Investigation of the 2.3 MHz Ripple at S-band Project TBASEDSB021218, 18 December 2002

Dana S. Balser

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Setup

The goal was to investigate the 2.3 MHz ripple, first observed at L-band—projects TBASEJRF021216 and TBASEJRF021217, at S-band. This ripple appears to be caused by reflections from the main reflector and subreflector.

The signal path consisted of channel 1 (X linear polarization) and channel 2 (Y linear polarization) connected to optical driver modules (ODMs) 5 and 8 (ODM 7 was out of service), converter modules 9 and 13, and sampler filters 1 and 5, respectively. The IF rack filters were 5840-6160 MHz and the analog filter rack filters 800-1000 MHz. The spectrometer was configured with two samplers (0 and 1), a bandwidth of 200 MHz, 8192 channels ($\Delta\nu$ = 24.4 kHz), and an integration time of 30 sec (1W2-001-200).

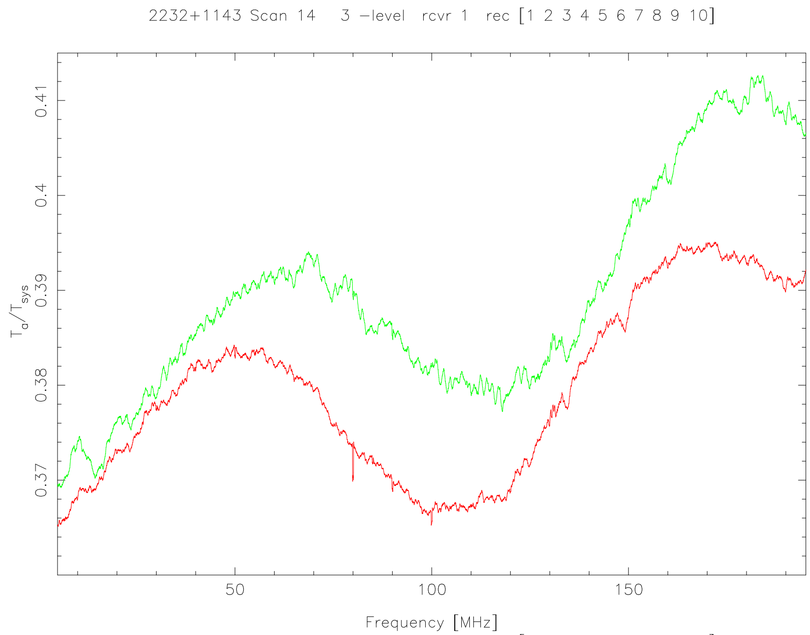
Continuum Source Spectra (2232+1143)

The continuum source 2232+1143 was observed using the *xonoff* procedure where 5 min was spent on the source and 5 min off the source. 2232+1143 has a flux density of $\sim$ 5.7 Jy at 1990 MHz. Figure 1 shows an averaged spectrum centered at a sky frequency of 1990 MHz consisting of three on-off pairs. Present are the $\sim$ 120, 10, and 2.3 MHz baseline features previously observed at S-band. As noted earlier the $\sim$ 10 MHz structure is irregular and stronger in receiver channel 2. The 2.3 MHz ripple has a peak-to-peak amplitude of $\sim$ 0.25% of the source continuum intensity. This is a factor of two less than observed at L-band at a frequency of 1400 MHz. Thus the amplitude scales approximately as λ^2.

Figure 2 plots the Fourier transform of the spectra in Figure 1. The 2.3 MHz ripple appears in both polarizations at a frequency of 2.29 MHz. Notice the weak, broad signal in the Y linear polarization spectrum around 1.6 MHz (Figure 3). This may be related to the 1.5 MHz polarized signal observed at L-band.

Spectra taken with a shift in the Y (axial) focus of $+\lambda/4$ (37.7 mm) are shown in Figure 4. The red and blue curves correspond to the nominal and defocussed data, respectively. It is not obvious that the 10 MHz structure cancels but it appears that the 2.3 MHz ripple shifts 180 degrees in phase.

Figure 5 shows the continuum spectrum of 2232+1143 from 1700-2600 MHz. The spectrum between 2300-2400 MHz was not observed due to very strong RFI. The blue line corresponds to a slope of $\nu^{-0.7}$.



