Continuum Source Spectra at X-band
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Introduction

The first observations of the new X-band InP LNAs detected very irregular structure in continuum source spectra (see TBASEDSB020103). Only one polarization was available at the time. It is thought that most of this structure resides in front of the first mixer but this has not been confirmed.

Here we further investigate these baseline structures with both circular polarizations. The Spectrometer was used in single bank mode (1W2-001-800) with 2048 channels, producing a frequency resolution of 0.391 MHz per channel. The receiver to Spectrometer connection matrix is shown in Table 1.

Cold Sky

On-off measurements with an integration time of 5 minutes were made towards cold sky centered at a sky frequency of 9000 MHz. Figure 1 plots the system temperature, in units of the CAL, for both polarizations with an integration time of 5 minutes. The overall structure is similar to what was observed earlier: a $\sim$ 23 MHz ripple superimposed on several large-scale features across the 800 MHz bandwidth. Both polarizations are similar, although not identical in detail. The antenna temperature, in units of the system temperature, is shown for two 5 minute on-off pairs in Figure 2. A $\sim$ 350 MHz ripple is detected with an amplitude of 0.05% of the system temperature. The cold sky antenna temperature changes by about 1% of the system temperature between the two pairs which is probably related to changes in the sky.

Table 1: Receiver to Spectrometer Connection Matrix

Polarization	ODM	CM	SF	AC Sampler
X-band LCP	6	9	1	0
X-band RCP	8	13	5	1

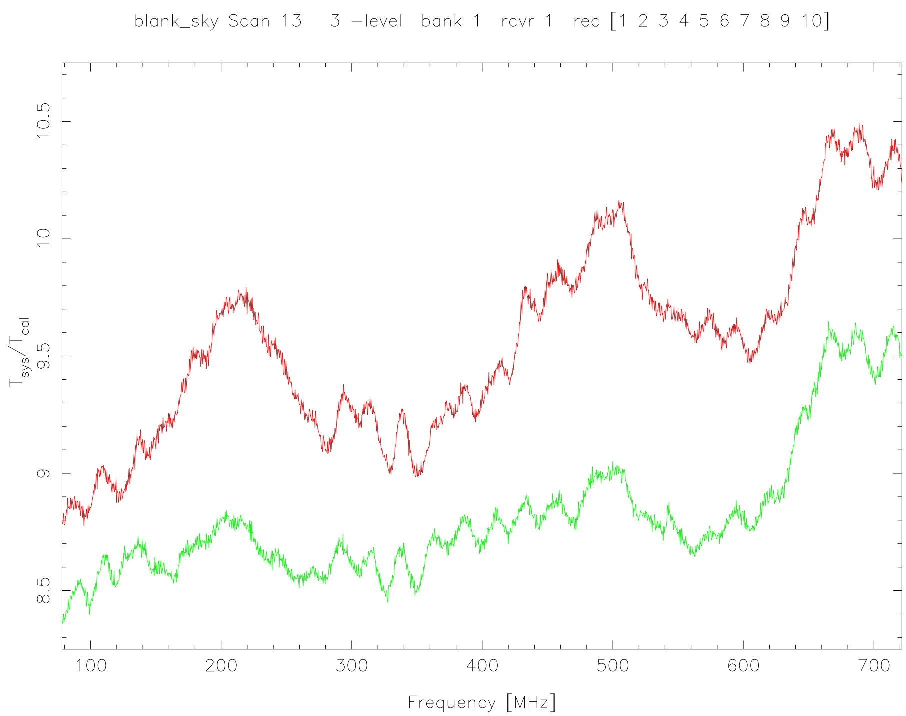

Figure 1: The system temperature on cold sky for LCP (red) and RCP (green) with an integration time of 5 minutes. The spectrum is centered at a sky frequency of 9000 MHz.

Continuum Source Spectra

Figure 3 shows the results of two 5 minute, on-off pair observations towards 3C48 (3.4 Jy at 8000 MHz). The very irregular structure is similar to what was reported earlier and appears in both polarizations. The amplitude of these features scales with source continuum intensity. Figure 4 show the normalized antenna temperature for 3C48 and 3C123 (10.6 Jy at 8000 MHz). The baseline structure is very similar.

These baseline features appear to be upstream of the first mixer. Figure 5 shows the antenna temperature versus sky frequency for two spectra centered at a sky frequency of 9000 MHz and 9010 MHz. Notice that most of the baseline structure is fixed with sky frequency. Similar to other Gregorian receivers there appears to be broad band frequency structure which is upstream of the first mixer but not related to the optics. One theory is that small variations in the impedance match exists between the LNAs, feed, and OMT components.

