Size and position of HII clouds in merging galaxies

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An HII region is a large cloud of partially ionised gas in which star formation has recently taken place. The average lifespan of HII regions are a few million years. During this time they play a key role in star formation through molecular clouds. In our research we will take a look at how the regions are distributed in the inner and outer regions of the merging galaxies. Furthermore we will look at the regions and determine whether they are bound or unbound.

Understanding how the HII regions position and evolve during the merge is very important in understanding star formation in the resulting galaxy. Merging has been a common process. It has been assumed that large elliptical galaxies were built up gradually over time through merging with many small dwarf galaxies. The gas in those galaxies would be converted into cool, low-mass stars, so that today they have exhausted all of their star-forming material.

A key aspect in whether a star region ends up being bound or unbound is the efficiency of the star-forming cloud which created these regions. An important factor regulating this efficiency is the internal gas pressure in the star-forming region[1]. This pressure is dependent on the size and the mass of the gas cloud. We will determine the pressure of the observed HII regions and through this we hope to answer the question whether the likelihood of a region ending up bound is dependent of its location in the galaxy and how this likelihood is affected by mergers.

To answer our research question we need to look at several galaxies and measure the sizes of the clouds. We can find these clouds by observing in the R-band. The R-band contains the Hα line and a strong Hα line is characteristic for a HII region. There is another group that is doing similar research to HII clouds so we will share observational data with them. The galaxies we will be looking at are at progressively further stages of the merging process. Therefore we will be able to see if the phase of merging will affect the distribution of the HII clouds on the inside and the outside of the galaxy. We can also determine the distribution of bound and unbound regions at different merging phases. We will determine the pressure by using the correlation between pressure, mass and size in a gas cloud. For determining the mass we will have to make one of the two following assumptions. Either we assume that the star-forming efficiency is constant throughout the galaxy so that mass correlates to star-forming rates, or we assume that the mass distribution of HII regions is the same for the inner and outer parts of the galaxy. In the past there has been some research done on the position of the HII clouds[2] which we will be using as reference.

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[2] H I, H II and R-band observations of a galactic merger sequence, J. E. Hibbard (1996)

Size and position of HII clouds in merging galaxies, technical justification

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We want to determine how the position and size of HII regions in merging galaxies change during different phases of the merging process. To do this we are going to look at three different mergers in different stages of merging. The objects we have chosen to observe are Arp 81, NGC 4767 and Arp 240. Because we have to look at three different objects, we are on a time limit. Luckily there is another group that is going to look at the same objects in the same filter. Because of this we think it is reasonable to look at each object twice to improve our data set.

An exposure time of 900 seconds will give us a good signal-to-noise ratio and won't give blurry results due to overlighting. This exposure time is chosen because other research[4] done on NGC 4676 used a similar sized telescope, with a diameter of 2.1m, in the same filter and we think their results are accurate enough to do our research.

HII regions consist of about 90% hydrogen. Therefore we have to look for the prominent Hα line which peaks at 6563Å (the R-band). Because the galaxies are moving away from us the Hα is shifted to higher wavelengths, by correcting for this the merging galaxies Arp 81, NGC 4767 and Arp 240 all fall in the range of the WFCS 6725 filter (See table 2). This filter has a central wavelength of 6725Å and a width of 80Å.

The visibility of the objects is roughly the same throughout the week we are going to observe. So the day doesn't matter much. The appropriate times to observe are given in table 1.

During our observations the moon won't be near the objects we want to observe so it won't provide a problem. However the moon will be very bright(~95% illuminated) that week so the sky will be bright. The coördinates, magnitudes, sizes and redshifts of the objects are given in table 2

Table 1

Galaxy	Visible (universal time)	Best visible (universal time)
Arp 81	between 12 and 5	between 3 and 5
NGC 4676	between 22 and 3	between 22 and 24
Arp 240	between 22 and 2	between 23 and 1

Table 2

Object	Right ascension	Declination	Magnitude	Size (arcmin)	Redshift (km/s)	Observed Hα wavelength (Å)
Arp 81	18 12 55.34 [1]	+68 21 48.8 [1]	13.6 [2]	2.0 * 0.9 [3]	6191 [1]	6697.85
NGC 4676	12 46 12.28 [8]	+30 43 37.3 [8]	13.2 [5]	2'.3 * 0'.7 [5]	6613 [5]	6693.95
Arp 240	13 39 54.9 [6]	+00 50 07 [6]	13.0 [7]	1.8*0.9 [7]	6745 [9]	6710.35

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