Internal and External Interference Problems at Effelsberg

(Part 1)

The intention of this first memo is to review some interference problems reported last time from observations with various receivers and the autocorrelators at Effelsberg. There have been some obvious problems during test observations with the **5 cm PFK-rx** (~6.0 – 6.7 GHz), observations with the **1.3 cm PFK-rx** (at ~22,24 and ~23.9 GHz) and test observations with the **18-21 cm PFK-rx** at 18 cm (~1.6 – 1.72 GHz).

Here I report about:

- Internal Interference in the 8192-channel autocorrelator
- Interferences in the 18 cm band
- Measurements with the 5cm PFK

Internal 5 MHz Interference in the 8192-channel correlator

One obvious interference (with a 5 MHz repetition rate) originates in the 8192-ch-correlator because of its 5 MHz frequency supply. Often these interferences do not show any effect in the normal on/off-reduction, because they seem to be very stable in amplitude and frequency. On the other hand these interferences are easy to recognize, because they are exactly at the midfrequency (offset 0 Mhz) and possibly at +/- 5 MHz, +/- 10 MHz etc.. Furthermore it is a very narrow signal with a broadness of only one channel. The cause for the strong increase of that interference is not exactly known until now.

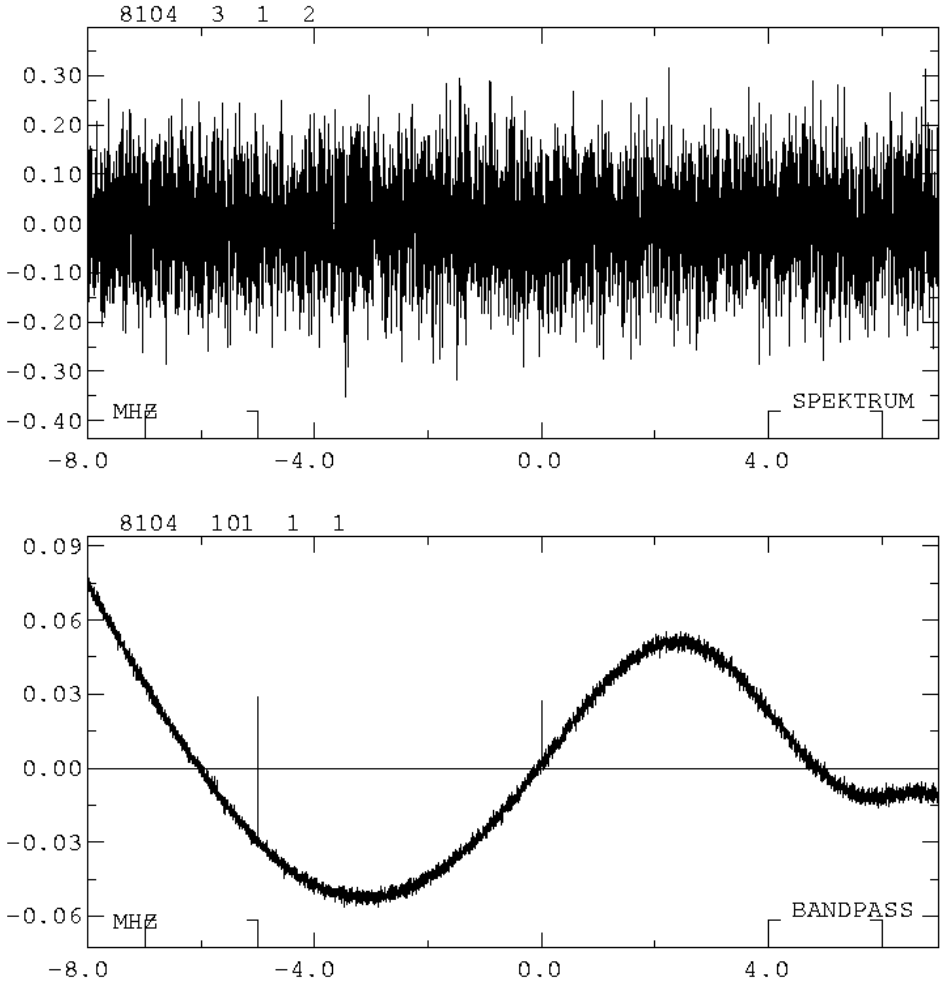
This interference have been suppressed by interventions of B. Klein and H. Wiedenhöver at least by a factor of 20. The following plots show the state before and after the intervention. They are thinking and working on further reduction of these internal interferences in the 8192-ch-correlator.

