

Testing the of new 550–900 MHz feeds

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1 Overview

Three antennas, C10, E02 and S03 of the GMRT have been now equipped with new 550–900 MHz feeds. We look at the bandshapes of these antennae, compare them with the band-shapes using deflection tests performed by the Front-End (FE) group. Here we present the band-shapes of these new feeds 550–900 MHz along with the band-shape of a typical current 610 MHz feeds for comparison. We compare the band-shapes of these new feeds obtained from sky-tests performed on a calibrator source with the deflection-tests performed by the Engineering team, performed for these new feeds, kindly shared by FE group. We use results from `rantsol` to determine these bandshapes.

2 Data

GMRT data using new GWB, which is acquired using the new GMRT analog baseband (GAB) chain at the 610 MHz band was acquired for three antennas, C10, E02 and S03 along with the rest in order to understand the performance of these and their comparison with the typical current 610 MHz feeds.

Since, these are an upgrade related tests of GMRT, observations were typically made on a flux density calibrator and the cross-bandshapes of these antennas were looked.

We performed two sets of observations,

one using 950 MHz as the RF

(Here, `ch-0` and `ch-2047` corresponds to 950 MHz and 550 MHz respectively.)

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2.1 RF = 950 MHz = ch-0

We present band-shape results for the RF equal to 950 MHz (= channel-0) case.

Table 1: Table showing observing log for data acquired on 13 Jan 2016.

Frequency: from 950 MHz (ch-0) to 550 MHz (ch-2047)
date of obs: 13 Jan 2016
data files: gwbh1:/data2/gpuuser/13jan/tst1356_13jan2016_lo950.lta
START-time: (approx) 00:00hrs (midnight)
STOP-time: (approx) 07:00hrs (afternoon)

SCN	OBJ	DATE	IST	RF (MHz)	CW (kHz)	N-rec
0	3C147	13/Jan/2016	23:57:13	950.00	195.312	0
1	3C147	14/Jan/2016	00:00:26	950.00	195.312	111
2	3C147	14/Jan/2016	00:21:10	950.00	195.312	111
3	3C147	14/Jan/2016	00:42:00	950.00	195.312	111
4	3C147	14/Jan/2016	01:02:49	950.00	195.312	111
5	3C147	14/Jan/2016	01:23:34	950.00	195.312	111
6	3C147	14/Jan/2016	01:44:24	950.00	195.312	111
7	3C147	14/Jan/2016	02:05:09	950.00	195.312	111
8	3C147	14/Jan/2016	02:25:58	950.00	195.312	111
9	3C147	14/Jan/2016	02:46:48	950.00	195.312	111
10	3C147	14/Jan/2016	03:07:37	950.00	195.312	111
11	3C147	14/Jan/2016	03:28:22	950.00	195.312	111
12	3C147	14/Jan/2016	03:49:17	950.00	195.312	111
13	3C147	14/Jan/2016	04:10:02	950.00	195.312	92
14	3C286	14/Jan/2016	04:30:56	950.00	195.312	111
15	3C286	14/Jan/2016	04:51:41	950.00	195.312	111
16	3C286	14/Jan/2016	05:12:25	950.00	195.312	111
17	3C286	14/Jan/2016	05:33:10	950.00	195.312	111
18	3C286	14/Jan/2016	05:53:55	950.00	195.312	111
19	3C286	14/Jan/2016	06:14:35	950.00	195.312	111
20	3C286	14/Jan/2016	06:35:20	950.00	195.312	111
21	3C286	14/Jan/2016	06:56:05	950.00	195.312	56

