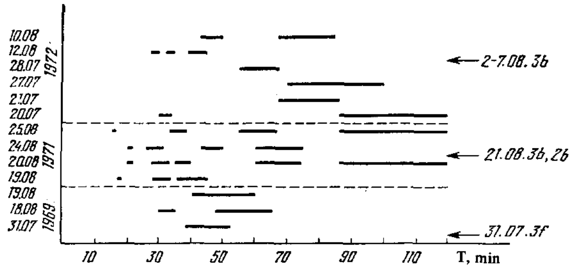


of the radio-frequency radiation by the natural mechanical oscillations of the sun was postulated, and the pertinent computations were carried out. Later, analogous periods were detected in the photosphere.

In 1971 and 1972 special experiments at 3-cm wavelength were set up with spaced telescopes: Gor'kiĭ-Kislovodsk and Gor'kiĭ-Chukotka.

The figure shows the experimental data on the spectra of the intensity fluctuations of the radio emission in 1969, 1971, and 1972. The horizontal lines for the respective dates indicate the presence and width of the peaks in the observed spectra (within the limits of the confidence interval). The data with arrows indicate the presence and class of high-power chromospheric flares. The presence of an entire QPC series with periods of from 10 to 120 min can be seen in the figure. The periods obtained turned out to be in good agreement with the periods of the Alfvên waves detected in the solar wind.

We can on the basis of the expounded material draw the following conclusions:

1) QPC with periods of from 100 sec to 2 hours was detected in the radio emission of the sun. This was, to the best of our judgement, the first experimental confirmation of the presence of wave motions in the sun's corona. The study of these motions may help solve the problem of the heating of the corona and the problem of energy transport to the solar wind.

2) The discrete character of the spectrum of the fluctuations in the radio-frequency radiation is a reflection of the presence of natural frequencies of the discrete spatial structures existing in the sun's atmosphere. The study of the QPC opens up the possibility of studying these structures, their parameters and the dynamics of the processes taking place in them. In the event of detection of the natural oscillations of the sun, the possibility of studying its internal structure will open up.

3) The existence of a connection between the QPC and the sun's activity (the amplitude of the individual QPC with, in particular, periods of 180 and 600–900 sec) permits us to hope that new information on the active regions will be obtained. It is to be hoped that the study of QPC will yield new data for forecasting solar activity.

4) The presence of waves in the sun's atmosphere affects the modulation of not only the optical and radio-frequency radiations and the solar wind, but, obviously, the x-ray and ultraviolet radiations as well. Therefore, the study of these wave motions is undoubtedly of interest not only for solar physics, but also for the physics of interplanetary space and geophysics.

The material of the report has been published in the papers: M. M. Kobrin, A. I. Korshunov, and A. I. Chandaev, Astron. Tsirk. No. 575, 1 (1970); M. S. Durasova, M. M. Kobrin, and O. O. Yudin, Nature **229** (5282), 83 (1971); M. M. Kobrin, Sbornik dokladov sessii Nauchnogo soveta no kompleksnoĭ probleme "Radioastronomiya" (The Collected Reports of the Session of the Scientific Committee on the Comprehensive Problem of "Radioastronomy") (IZMIRAN, October 13–16, 1970), IZMIRAN, M., 1972; M. M. Kobrin and A. I. Korshunov, Solar Physics **25**, 339 (1972); V. I. Aleshin, M. M. Kobrin, and A. I. Korshunov, Izv. Vuzov (Radiofizika) **16** (1973); M. M. Kobrin, V. V. Pakhomov, M. S. Durasova, B. V. Timofeev, N. A. Prokof'eva, E. I. Lebedev, G. A. Lavrinov, ibid.; V. V. Pakhomov and S. D. Snegirev, Astron. Tsirk. (1973).

**Yu. P. Shitov.** Pulsar Observations at the Radioastronomical Station of the USSR Academy of Sciences Physics Institute. Investigations of pulsars at the Radioastronomical station (RAS) of the USSR Academy of Sciences Physics Institute (FIAN) were begun immediately after the report of their discovery in the spring of 1968. These investigations, which were begun on the initiative, and with the direct participation of V. V. Vitkevich, are going on well at present. The observations on the radio emission of pulsars are being carried out on the DKR-1000 radiotelescope (on the east-west antenna) in the 10-120 MHz band, using several specialized multichannel radiometers. During the last two years (1971–1972) the staff of the Astronomy Laboratory of the FIAN have obtained a number of important new results in the investigation of the pulsars themselves, as well as of their interstellar plasma.

