Radio light-curve for WR 146 (HM19-3, WC6+08.5), 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+08.5) 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 $\alpha_{6-21\text{cm}} \approx -0.7$, in accordance with $\alpha_{6-18\text{cm}} = -0.6$ 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 $4 \times 12^h$ 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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introduced by using different calibrators (less than 1.5% of the flux density). The thermal noise for a typical 2h 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.

References