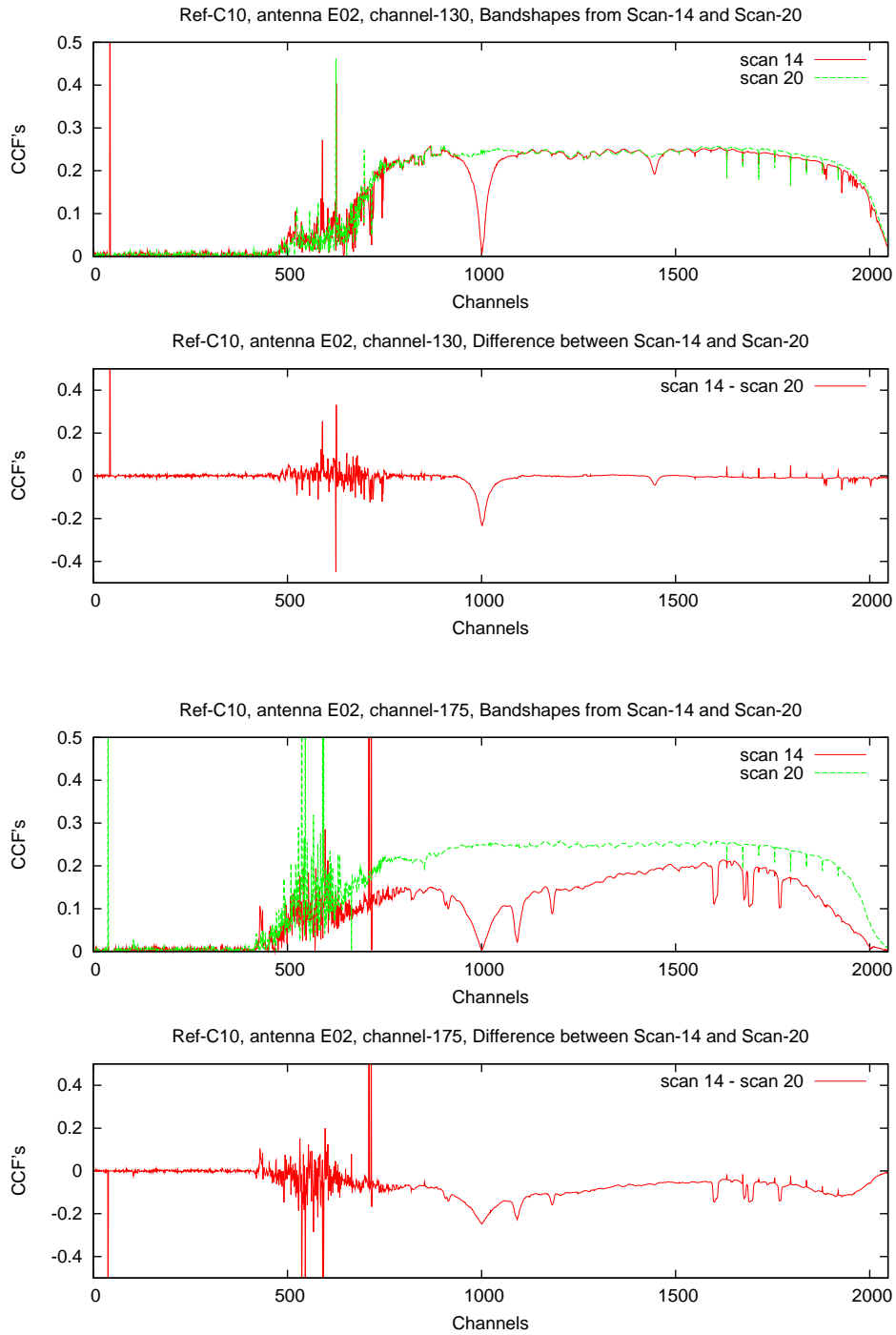


Figure 1: Band-shapes of E02 antenna using C10 as reference using 3C286 calibration source. Upper two panel and lower two panel figure has two plots, upper-plot shows band-shapes obtained from scan 14 (green plot) and scan 20 (red-plot), which are ~ 2.1 hr apart and the difference of these two band-shapes is shown in lower-plot. Upper two panel and lower two panel plots show band-shapes of 130 MHz (ch-1) and 175 MHz (ch-2) channels.

