

RUSSIAN ACTIVITY REPORT 1998

Valentin I. MAKAROV

Astronomical Observatory at Pulkovo, 196140, St. Petersburg, Russia

Solar research in Russia is carried out at the following institutions:

1. Ussuryisk Astrophysical Observatory, (692533,Ussuryisk AO).

Observations: Series of full-disc photosphere and chromosphere, monitoring of active regions and flares, daily radio-emission at 200 MHz, study of solar cycle activity.

2. Institute of Solar-Terrestrial Physics, (root@sitmis.irkutsk.su)

Observations: Sayan Mountain Observatory: magnetic and velocity fields, active regions, prominences, spicules, oscillations, spectrophotometry, polarimetry, infrared observations.

Baykal Astrophysical Observatory: monitoring of the active regions, spectrophotometry and polarimetry of sunspots. Radioastrophysical Observatory: monitoring of the solar activity, fine time-structure of the flares, spikes, surges, filaments, 2D radio-images of the Sun.

Theoretical work: Solar torsional oscillations and grand activity cycle, (Kitchatinov et al., 1998). A correlation between Sayan and Stanford observations. (Peshchero et al., 1998.) Physical mechanisms for chromospheric spicules evolution (Papushev, 1998). The Gleissberg cycle (Pipin, 1998).

Methods and Instrumentation:

1. For investigating the fine structure of the chromosphere, coronal hole boundaries, solar jets and coronal plumes a new two-bandpass birefringent filter to HeI 10830A has been produced. The FWHM is 0.046 nm, spectral tuning is +/- 0.2 nm and the filter's angular field is 1.17 degree. The second bandpass is centered on the H-alpha line. The bandpass parameters are 0.03 nm, 0.09 nm and 0.9 degree, respectively. First images in the HeI 1083 nm line were obtained at the Large coronagraph of the Sayan observatory in May-July 1998, (Kushtal and Skomorovsky, 1998).

2. The personal-computer-based automated system has been improved on Solar Telescope for Operative Predictions (STOP) at the Sayan Solar observatory. The first results with the new system for recording Stokes parameters simultaneously in several spectral lines were obtained. The CCD row in current use is a 3624-channel system, designed by Toshiba Company specially for spectral measurements. (Demidov et al., 1998; Peshchero et al., 1998).

3. On the Vacuum Solar Telescope at the Baikal Observatory the linear polarization in moustaches has been investigated. The preliminary conclusion is made that the observed polarization in moustaches arise due to influence of electron beams with an energy of approximately 20 keV. (Firstova and Bulatov, 1996; Kazanste et al., 1998).

3. Astronomical Observatory of Ural University, (Ekaterinburg, 620083).

Observations: magnetic fields in sunspots

4. Kalmyk University, (Elista, 358000). Theoretical aspects of the sunspots and flares.

5. Radiophysical Institute of N. Novgorod University, (root@nirfi.sci-nnov.ru)

Daily solar radio-emission at cm, dm and m-waves, solar VLBI at 327 MHz.

6. Applied Physics Institute, N. Novgorod (gapgr@appl.nnov.su).

LRC-circuit analog of current-carrying magnetic loop. Diagnostics of electric parameters, (Zaitsev et al., 1998)

7. Institute of Terrestrial Magnetism, Ionosphere and Propagation of Radiowaves, (IZMIRAN) (solter@izmiran.troitsk.ru)

1. It was shown that coronal holes are located in the large-scale magnetic field regions with a pattern of div B and in the "saddle" configurations. (Mogilevsky, et al., 1997)

2. It was shown the polar and mid-latitude magnetic field was connected by a narrow bridge, but later they evolve independently, (Obridko and Shelting, 1998, in press).

3. An atlas of the heliosphere structure for 1915-1996 was compiled. Variations of polar field and the number of polar plagues were compared to show a satisfactory agreement. The divergence of polar plumes was calculated and its quasi-periodic behaviour with a period about 70 years was revealed. (Obridko and Shelting, 1998, in press).

4. Location of CME events to two main systems (giant and supergiant) of the magnetic field has been investigated. The clustering of CME events and solar flares toward the neutral line of the global field was corroborated. CME locations track the heliomagnetic equator. (Ivanov, et al., 1998).