The plot shows the situation before the interventions. A normal short off/on observations was performed. The noise diode of the 150 MHz if-distribution-unit with its calibration signal served as signal source.

Interferences by the 5MHz frequency supply
in the 8192-ch-correlator

March 2004 / jn

Total Integration: 30 s

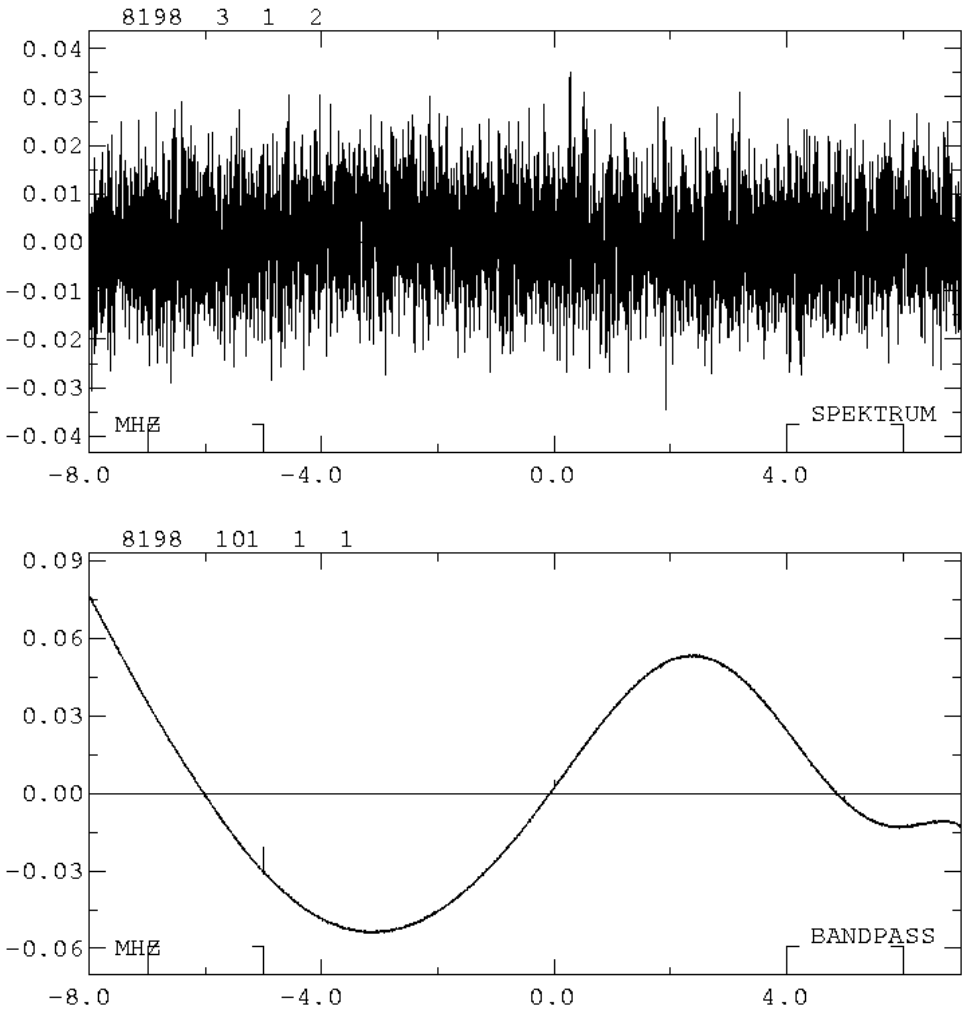


The next plot shows the actual state (after the interbvention). The observations have been made with the same equipment and in the same mode, but with a very long integration time.

Interferences by the 5MHz frequency supply
in the 8192-ch-correlator

March 2004 / jn

Total Integration: 5600 s



Interferences comming out of the building

Apart measurements to found out the originating instruments for interference from our installations (which already have been done in the past and have to be done further on in the future) we hopefully will have improvements, as soon as the Faradayroom will be ready and disturbing instruments put in there. Another improvement will bring the planned fixing of HF-shielding (~30 dB) foils on the windows of the front towards the telescope. The controlroom itself has already a good HF-shielding by the type of windows built in.