On possible method to partly remove this structure is to use strong continuum sources with no expected spectral features to calibrate these features. Observations at L-band (TBASEJRF021226) and C-band (TBASEJRF021230)

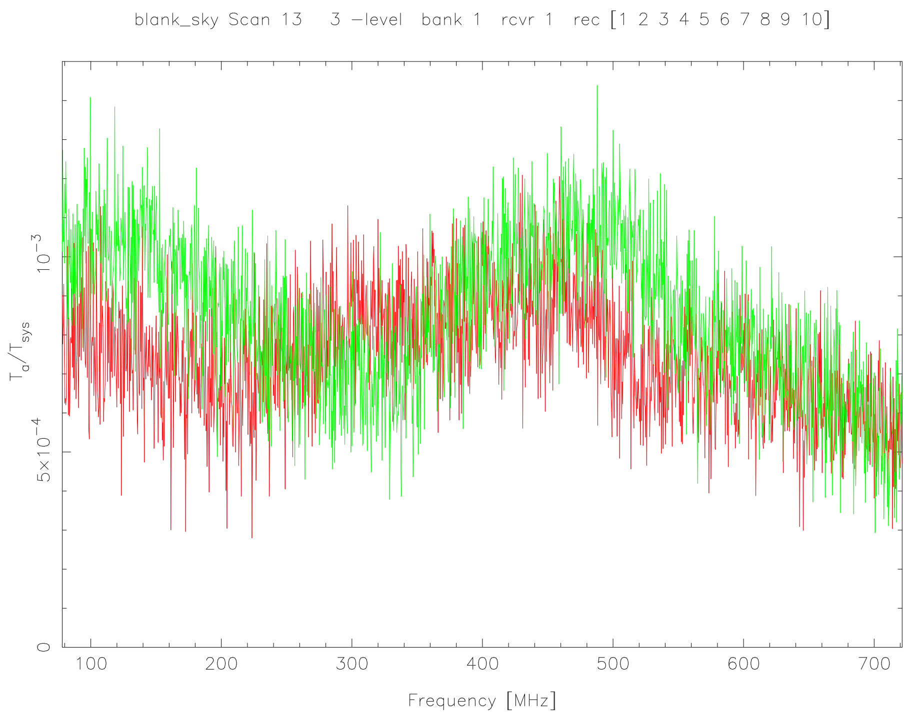

Figure 2: The antenna temperature on cold sky in units of the system temperature for LCP (red) and RCP (green). Two 5 minute on-off pairs (scans 13,14 and 15,16) were averaged together. The spectrum is centered at a sky frequency of 9000 MHz.

