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AID Report P-63-23 13 February 1963

PHENOMENA IN THE UPPER ATMOSPHERE

Review of Soviet Literature

AID Work Assignment No. 3
(Report No. 31 in this series)

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FOREWORD

This is the thirty-first in a monthly report series reviewing Soviet developments in selected problems in astrophysics and geophysics. It is based on materials received at the Aerospace Information Division in November 1962.

Topics covered in this series are

I. Ionospheric electron concentrations
II. Solar radiation and the ionosphere
III. Van Allen belts and cosmic rays
IV. Telluric currents
V. Atmospheric electricity
VI. Nuclear bursts in the atmosphere
VII. Satellite and missile data
VIII. Arctic and antarctic communications
IX. Meteorology of the upper atmosphere

Materials in this report deal with Topic II.

AID Report P-63-23
Work Assignment No. 3
13 February 1963

TOPIC II. SOLAR RADIATION AND THE IONOSPHERE

1) Dravskikh, A. F. Statistical regularities in the spectra of solar radio-emission bursts and possible mechanisms of emission. Solnechnyye dannyye 1962 g.: Byulleten', no. 4, 1962, 58-63.

Observations of the spectra of solar radio-emission bursts were made from 1958 through 1960 in the Main Astronomical Observatory on two- and three-component spectrographs. The spectral densities of the streams of emission were measured on two and three frequencies near that of the line of excited hydrogen ($\nu = 9850$ mc). Measurements were also made of the dependence of the spectral density of the burst-emission stream on the frequency, as well as the dependence of the residual intensity on the line frequency. Conclusions: 1) The most characteristic spectrum of radio bursts with $n = -0.75$ in the wavelength region near three centimeters can not be described by the thermal radiation of an isotropic plasma, assuming arbitrary gradients of electron temperature and concentration. 2) The most characteristic spectrum of the fairly small bursts in this region can be described by the thermal radiation of a magnetically active plasma in the presence of a constant magnetic field with an intensity exceeding 1000 gs. 3) The most characteristic spectrum of bursts can be described by the synchrotron radiation of relativistic electrons in the presence of a magnetic field with an intensity of less than 1000 gs. Of the two radiation mechanisms the latter corresponds more closely to reality. 4) In the light of present ideas on the synchrotron mechanism of radiation, the most characteristic change of the spectrum in the process of burst development (maximum n at burst maximum) can be explained by the change in the energy spectrum of relativistic electrons when the emission of the faster particles corresponds to the burst maximum, or else by an increase in the magnetic field at burst maximum as, for example, the result of compression. 5) Observation of the excited-hydrogen line ($\lambda = 3.04$ cm) indicates a nonequilibrium distribution of hydrogen atoms among the states $2^2P_{3/2}$, $2^2S_{1/2}$ in the bursts and the presence of a cold medium in the bursts or along the path of emission propagation.

2) Fomenko, B. D. Properties of corpuscular streams of the M-type, detected by their action on the troposphere. Astronomicheskiy zhurnal, v. 39, no. 5, 1962, 833-839.
QB1.A47

Correlations between corpuscular streams and phenomena in the troposphere are investigated by the author on the basis of M-perturbations of the geomagnetic field. The M-perturbations are associated with special active regions on the sun. The author considers the solar flocculi to be the active places from which the corpuscular streams depart. Corpuscular streams act on the upper layers of the atmosphere, and this action influences the state of the troposphere. The study of the correlations between the corpuscular streams and the M-perturbations is carried out using the method of superposition of epochs. The results are presented graphically.

Meteorological data are taken from Soviet stations, the M-perturbations being compared with the state of the atmospheric pressure. The meteorological data are processed by the method of superposition of epochs, which include several cycles of solar activity. The curves contain many maxima before and after the passage of flocculi through the center of the solar disk. The author especially notes the maximum on the sixth day after the passage and connects it with the action of the corpuscular stream. The other maxima are explained as the influence of other groups of flocculi.

Author's Association: Volgograd Pedagogic Institute.