5. Discovery of two type of large-scale shining chains of the solar disk. The chains are not counterparts of the inversion polarity lines of the large-scale magnetic fields. They can coincide with sharp boundaries of coronal holes and outline footpoint lines of some large X-ray arcades. (Chertok, 1997; 1998, 1998a)

6. Interferometric observations of emission features in the F-corona.

It was solving the problem of detection of the resonance emissions of Ca II ions created by the interplanetary dust sublimation during the eclipse of February 26, 1998, Guadeloupe. Unshifted K-Ca II is seen up to about $10R_{\odot}$. On the photograph are Doppler-shifted K-emissions in the SW-quadrant of the circumsolar space within the range of 5 to $20R_{\odot}$. The sign of the Doppler shift corresponds to direction of the planetary orbital motions. We suppose that these features were associated with the sublimating dust, (Gulyaev and Shcheglov, 1998).

7. Thin flux tube approximation for twisted flux tubes made possible to develop a theory of weakly nonlinear waves. Interaction of p-modes and convection is considered. (Zhugzhda and Nakariakov, 1997).

Observations: Active Regions, flares, filaments, corona, solar wind, solar cycle activity, helioseismology, integral radiofluxes and radiospectrograms, CORONAS mission.

8. Sternberg Astronomical Institute of the Moscow State University, (root@sai.msk.su).

I. Searching the regions of the solar wind acceleration: analysis of eclipse Fabry-Perot interferogrammes revealing emission line spectra in the range 1.3-1.8 R during the 1999 eclipse.

Main results: 1) different average of FWHM are found for different coronal structures: 0.8 A - streamers, 0.9 A - helmets, 1.0 A - regions with reduced intensities (holes), 2) a low-scattered light eclipse instrumentation should be used to get reliable spectra at far distances. 3) analysis of Doppler shifts based on former eclipse data; 4) getting spectra in the range 2-4 R during the forthcoming 1999 eclipse, (Alexeeva et al., 1997; Kim et al., 1995;).

II. Development of a new generation coronagraphic telescope (mirror coronagraph) based on employment of a super-smooth primary reflecting optics and Lyot's method (Kim et al., 1995; 1995a; 1998)

Researches: 1) comparative analysis of different techniques for reducing the scattered light in ground-based and space-borne telescopes; 2) manufacturing a 20-cm prototype at Sternberg Institute; 3) computer simulation of Point Spread Function (PSF) for a space-borne night-time coronagraphic telescope; 4) numerical simulation of the expected level of scattered light in operating and future reflecting coronagraphs. 5) Next step: measurements of actual level of scattered light for a 20-cm Si-monocrystalline and Si-C-SiC primary optics. (Kim, et al., 1997; 1997a).

9. Bauman Technical University. Radiomaps of the Sun in mm-waves.

10. Institute of Nuclear Physics of Moscow University, (root@decini.npi.msk.su)

Polar plume formation in the solar corona (Veselovsky, et al., 1998). The solar flare plasma density investigation method based on the 2.2 Mev gamma-line time profile analysis, (Kuzhevskij and Troitskaia, 1998).

11. Lebedev Physical Institute (FIAN, (postmaster@sci.fian.msk.su).

It was demonstrated numerically the current sheet creation above the preflare active region 20 MAY, 1991 in response to a disturbance at the photosphere. A current sheet development, and plasma ejection along the sheet was shown. It has been demonstrated that an x-ray bright point can appear due to reconnection in the neutral point. (Podgorny and Podgorny, 1998). Solar wind, CORONAS and other space mission.

12. Special Astronomical Observatory, (vbog@ratan.sao.ru)

Daily solar radio-emission observations (45 channels between 1,7 cm and 32 cm), panoramic spectral analysis at 45 wavelengths with registration of the intensity and circular polarization. (address: <http://www.saoru/sun>). The accuracy of the polarization measurements up to 0.03 are achieved. The magnetic field in the coronal hole (about 10 G) was measured. The new method of emission radio tomography for the study of 3-D magnetic field distribution under development.