1. Of great interest are the pulsars which emit complexly-shaped pulses consisting of two or more subpulses. The question arises with respect to these pulsars: is the complex pulse structure due to the corresponding complex shape of the directional diagram of the radio-emitting region, or is it that to each subpulse corresponds its own independent region of emission?

Investigations of the pulsar CP 1133 showed that its radio-frequency radiation subpulses I and II possess substantially different amplitude-time and polarization characteristics. It is inferred from this that the subpulses I and II are emitted by separate independent active regions located at an angular distance of ≈12° apart in the pulsar[1,2]. An analogous conclusion can apparently be drawn about other similar pulsars—AP 1237, PSR 2045, NP 0525, etc.

2. A special place is occupied by pulsars possessing the so-called periodicity of the second class[3]. A typical representative of this type of pulsars is the pulsar CP 0808, whose subpulses execute a regular drift inside the radio-emission window[4]. There are two models explaining the drift of the subpulses: a) the pulsating-rotational model[3] and b) the model with a differential revolution of the radio-emitting regions relative to the surface of the neutron star[5]; there was not until recently an unambiguous, conclusive argument in favor of one or the other model. A detailed analysis of the periodic process of the second class occurring on the pulsar CP 0808 showed that in a number of cases the interdependence $P = 24P_1P_3/(P_1 + 24P_3)$ of the periods $P$, $P_1$, $P_3$, which has to be satisfied in the pulsating-rotational model is clearly violated. Thus, in fact, the drift of the subpulses of the pulsar CP 0808 (apparently, of other similar pulsars as well) is due to the differential revolution of the radio-emitting regions (rotation of

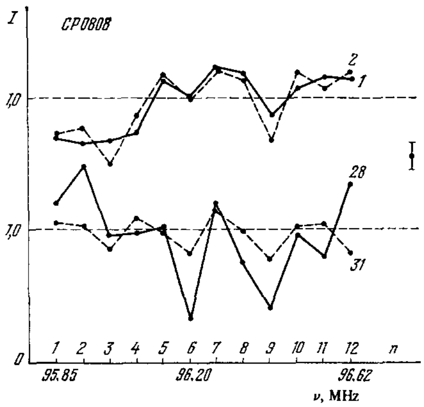


FIG. 1

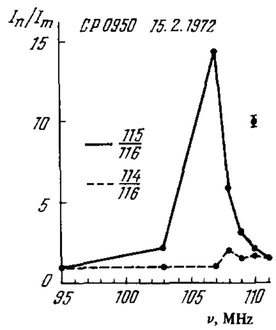


FIG. 2

their directional diagrams) relative to the surface of the neutron star.

3. The radio-frequency radiation spectra of the pulsars CP 0808, CP 0834, CP 0950, CP 1133, and CP 1919 manifest a fine structure characteristic of the emission process itself (apart from the structure due to diffraction by the inhomogeneities of the interstellar plasma). The fine structure has characteristic scales at frequencies of 200–300 kHz and less than 70 kHz and varies over a characteristic time less than the pulsar period with a root-mean-square intensity modulation ≈30%[7]. Examples of the spectra of individual pulses of CP 0808 are shown in Fig. 1 (12/8/1970).

In some pulses of the pulsar CP 0950, cases have been detected in which the radio-frequency radiation intensity increases sharply in a comparatively narrow frequency band $\Delta\nu = 1-3$ MHz[8]. This increase, which reached 10 times and more, was observed in the 110-MHz region: it is shown in Fig. 2, where the ratios of the spectra of three successive pulses of CP 0950 (Nos 114–116) are given. These two phenomena that have been detected in the spectra of the pulsars may be the key to the understanding of the mechanism underlying their radio emission.