Comment: The author's curves characterizing the connection of the M-perturbations with the corpuscular streams of flocculi and the atmospheric pressure changes show many maxima. The author, however, stresses only the maximum which happens to coincide with the sixth day after passage of flocculi through the solar disk center. This maximum slightly exceeds the other maxima, but does not otherwise differ from them. The author assumes corpuscular departure from flocculi to occur in a radial direction from the disk center. Flocculi, however, are not a fixed phenomenon on the solar surface; they change their position. It is impossible for each flocculus group to pass through the disk center during solar rotation, because these groups are bound to definite solar parallels. The radial departure of corpuscular streams has not yet been proved. The author's assumption of the correlation between meteorological elements and corpuscular streams of 300 km/sec velocity can only be accepted with reservations, since the solar escape velocity is 617 km/sec.

3) Gel'freykh, G. B. Estimating magnetic field intensity in regions of solar radio-emission bursts in the centimeter range. Solnechnyye dannyye 1962 g.: Byulleten', no. 3, 1962, 50-55.

An attempt is made to utilize the measurements of the degree of ellipticity of the polarized component of radio bursts arrived at by Akabane (references given) to determine the value of the magnetic field. Formulas derived for the intensity of the field yield a value of H = 550 gs. This value refers to a layer bordering the emitting region. It is concluded that a strong gradient of the magnetic field is present at the border of the emitting region. It should be of such magnitude that after passage through the transition region the character of polarization remains the same as it was at its inner border. It is believed possible that physical conditions of this sort exist in the front of a shock wave. The presence of the linearly polarized component of radio emission could then serve as an indicator of shock waves associated with chromospheric flares.

Comment: See also AID Work Assignment No. 3, Report 19, Topic II, Abstract 8.

4) Gel'freykh, G. B. Thermal model of a burst in the centimeter range. Solnechnyye dannyye 1962 g.: Byulleten', no. 5, 1962, 67-75.

The curve representing the intensity and degree of polarization as a function of time is examined in an attempt to support the hypothesis of the thermal nature of solar radio emission in the centimeter range. A series of bursts was observed at λ = 2.2 cm on the polarimeter at Pulkovo in the period July-September 1961. A burst that occurred on 19 July 1961, equivalent to about 30% of the intensity of the quiet sun, was analyzed in detail. The specific characteristics of the flux and polarization curves derived from this burst are attributed to the isotropic expansion of the condensation of matter in the corona according to the law $n \cdot T^{-3/2}$ = const., as well as to the constancy of the expansion rate. It is believed that if centimeter-range bursts are connected with such phenomena as the expansion of coronal condensation, then the role of the latter must also be substantial in other coronal processes. The mass of the emitting condensation, $N \cdot m_H = 5 \cdot 10^{15}$ gm, is two to three orders less than the mass of the corona. X-ray and ultraviolet radiation of 10^{28} - 10^{29} ergs are comparable to both the optical radiation and x-radiation of flares. It has been shown by Hachenberg and Krüger (reference given) that the moments of onset of centimeter bursts correspond to the onset of x-radiation associated with flares. It is noted that the rate of condensation expansion obtained in this study, viz., 2000 km/sec, is of the same order as the velocity of the agent causing Type II bursts. These latter usually follow directly after bursts in the centimeter range. Acceptance of this model is complicated mainly by the question of the origin of the hot, dense condensation, the expansion of which governs the shape of the curve of the burst. Within the limits of the thermal radiation mechanism, the inhomogeneity of the medium may be lessened and the contribution of the magnetic-braking radiation may be taken into account.

5) Ivanchuk, V. I. On the nature of arc formations in the solar corona. Solnechnyye dannyye 1962 g.: Byulleten', no. 3, 1962, 61-68.

