

EMIR Band 4 Commissioning Report DRAFT

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ABSTRACT. For the first time since more than 10 years, the telescope is equipped again with a line receiver for the 0.8mm window (the dual polarization band E330 of EMIR). Here, we describe the results of its commissioning.

Band 4 has been successfully tuned over most of the frequency range between 270 and 350 GHz. Continuum observations confirm the good adjustment of the primary dish. A number of issues have been uncovered and are described below. Over two very restricted frequency range, tuning is instable. The continuum stability is clearly different between the two polarisations. However, the effect on pointing and focus scans is minor. Spectroscopic observations do not show interferences with band 2, nor wrong header entries.

Here, we summarize the commissioning results of band 4 of EMIR at the IRAM 30m telescope, conducted this year. The local oscillator installed with EMIR for band 4 in April 2009, did not have sufficient power above 330 GHz and other problems. On November, 17th, 2009, a new and more powerful local oscillator for band 4 was installed.

1 Receiver Tuning

Sky frequencies between 270 GHz upto 351 GHz were tuned, encountering problems only in two frequency intervals described below. Higher frequencies can, at present, not be reached (25-Nov-09, SN).

At 330 GHz LO frequency (± 0.6 GHz) the LO cannot be locked. At 339 GHz LO frequency (± 1.5 GHz) the tuning is instable. This instability is an intermittent problem, changing from one day to the next for unknown reasons!

2 Continuum observations

2.1 Telescope beam widths and efficiencies

Observations were carried out on November, 24th, \pm one day, when weather conditions were excellent, with an amount of precipitable water vapor of 1 mm! The best estimate of the forward efficiency (Table 1) is based on 11 skydips. For the mean atmospheric window, the CLASS header information from the chopper wheel calibration was used. MIRA gave lower forward efficiencies with ATM85. ATM09 was not tried yet.

The aperture efficiency and beam widths (Table 1) are based on Mars observations (Fig.:1) at elevations of 30-60 deg under the same weather conditions. Mars had a diameter of $9.3''$. The drop of efficiency at low and high elevations (the gain elevation curve) could not yet be tested and compared with the predictions. The beam is circular and there are no indications of sidelobes or errorbeams down to the 10% level or less.

Table 1: Telescope half power beam width and forward, main eam, and aperture efficiencies.

Frequency	HPBW	F_{eff}	A_{eff}	Date
GHz	arcsec	%	%	
340	7.5	81 ± 1	28 ± 2	24-Nov-09 (JP)

2.2 Alignment with E1

On October, 29th, 2009, the alignment between E1 and E3 was checked on Mars (Fig. 2, over a wide range of elevations. The average alignment and rms are $0.75 \pm 0.25''$. The good alignment between E1 and E3 was confirmed on 24-Nov-09 under excellent weather conditions.

2.3 Focus differences

The focus difference between E1 and E3 is 0.2-0.3 mm (24-Nov, JP).

2.4 Noise

The noise of the Vertical polarisation is higher than for the Horizontal polarisation (Fig.3). Continuum total power observations occasionally show jumps, in both polarizations simultaneously.

Continuum data also shows negative spikes, showing up simultaneously in both polarisations (Fig. 3). Weaker, positive spikes are also seen (Fig. 4). The spike length is 100 msec or less.

3 Spectroscopic observations

Observations of two Galactic massive star forming regions (DR21, W51D) were carried out at 270, 280, 290, 300, 310, 320, 330, 345 GHz (BO, 20-Nov-09), partly under excellent weather conditions. Observations were conducted switching with the wobbler, in frequency, and in position. The backends WILMA, 4 MHz, and VESPA were used. Observations were done with E1 tuned to CS 3–2 in parallel to E3.

- All wobbler switched spectra have been viewed and they do not show obvious problems, in particular no line shifts or indications for spurious spikes (parasites).
- Spectral lines have been identified using a new line catalog provided by P. Schilke (Fig. 5).
- Spectra of both polarisations do not show any significant difference in noise. This was checked between 310 and 270 GHz.
- Receiver temperatures measured with the 4 MHz backend, after tuning by the operators, vary rather smoothly between 140-120 K at 345 GHz and 80 K at 270 GHz.

