OBSERVATIONAL MANIFESTATIONS OF SEQUENTIAL STAR FORMATION IN GIANT STAR-GAS COMPLEXES OF THE GALAXY

T. G. SITNIK
Sternberg Astronomical Institute
13 Universitetskij prospect
Moscow V-234,119899
USSR

ABSTRACT. The age distribution of stars and stellar groupings was studied in the galactic large-scale star-gas complexes (SGCs).

1. GALACTIC STAR - GAS COMPLEXES

Seventeen giant (170-700 pc) SGCs apart from the Local System have been detected within 3 kpc from the Sun (Fig.1) [1]. These SGCs include about 90% of stellar groupings (OB - associations and open o-b2 clusters) younger than 2-3 10^7 yrs and molecular clouds with masses 10^5-$10^6 M_0$. The largest SGCs with the dimensions of 300-700 pc are connected with HI superclouds' remnants, whose initial mass could be about 10^7-10^8 M_0. The large-scale complexes contain ten or more stellar groupings.

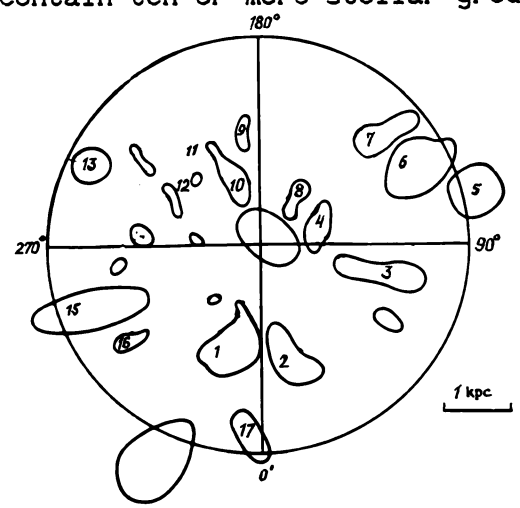

Figure 1. SGCs projected onto the galactic plane. The Sun is at the center

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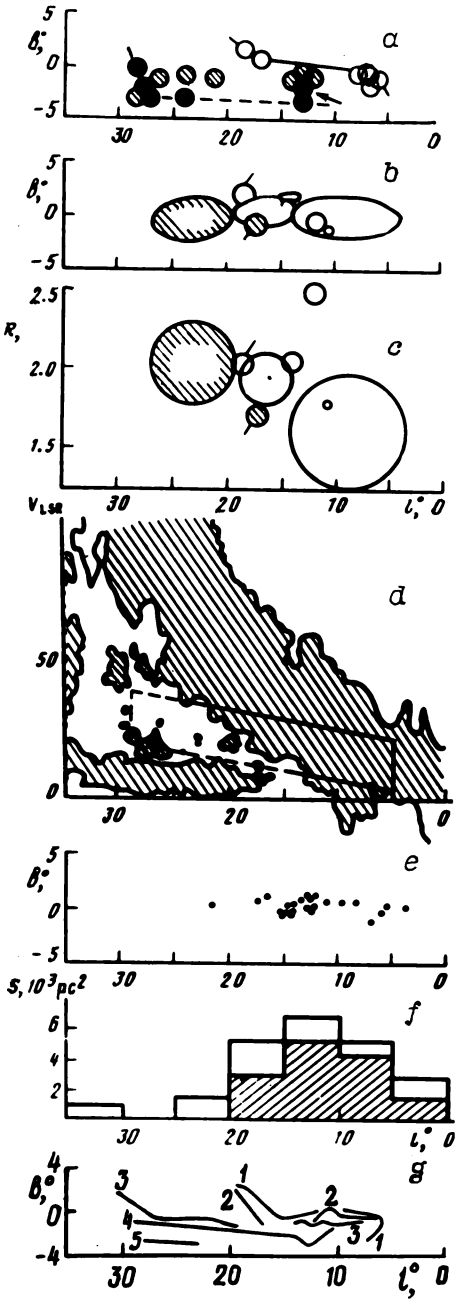