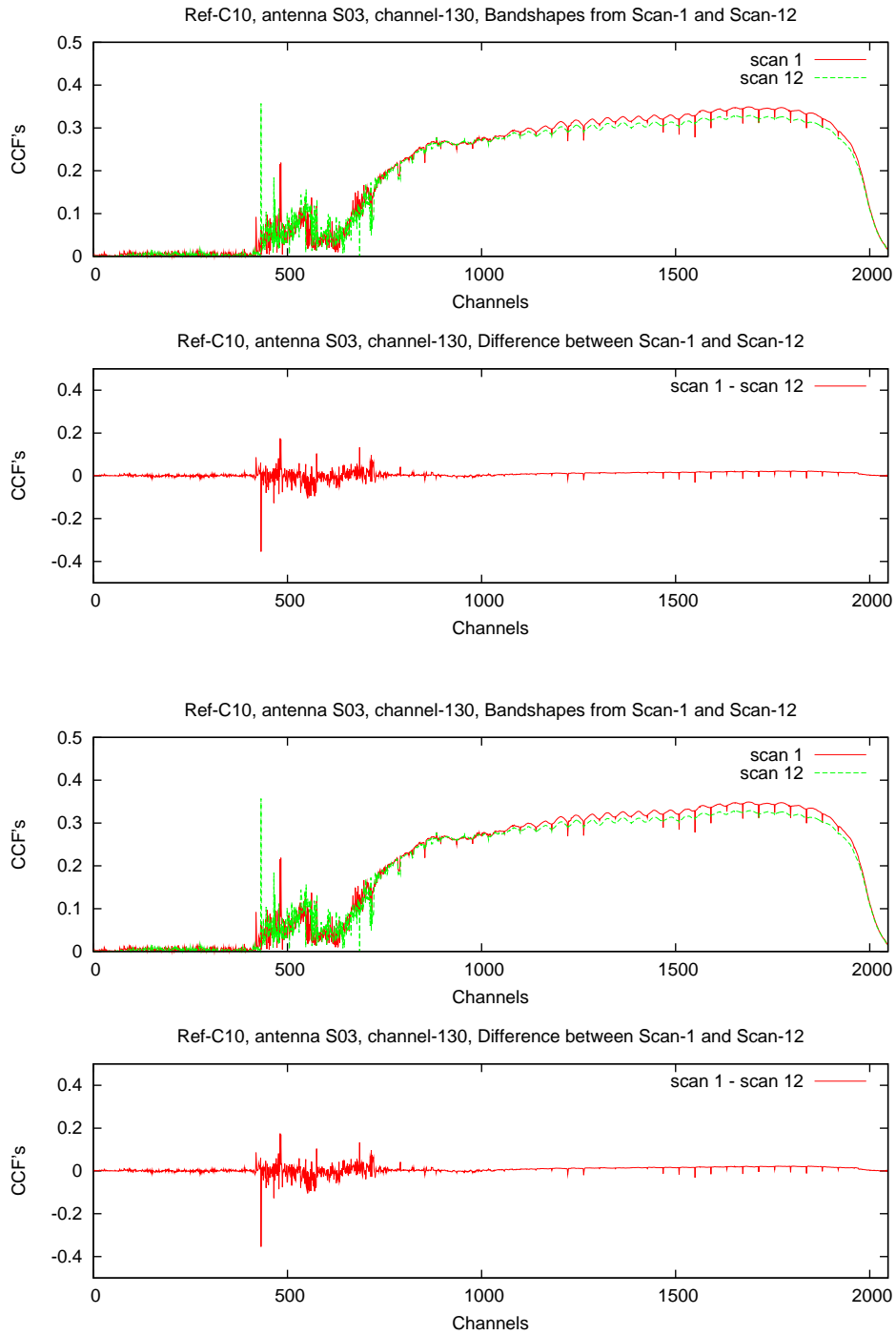


Figure 2: Band-shapes of S03 antenna using C10 as reference using 3C147 calibration source. The upper two panel and lower two panel, each has two plots, where upper-plot shows band-shapes obtained from scan 1 (green plot) and scan 12 (red-plot), which are ~ 3.75 hr apart and the difference of these two band-shapes is shown in lower-plot. Upper two panel and lower two panel plots show band-shapes of 130 MHz (ch-1) and 175 MHz (ch-2) channels.

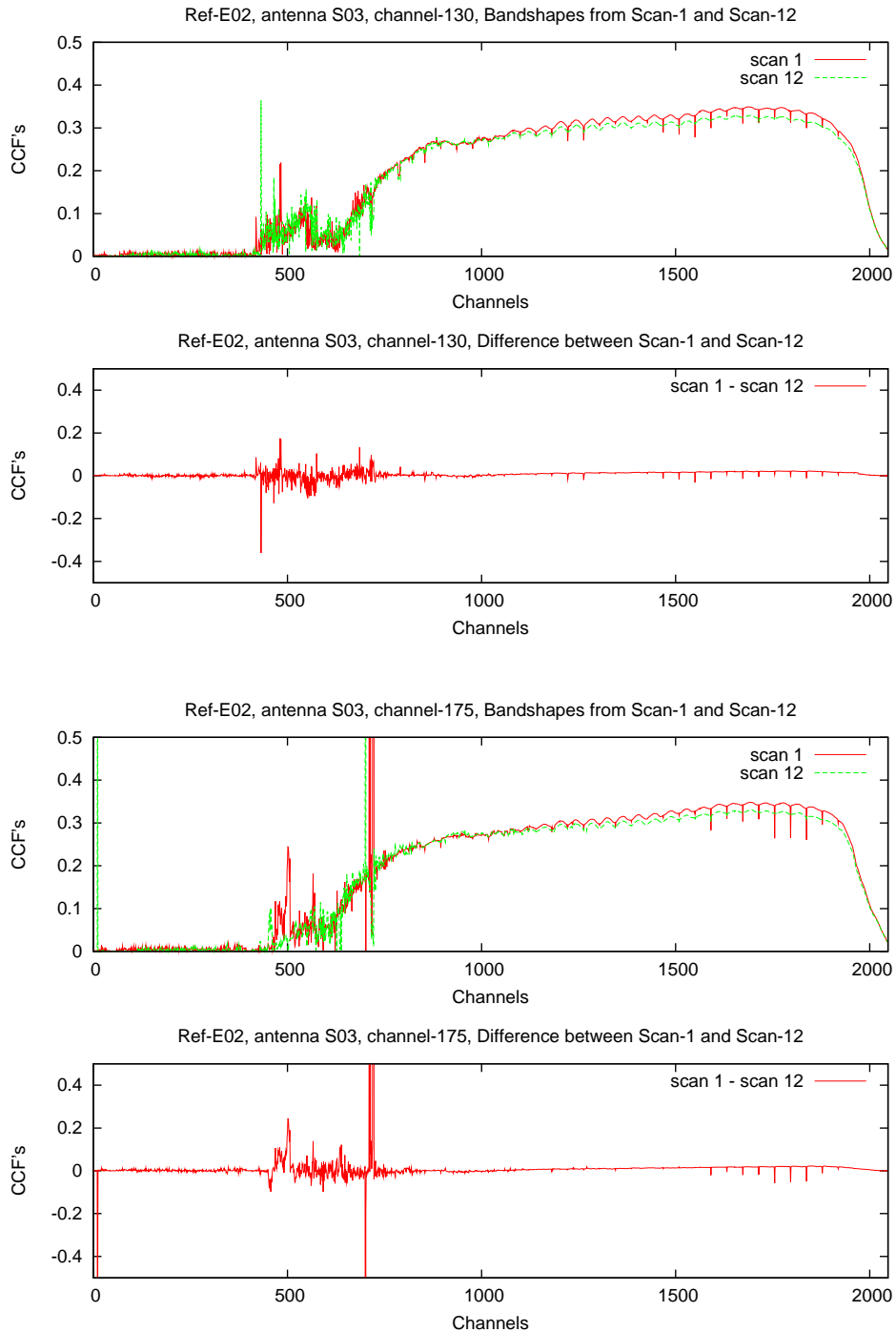


Figure 3: Band-shapes of S03 antenna using E02 as reference using 3C147 calibration source. The upper two panel and lower two panel each has two plots, where upper-plot shows band-shapes obtained from scan 1 (green plot) and scan 12 (red-plot), which are ~ 3.75 hr apart and the difference of these two band-shapes is shown in lower-plot. Upper two panel and lower two panel plots show band-shapes of 130 MHz (ch-1) and 175 MHz (ch-2) channels.

2.2 RF = 550 MHz = ch-0

We now present band-shape results for the RF equal to 550 MHz (= channel-0) case.

Table 2: Table showing observing log for data acquired on 24 Feb 2016.