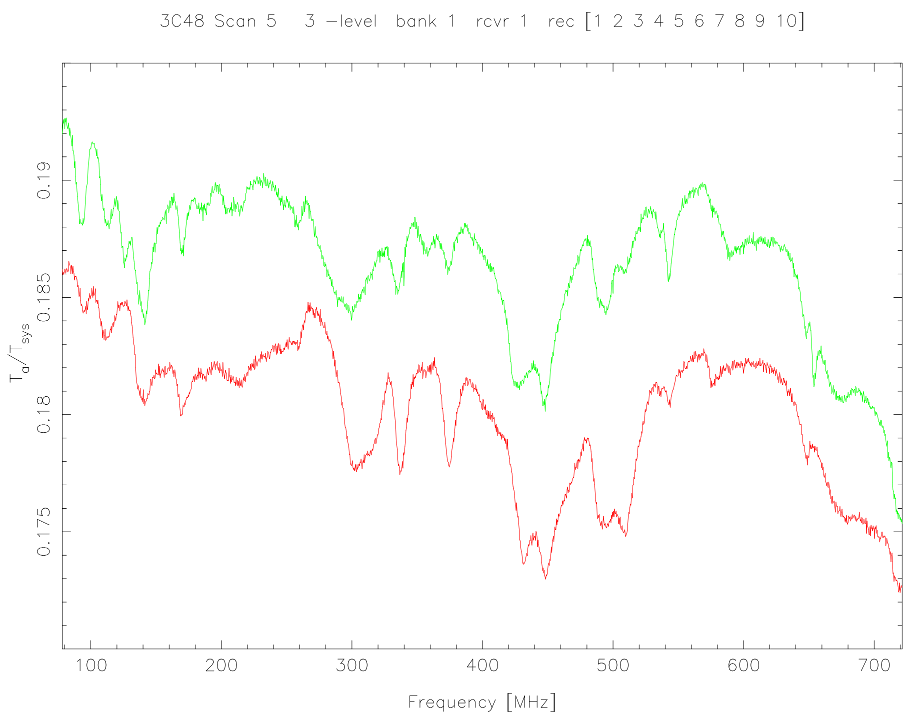

Figure 3: The antenna temperature towards 3C48 in units of the system temperature for LCP (red) and RCP (green). Two 5 minute on-off pairs (scans 5,6 and 7,8) were averaged together. The spectrum is centered at a sky frequency of 9000 MHz.

have had some success. We compare the two on-off spectra towards 3C48 to investigate how well this procedure might work at X-band. Figure 6 summarizes the results. The ratio of (Sig–Ref)/Ref is shown in the top panel and (Sig–Ref) is shown in the bottom panel. Overall, the spectra look significantly better.

Lastly, the spectrum of 3C48 was measured across the X-band receiver from 8000–10000 MHz. Figure 7 plots the antenna temperature, in units of the system temperature, for both polarizations. The LCP spectrum appears flatter than expected based on the measured flux density spectrum of 3C48. This assumes that the system temperature does not change very much during the observations. Although any change should show up in both polarizations.

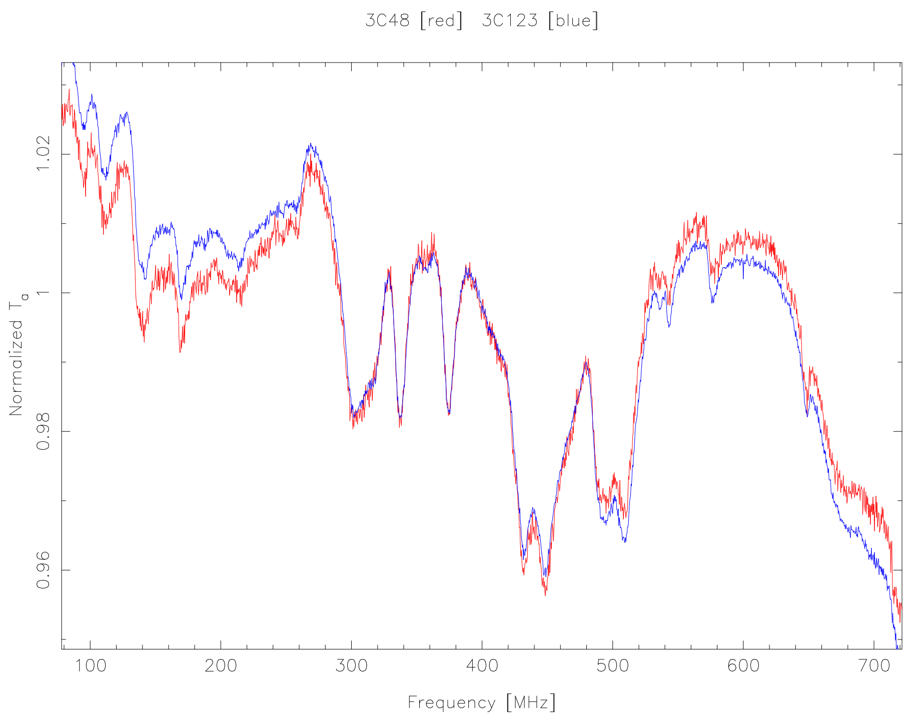

Figure 4: The normalized antenna temperature towards 3C48 (red) and 3C123 (blue). Each spectrum consists of one 5 minute on-off pair. The antenna temperature, in units of the system temperature, were divided by the median value in the spectrum. The spectrum is centered at a sky frequency of 9000 MHz.

