INTERFEROMETER INTERNAL REPORT

Gain Calibration - Baseline 21

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In order to determine fringe visibilities more accurately, some systematic procedure for the determination of the flux ratios of our calibration sources and the adoption of mean fluxes for the comparison of our observations with those of other observers are needed. I have applied such procedures to the observations on baseline 21 and will describe them in detail below.

1. The standard averaging program for interferometer records, AVGI, was applied to the data, averaging the observations into blocks up to 35 minutes in length. Then the six standard calibration sources (3C 48, 3C 147, 3C 286, 3C 345, 3C 380, CTA 102) were sorted out. Observations shorter than five minutes were discarded. Longer sets of observations were accepted with equal weight, because most of the remaining variations of amplitude, after averaging for five minutes or longer, come from systematic effects which decrease much more slowly with number of minutes of observing time than $(N)^{-1/2}$. The arithmetic average amplitude was taken rather than the vector average, because it is as good an indicator at true flux as the vector average and, in addition, is free from the effects of phase drifts. A typical work sheet is shown in Figure 1.

2. On those days when a source was well observed, a mean of the observations was taken, including only those observations within three hours of the meridian. To take this mean I required at least two observations and that the average hour angle lay within one hour of the meridian. Using this mean as the meridian intensity of the source, I divided all the other observations for that day by the mean to determine

the hour angle variation. These normalized intensities were then plotted against hour angle, an example of this plot being shown in Figure 2.

3. A mean line was drawn by eye through the points on these plots. These plots of the variation of observed amplitude with hour angle are reproduced in Figure 3. The observed amplitudes were divided by the values read from these curves to normalize the observations to the meridian. This correction is made in the work sheet of Figure 1 in the column labeled "H. A. Eff."

4. A new mean amplitude was derived for the source, employing the amplitudes corrected for the H. A. Effects. These means include observations taken within 3-1/2 hours of the meridian. Then the observed source ratios were calculated according to the following rules: the ratio of amplitudes was taken if the two sources transited within 18 hours of each other. This 18 hours was required not to include a maintenance interval or major receiver breakdown. The data were selected so that a given data pair was included only once, e.g., if on a given day observations were made of 3C 147, 3C 286, and 3C 345, the source ratios 3C 147 / 3C 286 and 3C 147 / 3C 345 were included, but the ratio 3C 286 / 3C 345 was not, as it can be derived exactly by dividing the first two. The ratios obtained when both sources were observed two or more times with an average hour angle within one hour of the meridian were given weight 2; those when only one source fulfilled these conditions, weight 1; and ratios when neither source fulfilled these conditions were discarded. The measured values for a given source ratio typically scatter $\sim \pm 5\%$ after the obviously erroneous values have been discarded. The various measurements of the fifteen possible ratios among the six sources were averaged, with the results in Table I.

TABLE I

Observed Ratios

Sources		Ratio	Weight
3C 147 / 3C 48	=	1.434	4
3C 286 / 3C 48	=	1.096	37
3C 48 / 3C 345	=	1.330	6
3C 48 / 3C 380	=	1.117	35
3C 48 / CTA 102	=	1.850	2
3C 147 / 3C 286	=	1.328	9
3C 147 / 3C 345	=	1.925	5
3C 147 / 3C 380	=	1.590	35
3C 147 / CTA 102	=	2.611	7
3C 286 / 3C 345	=	1.456	6
3C 286 / 3C 380	=	1.206	6
3C 286 / CTA 102	=	2.005	15
3C 380 / 3C 345	=	1.232	1
3C 345 / CTA 102	=	1.374	3
3C 380 / CTA 102	=	1.645	5

If we take the logarithm of the 15 equations of Table I and assume, say, that the intensity of 3C 286 is 1.000, then the equations become 15 linear equations in 5 unknowns, which may be solved by the method of least squares with the results indicated in the second column of Table III. In order to convert to a flux scale in common with that of other observers, we need the measured flux values for these sources from other observers. Some of these are given in Table II.

TABLE II

Fluxes of the Calibraters
Corrected to 2700 Mc/s

	Kellermann 1962	Moffett 1965	Kellermann/ Pauliny-Toth 140'	Adopted
3C 48	8.2	8.2	8.67	8.4
3C 147	11.6	11.7	12.34	12.0
3C 286	10.8	10.0	9.74	10.0
3C 345	5.7		6.70	6.4
CTA 102	4.7			4.7

The sum of the fluxes given in Table II is 41.5. The sum of the ratios in the second column of Table III (excluding 3C 380) is 4.409, so the flux adopted for 3C 286 was 41.5 / 4.409 = 9.41 to give the fluxes in the third column of Table III.

TABLE III

Observed Fluxes

Source	Ratio to 3C 286	Flux
3C 48	.915	8.61
3C 147	1.312	12.34
3C 286	1.000	9.41
3C 345	.683	6.43
3C 280 (Meridian)	.823	7.75
CTA 102	.499	4.70

5. Using the fluxes of Table III, the corrected amplitudes were divided by the source flux to give the system gain. This gain was then plotted on 10" chart paper, so that there is a continuous record of the system gain. A sample of this plot is reproduced in Figure 4. This gain plot is now in hand for baseline 21 and will shortly be available for baseline 27.