

Suppression of spurious lines in E230 after installation of a local oscillator filter

April 25, 2017

C.Marka, S.Navarro, D.John

Spurious lines in EMIR band E230 from mixing of astronomical lines with the seventh harmonic of the fundamental local oscillator frequency were reported in the past (see report January 2017).

A local oscillator filter (as before for bands E090 and E150) was installed on February 14th, 2017. The suppression of spurious lines is demonstrated in figure 1: in a tuning of 224.75 LI ($\nu_{LO}=231.0$ GHz), a spurious line of $T_A^* \sim 1.5$ K (corresponding to ca. 10% of the original astronomical line's strength) was noted at 220.511 GHz, which originates from mixing of $H^{13}CN(3-2)$ at 259.011 GHz with the 7th harmonic of the fundamental Gunn oscillator frequency (equal to $\frac{231}{6}$ GHz). With the filter in place, the spurious line is not detected anymore down to the noise level of the spectrum, corresponding to an upper limit of the suppression of the spurious line by the filter of 24 and 22 dB for vertical and horizontal polarization, respectively (calculated for the integrated line intensities, and using a limit of $3\sigma\sqrt{n_{chan}}$ – with n_{chan} the number of channels in the line region – for the non-detected lines). The suppression according to the technical specification is 40 dB.

The installed filter suppresses unwanted harmonics of the fundamental of the Gunn oscillator, but cannot suppress other harmonics generated on the subsequent active components (i.e. multiplier or the mixer). One such spurious line after installation of the filter has been reported at the low frequency end of the E230 band, which originates from mixing with a frequency equal to eight times the fundamental local oscillator frequency. The spurious reaches only ca. 1% the strength of the original astronomical line in this case (figure 2).

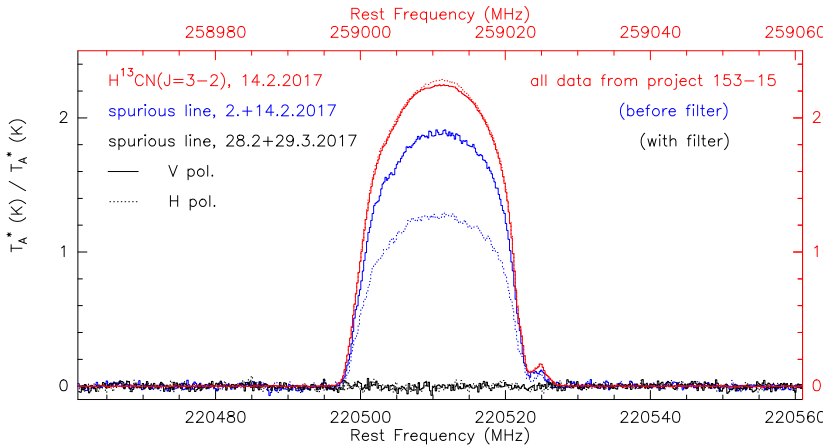


Figure 1: A spurious line towards IRC+10216 (blue), originating from mixing of the 7th harmonic of the fundamental local oscillator frequency with $H^{13}CN(J=3-2)$ (red) was detected before installation of the local oscillator filter. With the filter in place, the spurious line remains undetected at the noise level (black). All spectra courtesy of project 153-16 (PIs: J. Cernicharo & J.R. Pardo).

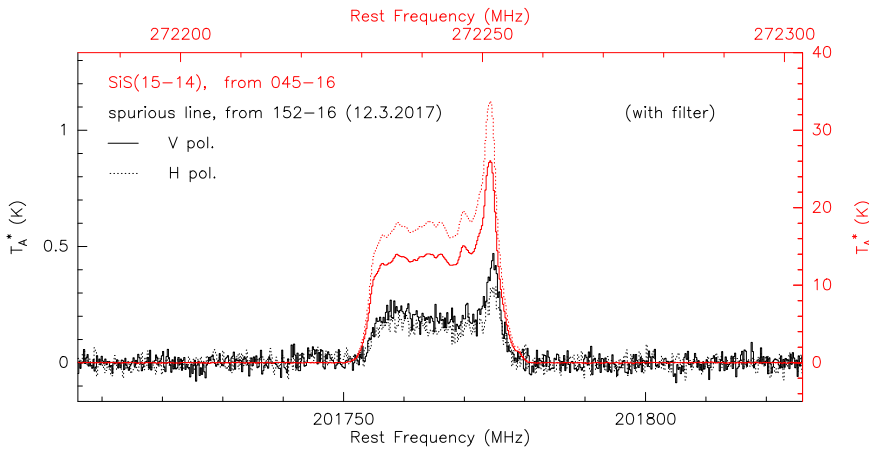


Figure 2: Spurious line at 201.766 GHz towards IRC+10216 (black), arising from mixing of a frequency equal to eight times the fundamental local oscillator frequency (tuning 202 LO) with SiS(15-14) at 272.243 GHz (red), detected after installation of the local oscillator filter. Spectra are courtesy of projects 045-16 & 152-16 (PIs: J. Cernicharo & J.R. Pardo).

References:

- Kramer, Navarrini, Navarro, John, Cernicharo; August 2014; IRAM Report on ghost lines.
- Marka, Navarro; January 2017; Spurious lines from mixing with higher harmonics of the local oscillator fundamental frequency in E230