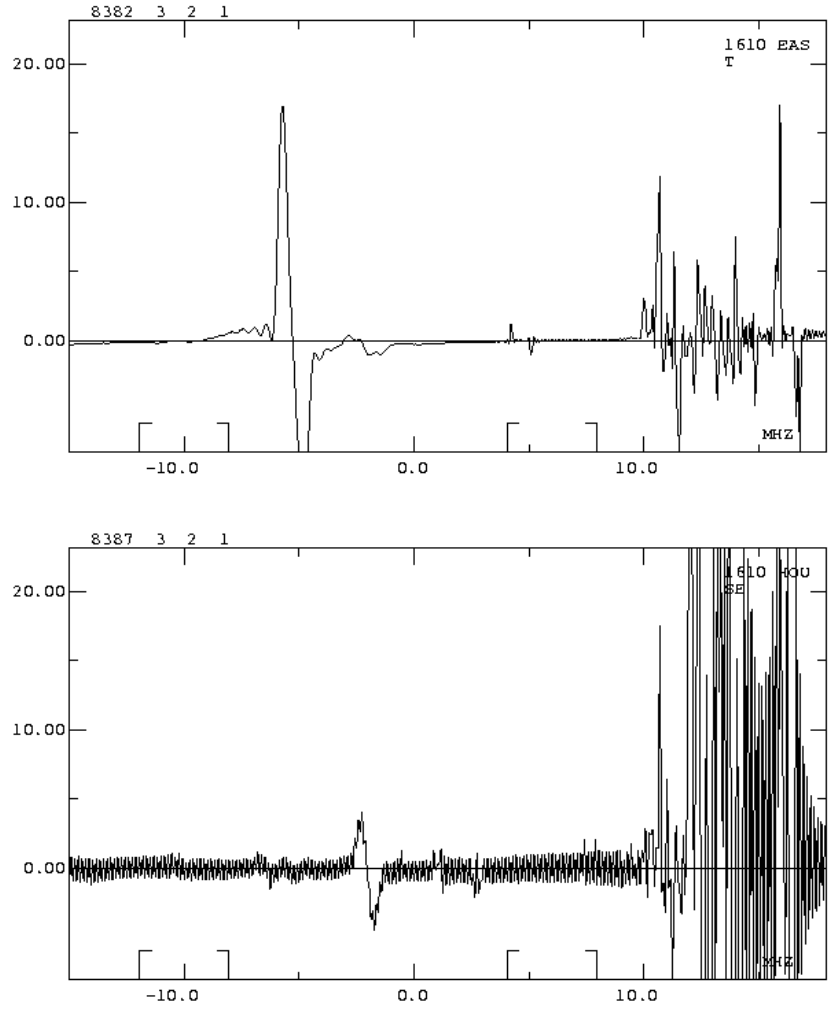
The situation in the 18 cm band (~ 1.6 – 1.72 GHz)

The 18 cm range is well known for its interferences by satellite systems and telecommunication. Beside these external emissions we securely have interferences comming from instruments and installations in the building as we know from measurements in the 21 cm band. There exist three small bands, where radioastronomy is defined to be the main user. These bands are: 1.610 – 1.614, 1.660 – 1.668 and 1.718 – 1.722 GHz.

We made some short technical observations in these bands to find out the possibilities for useful observations. The results from these observations are:

- The low band (around 1.61 Ghz) is full of external interference. Directly beside this band there are very strong emissions from satellite systems, which heavily disturb observations in the protected band. On the other hand there are some interferences comming out of the building, which have to be analyzed. The two plots show the situation in a greater part of the band including the protected area. The observations have been made in the frequency-switch mode (with 1 MHz switching distance) with measurements to north or east away from the building (EAST) and measurements at low elevation directly towards the building (HOUSE).

18cm band
~1595 - 1627 MHz
EAST: towards direction east
HOUSE: towards controlroom



