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Photometric properties of young blue compact dwarf galaxy candidates

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A tiny fraction (<1%) of very metal-deficient (12+log(O/H)$\leqslant$7.6) blue compact dwarf (BCD) galaxies exhibits a nearly galaxy-wide starburst activity and no signatures of an old stellar host galaxy. The evolutionary status and formation history of these most metal-deficient BCDs are still a subject of debate. Various lines of evidence suggest, however, that these systems do not contain a substantial population of stars older than ∼1 Gyr and hence qualify as nearby young-galaxy candidates. Elaborated multiwavelength studies of these rare, most metal-deficient BCDs may therefore provide crucial insights into the formation and starburst-driven evolution of low-mass galaxies in the early universe.

In particular, these extremely metal-poor BCDs constitute excellent nearby laboratories for studying high-ionization emission and the hardness of the ionizing radiation in nearly pristine extragalactic environments. If we wish to understand the spectra of primeval galaxies, it is highly important to understand how the UV radiation field of these systems changes as metallicity decreases. It is well established that the lower the metallicity, the harder is the radiation from massive stars (Campbell *et al.* 1986). As a consequence, strong high-ionization lines are expected in the spectra of these most chemically unevolved BCDs. Indeed, deep spectroscopy has led recently to the discovery of high-ionization emission lines, such as [Fe V] λ4227 and [Ne V] λ3346,3426, in addition to strong He II λ4686 emission, in a few of the most metal-deficient star-forming galaxies known in the local universe, as e.g. the young BCD candidates Tol 1214–277 (Fricke *et al.* (2001), Izotov *et al.* (2004); cf. Fig. 1b, d) and SBS 0335–052 (Izotov *et al.* (2001); see Fig. 1c). Evidently, spectroscopic studies with large telescopes are crucial for the detection and accurate analysis of those faint spectral features.

In order to assess the photometric structure and evolutionary status of young BCD candidates it is of critical importance to correct for the effect of extended nebular emission, as the latter may severely affect colors and age estimates obtained therefrom. One such example is I Zw 18 (Fig. 1a), the second most metal-poor emission-line galaxy known (12+log(O/H)=7.17...7.23; Thuan & Izotov (2005)). This system is embedded within a filamentary low-surface brightness (LSB) envelope, extending out to 18$''$ (∼1.3 kpc, assuming a distance of 15 Mpc) from its star-forming regions. Papaderos *et al.* (2002), using broad- ($BVRI$) and narrow-band (Hα, [OIII]) HST data, have shown that the extended LSB envelope of this young BCD candidate is entirely due to nebular line emission: ionized gas accounts for more than 80% of the line-of-sight emission at a galactocentric distance of 8$''$ (∼0.65 kpc) and for up to 50% of the total R light of I Zw 18. Consequently, a twodimensional subtraction of ionized gas emission is indispensable for a meaningful study of the photometric structure of this system. As evident from Fig. 1b, this correction leads to the complete removal of the filamentary LSB envelope in IZw18's main body, leaving behind a very compact (exponential scale length $\alpha \approx 120$ pc) dwarf galaxy (see Papaderos *et al.* (2002) for details).

