L-band Receiver Spectral Baselines on Continuum Sources Project TBASEDSB021216, December 16, 2002

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Setup

To check IF stability with the first scan the narrow-band IF noise source was used as the input signal. For all other scans linearly polarized receiver channels X and Y were connected to fibers 1 and 3, respectively. The IF rack filters were set to 2960 to 3040 MHz passband, and the analog filter rack outputs were set to 50 to 100 MHz passband. The spectrometer was set up for 50 MHz bandwidth, 9-level, 2 samplers, 2 quadrants, 16384 channels per IF configuration (2N2-4A-50-9). This appears to be a spectrometer mode that has not been verified, but it seemed to work OK. The signal path connections are shown in Table 1. An integration time of 30 seconds was used for all measurements.

IF Stability Check, Antenna Stationary

The first scan checked the spectral and gain stability of the IF channels to be used in the rest of the evening's measurements. The results are shown in Figures 1 and 2. Except for about 1% gain drift over the 30-minute scan duration, the spectra were quite stable.

Continuum Source Spectra

Five-minute on, five-minute off scan pairs were then made on three continuum sources of different intensities, each at two different center sky frequencies of 1405 and 1395 MHz. The (on - off) / off spectra for receiver channels X and Y are shown in Figures 3 and 4, respectively. The spectra for both center

Table 1: IF Rack to DCR Connection Matrix

Rcvr	OR	CM	SF	Sampler
X	1	1	1	0
Y	3	5	5	4

frequencies and all three radio sources are plotted on the same graph with the intensity values of two of the sources scaled by the stated amounts to get them close on the same graph. It is quite apparent that the spectra for all three continuum sources agree to considerable detail, except for a flux density scale factor, and that the majority of the spectral features are fixed in sky frequency. In the following evening's observations we will show that the 2.33-MHz period ripple is due to reflections between the telescope subreflector and main reflector edges nearest the paraboloid axis.

Figures 5 and 6 show a comparison of continuum source spectra with the spectra of the receiver's internal noise source with all spectra being processed the same way. The noise source is weaker than the continuum source noise so the former's random noise is somewhat higher. The major spectral features of the continuum source and calibrator noise are quite similar, except for a different slope and the 2.33-MHz ripple that is expected to only affect the continuum source. Part of the spectral slope difference is due to the spectral slope of the continuum source, which is about 4% stronger at 1370 MHz than at 1430 MHz. The similarity of the continuum source and calibrator noise spectra suggests that the major spectral shapes are due to receiver components between the cal coupler and the first receiver mixer.

Because the spectra are computed as the ratio of the injected noise power from the calibrator or continuum source and the total system noise power, we cannot distinguish between gain and amplifier noise frequency dependencies. A dip in the (on - off) / off could be due either to signal loss in the injected noise or higher amplifier noise at that frequency.

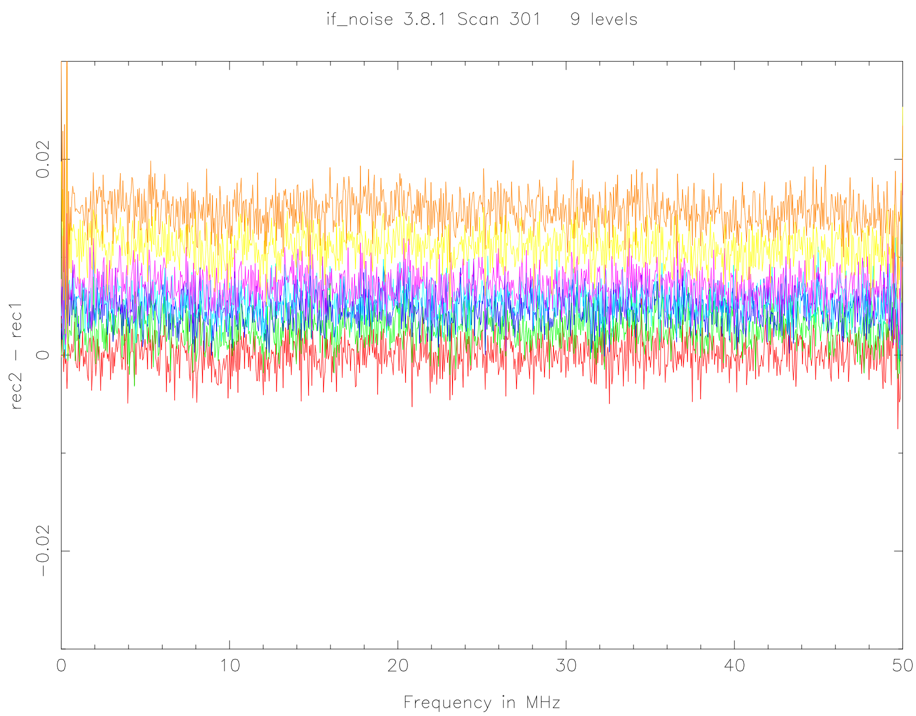

Figure 1: Scan 301, IF noise source spectra for channel 1 that are the difference, (recN - rec1) / rec1, between the first 30-second record and spectra for records 2 (red), 10 (green), 20 (dark blue), 30 (blue-green), 40 (violet), 50 (yellow), and 60 (orange). The vertical scale is the fraction of total system noise. The spectra were convolved to lower resolution by truncating the ACF's to 1024 points and Hanning smoothing the resulting spectra.

