



Simulation Of NGC 7753 and its Companion NGC 7752

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ABSTRACT

In the present paper the interaction of the pair NGC 7753 galaxy and its companion NGC 7752 galaxy is simulated. From the simulation it is shown that two arms are formed in the main galaxy, and the upper arm appears as a bridge connected with the companion. A snapshot of the interaction is obtained through the simulation which is similar to the image of the pair in the present day that is observed by telescopes

KEYWORDS : NGC 7753-NGC7752-Arp 86-Simulation of interacting galaxies.

INTRODUCTION:

NGC 7753 and NGC7752 are pair of interacting galaxies that locate in the Pegasus constellation, which are 270 million light-years away from us.

NGC 7753 is the large spiral galaxy with strong spiral arms, but small bar and nucleus. Its mass is ten times the mass of the Milky Way galaxy. Its magnitude is 12.8, while NGC 7752 which is an irregular compact companion of the main galaxy has magnitude of 14.4. This companion apparently attached to one of its spiral arms. The pair which are similar to the pair M 51 are classified as Arp 86 in Arp's atlas of peculiar galaxies (Arp 1966) in type of "spiral galaxies with large high surface brightness companions on arms".

When the two interacted galaxies are near to each other, the particles which indicate the stars, gas, and dusts undergo an acceleration which causes the formation of the tails as a result of affecting the gravitational force between them. In the interaction between the massive galaxies and the low mass companion, the discs may be distorted very strongly, and in such interactions tail and bridge also would be formed. (Toomre & Toomre 1972; Barnes & Hernquist, 1996; Sellwood 2001; Struck & Smith, 2003; Sellwood & Carlberg, 2014)

Several studies concentrate on the different properties of Arp 86 through telescopes or simulations model (Joseph et al 1984; Laurikainen & Moles 1989; Laurikainen et al 1993; Salo & Laurikainen 1993; Prieto et al 2001; Asari et al., 2007; Sengupta et al 2009; Cid Fernandes et al., 2009; Sengupta et al 2012; Zhou et al 2014)



Fig.1: The image of Arp 86 observed by Mount Lemmon SkyCenter.

METHOD:

Pair of NGC 7753 and NGC 7752 galaxy are examples of transferring

mass between the main galaxy and its companion. Through simulation of this pair arms form in the main galaxy, it becomes clear that this system is similar to the M51 system (Marcelin et al. 1987; Rasheed 2009). This property is obtained through our simulation in the present work in which the Intergalactic Gravitational Motion Simulator IGMS code (Perley 2000) is used. It is a proper code for explaining the constructed arms from the interaction.

For the initial conditions of setting the simulation, the mass of the main galaxy is assumed to be bigger many times than the mass of the companion before the interaction, and the other initial conditions that assumed in the simulation in the present work are: for the main galaxy, the halo radius = 6.48 kpc. While for the companion galaxy the halo radius = 2.27 kpc. The inclination which is the angle that the orbital plane of the small galaxy makes with the rotation plane of the big galaxy = -80° . The distance between the two centers of the two galaxies = 9.75 kpc, and the eccentricity = 0.8.

RESULTS AND DISCUSSION:

Figure 2 shows the main galaxy NGC 7753 and its companion NGC 7752 at time ($t = 0$ Myr.) that represents the beginning of the interaction between the two galaxies. The distortion in the discs of them is still not happened.

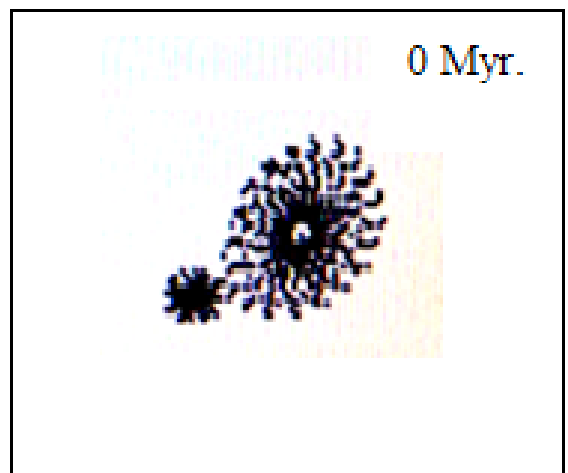


Fig.2: the main galaxy and its companion.

In Fig.3 that indicates the time ($t = 50$ Myr.) in our simulation, it is shown that the distortion happened between the two galaxies' disc as a result of the gravitational force between them, and the rotation of the main galaxy and its companion counter the clock wise, and the mass flows out of the main galaxy.

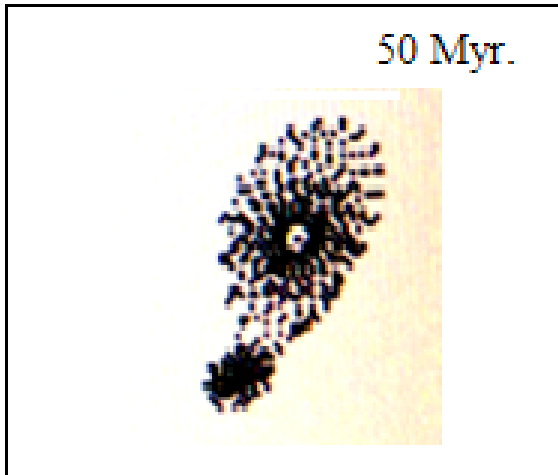


Fig.3: The distortion in the two discs of both Galaxies

Figure 4 represents the time ($t= 80\text{Myr.}$) which show the beginning of formation of the arms in the main galaxy. So, its shape changed, and the galaxies are in a continuous rotation.

