ELLIPTICITY OF OUTER REGIONS OF GALACTIC DISKS

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In hierarchical cosmologies, dark matter coronas arise from the gravitational collapse of density peaks in a random perturbation field. The result is a **triaxial**, slowly rotating, centrally concentrated dark corona (Dubinski and Carlberg, 1991; Dubinski, 1992). Binney (1978) was the first to consider the effects of triaxial coronas around disk galaxies, showing that they might explain the observed warps and apparent twists seen in many disks. In external galaxies these deformations of density and velocity fields are modeled with a system of **circular** annuli, each of which has its own inclination and line of nodes (LON). By examining warped systems in a variety of reference frames, Briggs (1990) has mentioned that galaxy kinematics uniquely specifies a new reference frame in which there is a common LON for orbits within the transition radius and also a differently oriented straight LON for the gas outside the transition radius, which is approximately equal to the Holmberg radius of the galaxy.

In a complete picture of galaxy formation, baryons become segregated from the collisionless dark matter through the dissipation of their gravitational energy and sink to the center of the dark corona (Katz and Gunn, 1991; Evrard, Summers and Davis, 1992). The resulting rotationally supported disk will be ovally distorted or **elliptical** (Kuijken and Tremaine, 1992; Dubinski, 1993). The long axis of the orbits is perpendicular to the long axis of the corona potential. Due to this antialignment, if the disk mass is comparable to the halo mass within the disk, the combined potential there becomes considerably rounder (Dubinski, 1993). As there is a distinct trend towards rounder axial ratios of the corona at larger radii (Dubinski, 1992), we may expect the highest triaxiality of the potential somewhere in the transition region from disk to corona.

Van Albada, Kotanyi and Schwarzschild (1982) have shown that there exist stable orbits of various tip-angles in a triaxial potential which under-

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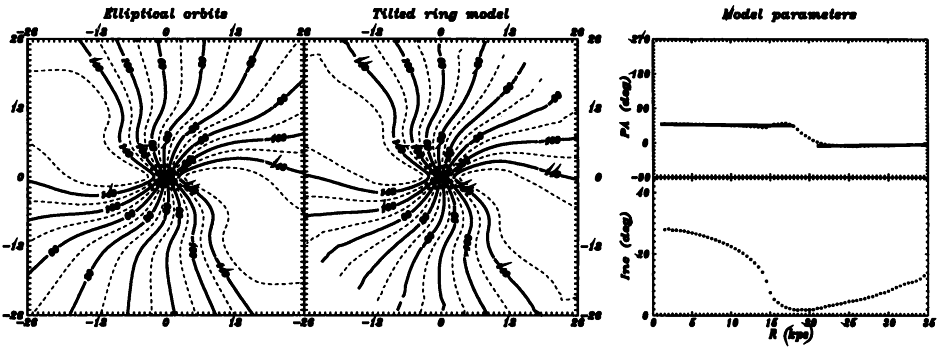

Figure 1. Left: the velocity field of the warped model galaxy with elliptical orbits having a common LON and the highest ellipticity at optical boundary of the galaxy; middle: the approximation of the velocity field with the standard circular orbit model; right: the plots of the tip angle and LON in the circular orbit model as a function of the radius of the ring, directly comparable to Fig. 3 by Briggs (1990).

goes figure rotation. The warp produced by such a system would have a constant line of nodes. In this model the findings by Briggs can be explained by the fact that most elongated gas orbits are found somewhere around the Holmberg radius of the system, where the gravitational potential of the corona becomes dominating. We illustrate this in Figure 1. As we can see, our model yields a simple explanation to the otherwise strange behavior of the tilted ring models for galactic warps, discussed by Briggs (1990).

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