Scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics of the Academy of Sciences of the USSR (29–30 May 1985)

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A joint scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics of the Academy of Sciences of the USSR was held on May 29 and 30, 1985 at the P. N. Lebedev Physics Institute of the Academy of Sciences of the USSR. The following papers were presented:

May 29

1. *Yu. N. Pariĭskiĭ.* RATAN-600 and cosmology.
2. *N. S. Kardashov, R. Z. Sagdeev, D. P. Skulachev, I. A. Strukov and N. A. Eĭsmont.* Spatial anisotropy of millimeter cosmic radio emission.
3. *G. Ya. Smol'kov, T. A. Treskov, and A. A. Pistol'kors.* Commissioning of the Siberian Solar Radiotelescope and the results of first observations.

May 30.

4. *V. A. Rubakov.* Theoretical aspects of the problem of heavy magnetic monopoles.
5. *A. E. Chudakov.* Search for heavy magnetic monopoles in an experiment at the Baksan underground scintillation telescope.
6. *G. V. Domogatskiĭ.* Search for heavy magnetic monopoles in the deep underwater experiment in Lake Baĭkal.

Two of the papers are briefly summarized below.

G. Ya. Smol'kov, T. A. Treskov, and A. A. Pistol'kors. *Commissioning of the Siberian Solar Radiotelescope and the results of first observations.* In 1984 in Eastern Siberia the construction was completed of the Siberian Solar Radiotelescopes (SSRT) with an angular resolution up to 20″ at a wavelength of 5.2 cm (Fig. 1).

Being designed for the investigation of an extended object continuously and significantly varying and with a wide spectrum of its structural scales, the SSRT is a cross-type radio interferometer of 256 antennas, which consists of two mutually orthogonal 128-element antenna arrays provided with the necessary receiving and computing apparatus.[1–3]

The base length of both antenna arrays is equal to 622.3 m. Antennas with parabolic reflectors are placed 4.9 m apart. With a reflector diameter of 2.5 m the field of view of the SSRT is approximately 70′. As a result of this the SSRT has a uniform spectrum of spatial frequencies sufficient to pick out in the distribution of radioluminousity details of all sizes from the principal components of the structure of the active regions (10″–20″) up to the radiodiameter of the Sun. Therefore one can study with the aid of the SSRT any active region or a flare-type process simultaneously with making diagnostic measurements of the state of the solar activity as a whole.

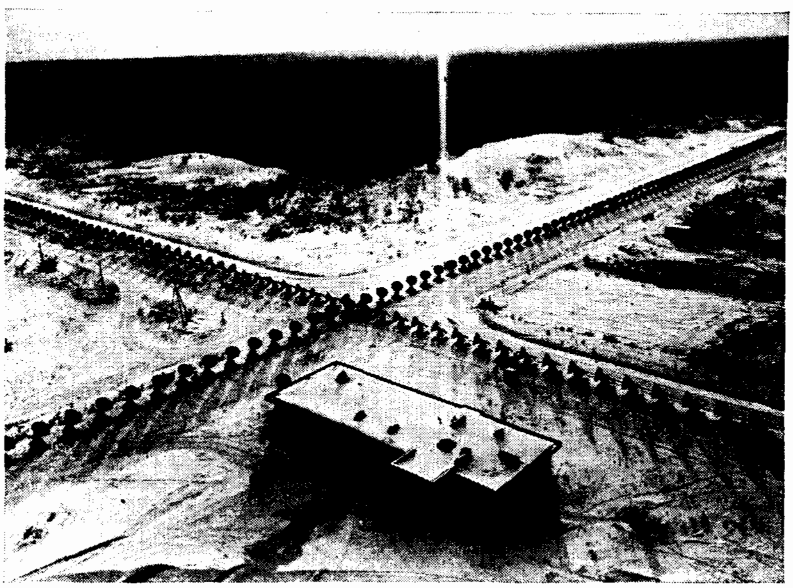

FIG. 1. Siberian solar radiotelescope of the Siberian Institute for the study of Terrestrial Magnetism, Ionosphere and Propagation of Radio Waves (SibIZMIR) of the Siberian Branch of the Academy of Sciences of the USSR in the Eastern Sayan mountains (view from the north-east).

