2cm tests 28/9. Dec. 1995

Assumption: TCAL = 10.0 for all four channels. Derive channel normalization factor from:

1.) Moon data

	Chan A	Chan B	Chan C	Chan D	
Scan	978	979	980	981	
Elevation	36.7	36.3	35.9	35.4	
Base	369.60	295.37	245.85	307.68	
Moon	480.27	442.65	485.81	535.34	
Normalization	1.000	1.085	0.989	0.897	(to Chan. A)

2.) Point source data

Source	Elv.	Chan A	Chan B	Chan C	Chan D
NGC7027	80	18.517	-	18.87	22.574
	62	19.115	17.760	19.56	21.337
3C273	36	75.002	69.663	75.89	83.460
	40	75.120	70.187	75.25	82.005
Cha.ratio	80	1.000	-	0.981	0.899
	62	1.000	1.076	0.977	0.896
	36	1.000	1.076	0.988	0.899
	40	1.000	1.070	0.998	0.916
Mean ratio		1.000	1.074	0.986	0.902
rms of ratio		-	0.002	0.005	0.005

Normalization factors, derived from Moon and point source data agree very well.

Intensity and HPW are function of elevation:

Typical values of Chan A

Source	Elv	Intensity	HPBW	SFC2
NGC7027	81.4	18.50	50.5	-21.1
"	61.9	19.11	51.6	-17.7
"	40.6	19.4	52.3	-17.2

The change of focus may be dependent on temperature and/or elevation.

The change of HPW is significant and similar for all channels:

Elv. [deg]	Channal A HPW["]	Channal B HPW["]	Cannal C HPW["]	Channal D HPW["]
81	50.46 +/-0.25	-	50.50 +/-0.5	50.40 +/-0.5
62	51.6 +/-1.0	51.20 +/-0.70	52.80 +/-0.5	51.72 +/-0.32
39	53.14 +/-0.19	53.19 +/-0.20	53.72 +/-0.55	53.62 +/-0.54

In scan 974 at 40.6 deg. elevation the signal of NGC7027 was 19.4. The measured flux density of Baars et al. [1977] was 6.16 Jy. So data of Chan. A must be multiplied by (6.16/19.4)=0.318 for calibration.

Rms determination.

Scan 984 (Betelgeuse), Signal in Ch A & D, intensities multiplied by 1000.
Elevation ~33.5 deg. All subscans are shown in Fig. 1.

SSc	rms Ch A	rms Ch B	rms Ch C	rms Ch D
1	46.9	64.5	43.2	45.8
2	48.1	76.0	45.7	52.8
3	46.5	57.6	36.7	47.5
4	39.3	61.4	44.1	44.4
5	40.8	95.0*	37.3	48.3
6	53.6	80.4*	35.3	53.2
7	40.7	59.1	35.8	40.9
8	47.0	60.4	38.0	44.8
9	39.7	70.1	30.9	46.1
10	58.4	91.0*	34.4	55.4
11	44.9	63.9	34.5	49.2
12	55.1	54.3	33.7	44.4
13	40.0	72.2	41.9	43.0
14	51.8	63.4	37.9	56.5
15	47.9	60.4	31.1	43.6
16	60.2	174.4*	33.4	32.2
17	50.7	64.5	37.5	41.2
18	43.3	74.4	32.7	41.1
19	43.7	65.0	35.6	37.4
20	58.7	72.8	44.1	47.6
21	55.6	82.2*	50.9	41.4
22	42.3	80.1*	28.4	48.3
23	38.7	133.2*	29.2	47.6
24	42.9	67.5	33.9	42.7
25	44.5	69.6	33.4	45.6
Mean	47.25	65.39	36.78	45.64
rms	6.60	6.12	5.49	5.44

Note: values with * ignored (spikes !)

Mean val. in mJy: (Calibr = normalization * 0.318 [Jy])

15.00 22.33 11.53 13.09

Values of the RX:
Integration time per point t: 0.638 s; Bandwidth BW: 100 MHz; Trx: 100 K, additionally Tatm + Tstray ~ 30 K. Tsys ~ 130 K, total power observations, i.e. k = 1.

