

Globular Cluster Formation in Merging Galaxies?

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The properties of a population of luminous blue clusters in the merging galaxy NGC 3597 are discussed, and the observability of the signature of such a population in later evolutionary stages of a merger is assessed.

NGC 3597 is an advanced merger which has already developed into an elliptical-like object with a de Vaucouleurs brightness distribution, but intense star formation is continuing in the central 4 kpc. A population of unresolved blue objects that are concentrated towards the central region is identified as clusters belonging to NGC 3597.

The luminosities and colours of these luminous blue clusters in NGC 3597 are those expected for young luminous globular clusters. After evolution to an age of 10 Gyr, they will resemble the most luminous globulars of the Milky Way (Lutz 1991).

New H α narrowband data do not show line emission from the clusters, confirming that the clusters already have passed the stage of active star formation (Fig. 1). Although the upper limit of about 100 pc for the size of the clusters is insufficient to distinguish unambiguously between compact globulars and more diffuse associations, the observations indicate that the specific globular cluster frequency of galaxies is not conserved during merging. The more recent observation of similar young luminous clusters in NGC 1275 (Holtzman et al. 1992) strengthens the argument for significant late additions of new clusters to the globular cluster systems of some galaxies, which has also been discussed by Ashman and Zepf (1992).

Simulated colour-magnitude diagrams for the globular cluster system of a merger are used to assess the further evolution of NGC 3597-like cluster systems. The signature of a mixture of old globulars and globulars newly formed during merging is observationally evident only in early stages. Taking foreground stars, background galaxies and observational errors into account, the colour-magnitude diagram of such a mixed globular cluster system will be indistinguishable from that of ordinary ellipticals at the time when other indicators of the merger origin (tidal tails) have dispersed (Fig. 2). The situation is complicated further by partial compensation of age and metallicity effects on the colours of a mixed system.

References:

- Ashman, K.M., Zepf, S.E., 1992, *Astrophys. J.* 384,50
Holtzman, J.A., et al., 1992, *Astron. J.* 103,691
Lutz, D., 1991, *Astron. Astrophys.* 245,31

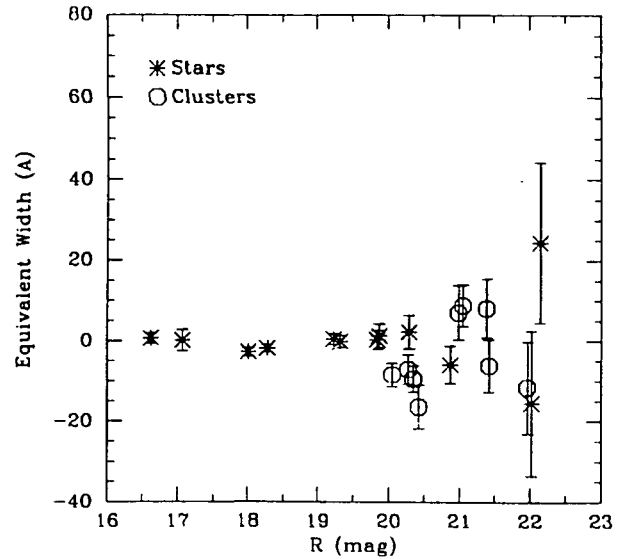
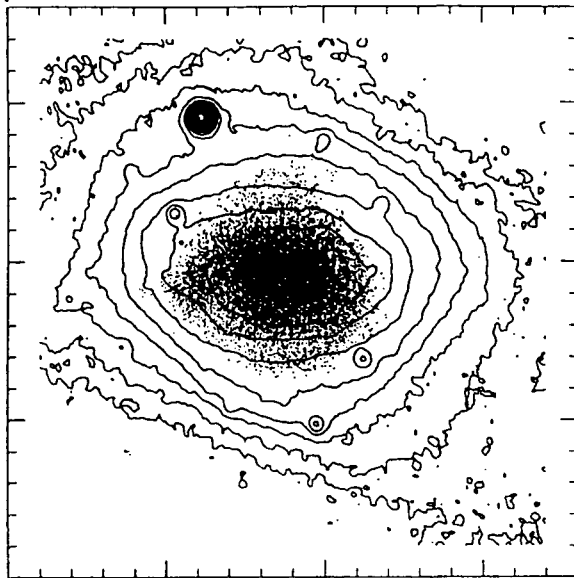


Fig. 1: Left: Continuum-subtracted $H\alpha$ image of the central region of NGC 3597 (greyscale), superposed on a narrowband continuum image at a wavelength close to $H\alpha$ (contours). The unresolved blue clusters seen in continuum light do not show up in $H\alpha$. The brightest unresolved object is presumably a foreground star. Right: Equivalent width of $H\alpha + [N II]$ for the brightest clusters and foreground stars. Data are derived from DAOPHOT analyses in the light of the line and at two neighbouring continuum wavelengths, and are corrected for differences in continuum colour. The equivalent width in the clusters is certainly lower than 20\AA , or the line even in absorption, implying that none of the clusters is still actively forming stars.

Fig. 2: Simulated colour-magnitude diagram for the globular cluster system of a merger that has been allowed to evolve for 5 Gyr. It is assumed that half of the clusters have been formed during the merging event, and now are on average 1 mag brighter and 0.1 mag bluer than the old clusters (mean $B-V=0.7$). No clear signature of the merging event can be seen, the reddening of the average colour from the bright end towards fainter magnitudes is marginal above the limit where errors and background contamination start to interfere.

Assumptions for this plot: Total number of clusters 2000, Virgo distance modulus, (excellent) limiting magnitudes $B=26.5$ and $V=26$. Different symbols denote "young" globulars (squares), "old" globulars (circles), foreground stars (asterisks) and unresolved background galaxies (crosses).