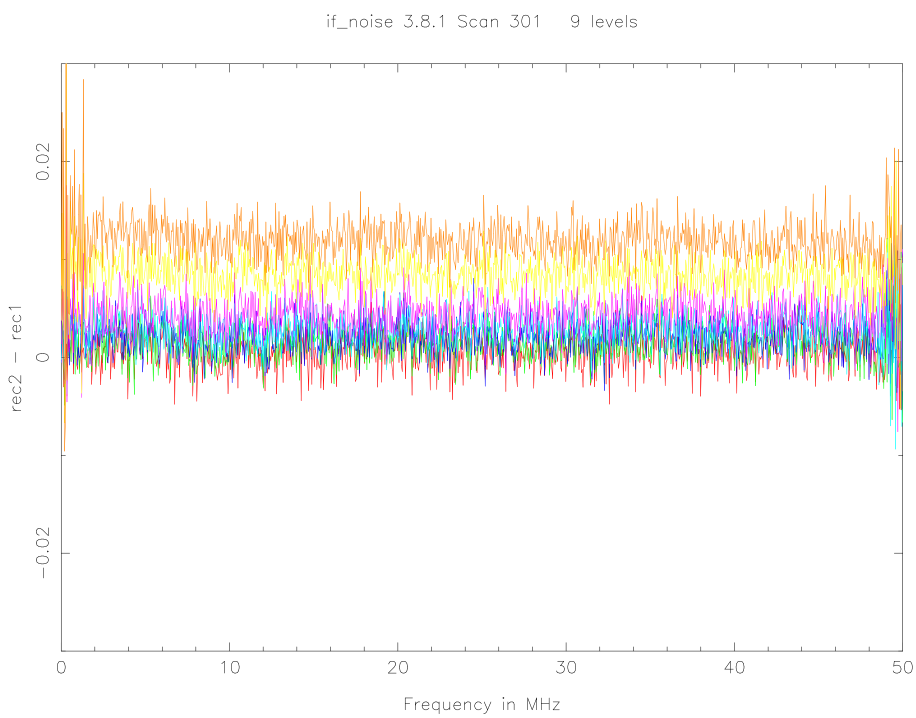

Figure 2: Scan 301, IF noise source spectra for channel 2 that are the difference, (recN - rec1) / rec1, between the first 30-second record and spectra for records 2 (red), 10 (green), 20 (dark blue), 30 (blue-green), 40 (violet), 50 (yellow), and 60 (orange). The vertical scale is the fraction of total system noise. The spectra were convolved to lower resolution by truncating the ACF's to 1024 points and Hanning smoothing the resulting spectra.

