Study of Intrinsic Parameters of Elliptical Galaxy NGC 1600

Arun Kumar Singh[1] and Arun Kumar Diwakar[2]
1 Department of Physics, Disha College, Ram Nagar, Raipur
(Affiliated to Pt. Ravishankar Shukla University, Raipur)
Chhattisgarh, India- 492009. E-mail : arunkumarsingh20@yahoo.com
2 Kalinga University, Raipur, Chhattisgarh, Email: diw.arun@gmail.com

ABSTRACT

We study the intrinsic parameters of elliptical galaxy NGC 1600 and determine intrinsic shapes by combining the profiles of photometric data. We use triaxial models. We find that short to long axial ratios at very small radii and at very large radii, and the absolute value of the triaxiality difference are the best constrained shape parameters. We use a modified prior as obtained from the shape estimates of a large sample of elliptical galaxies to determine the intrinsic shapes of the elliptical galaxy NGC 1600. These results are compared with the previous estimates which are determined by using flat prior reported by Chakraborty et al (2008) and Singh & Chakraborty (2009). The plot helps to study the intrinsic parameters and shows the intrinsic shapes of the NGC 1600 as a function of (q_0,q_∞) for two dimensional shapes and $(q_0,q_\infty,|T_d|)$ for three dimensional shapes, where q_0 and q_∞ are the short to long axial ratios at small and at large radii and |Td| is the absolute values of the triaxiality difference, defined as $|T_d|= |T_\infty - T_0|$. The probability is shown in the dark grey region: darker is the region higher is the probability. We find that the galaxy NGC 1600 is flatter inside and rounder outside.

Keywords: Intrinsic Shapes, Triaxial Models, Distribution, Photometry and Elliptical Galaxies etc.

1. INTRODUCTION

Determination of the intrinsic shapes of the individual elliptical galaxies have been investgated by Binney (1985), Tenjes et al (1993), Statler (1994a, b), Bak and Statler (2000), Statler et al (2001),Chakraborty (2004). These authors have used the kinematical data and the photometric data, and have used the triaxial models with the density distribution $\rho = \rho(m^2)$, where $m^2 = x^2 + y^2/p^2 + z^2/q^2$ with constant axial ratios *p* and *q*. We used photometric data alone to determine the shape of individual elliptical galaxies. Chakraborty et al (2008) and Singh & Chakraborty (2009) using flat prior, Singh (2011), Singh (2015), Singh (2019) and Singh (2019). These authors have used the photometric data alone for the intrinsic shape determination of the elliptical galaxies.

We determine the distribution of the intrinsic shapes of elliptical galaxies by combining the profiles of photometric data from the literature with triaxial models, and find that short to long axial ratios at very small and at very large radii, and the absolute value of the triaxiality difference are the best constrained shape parameters. Using a flat prior, the shapes of elliptical galaxies are reported by Chakraborty et al (2008) and Singh & Chakraborty (2009). We now find the distribution in shape and recalculate the shape of the individual elliptical galaxies by using modified prior.

2. METHODOLOGY

The photometric data of these galaxy is obtained from Peletier et al (1990). The profiles of ellipticity and position angles are largely monotonic and the distances R_{in} and R_{out} are sufficiently small and large. The models adopted also reproduces profiles of ellipticity and position angle which are largely monotonic.

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The shapes $P(q_0,q_\infty,T_d)$ as calculated by using a flat prior for the sample of the galaxies are superimposed over each other to obtain the distributions shown in Singh & Chakraborty (2009). This is regarded as a prior (a modified prior) and shapes of individual galaxies are again calculated by using such modified prior.

3. OBSERVATIONS AND RESULTS

3.1. NGC 1600

NGC 1600
NGC 1600 is the X-ray-bright E3 galaxy. NGC 1600 may have the largest number of ultra luminous X-ray point source (ULX) candidates in an early-type galaxy. The photometric data source of this galaxy is Peletier et al (1990). The effective radius is 56".0. The ellipticity ϵ in inner side is 0.360 at R_{in} = 11".3 and in outer side is 0.269 at R_{out} = 62".7. The position angle decreases by 0.5.