Frequency: from 550 MHz (ch-0) to 950 MHz (ch-2047)
date of obs: 24 Feb 2016
data files: gwbh1:/data2/gpuuser/24feb/tst1385_gwb_24feb2016_550lo.lta
 /data2/gpuuser/24feb/tst1385_gwb_24feb2016_550lo.lta.1
START-time: 00:00hrs (midnight)
STOP-time: 12:30hrs (afternoon)

SCN	OBJ	DATE	IST	RF (MHz)	CW (kHz)	N-rec
0	3C147	24/Feb/2016	17:14:58	550.00	195.312	113
1	3C147	24/Feb/2016	17:36:02	550.00	195.312	112
2	3C147	24/Feb/2016	17:56:56	550.00	195.312	111
3	3C147	24/Feb/2016	18:17:41	550.00	195.312	111
4	3C147	24/Feb/2016	18:38:31	550.00	195.312	111
5	3C147	24/Feb/2016	18:59:20	550.00	195.312	111
6	3C147	24/Feb/2016	19:20:10	550.00	195.312	111
7	3C147	24/Feb/2016	19:42:33	550.00	195.312	112
8	3C147	24/Feb/2016	20:03:18	550.00	195.312	111
9	3C147	24/Feb/2016	20:24:08	550.00	195.312	90
SCN	OBJECT	DATE	IST	RF (MHz)	CW (kHz)	Nrecs
0	3C147	24/Feb/2016	22:22:01	550.00	195.312	33
1	3C147	24/Feb/2016	22:28:54	550.00	195.312	111
2	3C147	24/Feb/2016	22:49:44	550.00	195.312	59

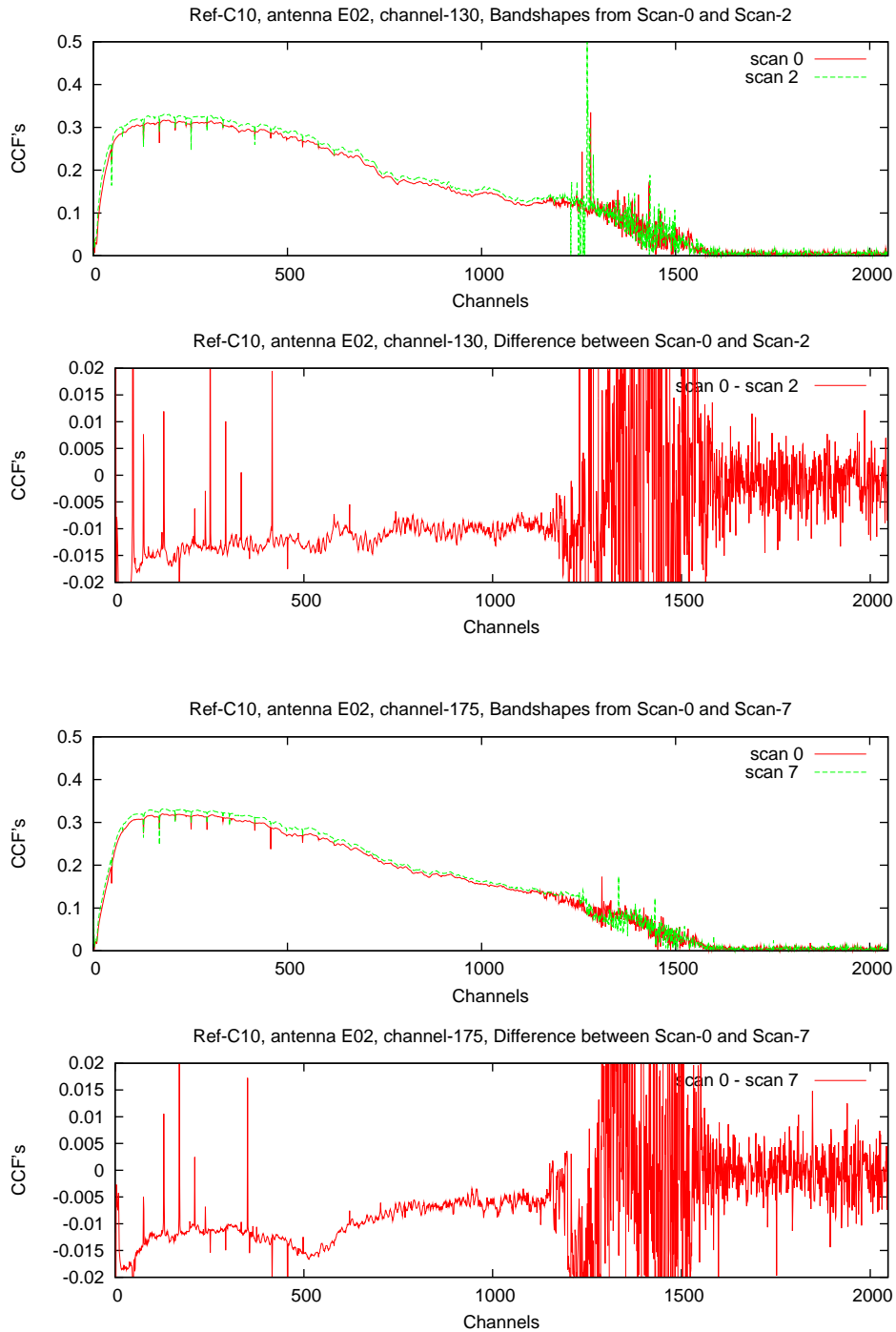


Figure 4: Band-shapes, amplitudes as a function of frequency channel, of baseline involving C10 and E02 antennae. Upper two panel and lower two panel figure has two plots, upper-plot shows band-shapes obtained from scan 1 (green plot) and scan 2 or scan 9 (red-plot), which are ~ 0.9 hr and ~ 2.7 hr, respectively apart and the difference of these two band-shapes is shown in lower-plot. Upper two panel and lower two panel plots show band-shapes of 130 MHz (ch-1) and 175 MHz (ch-2) channels.