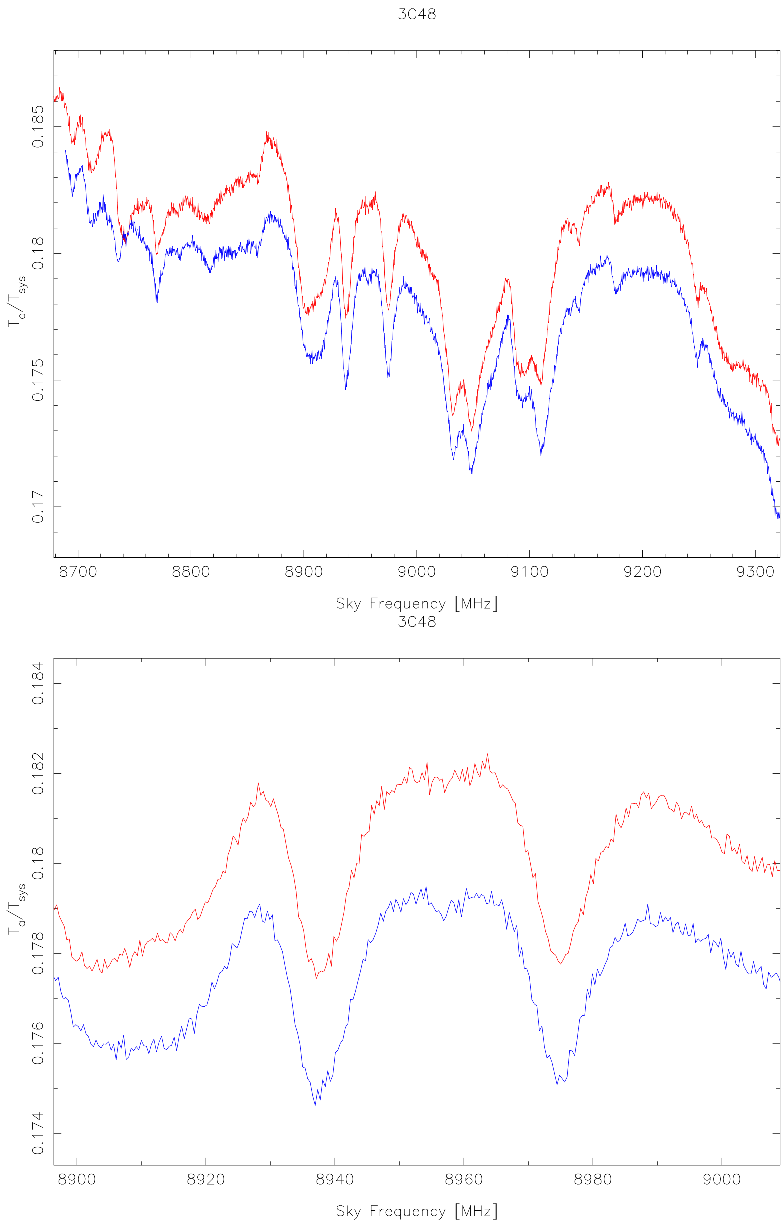

Figure 5: The antenna temperature towards 3C48, in units of the system temperature, centered at a sky frequency of 9000 MHz (red) and 9010 MHz (blue). The lower panel shows an expanded view.