We determine the intrinsic shapes of individual elliptical galaxies using modified prior which is the distribution of the sample of elliptical galaxies. The shapes $P(q_0,q_\infty,T_d)$ as calculated by using flat and modified prior is shown in the figure 3 and figure respectively. The values of the parameters are shown in the Table 3. The figure 1 represents the two dimensional shapes using flat prior and figure 2 represent the two dimensional shapes of NGC 1600 using modified prior. The table 2 represents the values of two dimensional shapes for both flat prior and modified prior and is used to compare the results obtained by using modified prior. The results obtained are clearly exhibits that the probability of obtaining the data is relatively insensitive to the parent distribution. The little difference appears in the values by using flat and modified prior shows the effect of using ensembles of models. In the figure it is clearly shown that the region where there is dark shade represents the highest probability of finding the shapes. This region is enclosed within a contour of 68 percent of the total flat region.

We present the plot of MPD as a function of (q_0,q_∞), summed over (T_0, T_∞) in figure 1 and figure 2 using flat and modified prior. The 3-dimensional shape $P(q_0,q_\infty,T_d)$ is presented in Figure 3 and figure 4 using flat and modified prior. The expected values of the shape using modified prior are $\langle q_0 \rangle = 0.54$, $\langle q \rangle = 0.85$, $\langle Td \rangle = 0.24$, while the most probable values are $q_{0P} = 0.43$, $q_P = 0.93$, $T_{dP} = 0.03$. We find that NGC 1600 is flatter inside and rounder outside.

3.2. Tables and Figures

Table 1 represents the observational data used in the models to determine the intrinsic shapes of the individual elliptical galaxies. Table 2 an table 3 represents the values of the two dimensional and three dimensional shape parameters.
Their respective figures are shown in figure 1, figure 2, figure 3 and figure 4.

Table 1 Observational data used in the models

Galaxy	R_e	R_{in}	R_{out}	ϵ_{in}	ϵ_{out}	$\boldsymbol{\theta d}$	***Source***
NGC 1600	56".0	11".3	62".7	0.360	0.269	-0.5	Peletier (1990)

TABLE 2. Summary of the 2-dimensional shape estimates by using flat and modified prior.

Galaxy	$\langle q_0 \rangle$	$\langle q_\infty \rangle$	q_{0p}	$q_{\infty p}$	***Type***	***Prior***
NGC 1600	0.54	0.83	0.58	0.93	FR	Flat
NGC 1600	0.56	0.86	0.59	0.93	FR	Modified

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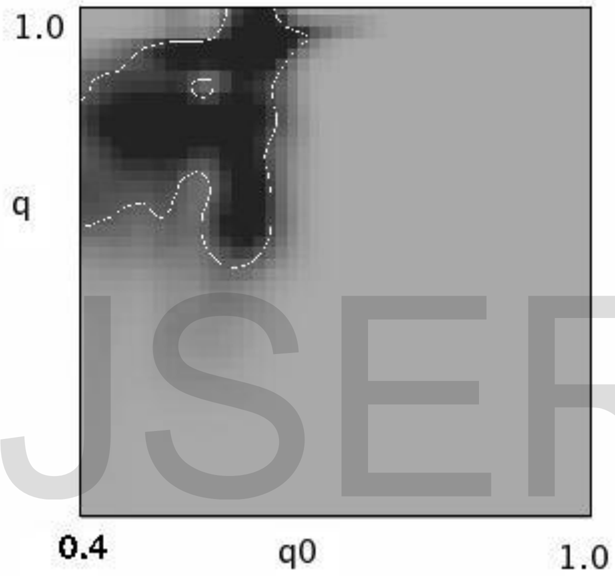
TABLE 3. Summary of the 3-dimensional shape estimates by using flat and modified prior.

Galaxy	$\langle q_0 \rangle$	$\langle q_\infty \rangle$	$\langle T_d \rangle$	q_{0p}	$q_{\infty p}$	T_{dp}	***Type***	***Prior***
NGC 1600	0.54	0.83	0.31	0.53	0.93	0.47	FR	Flat
NGC 1600	0.54	0.85	0.24	0.43	0.93	0.03	FR	Modified

Figure 1: Plot of the distribution as a function of (q_0,q_∞), summed over various values of (T_0,T_∞) for NGC 1600 using flat prior.



