Preliminary Observations of Strong Radio Sources with 1' Fan Beam In 3.75GHz

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PRELIMINARY OBSERVATIONS OF STRONG RADIO SOURCES WITH 1′ FAN BEAM IN 3.75 GHz

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ABSTRACT

Preliminary observations of Tau-A, Cas-A and Cyg-A were made with 3.75 GHz multiple element interferometer at Res. Inst. of Atmospherics in Toyokawa. Its half power beam width is $1' \times 120'$. Half power width of Tau-A is $3'.5$. Apparent diameter of shell structure of Cas-A is $3'$. Two components of Cyg-A have approximately equal flux density.

§ 1. Introduction

Observations of radio sources with multiple element interferometer were carried out by several authors. Although these observations were limited in the well-known sources, the observation with this type interferometer could provide the data more easily and more directly than that with any other type of interferometer.

Recently, a high resolution multiple element interferometer has been constructed at Research Institute of Atmospherics of Nagoya University and now is used for daily observation of solar noise.

This report gives some preliminary results of observations of strong radio sources with this interferometer.

§ 2. Devices

This multiple element interferometer consists of thirty-four paraboloidal dishes (3 meters in diameter). They are equipped on equatorial mountings lined up in east-west direction.

Thirty-two of them are separated $86.06\,\lambda$ each other, which are used as ordinal type multiple element interferometer. And by combining the other two dishes, it can be used as a compound type interferometer with phase switching system. In the later case, half power beam width becomes $21'' \times 120'$. Precise explanation on this device is given by Tanaka and Kakinuma (1968).

In the cource of this observation, we used thirty-two elements as a multiple interferometer, so that it gives multiple fan beams, each of them are separated with $40'$. The half power width of the 0-th order beam is $1' \times 120'$. A photograph of this device is shown in Fig. 1.

The receiver is of a switching type radiometer with a crystal balanced

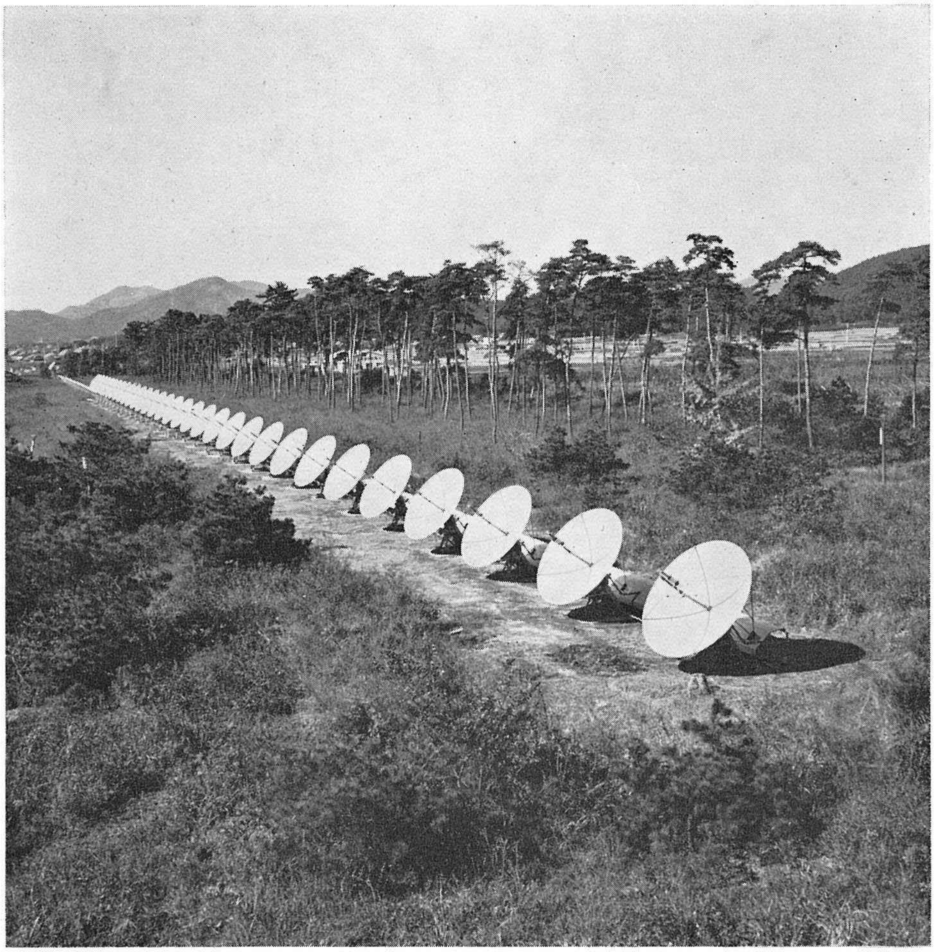

Fig. 1. General view of 34 elements interferometer. Diameter of dish is 3 meters. Whole length of the system is about 430 meters.

mixer, and reference noise comes from a piramidal horn directed to zenith of sky. The band width is 10 MHz, and the system noise temperature is about 900°K. Any low noise preamplifier is not used.

§ 3. Observational Procedure

As mentioned above, this interferometer provides multiple fan beams, and

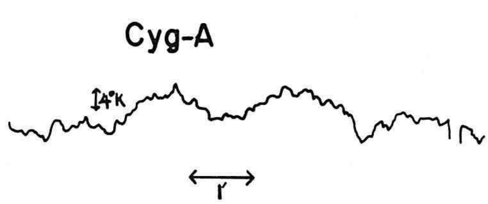

Fig. 2. The chart record of Cyg-A.

a radio source passes them one by one by diurnal motion.