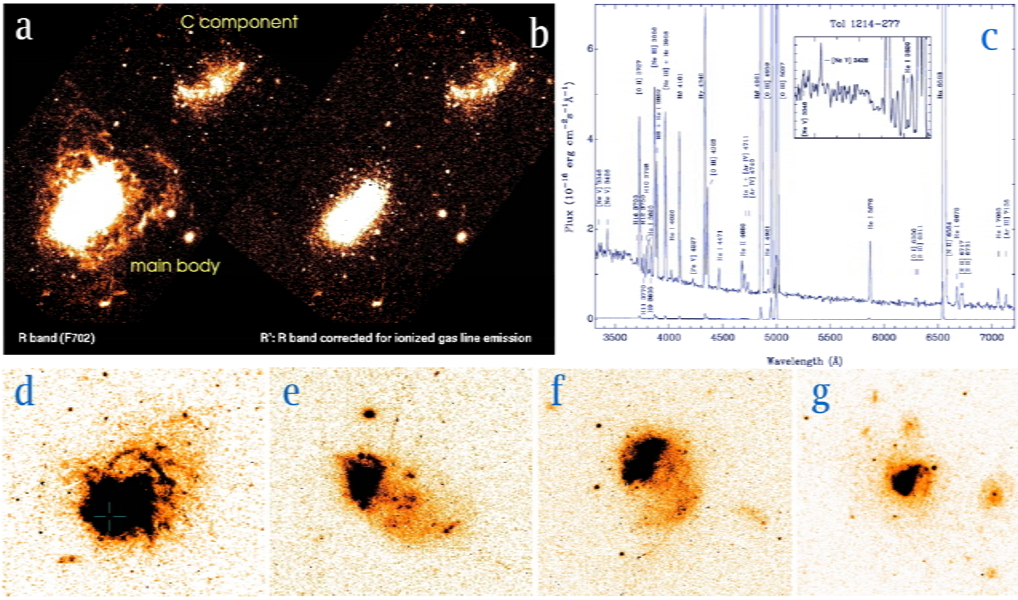

Figure 1. (a&b) Archival HST WFPC2 exposure of I Zw 18 (D=15 Mpc) in the R(F702W) band prior to and after subtraction of nebular line emission. **(c)** The redshift-corrected spectrum of the brightest HII region in the low-metallicity (12+log(O/H)=7.51) BCD Tol 1214–277 with labelled emission lines (from Izotov *et al.* (2004)). The lower spectrum is the observed spectrum downscaled by a factor of 50. The inset shows a close-up view of the blue part of the spectrum with the two high-ionization [Fe V]λ4227 and [Ne V]λ3426 lines. **(d–g)** HST WFPC2 exposures of the young BCD candidates SBS 0335–052 E (D=54.3 Mpc), Tol 1214–277 (D=104 Mpc), Tol 65 (D=36 Mpc) and Pox 186 (D=18.5 Mpc).

Other examples of young BCD candidates with colors significantly affected by intense, spatially extended nebular line emission are SBS 0335–052E (Fig. 1d; Thuan *et al.* (1997), Papaderos *et al.* (1998), Izotov *et al.* (2001), Pustil'nik *et al.* (2004)), Tol 1214–277 (Fig. 1e; Fricke *et al.* (2001), Izotov *et al.* (2004)), Tol 65 (Fig. 1f) and Pox 186 (Fig. 1g; Guseva *et al.* (2004)).

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References

Campbell, A., Terlevich, R. & Melnick, J. 1986, *MNRAS* 223, 811

Fricke, K.J., Izotov, Y.I., Papaderos, P., Guseva, N.G. & Thuan, T.X. 2001, *AJ* 121, 169

Guseva, N.G., Papaderos, P., Izotov, Y.I., Noeske, K.G. & Fricke, K.J. 2004, *A&A* 421, 519

Izotov, Y.I., Chaffee, F.H. & Schaerer, D. 2001, *A&A* 378, L45

Izotov, Y.I., Noeske, K.G., Guseva, N.G., Papaderos, P. *et al.* 2004, *A&A* 415, L27

Papaderos, P., Izotov, Y.I., Fricke, K.J., Thuan, T.X. & Guseva, N.G. 1998, *A&A* 338, 43

Papaderos, P., Izotov, Y.I., Thuan, T.X., Noeske, K.G., Fricke, K.J., Guseva, N.G. & Green, R.F. 2002, *A&A* 292, 461

Pustilnik, S.A., Pramskij, A.G. & Kniazev, A.Y. 2004, *A&A* 425, 51

Thuan, T. X., Izotov, Y.I. & Lipovetsky, V.A. 1997, *ApJ* 477, 661

Thuan, T.X. & Izotov, Y.I. 2005, *ApJS* 161, 240

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