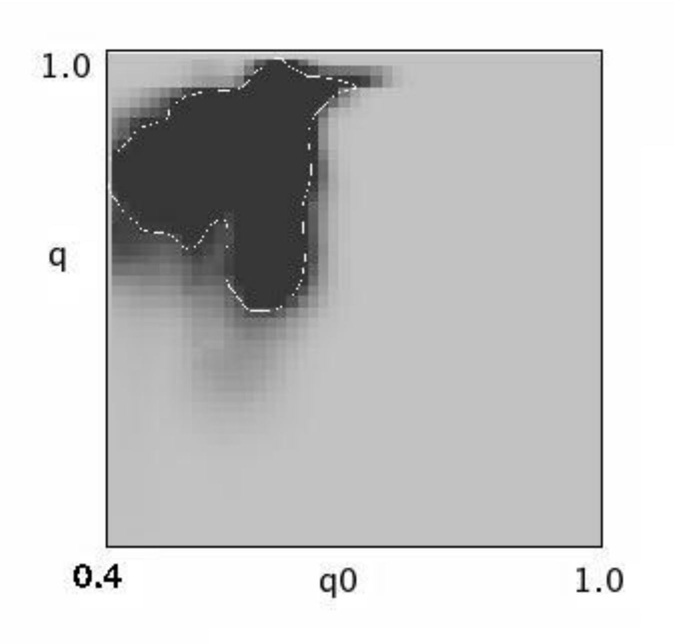


Figure 2: Plot of the distribution as a function of (q_0,q_∞), summed over various values of (T_0,T_∞) for NGC 1600 using modified prior.

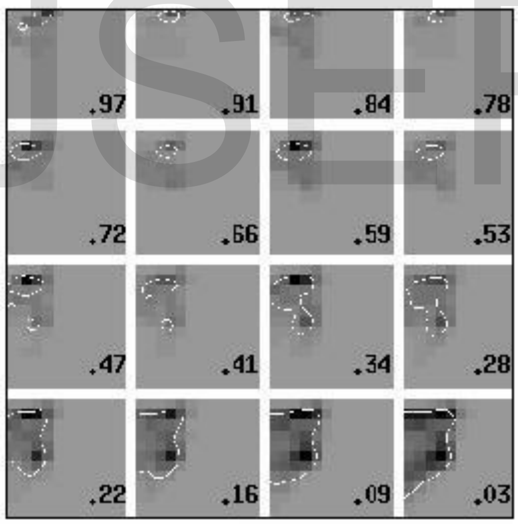


Figure 3: 3-dimensional plot of the unweighted sum of the distribution as a function of q_0,q_∞,T_d for NGC 1600 using flat prior. Values of T_d are constant in each section. q_0 goes from left to right, while q_∞ runs from bottom to top, each between 0.4 to 1.0, in each section.

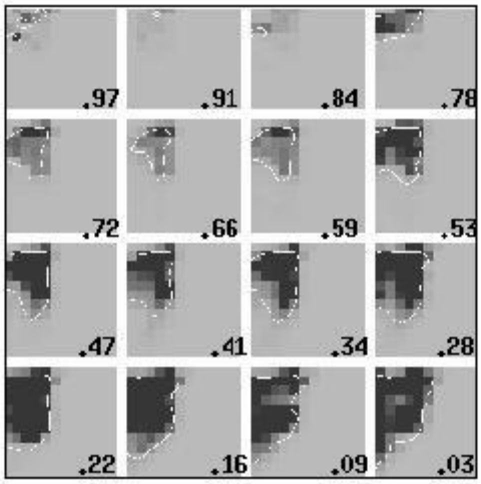


Figure4: 3-dimensional plot of the unweighted sum of the distribution as a function of q_0,q_∞,T_d for NGC 1600 using modified prior. Values of T_d are constant in each section.

4. DISCUSSION

As we know that the elliptical are triaxil in nature, we use triaxial model to find the intrinsic shapes of the elliptical galaxies. We have presented the shapes of the galaxies NGC 1600 in the plots shown in figure 1 and figure 2 for two dimensional shapes using flat prior and modified prior. The shapes of the galaxies NGC 1600 in the plots shown in Figure 3 and Figure 4 for three dimensional shapes using flat prior and modified prior. The results of the galaxy NGC 1600 is presented in Table 2 and Table 3. The changes in shapes, as compared to those calculated by using a flat prior are although small, but are significant, which illustrates the effect of the use of a prior which is not flat. The result obtained in table 2 is compared with the previous results was also well satisfactory and support the results.

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