Galactic Dynamics in the Era of Large Surveys
Proceedings IAU Symposium No. 353, 2019
M. Valluri & J. A. Sellwood, eds.

doi:10.1017/S174392131900824X

Effect of the gas percentage on the thickness of the galactic discs during minor mergers using hydrodynamical simulations

Swetha Thakkalapally[1], **Priya Hasan**[2] and **S. N. Hasan**[2]

[1]Osmania University, Hyderabad, India
[2]Maulana Azad National Urdu University, Hyderabad, India

Abstract. We study the minor mergers of galaxies using simulations. For this we use GADGET2 code. We present results of simulations of minor mergers of disc galaxies of mass ratio 1:10. These simulations consist of collisionless as well as hydrodynamical runs including a gaseous component in the galactic disc of primary galaxy. Our goal is to establish the characteristics of discs obtained after the merger.We observe that the primary galaxy discs are not destroyed after the merger. We take different initial conditions for the primary galaxy varying the gas percentage in disc from 0–40 percentage and study the thickness of the disc after the merger. We generally observe that the thickness of the disc increases after the merger for any gas percentage. We also observe that as the gas percentage increases in the disc of initial primary galaxy, the increase in the thickness keeps decreasing.

Keywords. Methods: N-body simulations, Methods: numerical, Galaxies: general, Galaxies: interactions

1. Introduction

Major and minor mergers are the generic features of the structure in the generic or hierarchical picture. Major mergers play an important role in transforming a disc dominated spiral galaxy into spheroids and triggering star bursts while minor mergers may explain the origin of the thick discs and the diffuse stellar halo around the galaxies.

Minor mergers are more frequent than the major mergers as there are far more smaller galaxies in the the Universe than the massive ones. Using the large scale surveys there is an accumulating evidence that suggests that minor mergers are important drivers of galaxy evolution (Kaviraj 2013) The most popular tool to study galaxy interaction and evolution is numerical simulations.

2. Numerical Simulations

We use parallel Tree-SPH code GADGET2 (Springel 2005) code for hydrodynamical simulations. The principle structure of this code is that of a Tree-SPH code where gravitational interactions are computed with a hierarchical multipole expansion and gas dynamics is followed with a Smoothed Particle Hydrodynamics. We use DICE (Disk Initial conditions Environment) (Perret *et al.* 2014) for creating the model for galaxies. Using this code dark matter halo is modelled using NFW profile, the gaseous and stellar disks are modelled using an exponential disk and the bulge is modelled using Hernquist profile.

We create the initial conditions with primary galaxy at the centre and the satellite galaxy at a distance of 100kpc from the primary galaxy. The mass ratios between primary

Table 1. The Table contains the parameters that are kept constant in all the three sets of simulations. The masses are in the units of 10^{10} solar masses and scale lengths and softening lengths are in kpc.

Galaxy	$\mathbf{M}_{vir}$	$\mathbf{M}_{disc}$	$\mathbf{M}_{bulge}$	$\mathbf{R}_{disc}$	$\mathbf{R}_{bulge}$	**Concentration**	N_{halo}	N_{disc}	N_{bulge}	**Softening DM**	**Softening disc**
Primary	100	2.4	0.6	3.0	0.5	9.65	10^5	10^4	10^3	0.1	0.1
Secondary	10	0.0	0.063	0.0	0.2	11.98	2.25×10^4	0	5×10^2	0.1	0.1

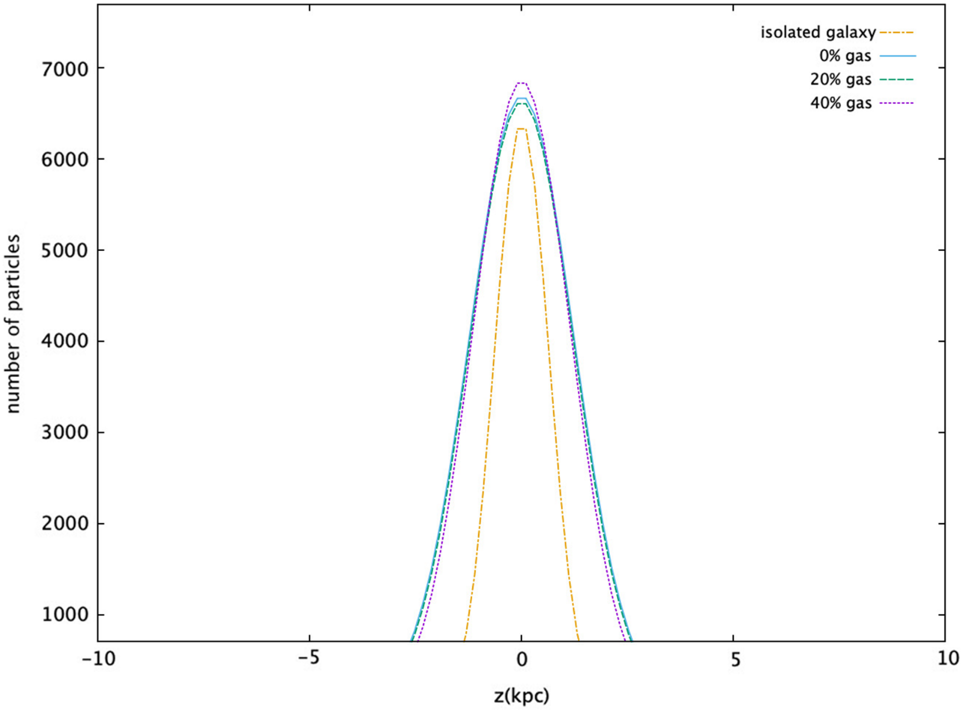

Figure 1. The distribution of stellar particles along the z axis for the isolated primary galaxy run and for the galaxies with different gas percentages.

and secondary galaxy is 1:10. We create three sets of initial conditions with 0, 20 and 40 percent gas in the disc of the primary galaxy and then carry out the merger simulations. The primary galaxy contains dark matter halo, stellar disc and/or gaseous disk and a stellar bulge while the secondary galaxy contains only dark matter halo and stellar bulge. We run the simulations from redshift 1 to redshift 0. The parameters of the galaxies used is presented in Table 1.

3. Results and Discussion

We plot the distribution of particles along the z-axis before and after the simulation for all three sets of simulations. We observe that the thickness of the stellar disk increases in all three sets of simulation after the merger. We also observe that that as the gas percentage in the primary stellar disk increases, the thickness of the stellar disk after the merger keeps decreasing. This is because the disk heating is reduced by gas by absorbing some of the kinetic impact energy thus preventing the destruction of the disks during minor mergers.

https://doi.org/10.1017/S174392131900824X Published online by Cambridge University Press

References

Kaviraj, S. 2013, *MNRAS*, 41–45, 437

Moster, B. P., Maccio, A. V., Somerville, R. S., Johansson, P. H., & Naab, T. 2010, *MNRAS*, 403, 1009

Springel, V. 2005, *MNRAS*, 364, 1105–1134

Perret, V., Renaud, F., Epinat, B., Amram, P., Bournaud, F., Contini, T., Teyssier, R., & Lambert, J. C, 2014, *A&A*, 562, A1

https://doi.org/10.1017/S174392131900824X Published online by Cambridge University Press