Proceedings of the Research Institute of Atmospherics,
Nagoya University, vol. 26 (1979)

FULL-AUTOMATIC RADIOPOLARIMETERS FOR SOLAR PATROL AT MICROWAVE FREQUENCIES

Chikayoshi TORII, Yoshio TSUKIJI, Shoji KOBAYASHI,

Naohiko YOSHIMI, Haruo TANAKA, and Shinzo ENOME

Performance is briefly described of full-automatic radiopolarimeters at 9.4, 3.75, 2, and 1 GHz, which have effectively taken the place of the old ones, worked since 1951 for the oldest one.

The new receiving system features in automatic operations, such as in tracking the Sun, in calibration, in attenuation of receiver gain, etc. It is also characterized in improvement of the stability of receiver gain and in easy access to data with a computer. Furthermore, to obtain a better time coverage of observation, antennas are placed on a mound about 8 meters above the ground. General view of the antennas is shown in Fig. 1. In the table are summarized basic specifications of the radiopolarimeters.

Automatic Tracking of the Sun Each of the four paraboloids is mounted on the equatorial mounting of the same structure. The declination axis is driven by a correction motor in either sense with a step of 0.05° in about 1 second, or driven manually. The polar axis can be operated in three modes, namely, normal mode, correction mode and quick mode. In the normal mode the polar axis tracks the daily solar motion. In the correction mode the polar axis is driven step-wise by 0.05° in about 1 second as the declination axis is done, to follow the non-uniform motion of the Sun. In the quick mode the axis rotates at an angular speed of 15°/minute. The automatic tracking is done in the

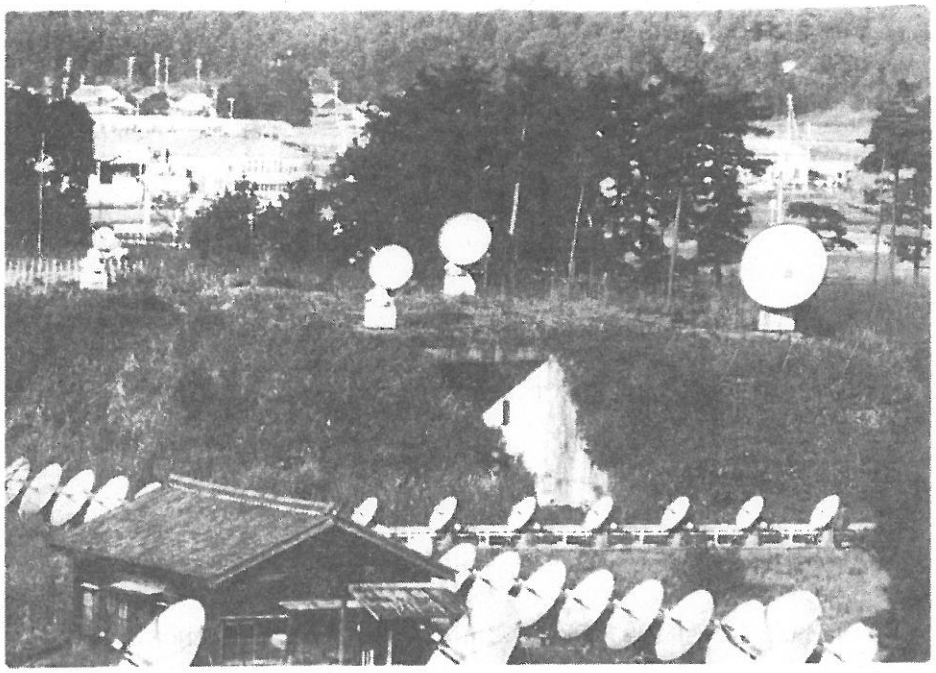

Fig. 1 General view of the full-automatic radiopolarimeters

Item	1 GHz	2 GHz	3.75GHz	9.4GHz
Diameter of paraboloid(m)	3.0	2.0	1.5	0.85
Aperture Angle(°)	90	90	80	80
Beam Width(°)	7.4	5.6	3.8	2.6
LO Frequency(MHz)	1060	2060	3732.5	9411
Band Width(MHz)	10	10	10	10
Time Constant(Sec)	0.3	0.3	0.3	0.3
Stability of Rec. Gain(dB/Day)	<0.04	<0.04	<0.04	<0.04
Noise Figure(dB)	6	7	6.5	5.5
Intermediate Frequency(MHz)	60	60	60	60

Table Basic specifications of the full-automatic radiopolarimeters

following way.