The structural formations and arc systems in the solar corona are discussed as a function of the action of magnetic fields. Among the arguments in favor of the idea that the arcs are flat formations ("materialized" arcs of the magnetic lines of force) are the following: 1) arcs adjacent to polar ray systems most often reproduce the form of the latter; 2) arc systems often show a structural resemblance to coronal fans; 3) prominences are usually found in the center of arc systems; 4) if the arcs were shells, it would be difficult to find a stable configuration of magnetic lines of force frozen in the coronal matter comprising the "skeleton" of the shell; 5) it would be very difficult to explain theoretically the generation of arcs solely as frontal surfaces of acoustic or shock waves. An explanation of the generation of arcs can perhaps be found by examining the relationship between the coronal arcs and the centers of prominences therein contained. Some 90% of prominences arise as a result of the cooling and condensation of coronal matter under the influence of magnetic forces. The magnetic field greatly hinders heat exchange between trapped matter and the surrounding plasma, as well as the diffusion of the former into the latter, thereby promoting the development of prominences. Arc structures of the magnetic field are most effective in this process. The development of prominences in the magnetic arc eventually results in the breakdown of the frozen condition, and the prominence is drawn into the chromosphere. The magnetic arc liberated from the cold matter scatters less solar light and is transformed into a dark nonluminous arc, the coronal arc. The author presents formulas for computing various arc parameters. The degree of corpuscular activity in the region of the arc and fan systems may be estimated from a knowledge of the parameters of the arc. Values of 0.0 - 0.3 gs are obtained for the intensity of the magnetic field at the crest of the arc.

Author's Association: Department of Astronomy, Kiyev State University.

Comment: See also AID Work Assignment No. 3, Report 24, Topic II, Abstract 16.

6) Ivanov-Kholodnyy, G. S., and G. M. Nikol'skiy. Short-wave solar radiacion and the structure of the solar atmosphere in active and undisturbed regions. Astronomicheskiy zhurnal, v. 39, no. 5, 1962, 777-791. QB1.A47

An attempt is made to construct a model of the intermediate layer of the solar atmosphere, i.e., the layer between the chromosphere and the corona. The study is based on an analysis of experimental data on solar radiation of wavelengths less than 3000 A and the "generalized emission measure"

$$\Delta\varphi_1 = \int_{h_1}^{h_2} n_e^2 \, T^{-3/2} \, dh,$$

which depends upon the temperature of ion radiation in the intermediate layer. n_e is the electron concentration and h the height. This problem has been treated in earlier papers by the authors (See AID Work Assignment No. 3, Reports 13, 28, and 29).

If the excitation of short-wave radiation lines of ions at a concentration of $n^{(i)}$ occurs by electron impact and the number of excitations is compensated by the number of spontaneous transitions, the equation of $\Delta\varphi_1$ is

$$\Delta\varphi_1 \equiv \int_{h(T_1)}^{h(T_2)} n_e^2 T^{-3/2} \, dh = \frac{2.3\cdot 10^{12} I\lambda}{\varkappa f W'(\lambda,\ T_m)} \cdot \frac{\Sigma n^{(i)}}{n^{(i)}}, \quad (1)$$

where I is the line intensity in ergs/cm^{2}sec at the earth, λ the wavelength of excitation in Å, $\varkappa$ is the relative content of the element with respect to hydrogen, T_1 and T_2 are temperatures characterizing the ion zone, T_m is the temperature at which the ion emission in the line attains its maximum, and $fW'T_m^{-3/2}$ is the probability of excitation by electron impact.

Computations show that in regions where the temperature T exceeds $5\cdot 10^4$ degrees, ionization by electron impact is stronger than photoionization. This is the reason, in the authors' opinion, for the extremely strong excitation of helium luminescence in such regions. The numerical values of $\Delta\varphi_1$ are computed from observational data of Western scientists in the 60-1300 A wavelength range (reference given) and represented in tabular form. The lines used appeared during atomic transitions in the basic state.

The temperature increases in the solar atmosphere, attaining a maximum in the inner corona and then dropping off slowly. In the vicinity of $T \sim 10^6$ degrees, $\Delta\varphi_1$ consists of two components with respect to the intermediate layer and the corona. The coronal component of $\Delta\varphi_1$ predominates in some layers of the upper atmosphere, especially in the contact layer between the intermediate layer and the corona.