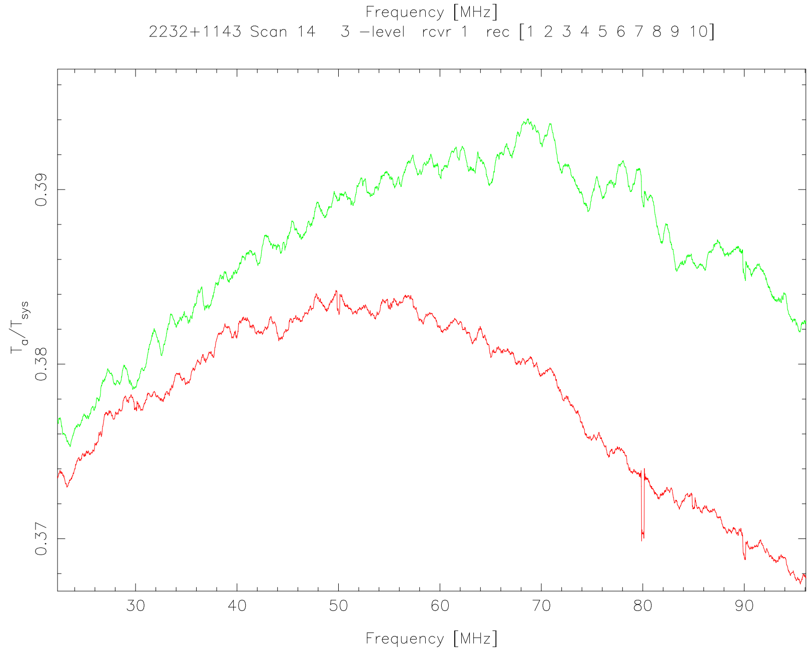


Figure 1: Project TBASEDSB021218, scans 14-19. Spectra for three on-off pairs towards the continuum source 2232+1143, centered at a sky frequency of 1990 MHz. The red and green curves correspond to receiver channels 1 (X linear) and 2 (Y linear), respectively. The spectra have been smoothed using a boxcar function with a width of 10 channels. Two hundred channels have been cutoff from the beginning and end of the spectrum. The lower panel shows an expanded view.

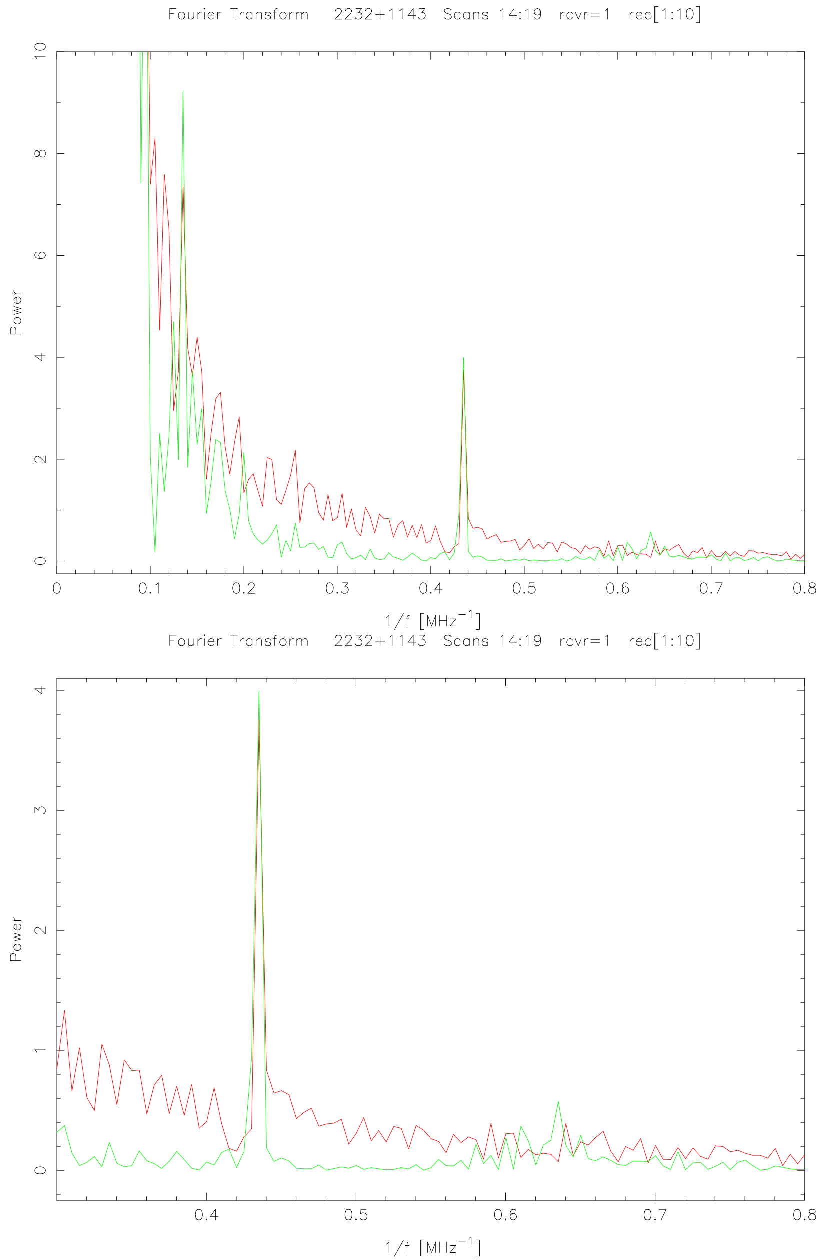


Figure 2: Project TBASEDSB021218, scans 14-19. The Fourier transform of the spectra in Figure 1. The red and green curves correspond to receiver channels 1 (X linear) and 2 (Y linear), respectively.

