STAR-FORMATION HISTORIES OF BLUE COMPACT DWARF GALAXIES

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Abstract. We present the results of a multi-wavelength observational study of actively star-forming dwarf galaxies (also known as Blue Compact Dwarfs). We combine optical, infrared and H-alpha imaging with optical spectroscopy and HI data in an attempt to better understand the stellar population make-up and star-formation histories of this type of galaxy. In particular, we address the long-standing ambiguity concerning the source of the near-infrared flux in BCDs. We find in nearly all cases that there is clear evidence for an older population of stars. However, the currently active starburst often contributes a large fraction of the total near-infrared flux in the form of nebular continuum emission and/or light from hot main sequence stars.

Blue Compact Dwarf galaxies (BCDs) are low mass dwarf galaxies (typical luminosities are 10^7 - 10^9 $L_\odot$) containing one or more super star-formation region(s). The high surface brightness starburst region usually dominates the optical appearance of the galaxy, often to the extent of masking the presence of any underlying, older stellar population. Optical colors are very blue (mean B–V = 0.21 for our sample), and spectra are dominated by line emission. Nebular abundances are typically very low (1/5 - 1/40 solar).

An important question concerning BCDs is their star-formation histories. Their observed properties indicate a very young age. One way to check for an older underlying population is with near-infrared (NIR) photometry. Unfortunately, JHK colors alone don't give an unambiguous result, since they can't distinguish between the case of the IR flux being due mainly to a population of red giants (indicating previous star-formation in BCDs), or being due primarily to red supergiants that are slightly evolved members of the current star-formation episode. Other possible sources of NIR emission in BCDs that can further confuse the issue include hot dust, nebular continuum, and photospheric emission from the O and B main-sequence stars formed in the starburst.

Our approach to solving the ambiguity concerning the NIR emission is to look for differences in the spatial distribution of the blue (B band) and IR (H band) fluxes. This was done by creating calibrated B–H images and looking for color gradiants. A sample of roughly 20 BCDs were observed with both optical CCDs (UBVRI plus Hα narrow-band) and IR arrays (JHK). The galaxies chosen represent some of the more extremely active star-forming dwarfs known. In all cases (except I Zw 18), large changes in the B–H color between the star-forming region(s) and the outlying portions of the galaxy are visible, indicating that the extended NIR flux is coming from a population of stars that is distinct from the current starburst population. JHK colors of most BCDs are consistent with them being due to a mixture of light from a quiescent older population (colors like normal irregular galaxies) plus a sometimes very strong component due to the young hot stars. Nebular continuum emission is also a major contributor to the NIR fluxes in some objects. Red supergiants undoubtedly contribute to the total NIR flux as well, but in no cases does it appear to be the dominant source.