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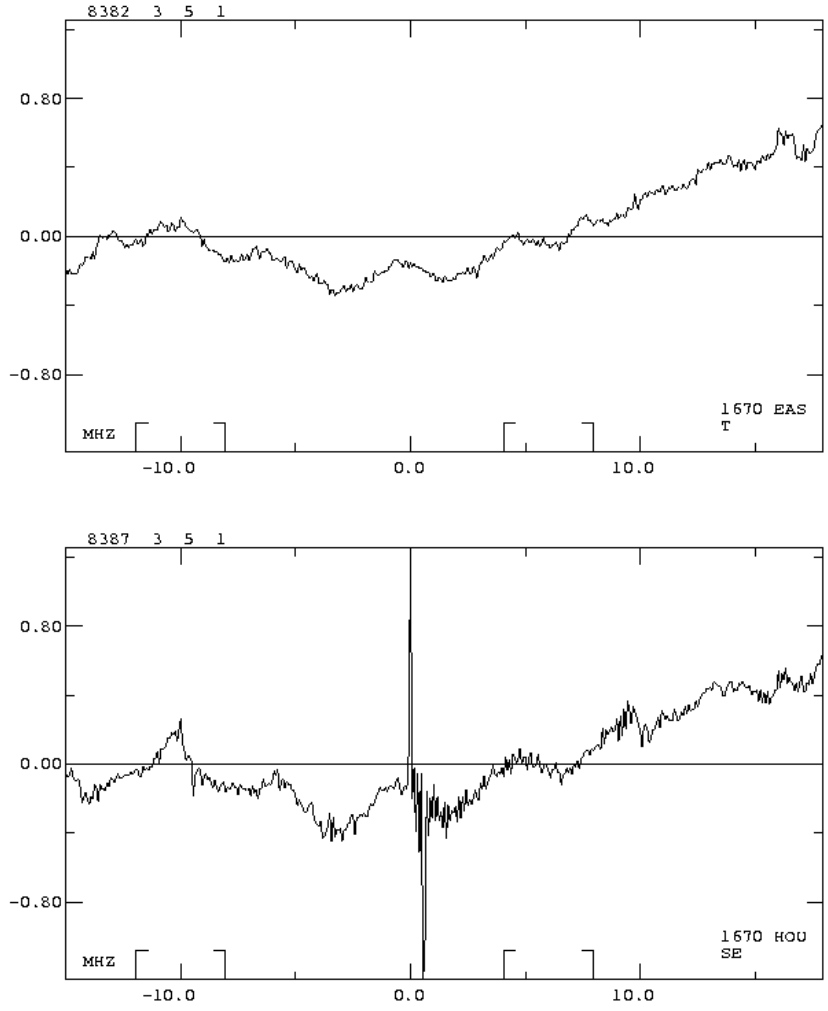
- The middle band (around 1.66 GHz) has some sporadic interferences, but a selection of interference-free scans may give good observational results. Also here we found interferences comming from the direction of the building. The observations have been made in the frequency-switch mode (with 1 MHz switching distance) with measurements to north or east away from the building (EAST) and measurements at low elevation directly towards the building (HOUSE). The next two plots show the situation in a greater part of the band including the protected area.

18cm band
~1656 - 1688 MHz
EAST: towards direction east
HOUSE: towards controlroom



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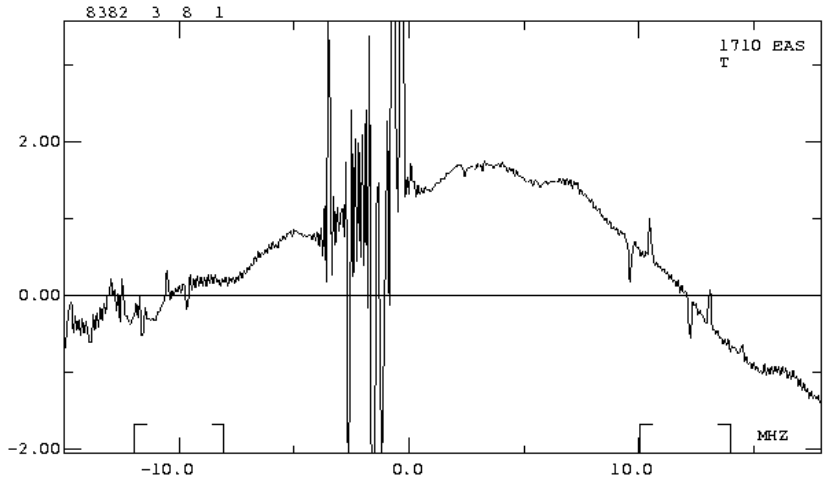
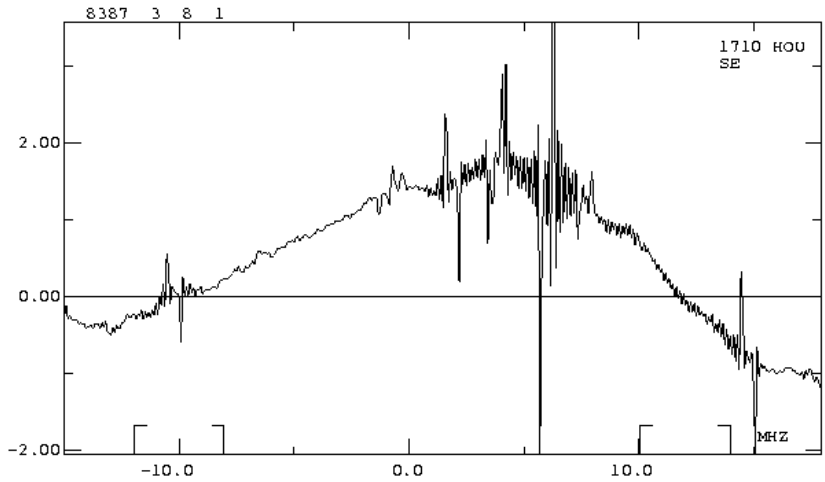
- <u>The high band (around 1.72 GHz)</u> seems to be the best of the three ranges for observations. There have been some sporadic interferences and the elimination of bad scans should give good results. Pointing to the building showed some additive interferences, which have to be found. The next two plots show the situation in a greater part of the band including the protected area. Observations have been made in the same way as before.