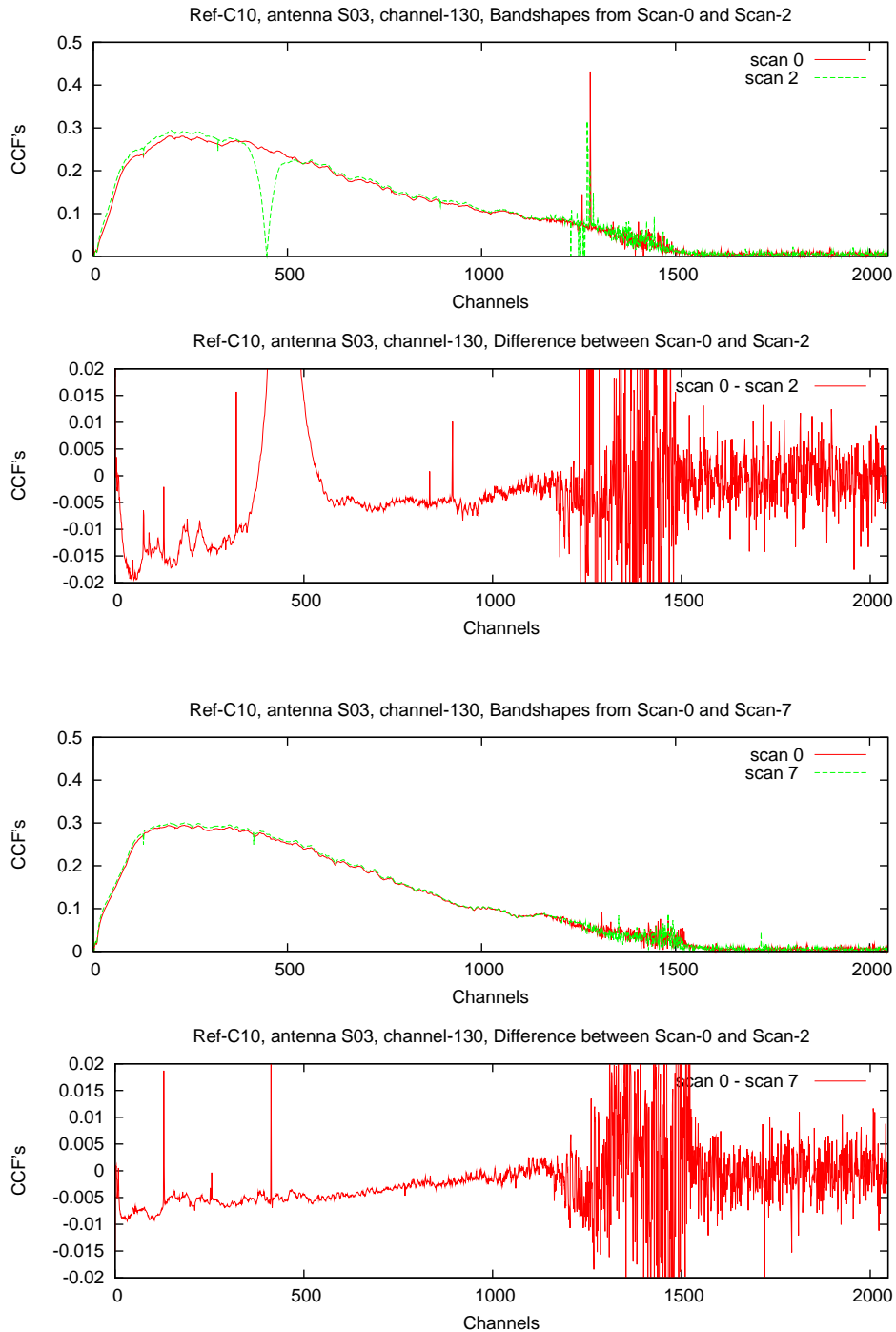


Figure 5: Band-shapes of S03 antenna using C10 as reference for 3C147 calibration source. The two, upper two panel and lower two panel plots are, upper-plot shows band-shapes obtained from scan 1 (green plot) and scan 2 or scan 9 (red-plot), which are ~ 0.9 hr and ~ 2.7 hr, respectively apart and the difference of these two band-shapes is shown in lower-plot. Upper two panel and lower two panel plots show band-shapes of 130 MHz (ch-1) and 175 MHz (ch-2) channels.

