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DYNAMICS OF GALACTIC SATELLITES ON ELONGATED ORBITS

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Current models of galactic satellites assume that the tidal field only imposes a limiting tidal radius to the satellite, without any other effect from that field on the internal dynamics of the satellite (e.g., Binney & Tremaine 1987). An interesting generalization of King's models, due to Heggie and Ramamani (hereafter HR), replaces the energy integral by the Jacobi integral, thus accounting for some of the effects of the tidal field on the satellite.

The HR models were valid, in their original formulation, for circular orbits only. Nevertheless, if the orbit of the satellite is only slightly elongated, it is easy to use the epicyclic approximation (e.g., Binney & Tremaine 1987) to show that the equations of motion of a star belonging to the satellite are the same, within this approximation, no matter whether the satellite is on a circular or on a slightly elongated orbit. That is, the HR models are valid for slightly elongated orbits as well. Two immediate consequences are that the tidal radius that should be adopted is the one corresponding to the circular orbit that has the same angular momentum as that of the satellite and that the deviation angle of the major axis of the satellite can be easily obtained considering that it remains always parallel to the radius that joins the center of the galaxy with that of the center of the epicyclic described by the satellite.

We used the multipolar code of L. A. Aguilar (Aguilar & Merritt 1990) to follow the evolution of a satellite similar to the one considered by Carpintero et al. (CelMechDynAstr, 73, 159, 1999), except that the 10^5 particles that make it up were randomly chosen from a HR model with $W_0 = 0.5$. We followed the satellite for 62.83 time units, which correspond to five periods of the circular orbit, or 110 crossing times of the satellite. The original satellite was on a circular orbit of 100 units radius and, besides, we also considered the same satellite on elongated orbits, starting at the apocenter and characterizing the orbit by the amount of departure of the apocenter distance from the original circular orbit. Figure 1 shows the evolution of the semiaxes of the satellite

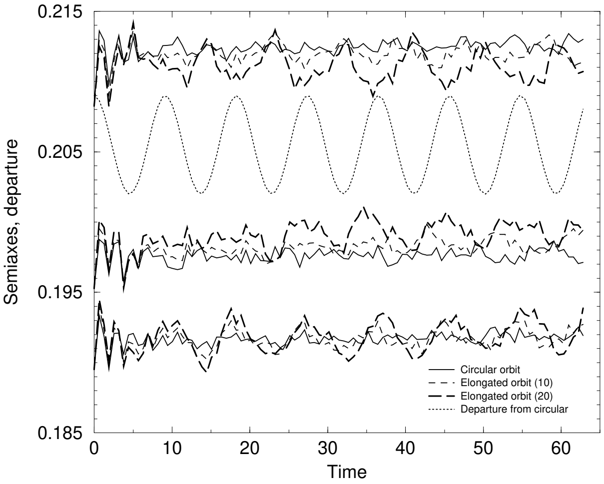

Fig. 1. Evolution of the HR models placed on circular and elongated (10% and 20% departures from the circular orbit at apocenter) orbits. The square roots of the mean square values of the semiaxes of the satellite are given as function of time.

for three orbits; the departure from the circular orbit is also shown in arbitrary units.

We see that for an apocenter distance exceeding the circular radius by 10% the results are very similar to those of the circular orbit. For a 20% difference it becomes clear that the satellite pulsates as it moves around its orbit: the middle and minor axes in phase, the major one in anti-phase, with the departure from circularity. Larger departures yield similar effects but, rather than being sinusoidal, the axial changes are small over most of the orbit while they are large and fast near the pericenter.

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