The authors consider the atmosphere above the active region as an independent atmosphere insulated from the undisturbed regions. The independent existence of the active and undisturbed regions may result from the influence of magnetic fields. The change of temperature depends upon the electron concentration in the active and undisturbed regions. In the intermediate layer the polytropic law $Tn_e^k = C$ is true. k is equal to 2.5, and the ratio C_a/C_u of the constants of active and undisturbed regions is about 2.5. The temperature of active regions is higher than that of the undisturbed regions at the same electron concentration. The authors compared their model of the intermediate layer with the models of Oster, Christiansen, et al. The Oster model is true for the central part of the intermediate layer. The Oster values are too high for $T<4 \cdot 10^4$ and too low for $T>3 \cdot 10^5$. The values of Christiansen differ markedly from the authors' numerical values.

The authors conclude that their model best characterizes the average state of the solar atmosphere, taking into consideration the fact that some active and undisturbed regions differ physically from each other. The active and undisturbed regions on the sun change during the activity phases, not only geometrically but physically as well.

Authors' Association: Institute of Applied Geophysics, Academy of Sciences USSR; Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences USSR.

Comment: This investigation is a continuation of earlier work abstracted in Reports 13 and 23 of Work Assignment No. 3. The model of the solar atmosphere is important for studies in solar physics. The dependence of the general measure of emission upon the temperature and electron concentration in active and disturbed regions is determined only in an average form, which does not reveal the physical law which holds true in these regions. Discrepancies in the results obtained by various authors indicate that the methods applied are unsuitable for investigating the physics of the solar atmosphere. It would be desirable to continue the study, using more suitable methods, in which all the principal factors are taken into consideration.

7) Krisenko, L. I., and R. M. Chirkova. Spectrophotometry of line K of Ca^+ in the flare of 30 August 1960. IN: Khar'kov. Universitet. Astronomicheskaya observatoriya. Tsirkulyar, no. 24, 1961, 25-30.

A detailed study is made of the profile of line K of Ca^+ in the chromospheric flare of 30 August 1960. The flare spectrum was obtained on the Khar'kov Astronomical Observatory spectroheliоscope in combination with the spectrograph. Three spectra were obtained. Investigation of the profile showed the presence of small displacements near the spot and additional emissions in the red and violet wings. The profiles of line K for different spectra are shown graphically. Examination of the profiles shows: 1) The wings of line K in the flare are somewhat elevated. 2) The line profiles in the first spectrum are almost symmetrical. There is a small displacement south of the spot towards the red end, and north of the spot towards the violet. 3) In the second spectrum there is a larger displacement in the same places and in the same directions. 4) Deformation is seen in the third spectrum north of the spot. In the center of the line, emission is observed in K_3 equal in value to the emissions in K_{2v} and K_{2r}. There is emission from the violet end for a distance of 1Å. In the spot region a small emission from the violet end, and south of the spot from the red end, is also noticed. The intensity of the emission reaches 0.3 of that of a continuous spectrum; its distance from the center of the line is 1 - 1.5 A. As Mustel' and Severnyy (reference given) suggest, the additional emission is probably associated with reverse ejection, the velocity of which amounts to ≈77 km/sec. 5) In all three spectra for the flare above the spot, the equivalent width and residual intensities of line K are great, although the intensity of the flare in this place is less than in others. Here, apparently, a contrast effect takes place, caused by the greater depth of lines H and K in the spot than in the photosphere. This also creates the apparent enhancement of emission in the flare above the spot. Measurement of sectors of the spectrum free of absorption lines in the photosphere and in the spot yields a value $I_{phot.}/I_{spot} = 1.8$. Slight asymmetry of some of the K-line profiles may have been caused by the Evershed effect near the spot.

