VLBA TEST MEMO NO. 40

VLBA SENSITIVITIES

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The attached tables represent the best numbers that we have at this time for the sensitivity related parameters on the VLBA. They were derived from pointing observations made between July and December 1992 that have been edited to remove all data with obvious problems including weather. I have plots of the compiled results, both for these data sets and for all data sets starting in mid 1991. Anyone is welcome to look at them.

The tables give the assumed cal temperatures, the gain, the system temperature, the efficiency (gain/0.178), and the system equivalent flux density (SEFD - otherwise known as Ts(Jy)). The cal temperatures are values measured in the lab and are for the most recent receiver. If there has been a receiver change, only data from the current receiver were used. The values shown are the median for the gains and the value for which 1/4 are lower and 3/4 are higher for the system temperatures and SEFDs. Note that the "medians" for the gain, Ts, and SEFD are determined independently so the SEFD may not simply be Ts/gain as it would be for and individual observation. The system temperatures and SEFDs are zenith values. Any atmospheric or spillover contributions at lower elevations will raise these numbers. At 13 cm, the spillover contribution is significant, being about 7 K at 45 deg elevation and 11 K at 30 deg elevation.

The most important numbers for calibration of observations are the gains. They are typically based on observations of several calibrators from the Baars (1977, A&A, 61, 99) catalog. 3C274 has had small adjustments made for resolution. 3C286, 3C48, and 3C147 have been updated as suggested by Perley for the VLA. I would estimate that, for wavelengths between 20 and 4 cm, the gains are accurate to between 2 and 5 percent with the 6 and 4 cm data being the best. The 13 cm results are somewhat more variable, I think because of effects of the dichroic plate. For 2 and 1 cm, the accuracy is worse because the calibrators are weaker and weather effects are stronger. Those results are probably good to 10% with some stations being better.

The results for 50 and 90 cm are clearly degraded by sensitivity to which calibrator (3C274, CygA, and TauA) dominates an experiment. The three seem to give different results often, but not always. This clearly needs investigation and I plan to do it sometime soon. Meanwhile, there may be errors in the sensitivity values at 90 cm of 20% and somewhat less at 50 cm, although I hope the errors are rather less than this. I suspect that the problem lies in the quality of the off-source regions used in the antenna temperature determinations.

I have not yet included 7mm observations in the regular pointing runs so this memo does not include that frequency. This will change soon.

At most frequencies, the gain curves (variation with elevation) can be assumed to be flat as long as opacity is accounted for. At 1 cm, the situation is a bit uncertain. At KP, LA, NL, and BR, the gain curves are flat. At PT, OV, and HN, the data show a variation of 10-20 % over the full range with lower gains at lower elevations. At FD there is a range of 30-40 %. All of these results depend on the opacity corrections that are applied. I am suspicious that the actual gain curves are flat in all cases and that errors in the cal temperatures are leading to incorrect opacity corrections. This is supported by the fact that FD has a very low system temperature and very low efficiency, which together give an overall sensitivity (SEFD) similar to other sites. Hot-cold load measurements of the cal temperatures will be made soon.

Some other points to note:

PT has the only planned 3 cm receiver.

The 2 cm receiver at BR is installed and working, but proper rotation, focus, pointing and gain values have not yet been deterimned.

There is a wide range of cal values, especially at 1 cm. Some are clearly way too high - they significantly increase the system temperature. This will be fixed eventually. Some values may be too low. The measurements at LA at 13 cm are rather noisy, maybe for this reason.

The SC and OV 1 cm receivers need to be improved.

Don't believe the SC 2 cm results. Only one observation is available and it is probably flawed.

At the time these data were taken, the polarizations at FD at 2 cm were swapped. They were fixed on 11 Jan. 1993. The system temperatures, gains, and efficiencies have been swapped and adjusted for the use of the wrong cal values.

There will clearly need to be an update of this memo as better data become available for some receiver/site combinations and as MK becomes available. For now, this is the best we have.