13. Astronomical Observatory at Pulkovo, (root@gaosun.spb.su)

Optical Observations: sunspot and polar faculae magnetic fields, oscillation in the sunspots, He-dark points, daily solar radioflux (I and V parameters between 2,3 cm and 20 cm-waves);

Theory. It was show that the small-scale brightness fine structure at the extreme limb of the Sun may be produced by temperature inhomogeneities of the upper photosphere, (Karpinsky et al., 1997). Organization of fine structure of

the solar photosphere: granules, protogranules, mesogranules, supergranules (Ikhsanov et al., 1997), and space-time distribution of coronal holes (Ikhsanov and Ivanov, 1998). Longitudinal structure of the double magnetic cycle, (Benevolenskaya, 1998). A nonlinear mathematical model for the solar cyclicity and prospects for reconstructing the solar activity in the past. Observations of coherent magnetic structures in sunspot areas, (Nagovitsyn, 1997; Nagovitsyna and Nagovitsyn, 1998). The generation of the solar slow shock wave inside the chromospheric transition region in the result of the rotational discontinuity's refraction was shown, (Grib, 1998; 1998a).

Pulkovo group of solar radio astronomy (GAO + SAO)

1. Electrostatic wave instability and plasma radiation from coronal loops (Stepanov, et al., 1997).
2. An analysis of inversion of the circular polarization of an active region with RATAN-600, (Ryabov, et al., 1998).
3. Using the Nobeyama radio heliograms the 3-min and 5-min oscillations were detected in several sunspot-associated sources with high degree of polarizations. This effect is manifestation of MHD waves in magnetic tubes of sunspots at the basis of the solar corona in the field of $B=2000$ G. The comparison with spectral polarization measurements made with the RATAN=600 has shown that the observed amplitude of oscillations can be due to oscillations in the magnetic field of only several gauss, about 4 G, (Gelfreikh, et al., 1998).
4. Magnetography of the Sun based on the analysis of the spectra, polarization and brightness distribution of thermal bremsstrahlung of active regions, prominences and coronal holes, (Grebinskij, et al., 1998).
5. Identification of the polar faculae observed optically (Kislovodsk Solar Station) with the bright radio features in polar regions (observations on the RATAN-600 and Nobeyama). This result opens a new effective way to study development of the global solar activity.
6. Detailed spectral analysis of polarization of radio emission of the active regions using panoramic analyzer of the spectra on the RATAN-600, (Urpo, et al., 1998; Gelfreikh and K.Shibasaki, 1998; Shibasaki, et al., 1998).

14 Kislovodsk Solar Station of the Pulkovo Observatory, (makarov@gaosun.spb.su)

Observations: intensity of the coronal lines 530.3 nm and 637.4 nm, H-alpha prominences and filaments, sunspots area and coordinates, Wolf number, magnetic fields;

Synoptic data: coronal line intensities, H-alpha synoptic charts, sunspots data, prominences, polar faculae numbers; Theoretical activities:

1. Long-term variations of the torsional oscillations of the Sun: On 1024 H-alpha charts for 1915-1990, 7 bands of faster- and 7 bands of slower-than-average rotation were revealed. The latitude span of the bands shows a variation of about 55 years (Makarov, Tlatov and Callebaut, 1997).
2. Torsional oscillations in the solar corona in the Fe XIV 5303Å line in 1940-1992. (Makarov and Tlatov, 1997)
3. Polar activity of the coming global solar cycle 23, (Makarov and Makarova, 1998).
4. Polar Magnetic Field Depth as Derived from SoHO EIT Polar Plumes Observations, ((Makarov et al., 1998.)

15. Ioffe Physical-Technical Institute, (root@pti.spb.su)

Two-millennial cycle in solar-terrestrial phenomena, (Dergachev, 1997). Signature of solar activity and strong solar proton events in abundance of nitrates in polar ice: recent 4 cycles, (Dreschhoff, et al., 1997). Diagnostics of the electron beams in the solar corona from X-ray and radioemission.

16. Institute of Physics of St.Peterburg University, (St.Peterburg, Petrodvoretz, 198904)

Solar wind, radiomaps of the Sun in mm-waves.

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