Predicted rms = k * Tsys/sqrt(t * BW) = 0.0163 K ^ 0.0129 Jy. (Assuming that 1 Jy ~ 1.26 K @ 2cm)

Predicted and achieved sensitivity with real source (Betelgeuse):

24 Subscans, 60 sec each, two channels = 2880 s; about 15% on source = 432 s. Expected rms of fit ~ 0.60 mJy; observed flux density of Betelgeuse: 10.0 +/-0.8 mJy. I.e. predicted and observed rms are about equal. Fig. 2 show folded scans of 3C138 and Betelgeuse with Gauss fit.

Calibration values applied to Moon (norm. factor from point sources):

	Chan A	Chan B	Chan C	Chan D
Scan	978	979	980	981
Base	148.1	127.1	97.1	111.2
Moon	192.4	190.5	191.9	193.5

The moon measurements were done shortly after first quarter (phase ~90 deg.) with an expected brightness temperature of ~233 K at the lunar center.

Zero point (OPOS=180 D*) of "Drehstand" are set to readout 5555 with Horn1 (main horn) and Horn1 displaced in Azimuth, with Horn1 offsets of +71" in Azm and -71" in Elevation with respect to the rotation axis.

In the fixed position (OPOS = 180 D*) the horn separation were measured by scans:

Horn1 & Horn2	143.93 +/-0.21 arcsec	in Azm
Horn1 & Horn4	142.39 +/-0.26 arcsec	in Elv
Horn3 & Horn2	142.69 +/-0.26 arcsec	in Elv
Horn3 & Horn4	142.92 +/-0.23 arcsec	in Azm

Check of the zero point of rotation (repeated observations of Horn1 and Horn2 with readout 5553:

Horn2 - Horn1	delta Elv = -1.67 +/- 0.67
	delta Azm = -1.38 +/- 0.91

Measurements with Drehstand in operation could not be done. (Correction for parallactic angle had wrong sign.)

Focus curve. Rel. intensities for 3C273 as function of OFC2; center value (OFC2=0) near best fit position. Data are displayed in Fig. 3.

OFC2 [mm]	Horn1	Horn2	Horn3	Horn4
-25.00	-1.1	2.3	0.8	3.6
-21.43	4.3	7.4	7.3	10.1
-17.86	16.2	18.1	19.3	23.0
-14.29	30.2	33.2	34.9	39.9
-10.71	47.1	47.6	51.1	57.9
-7.14	61.3	60.9	65.8	73.5
-3.57	70.5	74.3	73.8	82.3
0.00	73.1	70.5	74.2	83.4
3.57	67.9	65.0	68.2	77.3
7.14	57.2	57.0	56.3	65.4
10.71	42.4	42.3	42.3	49.8
14.29	29.2	29.5	28.9	35.6
17.86	21.5	18.8	17.5	23.1
21.43	9.8	11.7	10.1	14.2
25.00	4.5	8.3	5.2	9.4

The asymmetry, noticed in the first tests, is confirmed. This becomes obvious, if the symmetric values to OFC2=0 are connected.
The focus value obtained from the online fit depends on the focal scan length; with standard values for the focus scan the error in focus 2 can exceed 2 mm! The reason for the observed asymmetry is not clear.

The pointing error as function of focus 1 was measured; it is quite similar as at 43 and 30 GHz in the PF; it will be discussed elsewhere.

Comparison of calibration factors (equivalent of noise signal for S9=1):

	Chan. A	Chan. B	Chan. C	Chan. D	Comments
flux density (s.a.)	3.18	3.42	3.14	2.87	rel. to NGC7027
Ta (s.a.)	4.00	4.30	3.95	3.61	eta(a)* (60/HPW)**2
Ta (Lochner 1)	2.8	4.5	3.3	2.9	Meas. Dec. 5, 95, no radom
Ta (Lochner 2)	3.4	4.7	3.1	3.1	dto. / dto.

Resume: 1. Change sense of Drehstand rotation.

