($h_{50} \equiv H_0/50$km/s / Mpc). From a Jaffe profile fit, its absorption–corrected magnitude is $M_B = -21.07$, or luminosity $L_B = 4.16 \times 10^{10} h_{50}^{-2} L_{\odot,B}$. Its effective radius is $R_e = 30'' = 5.2\,h_{50}^{-1}$ kpc.

Our kinematic data for NGC 6703 extend to $2.6R_e$. The galaxy shows little rotation (≈ 0 km/s for $R < R_e$, $\approx 20-30$ km/s for $R > R_e$). The velocity dispersion drops from the central ≈ 190 km/s to ≈ 140 km/s at $R_e/2$, slowly declining to about 110 km/s in the outer parts. The h_3 and h_4 values are everywhere close to zero.

With a new non-parametric technique we determine the DF $f(E, L^2)$ directly from the VP data. Monte Carlo tests using simulated data with the spatial extent, sampling, and error bars of the NGC 6703 data show that smooth DFs can be recovered to an RMS accuracy of $\sim 10\%$, and the anisotropy parameter $\beta(r)$ to ~ 0.1, in a *known* potential. Similar tests analyzing models in *different* potentials show that, from data like ours for NGC 6703, an asymptotically constant halo circular velocity v_0 can be determined with an accuracy of $\pm \lesssim 50\,\mathrm{km\,s^{-1}}$, at 95% c.l.

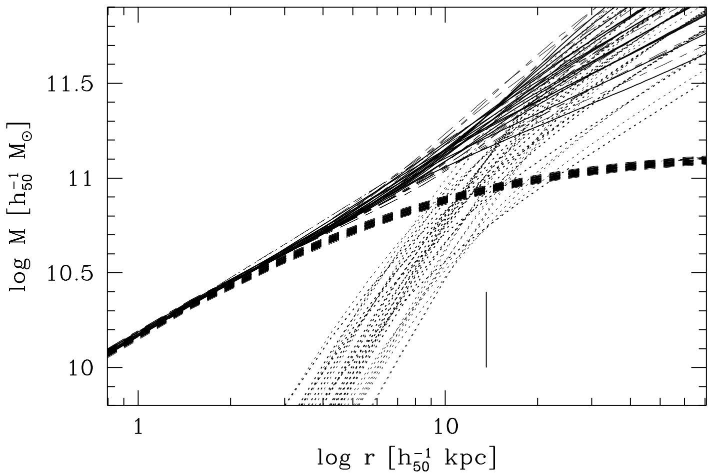

Figure 1. Luminous, dark, and total mass as a function of radius for acceptable models of NGC 6703 (short dashed, dotted, and dash–dashed or full lines, respectively). Mass distributions consistent with the data at 87% (1.5σ) and at 95% c.l. (2.0σ) are coded by full and dash–dashed lines, respectively. The vertical line denotes the position of the last kinematic data point. At this radius, the M/L ratio has increased by at least a factor of 1.6 from the center.

3. Results

For NGC 6703 we thus determine the true circular velocity at $2.6R_e$ to be $250 \pm 40\,\mathrm{km\,s^{-1}}$ (95% c.l.), corresponding to a total mass inside $78'' = 13.5\,h_{50}^{-1}\,\mathrm{kpc}$ of $1.6 - 2.6 \times 10^{11} h_{50}^{-1}\,\mathrm{M_\odot}$. No model without dark matter fits the data; however, a *maximum stellar mass* model in which the luminous component provides nearly all the mass in the centre does. In such a model, the total luminous mass inside $78''$ is $9 \times 10^{10}\,\mathrm{M_\odot}$ and the integrated B-band M/L out to this radius is $M/L_B = 5.3 - 10$ (95% c.l.), rising from the central $M/L_B = 3.3$ by at least a factor of 1.6.

The anisotropy of the stellar orbits in NGC 6703 changes from near-isotropic at the centre to radially anisotropic ($\beta = 0.3 - 0.4$ at 30", $\beta = 0.2 - 0.4$ at 60") and is not well-constrained at the outer edge of the data, where $\beta = -0.5 - +0.5$, depending on variations of the potential in the allowed range.

References

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