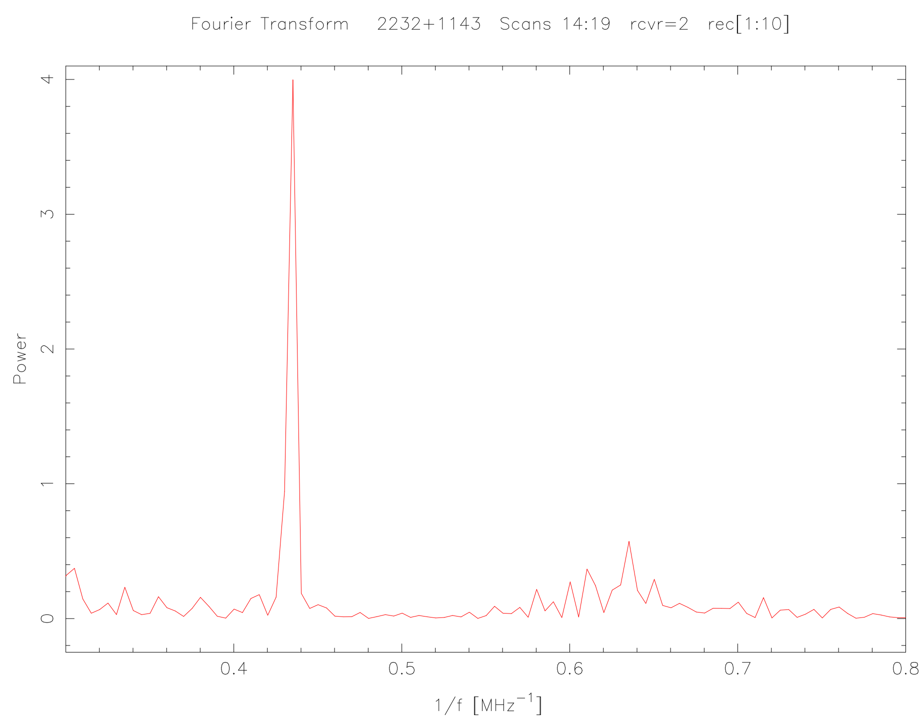
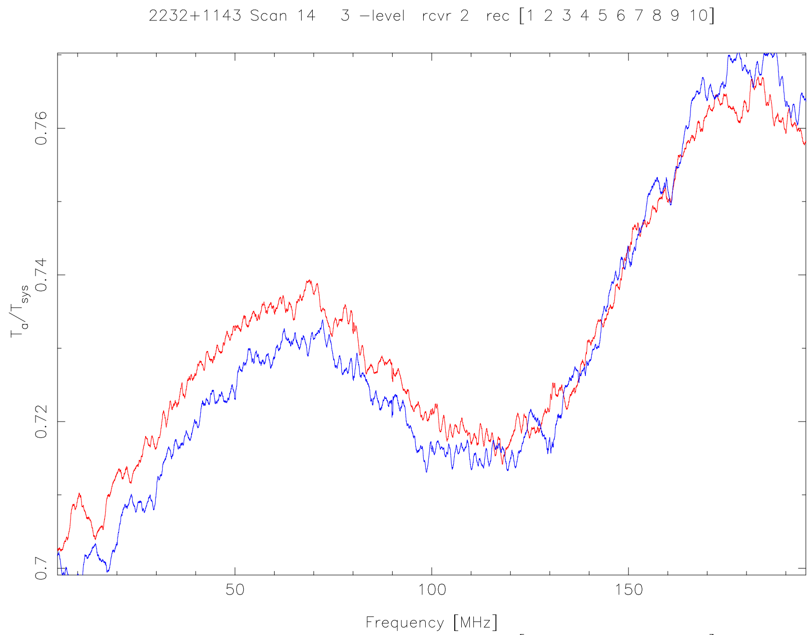


Figure 3: Project TBASEDSB021218, scans 14-19. The Fourier transform of the channel 2 (Y linear polarization) spectra in Figure 1



