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On the Relative Orientation of Binary Galaxies

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Abstract. The projected directions of the rotation axes of interacting binary disk galaxies tend to align orthogonal to each other. Sofue (1992) has suggested that this could be due to shorter merger times for galaxies with paralel spins. We show by means of N-body simulations that this suggestion is correct.

1 Introduction

The relative orientation of galaxy spins with the orbital spin in interacting binary systems has been examined by Sofue (1992). He found that the projected directions of the rotation axes tend to aling orthogonal to each other. He suggested that this could be explained in the case that paired galaxies with parallel spins have already merged, while those with the orthogonal spin axes are still in the process. So, systems with a "Tri-Axial" angular momentum distribution should have longer lifetimes. This assumes an scenario where both galaxies are formed altogether and the plane of the orbit lies near the planes of the galaxies.

It is know that the tidal disturbance on a galactic disc due to a companion is strongest in the case of prograde. Thus, binary systems where the spins of the galaxies are parallel to the orbital spin would suffer strong couplings and will merge very fast (Keel 1991). So, the chance for survival of this kind of system would be small. Even when one galaxy has an anti-parallel spin, the galaxy which have the spin parallel to the orbital spin will "see" the other galaxy in a direct (prograde) orbit and the chance for an anti-spin pair to survive a merger is also small. In this scenario, the "more stable" pair, i.e., the system which will take a longer time to merge is a "tri-axial" one, where neither the galaxies spins nor the orbital spin are aligned.

We will show that the merging time certainly depends on the orientation of galaxy spins, but it could also exist a dependence on the energy of the orbit and on the time of first pericenter passage. In this work, we perform a series of binary disk galaxy interactions to check the validity of the "Tri-Axial" hypothesis.