8) Kurt, V. G. On the problem of the relative intensities of coronal lines Fe XIII λ 10747 and λ 10798. Astronomicheskiy zhurnal, v. 39, no. 5, 1962, 792-797. QB1.A47

During the solar eclipse of 15 February 1961, the coronal lines of 10747 and 10798 A were obtained through the use of a special spectrograph. The equivalent widths $\overline{W}_\lambda$ of both lines were obtained by photometric processing and then related to the total continuous spectrum of the corona.

The characteristic property of the lines is their "saturation", i.e., the equivalent width does not change with the distance. The equation for the stationary state of the coronal plasma contains the electron concentration, the electron temperature, and the radiation temperature determining the photoexcitation. The population of Fe XIII on the level $^3P_0$ is determined from the ratio of concentrations at successive stages in the ionization of iron. It is assumed that iron ions exist only in stages of ionization from Fe IX to Fe XV. On the basis of these assumptions the volumetric brightness of the lines 10747 and 10798 A is determined and their ratio found. The populations of the levels $^3P_1$, $^3P_2$, $^1D_2$ are computed, using the iron line model.

Author's Association: State Astronomical Institute im. P. K. Shternberg.

9) Kuz'mina, V. A., A. V. Nevel'skiy, and Z. N. Shukstova. Photometry of the solar corona of 15 February 1961. Solnechnyye dannyye 1962 g.: Byulleten', no. 4, 1962, 68-77.

The results of photometric processing of negatives of the corona obtained during the total solar eclipse of 15 Feb 1961 are presented. Photography was performed from an ЛИ-2 aircraft, using an НАФА-6/50 camera. The survey was made above the cloud layer at an altitude of 5500 m as the aircraft passed over Kourovka near Sverdlovsk, where most of the expedition's equipment was located. Photos were made on ДК-10 panchromatic film. The moon at approximately full-moon phase was used as a photometric standard. The photos of the corona were of good quality; those of the moon were overdeveloped. The МФ-2 microphotometer was used for measurements. Isophotes of the corona are presented. The data indicate that the surface brightness of the corona changes to a great degree with distance and position angle. The polar zones differ appreciably with respect to brightness from sectors of the corona occupied by bright rays. A distinct shift of coronal fans to the northern solar hemisphere is noted.

The mean brightness factor of lunar formations was taken from L. N. Radlova's catalog. Computations are presented showing the integral brightness of the corona on 15 Feb 1961 to be about the same as during the eclipses of 25 Feb 1952 and 30 June 1954.

Authors' Association: Department of Astronomy and Geodesy, Ural State University.

10) Mamedov, S. G. On the physical nature of the weak chromospheric flare of 8 September 1960. I. Solnechnyye dannyye 1962 g.: Byulleten', no. 5, 1962, 54-63.

In an earlier paper (reference given) the populations of the levels of hydrogen atoms in the line of sight in the emission layers of the weak chromospheric flare of 8 September 1960 were given. The populations of the levels of hydrogen atoms arrived at by Sobolev (reference given) through the solution of steady-state equations are found to disagree with the values obtained by the author. Stepped transitions between the upper levels, when there are electron collisions of the first and second kinds, had not been taken into account, owing to the lack of data on the cross sections of these transitions. On the basis of data on the cross sections, provided by McCoyd, Mifford, and Wahl (reference given), steady-state equations for the hydrogen levels are again derived, this time taking into account the stepped transitions between the upper levels and the influence of electron collisions. Equations are set up for the 4th, 5th, 6th, and 7th levels; results are presented in tabular form.

Author's Association: Shemakha Astrophysical Observatory, Azerbaydhzan Academy of Sciences.

11) Orlov, P. P. Observations of solar radiation in Volgograd on 15 February 1961 with a gas-discharge counter. IN: Vsesoyuznoye astronomo-geodezicheskoye obshchestvo. Byulleten', no. 32(39), 1962, 35-36. QB1.V752

The author describes the use of the MC-9 glass counter in conjunction with the photocell of the Ю-16 luxmeter to measure illumination during the eclipse of 15 February 1961. Illumination values (in luxes) are presented in tabular form.

Author's Association: Volgograd Branch, All-Union Astronomical and Geodetic Society.