CAL TEMPERATURES

St	P	90cm	50cm	20cm	13cm	13cmsx	6cm	4cm	4cmsx	3cm	2cm	1cm	7mm
PT	RCP:	22.60	10.00	2.70	2.42	2.42	2.89	3.52	3.52	4.12	1.90	7.85	----
	LCP:	25.20	10.30	2.59	2.62	2.62	3.07	3.96	3.96	3.86	1.66	10.10	----
KP	RCP:	10.20	6.90	3.07	1.42	1.42	2.63	3.71	3.71	----	2.95	23.33	----
	LCP:	10.00	6.70	3.06	1.52	1.52	2.37	3.48	3.48	----	2.70	23.98	----
LA	RCP:	8.90	5.70	3.60	0.92	0.92	3.43	3.72	3.72	----	3.73	7.26	----
	LCP:	9.30	5.70	3.69	1.28	1.28	3.40	3.82	3.82	----	3.96	7.41	----
FD	RCP:	11.70	5.60	3.34	2.82	2.82	3.34	3.89	3.89	----	3.85	8.06	----
	LCP:	11.10	6.00	3.43	2.00	2.00	3.26	3.81	3.81	----	3.92	7.74	----
NL	RCP:	9.00	5.20	1.74	1.02	1.02	3.47	4.03	4.03	----	3.03	10.27	----
	LCP:	9.00	5.50	1.84	1.12	1.12	3.79	4.08	4.08	----	2.93	9.43	----
OV	RCP:	7.00	4.00	2.81	1.52	1.52	1.09	3.42	3.42	----	3.16	11.90	----
	LCP:	6.50	4.00	2.81	1.32	1.32	1.20	3.69	3.69	----	2.71	17.20	----
BR	RCP:	7.20	4.00	2.87	1.04	1.04	1.86	3.78	3.78	----	----	3.57	----
	LCP:	7.10	4.00	2.64	1.02	1.02	1.79	3.80	3.80	----	----	3.74	----
HN	RCP:	8.00	4.69	1.83	1.20	1.20	1.40	2.59	2.59	----	3.20	11.42	----
	LCP:	9.00	4.60	1.75	1.48	1.48	1.30	2.77	2.77	----	2.91	11.44	----
SC	RCP:	7.70	4.00	0.80	1.26	1.26	2.39	3.48	3.48	----	1.90	14.21	----
	LCP:	6.90	4.00	0.94	1.34	1.34	2.39	3.44	3.44	----	1.66	13.96	----

GAIN (K/Jy)

St	P	90cm	50cm	20cm	13cm	13cmsx	6cm	4cm	4cmsx	3cm	2cm	1cm	7mm
PT	RCP:	0.162	0.046	0.114	0.089	0.077	0.130	0.119	0.110	0.130	0.084	0.109	----
	LCP:	0.203	0.052	0.107	0.101	0.089	0.141	0.121	0.107	0.160	0.098	0.112	----
KP	RCP:	0.100	0.080	0.096	0.082	0.066	0.134	0.119	0.110	----	0.121	0.101	----
	LCP:	0.093	0.082	0.098	0.080	0.068	0.130	0.121	0.116	----	0.112	0.105	----
LA	RCP:	0.071	0.069	0.082	0.085	0.068	0.144	0.114	0.109	----	0.160	0.101	----
	LCP:	0.073	0.073	0.116	0.089	0.077	0.135	0.119	0.116	----	0.137	0.100	----
FD	RCP:	0.094	0.084	0.098	0.100	0.082	0.114	0.119	0.116	----	0.108	0.059	----
	LCP:	0.091	0.093	0.100	0.109	0.089	0.121	0.112	0.107	----	0.109	0.059	----
NL	RCP:	0.075	0.045	0.084	0.084	0.066	0.121	0.107	0.105	----	0.121	0.082	----
	LCP:	0.077	0.057	0.087	0.094	0.077	0.096	0.110	0.107	----	0.119	0.085	----
OV	RCP:	0.112	0.085	0.087	0.100	0.078	0.116	0.101	0.103	----	0.071	0.078	----
	LCP:	0.110	0.096	0.107	0.110	0.089	0.121	0.098	0.100	----	0.064	0.100	----
BR	RCP:	0.096	0.084	0.098	0.080	0.066	0.121	0.107	0.103	----	----	0.084	----
	LCP:	0.105	0.087	0.096	0.094	0.080	0.116	0.114	0.109	----	----	0.082	----
HN	RCP:	0.098	0.057	0.091	0.089	0.073	0.117	0.093	0.087	----	0.084	0.073	----
	LCP:	0.096	0.055	0.089	0.105	0.085	0.119	0.096	0.091	----	0.085	0.073	----
SC	RCP:	0.110	0.085	0.093	0.073	0.061	0.130	0.105	0.103	----	0.032	0.132	----
	LCP:	0.110	0.089	0.117	0.078	0.064	0.125	0.114	0.112	----	0.027	0.130	----

