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A NEW PROJECT OF 8-CM RADIOHELIOGRAPH

Masato ISHIGURO, Shinzo ÉNOMÉ and Haruo TANAKA

An 8-cm radioheliograph is planned by adding 17 N-S elements to the existing interferometer. The mapping speed will be one frame in 40 seconds. It is characterized by its ability of correcting phase errors by data processing.

Studies on the slowly varyng component and the radio burst has been made at Toyokawa by simultaneous one-dimensional observations with 3- and 8-cm compound interferometers. The 3-cm radioheliograph has offered important information about two-dimensional radio brightness distributions of the sun (Tanaka et al., 1970). The new 8-cm radioheliograph is to be composed of a T-shaped array of 3-m paraboloids (32 elements in E-W direction and 17 elements in N-S direction), a radiometer, a high speed beam sweeping device, and of a computer for controlling beam sweeping, data sampling and processing. The T-shaped array will be formed by adding an array of 17 new elements in N-S direction to the present (32+2)-element compound interferometer at Toyokawa. The unit antenna spacing is about 6.88 m (86.03λ). So, the whole length of this antenna system becomes 213 m in E-W direction and 107 m in N-S direction. This new radioheliograph is an advanced type of the one on 3-cm which is in operation at Toyokawa. Its distinctive features are as follows.

1. *Improved temporal resolution* It takes about 40 seconds to complete a radio map of the sun which is composed of 4096 picture elements. The beam is swept by a rotary phase shifter equipped in every antenna element. In order to take radio pictures of the sun successively during two hours each before and after C. M. P., the driving frequency of the rotary phase shifters and the data sampling rate must be controlled precisely to follow up the changes of declination and hour angle of the sun. For this purpose a computer-controlled frequency synthesizer is to be installed. Commands for this controlling are given intermittently, so during its unoccupied time the computer is available for data processing. Because of the high speed and unequal sampling, a buffer memory of big capacity is necessary.

2. *Array configurations for various purposes* Various modes of operation are possible in this interferometer system as shown in Fig. 1.

(1) E-W (32+2)-element compound interferometer (in operation).
The angular resolution is 0.4 min. arc. (B in Fig. 1)

(2) E-W 32-element grating interferometer (in operation).
The angular resolution is 1.1 min. arc. (B in Fig. 1)

(3) (E-W 32+N-S 16)-element T-shaped radioheliograph (planned). The angular resolution is 1.6 min. arc. (C in Fig. 1)

(4) N-S 16-element grating interferometer with additional one element for phase error correction (planned). The angular resolution is 2.2 min. arc. (D in Fig. 1)

(5) Two sets of E-W 16-element grating interferometer with additional one element for phase error correction (planned).
The angular resolution is 2.2 min. arc. (E and F in Fig. 1)

It is to be mentioned that since the scanning frequency and the data sampling rate is controlled by the frequency synthesizer, it is easy to change the 'shutter speed' as desired.

3. *Phase error correction of whole antenna elements* By observing the radio brightness distribution with the grating and compound interferometers simultaneously, it is possible to estimate the phase errors of whole antenna elements by comparing each spatial frequency spectrum, and corret them in the stage of data processing (Ishiguro, 1971; Arisawa, 1971). This phase-error correction method was established for our one-dimensional interferometers. This method has become more reliable by using an iteration technique (Ishiguro et al., 1971). Fig. 2 shows the daily variations of the phase error thus estimated between the adjacent two antennas (32nd and 31st from the east end) of the 8-cm compound interferometer, taken during the period from April 12 to November 24, 1971. The upper and the lower charts show the results before and after tenfold iterations respectively. In the lower chart, phase error estimation which failed to converge within ten iterations are omitted. At the moment, it is difficult technically and economically to apply an automatic phase control for such phase errors to the whole antenna elements, but we expect that the wide variety of the operating mode of this radioheliograph will enable us to correct them by data processing. With the operating modes of B, E and F in Fig. 1, the phase error distribution in E-W direction is estimated by comparing each pair of spatial frequency spectra, one coming from the grating interferometer that corresponds to the even Fourier components and the other from the phase-switch interferometer that corresponds to the odd Fourier components. With the operating mode of D in Fig. 1, the phase error distribution in N-S direction is estimated by quite the same way as in E-W direction.