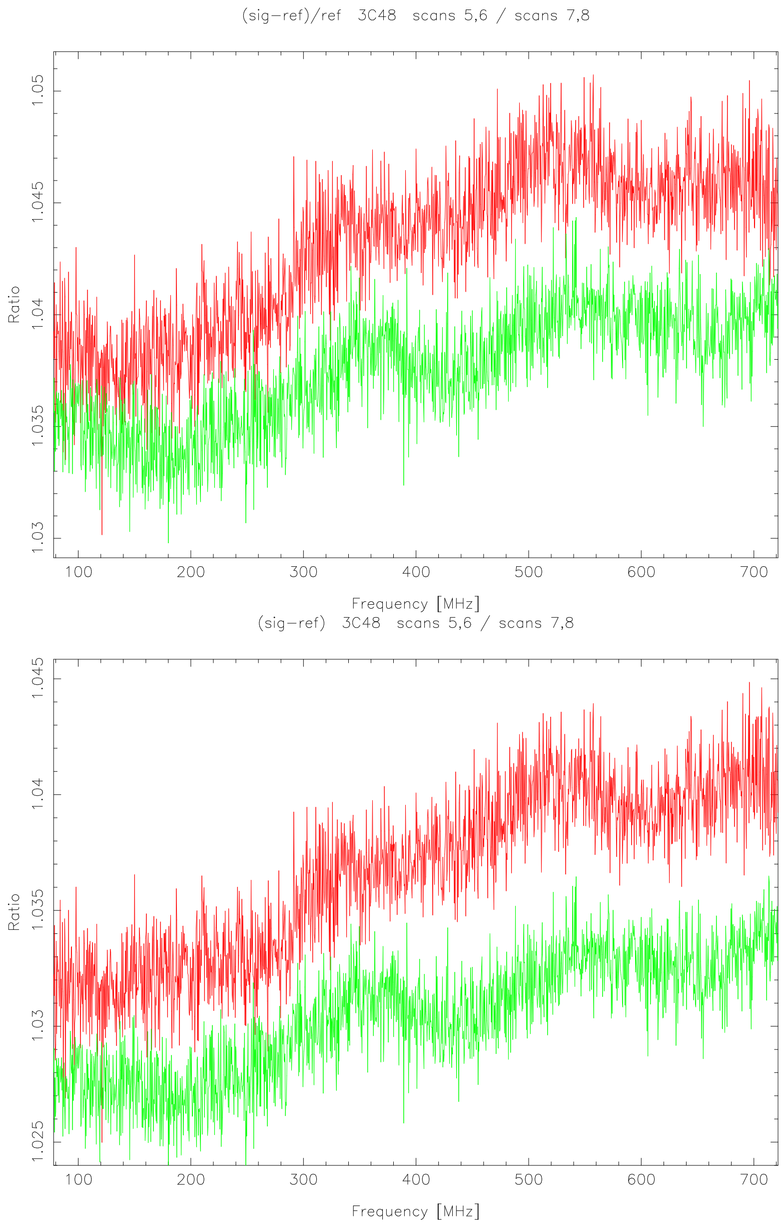

Figure 6: Ratio of the antenna temperatures for two consecutive 5 minute, on-off pairs towards 3C48. The red curve corresponds to LCP and the blue curve to RCP. The ratio is formed from scans pairs (5,6) to (7,8). The telescope position was approximately (Az=124, El=81) for scans (5,6) and (Az=140, El=83) for scans (7,8). Top panel: takes the ratio of (sig-ref)/ref. Bottom panel: takes the ratio of (sig-ref). That is, each spectrum produced from the on-off pair is not normalized by the reference (off) position.

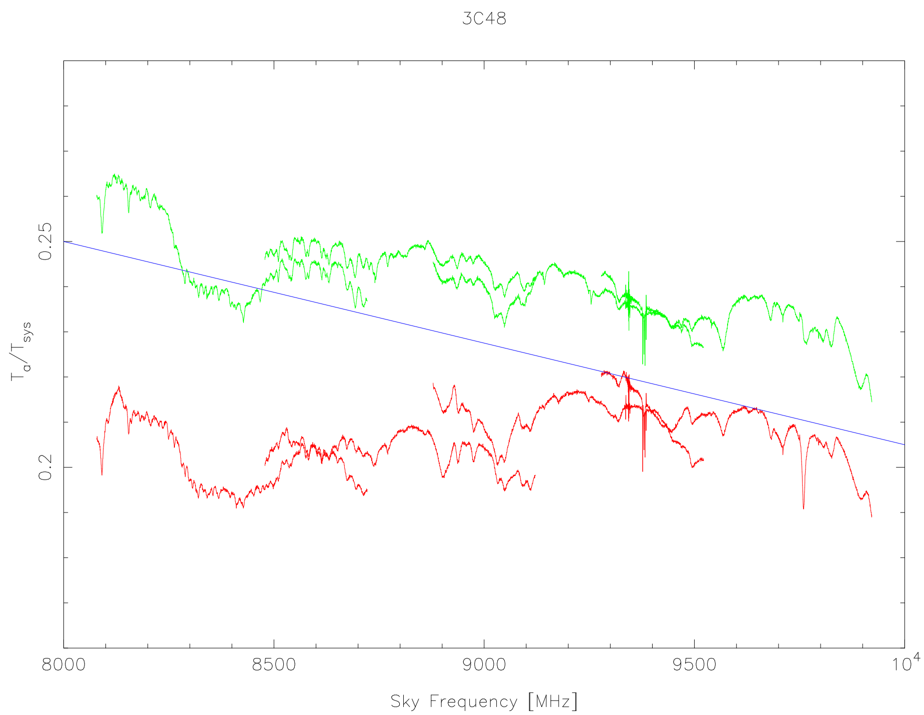

Figure 7: On-off spectra towards 3C48 centered at 8400, 8800, 9200, and 9600 MHz with a total integration time of 5 minutes. The antenna temperature is calculated in units of the system temperature. The red curve corresponds to LCP and the green curve to RCP. The blue line corresponds to a slope of $\nu^{-0.9}$, the expected spectral index for 3C48.