SYSTEM TEMPERATURES

St	P	90cm	50cm	20cm	13cm	13cmsx	6cm	4cm	4cmsx	3cm	2cm	1cm	7mm
PT	RCP:	340.	177.	32.	26.	25.	44.	37.	43.	95.	54.	89.	----
	LCP:	420.	202.	30.	30.	30.	48.	37.	43.	94.	56.	95.	----
KP	RCP:	194.	198.	32.	36.	44.	43.	32.	40.	----	48.	94.	----
	LCP:	184.	197.	33.	35.	38.	43.	33.	40.	----	58.	89.	----
LA	RCP:	204.	224.	24.	35.	34.	44.	34.	41.	----	83.	90.	----
	LCP:	196.	197.	32.	40.	40.	40.	39.	46.	----	75.	93.	----
FD	RCP:	216.	181.	27.	30.	34.	36.	31.	38.	----	49.	57.	----
	LCP:	195.	191.	28.	33.	35.	40.	30.	36.	----	52.	54.	----
NL	RCP:	182.	174.	29.	36.	38.	47.	45.	52.	----	90.	112.	----
	LCP:	185.	200.	31.	42.	44.	42.	48.	56.	----	81.	113.	----
OV	RCP:	225.	165.	32.	28.	26.	32.	46.	54.	----	33.	150.	----
	LCP:	210.	184.	35.	34.	31.	36.	43.	53.	----	33.	148.	----
BR	RCP:	201.	176.	28.	30.	32.	32.	34.	43.	----	----	95.	----
	LCP:	213.	171.	28.	39.	41.	33.	39.	50.	----	----	89.	----
HN	RCP:	177.	180.	30.	39.	40.	37.	33.	42.	----	68.	100.	----
	LCP:	195.	188.	31.	47.	49.	39.	35.	44.	----	102.	99.	----
SC	RCP:	246.	189.	28.	25.	26.	44.	33.	42.	----	81.	199.	----
	LCP:	239.	241.	39.	27.	28.	38.	43.	52.	----	69.	207.	----

EFFICIENCIES (Percent)

St	P	90cm	50cm	20cm	13cm	13cmsx	6cm	4cm	4cmsx	3cm	2cm	1cm	7mm
PT	RCP:	91	26	64	50	43	73	67	62	73	47	61	----
	LCP:	114	29	60	57	50	79	68	60	90	55	63	----
KP	RCP:	56	45	54	46	37	75	67	62	----	68	57	----
	LCP:	52	46	55	45	38	73	68	65	----	63	59	----
LA	RCP:	40	39	46	48	38	81	64	61	----	90	57	----
	LCP:	41	41	65	50	43	76	67	65	----	77	56	----
FD	RCP:	53	47	55	56	46	64	67	65	----	61	33	----
	LCP:	51	52	56	61	50	68	63	60	----	61	33	----
NL	RCP:	42	25	47	47	37	68	60	59	----	68	46	----
	LCP:	43	32	49	53	43	54	62	60	----	67	48	----
OV	RCP:	63	48	49	56	44	65	57	58	----	40	44	----
	LCP:	62	54	60	62	50	68	55	56	----	36	56	----
BR	RCP:	54	47	55	45	37	68	60	58	----	----	47	----
	LCP:	59	49	54	53	45	65	64	61	----	----	46	----
HN	RCP:	55	32	51	50	41	66	52	49	----	47	41	----
	LCP:	54	31	50	59	48	67	54	51	----	48	41	----
SC	RCP:	62	48	52	41	34	73	59	58	----	18	74	----
	LCP:	62	50	66	44	36	70	64	63	----	15	73	----

SEFD (System Equivalent Flux Density)

St	P	90cm	50cm	20cm	13cm	13cmsx	6cm	4cm	4cmsx	3cm	2cm	1cm	7mm
PT	RCP:	2101	3825	280	280	326	333	303	386	725	615	768	----
	LCP:	2025	3931	281	283	313	338	311	400	573	581	798	----
KP	RCP:	1948	2455	329	437	629	314	267	364	----	399	898	----
	LCP:	1922	2395	324	434	568	327	272	348	----	516	837	----
LA	RCP:	2888	3218	304	392	484	301	297	379	----	517	874	----
	LCP:	2695	2701	268	420	489	297	332	401	----	553	915	----
FD	RCP:	2273	2162	271	297	414	310	260	325	----	477	962	----
	LCP:	2131	2071	276	305	386	322	268	344	----	454	923	----
NL	RCP:	2268	3938	352	435	562	386	426	496	----	700	1352	----
	LCP:	2233	3484	355	444	573	428	436	530	----	539	1310	----
OV	RCP:	1988	1818	372	289	311	272	434	536	----	465	1954	----
	LCP:	1868	1821	331	300	346	296	409	542	----	517	1513	----
BR	RCP:	1945	2064	284	374	477	269	307	418	----	----	1108	----
	LCP:	1869	1954	281	413	513	285	341	459	----	----	1076	----
HN	RCP:	1978	3163	328	436	545	316	365	483	----	697	1312	----
	LCP:	2008	3435	352	440	563	330	370	493	----	974	1296	----
SC	RCP:	2234	2180	306	338	431	338	309	401	----	1500	1548	----
	LCP:	2110	2724	316	337	422	311	373	460	----	1500	1676	----