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THE STELLAR POPULATION STUDY OF THE POLAR RINGS IN THE GALAXIES NGC 2685 AND NGC 4650A

G. M. Karataeva,[1] I. O. Drozdovsky,[1,2] N. A. Tikhonov, [3] O. A. Galazutdinova[3] and V. A. Yakovleva[1]

Polar ring galaxies (PRGs) are dynamically peculiar systems with a ring or annulus of gas, stars and dust orbiting in a plane nearly perpendicular to the equatorial plane of the host galaxy (Withmore 1990). According to the most popular point of view, PRGs are the result of galaxy interaction, which ranges from simple gas accretion to a complete merger. Alternatively, polar rings can represent the delayed inflows of primordial gas. Therefore the problem of PR's age is actual (Eskridge & Podge 1997; Gallagher et al 2002). Deep single-star photometry can directly identify stars in various evolutionary phases through their positions on CMD. This can cast light on the origin and evolution of PRGs.

We make use of archival HST/WFPC2 data of NGC 2685 and NGC 4650A.

NGC 4650A is a prototypical PRG with extraordinary extended polar ring (Sersic 1967). The optical CMD that is the result of single-star photometry is shown in Fig. 1, left. In the region $B - I_c > 3$ stars of our Galaxy are distributed in a disorderly manner over the image of the galaxy. The stellar population from the "blue" plume is concentrated in the ring area following its structure and is practically absent at the periphery. Keeping the few candidates for red supergiants in mind, we can conclude that the last star-formation outbreak took place not long before 10 Myr.

NGC 2685 (Arp 336, also known as "The Helix galaxy" and "The Spindle") has long been known to be an unusual galaxy (Sandage 1961). The CMD for NGC 2685 is presented in Fig. 1, right. As compared with CMD for NGC 4650A, it is more complete and must include fewer unresolved diffuse objects, but still it does not reach the area of red giants. Both the red and blue supergiants of the polar ring tend to gather into stellar associations. The number of red supergiants is quite small. The branch of blue supergiants is wide and red-shifted. We estimated a color excess as $E(B - I) \sim 0.5$.

We constructed a luminosity function of blue stars for both galaxies. The slope of luminosity functions is 0.59 ± 0.02 for NGC 4650A and 0.66 ± 0.01 for NGC 2685, in agreement with those obtained for the disks of spiral galaxies (Freedman 1985).

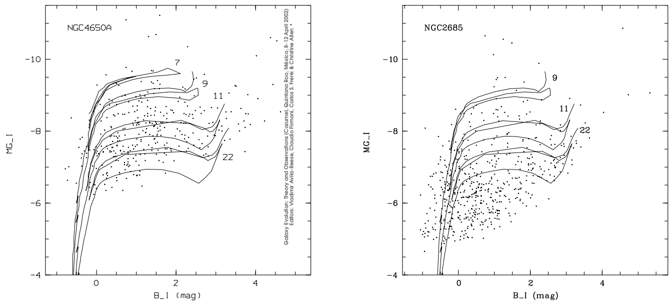

Fig. 1. $(B - I)_0, M_{I_0}$ CMDs of NGC 4650A and NGC 2685. Stellar isochrones for the metallicity of Z=0.008 from the Padova library are overplotted.

Figure 1 also presents isochrones for stellar populations of to various ages (7,9,11 and 22 Myr). The star-formation process goes on continuously, and the last star-formation outbreak in NGC 4650A possibly took place later than in NGC 2685.

Our research is the first one relating to resolvable stellar populations in the polar rings. The data show that the distribution of the brightest blue stars and red supergiants is clumpy and follows the stellar associations and HII regions. The CMDs are populated by stars in a range of evolutionary phases: young BSG, and RSG stars, young and intermediate-age BL and possibly the brightest AGB stars. The detection of older stars (e.g. red giants) would allow in future to further constrain to the age of PRs in these galaxies.

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[1]Astronomical Institute of St.Petersburg State University, 28 Universitetsky pr., Petrodvoretz, 198504, St.Petersburg, Russia (narka@astro.spbu.ru).
[2]Department of Physics & Astronomy, University of Pittsburgh, USA
[3]Special Astrophysical Observatory, Russia