Source: Mars Scan: 100 Telescope: IRAM 30m Date: 2009-11-24T08:07
 Frontend: E300HUI Backend: CONT/3 Rest Frequency = 340 GHz
 Azimuth = 255.5° old Az corr = -2.8" new Az corr = -2.4"
 Elevation = 48° old El corr = 5.5" new El corr = 6"

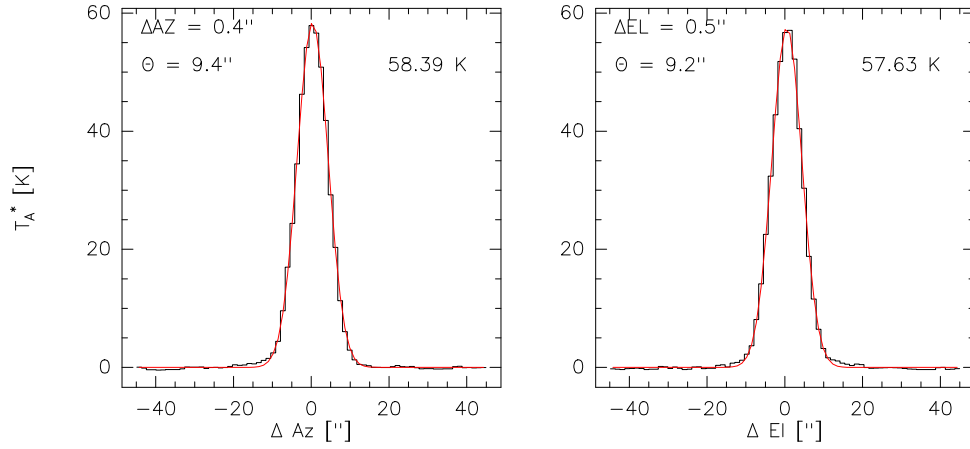


Figure 1: Mars pointing scan at 340 GHz.

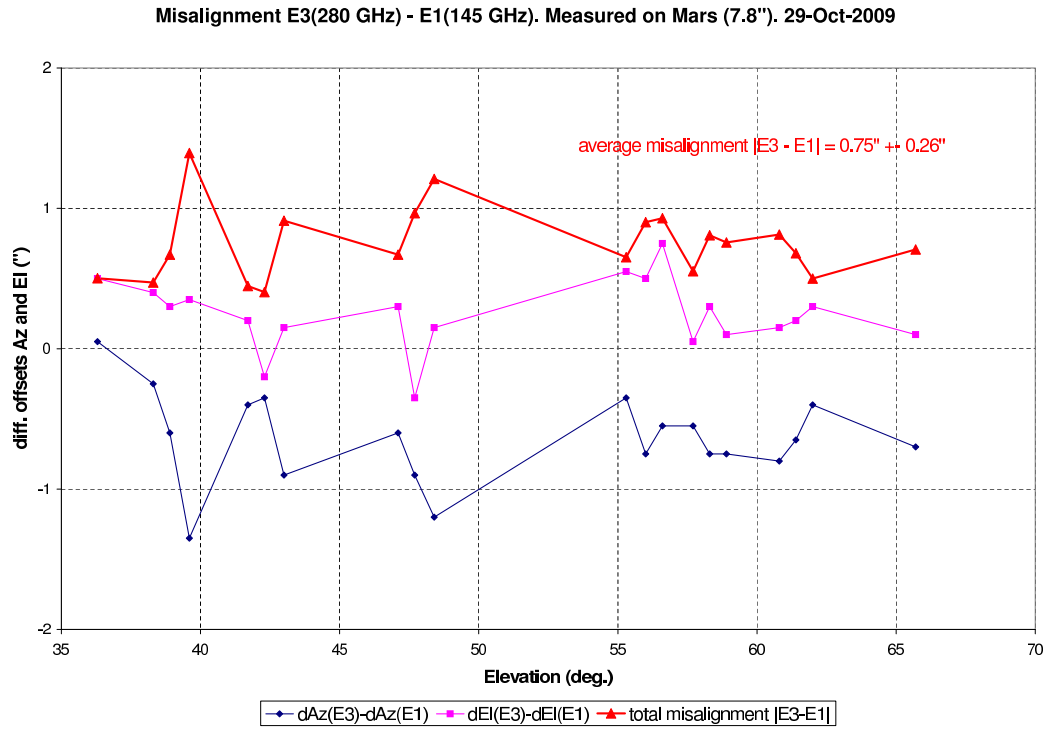


Figure 2: Alignment between E3 and E1.

