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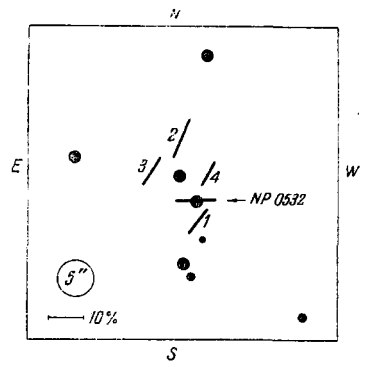
N. M. Shakhovskiĭ, Yu. S. Efimov, and V. I. Pronik. Polarization of the Crab Nebula Pulsar in the Optical Band.

The pulsar NP0532 was recently identified[1] with the southern component of a binary star in the center of the Crab Nebula. On 13 March 1969 we measured the linear polarization of the optical radiation of both components of this binary and the nebula points close to it.

The observations were made with the ZTSh 2.6-meter telescope using an integrating polarimeter with photon counting. We used a diaphragm of 5″ diameter and the star images were on the order of 1.5″. All the observations were carried out without a light filter in the 3500–8000 Å band at $\lambda_{eff} \approx 5500$ Å. Each object was observed with an accumulation time (exposure) of 50 sec. There was no time selection of the pulsar pulses.

The figure shows schematically the arrangement of the stars in the central region of the Crab Nebula. The numbers designate the points of the nebula measured by us. The choice of these points was based on an examination of old[2] and new photographs of the background of the nebula, we disregarded the ratio of the brightness of the northern star and of the pulsar, given in[3], and the data on the contrast of the pulsar pulses over the background from[4].

The instrumental polarization was taken into account by means of observations of bright stars from the catalogs of[5,6]. The data presented below on the polarization of both stars are already free of the influence of the radiation of the nebula and of the instrumental polarization.



As a result we have found that the degree of linear polarization of the integral radiation of the pulsar is 12.6 ± 1.6% at a position angle of the oscillation plane 91 ± 4°. The corresponding data for the northern star are 1.9 ± 0.7% and 166 ± 11°. The degree of polarization at the measured points of the nebula changes from 8 to 15%, and the position angle of the plane of oscillations lie between 142° and 157°. The errors indicated are mean-squared errors obtained with allowance for both the internal convergence of the measurements and the errors in the elimination of the instrumental polarization.

The results show that the radiation of the northern star has a noticeable polarization near 13%. At the customarily employed values of the distance to the Crab Nebula and the interstellar absorption, such a large polarization cannot be of interstellar origin.

Since, according to[4], practically all the radiation of the southern star is observed in the form of pulses, it follows that the obtained polarization parameters pertain to the intrinsic radiation of the pulsar, averaged over the entire period (the summary radiation of the primary and secondary pulses). The presence of an appreciable linear polarization apparently confirms the synchrotron nature of the optical radiation of the pulsar.

After the completion of our work, we learned of the results of polarization observations of the pulsar in the Crab Nebula, performed in the USA[7] and in Australia[8]. In both investigations, the measurements were made with time selection of the pulsar pulses: the brilliance curve of the pulsar was successively registered at different positions of the analyzer (polaroid).

Warner's group[7] has found that the average degree of linear polarization of the principal pulse of the pulsar is approximately 14%, and the direction of the plane of observation differs by 60° from the corresponding direction for the central part of the Crab Nebula. These data agree very well with our measurements. It is also noted in[7] that a change takes place in the position of the plane of oscillations during the course of the pulse.

The Australian investigators[8] have found that the degree of linear polarization of the pulsar pulses probably does not exceed 15%, and the degree of circular polarization amounts to 13 ± 11%.

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V. I. Pronik, I. I. Pronik, and K. K. Chuvaev. Distribution of the Energy in the Spectrum of the P Pulsar of the Crab Nebula.

