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THE RECURRENT NATURE OF TYPE I NOISE ACTIVE REGIONS DURING 1965 THROUGH 1969

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ABSTRACT

The recurrent tendency of type I noise sources in metric frequencies is studied during the period from 1965 to 1969. It is shown that their recurrent period is slightly longer than 27.0 days and that the number of such recurrent trends for those noise sources is generally four. Discussion is given on the close relationship between those sources and the active regions where proton flares occur.

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1. Introduction

Based on their analysis on the recurrent type I noise activity during the period from March to August, 1968 (six solar rotation periods), Sakurai and Stone (1971) have shown that metric type I noise sources tended to recur with the period of about 27 days. Furthermore, they have shown that, during one solar rotation period, there were four active type I noise sources, and that their development at the sun was closely related to the formation of the sector structure of the interplanetary magnetic field.

The results as shown above indicate that the longitude regions where type I noise sources developed were stable for several solar rotations at least: i.e., those sources did not develop randomly over the solar surface in longitude. If this recurrent nature is further found for a much longer period as a year or more, it can, therefore, be said that this nature is universal to some extent.

In this paper, we shall analyze the recurrent property of type I noise active sources for the period between 1965 and 1969 using the observational data. Then, we shall consider a relationship between the type I noise active longitudes and proton flare active regions for the increasing and maximum periods of the current solar cycle, No. 20.

2. The Active Longitudes on Metric Type I Emissions At the Sun

We have examined the time of the central meridian passage of all distinguished metric type I noise sources, on the solar disk, which developed during the period from 1965 to 1969. The data on these noise sources have been taken from the records of Nancay interferometric observations (169 and 408 MHz) published in Solar Geophysical Data.

In order to find the recurrent tendency of type I noise sources during the above period, we have used the 27-day periodic diagram first deviced by Bartels and then plotted the times of the central meridian passage of these noise sources on this diagram as shown in Fig. 1. The solid circles in this figure indicate these times. Unfortunately, many data on type I noise sources were not reported during 1965 because of malfunction of the Nancay interferometer, though this does not so much influence our present study. The recurrent trends of the same noise sources is connected by solid lines in Fig. 1.

The result as shown in Fig. 1 clearly indicates that, during those years, in general, there were four main active recurrent trends over the solar surface. Their recurrent periods were all slightly longer than 27.0 days. In Fig. 1, those active trends are indicated by A,B,C and D.

The open circles in Fig. 1 indicate the times of the central meridian passage of the active regions which produced proton flares. It is clear that such active regions well developed in the recurrent trends which were active in type I noise emissions. Hence, this fact indicates that the recurrent period of the active regions which produced proton flares was also slightly longer than 27.0 days.

As have been mentioned above, the recurrent periods of type I noise source regions are longer than 27.0 days. In order to estimate the mean recurrent period for those regions, we have calculated the deviation from 27.0 day recurrence for each recurrent type I noise source in the interval from one solar rotation to another.

Such deviations have been summed up with respect to the interval of 0.5 days as shown in Fig. 2. This figure shows that the mean recurrent period is longer than 27.0 days by an amount of about 1/4 days. It should be remarked that this recurrent period is almost the same as that which is calculated based on the Carrington longitude system.

3. The Persistence of Type I Noise Active Regions and Its Relation to Solar Proton Active Regions

We have shown in Fig. 1 that there were four recurrent trends of type I noise sources for the period from 1965 to

1969. Furthermore, the recurrent periods for these trends were remained constant throughout these years.

As shown by A,B,C and D in Fig. 1, in general, four type I noise sources were observed for one solar rotation period. They were, furthermore, separated each other by about 90 degrees in longitude for those years. When we consider the white circles in Fig. 1, it becomes evident that these four recurrent trends for type I noise sources were also active on the generation of proton flares. If we extrapolate these four trends to such earlier periods as in the declining period of the last solar cycle (1959-1963), two recurrent trends as indicated by B and D can be connected with the active trends which were active on the generation of proton flares during the last solar cycle. These latter trends have been found by Sawyer (1965, 1968), Sakurai (1966, 1967) and Dodson and Hedeman (1969).

If we refer to the Carrington longitude system, the longitudes for these two trends, B and D, are given by $\sim 180^\circ$ and $\sim 360^\circ$ (or 0°), respectively. These values are the same as those which have been estimated by Dodson et al. (1969) by referring to the Carrington longitude system. As is shown in Fig. 1, four trends for type I noise sources are related to the generation of proton flares during the period from 1965 to 1969. This difference in number of such trends related to proton flare generation seems to be dependent of the phase of solar activity cycle, since the period under consideration coveres the increasing and maximum phases of the current solar cycle, No. 20. In fact, the other active trends, A and C, for proton flare generation did not exist during the declining and minimum phases of the last solar cycle (1960-1964)(e.g., Sakurai, 1966,1967). These two trends became active since the beginning of this solar cycle (1964 - (Sakurai, 1972).

