RADIO EMISSION OF SPOTGROUPS

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ABSTRACT

The slowly varying component (SVC) of solar radio emission and burst activity associated with different types of spotgroups from the past solar minimum have been investigated statistically.

The solar minimum is an appropriate period for studying some aspects of solar activity. The isolation of events in space and time facilitates, among other things, the study of the relation between optical and radio phenomena. The days with no or only one spot group seem convenient for studying the slowly varying component and burst activity of individual types of spotgroups. As the sequence of Zürich types approximately corresponds to the evolution of active centres, one can get statistically an idea of the evolution of active regions in radio waves, which is otherwise possible only by interferometric methods.

In the last solar minimum there were 251 days without a spotgroup and 521 days with one group only, which challenge our attention. Fraunhofer maps were used as photospheric data.

We made the assumption that the photospheric situation does not change during a whole calendar day. It is not possible to verify how much our results are influenced by this assumption. The radio data used are spectral types of bursts and 1420 MHz radioheliograms published in the *Quarterly Bulletin on Solar Activity* and single frequency records from the Heinrich-Hertz Institute as well as from some other observatories. We assumed that the recorded radio events were produced by the one spotgroup present on the Sun on the selected days. This assumption does not distort our results, because the burst activity associated with plages is relatively low. The full text of the paper will be published in the *Bull. Astr. Inst. Czechoslovakia*, and only some of its main results will be mentioned here:

(1) The slowly varying component is composed of two parts: One connected with plages and the other with active centres containing sunspots. Their mean values are represented in Figure 1 which, at the same time, gives an impression of the average development of SVC of a single centre of activity. The SVC from plages seems to vary with the phase of the solar cycle, as may be seen from Figure 2. However, during the minimum period no clear correlation could be found between the SVC flux and any measure of plage activity (i.e. area, corrected area, Arcetri index, intensity of the

Kiepenheuer (ed.), Structure and Development of Solar Active Regions, 594–597.

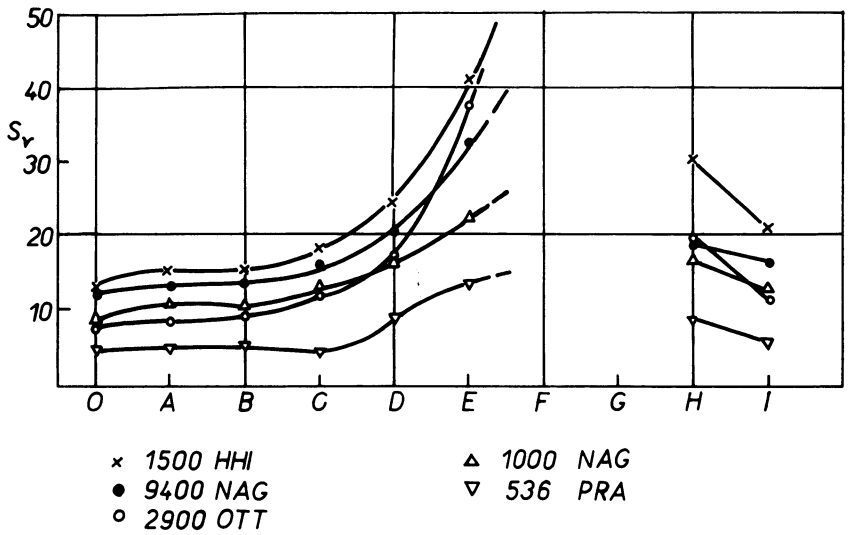

FIG. 1. *Mean values of flux of radiation for days with no spotgroup (O) or only one spotgroup (Zürich types A, B, ... I). According to this figure, the flux of an active region becomes significant after it has reached the type C.*