18cm band
~1695 - 1727 MHz
EAST: towards direction east
HOUSE: towards controlroom





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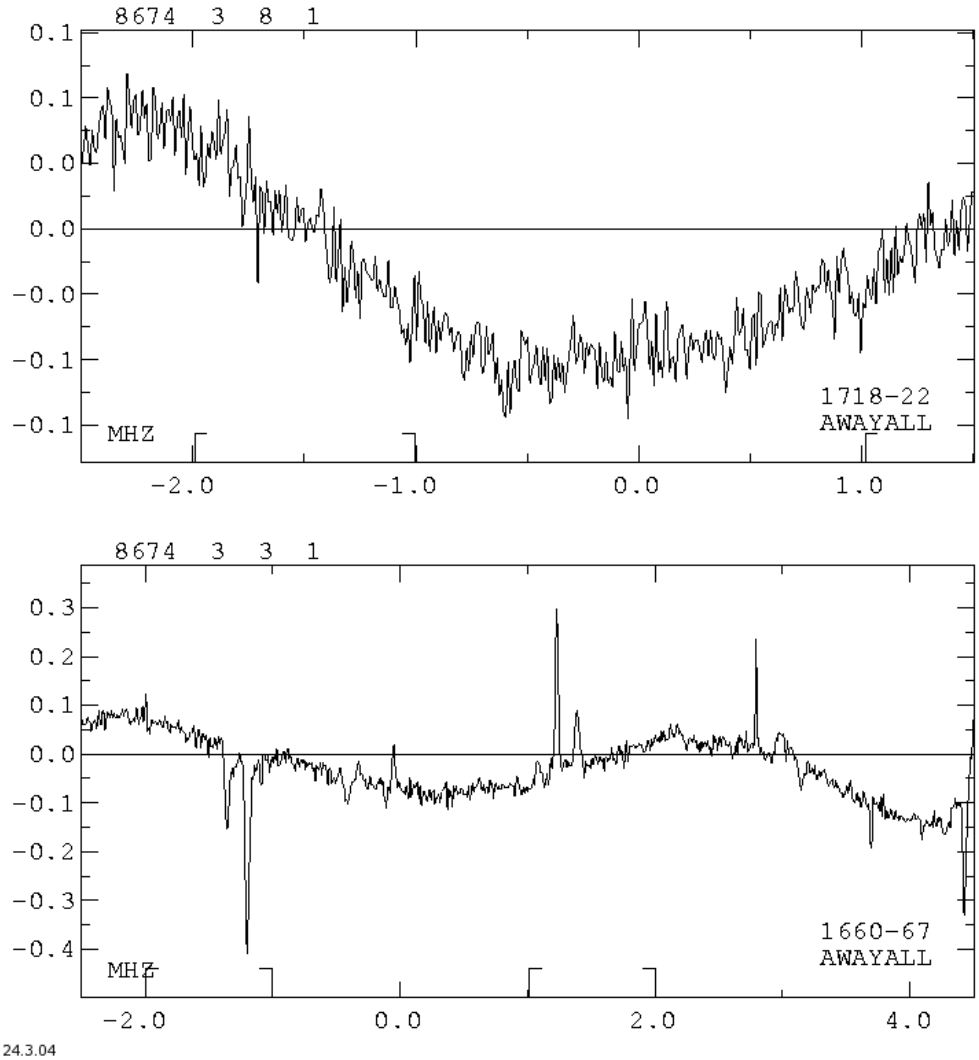
The (protected) astronomical bands:

- The lower part (**1.610 – 1.614 GHz**), as mentioned above basing on our measurements, cannot be used for useful astronomical observations, whereas the other two (protected) bands (**1.660 – 1.668 and 1.718 – 1.722 GHz**) one can use, because the interferences are sporadic and can be well eliminated.

  The next plots show the situation towards the direction east and north away from the building adding up all scans of the observations we did.

Astronomical Bands 18cm
All observed scans
directed towards east and north
(away from controlroom)
integration time ~35 min



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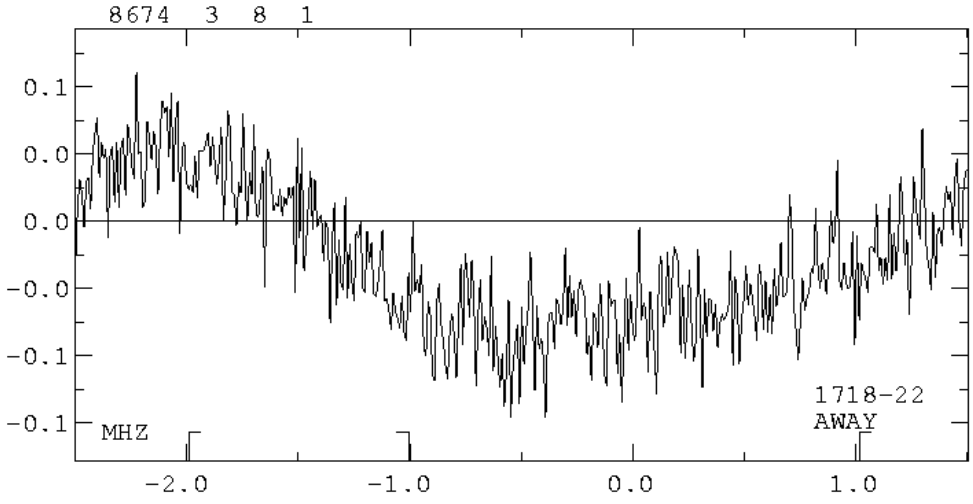
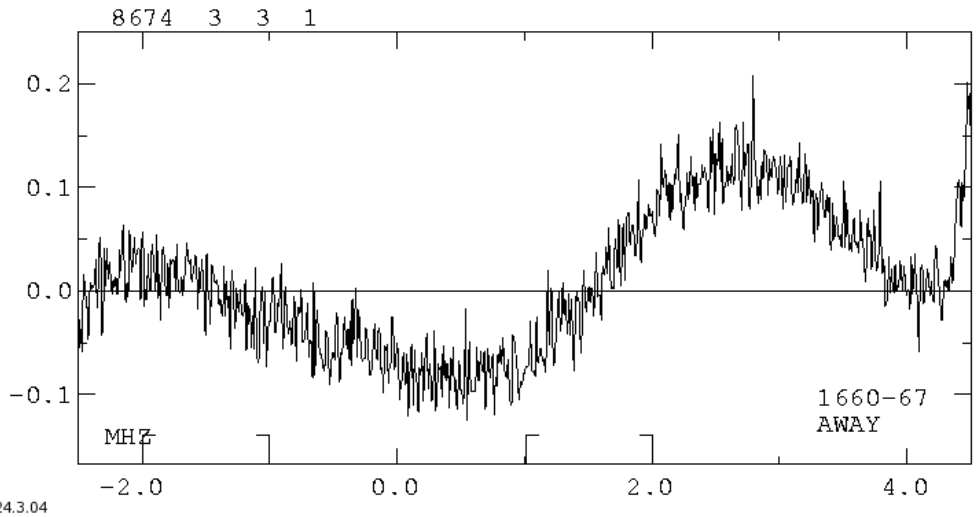
For the following plots all scans (each with an integration time of 5 minutes) showing interferences have been eliminated.