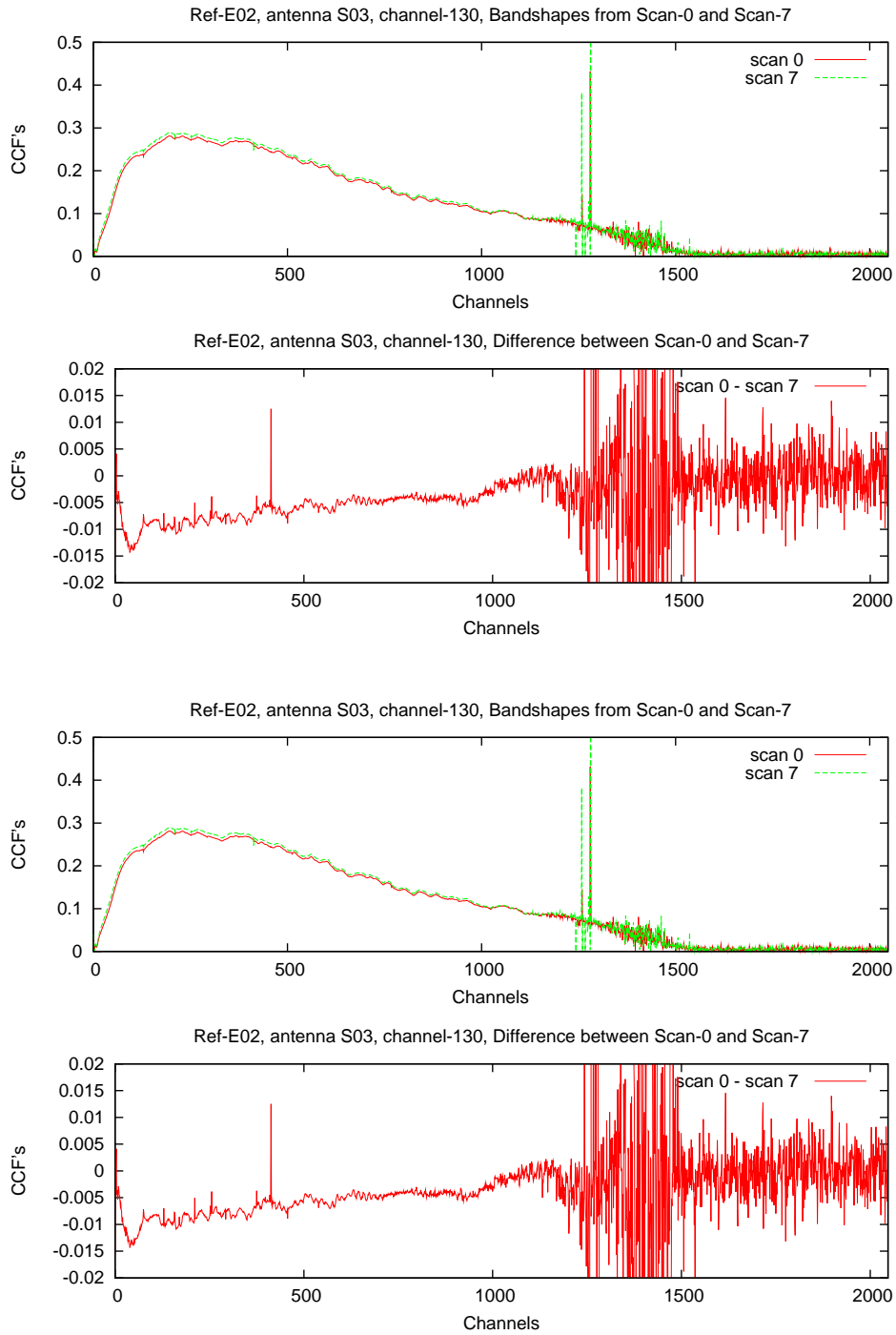


Figure 6: Band-shapes of S03 antenna using E02 as reference for 3C147 calibration source. The two, upper two panel and lower two panel plots are, upper-plot shows band-shapes obtained from scan 1 (green plot) and scan 9 (red-plot), which are ~ 2.7 hr apart and the difference of these two band-shapes is shown in lower-plot. Upper two panel and lower two panel plots show band-shapes of 130 MHz (ch-1) and 175 MHz (ch-2) channels.

2.3 Comparison with results from Engineering Front-End Team

Engineering team members, Mr. Imran Khan, Hanumanth Bandari and Ankur Prajapati had performed defelections tests for these antennas, C10, E02 and S03 in order to understand performance of these new upgraded feeds.