Figure 2. SGC2

2. THE AGE GRADIENT OF STAR GROUPINGS

We have held the detailed investigation of all eight large-scale SGCs and of the nearby aged clusters whose spectral types were later than b2 [2]. It was found that in the seven SGCs there is a gradient of the OB-associations' ages equal to (0.3-1.2) 10^7 yrs for the distances 0.3-0.5 kpc. Moreover the age of the stellar groups is changing sequentially from one edge of the SGC (HI supercloud) to the other one. In the interstellar medium the exis - tence of the regions with the different ages manifests itself in the following way. The giant molecular clouds with masses $M \gtrsim 10^5 M_\odot$, young H_2O masers and HII regions are associated mostly with stellar associations which are not older than $6.5\ 10^6$ yrs. The discussed situation is illustrated by the example of the SGC2 (Fig.2). SGC2 (Fig.1) is located in the Sgr arm at the distances 1.2-2.0 kpc. Clusters of early spectral types (open circles on Fig.2a), young OB-associations with $t \lesssim 6.5\ 10^6$ yrs (they are not shaded on Fig.2b, c), molecular clouds (inside the marked parallelogram on Fig.2d), HII regions (Fig.2f) and young H_2O-masers (Fig.2e) are localized near the inner border of the arm, whereas the old groups (dark and shaded circles on Fig.2a,b,c) are closer to the outer one.

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3. THE STRATIFICATION OF THE INDIVIDUAL STARS OF VARIOUS AGES

We have also explored the distribution of the youngest and the evolved stars in the SGCs [3] . The youngest objects are OV stars with the initial masses greater than $30M_\odot$. The evolved objects are less massive supergiants with $M_{in} \ll 15M_\odot$. WR stars and Cepheids. We included the o-aO open clusters and H_2O masers, connected with the sites of star formation into our examination. The age of the stars was determined by means of the evolutionary tracks with mass loss [4]. The Cepheids' age was determined from the period age relationship [5]. The age of the open clusters was found from the absolute stellar magnitude of the brightest main-sequence star [6]. All these objects were used for the construction of the isochrones. The obtained results are shown again by the example of the SGC2. As it is seen from Fig. 2g, the spatial stratification of the stars of different ages is observed in the SGC2 even in (l,b) plots without using the less accurate coordinate - the distance.

The isochrone 1 corresponds to $t \ll 6.5\ 10^6$ yrs, 2 - $t \ll 8\ 10^6$ yrs, 3 - $(1.8\text{-}3.7)\ 10^7$ yrs, 4 - $(4\text{-}5.4)\ 10^7$ yrs, 5 - $t \gg 8\ 10^7$ yrs. Only about 9% of the 76 objects investigated lies out of the obtained isochrones. Thus in the SGC2 the relative displacement of the individual stars of different ages is observed, similar to that found earlier for the stellar groupings. The age change occurs across the Sgr arm at some angle to the plane $b = 0^\circ$: the older regions are mainly localized below the plane $b = 0^\circ$ and at greater l's , young regions - above the older ones and at smaller l's.

4. CONCLUSIONS

The obtained picture of the distribution of different components inside the SGCs - star groupings and individual stars of various ages, interstellar clouds and young H_2O masers is typical for seven out of eight largescale SGCs. A natural explanation is the following. The shock wave is propagating across the HI supercloud with molecular clouds inside. The generations of stars with different ages are born sequentially behind the shock front. The observed age gradient across the Car-Sgr arm gives

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evidence that star formation in all the three SGCs (1, 2,15 on Fig.1) of this arm is connected with a spiral density wave. Perhaps the Cygnus arm is lying near the corotation radius, since there is no age gradient across this arm [2]. The direction of the age's changing is different in all the three Cas-Per arm's SGCs. It cannot be excluded that in SGC6 a "reverse" age gradient is observed.

The existence of the described above SGCs confirms the hypothesis about large-scale star formation concentrated in supergiant HI clouds with embedded giant molecular clouds [7,8]. The components of stellar population and of the interstellar medium earlier united into SGCs on the basis of their close spatial location are indeed physically interconnected.

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