As has been shown in this section, the most proton flares occurred in type I noise active sources during the period from 1965 to 1969. This result, therefore, means that the active regions which are responsible for metric type I noise sources and produce proton flares, do not develop randomly on the solar surface in longitude.

4. Conclusion

In this paper, we have investigated the recurrent nature of metric type I noise sources and their relation to the active regions which produced proton flares during the period from 1965 to 1969. It has been found that, during this period, the recurrent type I noise sources were remained very stably and did not develop randomly over the solar surface. Their development was factually restricted in four regions with respect to heliographic longitude. Furthermore, the recurrent periods for these four regions were slightly longer than 27.0 days (Fig. 2).

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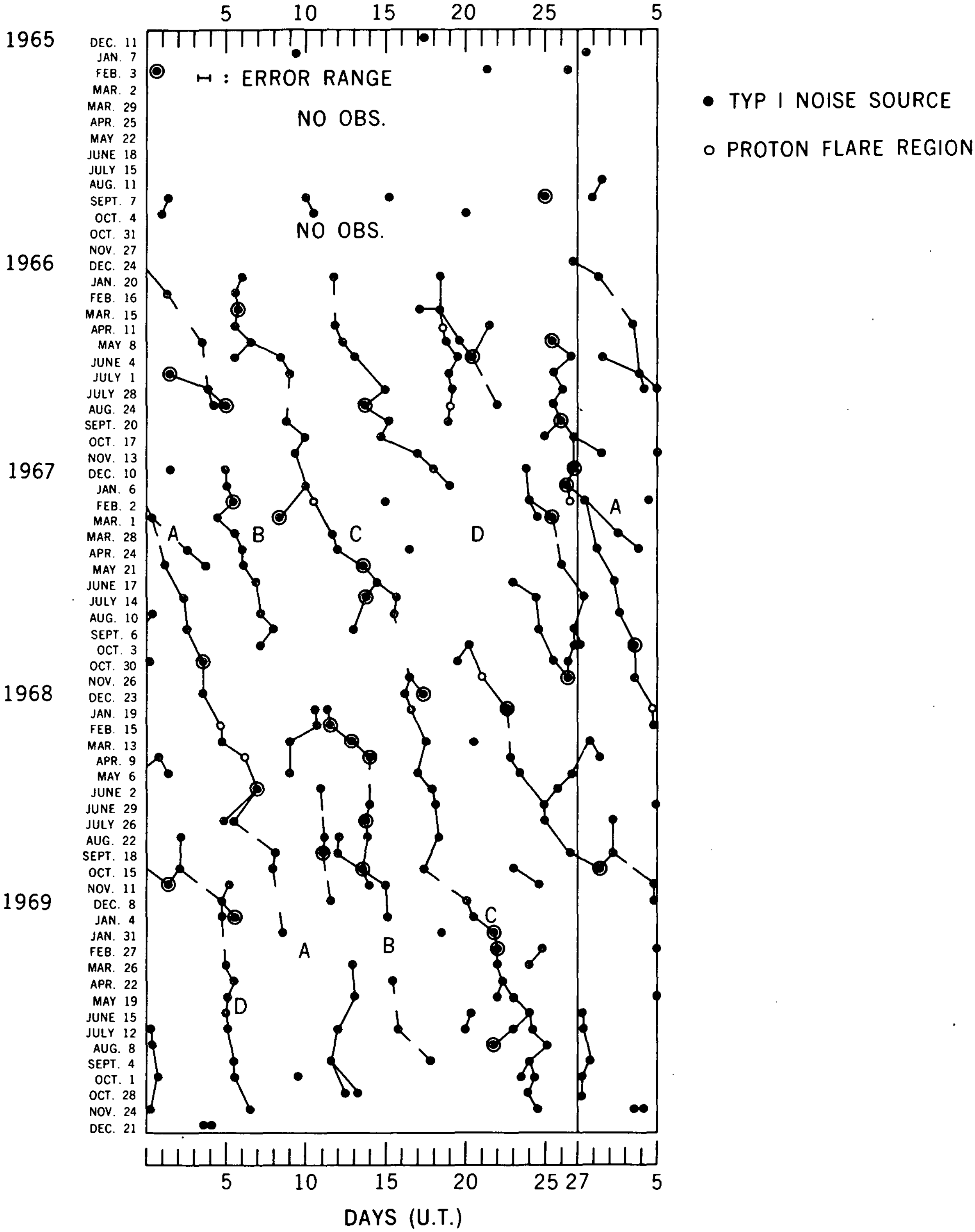

Fig. 1 - The 27-day recurrent diagram of metric type I noise sources during the period from 1965 to 1969. The black and white circles indicate the times of the central meridian passage of each type I noise source and each active region which produced proton flares, respectively. Four main trends are indicated by A,B,C and D.