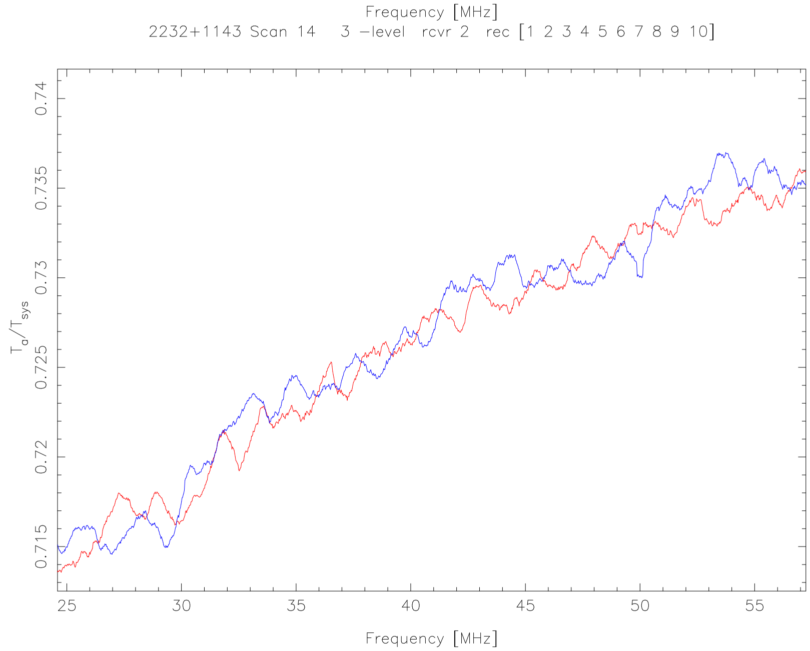


Figure 4: Project TBASEDSB021218, scans 14-19 and 22-27. Comparison of spectra taken with a nominal focus (red) and with a $\lambda/4$ shift in the axial (Y) focus (blue) for receiver channel 2. The spectra have been smoothed using a boxcar function with a width of 10 channels. Two hundred channels have been cutoff from the beginning and end of the spectrum. In the top panel the blue curve has been shifted vertically 0.015 for clarity. An expanded view is shown in the bottom panel where the blue curve has been shifted vertically 0.022.

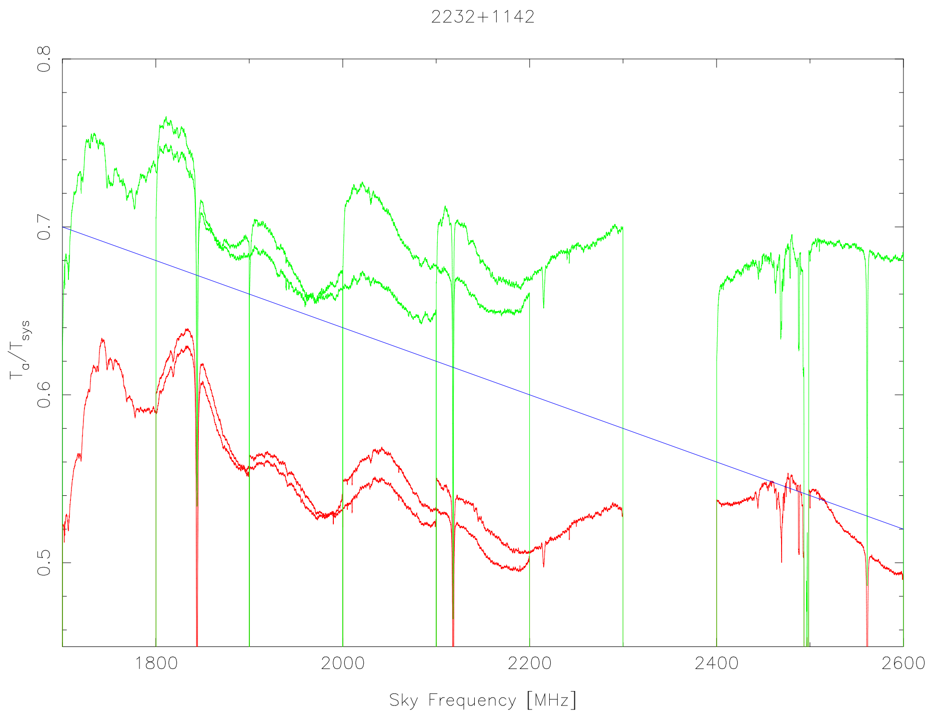


Figure 5: Project TBASEDSB021218. Spectra for the following center frequencies: 1800 MHz (scans 32-33); 1900 MHz (scans 34-35); 2000 MHz (scans 36-37); 2100 MHz (scans 38-39); 2200 MHz (scans 30-31); 2500 MHz (scans 28-29). The blue line corresponds to a slope of $\nu^{-0.7}$.