THE NATURE OF BLUE COMPACT DWARF GALAXIES

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The studies of blue compact dwarf (BCD) galaxies at the Main Astronomical Observatory of the National Academy of Sciences of Ukraine are reviewed. The following problems are discussed: 1) the importance of BCDs for cosmological studies; 2) properties of extremely metal-deficient BCDs; 3) a primordial helium abundance and the baryon mass fraction in the Universe; 4) heavy element abundances in large samples of BCDs; 5) properties of massive stellar populations; 6) properties of the oldest stellar populations; 7) the evolutionary status of BCDs.

The question of whether there are young star-forming galaxies in the local universe, is for the first time of considerable interest for the galaxy formation and cosmological studies. There are several reasons for this. First, the Cold Dark Matter models predict that low-mass dwarf galaxies could still be forming at the present epoch because they originate from density fluctuations considerably smaller than those giving rise to the giant galaxies ones. Thus, the existence of young dwarf galaxies in the local universe would put strong constraints on the primordial density fluctuation spectrum. Second, while much progress has been made in finding large populations of galaxies at high ($z \geq 3$) redshifts, truly young galaxies in the process of forming remain elusive in the distant universe. The spectra of those far-away galaxies generally indicate the presence of a substantial amount of heavy elements, implying previous star formation and metal enrichment. Thus, it is important to have examples of bona fide young galaxies in the local universe because they can be used as laboratories for studying star formation and chemical enrichment processes in environments that are sometimes much more pristine than those in the known high-redshift galaxies. Moreover, their proximity allows studies of their structure, metal content, and stellar populations with the sensitivity, precision, and spatial resolution that faint distant high-redshift galaxies do not allow. Finally, in the hierarchical model of galaxy formation, large galaxies result from the merging of smaller structures. These building-block galaxies are too faint and small to be studied at high redshifts, while we stand a much better chance of understanding them if we can find local examples.

The blue compact dwarf (BCD) galaxies are the best candidates for being truly young galaxies. Therefore, their detailed studies can shed light on the properties of distant primeval galaxies. They allow also to derive one of the important cosmological parameters, the baryon mass fraction in the Universe, using the helium abundance obtained from spectroscopic observations of BCDs. Such studies were carried out at the Main Astronomical Observatory during the period 1986–2004 in collaboration with researchers from different countries. The main results of these studies were published in the following papers:

a) on the properties of extremely metal-deficient BCDs – in [1, 10, 12, 15–17, 19, 30–32, 35, 36, 40–42, 44–47];

b) on the primordial helium abundance determination – in [9, 11, 22, 23, 26, 28, 29, 38];

c) on heavy element abundances in large samples of BCDs – in [20, 21, 24, 39, 43];

d) on the properties of massive stellar populations – in [1, 3, 13, 14, 18, 19, 37];

e) on the properties of the oldest stellar populations and on the evolutionary status of BCDs – in [2, 4–8, 10, 25, 27, 31–34, 42, 44, 46].

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