Work report on ghost line observations with E150 on IRC+10216 of 11-March-2015

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Tests done on March, 10th and 12th, 2015, show that a ghost line showing up in the EMIR 2 mm band at 128.42 GHz, stemming from 195.95 GHz, is suppressed by −24 dB with an LO filter installed, in comparison with the situation without filter.
On March, 10th, 2015, IRC+10216 was observed with E150 without any local oscillator filter and with one filter installed [1,2,3], to compare the strengths of a ghost line which shows up at 128.42 GHz, originating from the CS 4-3 line at 195.95 GHz. After installation of the filter, the ghost line could not be detected anymore within the available observing time. The filter rejection is found to be better than −15 dB at this frequency.
On 12-March, a line was injected at 195.954217 Ghz corresponding to the CS 4-3 transition with a 2mm tuning of 128.8239 GHz LI. The down-converted line was found at the expected IF frequency. The rejection of the injected line is −25 dB and −24 dB for the vertical and horizontal polarisations, respectively, consistent with the astronomical observations of 10-March.
The observations on IRC+10216 did not detect the SiC2 line at 196.36GHz (IF 6.25 equivalent to 128.823 GHz), which had been seen in the past [4]. This species does not show any signs of time-variability (P. Cernicharo, priv. comm.).
All observations described here, were conducted after the deinstallation of the waveguide spacer of the LO on 10-February.

1 Details

Observations

Observations on 10-March were done in position switched mode, as the wobbler did not work, and in the lower inner sideband, tuned to 128.823 GHz. This allows to detect the CS 4-3 line at 195.95421 GHz as ghost line showing up at 128.4176 GHz.
The pako commands are:

```
set emirCheck relaxed
RECEIVER E150 LINE128LI 128.823 LI /HOR LI UI /VER LI UI /dop dop
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Checks

As expected, the ghost line is broadened by about a factor of 1.5 relative to the widths of $\sim 31\,\mathrm{kms}^{-1}$ of the nominal lines showing up in the 2mm band.
During a similar experiment on 14-August-2014, the same ghost line was observed without filter, and the LO was shifted by 100 MHz. As expected, the ghost moved by 150 MHz.

Data

The baseline rms of the spectrum with filter, both polarisations averaged, with no line detected (cf. Fig. 3), is $T_{\mathrm{rms}} = 9.7\,\mathrm{mK}$, the number of channels of the ghost line is $N = 89$, and the channel width is $\Delta v = 0.4545\,\mathrm{kms}^{-1}$. This results in a 3σ uncertaintly on the integrated line intensities of $0.126\,\mathrm{Kkms}^{-1}$ using $3\sigma = 3\sqrt{N}\Delta v T_{\mathrm{rms}}$. The integral over the ghost line (without filter, both polarisations averaged) is $3.8\,\mathrm{Kkms}^{-1}$, which gives a rejection by the filter by at least a factor 30, or better than −15 dB.

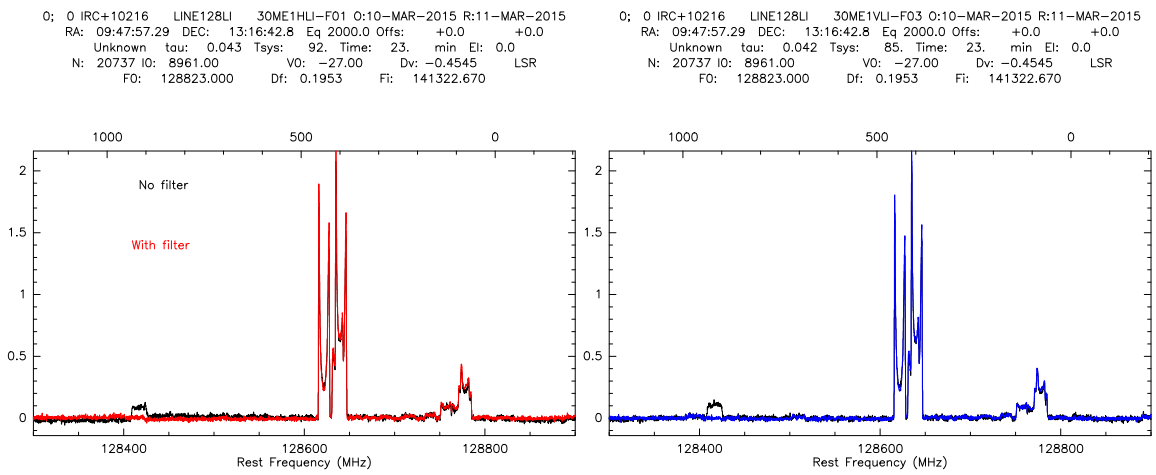

Figure 1: Spectra of IRC+10216 in horizontal (left) and vertical polarization (right), with and without LO filter.

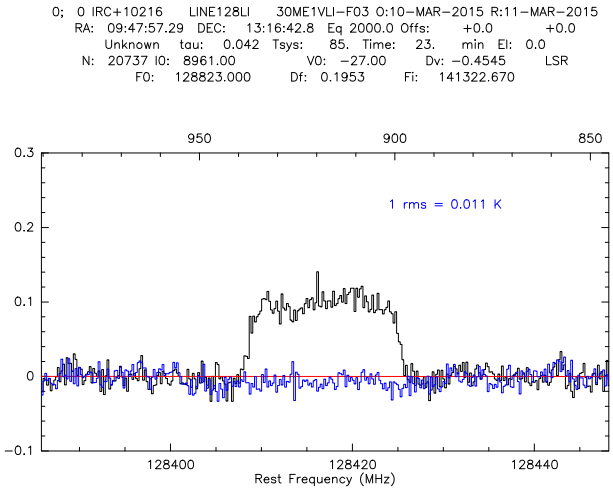

Figure 2: Detail of the ghost line in vertical polarization, without (black) and with the LO filter installed (blue).

2 References

1. Mattiocco, "Qualification des filtres pass-bande 134-184 GHz fabriques en impression 3 D plastique par la societe SWISS to 12 pour L'attenuation des harmoniques de l'OL Band2 NOEMA et comparaison avec les filtres usines de maniere traditionnelle." FEND-02-10.012-A-REP 2014 11–03

2. Mattiocco, "NOEMA Band1 and Band2 2SB SIS mixers pumped by unwanted harmonics of the oscillator" FEND-02.10.013-A-REP 2014-24-07

3. Mattiocco, NOEMA band2 LO spurious harmonics identification and suppression using a custom made 135-184 GHz band pass filter. FEND-02-10.014-A-REP. 2015–01-12

4. Kramer, Navarrini, Navarro, John, Cernicharo; August 2014; IRAM Report on EMIR ghost lines (unwanted harmonics of the local oscillators)