Astronomical Bands 18cm
selected good scans
directed towards east and north
(away from controlroom)
integration time ~15 min





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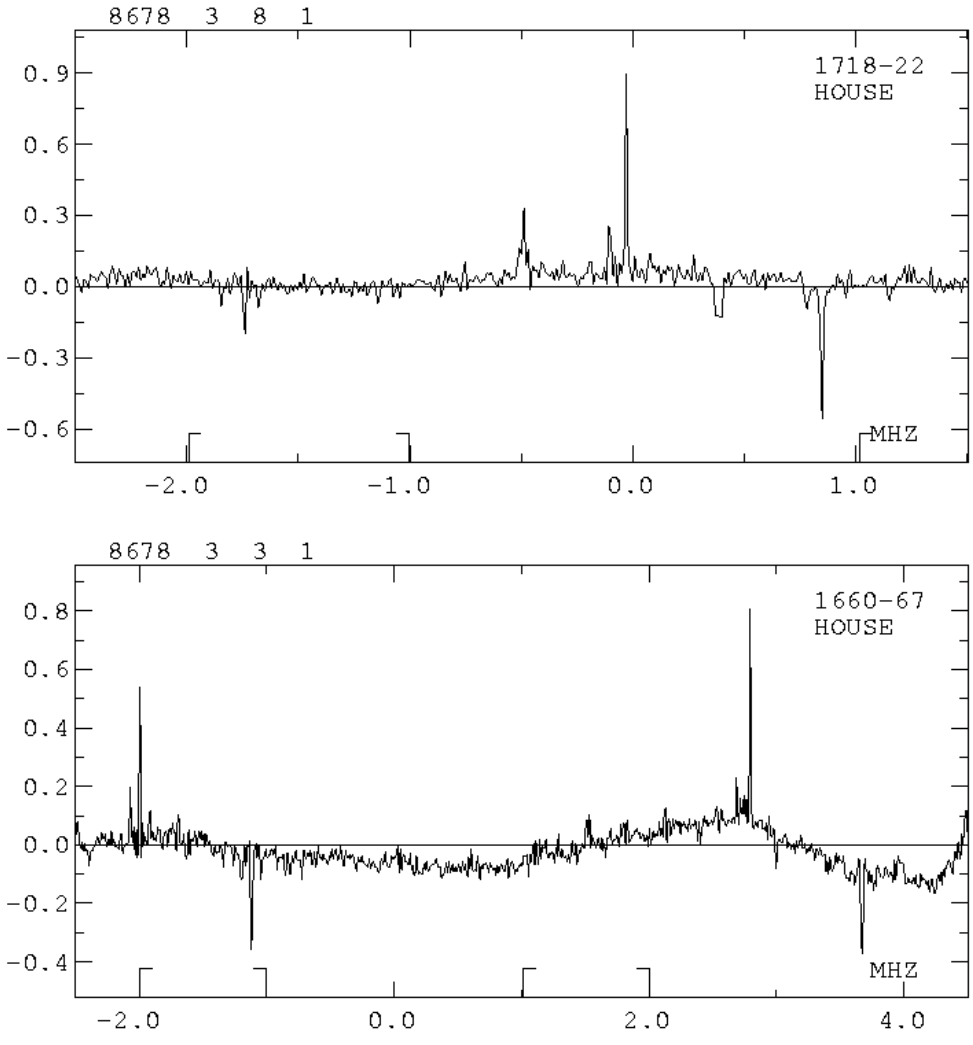
Towards the building we have some more interferences, which have to be analyzed in extra measurements. The next plots show the sum of measurements at different azimut positions with low elevation towards the building.

Astronomical Bands 18cm
directed to controlroom
(different positions)
integration time ~35 min