In February—March of this year, an attempt was made at the Crimean Astrophysical Observatory of the USSR Academy of Sciences to obtain the distribution of the energy in the spectrum of the pulsar NP0532 in the optical range. The observational material constitute the ordinary photographs of the Crab Nebula, obtained with the ZTSh telescope with different filters having λ_{eff} from 3600 to 7400 Å, and exposures from several seconds to several minutes. From the photographs obtained in February, we estimated the brightness of the pulsar at different wavelengths relative to the brightness of the nearest northern star (spectral class G), and found that besides the ultraviolet excess in the spectrum of the pulsar, there is apparently an excess of radiation also in the near infrared region. At the beginning of March, using the ZTSh telescope, photographs of the pulsar, of very good quality, were again obtained. In order to eliminate the influence of the gas flocculi projecting from the pulsar, the photographs taken with filters that transmit the emission lines of the flocculi were not processed. The brightness of the pulsar in each filter was determined relative to the brightness of the adjacent background of the nebula, the spectrum of which was assumed to be equal to the spectrum of the nebula as a whole. The latter was constructed from the observation data of various authors (○—[1], □—[2], •—[3]), and is shown in Fig. 1. Observations in the infrared region of the spectrum are presented only to verify that the break of the spectrum, near λ 5500 Å, actually exists. Figure 2 the spectrum of the pulsar (2): the light circles represent our measurements of the pulsar with different filters relative to the nebula, pertaining to the summary effect from both pulses; the dark circles are the measurements of Oke[4], pertaining to the principal pulse. For comparison, the same figure shows the integral spectrum of the Crab Nebula (1) and the spectrum of the background of the nebula under the pulsar, measured by Oke at the instants between the pulses (3). The deviation of the designated points on curve 3 gives an idea of the intensities of the lines in the spectrum of the gas flocculi projecting from the pulsar. The zero point of the vertical scale differs for the different curves. The good

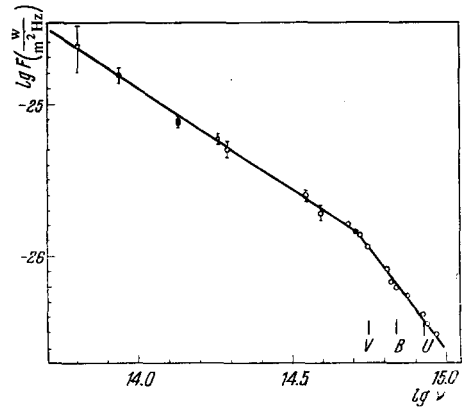

FIG. 1. $\alpha = -1.3$ for the upper left part of the curve, and $\alpha = -2.8$ for the lower right.

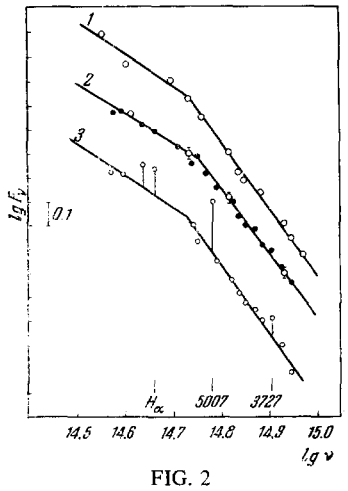

FIG. 2

agreement between our results and the results of Oke confirms the correctness of the assumption made above, namely that the spectrum of the background from the nebula near the pulsar is the same as the spectrum of the Crab Nebula as a whole. It is clearly seen in Fig. 2 that the spectrum of the pulsar in the optical band is identical to the spectrum of the Crab Nebula, with the only possible slight difference that the spectrum of the pulsar is shifted relative to the spectrum of the nebula towards higher frequencies by an amount $\Delta \log \nu \sim 0.025$.

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Yu. I. Alekseev, V. V. Vitkevich, and Yu. P. Shitov, Fine Structure of the Pulses of the Pulsar CP0808 and Variation of the Periods of the Second Class

The paper reports a discovery, made at the Radio Astronomical Station of FIAN, that the pulsar CP0808 has periodic pulsations of the second class, with a