Every morning the antennas are waiting the Sun in the direction of hour angle of local starting time of observation. With the clock signal of start which is preset, the polar axis is brought to track the Sun. The correction of the antenna pointing is done, when necessary, every three hours to keep the pointing error less than 0.05° in both right ascension and declination. This pointing accuracy satisfies the condition that the antenna gain error is less than 1.5% for the severest case. Correction values of antenna motion are punched on a computer paper tape of 18 meter long for one year, which is set on a paper tape reader.

At the sunset the motion of each antenna is reversed, by the function of mechanical limiters, in the quick mode, whereby the background radiation is recorded, up to the direction of the local noon, and the antennas are stopped at the central meridian. On the next morning the antennas are drived, in the reverse direction, from the central meridian to the direction of the Sun at the local starting time, and wait for the operational start. The above procedure describes one-day cycle of the antenna operation, which is repeated for one year automatically.

Automatic Calibration Calibration of the receiver gain is done every three hours by switching the input of the receiver to an argon-tube noise generator for one minute of switch-on and another minute of switch-off. Each argon-tube is put in a temperature-controlled box with the Dicke switch and the front-end of the receiver.

Automatic Operation of the Attenuators Seven-step attenuator (0-49 dB) is equipped on the IF line to avoid off-scale of the record during a large burst. Reset of attenuator is made both by a timer started at the first insertion of an attenuator and by a level comparator.

Improvement of the Stability of the Receivers It is well known that the receiver gain is stabilized if the ambient temperature is controlled and the voltage of the power supply is regulated. As solid state components are very common now, the physical size of the receiver equipments are greatly reduced. The front-end of the receiver is installed in a box, the temperature of which is controlled in a range between 35°C and 40°C with an accuracy of 0.5°C. The back-end of the receivers is placed in a room with temperature variation less than 3°C a day. With the above-mentioned improvements, the receiver gain is

as stable as within 1% or 0.04 dB a day in overall.

Acquisition of Data 8-channel outputs are digitized into 12 bits and sampled every tenth of second. Receiver status and attenuator status of four channels, each expressed by 4 bits, are also sampled at the same rate by the PIO of the minicomputer of the Solar Data Acquisition and Communication System (SORDACS), which is described in this volume (Shibasaki et al., 1979). Temperature of each front-end box is sampled every one minute. All these data are grouped into blocks in the CPU of the minicomputer and then are written on the magnetic tape of the minicomputer subsystem of SORDACS, and are transmitted to the host-computer of SORDACS at the same time.

To monitor the solar radio intensity, receiver output is recorded on a roll-type paper chart. An exmple of record is shown in Fig. 2.

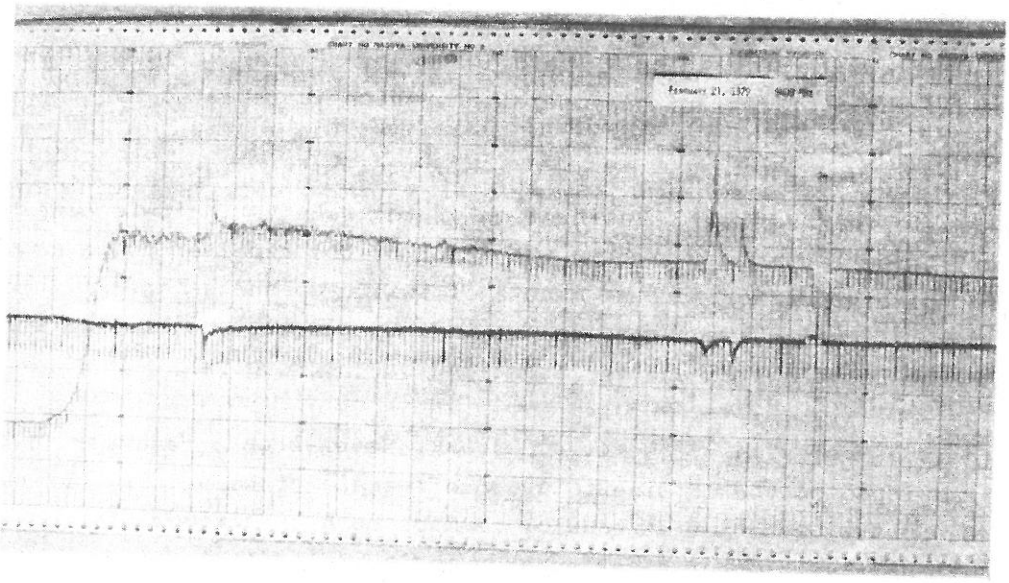

Fig. 2 An example of 9.4 GHz chart records observed by the full-automatic radiopolarimeters

Reference

Shibasaki, K., Ishiguro, M., and Enome, S.: Solar Radio Data Acquisition and Communication System (SORDACS) of Toyokawa Observatory, Proc. Res. Inst. Atmospherics, Nagoya Univ., in this volume.