TRIAXIAL SCALE-FREE MODELS OF HIGHLY FLATTENED ELLIPTICAL GALAXIES WITH MASSIVE HALOS

Harold F. Levison & Douglas O. Richstone
Department of Astronomy
University of Michigan

ABSTRACT. Two surveys of dynamical models of highly flattened, triaxial elliptical galaxies with isothermal potentials have been constructed. These models were constructed in order to better understand the range of possible observable dynamical properties of triaxial galaxies. All models have been constructed so that they appear as E6 galaxies when seen from their intermediate axes. However, one set of models is nearly oblate; the other is nearly prolate. The models are constructed with massive halos such that $M/L \propto r$. Triaxial models of either shape can be constructed with their projected axes of rotation at any position angle with respect to the major axes of the galaxies. The most surprising result is that in most models, the position angle of maximum observed rotation is not perpendicular to the position angle of zero rotation.

1. METHODS

The construction of models of elliptical galaxies requires that a phase density be found that is a solution of the collisionless Boltzmann and Poisson equations. We use a modified version of a completely general method developed by Schwarzschild (1979). His technique requires that a complete set of orbits calculated in a potential. Then these orbits are added together to produce the density distribution the creates that potential. However, if the population of stars modeled does not produce the potential, then any emissivity distribution can be substituted in this final step.

We have chosen an isothermal scale-free potential,

$$\Phi = \ln(s)$$

where $s^2 = x^2 + y^2/p^2 + x^2/q^2$. q is set to 0.75. In one survey $p = 0.8$ (almost prolate), in the other $p = 0.9$ (almost oblate). The density distribution that produces this potential looks like an E6 galaxy when 'viewed' from the intermediate (y) axis and falls off as r^{-2} along any radial ray. To better represent real galaxies we let $M/L \propto r$ or

$$\epsilon = \frac{\rho}{r} \propto r^{-3}.$$

T. de Zeeuw (ed.), Structure and Dynamics of Elliptical Galaxies, 499–500.

2. OBSERVABLE PROPERTIES OF TRIAXIAL GALAXIES

These models look like E6 galaxies when viewed from their intermediate axes. They were constructed to compare with observations of real E6 galaxies. E6 galaxies are unique because they are the only ellipticals with known orientation (They are seen along their intermediate axis).

Figure 1 shows the observable properties of a few triaxial galaxies models viewed from their intermediate axis. The model in frame 'a' has a large amount of rotation along its major axis and none along its minor axis. This type of rotation is usually associated with oblate galaxies. Frame 'b' shows a model that is a minor axis rotator. This type of rotation is usually associated with prolate galaxies. However, both these types of models can exist in either potential. The model shown in frame 'c' has an equal amount of angular momentum in the z and x directions. In either triaxial potential it is possible to construct models with their projected axis of rotation at any position angular with respect to the major axis of the galaxy. The model in frame 'd' is more typical of the type of models found. It has rotation along both axes. Note that the axis of maximum rotation and the axis of zero rotation are not perpendicular.

Almost all triaxial models have a significant amount of minor axis rotation. So, if elliptical galaxies are triaxial, then why do so few have significant rotation along their minor axis?

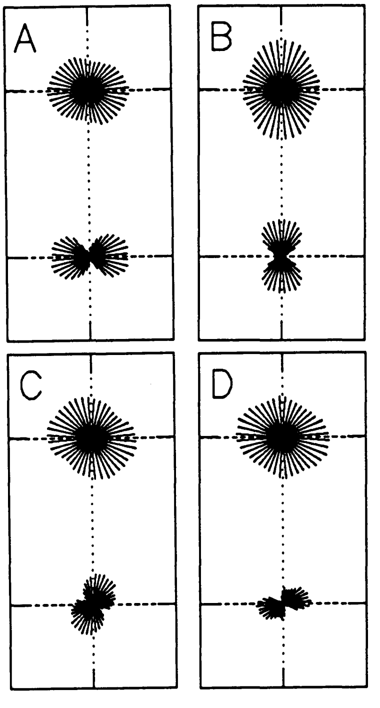

Figure 1:
The observable properties of 4 models (see text). The models have flat rotation curves and velocity dispersion profiles. Therefore, the rotation velocity and velocity dispersion are constant along any radial ray and vary only as a function of position angle. On the diagram, the dashed line represents the major axis of the model. The dotted line is the minor axis. In the top part of each frame, the length of the black line at a position angle is proportional to the line of sight velocity dispersion at that position angle. The bottom part of each frame is the rotation velocity.

3. REFERENCE

Schwarzschild, M. 1979, *Ap.J.*, **232**, 236.

https://doi.org/10.1017/S0074180900185936 Published online by Cambridge University Press