Study of the massive stellar population in M 31 galaxy, based on photometric data

Todor V. Veltchev
Department of Astronomy, University of Sofia
eirene@phys.uni-sofia.bg
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Изследване на масивното звездно население на галактиката M 31, базирано на фотометрични данни

Тодор В. Велчев. Анотация на дисертация

In the observational astronomy, the term "massive stellar population" comprises stars with high bolometric luminosity that are easily detected on astronomical images of nearby galaxies and allow high-precision photometry. Due to their fast evolution, such objects are young ($t \leq 10^7\ yr$) and thus delineate regions of current star formation. Most of the massive stars build up hierarchical structures (associations and clusters), often embedded in gas/dust clouds. They interact intensively with the interstellar medium through ionizing radiation, stellar winds and SNe bursts and are agents of its chemical enrichment. Therefore a study of the massive stellar population is of crucial significance for undestanding the star formation processes in galaxies and their evolution.

We study the formation and the characteristics of the massive stellar population (OB stars and red supergiants) in the nearby M 31 galaxy using broadband CCD photometry data, mainly from the archives of HST, 2MASS and UIT. As a preliminary step of the research, models of rotating massive stars from the Zero Age Main Sequence were developed and the effect of implementation of the opacity tables OP on the photometric characteristics was estimated. Further, by use of evolutionary tracks and isochrones for non-rotating stars, based on OPAL opacities, we solve several problems:

- Smoothed maps of the spiral arm S4 in the optical and near infrared range are constructed. They reveal spatial anticorrelation between the radiation from the OB stars and that of the neutral hydrogen clouds ($\lambda \sim 21\ cm$) which points – together with the high blue-to-red stars ratio in the complexes OB 78 and OB 79, – to a recent starburst. On the NIR map, the arm S4 appears narrower than in blue light (traced through the OB associations). This could be interpreted as an evidence for stochastic star formation after a passage of spiral density wave.
- Further evidence of stochastic star formation (in several bursts) within the boundaries of the stellar complexes is supplemented through the reconstruction of the star formation history in the giant complex NGC 206.
- Three different samples of RSG candidates with their mass estimations are selected. Five objects have masses $> 20\ M_\odot$ which raises again the theoretical problem about the upper mass limit of RSGs.
- The metallicity Z as a function of the galactocentric distance in M 31 is estimated by use of photometric data for 74 RSG candidates. The lack of pronounced metallicity gradient in M 31 is confirmed.
- The derived slope $\Gamma = -1.59 \pm 0.09$ of the average initial mass function (IMF) for 50 OB associations in the South-Western part of M 31 is close to the universal Salpeter's law ($\Gamma = -1.35$) and to recent estimates for massive stars' IMF in the Galaxy and in the Magellanic Clouds. This hints at similar mechanisms and parameters of star formation in M 31 in comparison with the Milky Way and the Magellanic Clouds.

Key words: galaxies, M 31