

## A multi-frequency study of the Wolf-Rayet blue compact dwarf galaxy He2-10

David I. Méndez<sup>1</sup>, César Esteban<sup>1</sup>, Miroslav D. Filipović<sup>2,3,4</sup>,  
Matthias Ehle<sup>2</sup>, Frank Haberl<sup>2</sup> and Raymond F. Haynes<sup>4</sup>

<sup>1</sup>*Instituto de Astrofísica de Canarias,*

*E-38200 La Laguna, Tenerife, Canary Islands, Spain*

<sup>2</sup>*Max-Planck-Institut für extraterrestrische Physik, Garching, Germany*

<sup>3</sup>*University of Western Sydney, Nepean, NSW 2747, Australia*

<sup>4</sup>*Australia Telescope National Facility, CSIRO, NSW 212, Australia*

**Abstract.** We present preliminary results on multi-wavelength observations of the Wolf-Rayet Blue Compact Dwarf Galaxy He2-10. These observations include H $\alpha$  and continuum imaging, high-resolution H $\alpha$  spectroscopy, high-resolution radio-continuum mapping at 6.3 and 3.5 cm and X-ray mapping. The deep H $\alpha$  image reveals that the galaxy consists of a complex system of different star-forming knots surrounded by kpc-scale bubble-like and filamentary structures. The most interesting structure is a bipolar superbubble centered on the most intense star-formation knot. High-resolution spectroscopy of this structure indicates that it is expanding with a velocity in the range 75–250 km s<sup>-1</sup>. This kind of outflows is likely to be produced by the mechanical action of stellar winds and supernovae explosions in the intense starbursts that the galaxy hosts. This scenario is consistent with the finding of a very steep radio spectral index in the extended radio continuum emission ( $\alpha = -0.59$ ) that confirms the presence of a large number of supernova remnants in the galaxy.

### 1. Introduction

Among the Blue Compact Dwarf Galaxies, He2-10 is interesting, as it is the first emission line galaxy found to exhibit evidence for Wolf-Rayet stars in its spectrum (Allen *et al.* 1976). Optical imaging and spectroscopy of He2-10 has been reported by Johansson (1987), Sugai & Taniguchi (1992) and Corbin *et al.* (1993 and references therein). Vacca & Conti (1992) found large numbers of Wolf-Rayet stars in the two nuclear starburst regions, mostly in the brightest one named A (after Corbin *et al.* 1993). He2-10 was also the first BCDG detected in radio-continuum (Allen *et al.* 1976).

### 2. Observations

We have carried out multi-wavelength observations of He2-10 using the Nordic Optical Telescope (*NOT*) at the Roque de los Muchachos (La Palma, Canary Islands) and the Australia Telescope Compact Array (*ATCA*) at Narrabri (NSW, Australia). We have also taken data from the X-ray *ROSAT*-HRI archive.

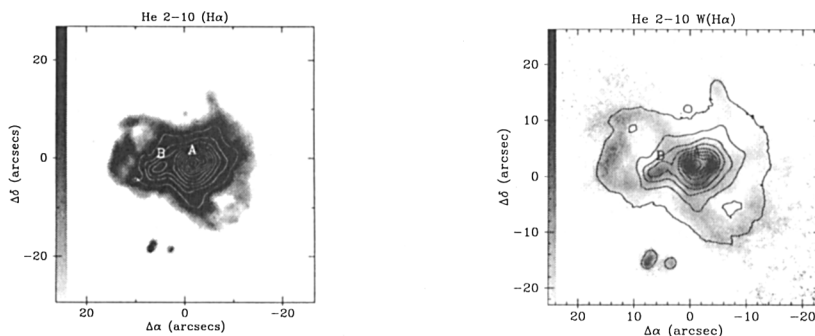


Figure 1. *Left:* Gray-scale representation of He2-10; *Right:* H $\alpha$  equivalent-width map of the central zones of He2-10. The continuum-subtracted H $\alpha$  image is superposed as isocontour plot. North is at the top and East on the left.

### 3. Results

The net H $\alpha$  image shows that emission is distributed in several star-forming knots (Figure 1 left). At low intensities the presence of two bubble-like structures is apparent in the NE direction around knot A, extending out to  $\sim 16''$  from this knot ( $\sim 925$  pc). Our estimate for the radio spectral index of the whole galaxy based on integrated fluxes at 4.8 and 8.64 GHz is  $\alpha = -0.59 \pm 0.05$ . Comparing the total radio-continuum luminosity of He2-10 in our observations with that of the LMC, we estimate a number of  $\sim 3500$  supernova remnants (SNRs) in the galaxy. Assuming an expansion velocity of  $75\text{--}250$  km s $^{-1}$  for the bubble-like structures (obtained from high-resolution H $\alpha$  spectra), we obtain a kinetic energy associated with them of  $0.01\text{--}0.13 \times 10^{54}$  erg s $^{-1}$ . This value is considerably less than  $3.5 \times 10^{54}$  erg s $^{-1}$ , the energy that can be ejected into the surrounding interstellar medium by the  $\sim 3500$  SNRs thought to be present in He2-10 according to our previous estimate. Therefore, the energy involved in the flow is consistent with the action of a galactic wind powered by the massive stars of the starburst. For the X-ray luminosity of He2-10 ( $d = 11.9$  Mpc) we obtain a range of  $L_X = 8.5 \times 10^{39\text{--}40}$  erg s $^{-1}$  for a simple *Bremsstrahlung* model. The best-fit temperature is 0.45 keV, with photoelectric absorption of  $1.8 \times 10^{21}$  cm $^{-2}$ .

### References

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