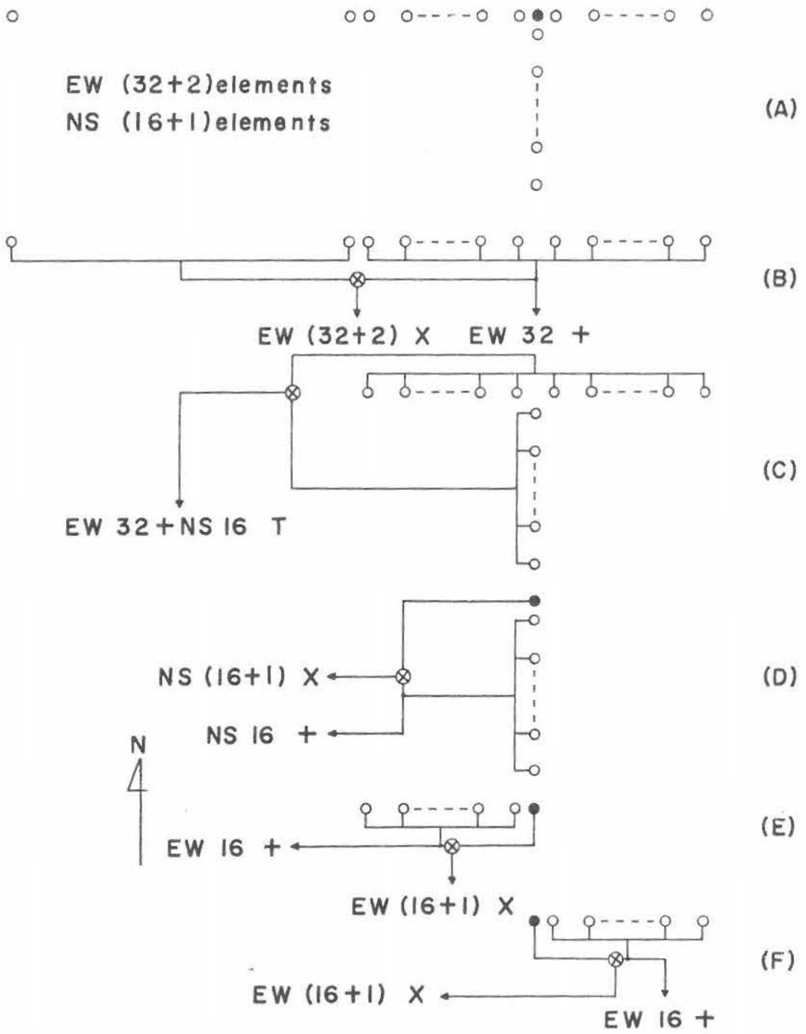

Fig. 1. Various modes of operation of 8-cm radio interferometer system.

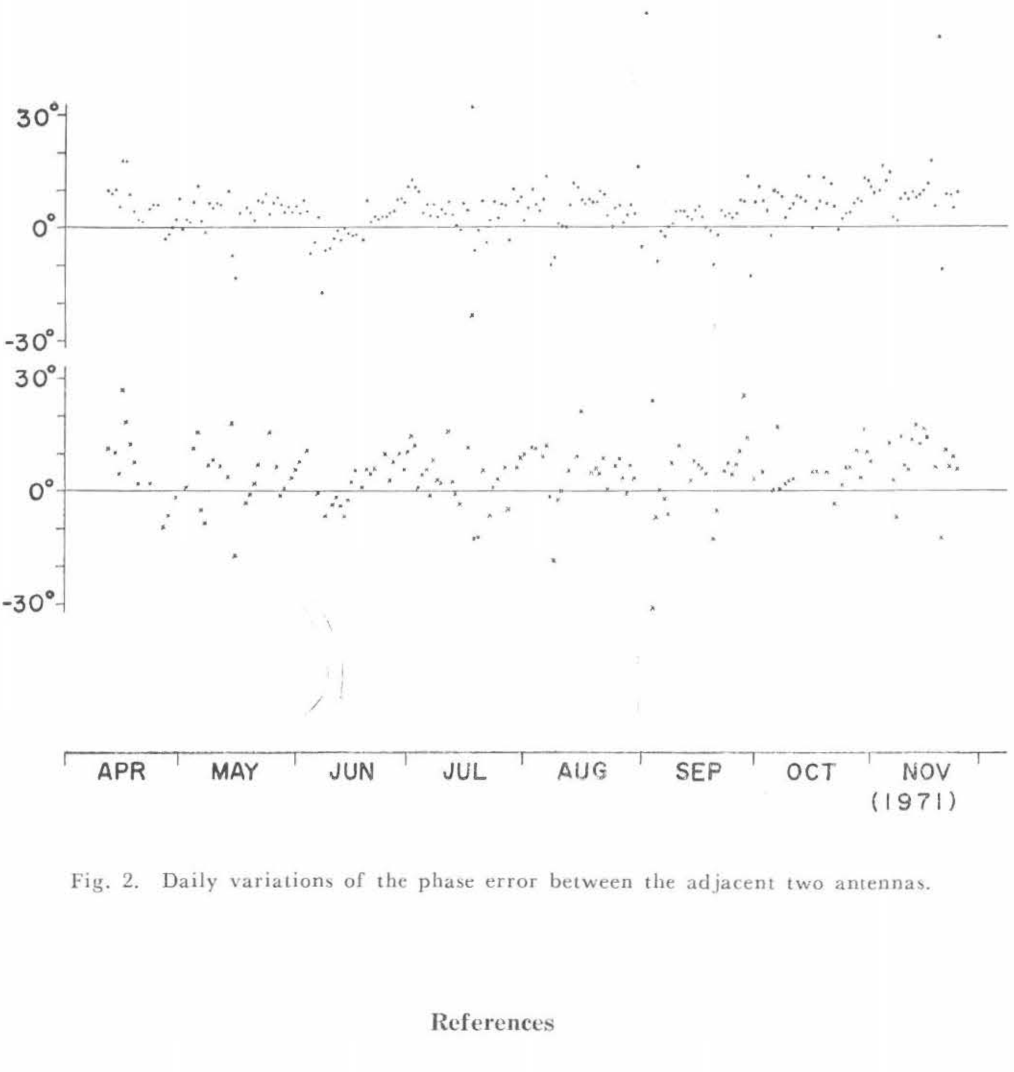

Fig. 2. Daily variations of the phase error between the adjacent two antennas.

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