A TRIGGERING MECHANISM FOR ENHANCED STAR-FORMATION IN COLLIDING GALAXIES

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We propose a physical mechanism to explain the origin of the intense burst of massive-star formation seen in physically colliding/ merging, field, spiral galaxies. We consider the detailed evolution of a realistic, two-component interstellar medium (consisting of H_2 and HI) within each galaxy. Also note that, in a typical spiral galaxy - like our Galaxy, the Giant Molecular Clouds (GMCs) are in a near-virial equilibrium and form the current sites of massive-star formation, but the star formation rate is low. We show that this star formation rate is greatly increased following a collision between galaxies. During a collision between two field spiral galaxies, the HI clouds from the two galaxies undergo collisions at a relative velocity of $\sim 300\ \mathrm{km \cdot s^{-1}}$. However, the GMCs, with their lower volume filling factor, do not collide. The collisions among the HI clouds lead to the formation of hot, high-pressure remnant gas. The overpressure due to this hot gas causes a radiative shock compression of the outer layers of pre-existing GMCs in the overlapping wedge region. This triggers a burst of massive-star formation in the initially barely stable GMCs. For details, see Jog and Solomon (1990).

The typical IR luminosity, resulting from the young, massive stars from a pair of colliding galaxies, is estimated to be $\sim 4\times\ 10^{11} L_\odot$, in agreement with the observed values (Joseph and Wright 1985, Sanders *et al.* 1986). The enhanced star formation occurs *in situ* in the overlapping regions of a pair of colliding galaxies. We can thus explain the spatially extended, central starburst regions ($\sim$several kpc in diameter), as seen in typical colliding galaxies, and also the starbursts in the regions of disk overlap as seen in Arp 299 (NGC 3690/IC 694) and in Arp 244 (NGC 4038/39). The net burst of star formation is expected to last over the crossing time for the gas in a pair of colliding galaxies $\sim 4\times\ 10^7$ yr.

References:

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