Baseline ripples in the Effelsberg 100m secondary focus receivers

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1 Introduction

This report is based on recent test observations done with the Effelsberg 100m telescope at the secondary focus. The spectroscopic observations done with the secondary focus receivers are often found to have a frequency baseline structure. This might pose serious problems in the accurate measurement of the lines especially for weak lines. Baselines of a ghastly order (10 or higher) have to be subtracted to filter out the ripples. These ripples are found towards sources which have a strong continuum and are caused by the standing waves between the various antenna structures mainly the sub reflector and the feed of the antenna. The MPIfR Technicher Bericht no. 75 (Bania et al. 1993) explains the test observations done and the technique to minimize the baseline structure. The standard procedure to minimize the ripples is to make defocussed measurements at $\pm\frac{\lambda}{8}$ alternatively and to average these measurements. For a perfectly sinusoidal baseline structure, this would cancel the ripples. But since there are multipath reflections with different periods, the residual retains some ripple.

2 Recent Test Observations

In order to check whether the installation of the new subreflector since the last test (1993) has improved the system, a similar test was performed at 4.8 GHz in August 2004. The spectrometer was a 8192 channel autocorrelator which was used with a single subunit of 20 MHz bandwidth. The peak-to-peak amplitude of the baseline structure is proportional to the source continuum. Hence our test sample comprises of two sources (W3 and W3OH) in the W3 complex, a well known star forming region where W3 has an associated strong continuum source (34 Jy, Wilson et al. 1976). The observations were made in the position switching mode. Towards W3 we find as expected strong baseline ripples and in Fig 1 we summarise the sequence of tests towards it. The lowermost panel shows the original spectrum, the absorption line corresponding to the H_2CO $J_{KaKc} = 1_{10} - 1_{11}$

line at 4.82966 GHz. The middle panel shows the spectra obtained after defocussing by $\pm\frac{\lambda}{8} = 7.76\ mm$ at 4.8 GHz. In the upper panel we plot the spectrum averaged over the defocussed values.

