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The M/L Ratio Along the Major-Axis of NGC 1399

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In this paper, we derive the mass-to-light ratio (M/L) profile for the Fornax elliptical galaxy NGC 1399 from the observed intensity and velocity dispersion measurements along its major-axis. The observed light profile is taken from Caon et al. (1994). We fit the Sersic $R^{1/n}$ model, where n is a free parameter controlling the *shape* of the light profile model. This allows one to address the issue of broken structural homology, specifically, departures from the $R^{1/4}$ luminosity profile (Caon et al. 1993; D'Onofrio et al. 1994; Graham et al. 1996). The assumed universality of the $R^{1/4}$ model for elliptical galaxies is known to produce systematic errors in the model parameters (Graham & Colless 1997). The best-fitting $R^{1/4}$ and $R^{1/n}$ models for NGC 1399 are shown in Figure 1.

The dynamical profiles (rotation curve and velocity dispersion profile, VDP) were obtained with the Siding Spring Observatory 2.3 m telescope (Graham et al. 1997) and reduced by G. Busarello using an 'adaptive filtering' technique (Richter et al. 1992). As with the light profile, this data has been taken along the major-axis of NGC 1399. Our rotation curve shows that this galaxy possesses negligible rotation. The VDP is displayed, with its corresponding 1σ error-bars, in Figure 2.

The velocity dispersion required to support the inferred density structure was computed through application of the Jeans equation (Ciotti 1991) to that portion of the light profile for which there was dynamical data (<80 arcsec). The VDPs computed from the best-fitting $R^{1/4}$ and $R^{1/n}$ model to the light profile within 80 arcsec are shown in Figure 2. In order to do this, these models assumed a constant M/L (=12) to obtain the density structure from the observed luminosity structure. Differences between the model VDP and the measured VDP can be attributed to changes in M/L. Figure 3 shows, as a function of radius, the M/L required to reconcile the models to the data.

It can be seen that the inappropriate use of the $R^{1/4}$ law can lead to the false prediction of centrally concentrated dark matter. The VDP derived from the $R^{1/n}$ model correctly reproduces the up-turn observed at the centre of the real VDP. Beyond 20 arcsec, it also predicts an increasing M/L with increasing radius.

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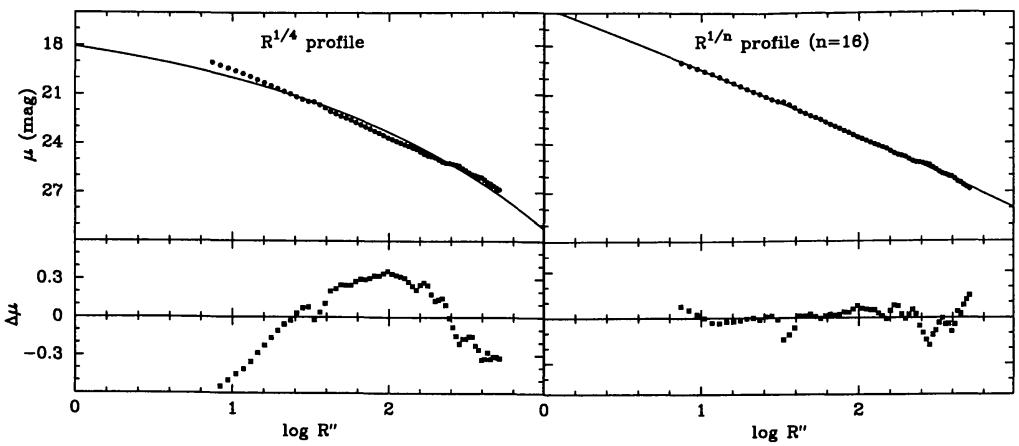

Figure 1. An $R^{1/4}$ and $R^{1/n}$ light profile model are fitted to the observed major-axis surface brightness profile of NGC 1399.