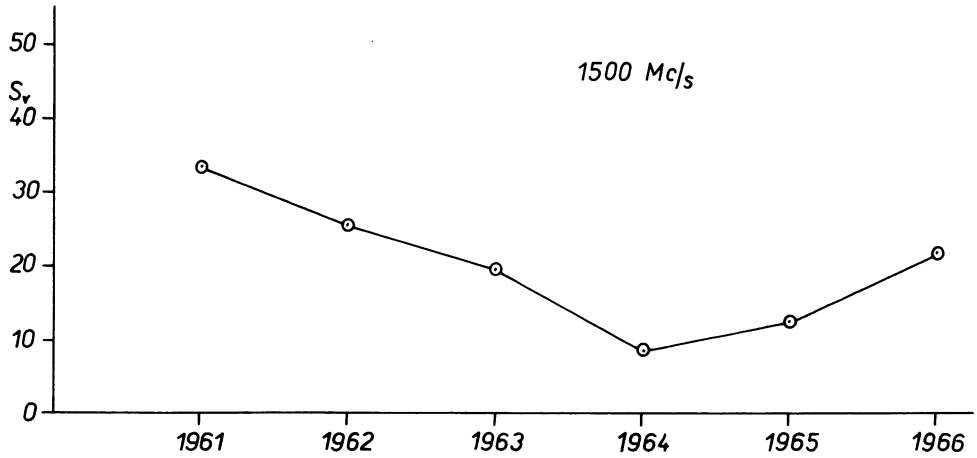

FIG. 2. *Mean yearly values of flux for days without spotgroups seem to depend on the phase of the cycle.*

brightest plages, and combinations of them). In this connection the role of a basic component is not yet clarified.

(2) The contribution of active centres to the total SVC flux depends upon the type of the spotgroup, as may be seen from Figure 1. It becomes noticeable for type C or later.

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(3) The increase of the flux for active centres containing D, E, F and G groups is due to the increase of brightness as well as of bright area. This result has been obtained by isophote integration of radio heliograms at 21-cm wavelength.

(4) The existence of a spectral maximum due to a predominant influence of local magnetic fields is especially marked for active regions containing E groups.

(5) As for the burst activity of the Sun, the material from the past minimum shows, that in some cases, bursts – especially type-III and microwave bursts – can be produced by active regions associated only with plages.

(6) Nevertheless, burst activity increases rapidly with the growth of the active centre and decreases again with its decay. Similar to the SVC, also the burst activity becomes noticeable for spotgroups later than type C (cf. Figure 3). The connection to

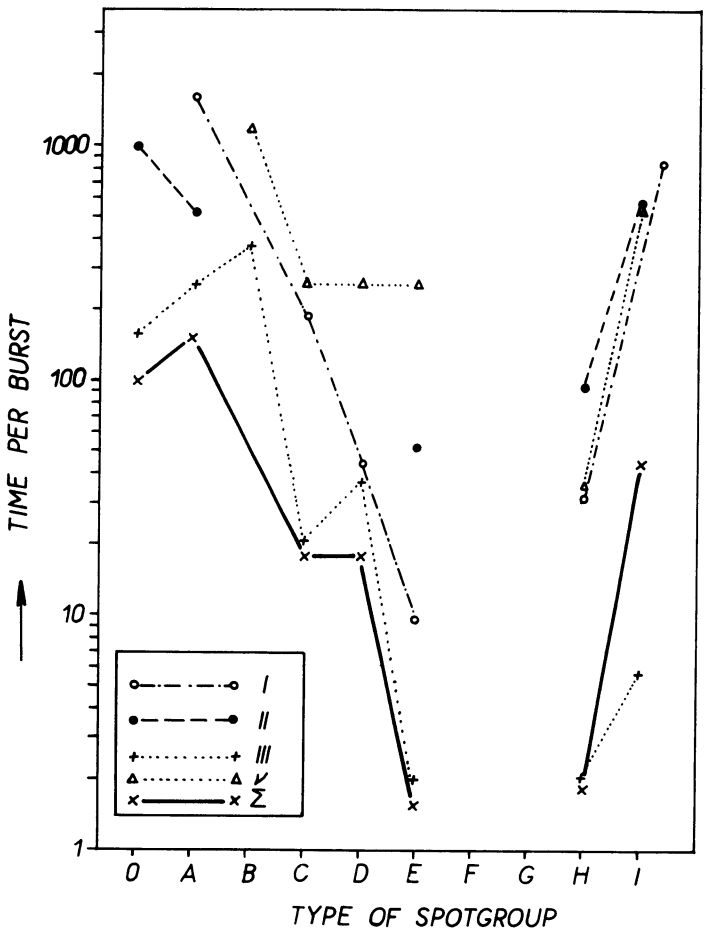

FIG. 3. *Mean time interval between two following bursts depends on the type of burst and on the producing spotgroup.*

the type of related spotgroup is closest for microwave bursts and becomes looser with decreasing radio frequency of the burst events.

(7) In general, the burst activity of a given type of spotgroup seems also to depend upon the phase of the solar cycle. It has been considerably higher for the 1966 groups than for the previous years of the minimum.

Conclusions

The results are not surprising but verify the close connection between the stage of spot development and the associated radio emission, both for the SVC and for different types of bursts. Because of the special role of spotgroups of D and E type shown here, this investigation underlines the importance of stronger complex magnetic fields for an increase of electron density and temperature as indicated by the SVC and resulting instabilities leading to different types of radio bursts and flares.