2. HPW (and efficiency) elevation dependent. Why?

3. Axial focus curve not symmetric (use short focal scan distance !)

4. RX of horn2 shows big spikes, also scans without spikes shows excessive noise. Repair needed.

5. Calibration signals, Tsys, T(Moon), derived from thermal calibration and from astronomical measurements (calibrated in flux units and Ta from revised aperture effixciency, deduced from increased resolution) agree qualitatively.

6. rms of single scans and rms of a fit to a weak source in 24 stacked scans could both be explained by an effective bandwidth of 100 MHz together with the given integration time and system temperature.

7. Beam deviation factor needs update at 15 GHz, too.

8. Tests with (correctly) rotating "Drehstand" still needed.

Version: 4. Jan. 1996. wja

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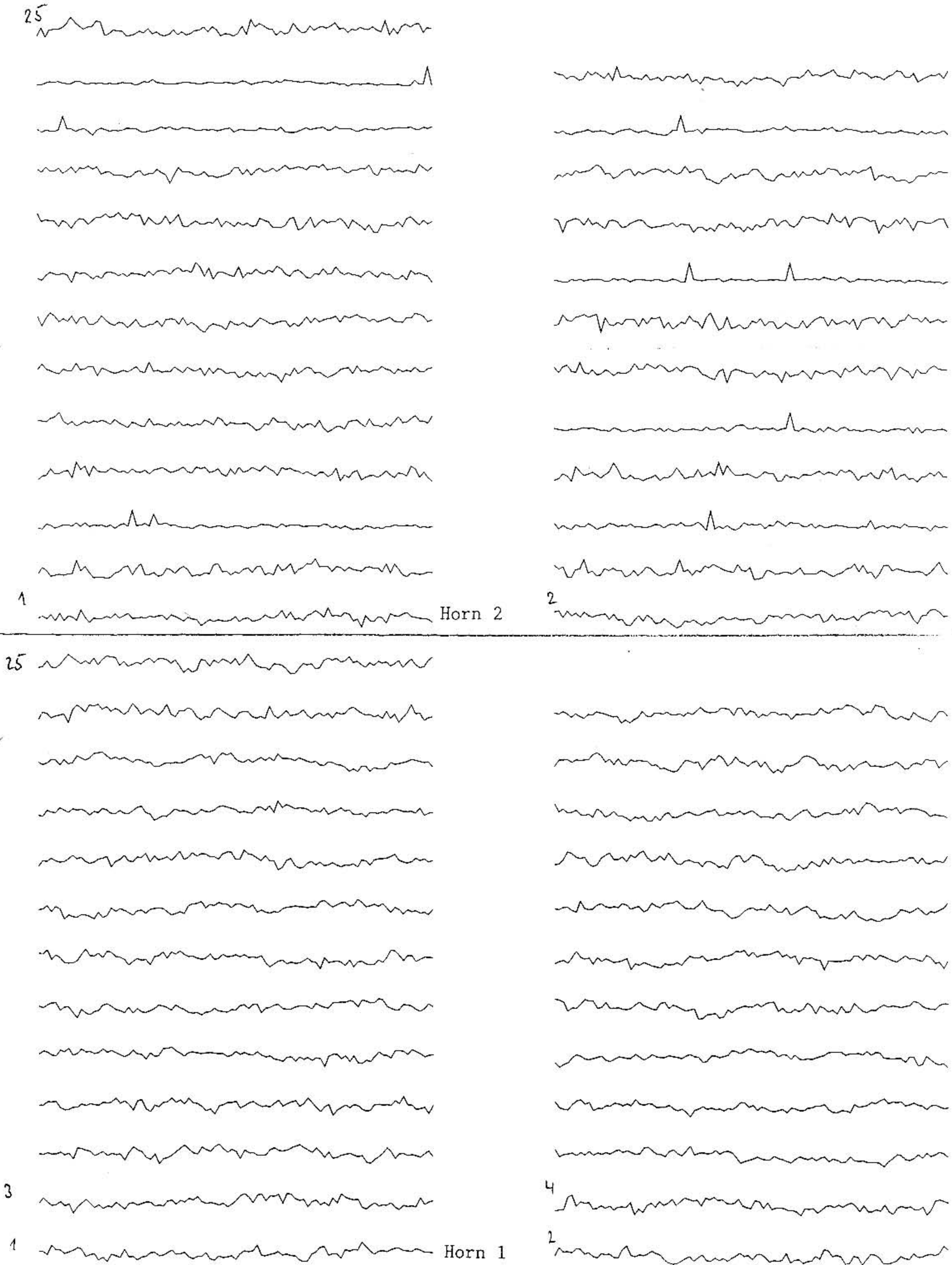
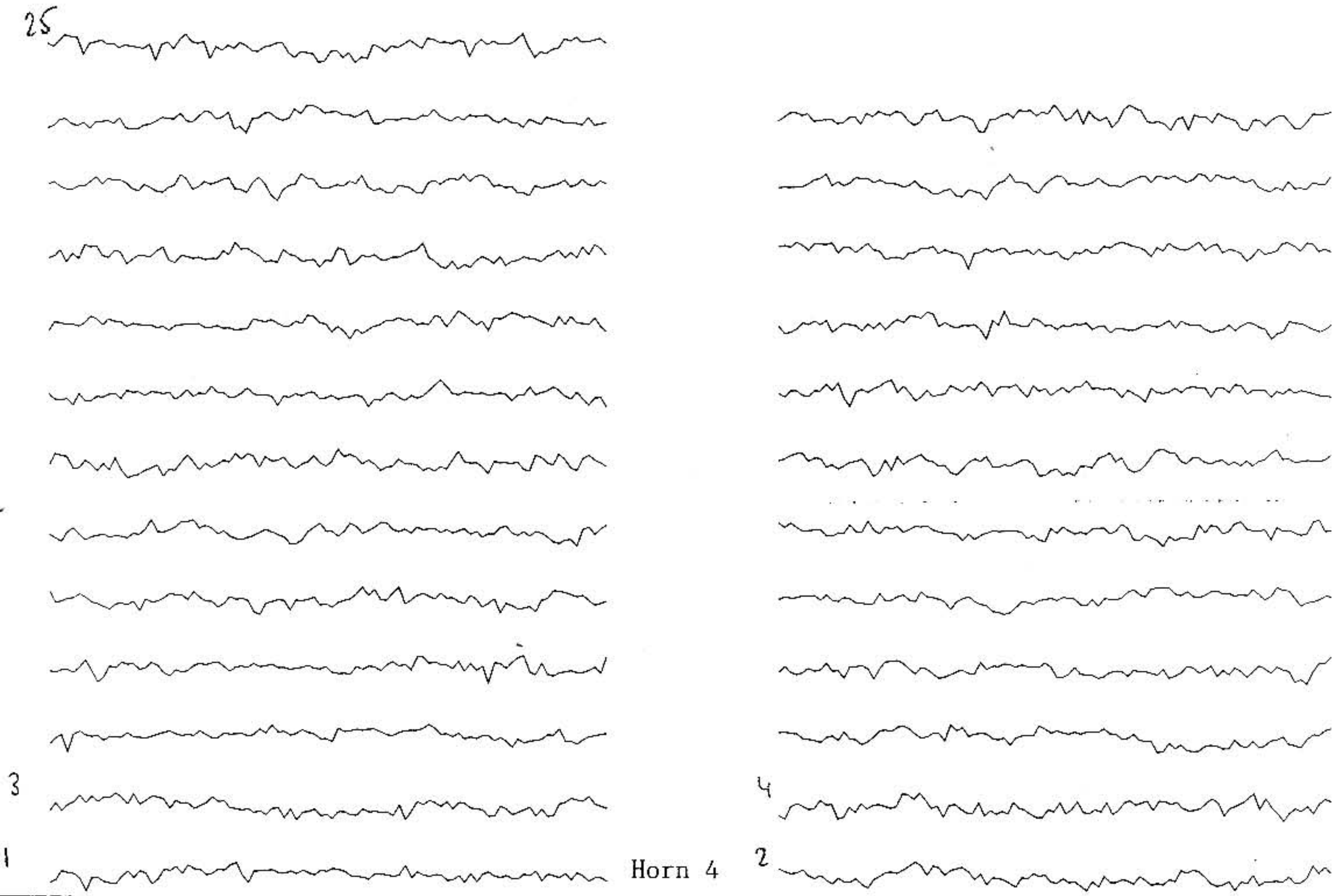
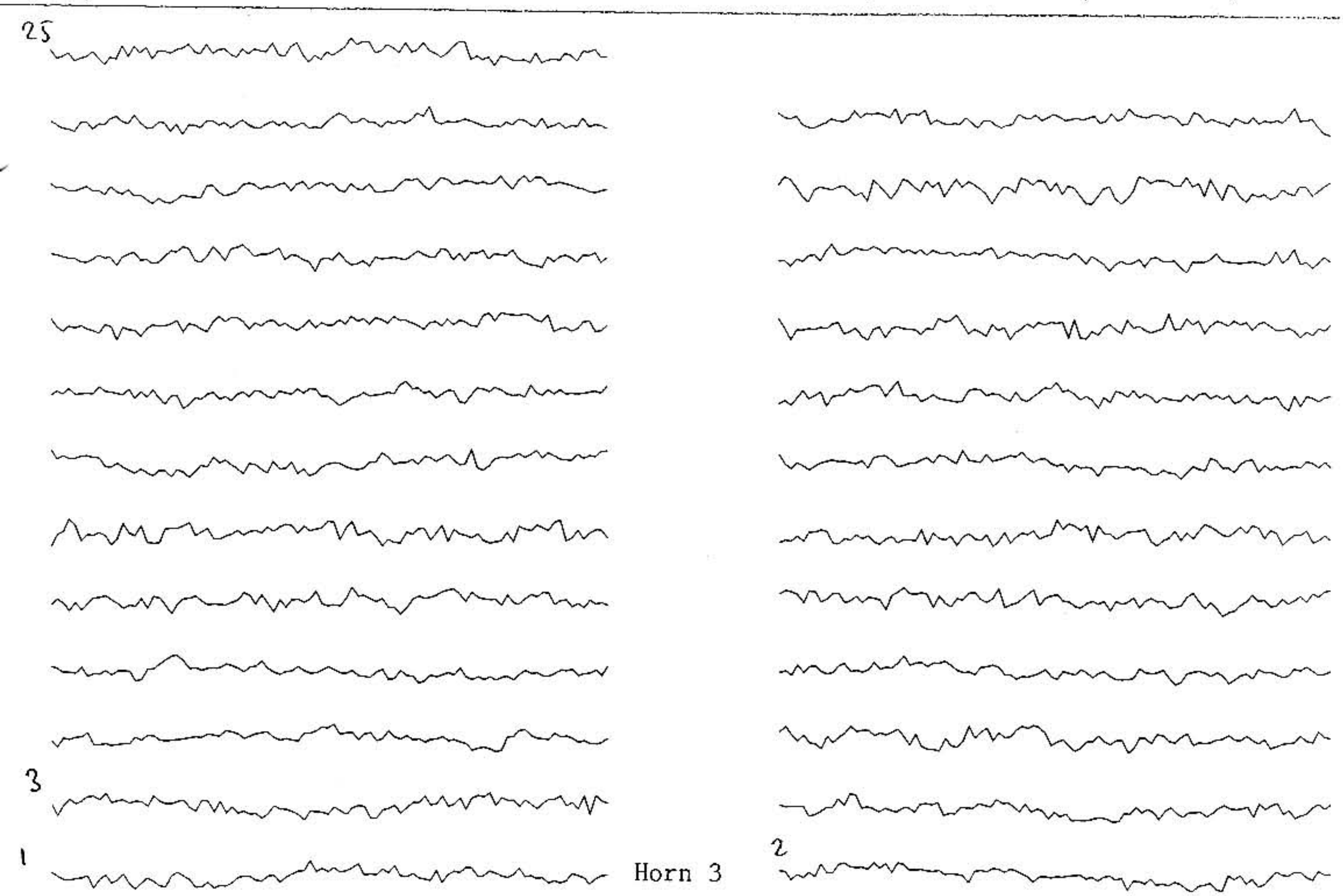
Figure 1. Measurements of Betelgeuse with 4 channels. 25 Subscans with each channel (Horn). Scan number is 0984 of December 28, 1995.





