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HIGH-RESOLUTION RADIO INTERFEROMETRY AT 610 MHz

ABSTRACT

High-resolution interferometer observations, with a baseline of 5.2×10^6 wavelengths at 610 MHz, are reported. Fringes were detected at a level of greater than 1 flux unit on twelve radio sources.

Since the completion of the first observations in 1967 May (Bare *et al.* 1967) we have reported the results of observations with a long-baseline interferometer at wavelengths of 18 and 6 cm (Clark, Cohen, and Jauncey 1967; Clark *et al.* 1967*a, b;* Kellermann *et al.* 1968). This paper presents the results of observations at 610 MHz (49 cm) between the 1000-foot spherical reflector of the Arecibo Ionospheric Observatory in Puerto Rico and the 140-foot telescope of the National Radio Astronomy Observatory in Green Bank, West Virginia. The resulting interferometer has a baseline of 5.2 million wavelengths and is comparable with the NRAO-Haystack baseline of 4.7 million wavelengths at 18 cm (Clark *et al.* 1968*b*) and the Algonquin Park–Penticton baseline of 4.6 million wavelengths at 67 cm (Broten *et al.* 1967*a*, *b*).

The observations were made in 1967 August and November and 1968 March, and were restricted to sources suspected of having small angular diameter. The equipment used is the same as that described by Clark *et al.* (1968*b*). The overall mean temperature of the system was close to 200°, and the rms noise level for a single 3-minute observation was just under 0.3 flux units. Local oscillator instabilities yield negligible broadening of the fringe pattern at 610 MHz. Time synchronization of the two stations was accomplished by monitoring the 100-kHz loran C navigational transmissions.

Fringes were seen on only a small fraction of the sources observed. There were periods during the observations for which no fringes were detected; in particular, no fringes were seen at all in the 1968 March run. The reason for this is not completely understood, but it is believed to be due to improper operation of the phase-lock unit used to derive the 610-MHz local oscillator from the 5-MHz standard. Consequently, we have placed more weight on positive results than on negative ones, and those sources which did not show fringes have not been listed.

The flux-density scale was set by using CTA 102 and PKS 2127+04 as calibrators. These sources have simple spectra and probably consist of a single component. They are unresolved at 4.7 million wavelengths at 18 cm (Clark *et al.* 1968*b*) and are also 100 percent scintillators at 430 MHz (Harris and Hardebeck 1969). In each case the scale is consistent with that expected from the gains of the individual antennas. The resultant flux-density scale is thought to be accurate to about 10 percent.

The results are summarized in Table 1. The first column gives the source name; the second, the optical identification. The total flux density and the correlated flux density are given in the third and fourth columns. The projected baseline in millions of wavelengths is given in the fifth column, and the angular size in the sixth column.

In interpreting the data we have made use of the existing observations at 18 and 6 cm (Clark *et al.* 1968*a, b;* Kellermann *et al.* 1968), as well as the interplanetary-scintillation results of Cohen, Gundermann, and Harris (1967) and Harris and Hardebeck (1969), and spectral observation by Jauncey and Niell (unpublished) and Kellermann and Pauliny-Toth (unpublished). Fringes were seen at a level of greater than 1 flux unit on twelve sources, seven of which appear to be unresolved and are less than 0".02 or 0".015 in angular extent. Two other sources, 0202+14 (NRAO 91, 4C 15.05) and 0019−00, appear from their radio spectra to have a single component. For 0202+14 there are also data at 18 cm (Clark *et al.* 1968*b*) made with comparable resolution, and the measured visibilities at 49 and 18 cm are in good agreement, indicating little frequency-dependent structure. Three sources, CTA 21, NRAO 140, and 3C 120, have more complex structure. Their spectra indicate the presence of two opaque components, and the lower visibilities measured at 49 cm probably reflect the greater contribution of the larger component which becomes opaque at a longer wavelength than the smaller component. The latter contribute the majority of the total flux density at 18 cm.

TABLE 1

SOURCES SEEN WITH THE AIO-NRAO INTERFEROMETER AT A WAVELENGTH OF 49 CENTIMETERS

Source (1)	Identification (2)	Total Flux Density (3)	Correlated Flux Density (4)	Projected Baseline $\times 10^6 \lambda$ (5)	Angular Size (6)
0019−00	...	3.6	2.2±0.4	4.1	0″.015±0″.005
0122−00	QSS	1.5	1.5±0.3	4.6	≤0″.02
0202+14	...	4.7	{2.6±0.5 1.4±0.3	4.1 5.1}	0″.020±0″.002
CTA 21	...	9.0	3.4±0.6	5.2	*
NRAO 140	QSS	3.8	{2.7±0.5 2.1±0.5	3.1 5.2}	*
3C 120	Seyfert galaxy	5.6	{1.9±0.4 1.6±0.3	4.3 5.0}	*
NRAO 190	QSS	1.8	1.5±0.3	4.6	≤0″.02
0735+17	...	1.8	2.0±0.4	4.8	≤0″.015
2127+04	...	4.7	5.2±0.8	4.4	≤0″.015
2145+06	QSS	3.0	2.5±0.5	4.5	≤0″.02
CTA 102	QSS	7.8	{7.8±0.8 7.8±0.8	4.1 3.9}	≤0″.015
3C 454.3	QSS	12.5	12.5±1.3	3.7	≤0″.015

NOTE.—Sources marked with an asterisk are discussed in the text.

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D. L. JAUNCEY

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CORNELL-SYDNEY UNIVERSITY ASTRONOMY CENTER
CORNELL UNIVERSITY, ITHACA, NEW YORK*

C. C. BARE
B. G. CLARK
K. I. KELLERMANN

NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA†

M. H. COHEN‡

CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA

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