12) Popovici, Călin, and Vasile Dinulescu. Activity of the photosphere in the period 1955-1961. Studii şi cercetări astronomie şi seismologie, v. 7, no. 1, 1962, 111-139.

Solar photospheric activity in the period July 1955 to June 1961 was studied on the basis of observational data obtained at the Bucharest and other observatories. Solar activity was measured by Wolf numbers reduced to the Zürich system, spot areas, the number of spot groups, the latitudinal displacement of spots, etc.

Rounded mean Wolf numbers for 3, 5, and 12 consecutive months were used to determine the date of maximum of the 19th cycle. The average for the 12-month interval yields 15 March 1958 (1958, 25) as the day of maximum. This is quite close to the values obtained by Waldmeier (1958, 2) and Mueller (1958, 14).

This date was not accepted, however, since it was displaced along the descending branch of the curve of solar activity. The reason for the shift is to be found in the existence of two secondary maxima (1 Sep 1958 and 1 Jan 1959), in addition to the main maximum of 1 Oct 1957 - a fact observed on the curve of monthly means. For this reason the authors chose to establish the mean for a shorter interval, viz., 5 or 3 months; the date found was 15 Nov 1957 (1957, 9). It is noted that the dates of maximum and minimum can not be established with an accuracy exceeding one month, owing to the period of synodic solar rotation.

On the basis of the number of spot groups in the hemispheres, the conclusion is drawn that the northern hemisphere in the period 1955-1961 was characterized by greater activity than the southern, with the exception of 1957, inasmuch as the average latitude of the groups in the southern hemisphere was less than in the northern. These peculiarities are associated with the earlier appearance of the maximum in the southern hemisphere and to the predominance of activity in the northern hemisphere during this period, with the exception of 1957.

Cycle 19 is characterized by an exceptionally high Wolf number (R = 227 from the mean monthlies in Bucharest), as well as by the continuance of solar activity at a high level for a long time (the mean yearly Wolf number exceeded 150 in 1957, 1958, and 1959).

The exceptionally intensive character of cycle 19 cannot be explained by the profusion of spot groups with small surfaces, since the "surface-mean yearly Wolf number" ratio for the given cycle has a value of 16.1, i.e., quite close to the mean value 16.7 of this ratio obtained by Waldmeier.

The cycle does not support the "explosion" theory (Waldmeier), inasmuch as the mean latitudes of the spots in the epoch of the maximum, with 50 revolutions before and 50 revolutions after this epoch, were less than assumed on the basis of the average monthly Wolf number (R_M = 201.5 in Zürich). Further, this cycle does not support the relationships found by Xanthakis, yielding maximal area on the entire solar surface or the hemispheres as a function of the time of ascension. It is noted in conclusion that solar activity must be studied by hemispheres, and that a parameter must be found which can define solar activity with the greatest possible accuracy, something the Wolf number is unable to do.

There are 15 references.

13) Rakhubovskiy, A. S., and Ye. I. Didychenko. Solar flares observed at the Main Astronomical Observatory of the Ukrainian Academy of Sciences from 1957 through 1960. IN: Akademiya nauk Ukrainskoy SSR. Glavnaya astronomicheskaya observatoriya. Izvestiya, v. 4, no. 2, 1962, 77-112.
QB1.A17652

Observations of the chromosphere on the AFR-2 telescope in line H_α has served as a basis for compiling a catalogue of flares for the period 1957-1960. From July through Nov 1957 the chromosphere was patrolled visually and photographically. Photos were made with an exposure interval of 10 minutes, using the "Zorkiy" camera. Starting in Nov 1957, motion pictures were made of the chromosphere, using the KS-50B camera and standard 35-mm panchromatic film of high sensitivity. The flare-importance scale comprised the following values: 1-, 1, 1+, 2, 2+, 3, 3+, the readings were determined on the basis of brightness and area. The distribution of flares by scale value is shown in tabular form. It is seen that the greatest number of observations each year occurs in the period May-Oct. Flares appeared less often in 1959-1960 than in 1957-1958. Flares ranging from 1- to 1+ occurred most often; more powerful flares of 2 and above were quite rare, on the average of once every 30-40 patrol hours. The mean area of flares is seen to change quarterly, but on the average remains almost unchanged in a year.

