THE RESPONSE OF MICROWAVE EMISSION TO THE DEVELOPMENT OF ACTIVE REGIONS

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As is known from eclipse observations, the microwave emission of an active region consists of three main components: floccular, inter-spot (halo) and spot components which differ in intensity, the degree of polarization, and in structure and sizes /1/. A possibility of identifying the finer spatial and temporal structure in the active region (AR) emission has existed since RATAN, the VLA and WSRT became operational. The construction of the SSRT permitted the initiation of a systematic study of spatio-temporal properties of the development of active regions /2, 3/.

The majority of the properties in the AR development are reflected in detail and rapidly in the microwave emission characteristics /4, 6/.

The heating of the solar atmosphere, brought about by emergence of a strong magnetic flux from below the photosphere, leads to the formation of a local source (LS) one day or less before the appearance of the first sunspot in the active region. The increase in flux of the LS has a step-like character, rather than being smooth, thus reflecting the character of magnetic flux emergence. The LS emission flux increases on a time scale of about several tens minutes, persisting for a long time period (often decreasing later on). The increase in emission flux in associated either with growth in size of the spot source or is due to the increased rate of energy dissipation of additional longitudinal electric currents (a loop or an inter-spot source) /7/.

Rapid emergence of portions of AR magnetic field is associated with an excitation of wave motions (transients of the slow magneto-sound type) in the atmosphere. In the microwave emission, an oscillatory process manifests itself in the flux modulation with stable periods of about 3, 5 and 7 min /8, 9/. An enhancement of the oscillations of non-polarized emission with a period of 7 min often precedes a strong microwave burst (flare).

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Also, second-duration pulsations which precede weak impulsive bursts, were found /10/. In earlier studies, such pulsations were noted only at a background of strong radio bursts. The appearance of the pulsations seems to be due to wavelike, transient processes of the fast magnetosound and Alfvenic type /11/. Such processes accompany the plasma motions which arise as the inner (current) structure of a coronal loop or a loop system are rearranged.

As far as the spatial distribution of AR radio brightness is concerned, the following points should be emphasized:

a) The microwave emission source of a flare may be located near one of the AR sunspots, may migrate from one portion of the sunspot group into the other or may cover the entire sunspot group /5/. Details may show up in the distribution of emission which have no counterparts at the photospheric level.

b) Observations of the appearance and disappearance of an AR at the solar limb were used to identify in the microwave emission source two parts: compact (1000 km) and extended but less intensive (into 30-40 thousand km heights) /2/.

c) Large flares occurring in, for example, the region of interaction between the magnetic field of an active spot with the field of the adjacent complex of activity, are preceded by the appearance (about three days before) of a bright radio source with a high degree of polarization /12/. The formation of such a source in a region of sufficiently weak (100 Gs) magnetic fields and the sign of polarization (which corresponds, perhaps, to the ordinary wave) do not contradict the supposition about the plasma mechanism of emission generation. It is likely that this process reflects the energy accumulation prior to a flare.

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