DO BINARY CLUSTERS EXIST IN THE LARGE MAGELLANIC CLOUD?

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The possible existence of binary clusters in our Galaxy (h and x Persei, Ocl 556) has been argued in the past, but it has never been a well established fact either in our Galaxy, or in external systems . An early speculation on the problem by Innanen et al (1972) has predicted a considerable degree of stability for binary clusters in low nuclear density galaxies, like the LMC .

A complete (down to the 17th visual magnitude) survey of the LMC cluster system on UKSTU plates has yielded a total of 69 double clusters with a centre-to-centre separation of less than 1.3 arcmin (~21 parsecs) (see e.g. Plate 1).

The large number of clusters in the field studied implies that a fraction of the double clusters observed may be due to projection effects. Taking into consideration the surface density distribution of the LMC cluster system we estimate that an upper limit on the expected number of double clusters due to projection effects is 31. Application of the Kolmogorov-Smirnov two-sample test has shown that the observed distribution of double clusters differs from the one predicted by chance at the 99.9% confidence level. Therefore, a significant number of the observed double clusters must be physically associated.

The dynamical stability of a binary cluster is a complicated problem that has to be treated in detail. To a first approximation, however, we can assume three main sources of instability for the system : (i) the tidal field of the parent galaxy, (ii) the mutual dynamical interaction of the members of the binary (leading either to coalescence, or to the disruption of the system) and (iii) the effect of passing giant molecular clouds (Alladin and Parthasarathy, 1978; Alladin et al. 1985; Bahcall et al. 1985). The timescales over which these processes affect significantly the binary cluster are functions of the initial separation of its members and of their mass and density ratios. Plausible values for these parameters give an upper limit of a few 10^8 yrs on the maximum possible age of a binary cluster.

It is important to note that the few clusters in our sample for which ages are available (van den Bergh, 1981; Elson and Fall, 1985) are all younger than a few 10^8 yrs, which is consistent with the above mentioned age limit. Moreover, the space distribution of the observed double clusters correlates (Spearman rank

correlation test) very well with that of the very young and young clusters in the LMC, while it correlates relatively weakly with the intermediate and old clusters distribution .

Although further observations (especially on the clusters ages) are necessary to settle the question, the data presented here give considerable evidence in favour of the existence of binary clusters in the LMC, with obvious implications on the cluster formation (and evolution) processes in this galaxy and in Magellanic type irregulars in general .
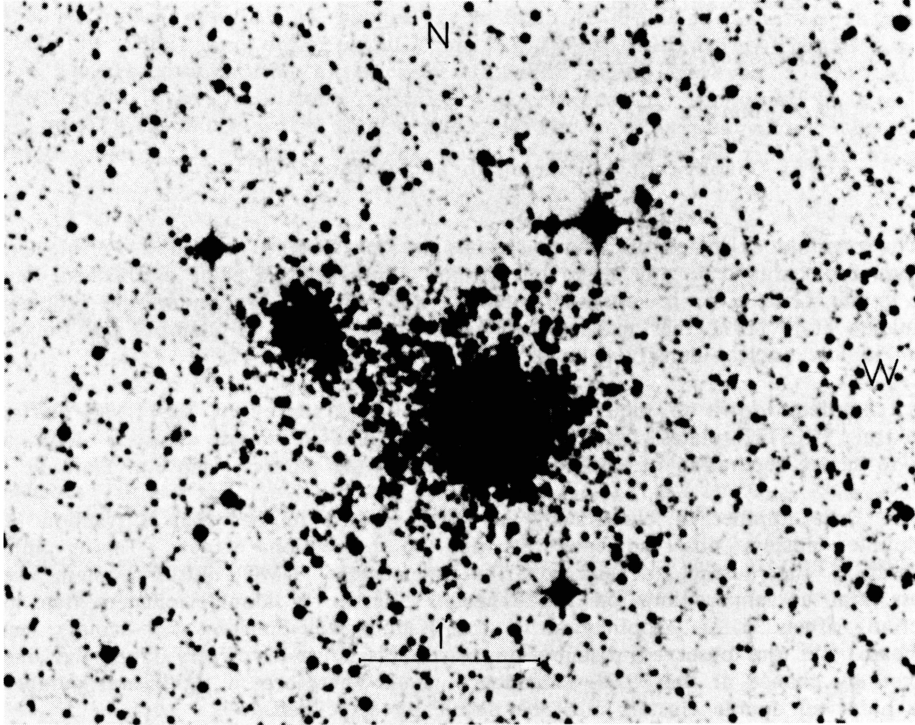

Fig. 1. A prominent LMC pair: NGC 2137 (left) and NGC 2136 (right).

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