Study of flare distribution with respect to distance from the center of the disk indicates that the majority of flares are observed in the central zone. Apparently, the number of flares observed per unit of solar surface follows a definite law in its dependence on the distance from the center of the disk. However, attempts to fix this law by correlating the number of flares observed with distance from the center were unsuccessful, since the frequency of flare appearance is also subject to the law of spot distribution by latitudinal zones.

The number of small flares is observed to increase near the central meridian. The visibility factor is taken into account here. The number of flares was the same in the eastern and western hemispheres. The distribution of flares with respect to latitude shows that the frequency of appearance in the second half of 1957 and 1958 was the same in the northern and southern hemispheres. In 1959 and 1960, however, a sharp increase of flares in the northern hemisphere was observed. These results are shown graphically. It is also seen that in the northern hemisphere the zone of flare appearance gradually shifts towards the equator. In the southern hemisphere in 1958 the flare zone shifted sharply towards the equator, then stabilized between 5 and 25°. The northern hemisphere was observed to be more active in 1959, the southern in 1958.

A 30-page catalogue providing data on 554 flare observations is annexed. Data presented include: flare number; date; time of onset, end, and maximum; latitudinal and longitudinal coordinates; scale reading; distance of flare from center of disk, in decimal fractions of radius; area of the flare in millionth parts of the solar disk; area of the flare corrected for the projection effect, expressed in square degrees; flare intensity in units of continuous-spectrum intensity near the H_α line; and notes on the conditions and character of flare development.

14) Severnyy, A. B. Nonstationary processes in solar magnetic fields. The generation of flares and heating of faculae. IN: Akademiya nauk SSSR. Krymskaya astrofizicheskaya observatoriya. Izvestiya, v. 27, 1962, 71-109.
QB1.A17642

There is observational evidence that flares appear in neutral points of magnetic fields and that the surrounding magnetic fields are changed in comparison with the state before and after the flare (changes of field strength, gradients and rearrangement of magnetic hills), although in the region of the flare itself there are no appreciable changes of the field after the onset of the flare. There is also some evidence of very rapid changes of the surrounding field during the phase of development of the flare. H_α films and spectra of limb flares and of moustaches show the rapid formation of cumulative ejections with a velocity gradient along the jet. Comparison of the spectra of flares and of laboratory pinch in hydrogen shows the possible dependence of the mechanism of line-emission broadening in flares on the direction between the jet and the line of sight. Automodel contraction and heating of solar plasma, initially in equilibrium near the neutral point, during the rapid and slow growth of external magnetic fields of sunspots are considered. It is shown that contraction may be violent and rapid, leading to the formation of shock waves converging to the neutral point and producing intensive heating of plasma even at a comparatively moderate increase of the external magnetic field. The process can be accompanied by ejections in the direction perpendicular to contraction. Ohmic losses are shown to be important for the slow heating of faculae. (Author's abstract)

15) Shpital'naya, A. A. Method of determining the true profile of the green coronal line. I. Case of the Doppler profile. Solnechnyye dannyye 1962 g.: Byulleten', no. 4, 1962, 81-91.

The author proposes a method which makes it possible to determine the true profile of the green coronal line 5302.86 A by comparing the observed form of the profile with that of the Fraunhofer line (5302.31 A) which distorts it. The method consists in the superposition of the most probable Doppler profile of the coronal line and the Doppler profile of the absorption line 5302.31 A (the cases of non-Doppler and asymmetrical profiles are to be discussed in a later paper). The comparison reveals differences between the two profiles. The "red" wing of the absorption line 5302.31 A begins to distort the center of the profile of the coronal line at a distance of 0.4 A from the beginning of the wavelength reading, i.e., beginning at 5302.71 A.