4. The interstellar plasma, which determines to a considerable extent the nature of the radio-frequency radiation received from the pulsars, is very effectively investigated with the aid of pulsars. From the measured characteristic scales of the fine structure of the spectra in the direction of an entire series of pulsars were determined the weighted mean of the longitudinal component $H_{\parallel}$ of the magnetic field of the Galaxy[9,10], the characteristic dimension a, and the root-mean-square value of the electron concentration $\Delta N_e$ in the inhomogeneities of the interstellar plasma[2,10] (see the table).

| Pulsar | $10^{10}$ cm | $\Delta N_c$, $10^{-5}$ cm$^{-3}$ | $H_{\parallel}$, $10^{-6}$ Oe |
|---|---|---|---|
| CP 0808 | 1.0 | 1.1 | — |
| CP 0834 | 2.4 | 5.6 | — |
| CP 0950 | 1.3 | 0.9 | — |
| CP 1919 | 1.4 | 2.8 | — |
| CP 1133 | 2.4 | 8.0 | 1.2 |
| AP 1237 | 2.4 | 7.5 | 2.1 |
| MP 0031 | — | — | 1.25 |
| CP 0329 | — | — | 2.7 |
| MP.0628 | — | — | 1.6 |
| PP 0943 | — | — | 1.4 |
| PSR 2218 | — | — | 0.95 |

The phase increments accumulated in the inhomogeneities up to the nearest pulsars CP 0808, CP 0950, and CP 1133 were determined at the same time (from the distinctive features of their spectra), thereby significantly improving the accuracy of determination of the parameters a and $\Delta N_e$. It is shown that the electron concentration $\Delta N_e$ in the inhomogeneities apparently possess a considerable anisotropy in the galaxy[10].


[1]V. V. Vitkevich and V. M. Malofeev, Preprint FIAN SSSR No. 92, Moscowk 1971; Yu. N. Alekseev, V. V. Vitkevich, and V. M. Malofeev, Dokl. Akad. Nauk SSSR **205**, 307 (1972) [Sov. Phys.-Doklady **17**, 615 (1973)]; Nature (Phys. Sci.) **235**, 167 (1972).

[2]Yu. P. Shitov, Astron. Zh. **49**, 470 (1972) [Sov. Astron.-AJ **16**, 383 (1972)].

[3]F. D. Drake and H. D. Craft, Nature **220**, 231 (1968).

[4]V. V. Vitkevich and Yu. P. Shitov, Dokl. Akad. Nauk SSSR **191**, 553 (1970) [Sov. Phys.-Doklady **15**, 194 (1970)]; Nature **225**, 248 (1970).

[5]J. M. Sutton, D. H. Staelin, R. M. Price, and R. Weimer, Astrophys. J. (Lett.) **159** (No. 2, Pt. 2), L89 (1970).

[6]D. H. Staelin, M. S. Ewing, R. M. Price, and J. M. Sutton, ibid. **160** (No. 1, Pt. 2), L7; V. V. Vitkevich and Yu. P. Shitov, Izv. Vuzov (Radiofizika) **13**, 1833 (1970).

[7]V. V. Vitkevich and Yu. P. Shitov, Astron. Tsirk. No. 740, 1 (1972); doklad na VII konferentsii po radioastronomii (Paper presented at the 7th Conference on Radioastronomy), Gor'kiĭ, 1972.

[8]V. A. Udal'tsov and V. N. Zlobin, Doklad na XVII assamblee URSI (Paper presented at the 17th Assembly of URSI), Warsaw, 1972.

[9]V. V. Vitkevich and Yu. P. Shitov, Dokl. Akad. Nauk SSSR **195**, 53 (1970) [Sov. Phys.-Doklady **15**, 993 (1971)]; Nature **226**, 1235 (1970); Yu. P. Shitov, Astron. Zh. **48**, 638 (1971) [Sov. Astron.-AJ **15**, 501 (1971)]; Nature **229**, 179 (1971); V. V. Vitkevich, V. M. Malofeev, and Yu. P. Shitov, Astron. Zh. **48**, 133 (1971) [Sov. Astron.-AJ **15**, 1059 (1972)]; V. A. Izvekova, V. M. Malofeev, S. A. Syleĭmanova, and Yu. P. Shitov, Doklad na VII konferentsii po radioastronomii (Paper presented at the 7th Conference on Radioastronomy), Gor'kiĭ, 1972.

[10]Yu. P. Shitov, Candidate's Dissertation, FIAN SSSR, 1971.


**V. V. Zheleznyakov.** On the Origin of Pulsar Radiation. The theory of pulsars deals with three main problems: 1) type and structure of the central body—the star, 2) the structure and dynamics of the surrounding mantle—the magnetosphere, and 3) the emission mechanism for pulsars. The ideal, but extremely complicated way of constructing the theory is to successively solve these problems. A simpler, but more restricted approach characteristic of radioastronomy is possible; it consists in finding those conditions in the stellar magnetosphere which will guarantee in the framework