G. Ya. Smol'kov. *New results on microwave emission from active regions of the sun.* During the staged deployment and breaking in of the Siberian Solar Radiotelescope (SSRT)[1,2] angular resolution of up to 17″ with one-dimensional scanning of the sun during each day (this regime is useful for recording simultaneously all manifestations of solar activity against the intense background radiation emission from the quiet sun) was achieved together with the corresponding rapid recording of flare development (up to 15 msec); systematic observations (all-weather monitoring) were conducted over the entire cycle of solar activity; a database was constructed, and is now being expanded, for investigations performed at the Radio Astrophysical Observatory[3] of the Institute of Solar-Terrestrial Physics of the Siberian Branch of the Russian Academy of Sciences on the most important problems concerning the modern physics of the sun (active regions, oscillatory and transient processes in the atmosphere of these regions, flares, geoeffectiveness of the flares, etc.), which are important for the physics of solar-terrestrial couplings; mutually advantageous scientific collaboration with foreign observatories on implementation of a number of international scientific programs (STEP), flare-22, and others) has been established and is developing fruitfully.

As expected, observations have confirmed that due to the systems approach to the development and construction of the SSRT this new instrument will make it possible to obtain a great deal of information. Because of the characteristics of the telescope, the emergence of new magnetic fluxes into the solar atmosphere is reflected effectively in the microwave emission, the generation of new active regions manifests before calcium floccula, and the structure and the dynamical and evolutionary features of the development of these regions as well as the transformation of energy accompanying interaction and changes in the magnetic fluxes or wave processes can also be traced.[4,5] The preconditioning for flares and the degree and character of their geoeffectiveness can be judged from the distribution of polarized radiation in the active regions, based on their arrangement on the visible side of the sun, and the relative number of flares and oscilla-

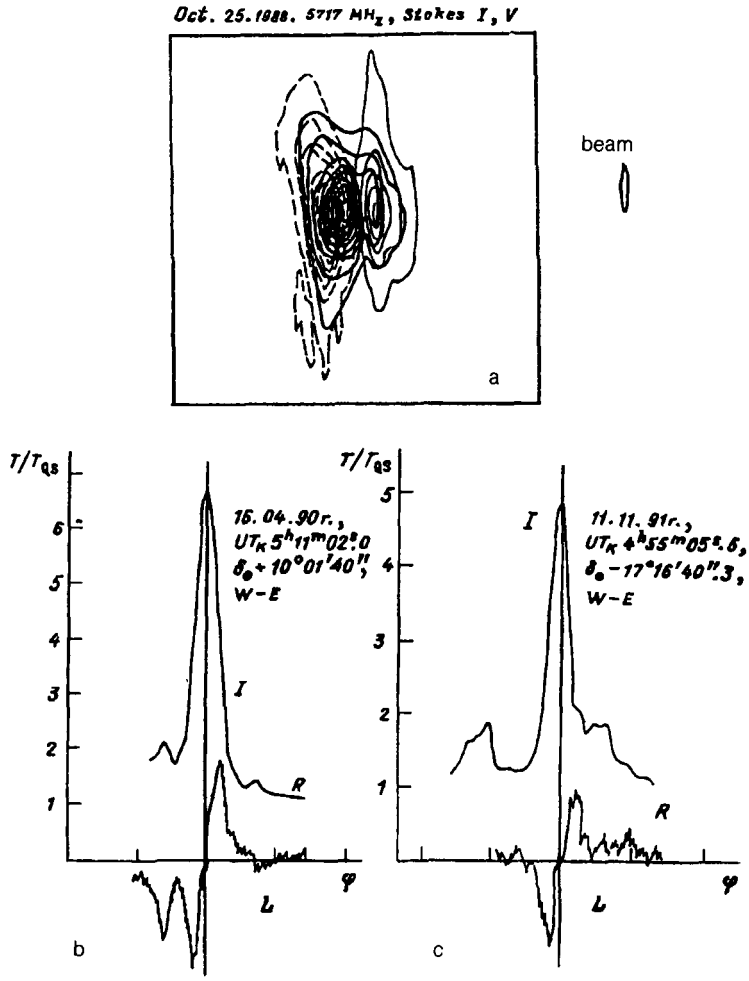

FIG. 1. Arrangement of the microwave source above the line separating regions of different magnetic polarity in the active region on the synthesized map (clean Badary map; the thick lines depict the intensity distribution and the thin dashed lines depict magnetic bremsstrahlung (polarized) associated with strong magnetic fields above sun spots) (a) and on the April 16, 1990 (b) and November 11, 1991 (c) one-dimensional scans.

tory and dynamical phenomena.[6] All this has made it possible to obtain new information about each of these problems.

One of the most interesting new results is the nonmonotonic character of the development of microwave emission at practically all stages of development of active regions.[4,7] This indicates that the process of accumulation of energy in magnetic fluxes is "quantized" and provides evidence of the realization of "quantization." This nonmonotonicity is manifested in the form of a series of stepped increases in the radiation intensity. In addition, the radiation flux increases rapidly over a time interval significantly shorter than the time interval between these stepped changes. The growth time of the radiation emission changes with the age of the active region: It is shorter initially (during the first few minutes) and increases as the active region evolves (up to several tens of minutes). This stepped character occurs together with the appearance of microwave emission in the process of generation of a new active region. Energy accumulates in a similar stepped manner above the line separating regions of different magnetic polarity in the active region. This zone is a good indicator of the energy state of active regions as a whole, and it plays a key role in their flare productivity. Such sources are singled out by synthesizing two-dimensional maps of active regions from data obtained with the SSRT during the day with one-dimensional resolution.[8] Figure 1a displays one such case. Such sources are also easily singled out in one-dimensional scans (Figs. 1b and c). When sufficient energy is accumulated in them (their temperature is high enough), they become precursors of powerful flares. Analysis of such data shows that the appearance of a "sub-

flare" in the microwave radiation is an indication of "stepped" accumulation of energy for subsequent flare development, contrary to the process previously believed to be involved in the realization of the energy stored in the field.

Thus the stepped character of the development of microwave emission from the active regions reflects a universal property of the evolution of active regions irrespective of their energy state. It is explained, on the basis of the twisted fine-structure configuration of the magnetic field of active regions, as successive manifestation of the interactions of separate elements or aggregates of elements at first, evidently, by simple and then by more complicated volume structure of magnetic fluxes. This picture is confirmed by a series of photographs showing loop structures above an active region as the loops rise and interact and the flare develops.

The kind of information that the SSRT can provide about weak-contrast large-scale manifestations of solar activity, and primarily about coronal holes as sources of the solar wind perturbing the earth's magnetosphere, is now becoming clear.

Unfortunately, under the conditions of economic reform it is becoming impossible to utilize this unique tool at the cutting edge of research—a symbol of scientific and technical achievement and therefore the common property of all Russians—efficiently due to inadequate funding, lack of high-quality media for recording and storing data, and suboptimal memory capacity and speed of available computers.

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