OBSERVATION OF RADIO SOURCE W49 AT 9.4 GHz

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An observation of radio source W49 was made in the summer of 1966 to investigate the intensity distribution and the flux density of the radio source at 9.4 GHz making use of a 10 meter diameter palaboloidal antenna and a maser preamplifier at the Research Institute of Atmospherics.

The 10 meter dish has an aperture efficiency of approximately 50 % and about 14 min.-of-arc half-power beam width at the frequency used. The receiver is of a switching type and its reference signal is taken from a matched load cooled by liquid nitrogen. The equivalent noise temperature and the G • B product of the maser are 40°K and 100 MHz respectively. A more detailed description of this maser has been reported by Tanaka et al. (1965).

The preamplifier is followed a T.W.T. amplifier, and its equivalent noise temperature is about 1200°K in optimum operation. With this configulation of the equipment, the equivalent noise temperature of the whole system including the transmission losses of waveguides and a circulator is about 180°K.

Observations are usually carried out through diurnal drift scans of radio sources, and in the course of observation, frequent calibrations are accomplished by means of an argon discharge tube whose noise is injected into the antenna arm of the transmission lines through a 20 dB directional coupler and a calibrated precision attenuator.

It is well known that W49 consists of thermal and non-thermal components, and their declination differs by only about 40 sec.-of-arc (Pauliny-Toth, Wade, Heeschen 1966) and considering our antenna's rather beam width, we can still obtain meaningfull data by a scan in one declination.

Drawn in Fig. 1 is the drift curve of W49 and is the average of ten scans. The drift curve is resolved into two gaussian components and each corrected for time constant by the formula (Pariiskii 1962)

$$\mathrm{Ta}(t) = \frac{\partial \mathrm{Ta}'(t)}{\partial t}\tau + \mathrm{Ta}'(t), \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (1)$$

where Ta′(t) is the antenna temperature as distorted with time constant τ, (we used $\tau = 17$ sec.), and Ta is the corrected value for the antenna temperature. The results also appear in Fig. 1.

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After these procedures, we determined flux density of each source by the formula (Sloanaker, Nichols 1960)

$$S = \frac{2kTa}{Ae}\left(1+\frac{D^2}{B^2}\right), \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (2)$$

where

k : Boltzmann's constant
Ta : maximum antenna temperature
Ae : effective area of antenna
D : half-intensity width of the source brightness distribution
B : antenna-beam half-intensity width

D is obtained by the formula

$$D^2 = P^2 - B^2 \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (3)$$

where P is half-intensity width of observed gaussian drift curve (corrected for τ). The results are

Thermal component: $(71 \pm 14) \times 10^{-26}$ Watt m^{-2} Hz^{-1}.
Non-thermal component: $(16 \pm 4) \times 10^{-26}$ Watt m^{-2} Hz^{-1}.

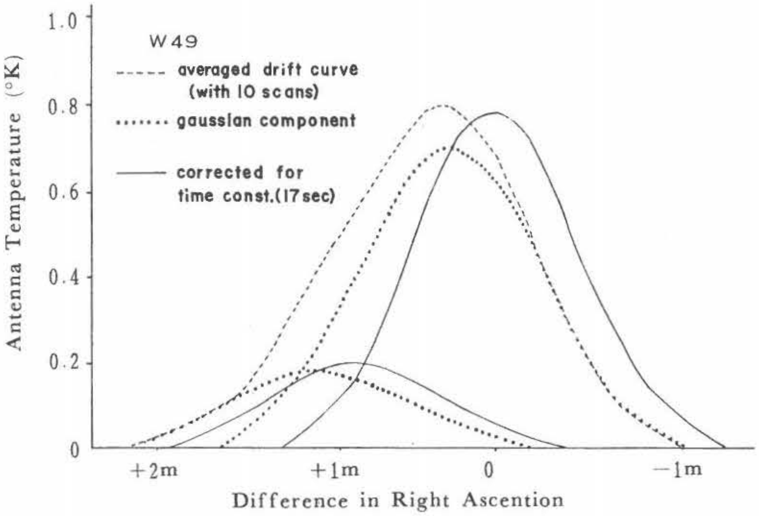

Fig. 1 Averaged drift curve of W49, and its gaussian components are shown. Also the result of correction for time constant is exibited.

References

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