INTENSITY DISTRIBUTION ACROSS THE CYGNUS AND CASSIOPEIA SOURCES

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Measurements of the angular distribution of intensity across the intense discrete sources in Cassiopeia and Cygnus have previously been handicapped by lack of knowledge of the phase of the Fourier transform at very long aerial spacings. The technical difficulties of measuring the phase of the transform and also of calibrating the absolute amplitude have been solved by a new technique involving three stations. This method enables the phase to be measured relative to a frame of reference within the source and obviates the need for retaining the phase angles accurately constant on the removal of one of the aerial systems to a new site. The phase measurement is not limited to observations of the central fringe, and useful measurements may be made on all the fringes contained within the aerial polar diagrams.

The three stations are arranged in a straight line and the outputs are connected together to form three interferometer systems (Fig. 1). The principle evoked is that, under the illumination of a point source, the addition of the wave-forms of the fringes from the two inner systems *AB*, *BC* is always equal to the fringe pattern observed on the outer system *AC*, irrespective of any errors in the equipment prior to the final multiplier system. If the source is extended and contributes a phase component, the relative phase of the fringe pattern traced by the interferometer *AC* to the sum of patterns *AB* and *AC* will represent the relative phase of the transform over these spacings. For calibration purposes it is possible to place station *B* mid-way between *A* and *C* so that $AB=BC$; the relative phase of the fringes now simply refers to the single intermediate point. It is, however, possible to use the equipment when *AB* and *BC* are widely different spacings, provided that the phase of the transform over distance *AB* and distance *BC* has been, or will be, determined. Provision is incorporated for slowing down the fringe systems by means of separate continuously rotating resistance capacity quadrature phase shifters incorporated in a common local oscillator unit.

The three stations may be utilized to determine the absolute amplitude of the transform at any spacing provided that a total power recorder is incorporated in one channel.

The experimental procedure is to have the largest aerial system and total power recorder in a fixed station, whilst the two remaining stations are moved out successively to greater distances. The centre station may be

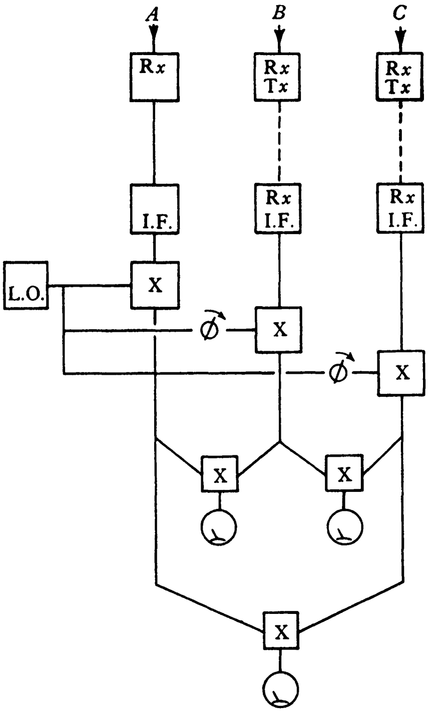

Fig. 1. Basic block diagram of the phase-sensitive interferometer. X = multiplier or mixer; Rx = receiver; Tx = transmitter. The dotted lines represent the coherent radio links from the outstations, *B* and *C*, and incorporate both local oscillator and signal channels.

transplanted to become the farthermost station in the next series of measurements so that only one station is actually moved to give a new reading. Both the phase and the amplitude of the transform are measured concurrently during each series of measurements.

PRELIMINARY RESULTS

The equipment has recently been applied to the measurement of the phase and amplitude of the Fourier transform of the intensity distribution across the intense sources Cygnus and Cassiopeia. The base-lines used have varied between 500 and 2000 λ in an east–west direction. The operating frequency is 127 Mc./s.

Preliminary results on Cassiopeia are inconclusive as the measurements so far have been carried out at spacings where the source is almost completely resolved, and further readings on short spacings are required in order to establish the general nature of this transform.

The results on Cygnus are shown in Fig. 2, in which the square of the amplitude, ρ^2, is used as an ordinate. The new measurements of ρ^2 are

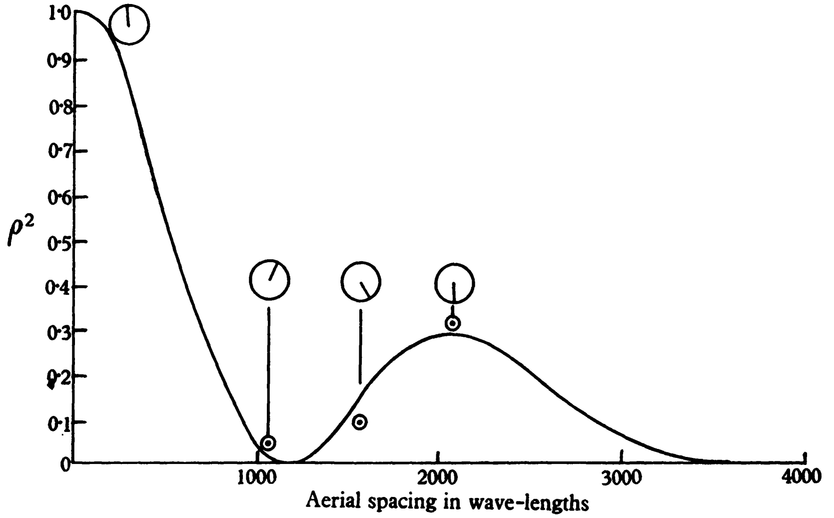

Fig. 2. The radio source in Cygnus, variation with base-line of the square of the amplitude of the Fourier transform (full curve) and phase angle, or argument of the Fourier integral (clock faces).

shown by the small circles whilst the phase is indicated by the position of a unit vector on a clock dial. The full curve is a reproduction of that obtained in a previous survey of the source using a post detector interferometer [1, 2]. The Fourier transform of the original curve when supplemented by the new phase measurements yields an intensity distribution which is generally in agreement with the earlier interpretation of measurements in which the phase was not recorded [1, 2]. The source consists of two prominent centres of emission but it now appears that the system as a whole is slightly asymmetrical.

REFERENCES

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[2] Jennison, R. C. and Das Gupta, M. K. *Phil. Mag.* **1** (Ser. 8), 55, 1956.

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