RECURRENCE PERIOD OF TWO SUCCESSIVE SOLAR ROTATION NUMBERS

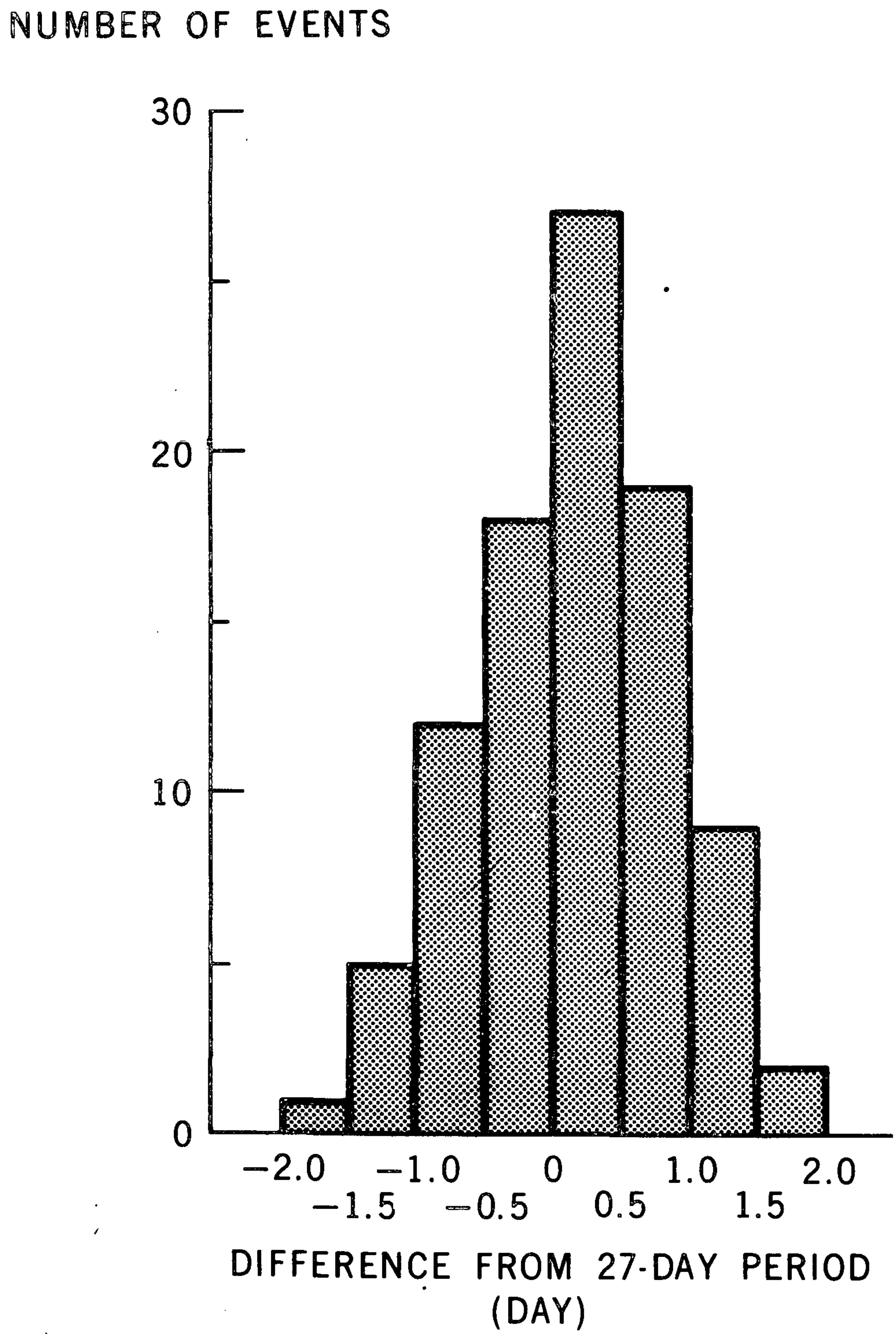

Fig. 2 - Histogram of the recurrent periods of type I noise sources for the period from 1965 to 1969.