

E150 ghost line from 5th harmonic of local oscillator fundamental frequency

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In IRC+10216 observations during the commissioning of the upgraded EMIR bands E0 & E1 in December 2015, two weak lines of ca. 0.1 K were detected at 143.752 and 143.732 GHz in a frequency setup with $\nu_{LO}=134.03$ GHz, which do not correspond to any astronomical line and not originate from the image sideband. The lines however match very well the profiles and linewidth (in frequency scale) of the ca. 40 K strong HCN($J=2-1, v=0$) and ($J=2-1, v=1$) lines at 177.259 and 177.239 GHz, which were covered in a different frequency setup on the same day (figure 1).

If these HCN lines are indeed the true origin of the ghost lines¹, the intermediate frequencies $\nu_{IF}=9.722$ and 9.702 GHz of the ghosts correspond to a mixing of the astronomical lines with an frequency of 167.537 GHz, which equals the 5th harmonic of the fundamental oscillation frequency of the Gunn local oscillator, $\nu_{fund}=33.5075$ GHz, for the $\nu_{LO}=134.03$ GHz setup (since E150 employs the second harmonic of ν_{fund} multiplied by two, see report on EMIR ghost lines, August 2014). This fifth harmonic is not attenuated by the E150 LO filter installed since December 2014 because it is located within the E150 bandpass, but could be suppressed by an additional filter at the input of the multiplier. The ratio of the peak temperatures corresponds to an attenuation of -26 dB (similar for horizontal and vertical polarization), indicating that ghost lines arising from mixing with this high-order harmonic are potentially of concern for very strong astronomical lines.

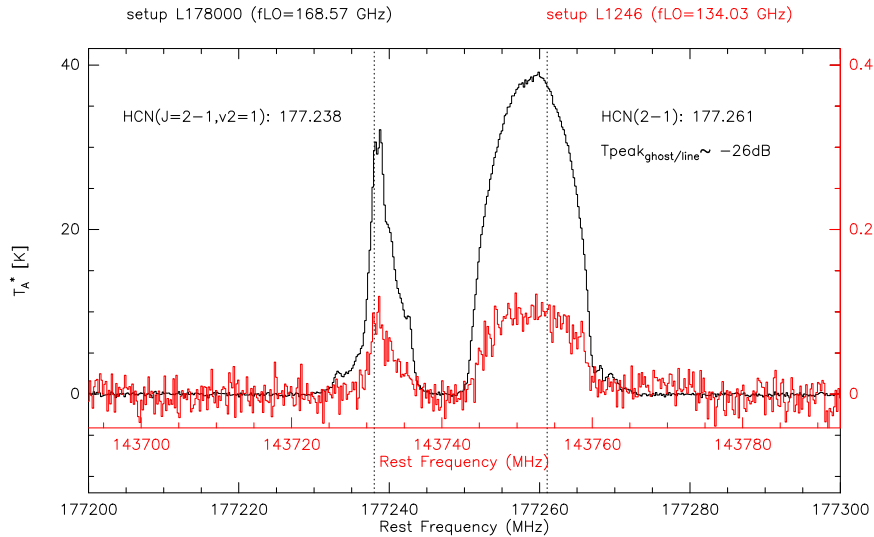


Figure 1: HCN($J=2-1, v=1$) and ($J=2-1, v=0$) lines at 177.239 and 177.259 GHz (peak positions, which are slightly shifted from the rest frequencies) towards IRC+10216 are shown in black, the ghost lines at 143.752 and 143.732 GHz in red at the same frequency scale; the temperature scale for the ghost lines a factor of 100 smaller. Horizontal and vertical polarizations have been averaged (they agree within 10%).

References

Kramer, Navarrini, Navarro, John, Cernicharo; August 2014; IRAM Report on ghost lines.
Sievers, John, Navarro, Kramer; March 2015; Work report on ghost line observations with E150.

¹Other rotational transitions of vibrationally excited states of HCN with potentially similar, strongly time variable line profiles are known in the source (Lucas & Cernicharo 1989, A&A 218), but are not at similar distance from the $v=0$ line as in the $J=2-1$ transition.