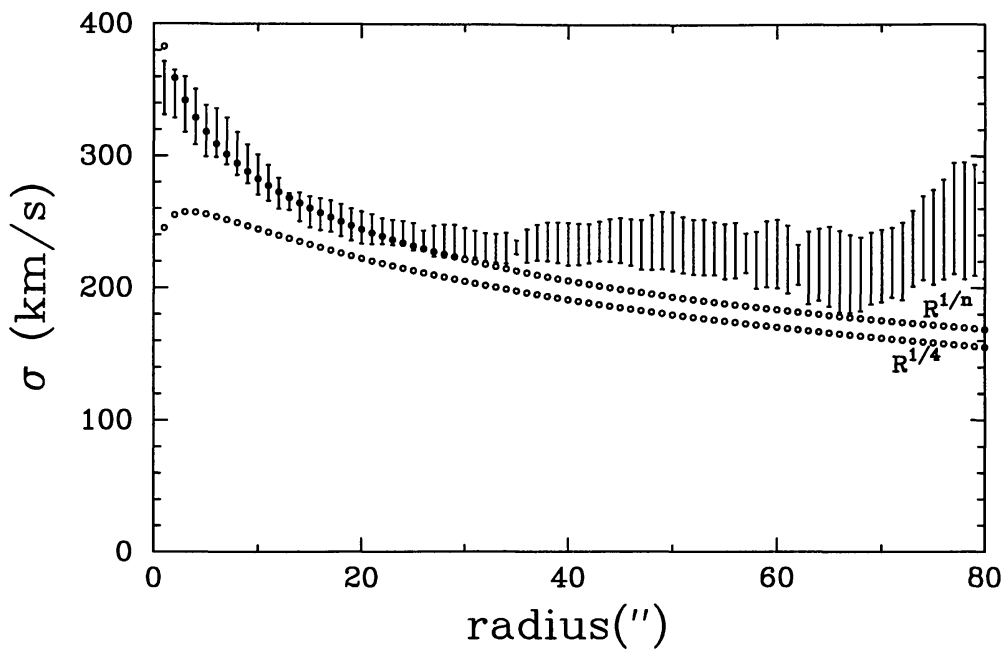

Figure 2. The observed major-axis VDP of NGC 1399 is shown with its measured 1σ error-bars. The Jeans equation was applied to the best-fitting $R^{1/4}$ and $R^{1/n}$ light profile models of NGC 1399, assuming a constant M/L, and solved to give the projected VDP's shown here.

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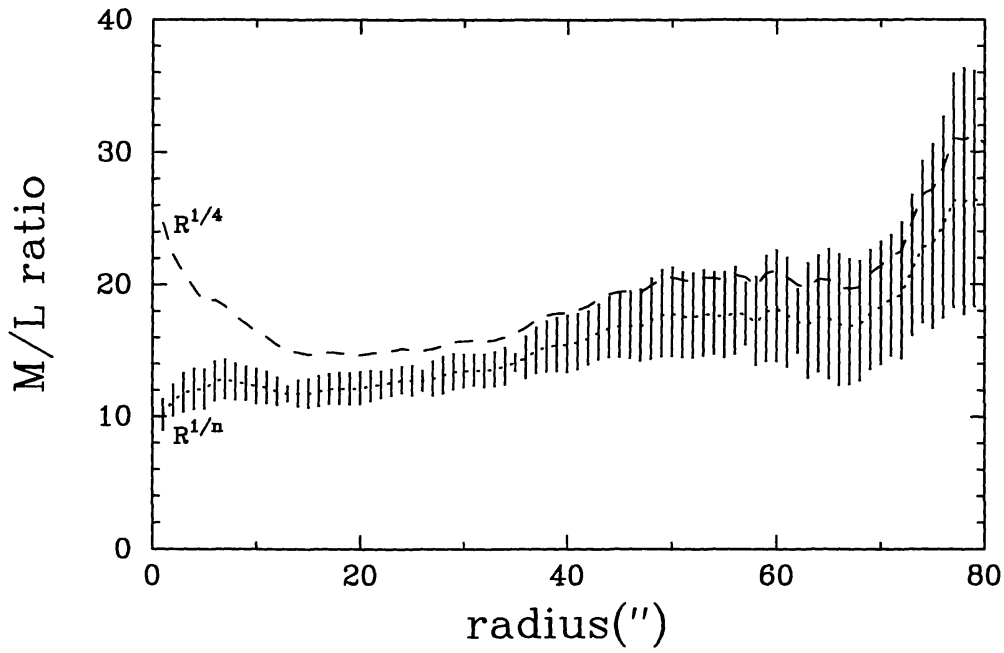

Figure 3. The M/L profiles have been computed by comparing the observed VDP with that predicted from the luminosity profile, the ratio going as $\sigma^2_{obs}/\sigma^2_{pred}$. To avoid confusion, only the errors (coming from the observed VDP) for one profile are shown.

A more detailed treatment of this work will be presented in a forth-coming paper.

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