Calibration is tentatively carried out by the matched load in room temperature. In the regular observation a discharge noise tube will be used for this purpose.

Integration time is 0.6 sec. for both Tau-A and Cyg-A, and 0.4 sec. for Cas-A. Typical record of Cyg-A is shown in Fig. 2.

§ 4. Results

(a) Tau-A

The averaged drift curve and the one after correction for antenna smoothing due to chord construction by Bracewell (1955) are shown in Fig. 3.

Half power width of this source is 3′. 5 in case of the corrected curve. This value is generally in agreement with other observations, for example 3′. 1 in 3.292 GHz by Thompson and Krishnan (1965), with a beam width of 1′.

This source is used as a standard source for the evaluation of flux density of other sources. Its flux density is assumed with 6.6×10^{-24} Watt $m^{-2}Hz^{-1}$ by interpolation of values of flux density in other frequencies.

The flux densities of Cas-A and Cyg-A are evaluated by the formula

$$\text{Flux density}=\frac{A(\text{Cas-A or Cyg-A})}{A(\text{Tau-A})}\cdot 6.6\times10^{-24}\ \text{Watt m}^{-2}\text{Hz}^{-1},$$

where "A" indicates the area of underlying part of the drift curve for each radio source.

(b) Cas-A

In the same way as above, the drift curve and the corrected one are shown in Fig. 4.

It is suggested that Cas-A has a shell structure by inspection of these curves. The apparent diameter of this shell is estimated to be 3′ (peak to

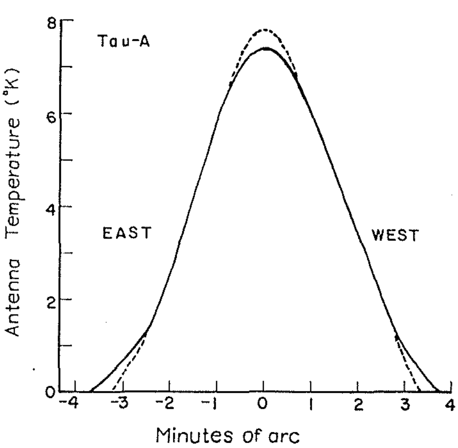

Fig. 3. The drift curve of Tau-A.
full line: averaged with 7 scans.
broken line: after chord construction.

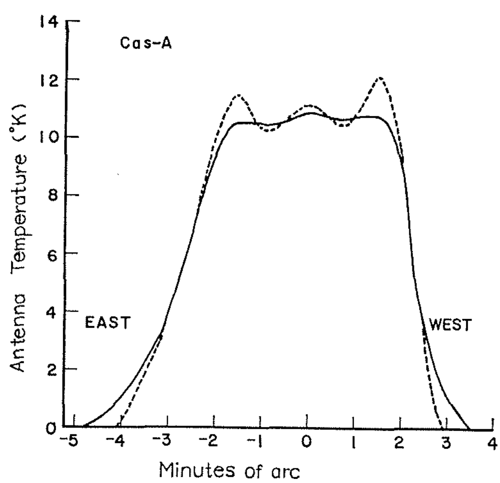

Fig. 4. The drift curve of Cas-A.
full line: averaged with 13 scans.
broken line: after chord construction.

peak). This value is in accordance with Leqneux's observation in 1.42 GHz.

Flux density of this source is evaluated as $1.3 \pm 0.2 \times 10^{-23}$ Watt $m^{-2}Hz^{-1}$.

(c) Cyg-A

In Fig. 5 the averaged drift curve and the corrected one are shown.

Peak values of antenna temperature of both components are the same order of magnitude in this observation. The eastern component is slightly higher, by a factor of 1.02, than the western one. In the observation in 2.8 GHz with 1′. 5 beam by Covington and Bell (1967), this value is 1.04.

Flux density here obtained is

Eastern component: $3.2 \pm 0.6 \times 10^{-24}$ Watt $m^{-2}Hz^{-1}$,
Western component: $3.0 \pm 0.6 \times 10^{-24}$ Watt $m^{-2}Hz^{-1}$.

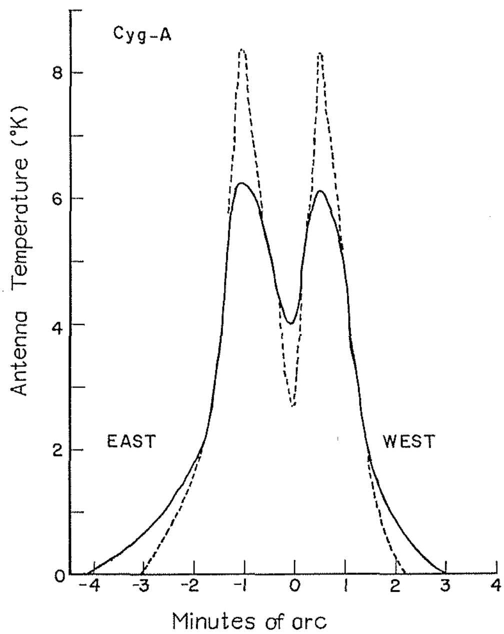

Fig. 5. The drift curve of Cyg-A.
full line: averaged with 15 scans.
broken line: after chord construction.

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