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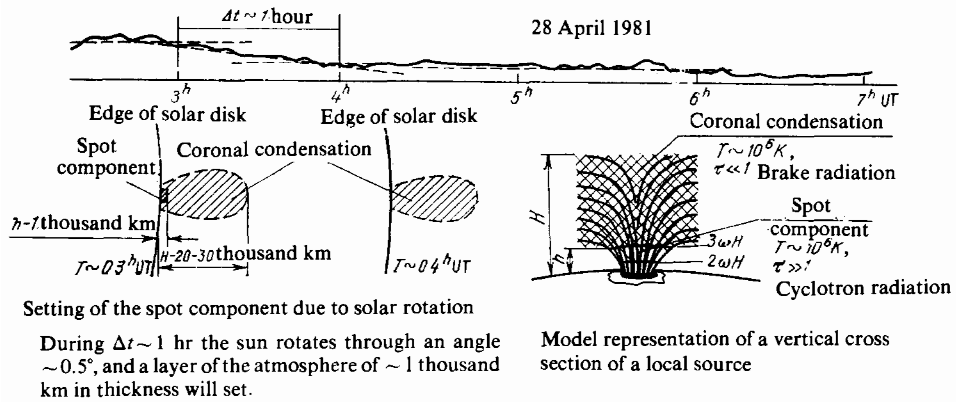

FIG. 2. Model of sources of microwave radiation from active regions based on observations at the Siberian solar radiotelescope.

The diffraction maxima of the lobe diagrams of both antenna arrays cover the sky uniformly. Therefore the existence in the SSRT of two mutually orthogonal arrays makes it possible to observe the sun practically during the whole day with a high uniform resolution up to 17″. The multi-ray lobe diagram of the "cross" consists of pencil-shaped rays.[4]

In order to obtain two-dimensional radio images of the sun provisions were made for: 1) parallel multifrequency recording of the distribution of radio luminosity with respect to the angle of the location with the aid of an 180-channel receiving assembly with time constants which eliminated the distortion of radio images as a result of the rotation of the sun and sufficient to study flares, and 2) scanning of the sun every few minutes along the azimuth as it passed through such fanlike arrays of the lobe diagram in the course of its motion across the sky as a result of the diurnal rotation of the earth. The use of such a method of "frequency" scanning is based on the dependence of the orientation of the lobe diagram of the antenna arrays on the wavelength and is achieved by means of connecting the antennas to the multichannel receiving assembly by waveguides of equal electrical length. The recording with this arrangement of the distribution of the degree and sign of circular polarization enables one to draw conclusions concerning the structure and the dynamics of magnetic fields within the atmosphere of the active regions.

The shaping of the complex lobe diagram of the SSRT has been achieved as a result of the engineering and constructional designs adopted and the use of the method of phase adjustment (of the antenna arrays with record-high values of electrical dimensions and number of antenna and waveguide elements) with respect to the radio emission of the sun taking into account the nonuniform distribution of radioluminosity over its disk. The synchronous tracking by 256 antennas, the diagnostics of the operational efficiency and the control over the operation of all the systems, the sampling of the 360 outputs of the receiving assembly, the operational imaging and the primary reduction of the results of observations are carried out with the aid of a multiprocess automated assembly, accessible for development and capable of being adapted to the solution of new problems.[3,5]

The stage-by-stage commissioning began in the spring of 1981. Daily recording of one-dimensional distributions of radioluminosity in the course of phasing the antenna arrays with respect to the radio emission of the sun has made it possible to initiate the study of spatial-temporal features of the development of active regions and flares.[6–10] Repeated recording in this program of known facts has confirmed the correctness of the development and construction of the SSRT project. At the same time new information has been obtained on the structure and development of active regions which are accessible only to the application of the method of observation with the aid of the SSRT: the rapid and significant variability of the microwave emission of the active regions[6,7], the pulsations of the microwave emission from the active regions with a period of the order to several seconds,[8] the localization and displacement of flare-type processes with respect to sunspots, the change in the structure and sign of the circularly polarized radiation from the active region as a result of a flare, etc.[6]

The ability to pick out emission from individual details of active regions, the study of their structure and development made it possible to initiate a search for precursors of flares[9,10] and a study of special features of sources of microwave radiation aimed at diagnostics of the development of physical processes in the solar atmosphere. As a result of observations of active regions at the edges of the solar disk two components have been distinguished: an extended one up to heights of 30–40 thousands of km and a compact one (~1000 km in height) (Fig. 2). A rapid brightening of a source of microwave radiation signifies the emergence of a new portion of magnetic field in the active region.[11]

Already the preliminary observations of the sun carried out in the process of adjusting the stage-by-stage commissioning of the SSRT have demonstrated its great ability to provide information. The utilization of the SSRT together with the Sayan and Baĭkal (optical) observatories of SibIZMIR (Siberian Institute for the Study of Terrestiral Magnetism, Ionosphere and Propagation of Radio Waves)[12] will make it possible to solve urgent problems of present-day physics of the sun and of solar-terrestrial physics.

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sistemy (Automation system of the Siberian solar radiotelescope: Microprocessing means and systems) GKNT (State Committee on Science and Technology), M., 1985, vol. 1.
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