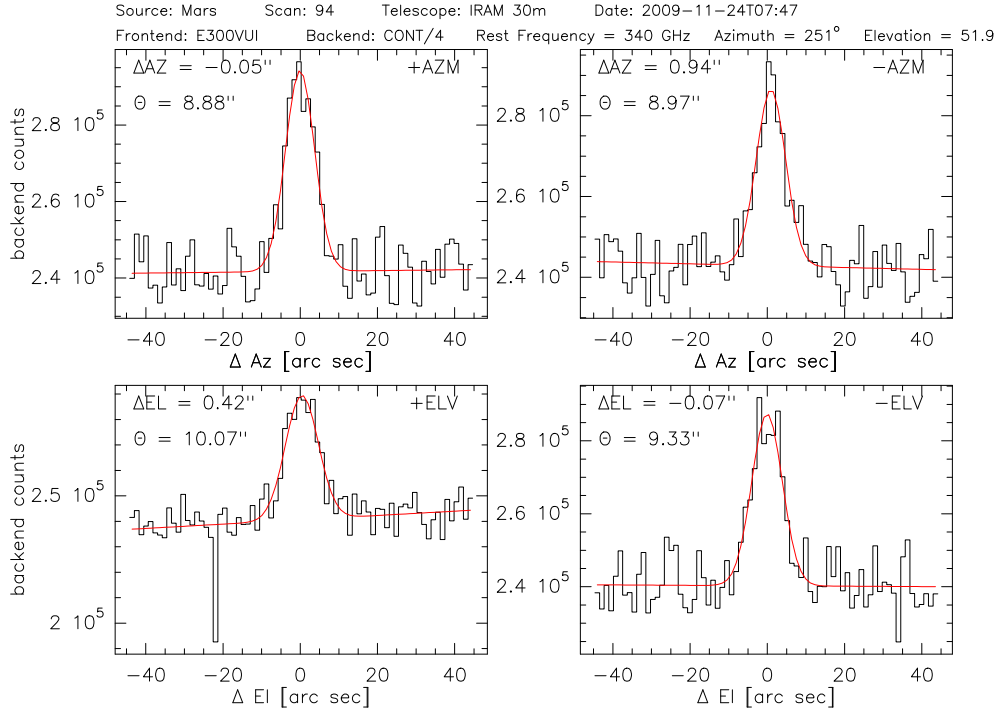


Figure 3: Mars data taken with the Vertical polarisation in total power mode, showing excess noise, and negative spikes.