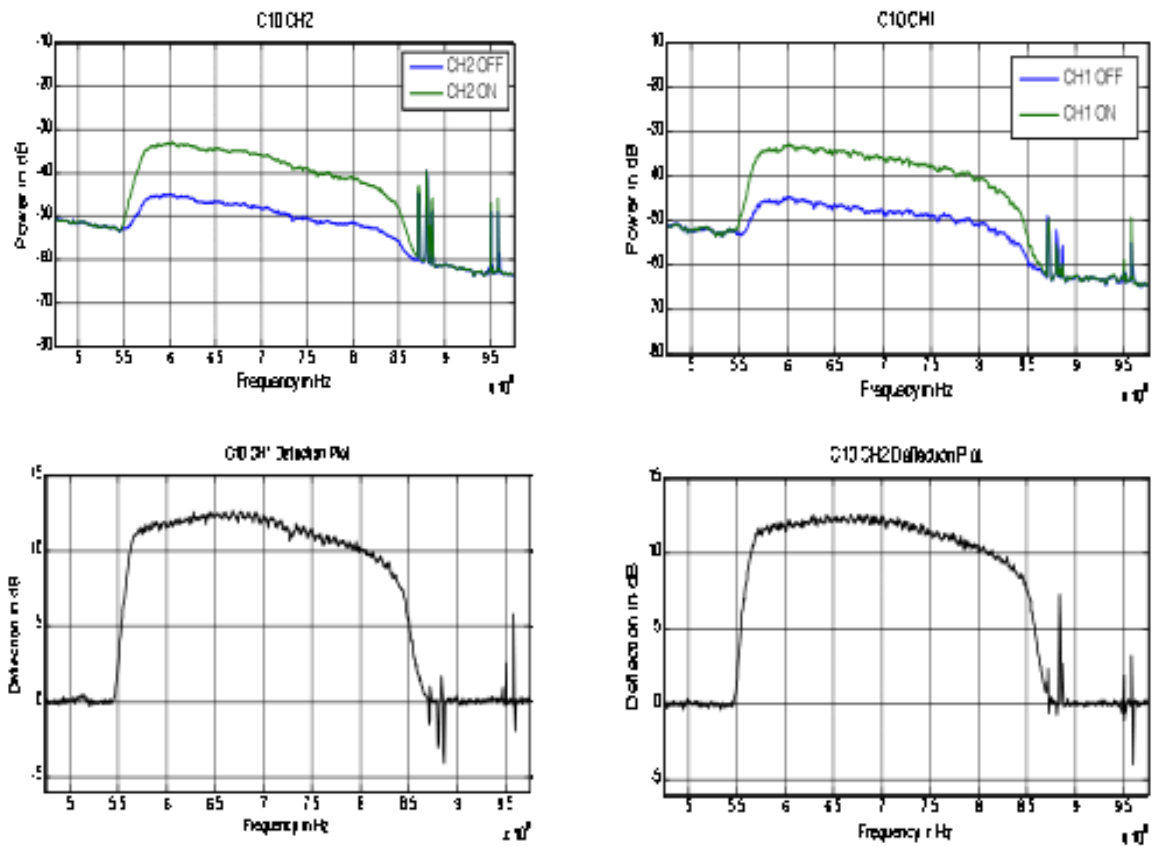


Figure 7: Band-shapes of C10 antenna obtained by performing the deflection test on Cygnus A, a calibrator source by the Engineering team on 10 December 2015. Upper-panel plots are for deflections obtained by firing (ON) and not-firing (OFF) an attenuation source for the two channels, ch-1 (130 MHz; left-side plot) and ch-2 (175 MHz; right-side plot). The expected deflection is 10.7 dB at a frequency of 700 MHz. Lower-panel plots show the amount of deflection observed for the two channels, respectively.

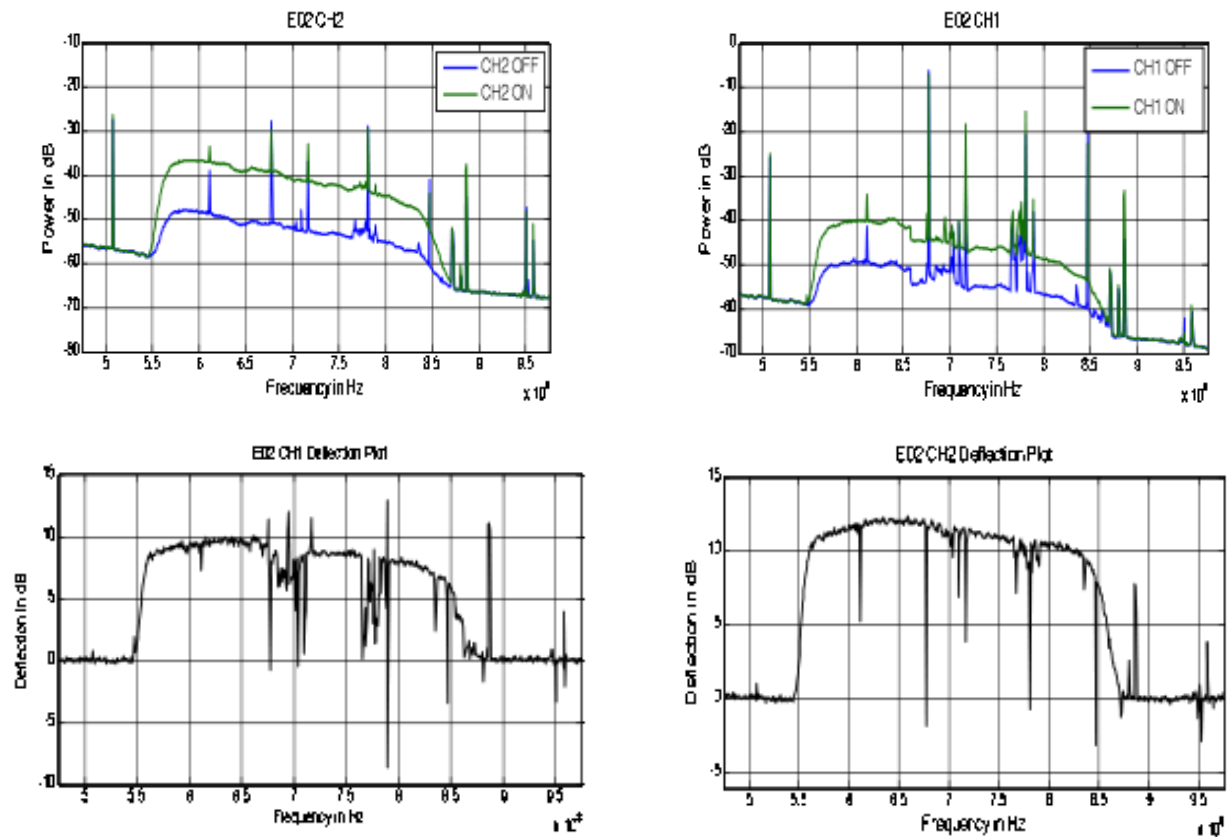


Figure 8: Band-shapes of E02 antenna obtained by performing the deflection test on Cygnus A, a calibrator source by the Engineering team on 10 December 2015. Upper-panel plots are for deflections obtained by firing (ON) and not-firing (OFF) an attenuation source for the two channels, ch-1 (130 MHz; left-side plot) and ch-2 (175 MHz; right-side plot). The expected deflection is 10.7 dB at a frequency of 700 MHz. Lower-panel plots show the amount of deflection observed for the two channels, respectively.

