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THE TRANSFER OF ANGULAR MOMENTUM BETWEEN INTERACTING GALAXIES

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In this work, we employ a TREE-Code to study the collision of two spiral galaxies when they approach each other in a parabolic orbit. During a collision, we follow the evolution of the angular momentum (AM) of the different components of the galaxies, i.e., disk, bulge and halo.

Oosterloo (1993) found that at formation time the components of binary spiral systems were not dynamically isolated. A statistical analysis of a larger sample of galaxies (Sugai & Iye 1995) shows no evidence of any correlation in the spatial distribution of spin AM.

The initial galaxy model used here is that described by Barnes (1996). In this model, both bulge and halo are spherically symmetric non-rotating systems with isotropic velocity dispersions. The initial spin $\mathbf{J} = \sum m_i \mathbf{v}_i \times \mathbf{r}_i$ of the exponential disk is roughly 0.05 in units such that $G = 1$, $M = 1$, $R = 1$. The only difference between the galaxy models is their direction of rotation. Previous similar works performed by Hernquist (1993) show evolution of spin AM for various encounter parameters. Here we consider only parabolic encounters with disks lying on the orbital plane. We analyse three runs where the galaxies are: in prograde orbits; in retrograde orbits; and prograde-retrograde orbits. The pericentric separation p is 0.2 for all cases.

The results are as follows: The first and second passages occur at time $t = 1.5$ and $t \approx 3$, respectively. At these times, major transfer of angular momentum occurs. After the first passage, orbital AM decreases to about one half of the initial value, and at time $t \approx 3$, due to orbital and spin AM interchange, it decreases again significantly. At later times we deal with a merger remnant. The evolution of specific AM of the components of the galaxy in retrograde orbit is presented in Figure 1a.

The spin AM of the galaxy in retrograde orbit decreases to zero at $t = 1.5$, while that of the galaxy in prograde orbit does not suffer such behavior (Figure 1b). The former happens because the halo obtains momentum with a direction which is negative in comparison with that of the disk. In general, during encounters, the spin angular momentum of the bulge and halo increases for both galaxies ($J/M \propto O(10^{29})\ cm^2/s$), while that of the disk depends on its direction of rotation. When the disk is in prograde motion, its spin AM increases, and it decreases in the retrograde case.

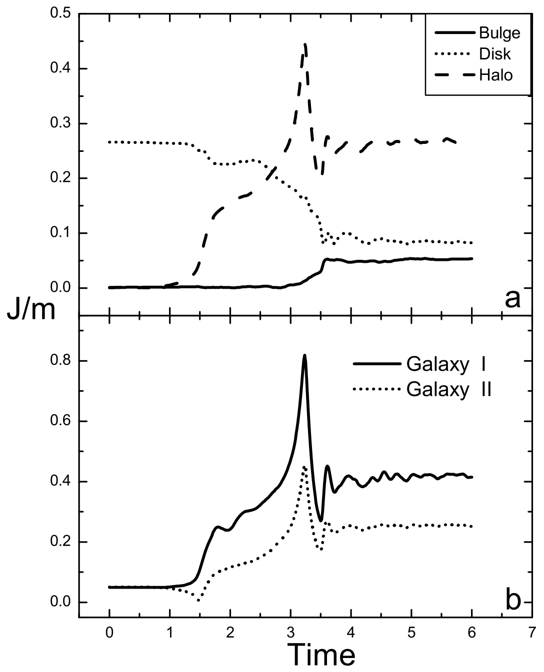

Fig. 1. Spin AM of the components of the galaxy (a). The total spin AM in prograde-retrograde case (b).

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