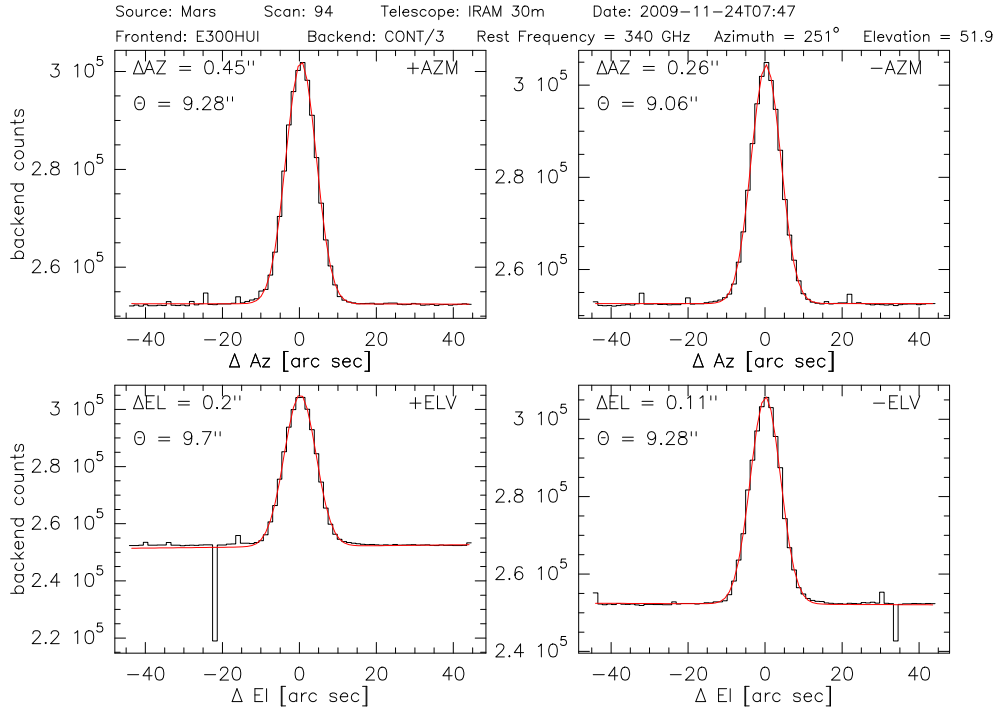


Figure 4: Mars data taken with the Horizontal polarisation in total power mode, showing much less noise than the Vertical polarisation shown above and taken simultaneously. Note the negative and positive spikes, but note also that this is one of the worst examples, concerning the spikes.

209; 1 W51D TEST290 30ME3HLI-W01 0:20-NOV-2009 R:20-NOV-2009
RA: 19:23:39.86 DEC: 14:31:08.2 Eq 2000.0 Offs: +0.0 +0.0
Unknown tau: 0.273 Tsys: 275. Time: 1.6 min El: 67.5
N: 1860 I0: 798.000 V0: 57.00 Dv: -2.068 LSR
F0: 290000.000 Df: 2.000 Fi: 302497.541

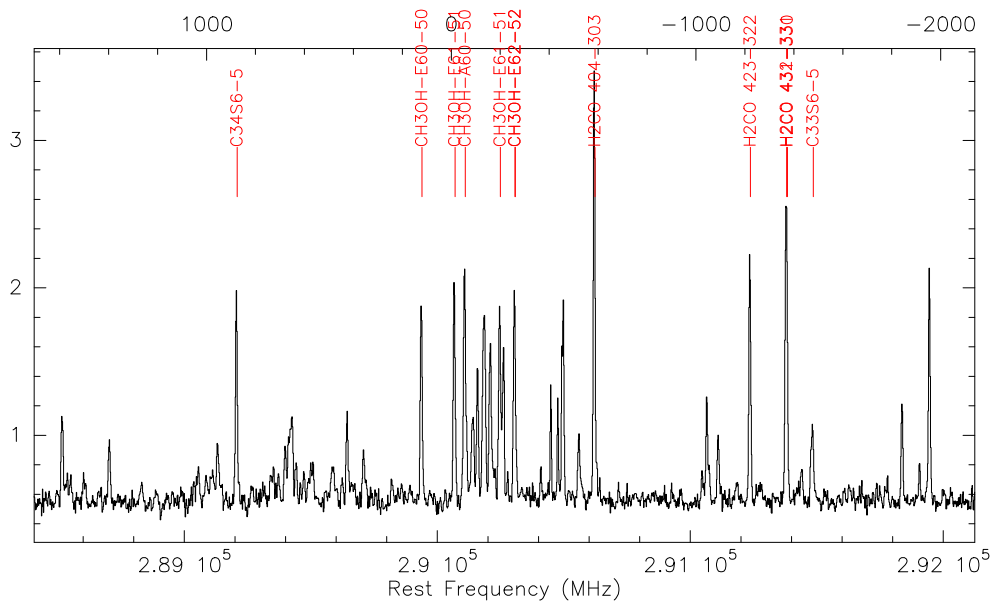


Figure 5: 4 GHz wide spectrum centered on 290 GHz, taken on W51D, using E3 and the 4MHz backend, wobbler switching.