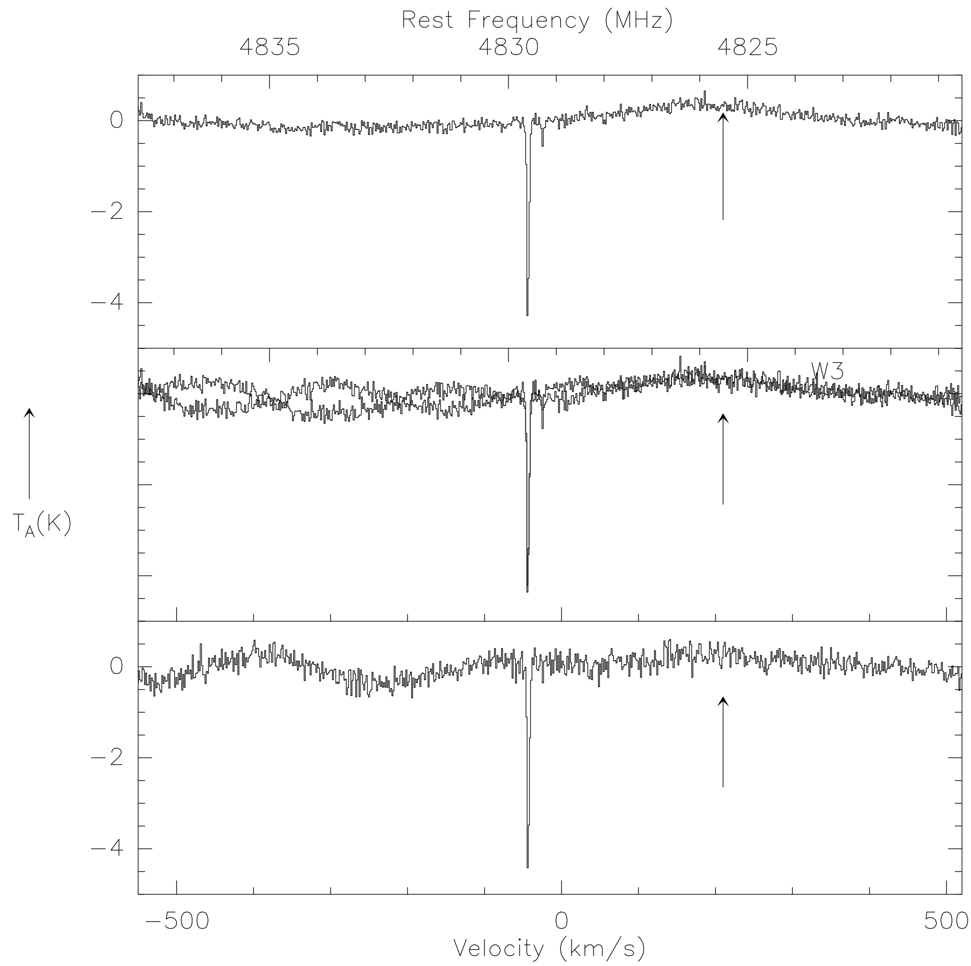

Figure 1: Sequence of the test observations towards W3 (from bottom to top). Refer to the text for details

Fig 2 shows the measurement taken towards W3OH.

3 Discussion

We need to subtract a baseline of order 10 or higher to minimize the ripples in case of W3(lower panel of Fig 1) while a baseline of order 3 is sufficient for the measurement averaged over the defocussed observations(upper panel). On comparing the rms before and after defocussing, we find that the frequency baseline structure improves by at least by a factor of 2 by defocussing. Clearly, the defocussing procedure minimises the ripples but there remains

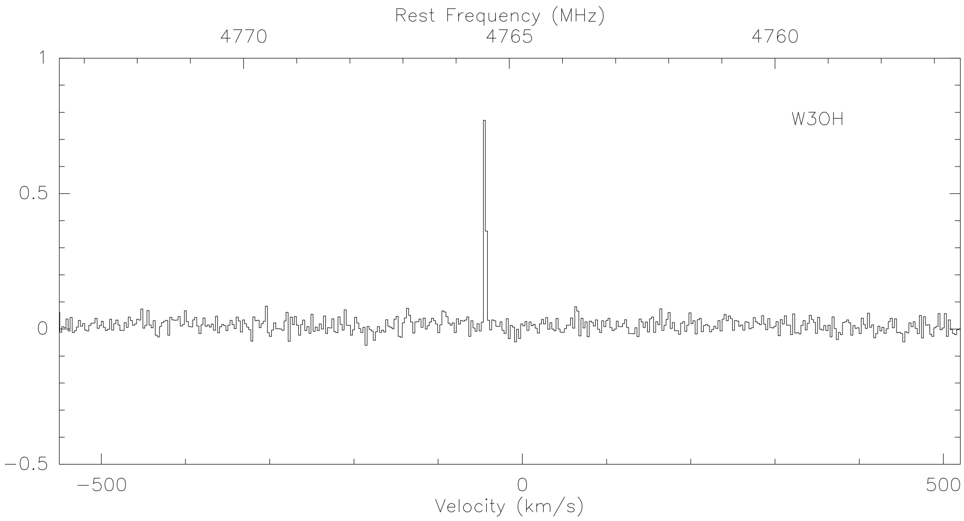

Figure 2: OH spectrum towards W3OH. Note that there are no baseline structures.

a residual structure. The arrow marks point towards the part of the spectra where the residual feature is maximum. The peak amplitude of the feature is $\sim$ 0.3 K, a $\sim$ 0.9% of the continuum level. This feature seems to be unaffected by focus offsets and hence must be of a non-axial origin. OH maser observations in W3OH appear to be free from the baseline structures because of the weak continuum.

Thus the results reported by Bania et al. seems to be similar to ours and demands more rigorous tests as to the nature of these ripples.

References

T.M.Bania, R.T.Rood, & T.L.Wilson 1993, Technischer Bericht Nr.:75

Wilson, T. L., Bieging, J., Downes, D., & Gardner, F. F. 1976, A&A, 51, 303