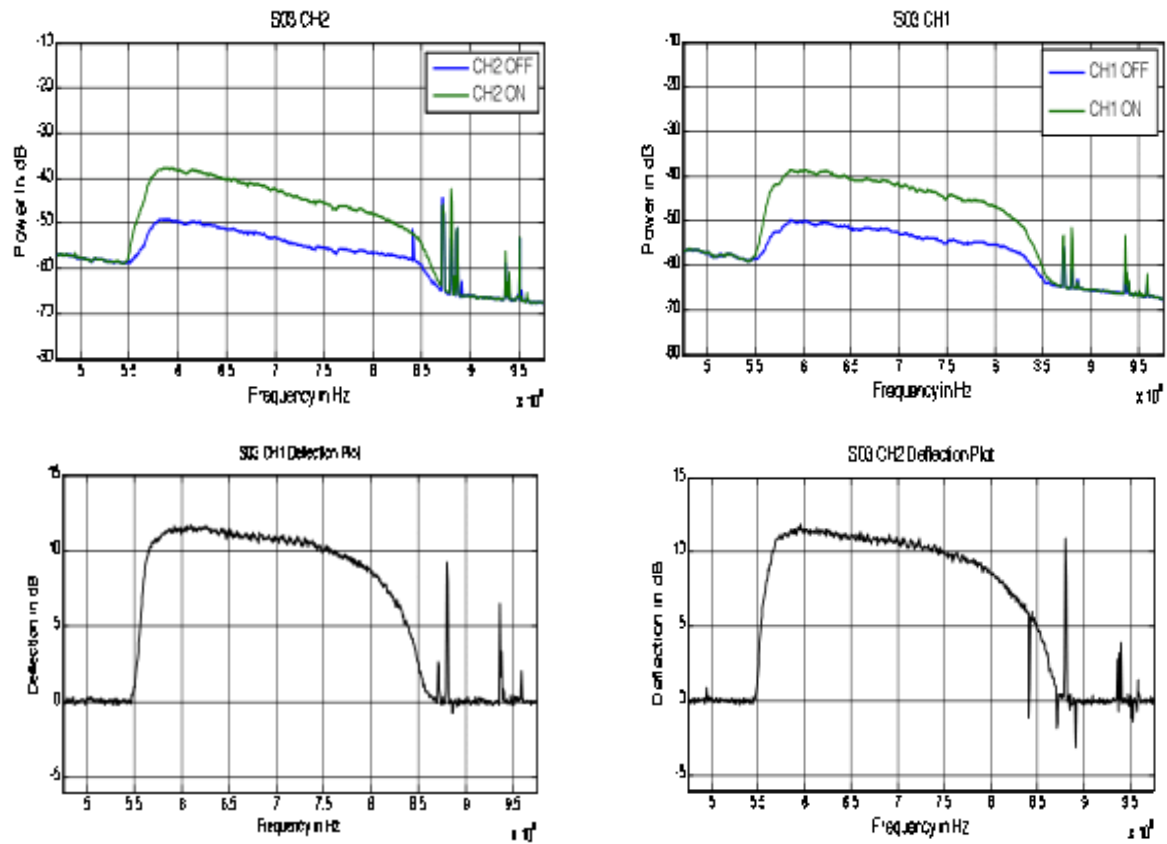


Figure 9: Band-shapes of S03 antenna obtained by performing the deflection test on Cygnus A, a calibrator source by the Engineering team on 10 December 2015. Upper-panel plots are for deflections obtained by firing (ON) and not-firing (OFF) an attenuation source for the two channels, ch-1 (130 MHz; left-side plot) and ch-2 (175 MHz; right-side plot). The expected deflection is 10.7 dB at a frequency of 700 MHz. Lower-panel plots show the amount of deflection observed for the two channels, respectively.

2.4 Results

Clearly the new upgraded feeds installed on C10, E02 and S03 show marked improvements as compared to existing 32 MHz system.

We list the inferences drawn from several Figures 1–6 obtained from data detailed in Tables 1–2

	Baseline	Cal-src	RF
Fig. 1:	bandshape C10-E02	3C286	950 MHz
Fig. 2:	bandshape C10-S03	3C147	950 MHz
Fig. 3:	bandshape E02-S03	3C147	950 MHz
Fig. 4:	bandshape C10-E02	3C147	550 MHz
Fig. 5:	bandshape C10-S03	3C147	550 MHz
Fig. 6:	bandshape E02-S03	3C147	550 MHz
Fig. 7:	bandshape from defelection test for C10 antenna		
Fig. 8:	bandshape from defelection test for E02 antenna		
Fig. 9:	bandshape from defelection test for S03 antenna		

Briefly, to summarise these findings,

- it appears that the sky tests performed with GWB seems to match the results obtained by the Engineering Front-End team for these three antennas with broad-band upgraded feeds.
- Both sky-tests performed using a calibrator-source through the complete new path from antenna base to the correlator via the GMRT Analog Baseband (GAB) system and the defelection-tests performed by the GMRT Engineering team, provide (nearly) identical band-shapes.
- Amount of defelection seen by the Engineering team in antenna E02 is low as compared to C10 or S03, which is due to a cable, cable connecting the feed and the LNA-hood and it has been replaced to fix this.

We will next look at

- the stability of these band-shapes on several time-scales, from a few minutes to several days or weeks.
- Amount of usable band-width.
- Since, this (550–900 MHz band) now is a hybrid system, consisting of antennas with old and new feeds, we would provide the recommended RF and GAB–LO settings to perform routine GTAC observations.