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STAR FORMATION IN THE LARGE MAGELLANIC CLOUD

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This conference has concerned itself largely with the properties of galaxies that are very much more luminous than the Milky Way and shine predominately in the far and mid-infrared. One might ask what role the Large Magellanic Cloud, a dwarf irregular, can play in this endeavor. There are two main reasons the LMC may prove helpful in our attempt to understand the infrared luminous galaxies. One, the LMC is only 55 kpc away, very nearby compared to the much rarer high luminosity systems. Second, the environment in the LMC is distinctly different than in the Milky Way, at least those parts of the Milky Way interior to the sun, where most of the studies of massive star formation have been concentrated. The environment in the LMC is not, of course, likely to be similar to that in the infrared luminous galaxies, but the fact that it is different than in the Milky Way does provide a test for the universality of our theories of star formation.

Despite the title of this conference, the star formation process in galaxies was not the central topic. Rather, the observed properties of infrared luminous galaxies have dominated the discussion. There is plenty of observational evidence for and theoretical understanding of how to push a large amount of gas around (say in an encounter) and we also know that massive star formation results in a large amount of mid and far-infrared luminosity. The connection between the two, however, has yet to be established. That is, the star formation process itself in these galaxies (if star formation is the correct explanation) is simply not well understood. The study of the infrared luminous galaxies as a class is still in its infancy, so this state of affairs is to be expected. As pointed out by Becklin (these proceedings) only by detailed groundbased studies will we be able to improve our understanding of these galaxies.

We sometimes forget that the LMC is an interacting system with a large amount of neutral hydrogen that has been pushed around by the galaxy's encounter with the Milky Way. Perhaps a good understanding of the star formation process in the LMC will provide guidance in our study of the infrared luminous galaxies. The two questions I wish to address are: 1) How is star formation in the LMC similar to our galaxy, and 2) How is it different?

SIMILARITIES

1) The field IMF in the LMC is similar to the Milky Way (Humphreys and McElroy 1984), although the very top of the IMF is probably hidden from optical view by plasma and dust.

2) At least two LMC HII regions contain point IR sources with no Lyman continuum or photospheric absorption features (i.e., protostars, Gatley et al. 1981, 1982).

3) There is some dust in the LMC star forming regions as evident in the FIR emission (IRAS, Werner et al. 1978, Jones et al. 1986), near IR reddening (Gatley et al. 1982, Jones et al.) and silicate absorption at 10μm (Epchtein et al. 1984).

4) A few H_2O and OH masers have been found in LMC HII regions.

DIFFERENCES

1) There is proportionately more HI mass in the LMC than in the Galaxy. There is plenty of raw material for making stars, the problem is how to go from HI to massive stars.

2) The CO luminosity of the LMC is very low compared to the FIR luminosity and Hα luminosity of the LMC, both of which are in the expected proportion to one another based on observations of a wide range of galaxy luminosities. This MAY indicate a significant lack of molecular hydrogen in the LMC, despite the vigorous star formation going on. Israel (private communication) has argued that there could still be large amounts of molecular hydrogen in the LMC without the corresponding amount of CO and dust expected for a galactic molecular cloud in the Milky Way.

3) There are no deeply imbedded, high surface brightness, very luminous FIR cores in any of the LMC HII regions. This is further indication that the giant molecular cloud phase may not be necessary (or considerably reduced in importance) in the LMC.

4) The six protostars found to date (Jones et al., Hyland et al. 1986), tend to lie behind what appear to be the intersections of giant mass loss bubbles. This suggests that direct compression of the HI gas results in the formation of stars in the LMC.

5) There appears to be an excess of very early O stars in at least two of the LMC giant HII regions (Jones et al.). This is best explained by a truncation of the IMF below about 30 $M_\odot$. The lack of any protostars below a few$\times 10^4$ $L_\odot$ supports this contention. Thus, the LMC may be producing more total luminosity and Lyman continuum flux per unit mass of available gas than is the case in galactic giant molecular clouds.

Without further study we can't be certain, but the LMC may be showing us that massive star formation does not require exorbitant amounts of mass in gas, molecular or otherwise, and that once the process gets going in the presence of a large amount of neutral hydrogen, mass loss bubbles and supernovae keep the process continuing at a high rate.

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