Horn 4



Horn 3

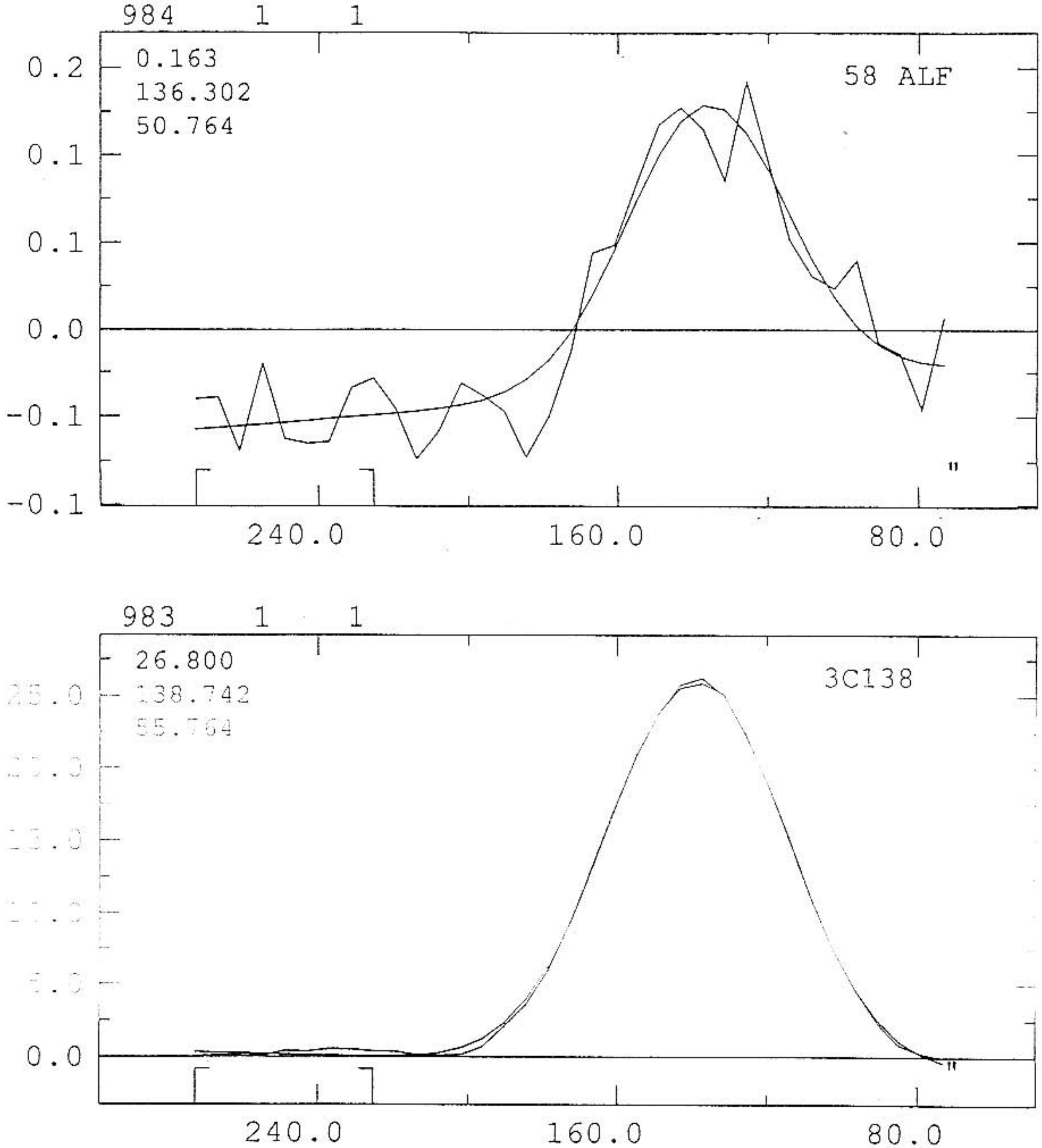


Figure 2. Double beam observations (software beam switching) of 3C138 and Betelgeuse. For maximum imtegration, beams were folded. The flux density of 3C138 was assumed to be 1.64 Jy. The flux density of Betelgeuse becomes 10.0 +/-0.8 mJy.