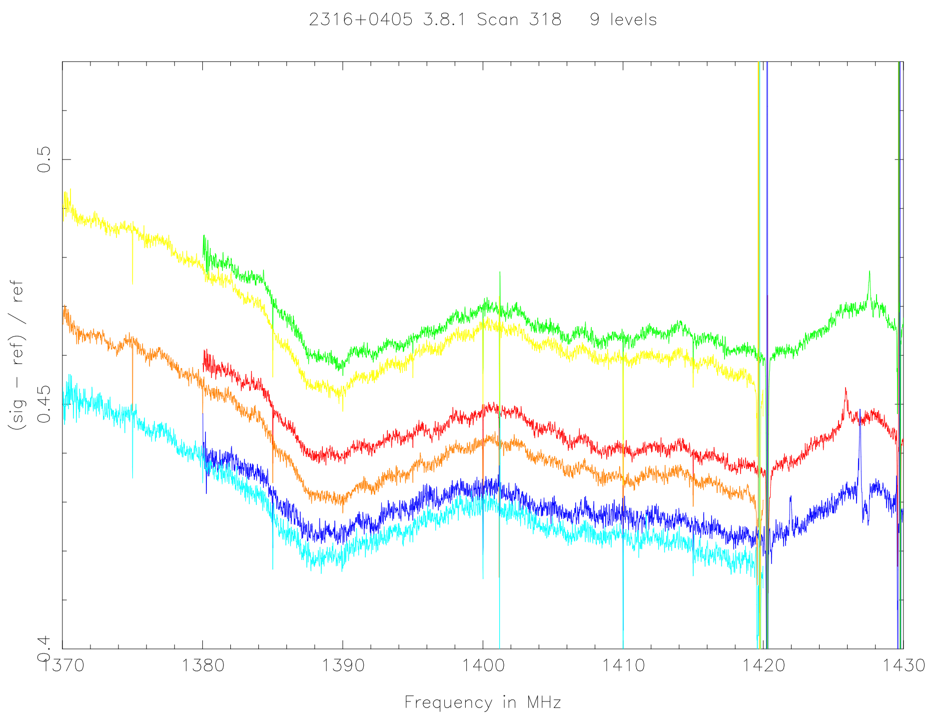

Figure 3: Scans 317-328, receiver X continuum source difference spectra, (on - off) / off, for three radio sources at two sky center frequency settings. The sources are 2316+0405 (4.68 Jy, red and orange curves), 0054-0333 (2.21 Jy, dark blue and blue-green curves), and 0120-1520 (5.08 Jy, green and yellow curves). The intensity scales for 0054-0333 and 0120-1520 were scaled by 1.9 and 0.98, respectively to put their spectra close to that for the third source for easy comparison. All spectra were convolved to lower resolution by truncating the ACF's to 4096 points and Hanning smoothing the resulting spectra.

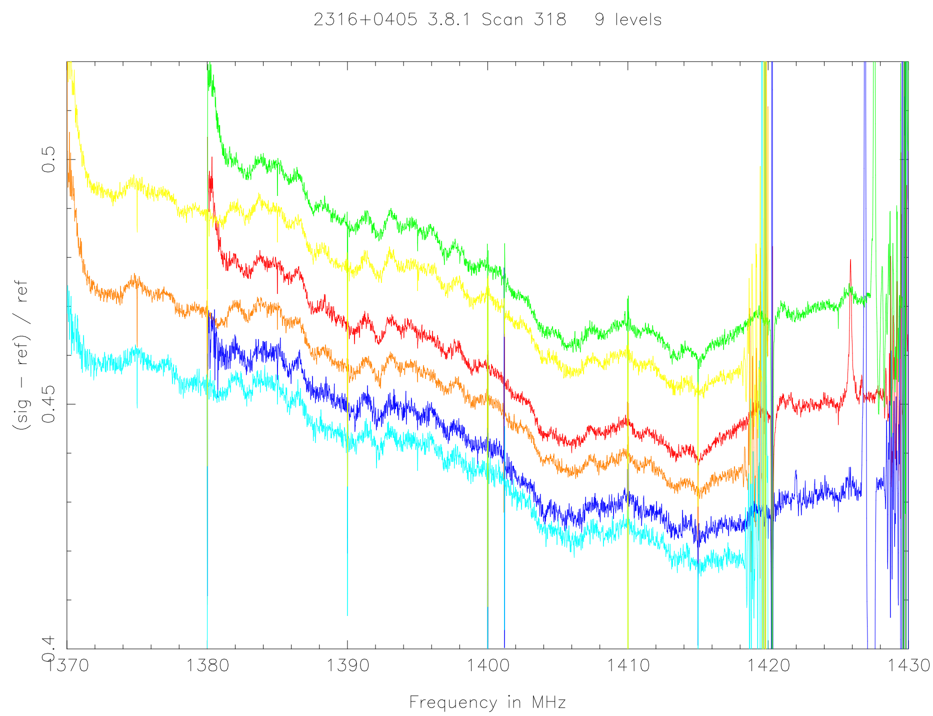

Figure 4: Scans 317-328, receiver Y continuum source difference spectra, (on - off) / off, for three radio sources at two sky center frequency settings. The sources were 2316+0405 (4.68 Jy, red and orange curves), 0054-0333 (2.21 Jy, dark blue and blue-green curves), and 0120-1520 (5.08 Jy, green and yellow curves). The intensity scales for 0054-0333 and 0120-1520 were scaled by about 1.9 and 0.98, respectively to put their spectra close to that for the third source for easy comparison. All spectra were convolved to lower resolution by truncating the ACF's to 4096 points and Hanning smoothing the resulting spectra.

