BOX MODELS WITHOUT CYLINDRICAL ROTATION

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ABSTRACT. We describe here a way of constructing models for box-shaped dynamical systems without cylindrical rotation. We argue that such models may arise as a result of the external heating of a disk.

1. INTRODUCTION

The purpose of this work is to show that it is possible to construct models of box-shaped ellipticals without cylindrical rotation. To show this, we employ the techniques used by Binney and Petrou (1985).

Our method consists in distorting the isochrone sphere into a box, keeping the distribution of particles with respect to their energy unchanged and thus keeping the density profile almost unchanged too. We can then assume that the potential is not very different from that of the isochrone sphere and proceed to compute the response density of the distorted model.

As our purpose is simply to illustrate our point, we do not worry at this stage for the lack of self-consistency.

2. THE DISTRIBUTION FUNCTION

We assume that the distribution function f depends only on the energy E and the angular momentum L_z. We argue that any distribution function which looks like the function shown in Figure 1, when plotted against L_z, for constant E, will give rise to rotationally supported boxes without cylindrical rotation. We choose:

$$f(E, L_z) = f_0(E)(a + (L_z/(J_c + d) - b)^{1/g}), \tag{1}$$

where a, b and d are parameters chosen so that $f \geq 0$ always, g is an odd integer, J_c is the circular angular momentum for given energy and f_0 is:

$$f_0(E) = f_i(E)e^2/G \qquad \text{where} \qquad e = J_c/(J_c + d) \tag{2}$$

$$G = ae^2 + g^2 \frac{(2b^{(2g+1)/g} + (e-b)^{(2g+1)/g} - (e-b)^{(2g+1)/g})}{(2g+1)(g+1)} \tag{3}$$

T. de Zeeuw (ed.), Structure and Dynamics of Elliptical Galaxies, 501–502.

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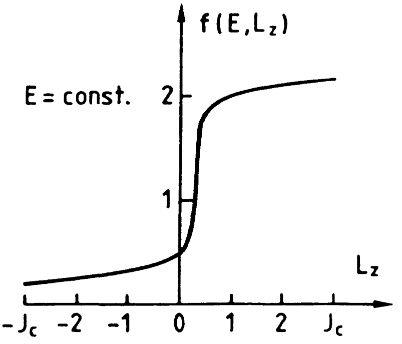

Figure 1. $f(E, L_z)$ versus L_z for $a = 1.2$, $b = 0.1$, $g = 7$, $d = 0.1$ and energy such that $J_c = 3$.

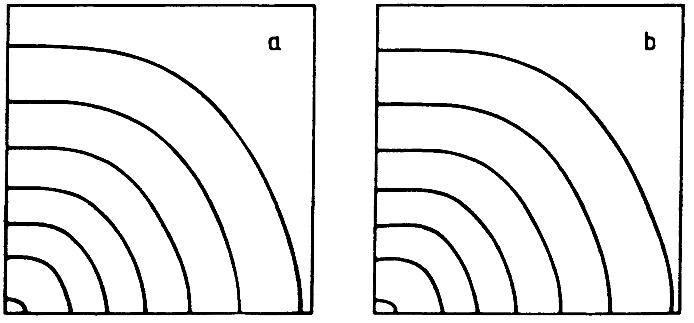

Figure 2. Projected density contours for two models: a) $a = 1.2$, $b = 0.1$, $d = 0.1$, $g = 7$. b) $a = 1.2$, $b = 0.1$, $d = 0.1$, $g = 11$.

and $f_i(E)$ is the distribution function of the isochrone sphere (Hénon 1960). Figure 2 shows the density contours of two models when projected edge on.

3. DISCUSSION

We think that a distribution function such as the one described here, is likely to arise from the external heating (i.e. collisions with other galaxies) of a cold disk. Note that the corresponding profile of Figure 1 for a cold disk is a delta function at $L_z = J_c$. It is plausible, therefore, to assume that external heating of the disk will fatten up the delta function, possibly to the square-like shape of Figure 1.

4. REFERENCES

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