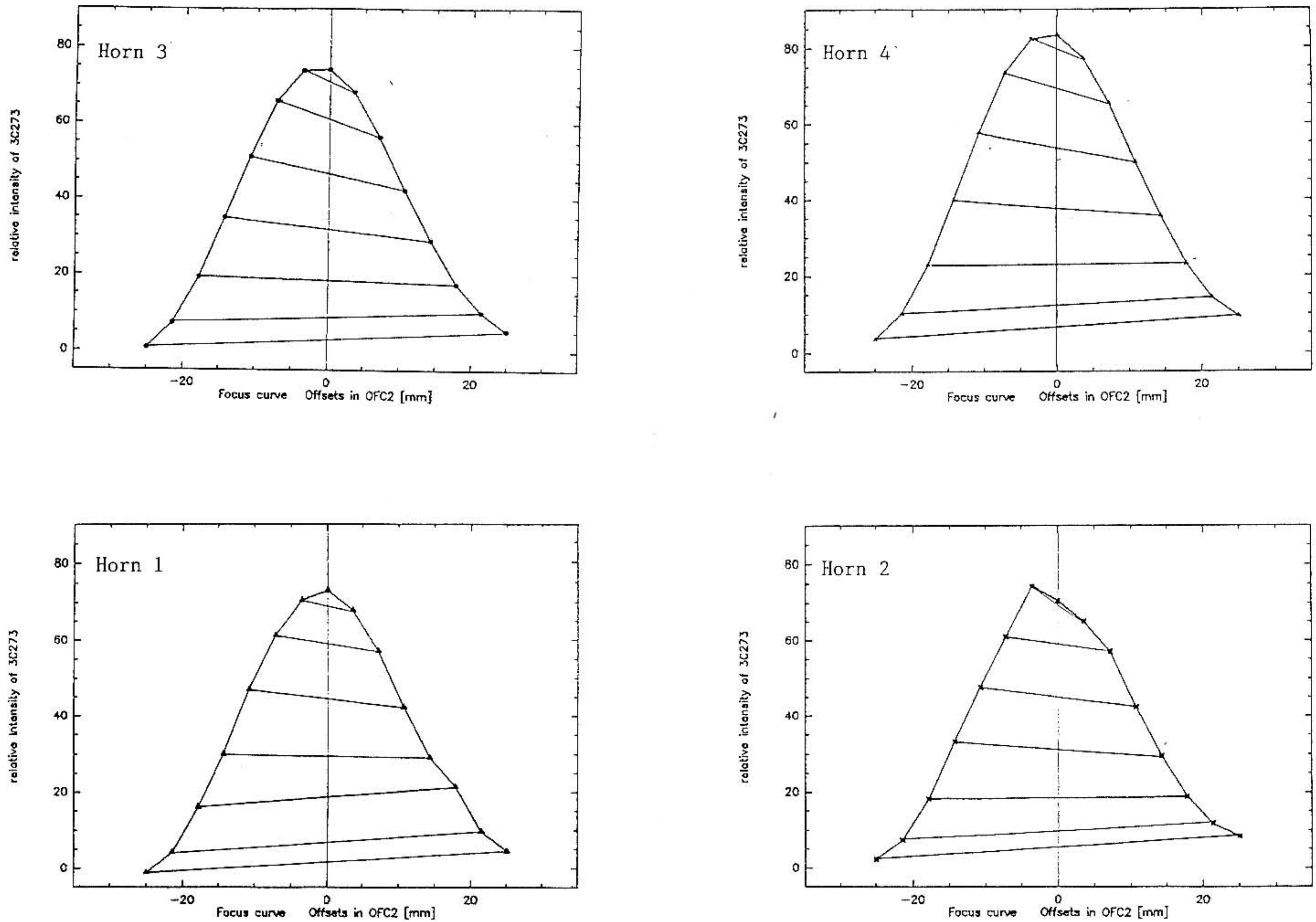

Horn 3
Horn 4
Horn 1
Horn 2
relative intensity of 3C273
Focus curve Offsets in OFC2 [mm]
80
60
40
20
0
-20
20

Figure 3.