VLBA TEST MEMO NO. 43

CALIBRATOR FLUX DENSITIES

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I have long noticed that the gain calibrations provided by various calibrators were not consistent at the few percent level. A prime offender was 3C274 for which a resolution correction is needed. I had obtained that correction from a table in the VLBI Handbook. I do not know where the numbers in that table came from. I now have extensive data from pointing observations on the VLBA antennas which should allow the resolution corrections to be determined empirically. I selected the following data sets for this job:

93JAN15
93JAN27
93MAR27
93APR08
93APR20

Each of these data sets provided about 20 measurements of 3C274 from each of several stations. They also included 3C123, 3C295, 3C286, and, at 1cm, DR21. After noticing some possible problems with 3C123, I ran the pointing analysis program, ptanal, on the above data sets in such a way as to derive flux densities for 3C274, 3C123, and 3C295 based on the Baars flux densities of 3C286 and DR21.

In the process of doing this, I discovered an error in ptanal that caused it not to use any resolution correction for 3C274. This error has affected all data taken to date. According to the data shown below, 3C274 flux densities should have been adjusted by 0-7 percent depending on frequency. The gain measurements given to the community, for example in VLBA Test Memo 40, are based on several calibrators including 3C274. I suspect that the error introduced by the use of incorrect 3C274 flux densities ranged from about 0 to 3 percent.

The following table gives the derived flux densities for the calibrators. The "Baars" column is the flux density according to the coefficients in the Baars paper as calculated by ptanal. The "Handbook" column gives the corrected flux according to the corrected version of ptanal, but with correction factors based on the VLBI Handbook values. "Avg" gives the average flux density from the data sets listed above after editing of a few antenna/days based on excessive scatter. "RMS" gives the RMS scatter of the the data. Note that the error of the estimate of the average should be much smaller. "npts" gives the number of individual measurements that were used in the average. The number of observations of the primary calibrators 3C286 and DR21 that contributed to these numbers were similar. "Ratio" is the ratio of the measured flux density to the Baars flux density.

The required resolution corrections for 3C274 are clearly smaller than those recommended in the VLBI Handbook but are large enough to be significant. 3C123 also appears to need some flux correction, probably about 2.5 percent at all bands. The results on 3C295 indicate that this source is a good calibrator consistent with 3C286 and gives an idea of the quality of these data.

I have modified ptanal to use these new values for 3C274 and for 3C123. As soon as I have a reasonable set of data from MK, I will rederive the sensitivities of all VLBA antennas and issue a new memo.

CALIBRATOR FLUXES

Based on Baars flux density for 3C286 and DR21

Band	Freq (MHz)	Baars (Jy)	Handbook (Jy)	Pointing data. Avg. (Jy)	RMS (Jy)	npts	Ratio
3C274:							
20cm	1655	185.2	176.0	180.5	2.0	329	0.975
13cm	2262	141.8	132.0	136.6	1.8	735	0.963
6cm	4998	71.92	63.29	67.21	0.50	556	0.935
4cm	8418	46.03	41.90	42.72	0.81	896	0.928
2cm	15068	27.96	27.11	27.52	0.73	332	0.984
1cm	22228	20.05	20.05	19.96	0.82	372	0.996
3C123:							
20cm	1655	42.64		41.71	1.5	172	0.978
13cm	2262	33.03		32.16	0.8	422	0.974
6cm	4998	16.49		16.03	0.16	288	0.972
4cm	8418	10.06		9.65	0.44	524	0.959
2cm	15068	5.60		5.51	0.37	230	0.982
3C295:							
20cm	1655	19.32		19.50	0.8	80	1.009
13cm	2262	14.51		14.48	0.6	228	0.998
6cm	4998	6.36		6.43	0.17	139	1.011
4cm	8418	3.43		3.44	0.28	259	1.003