A study of the local environment of novae in the Large Magellanic Cloud

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1. Introduction

The Large Magellanic Cloud (LMC) is one of the very few external galaxies where a number of novae have been detected and studied in detail over the years. It is also a galaxy where the stellar population is well understood, especially with the help of many recent surveys. A study of the immediate environment of novae can be made by studying the underlying stellar population which includes nearby star clusters and field star population. This, together with the estimates of ages and chemical composition of the immediate environment may be able to throw some light about the characteristics of the progenitor of novae and also explain the differences observed in novae during outburst.

Van den Bergh (1998) studied the distribution of novae and supernova remnants in the LMC. The novae were found to be widely distributed over the face of the LMC with a possible clumping slightly to the south of the Bar. Van den Bergh also noted that there was no concentration of novae within the Bar itself and concluded that the Bar in LMC is younger than the old disk population with which the novae are associated. Several new novae have been detected in the LMC since the study by van den Bergh. Further, more extensive data on the LMC stellar population is now available. Hence, a project to study the distribution of novae, their characteristics and a comparison of the environment at various locations of the LMC was undertaken. Initial results of the study are presented in this paper.

2. Data on Novae

Data available in the literature on 28 novae detected in the LMC have been used in this study. Figure 1 shows the distribution of LMC novae. Of the 28 novae used, light curve were available for 20. Of these, 12 belong to the very fast / fast category, with one superbright, one recurrent and three identified as ONeMg novae. 6 novae belong to the moderately fast category and the rest are slow novae.

3. Data on star clusters

We have considered three catalogs of star clusters in LMC. They are Pietrzynski et al. (1999), Bica et al. (1999), Bica et al. (1996), Pietrzynski and Udalski (2000). U99 and B99 are catalogs of star clusters which contain 6679 and 1808 star clusters respectively. These two are used to identify the clusters near the novae.

4. Data on field stars

The V, $(V - I)$ data of field stars are taken from OGLE II data (Udalski et al. 2000). We have used stars within 5 arcmin from Nova 1948 and 10 arcmin from novae 1978b and 1988b. These correspond to 80 pc and 160 pc respectively, for a distance modulus of 18.7 mag. The colour-magnitude diagrams of the three regions indicate a significant differential reddening in the regions of Nova 1948 and 1988b and minimal in the case of 1978b. A comparison of the slopes and the brightness of the tip of the red giant branch indicates that the field of Nova 1988b is more metal rich than the other two regions.

5. Results

Several new novae have been detected in the bar, indicating a change of scenario from van den Bergh (1988). 60% of the novae analysed in this study are found to be in the very fast/fast category. All these are located inside, and South of the Bar with the exception of Nova 1978a and the recurrent nova. Only 10% of Novae are in the slow-very slow type and most of them lie in the outer regions. Two of the novae studied are potential SN type Ia progenitors: RN (LMC 1968/1990b - USco type) and LMC 1995 (Super soft X-ray source- Orio & Greiner 1999). The above points indicate the presence of an intermediate – old population in the region of the bar, contrary to conclusion of van den Bergh (1988).

The distribution of novae and star clusters are similar, except for three novae. The two ONeMg novae detected in the Bar have occurred in regions of relatively higher metallicity (1990a: Ardeberg et al. (1997); 1988b: This study). Field star population near Nova 1948 shows large amount of differential reddening. The ages of star clusters found near the novae indicate that the clusters are mostly of age between log (age) = 8.0 – 9.0. This indicates that the progenitor of the nova population is similar or older than the cluster ages, consistent with the nova evolution models. The nova distribution might indicate the extent of the intermediate age population over the face of the LMC.

References

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