Wolf-Rayet Phenomena in Massive Stars and Starburst Galaxies
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Radio light-curve for WR 146 (HM19-3, WC6+O8.5), a colliding wind binary*

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Abstract. We report preliminary results of monitoring the flux from the Wolf-Rayet object WR 146 with the *Westerbork Synthesis Radio Telescope* at 21 cm since 1989. We find the average flux density slowly rising in the period 1989–1997, with evidence of shorter time-scale variability.

WR 146 (HM19-3, WC6+O8.5) is the brightest among the radio WR stars. With *WSRT* data, van der Hucht *et al.* (1995) and Setia Gunawan *et al.* (1996) showed the flux density of WR 146 to be varying at both 6 cm and 21 cm, with a time-averaged spectral index $\alpha_{6-21\mathrm{cm}} \approx -0.7$, in accordance with $\alpha_{6-18\mathrm{cm}} = -0.6$ found from *MERLIN* data (Dougherty *et al.* 1996). The spectral indices clearly point to a non-thermal source, since, in practice, $\alpha \approx +0.8$ is expected from a free-free stellar wind (see *e.g.*, Williams 1996). A *MERLIN* 6-cm image of WR 146 (Dougherty *et al.* (1996) resolved the system in two components: a bright non-thermal northern and a weaker thermal southern component separated by 116 ± 14 mas.

We have been monitoring the system with the *WSRT* since 1989 at 21 cm. The radio components of WR 146 resolved by *MERLIN* can not be resolved by the *WSRT* and thus we observed the total flux densities of the system. Some of the data were obtained in full 12-hr observing runs, but most of them in filler time of a few hours. The reduction of the data, which includes calibration and mapping, was carried out with the *WSRT*-NEWSTAR software package. The data were flux-calibrated with one of the major calibrators, observed immediately before and/or after WR 146. Some of them were combined to make an as complete as possible 4×12^h map, which was subsequently CLEAN-ed. From this map we obtained a model of the field, which includes discrete and extended sources. We used a least-squares technique to fit the model to the observed visibilities, using the NEWSTAR-UPDATE procedure.

We plot the flux densities obtained with UPDATE as a function of time in Fig. 1. The error bars are a combination of the thermal noise and the error

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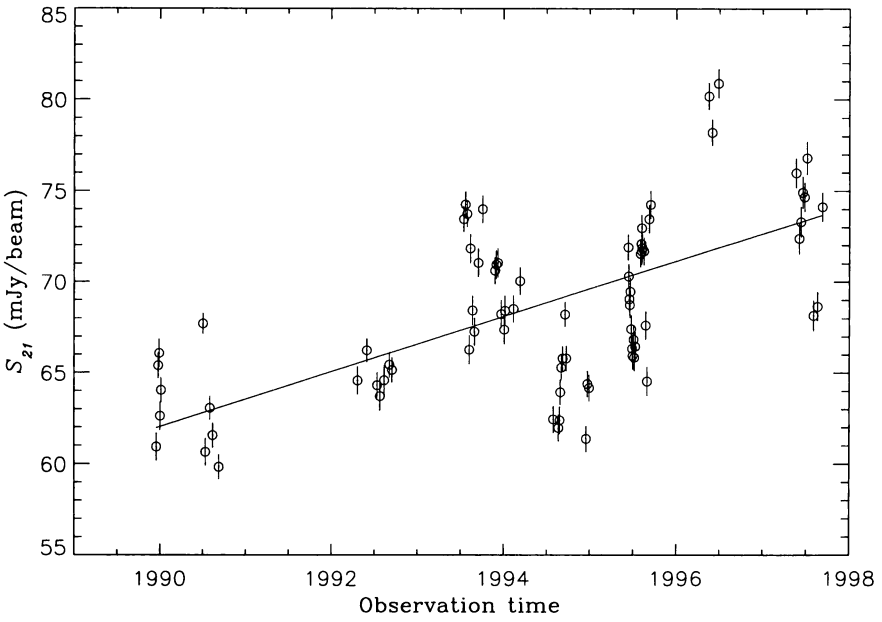

Figure 1. *WSRT* 21-cm monitoring of WR 146

introduced by using different calibrators (less than 1.5% of the flux density). The thermal noise for a typical 2^h filler observation of the galactic plane area is about 0.25 mJy.

It is evident that there are variations on time-scales of weeks to years, of up to ± 8 mJy, superimposed on a slowly rising flux density from ~ 62 mJy to ~ 73 mJy over the period 1989–1997. We show a linear model fitted to the light-curve, using the robust least-squares absolute deviation method. A full analysis of the WR 146 21-cm light-curve will be submitted shortly to A&A.

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