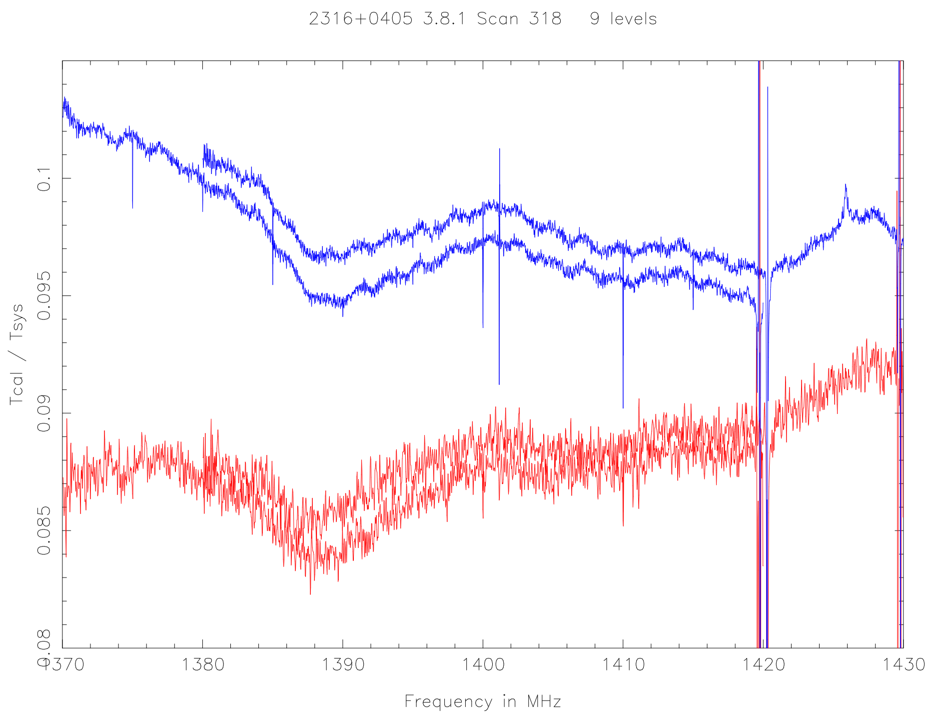

Figure 5: Scans 317-320, receiver X comparison of continuum source 2316+0405 (4.68 Jy, blue curves) and calibration noise source (red curves) difference spectra, (on - off) / off, at two sky center frequency settings. The continuum source intensity was scaled by 0.22 to put it on roughly the same scale as the noise source spectrum. All spectra were convolved to lower resolution by truncating the ACF's and Hanning smoothing the resulting spectra.

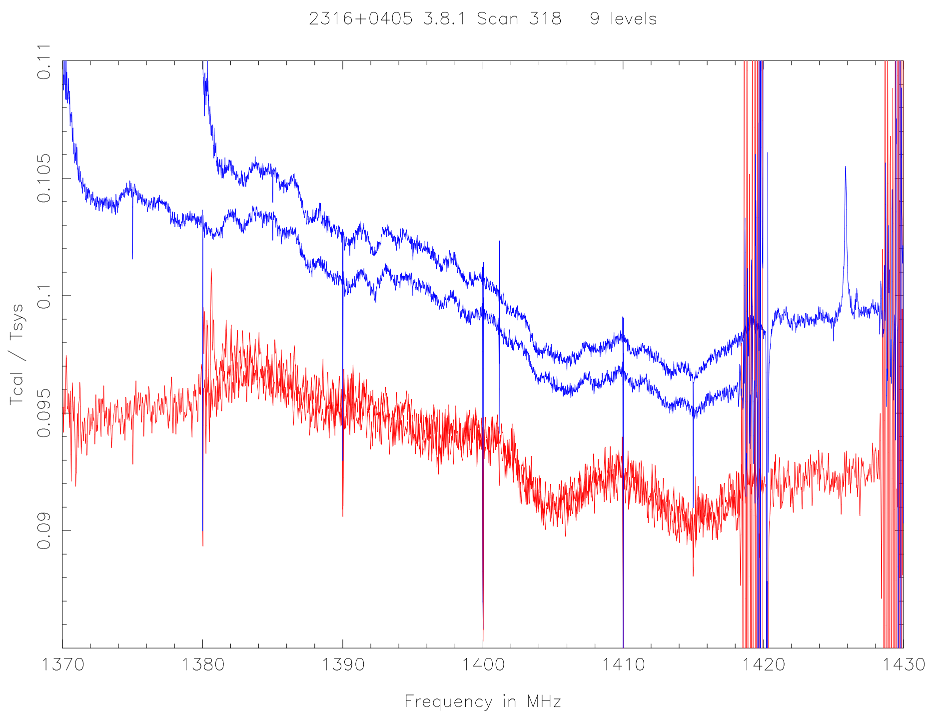

Figure 6: Scans 317-320, receiver Y comparison of continuum source 2316+0405 (4.68 Jy, blue curves) and calibration noise source (red curves) difference spectra, (on - off) / off, at two sky center frequency settings. The continuum source intensity was scaled by 0.22 to put it on roughly the same scale as the noise source spectrum. All spectra were convolved to lower resolution by truncating the ACF's and Hanning smoothing the resulting spectra.