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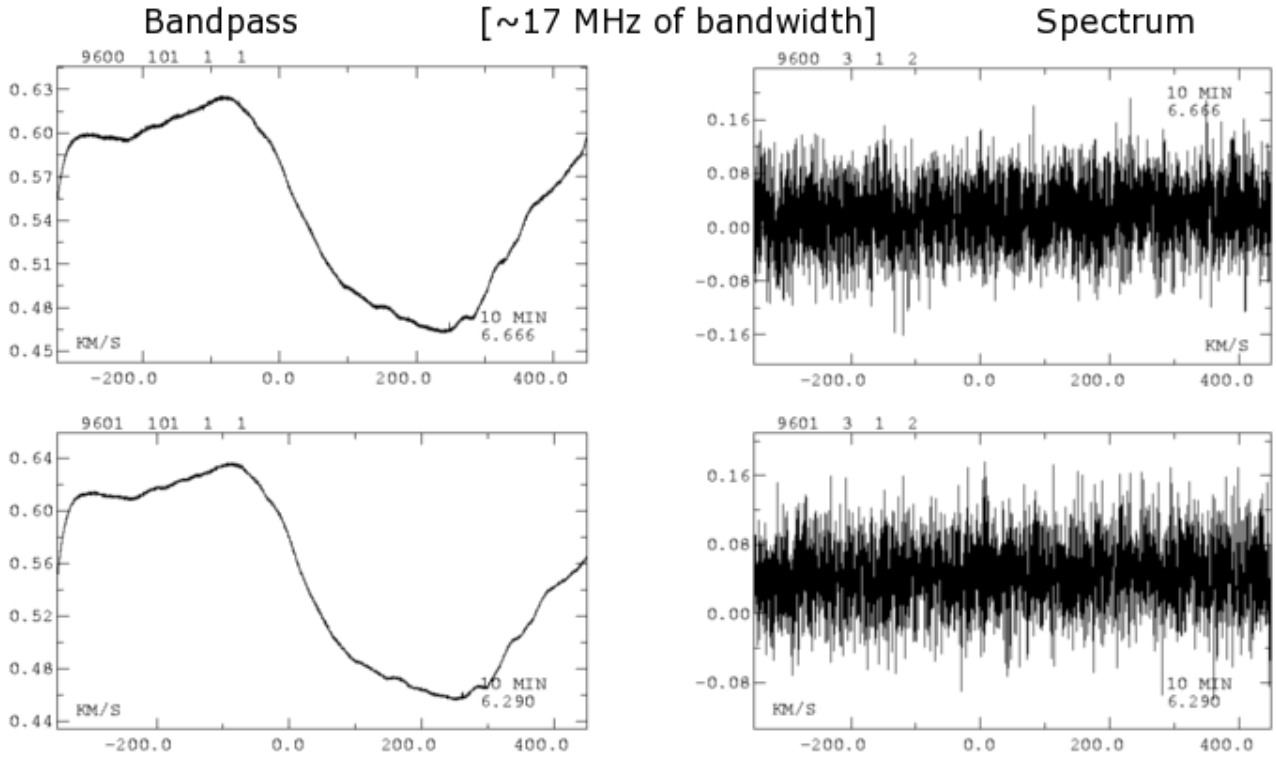
Test observations with the 5 cm primary focus receiver

W. Batrla has reviewed first test observations with the new reconstructed 5 cm receiver in the range 6.0 – 6.7 GHz. Beside the fixed problem in the 8192-channel correlator (5 MHz interferences, mentioned above) there have been other interferences not yet clear until now.

On March, 29, 2004 during daytime we made some tests with this receiver together with the 8192-channel correlator in the zenit-position and towards the building. We chose the two bands mentioned in

Batrla's review (6.666 GHz and 6.290 GHz). We can state, that in these tests we did not found any interference in these bands apart the known 5MHz interference from the 8192-channel correlator, which is eliminated by the off/on reduction. Also long (10 min) scans towards the building did not show any interference. The following plots show some measurements of the test under the worst conditions. We used both receiver channels (showing no significant difference) with a splitmode of two if-channels of 20 MHz bandwidth with 4096 correlator channels each.

5 cm Receiver PFK (~ 6.0 - 6.7 GHz)
Measurements towards the building at 6.290 and 6.666 GHz (~ 5 min OFF/ON)



The plots show as an example the observations towards the building (controlroom) at the two frequency bands with midfrequencies of 6.290 and 6.666 GHz. Shown is channel A of the receiver; channel B showed no difference in its behaviour. At about +250/275 km/s there is the 5 MHz interference from the 8192-channel correlator itself (see the bandpass!), which disappears in the spectrum because of the on-off reduction method. The integration time was 5 min OFF + 5 min ON.

Line observations with the 1.3 cm at 22.35 GHz (H_2O maser)

There have been reported during observations at ~22.35 GHz the detection of lines in the 8192-channel correlator, which are not possible in the chosen band (B. Sherwood). These must be created in the correlator itself, maybe by crosstalk or mixing of nearby strong lines into the observed band. Also W. Batrla reported some interference problems at ~23.9 GHz.

Until now these problems could not yet be investigated in details.