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Dynamical modeling of elliptical galaxy NGC 2513

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Abstract. We have analysed the photometric and kinematical data of the elliptical galaxy NGC 2513 to determine its intrinsic structure. For the photometric data we have used our own observations and for the kinematical data we have referred to the literature. The galaxy shows isophote twist and further, the line of sight velocity along the apparent minor axis is comparable to that along the major axis. These indicate that the galaxy is triaxial.

We have used a model which is a triaxial generalisation of the γ model of Jaffe and Hernquist. The projected surface density has central cusp (for $\gamma > 1$), ellipticity variations and isophote twists. We compare the projected surface density by taking a suitable line of sight and choosing the parameters in the model, so as to obtain a best fit with the photometric data. The results of our analysis show that models with cusp fits the data better.

Keywords : elliptical galaxies - surface photometry - modeling

1. Introduction

Elliptical galaxies are generally regarded as triaxial objects with an anisotropic velocity distribution. Schwarzschild (1979, 1982), Statler (1989) presented models of equilibrium triaxial galaxies, which had large constant density cores. However, the recent observations (Lauer et al. 1995) rejects the idea of constant density cores and show that the surface density $\Sigma(R)$ rises as $R^{-\alpha}(\alpha > 0)$ at small projected radii R. It will therefore be a worthwhile effort to examine triaxial models which have central cusps, against the data.

A family of triaxial mass models with central cusps has been recently proposed by de Zeeuw and Carollo (1996, hereafter ZC/96) which also shows variations in ellipticity and position angle in its projection. We use this model and compare it with the data of NGC 2513 galaxy.

2. Observation and photometric data

Broad band B, V and R images of NGC2513 were recorded at the cassegrain focus of 1m telescope at UPSO. The data was analysed by using IRAF and STSDAS packages. After the preliminary reduction of the CCD data like bias subtraction, flat fielding and cosmic ray removal, isophotal-shape analysis was performed by the method described by Jedrzejewski (1987). The results are presented in Fig. 1.

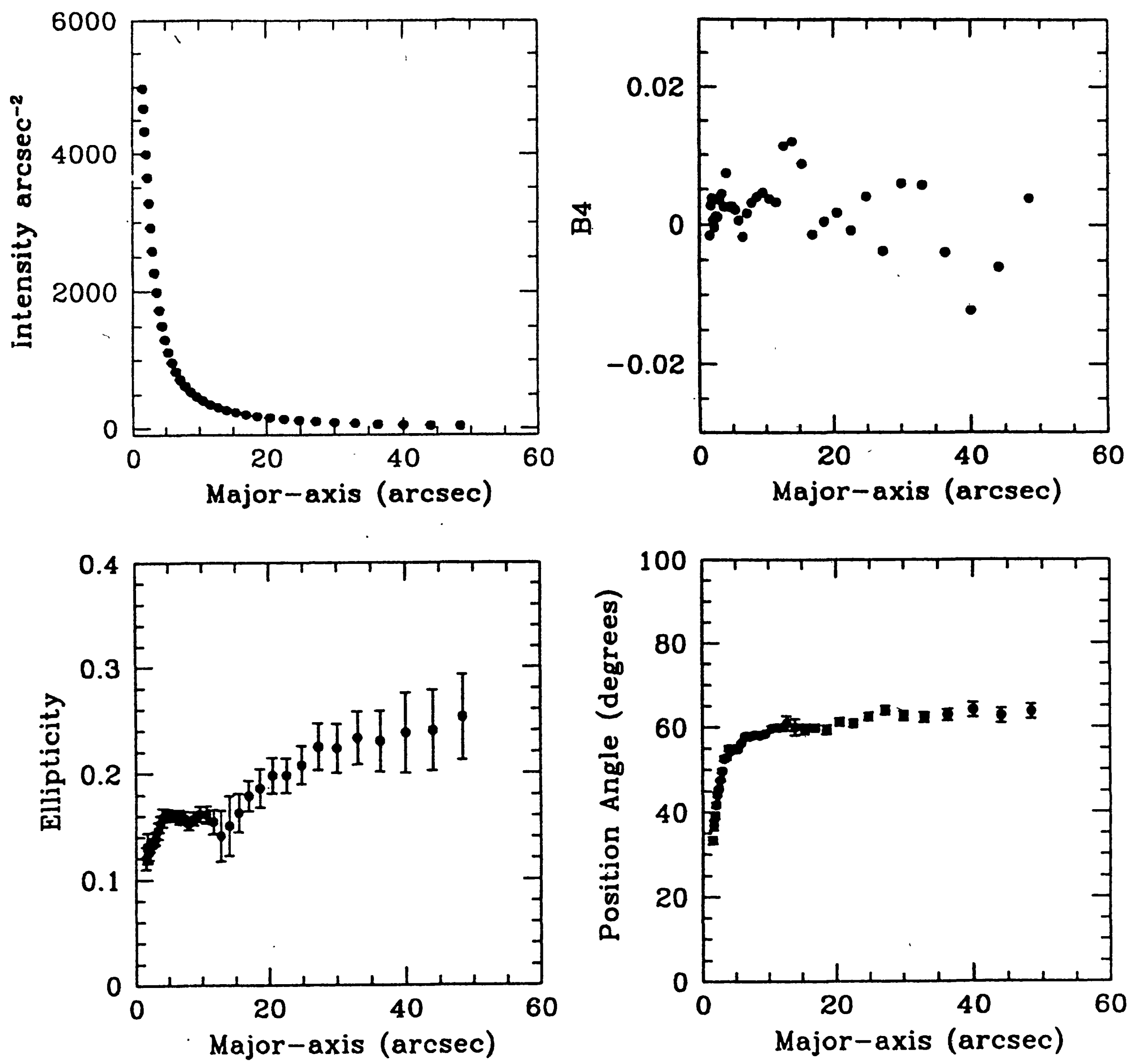

Figure 1. The results of isophotal analysis of NGC 2513.

3. Algorithm for the comparison of model with data

A table of data specifying mean intensity, ellipticity, position angle, coefficients A_3, A_4, B_3, B_4 and the rms error in each, as a function of radial distance is generated during the ellipse - fitting algorithm on the photometric data. We consider the axis ratio $\frac{b}{a}$ as generated through the ellipse fitting algorithm on data at smallest and at largest radial distances and calculate q_o and q_i which will reproduce such $\frac{b}{a}$, for a chosen set of values of p_o, p_i, γ and viewing angles. We then calculate the functions F_1, G_1, H_1, H_2 and G_2 (cf. ZC/96). The scale factor r_0 is estimated such that the effective radius of the projection of the model is identical with reported value of r_e. Finally to calculate M, we assume a constant light to mass ratio and match the intensity of the projection of the model with the data at a particular value of 2.29 arcsec radius.

We now vary the parameter p_o, p_i, γ and the viewing angle θ, ϕ, so as to obtain a best-fit, in the sense of minimum χ^2, for the radial profiles of the intensity. The best fit parameters are reported in Table 1.

Table 1. Best fit model parameters

Parameter	NGC 2513
γ	1.5
p_0	0.52
q_0	0.4340
p_∞	0.52
q_∞	0.7012
θ	75.0°
ϕ	30.0°

4. Results and discussion

We find a reasonably good agreement between the data and the model. The triaxiality parameter and the position angle also change which radius, which indicate that a more realistic model would be one which incorporates the changing position angle and triaxiality parameter with radial distance. This is a point of merit over the procedure adopted by Tenjes et al. (1993) who consider a model which doesn`t allow such variations.

We find the models with $\gamma > 1$ fit better as shown by an increase in χ^2 when γ decreases below unity.

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