STARBURST MODELS OF MERGING GALAXIES

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1. INTRODUCTION

In the past decade, infrared observations have shown that interacting and merging galaxies have higher luminosities than isolated systems, with the luminosities in mergers as high as $10^{12}L_{\odot}$. However, the origin of the luminosity found in mergers is controversial, with two main competing theories. The first is the starburst scenario. As two gas rich galaxies start to merge, cloud-cloud collisions induce fast shocks in the molecular gas. This gas cools, collapses and fragments, producing a burst of star formation. The main rival to this theory is that the infrared luminosity is produced by a dust embedded active nucleus, the merger of two gas rich galaxies providing the 'fuel to feed the monster'. There has even been speculation that there is an evolutionary link between starbursts and active nuclei, and that possibly AGN's and QSO's were formed from a starburst. Assuming that the infrared luminosity in merging galaxies is due to star formation, there should be ionizing photons produced from the high mass stars, giving rise to recombination line emission. The objective of this study is to use a simple starburst model to test the hypothesis that the extreme infrared luminosity of merging galaxies is due to a starburst.

2. MODELLING THE BRACKETT LINE EMISSION

If the infrared luminosity of merging galaxies is indeed due to a burst of star formation, the infrared recombination lines arise in HII regions ionized by young stars. The number of ionizing photons from the burst can then be calculated assuming Case B recombination. We aim to determine whether the number of OB stars inferred from the flux of ionizing photons can produce the observed far infrared luminosity in a sample of merging galaxies. This is done by using a simple starburst (e.g. Telesco and Gatley 1984, Ap. J. 284 557) model to compare the star formation rate implied by the infrared luminosity measured by IRAS, to the star formation rate inferred from the number of ionizing photons measured by the $B\gamma$ flux. A starburst is a viable model for the luminosity generation if the ratio of the star formation rate implied by the infrared luminosity to that inferred from the ionizing flux (denoted Q) is ~ 1.

3. RESULTS AND DISCUSSION

Figure 1 shows the Bγ flux plotted aginst the integrated flux for all of the mergers in this sample. Also shown are lines of $Q = 1$ for several starburst models. Most of the mergers in this sample (6 out of a total of 8) have $L_{B\gamma}/L_{LIR}$ ratios that are consistent with a simple starburst model. The starbursts are either young or if they are evolved the lower mass cut off of the burst is $\sim 5M_{\odot}$, higher than seen in galactic star forming regions. These results lend quantitative support to the idea that mergers create a "super starburst", and that in some respects the star formation is very different from that in quiescent spiral galaxies. There are two infrared bright galaxies, Arp 220 and NGC 6240 that have a deficit of ionizing photons when compared to the other galaxies in this sample. In these galaxies an active nucleus may dominate the far infrared luminosity, but it is possible that extinction plus dust absorption of the Lyα photons results in a much decreased recombination line flux from a starburst. It is exciting to speculate that Arp 220 and NGC 6240 are evolved starbursts that have developed active nuclei.

Figure 1