16) Slonim, Yu. M. Relationship between chromospheric flares and prominences in active regions. Astronomicheskiy zhurnal, v. 39, no. 5, 1962, 798-812. QB1.A47.

On the basis of observations made in the Tashkent Astronomical Observatory in 1959-1960, chromospheric flares are examined in their relation to prominences. A close genetic relationship between flares and prominences is seen for several reasons: 1) the similarity between the spectra of flares and prominences near spots; 2) the observed tendency of flares to propagate along the trajectories of active filaments (this phenomenon is attributed to the inflow into the center of the flare, or ejection from it, of jets of class III prominences); 3) the fact that flares and prominences accompany each other even when the process occurs far from an active region. Strong ejections of chromospheric matter, observed as eruptive prominences or the sudden disappearance of elongated stationary filaments, are also accompanied by flares.

The character of flare development corresponds to that of the accompanying prominences. In the case of rapid ejections of chromospheric matter the flare is of the short impulse type; in the case of a slow outflow of chromospheric matter it is of the prolonged emission burst type; in the case of coronal inflows - a prolonged pulsating type of flare, which is in good agreement with the delayed and intermittent development of these prominences. The relationship is further confirmed by the fact that flares characterized by plasma movement repeat the usual forms of spot prominences, especially the typical loop structures.

It is concluded that the relationship between flares and prominences is not trivial, but very close. It is possible that flares and prominences should be viewed merely as different stages, phases, and degrees of a single disturbance involving the upper layers of the sun.

Author's Association: Tashkent Astronomical Observatory.

17) Sobolev, V. M. On He II emission in λ 4686 in chromospheric flares. Solnechnyye dannyye 1962 g.: Byulleten', no. 3, 1962, 69-72.

According to Steshenko and Khokhlova (reference given), the observed profile of λ 4686 consists of two components, the distance between whose centers is of the order of 0.4 A. The ratio of intensity of the weaker component (designated as I) to the stronger (designated as II) is 0.38. To explain the mechanism of excitation, Steshenko and Kokhlova derived steady-state equations for the third and fourth levels of He II and solved them, assuming $n_e = 10^{13}$ and $T_e = 25{,}000°K$. They further assumed that self-absorption of flare radiation in line L_α of hydrogen plays a role in the excitation of the fourth level of He II. They found that under these conditions it is possible to explain the observed intensity values of λ 4648. It is suggested, however, that steady-state equations be solved separately for each sublevel, examining the different mechanisms of excitation, with a view to evaluating the role of the different processes determining the excitation of line λ 4648.

Analysis of the flare of 14 Sep 1958 indicates that the excitation was chiefly the result of electron shock and recombination. Several conclusions are drawn from tabular data introduced by the author. At $T_e = 20,000°$ the ratio of intensities of components I and II is unexpectedly great, so that in regions of λ 4686, $T_e > 20,000°$. This ratio decreases with increased T_e. The same pattern is observed with increased n_e. At $T_e \geqslant 30,000°$ this ratio is almost independent of the value of T, which is the measure of intensity of L_α radiation. This indicates the predominant role played by electron shock and recombination.

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It was shown in determining the populations of the second level n_2 of the hydrogen atom for prominence-ejections that the spectral lines consist of two components. Equations used to determine n_2 for prominence-ejections are presented. Results indicate that the ratio of the values of the intensities of the two line profiles of the hydrogen Balmer series is a constant. This fact is the basis of the method of determining the factor of self-absorption for prominences. In order to compute n_2 the Doppler half-width of the line profile must also be known. This may be determined 1) directly from the true H_α line contour, or 2) on the basis of the Doppler half-width of the H_δ line profile. It is shown that on the average the spectral line H_α of prominence-ejections is about one and a half times wider than line H_α constructed on the basis of line profile H_δ. It is supposed that the spectral lines of the Balmer series of hydrogen of prominence-ejections consist of two components, a nucleus and a tail. The nucleus component has a more sloping decrement of intensities than the tail, which is practically absent in line H_δ.

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