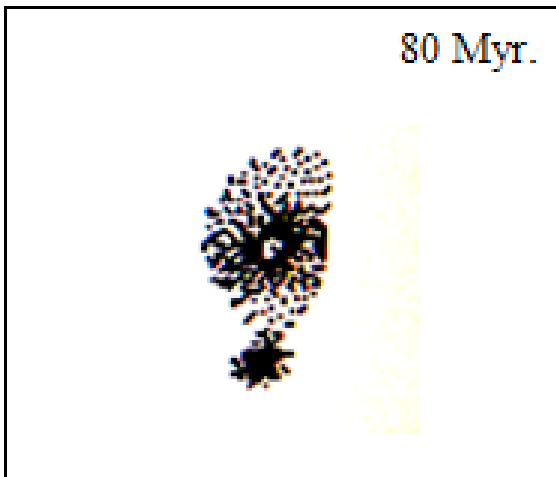


Fig.4: more distortion of the main galaxy.

In Fig.5 the two tidal arms in the beginning of construction in the main galaxy at time ($t= 100\text{Myr.}$). The lower arm is clearer than the upper arm, and it appeared as a bridge with the companion.

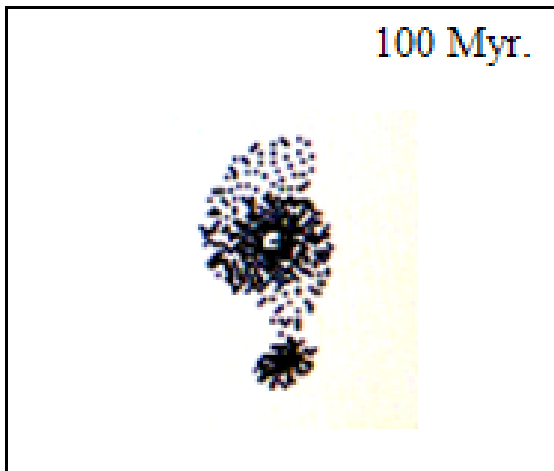


Fig.5: the two arm in the beginning of the Construction.

Figure 6 shows at time ($t= 125\text{Myr.}$) how the two tidal arms evolve

and deviate from the bulge of the main galaxy.

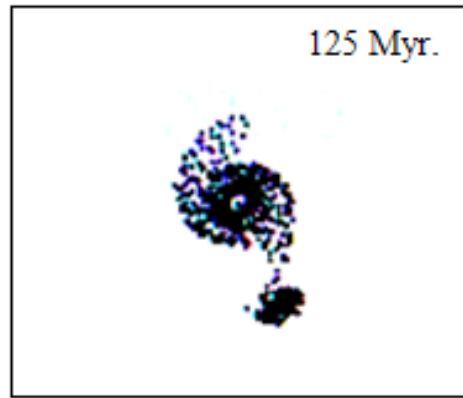


Fig.6: Formation of the two tidal arms in the main galaxy.

Figure 7 represents the time ($t= 135\text{Myr.}$) at which the two arms extended. The upper arm appeared more clearly than before in this stage of interaction of the main galaxy, and its companion. So, in this stage the system of the pair galaxy which is known as Arp 86 is formed. This snapshot of our simulation is similar to the image of this system that observed by telescopes. (see Fig.1).



Fig.7: Formation of Arp 86.

In Fig.8 the arms of the main galaxy deviate more from the bulge, and the galaxies are rotating in the time ($t=160\text{Myr.}$) the bulge inclined as a result of rotation, while the companion starts to release from the connection with the main galaxy.

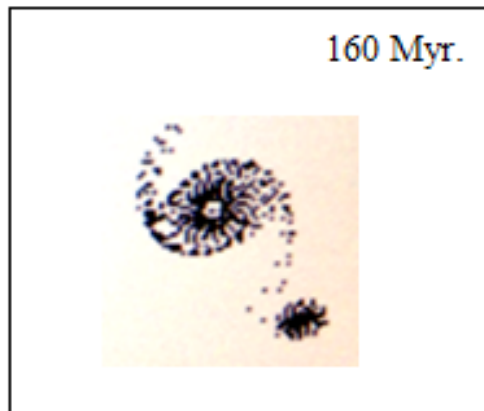


Fig.8: the companion starts to release from the main galaxy.

Figure 9 shows rotating counter clock wise of the main galaxy at time ($t=160\text{Myr.}$) and the companion released from the main galaxy.

From figs. 8 & 9 of the simulation one can estimate the interaction between the pair will be vanished, and the companion would be released from the main galaxies if the pair are not affected by other bodies in the future.

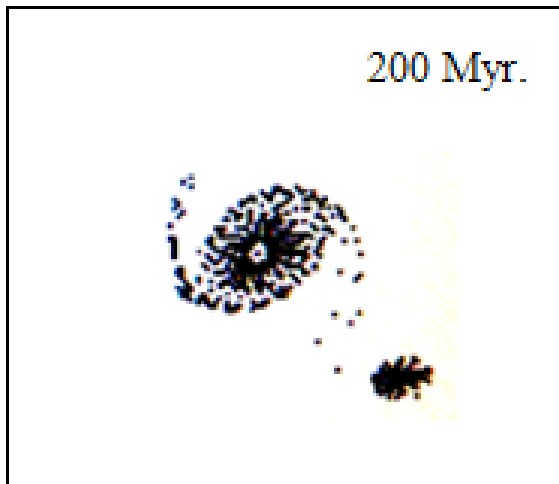


Fig.9: the companion released from the main galaxy.

Conclusion:

In the present work of simulating the interaction of the pair of galaxy system NGC 7753 and its companion it is found that two arms formed in the main galaxy. The simulation of this pair is similar to that of M51 and its companion. In the simulation it is also found that the interaction of the two galaxies at 135Myr is in good agreement with the image of the pair observed by telescope in the present day.

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