Master's thesis – Astronomy and Astrophysics
'The effect of galaxy interaction on star formation'

Abstract:
In this Master's thesis we study the effect of galaxy interaction and merging on star formation. In many studies it is shown that galaxy interaction is an important process in the evolution of galaxies. For the first time we use cosmologically based initial conditions and therefore realistic histories of galaxies at redshift 0. We also include the large hot gaseous halo around
the galaxies, consistent with galaxy formation models and observations. We use the SPHmethod with the hydrodynamical TreePM code GADGET3 to simulate the evolution of twelve merger trees and twelve isolated galaxies from redshift 1.5 to 0 and study the star formation rate of the central galaxy.
We find that including the hot gaseous halo has a number of important effects, first the star formation rate at large timescales is increased due to cooling of the hot halo and refueling of the cold gas reservoir. We see that the incoming and orbiting galaxies create shockwaves in the hot gaseous haloes and that this increases the temperature at 30 to 40 kpc. Consequently the cooling rate decreases and because of this the SFR drops below that of the isolated galaxies, showing that interacting galaxies reduce their star formation rate when they orbit for a longer time. A third result is that the relative size of the starburst is much smaller than previous studies show. We have also run all simulations again with the inclusion of super massive black holes at the centre of galaxies and performed the same analysis. We find that black hole accretion reduces the central density and the SFR in the galaxies. Because of this, the starburst is much smaller during a merge and the black holes grow fast during merging processes. For both sets of simulations we have tried to find a relation between the mass ratio and the amount of extra stars that is formed, as done before in studies neglecting the hot gaseous halo. For the simulations with only a hot halo we find that a power-law can be fitted to the data, but note that the scatter is of the same order of magnitude and that other effects might be of larger influence than the mass ratio of the galaxies. For the black hole simulations this effect is even stronger and the amount of extra star formation can be considered as independent of mass ratio.
From observations of groups and clusters of galaxies and from and SAMs it is seen that galaxies have a series of merging events and can have multiple interactions or mergers at the same time. Other simulations consider only binary galaxy interactions and models use recipes based on single interactions for all merging events. We simulate 3 merger trees that include simultaneous merging and find that the extra amount of stars formed is smaller or equal to a single merge with only two galaxies. This shows that the sequence and timing of mergers is important for the evolution of galaxies.